



YASKAWA

AC Servo Drives

# $\Sigma$ -V Series

## USER'S MANUAL

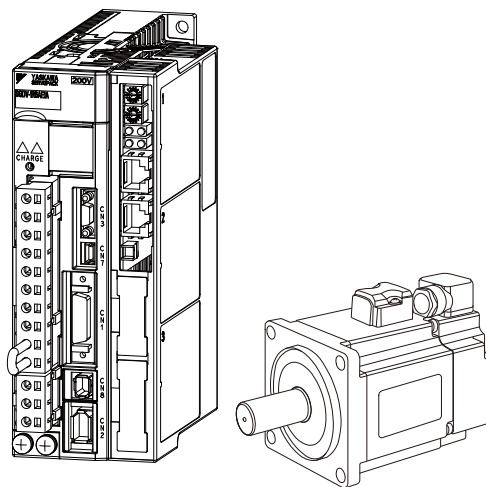
### Design and Maintenance

Rotational Motor

Command Option Attachable Type

SGDV SERVOPACK

SGMJV/SGMAV/SGMPS/SGMGV/SGMSV/SGMCS Servomotors



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# About this Manual

This manual describes informations required for designing, and maintaining  $\Sigma$ -V Series SERVOPACKs.

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

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

## ■ Description of Technical Terms

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

| Term         | Meaning   |
|--------------|---|
| Cursor       | A mark that indicates the input position of data displayed on the digital operator                                  |
| Servomotor   | $\Sigma$ -V Series SGMJV, SGMVA, SGMPA, SGMGV, SGMSV, or SGMCS (Direct Drive) servomotor                            |
| SERVOPACK    | $\Sigma$ -V Series SGD V SERVOPACK  |
| Servo drive  | A set including a servomotor and SERVOPACK (i.e., a servo amplifier)  |
| Servo System | A servo control system that includes the combination of a servo drive with a host controller and peripheral devices |
| Servo ON     | When power is being supplied to the servomotor  |
| Servo OFF    | When power is not being supplied to the servomotor  |
| Base block   | Turning OFF the power by shutting OFF the base current of the IGBT for the current amplifier                        |

## ■ 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

### • Reverse Symbol Notation

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

#### Example

The notation for  $\overline{\text{BK}}$  is /BK.

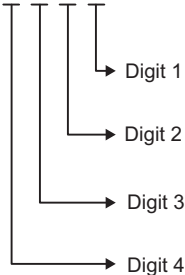
### • Parameter Notation

The following two types of notations are used for parameter digit places and settings.

#### Example

Digital Operator Display

Pn000 = n . 0 0 0 0



Notation Example for Pn000

| Digit Notation  |   | Set Value Notation    |   |
|-----------------|---|-----------------------|---|
| Notation Method | Meaning                                     | Notation Method       | Meaning   |
| Pn000.0         | Indicates digit 1 of the parameter (Pn000). | Pn000.0 = x or n.□□□x | Indicates that digit 1 of the parameter (Pn000) is x. |
| Pn000.1         | Indicates digit 2 of the parameter (Pn000). | Pn000.1 = x or n.□□x□ | Indicates that digit 2 of the parameter (Pn000) is x. |
| Pn000.2         | Indicates digit 3 of the parameter (Pn000). | Pn000.2 = x or n.□x□□ | Indicates that digit 3 of the parameter (Pn000) is x. |
| Pn000.3         | Indicates digit 4 of the parameter (Pn000). | Pn000.3 = x or n.x□□□ | Indicates that digit 4 of the parameter (Pn000) is x. |

■ **Manuals Related to the  $\Sigma$ -V Series**

Refer to the following manuals as required.

| Name  | Selecting Models and Peripheral Devices | Ratings and Specifications | Panels and Wiring | Trial Operation | Trial Operation and Servo Adjustment | Maintenance and Inspection |
|---|---|----------------------------|-------------------|-----------------|--------------------------------------|----------------------------|
| $\Sigma$ -V Series<br>User's Manual<br>Setup<br>Rotational Motor<br>(SIEP S800000 43)                   |   |                            | ✓                 | ✓               |                                      |                            |
| $\Sigma$ -V Series<br>Product Catalog<br>(KAEP S800000 42)  | ✓                                       | ✓                          |                   |                 |                                      |                            |
| $\Sigma$ -V Series<br>User's Manual<br>Operation of Digital<br>Operator<br>(SIEP S800000 55)            |   |                            |                   | ✓               | ✓                                    | ✓                          |
| $\Sigma$ -V Series<br>AC SERVOPACK SGDV<br>Safety Precautions<br>(TOBP C710800 10)                      | ✓                                       |                            | ✓                 |                 |                                      | ✓                          |
| $\Sigma$ Series<br>Digital Operator<br>Safety Precautions<br>(TOBP C730800 00)                          |   |                            |                   |                 |                                      | ✓                          |
| AC SERVOMOTOR<br>Safety Precautions<br>(TOBP C230200 00)  |   |                            | ✓                 |                 |                                      | ✓                          |
| $\Sigma$ -V Series<br>User's Manual<br>Indexer Module<br>(SIEP C720829 02)<br>(Will be available soon.) |   | ✓                          | ✓                 |                 | ✓                                    | ✓                          |
| $\Sigma$ -V Series<br>User's Manual<br>EtherCAT (CoE)<br>Network Module<br>(SIEP C720829 04)            |   | ✓                          | ✓                 |                 | ✓                                    | ✓                          |
| $\Sigma$ -V Series<br>Option Module<br>Safety Precautions<br>(TOBP C720829 00)                          | ✓                                       |                            | ✓                 |                 |                                      | ✓                          |
| $\Sigma$ -V Series<br>Command Option Module<br>Installation Guide<br>(TOBP C720829 01)                  | ✓                                       |                            | ✓                 |                 |                                      | ✓                          |
| $\Sigma$ -V Series<br>Indexer Module<br>Installation Guide<br>(TOBP C720829 02)                         | ✓                                       |                            | ✓                 |                 |                                      | ✓                          |
| $\Sigma$ -V Series<br>Feedback Option Module<br>Installation Guide<br>(TOBP C720829 03)                 | ✓                                       |                            | ✓                 |                 |                                      | ✓                          |
| $\Sigma$ Series<br>Digital Operator Safety<br>Precautions<br>(TOBP C730800 00)                          |   |                            |                   |                 |                                      | ✓                          |



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## ■ Safety Information

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



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



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



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



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





## Safety Precautions

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



### WARNING

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

## ■ Storage and Transportation

### CAUTION

- Do not store or install the product in the following locations.  
Failure to observe this caution may result in fire, electric shock, or damage to the product.
  - Locations subject to direct sunlight
  - Locations subject to ambient operating 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 detector 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, inflammable gases, or combustibles.  
Failure to observe this caution may result in electric shock or fire.
- Do not step on or place a heavy object on the product.  
Failure to observe this caution may result in injury.
- Do not cover the inlet or outlet ports and prevent any foreign objects from entering the product.  
Failure to observe this caution may cause internal elements to deteriorate resulting in malfunction or fire.
- Be sure to install the product in the correct direction.  
Failure to observe this caution may result in malfunction.
- Provide the specified clearances between the SERVOPACK and the control panel or with other devices.  
Failure to observe this caution may result in fire or malfunction.
- Do not apply any strong impact.  
Failure to observe this caution may result in malfunction.

## ■ Wiring



### CAUTION

- 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 power supply terminal screws, control power supply terminal screws, and servomotor connection terminal screws.  
Failure to observe this caution may result in fire.
- Do not bundle or run the main circuit cables together with the input/output signal cables or the encoder cables in the same duct. Keep them separated by at least 30 cm.  
Failure to do so may result in malfunction.
- Use shielded twisted-pair wires or multi-core shielded twisted-pair wires for input/output signal cables and the encoder cables.
- I/O signal cables must be no longer than 3 m, encoder cables must be no longer than 50 m, and control power supply cables for the SERVOPACK with a 400 V power supply (+24 V, 0 V) must be no longer than 10 m.
- Do not touch the power terminals while the charge indicator is ON after turning power OFF because high voltage may still remain in the SERVOPACK.  
Make sure the charge indicator is off first before starting an inspection.
- Observe the following precautions when wiring main circuit terminal blocks of the SERVOPACK.
  - Remove the detachable main circuit terminal blocks from the SERVOPACK prior to wiring.
  - Insert only one main power line per opening in the main circuit terminals.
  - Make sure that no part of the core wire comes into contact with (i.e., short-circuit) adjacent wires.
- Install a battery at either the host controller or the SERVOPACK, but not both.  
It is dangerous to install batteries at both ends simultaneously, because that sets up a loop circuit between the batteries.
- Always use the specified power supply voltage.  
An incorrect voltage may result in fire or malfunction.
- Take appropriate measures to ensure that the input power supply is supplied within the specified voltage fluctuation range. Be particularly careful in places where the power supply is unstable.  
An incorrect power supply may result in damage to the product.
- Install external breakers or other safety devices against short-circuiting in external wiring.  
Failure to observe this caution may result in fire.
- Take appropriate and sufficient countermeasures for each form of potential interference when installing systems in the following locations.
  - Locations subject to static electricity or other forms of noise
  - Locations subject to strong electromagnetic fields and magnetic fields
  - Locations subject to possible exposure to radioactivity
  - Locations close to power suppliesFailure to observe this caution may result in damage to the product.
- Do not reverse the polarity of the battery when connecting it.  
Failure to observe this caution may damage the battery, the SERVOPACK, the servomotor, or cause an explosion.
- Wiring or inspection must be performed by a technical expert.
- Use a 24-VDC power supply with double insulation or reinforced insulation.

## ■ Operation

### CAUTION

- Always use the servomotor and SERVOPACK in one of the specified combinations.  
Failure to observe this caution so may result in fire or malfunction.
- Conduct trial operation on the servomotor alone with the motor shaft disconnected from the machine to avoid accidents.  
Failure to observe this caution may result in injury.
- If a servomotor with a holding brake is to be used, check that the holding brake operates correctly in trial operation. Also ensure that safety is maintained in the event of an error, such as disconnection of signal wires.
- Before starting operation with a machine connected, change the settings to match the parameters of the machine.  
Starting operation without matching the proper settings may cause the machine to run out of control or malfunction.
- Do not frequently turn power ON and OFF.  
Since the SERVOPACK has a capacitor in the power supply, a high charging current flows when power is turned ON. Frequently turning power ON and OFF causes main power devices like capacitors and fuses to deteriorate, resulting in unexpected problems.
- When using JOG operations (Fn002), search operations (Fn003), or EasyFFT operations (Fn206), the dynamic brake function does not work for reverse overtravel or forward overtravel. Take necessary precautions.
- When using the servomotor for a vertical axis, install safety devices to prevent workpieces from falling due to alarms or overtravels. Set the servomotor so that it will stop in the zero clamp state when overtravel occurs.  
Failure to observe this caution may cause workpieces to fall due to overtravel.
- When not using turning-less function, set to the correct moment of inertia ratio (Pn103).  
Setting to an incorrect moment of inertia ratio may cause machine vibration.
- Do not touch the SERVOPACK heatsinks, regenerative resistor, or servomotor while power is ON or soon after the power is turned OFF.  
Failure to observe this caution may result in burns due to high temperatures.
- Do not make any extreme adjustments or setting changes of parameters.  
Failure to observe this caution may result in injury or damage to the product due to unstable operation.
- When an alarm occurs, remove the cause, reset the alarm after confirming safety, and then resume operation.  
Failure to observe this caution may result in damage to the product, fire, or injury.
- Do not use the brake of the servomotor for braking.  
Failure to observe this caution may result in malfunction.
- An alarm or warning may be generated if communications are executed with the host controller during operation using SigmaWin+ or the digital operator.  
If an alarm or warning is generated, the process currently being executed may be aborted and the system may stop.

## ■ Maintenance and Inspection

### CAUTION

- Do not disassemble the SERVOPACK.  
Failure to observe this caution may result in electric shock or injury.
- Do not 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 product.

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■ Disposal



**CAUTION**

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

■ General Precautions

**Observe the following general precautions  
to ensure safe application.**

- The products shown in illustrations in this manual are sometimes shown without covers or protective guards. Always replace the cover or protective guard as specified first, and then operate the products in accordance with the manual.
- The drawings presented in this manual are typical examples and may not match the product you received.
- 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.

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## Warranty

### (1) Details of Warranty

#### ■ Period of Warranty

The period of warranty for a product that was purchased (hereafter “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.

#### ■ Scope of Warranty

Yaskawa shall replace or repair a defective product free of charge if a defect attributable to Yaskawa occurs during the period of warranty above. Defects due to the delivered product reaching the end of its service life and replacement of parts that require replacement or that have a limited service life are also outside the scope of this warranty.

Failures that occur for any of the following causes are outside the scope of the warranty.

1. Using or handling the product under conditions or in environments not described in product catalogs or manuals, or separately agreed-upon specifications
2. Causes not attributable to the delivered product itself
3. Modifications or repairs not performed by Yaskawa
4. Using 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 programming (including parameter settings) or the results of program execution if a programmable Yaskawa product was programmed by the user or by a third party.

### (3) Suitability for Use

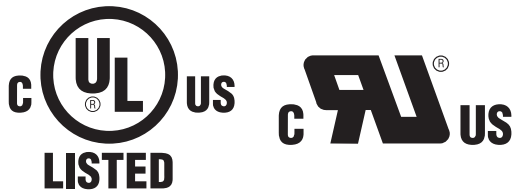
1. It is the customer’s responsibility to confirm conformity with any standards, codes, or regulations that apply if the Yaskawa product is used in combination with any other products.
2. The customer must confirm that the Yaskawa product is suitable for the systems, machines, and equipment used by the 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 required safety has been designed into the system 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) Changes to Specifications

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. When a catalog or a manual is revised, the catalog or manual code is updated and the new catalog or manual is published as a next edition. Consult with your Yaskawa representative to confirm the actual specifications before purchasing a product.

## Applicable Standards

### ■ North American Safety Standards (UL/CSA)



|            | Model   | UL* Standards<br>(UL File No.) |
|------------|---|--------------------------------|
| SERVOPACK  | • SGD V   | UL508C (E147823)               |
| Servomotor | • SGMJV<br>• SGM AV<br>• SGMPS<br>• SGMGV<br>• SGM SV | UL1004 (E165827)               |

\* Underwriters Laboratories Inc.

### ■ European Standards



|            | Model   | Low Voltage Directive                                | EMC Directive                              |                          | Safety Standards           |
|------------|---|--|--|--------------------------|----------------------------|
|            |   |  | EMI  | EMS                      |                            |
| SERVOPACK  | • SGD V   | EN50178<br>EN61800-5-1                               | EN55011/A2<br>group 1 class A<br>EN61800-3 | EN61800-3<br>EN61000-6-2 | EN954-1<br>IEC61508-1 to 4 |
| Servomotor | • SGMJV<br>• SGM AV<br>• SGMPS<br>• SGMGV<br>• SGM SV | IEC60034-1<br>IEC60034-5<br>IEC60034-8<br>IEC60034-9 | EN55011/A2<br>group 1 class A<br>EN61800-3 | EN61800-3<br>EN61000-6-2 | –                          |

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



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**Revision History**

## Outline

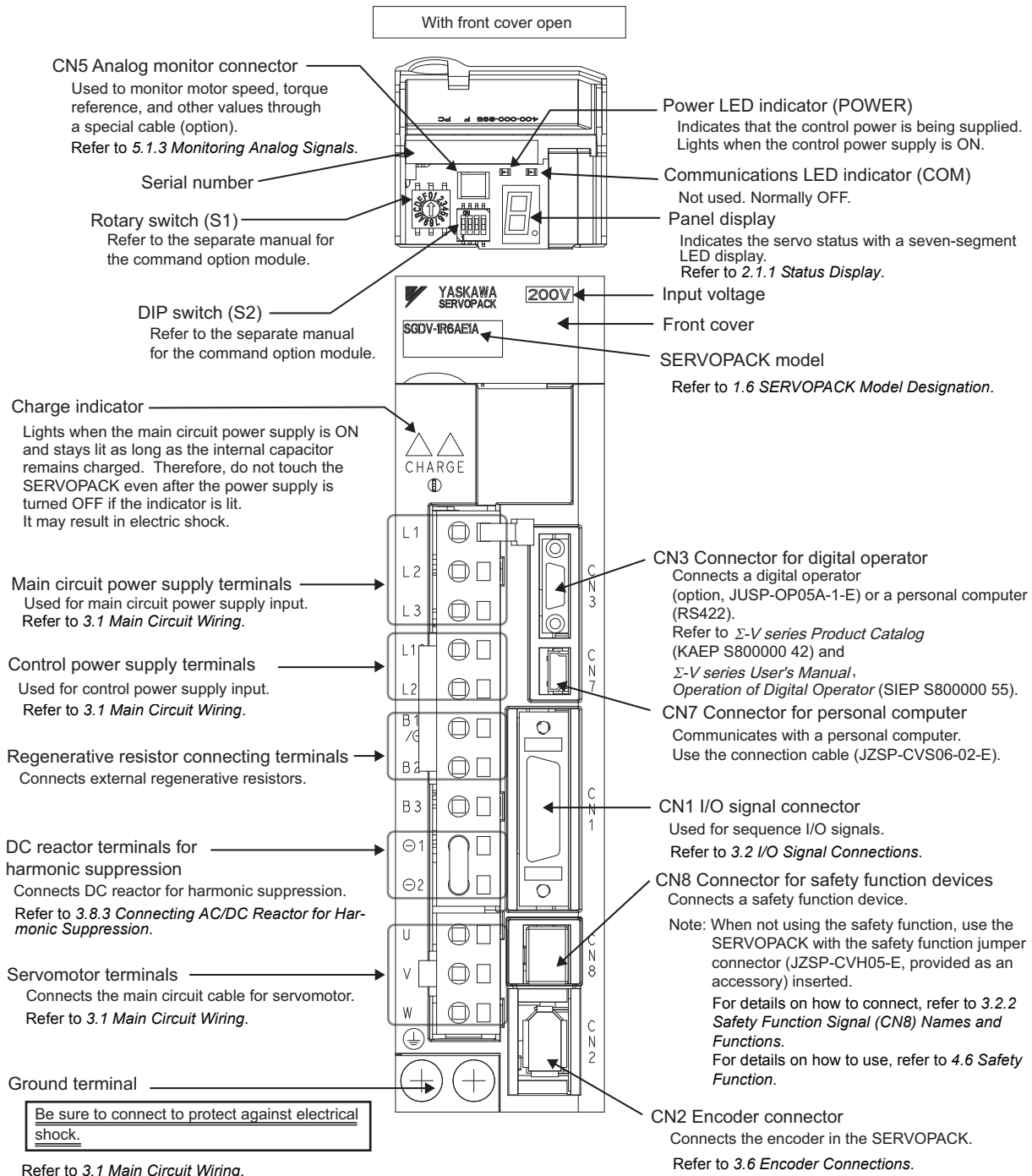
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## 1.1 Σ-V Series SERVOPACKs

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

## 1.2 Part Names

This section gives the part names of the SGD-V SERVOPACK (command option attachable type).



# 1.3 SERVOPACK Ratings and Specifications

This section describes the ratings and specifications of SERVOPACKs.

## 1.3.1 Ratings

Ratings of SERVOPACKs are as shown below.

### (1) SGDV Single-phase 100-V Ratings

| SGDV (Single-phase, 100 V)       | R70  | R90  | 2R1 | 2R8 |
|----------------------------------|--|------|-----|-----|
| Continuous Output Current [Arms] | 0.66   | 0.91 | 2.1 | 2.8 |
| Max. Output Current [Arms]       | 2.1  | 2.9  | 6.5 | 9.3 |
| Regenerative Resistor            | None/External  |      |     |     |
| Main Circuit Power Supply        | Single-phase, 100 to 115 VAC $\begin{smallmatrix} +10\% \\ -15\% \end{smallmatrix}$ , 50/60 Hz |      |     |     |
| Control Power                    | Single-phase, 100 to 115 VAC $\begin{smallmatrix} +10\% \\ -15\% \end{smallmatrix}$ , 50/60 Hz |      |     |     |
| Overvoltage Category             | III  |      |     |     |

### (2) SGDV Single-phase 200-V Ratings

| SGDV (Single-phase, 200 V)       | 120*   |
|----------------------------------|--|
| Continuous Output Current [Arms] | 11.6   |
| Max. Output Current [Arms]       | 28   |
| Regenerative Resistor            | Built-in/External  |
| Main Circuit Power Supply        | Single-phase, 220 to 230 VAC $\begin{smallmatrix} +10\% \\ -15\% \end{smallmatrix}$ , 50/60 Hz |
| Control Power                    | Single-phase, 220 to 230 VAC $\begin{smallmatrix} +10\% \\ -15\% \end{smallmatrix}$ , 50/60 Hz |
| Overvoltage Category             | III  |

\* The official model number is SGDV-120AE1A008000.

### (3) SGDV Three-phase 200-V Ratings

| SGDV (Three-phase, 200 V)        | R70  | R90  | 1R6 | 2R8 | 3R8               | 5R5  | 7R6 | 120  | 180  | 200  | 330      | 470  | 550  | 590  | 780  |
|----------------------------------|--|------|-----|-----|-------------------|------|-----|------|------|------|----------|------|------|------|------|
| Continuous Output Current [Arms] | 0.66   | 0.91 | 1.6 | 2.8 | 3.8               | 5.5  | 7.6 | 11.6 | 18.5 | 19.6 | 32.9     | 46.9 | 54.7 | 58.6 | 78.0 |
| Max. Output Current [Arms]       | 2.1  | 2.9  | 5.8 | 9.3 | 11.0              | 16.9 | 17  | 28   | 42   | 56   | 84       | 110  | 130  | 140  | 170  |
| Regenerative Resistor            | None/External  |      |     |     | Built-in/External |      |     |      |      |      | External |      |      |      |      |
| Main Circuit Power Supply        | Three-phase, 200 to 230 VAC $\begin{smallmatrix} +10\% \\ -15\% \end{smallmatrix}$ , 50/60 Hz  |      |     |     |                   |      |     |      |      |      |          |      |      |      |      |
| Control Power                    | Single-phase, 200 to 230 VAC $\begin{smallmatrix} +10\% \\ -15\% \end{smallmatrix}$ , 50/60 Hz |      |     |     |                   |      |     |      |      |      |          |      |      |      |      |
| Overvoltage Category             | III  |      |     |     |                   |      |     |      |      |      |          |      |      |      |      |

### (4) SGDV Three-phase 400-V Ratings

| SGDV (Three-phase, 400 V)        | 1R9   | 3R5 | 5R4 | 8R4 | 120  | 170  | 210  | 260      | 280  | 370  |  |
|----------------------------------|---|-----|-----|-----|------|------|------|----------|------|------|--|
| Continuous Output Current [Arms] | 1.9   | 3.5 | 5.4 | 8.4 | 11.9 | 16.5 | 20.8 | 25.7     | 28.1 | 37.2 |  |
| Max. Output Current [Arms]       | 5.5   | 8.5 | 14  | 20  | 28   | 42   | 55   | 65       | 70   | 85   |  |
| Regenerative Resistor            | Built-in/External   |     |     |     |      |      |      | External |      |      |  |
| Main Circuit Power Supply        | Three-phase, 380 to 480 VAC $\begin{smallmatrix} +10\% \\ -15\% \end{smallmatrix}$ , 50/60 Hz |     |     |     |      |      |      |          |      |      |  |
| Control Power                    | 24 VDC $\pm 15\%$   |     |     |     |      |      |      |          |      |      |  |
| Overvoltage Category             | III   |     |     |     |      |      |      |          |      |      |  |



### 1.3.2 Basic Specifications

Basic specifications of SERVOPACKs are shown below.

|                      |  |  |   |  |
|----------------------|--|--|---|--|
| Control Method       |  | IGBT-PWM (sine-wave driven)  |   |  |
| Feedback             |  | Serial encoder:<br>13-bit (incremental), 17-bit, 20-bit (incremental/absolute)   |   |  |
| Operating Conditions | Surrounding Air/Storage Temperature      | 0 to +55°C/ -20 to +85°C   |   |  |
|                      | Ambient/Storage Humidity                 | 90% RH or less (with no condensation)  |   |  |
|                      | Vibration/Shock Resistance               | 4.9 m/s <sup>2</sup> / 19.6 m/s <sup>2</sup>   |   |  |
|                      | Protection Class/<br>Pollution Degree    | Protection class: IP10, Pollution degree: 2<br>An environment that satisfies the following conditions. <ul style="list-style-type: none"> <li>• Free of corrosive or explosive gases</li> <li>• Free of exposure to water, oil or chemicals</li> <li>• Free of dust, salts or iron dust</li> </ul> |   |  |
|                      | Altitude                                 | 1000 m or less   |   |  |
|                      | Others                                   | Free of static electricity, strong electromagnetic fields, magnetic fields or exposure to radioactivity  |   |  |
| Applicable Standards |  | UL508C<br>EN50178, EN55011/A2 group 1 class A, EN61000-6-2, EN61800-3,<br>EN61800-5-1, EN954-1, IEC61508-1 to 4  |   |  |
| Configuration        |  | Base-mounted *1  |   |  |
| Performance          | Speed Control Range                      |  | 1:5000  |  |
|                      | Speed Regulation*2                       | Load Fluctuation   | 0 to 100% load: ±0.01% max. (at rated speed)  |  |
|                      |  | Voltage Fluctuation  | Rated voltage ±10%: 0% (at rated speed)   |  |
|                      |  | Temperature Fluctuation  | 25 ± 25 °C: ±0.1% max. (at rated speed)   |  |
|                      | Torque Control Tolerance (Repeatability) |  | ±1%   |  |
| I/O Signals          | Encoder Output Pulses                    |  | Phase-A, -B, -C: line driver<br>Encoder output pulse: any setting ratio   |  |
|                      | Sequence Input                           | Input Signals which can be allocated   | Number of Channels<br>7 channels  |  |
|                      |  | Functions  | The signal allocation and positive/negative logic can be modified.<br>Forward run prohibited (P-OT), reverse run prohibited (N-OT), forward external torque limit (/P-CL), reverse external torque limit (/N-CL), general-purpose input signal (/SI0 to /SI6)*3 |  |
|                      | Sequence Output                          | Fixed Output   | Servo alarm (ALM)   |  |
|                      |  | Output Signals which can be allocated  | Number of Channels  | 3 channels   |
|                      |  |  | Functions   | The signal allocation and positive/negative logic can be modified.<br>Positioning completion (/COIN), speed coincidence detection (/V-CMP), servomotor rotation detection (/TGON), servo ready (/S-RDY), torque limit detection (/CLT), speed limit detection (/VLT), brake (/BK), warning (/WARN), near (/NEAR) |

|                                 |  |   |   |
|---------------------------------|--|---|---|
| Communi-<br>cations<br>Function | RS422A<br>Communi-<br>cations<br>(CN3) | Interface   | Digital operator (JUSP-OP05A-1-E), personal computer (can be connected with SigmaWin+), etc.  |
|                                 |  | 1:N<br>Communi-<br>cations  | N = Up to 15 stations possible at RS422A  |
|                                 |  | Axis<br>Address<br>Setting  | Set by parameter  |
|                                 | USB<br>Communi-<br>cations<br>(CN7)    | Interface   | Personal computer (can be connected with SigmaWin+.)  |
| Communi-<br>cations<br>Standard |  | Complies with standard USB1.1. (12 Mbps)                          |   |
| LED Display                     |  |   | Panel display (seven-segment, 1 digit), CHARGE and POWER indicators   |
| Analog Monitor (CN5)            |  |   | Number of points: 2<br>Output voltage: ± 10V DC (linearity effective range ± 8V)<br>Resolution: 16 bit<br>Accuracy: ± 20 mV (Typ)<br>Max. output current: ± 10 mA<br>Settling time (± 1%): 1.2 ms (Typ) |
| Dynamic Brake (DB)              |  |   | Activated when a servo alarm, overtravel, or hard wire base block occurs or when the power supply for the main circuit or servomotor is turned OFF.   |
| Regenerative Processing         |  |   | Built-in or external regenerative resistor (option)   |
| Overtravel Prevention (OT)      |  |   | Dynamic brake stop at P-OT or N-OT, deceleration to a stop, or free run to a stop   |
| Protection Function             |  |   | Overcurrent, overvoltage, insufficient voltage, overload, regeneration error, and so on.  |
| Utility Function                |  |   | Gain adjustment, alarm history, JOG operation, origin search, and so on.  |
| Safety Function                 | Input                                  | /HWBB1, /HWBB2: Baseblock signal for power module                 |   |
|                                 | Output                                 | EDM1: Monitoring status of internal safety circuit (fixed output) |   |
| Option Modules                  |  |   | Fully-closed option module and command option module  |

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

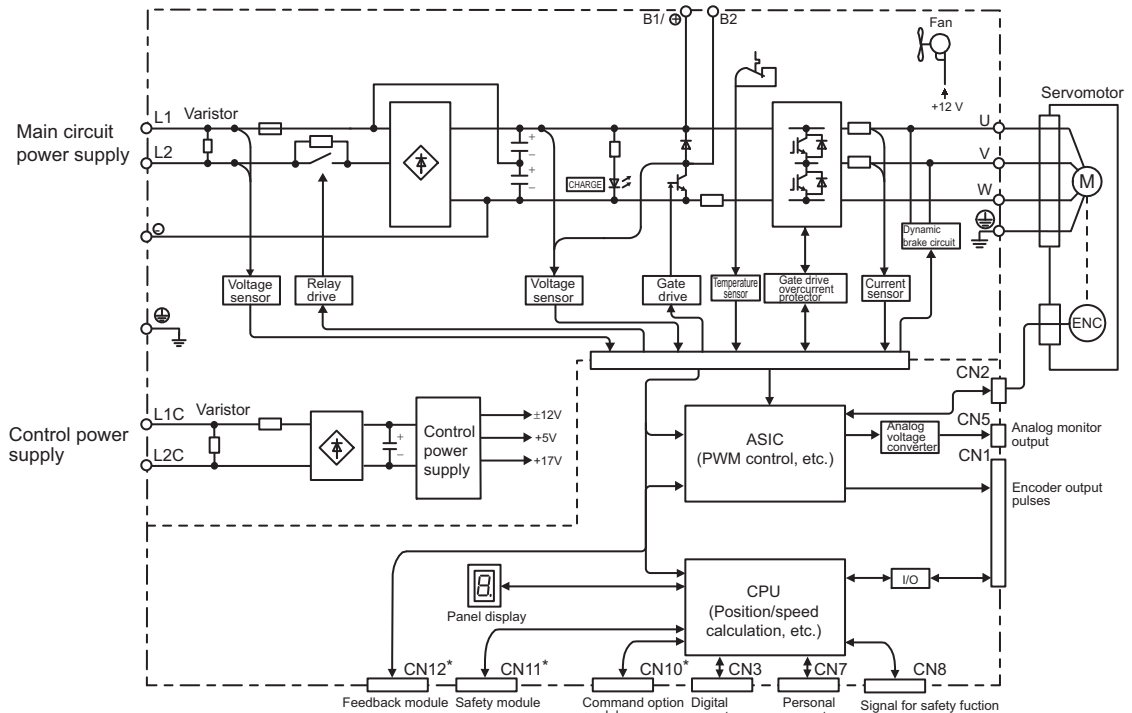
\*2. Speed regulation by load fluctuation is defined as follows:

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

\*3. For information on functions, refer to the manual of the connected command option module.

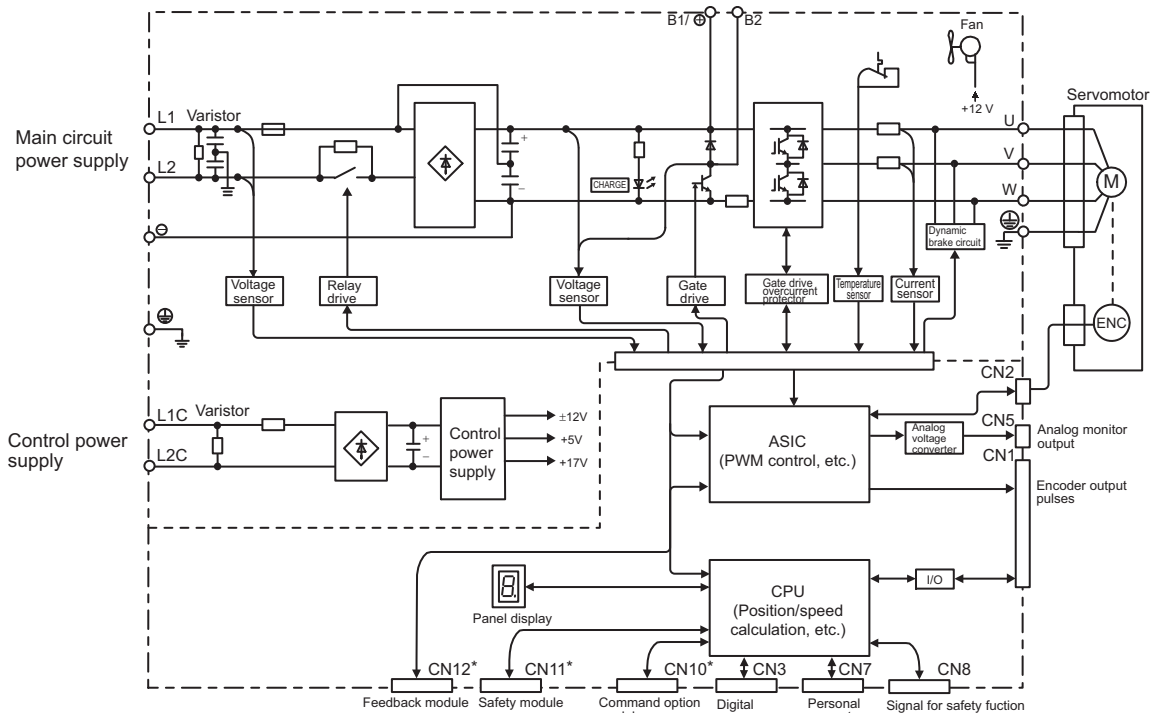
## 1.4 SERVOPACK Internal Block Diagrams

### 1.4.1 Single-phase 100-V, SGDVR70FE1A, -R90FE1A, -2R1FE1A Models



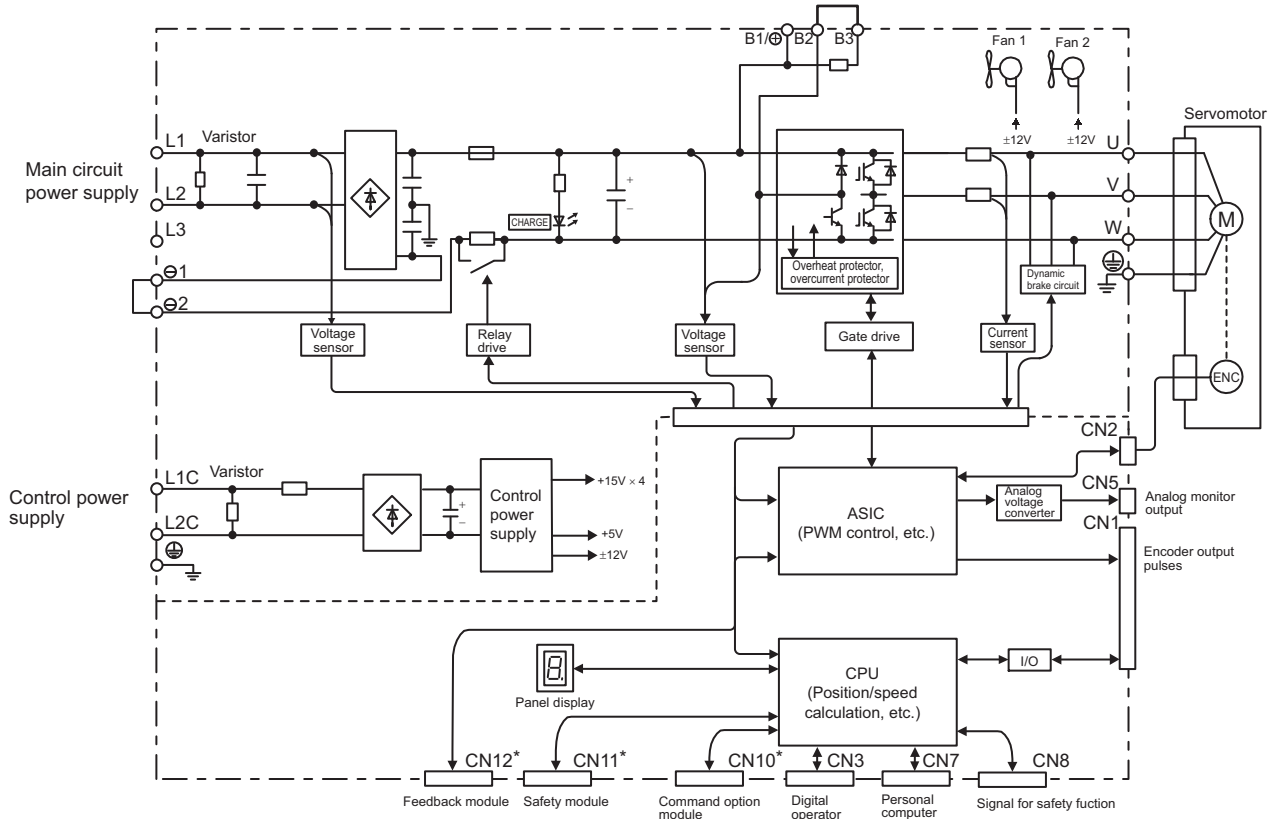
\* This external input signal is used by the option module.  
For details, refer to the manual of the connected option module.

### 1.4.2 Single-phase 100-V, SGDVR2R8FE1A Model



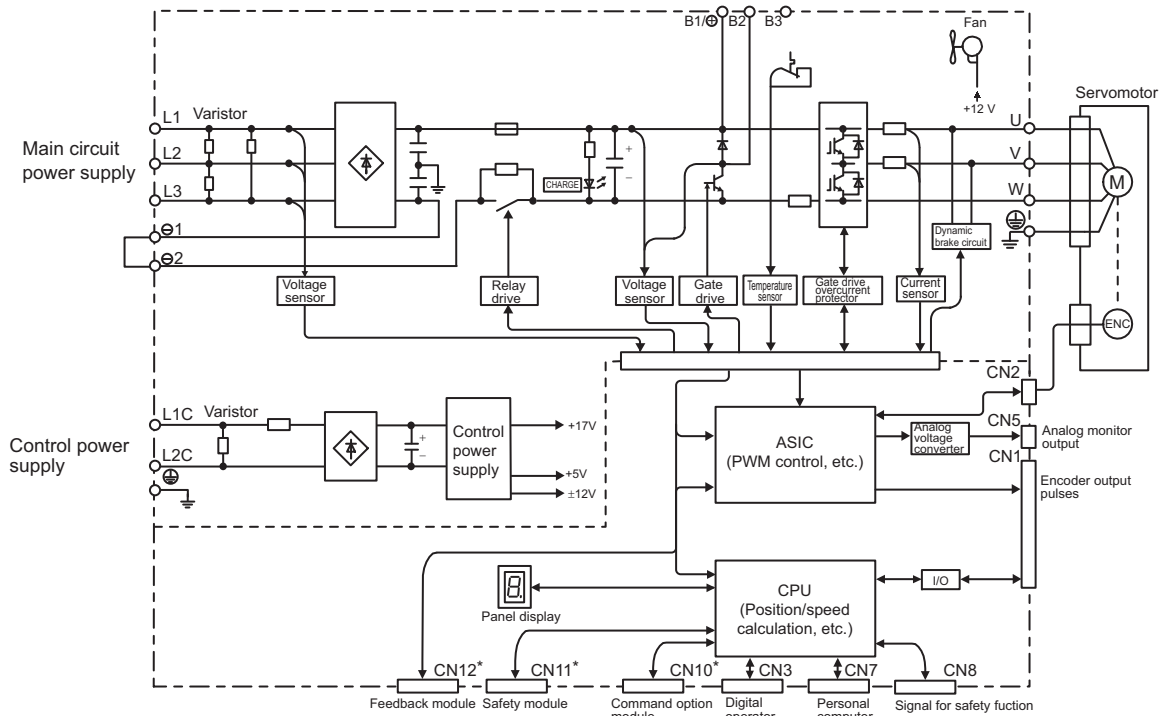
\* This external input signal is used by the option module.  
For details, refer to the manual of the connected option module.

### 1.4.3 Single-phase 200-V, SGDV-120AE1A008000 Model



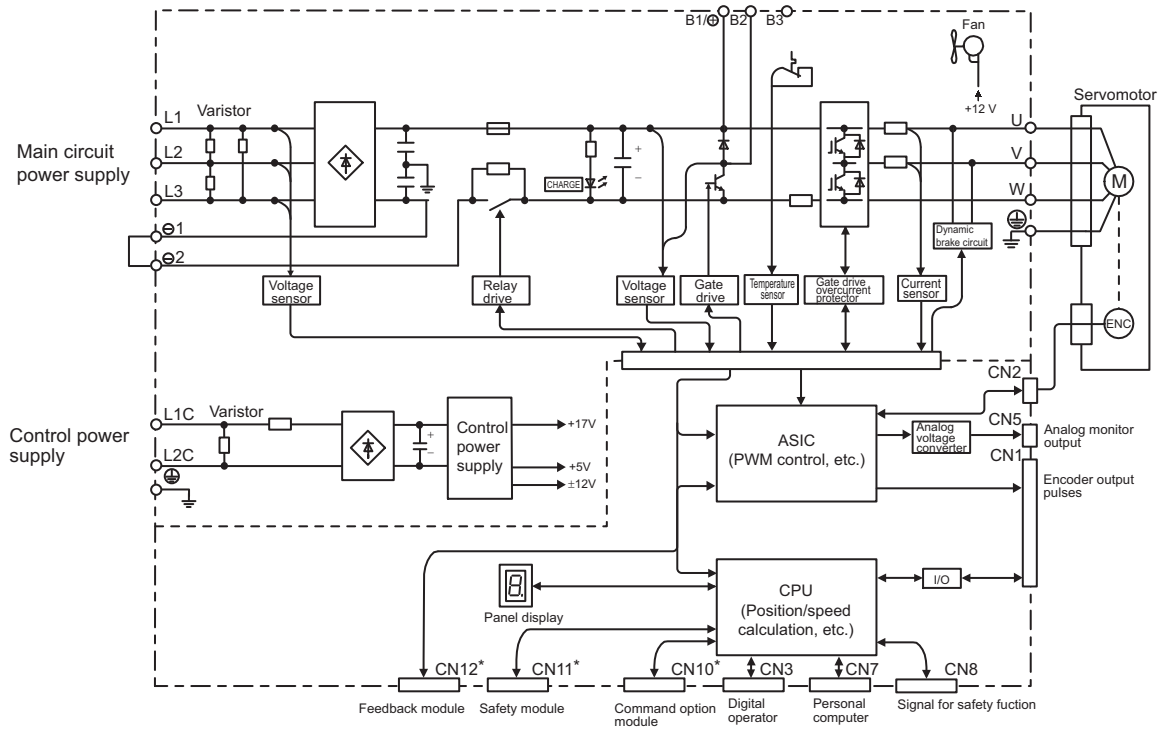
\* This external input signal is used by the option module.  
For details, refer to the manual of the connected option module.

### 1.4.4 Three-phase 200-V, SGDV-R70AE1A, -R90AE1A, -1R6AE1A Models



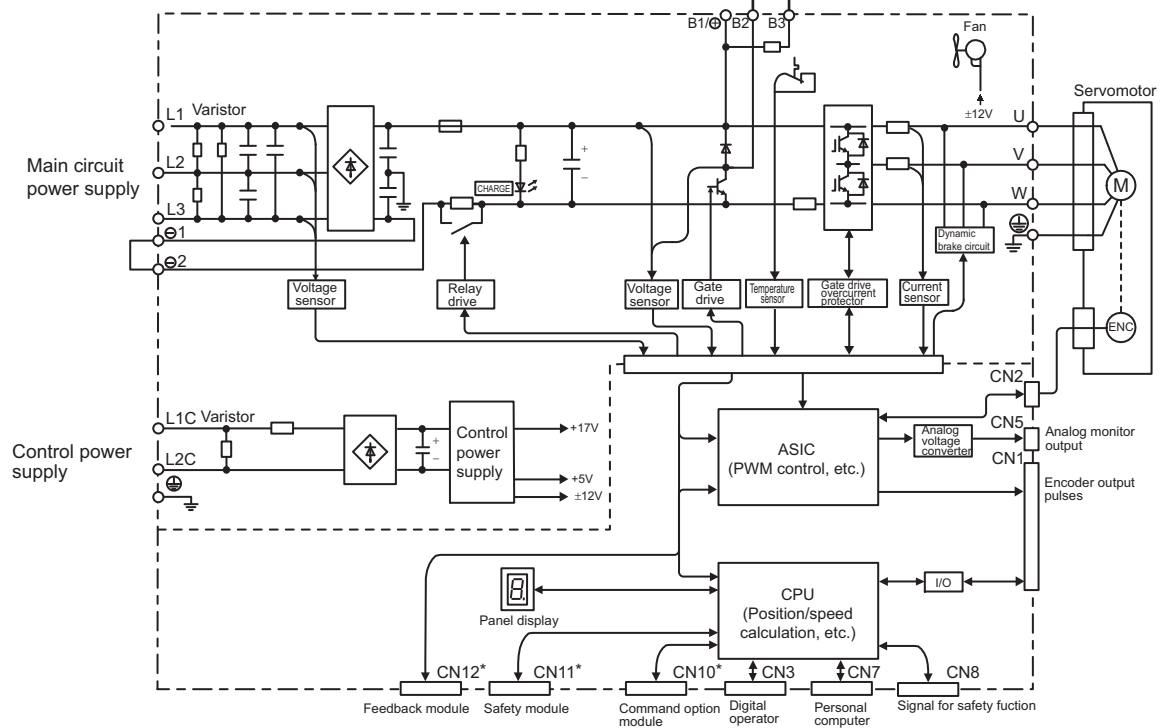
\* This external input signal is used by the option module.  
For details, refer to the manual of the connected option module.

### 1.4.5 Three-phase 200-V, SGDV-2R8AE1A Model



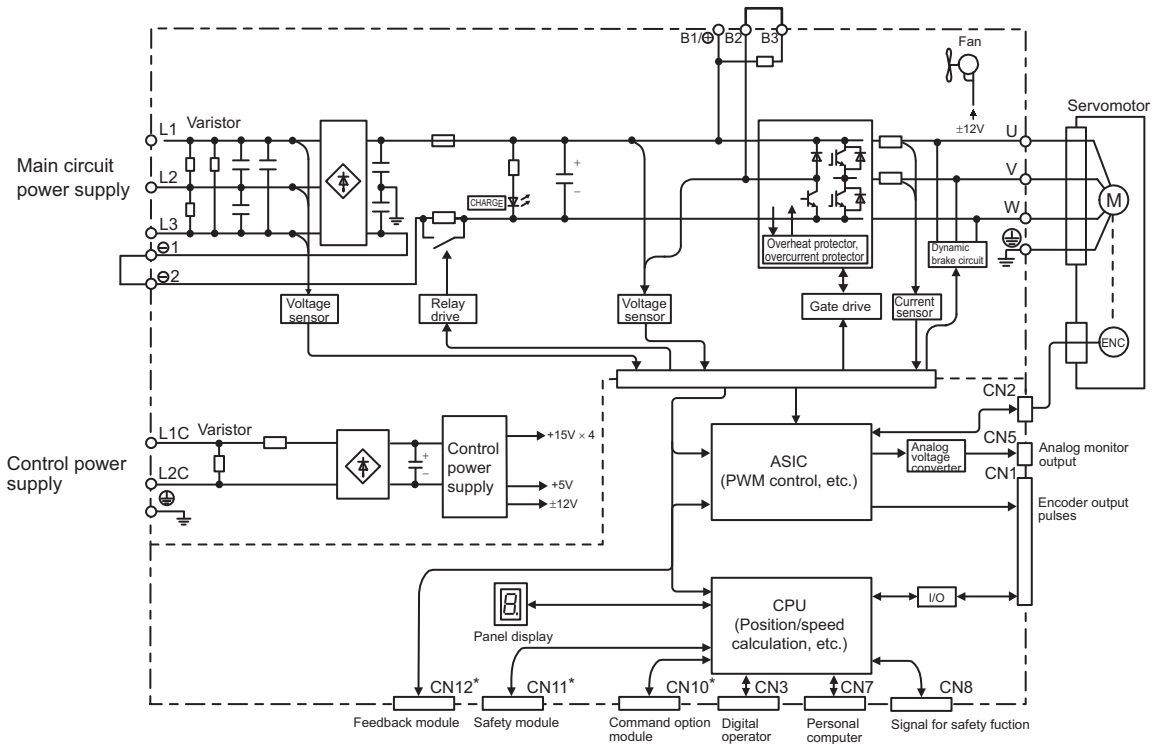
\* This external input signal is used by the option module.  
For details, refer to the manual of the connected option module.

### 1.4.6 Three-phase 200-V, SGDV-3R8AE1A, -5R5AE1A, -7R6AE1A Models



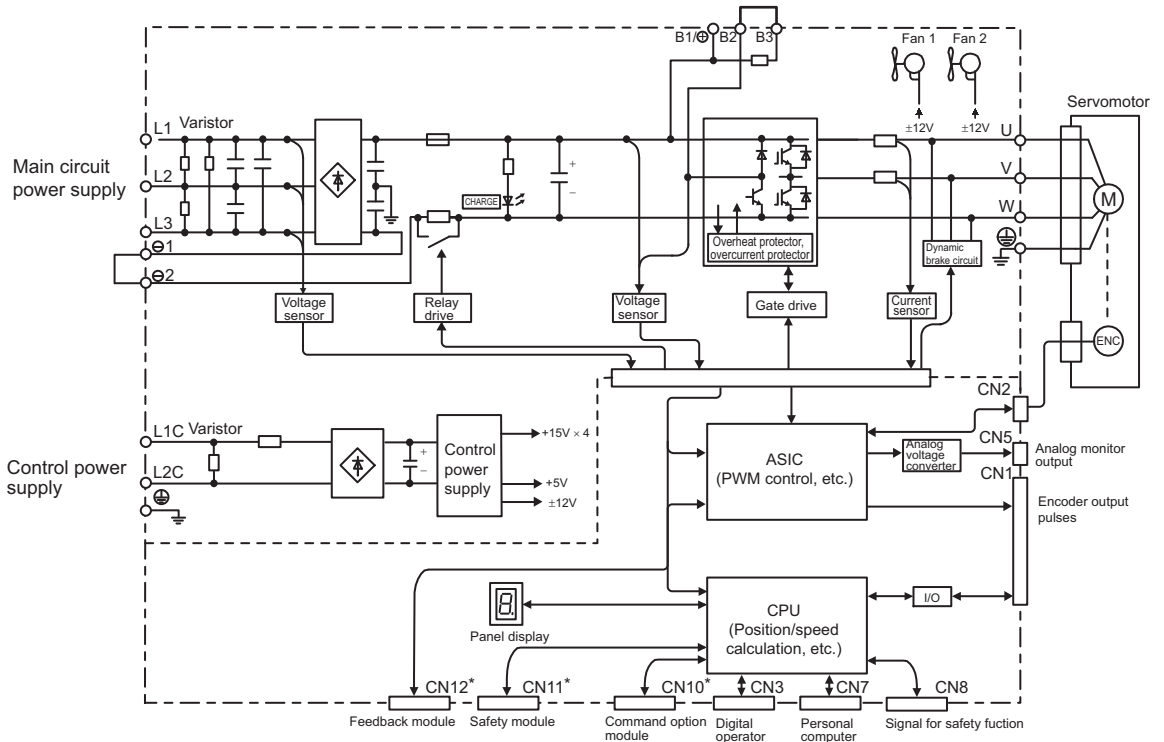
\* This external input signal is used by the option module.  
For details, refer to the manual of the connected option module.

### 1.4.7 Three-phase 200-V, SGDV-120AE1A Model



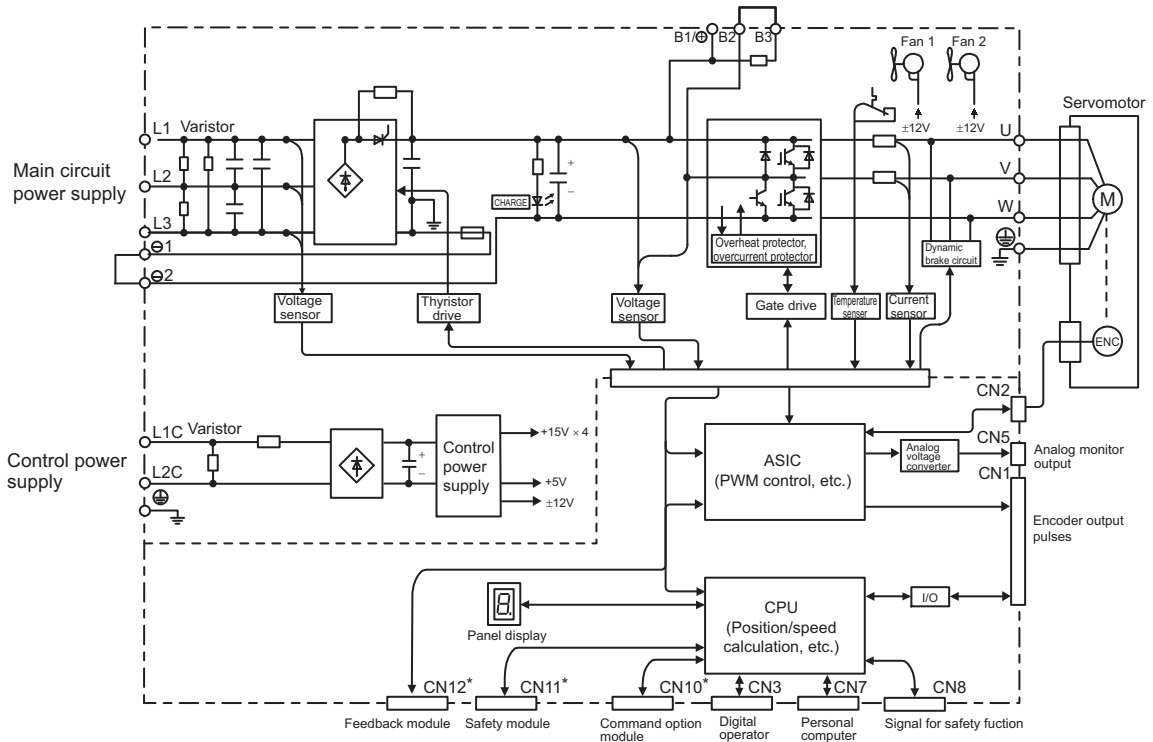
\* This external input signal is used by the option module.  
For details, refer to the manual of the connected option module.

### 1.4.8 Three-phase 200-V, SGDV-180AE1A, -200AE1A Models



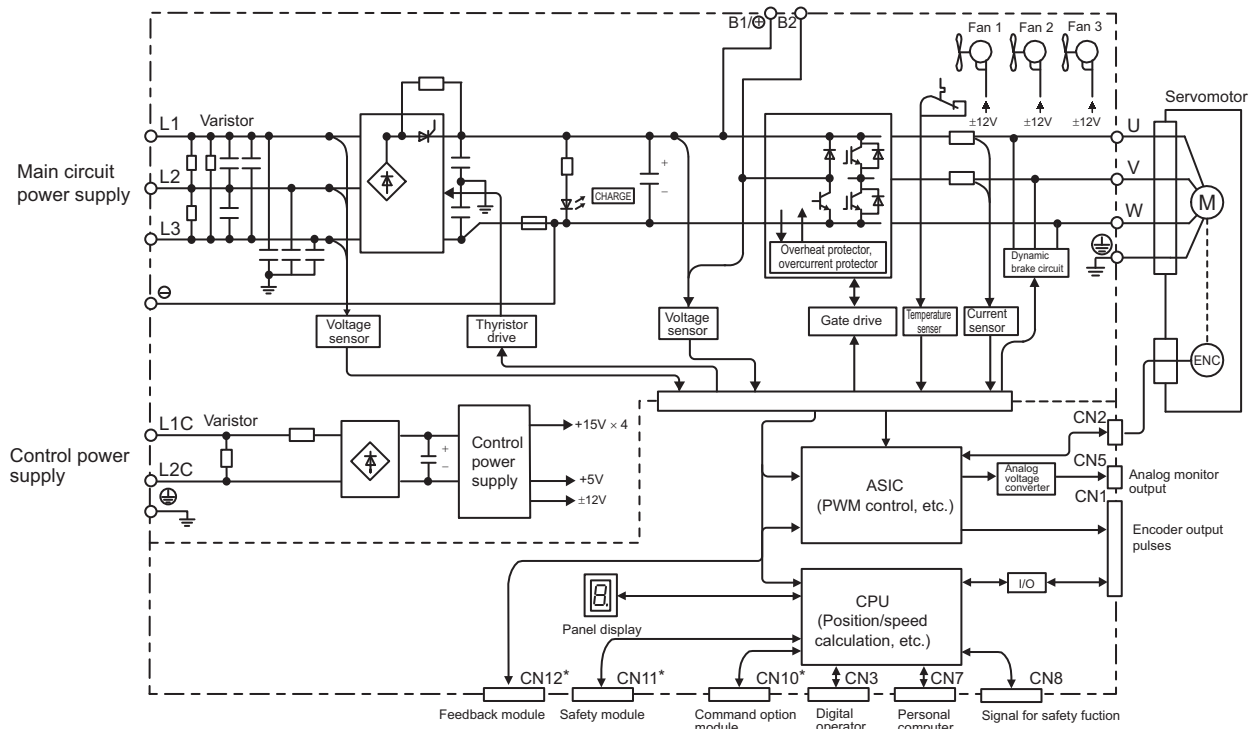
\* This external input signal is used by the option module.  
For details, refer to the manual of the connected option module.

### 1.4.9 Three-phase 200-V, SGDV-330AE1A Model



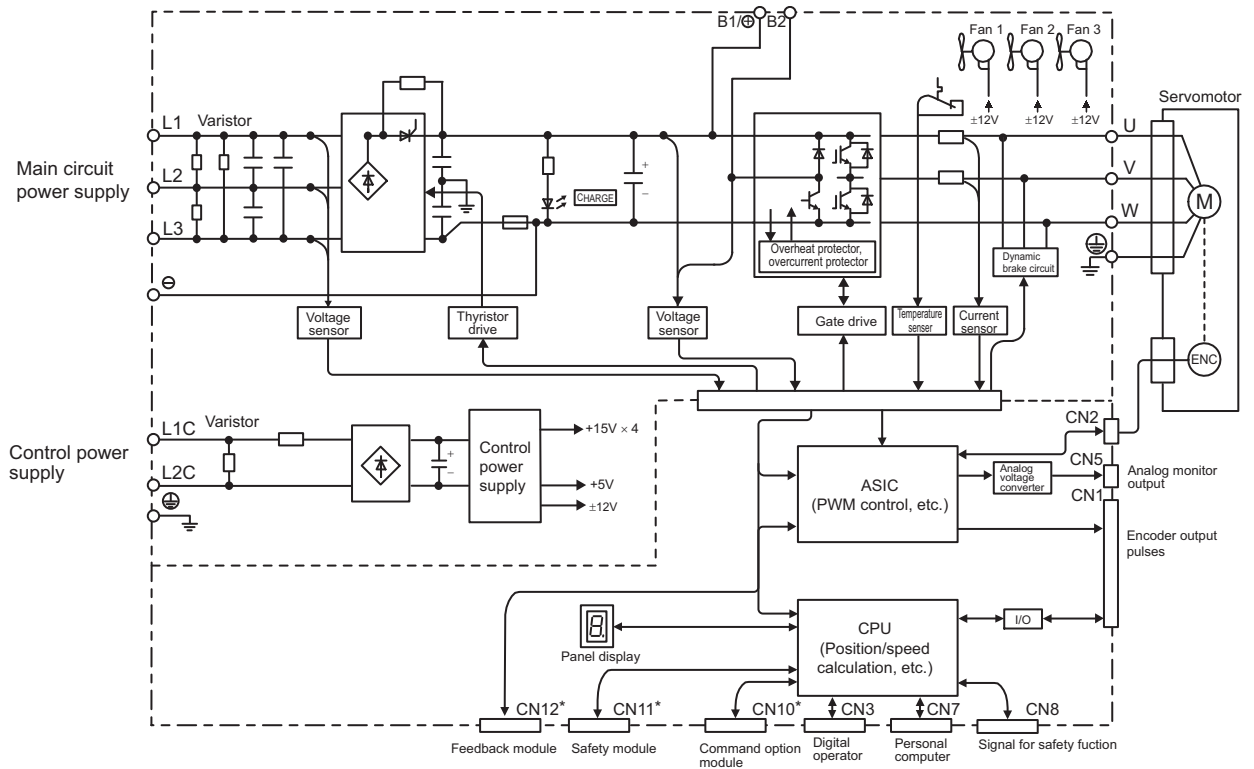
\* This external input signal is used by the option module.  
For details, refer to the manual of the connected option module.

### 1.4.10 Three-phase 200-V, SGDV-470AE1A, -550AE1A Models



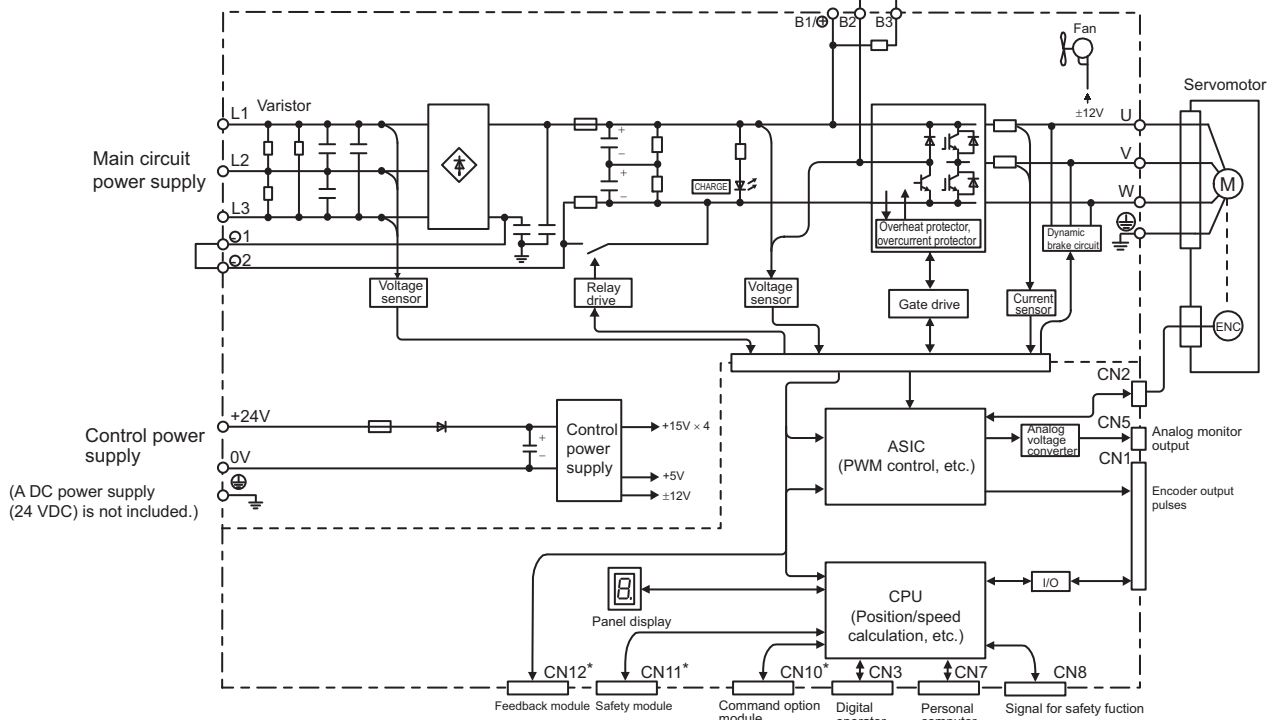
\* This external input signal is used by the option module.  
For details, refer to the manual of the connected option module.

### 1.4.11 Three-phase 200-V, SGD5-590AE1A, -780AE1A Models



\* This external input signal is used by the option module.  
For details, refer to the manual of the connected option module.

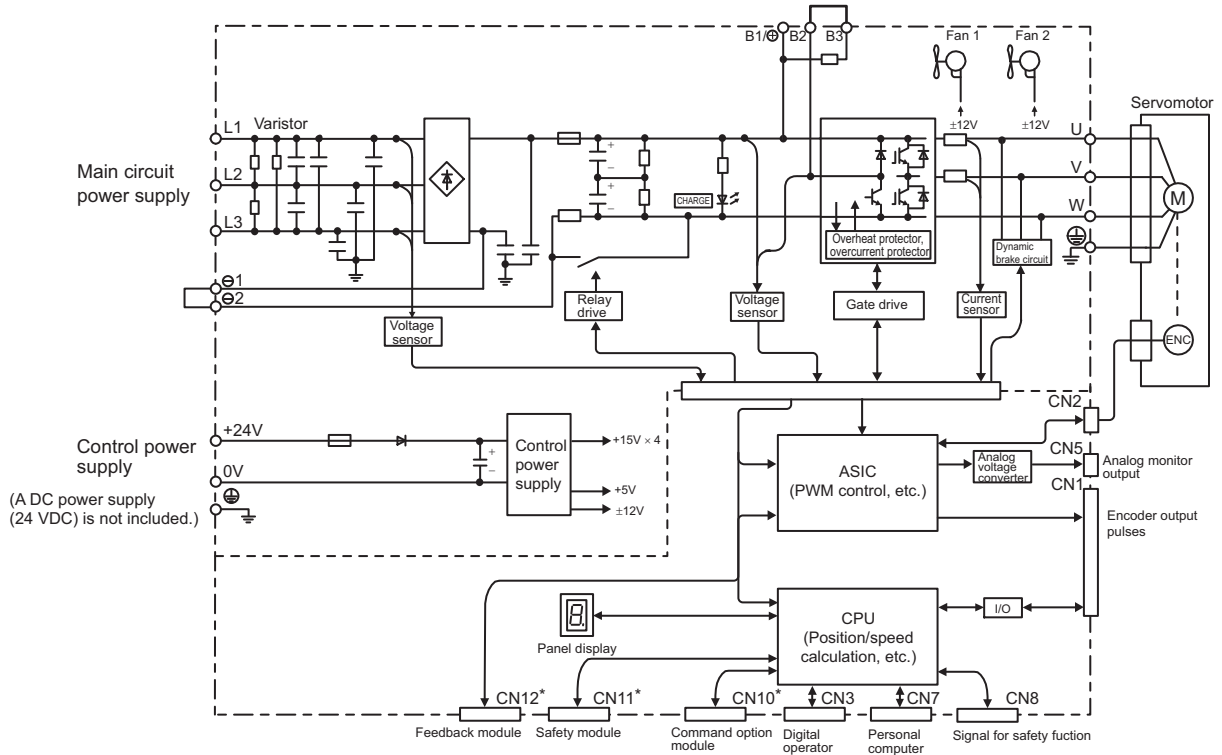
### 1.4.12 Three-phase 400-V, SGD5-1R9DE1A, -3R5DE1A, -5R4DE1A Models



\* This external input signal is used by the option module.  
For details, refer to the manual of the connected option module.

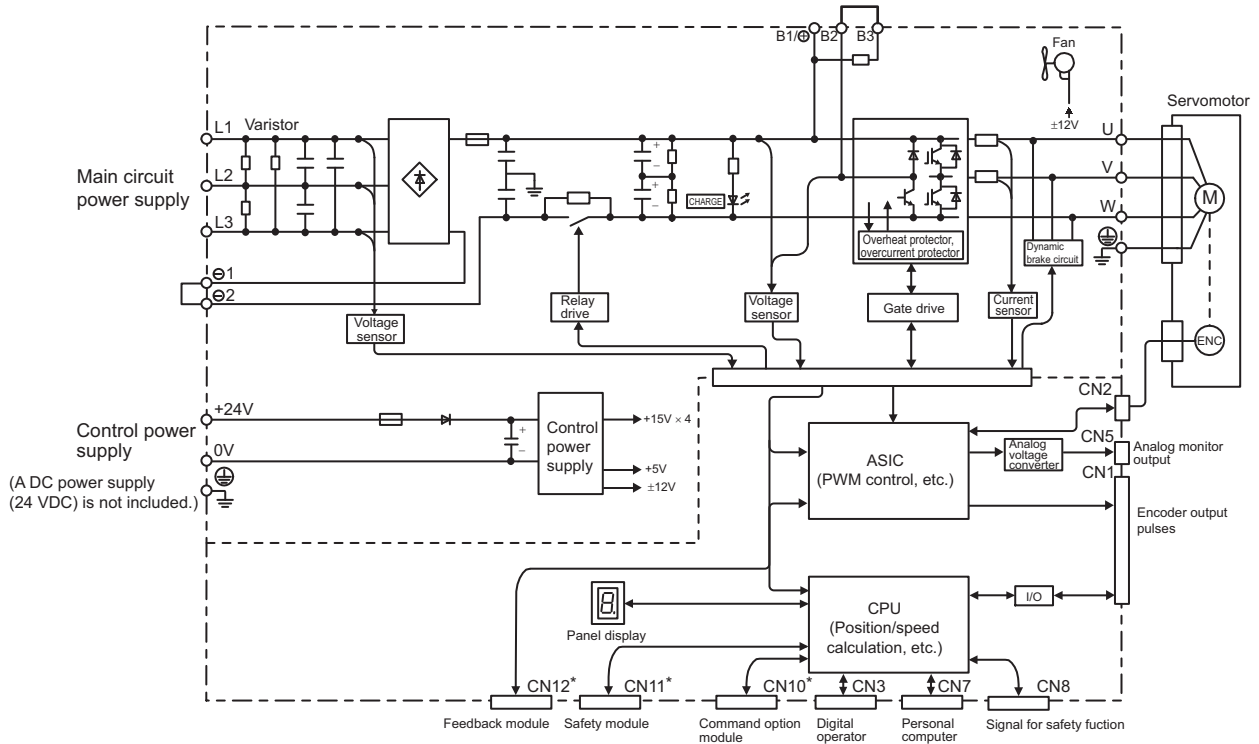


### 1.4.13 Three-phase 400-V, SGDV-8R4DE1A, -120DE1A Models



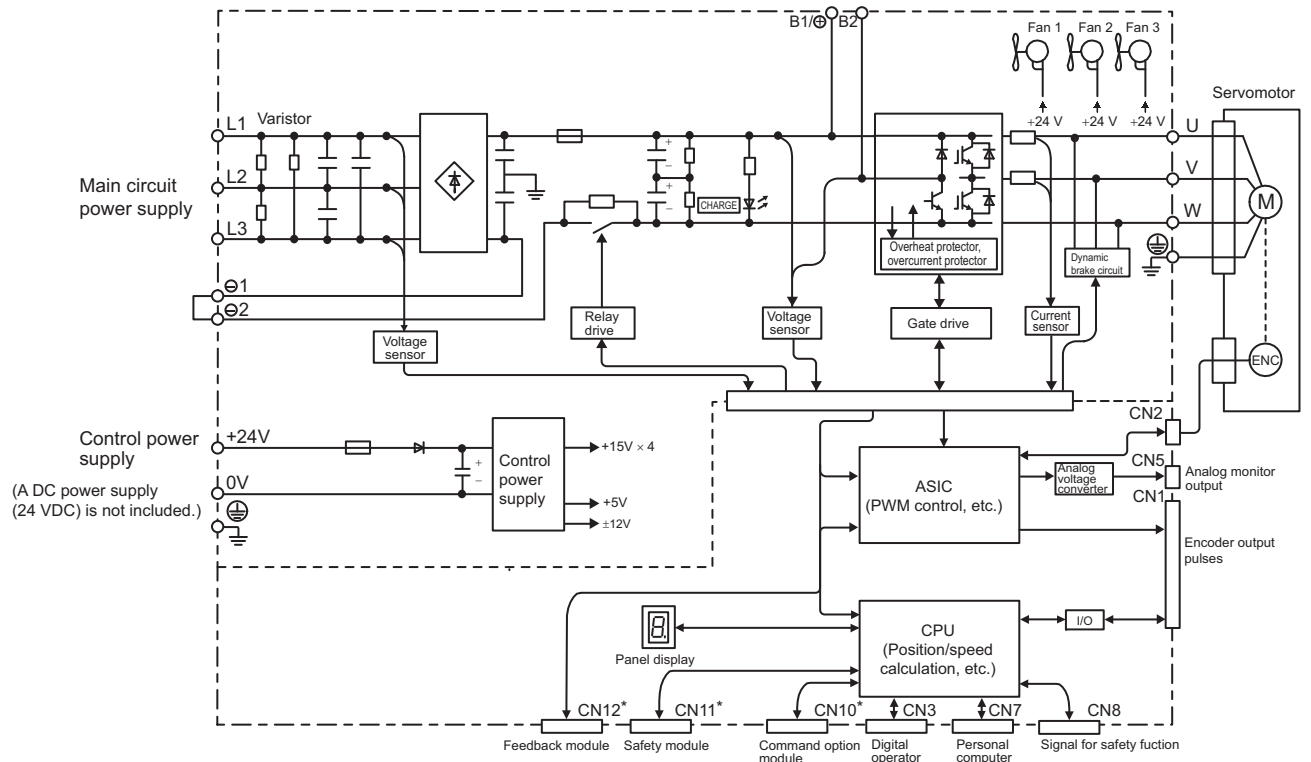
\* This external input signal is used by the option module.  
For details, refer to the manual of the connected option module.

### 1.4.14 Three-phase 400-V, SGDV-170DE1A Model



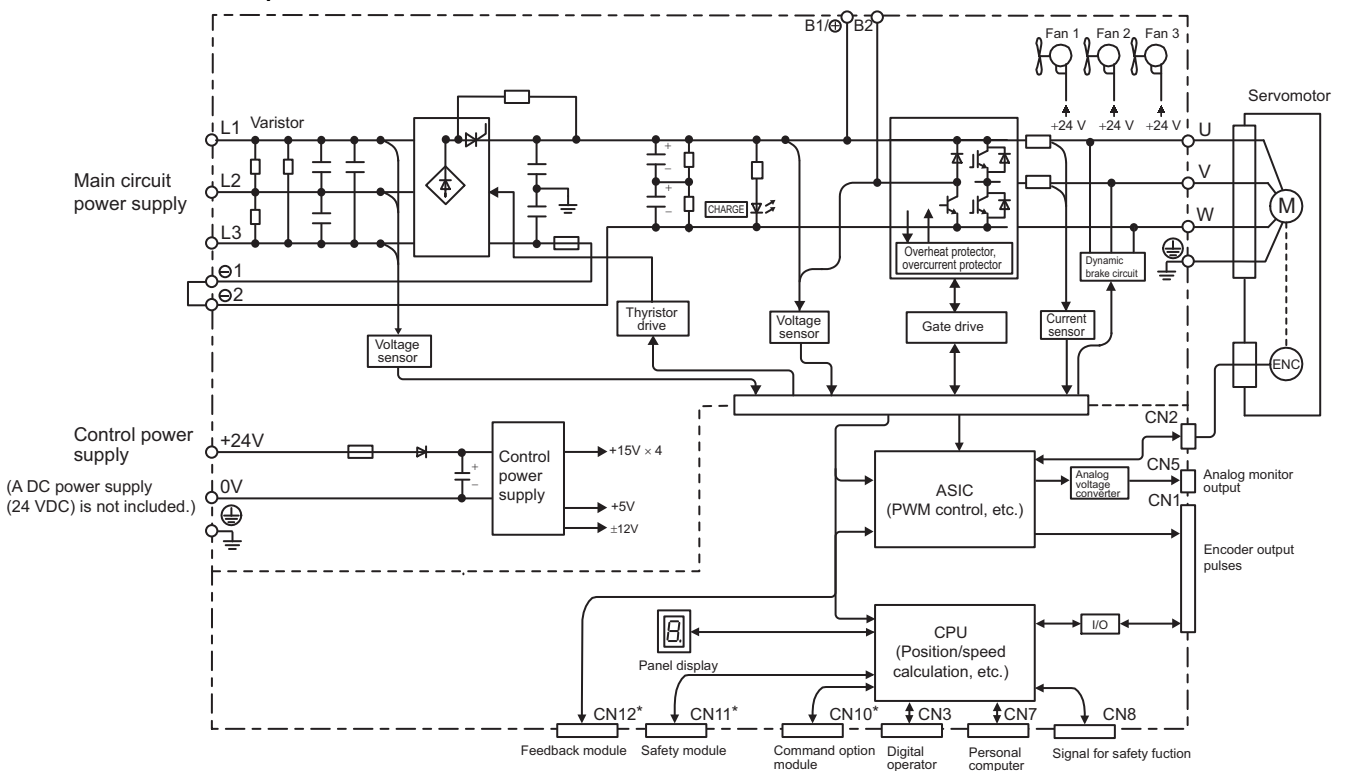
\* This external input signal is used by the option module.  
For details, refer to the manual of the connected option module.

### 1.4.15 Three-phase 400-V, SGDV-210DE1A, -260DE1A Models



\* This external input signal is used by the option module.  
For details, refer to the manual of the connected option module.

### 1.4.16 Three-phase 400-V, SGDV-280DE1A, -370DE1A Models

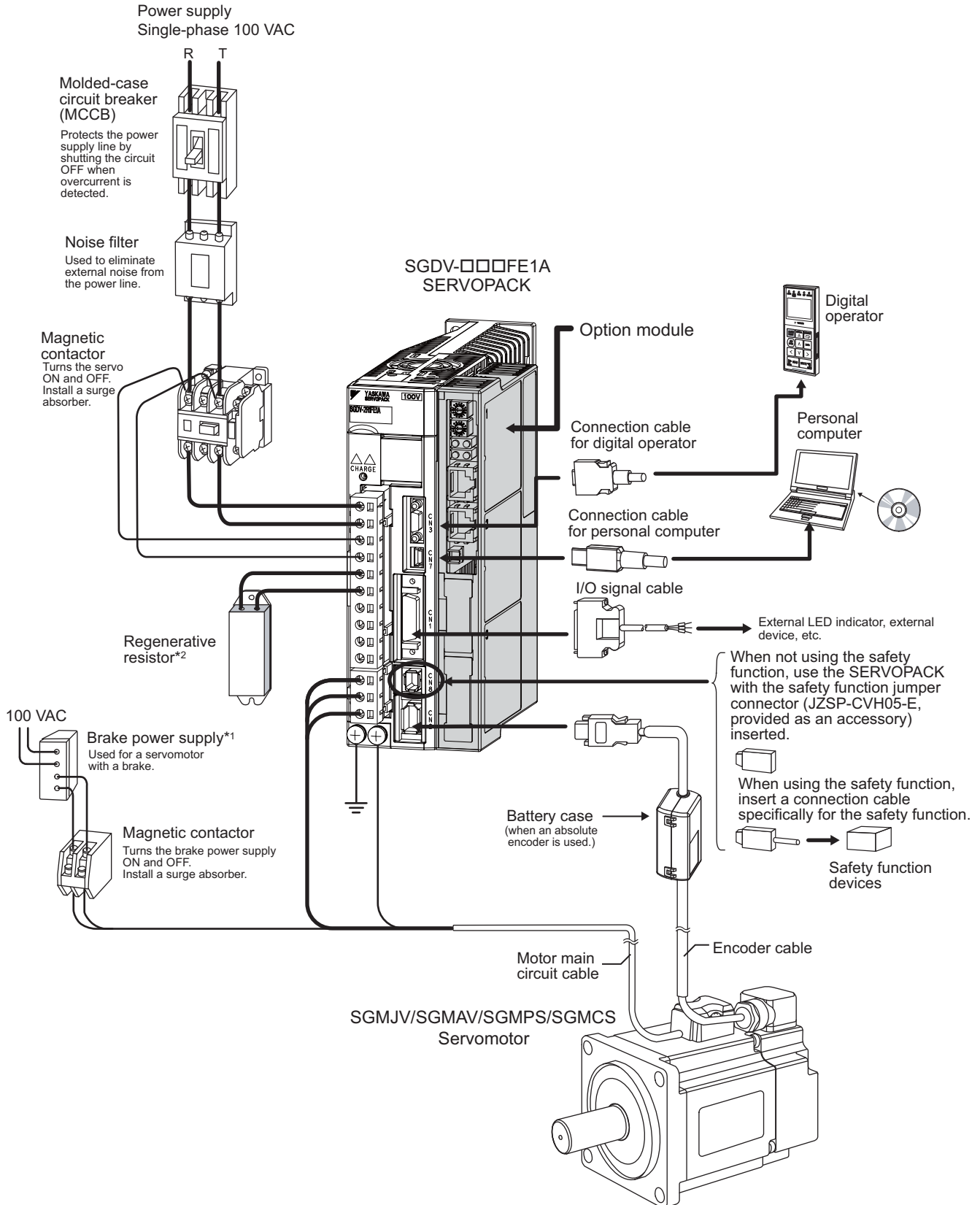


\* This external input signal is used by the option module.  
For details, refer to the manual of the connected option module.

## 1.5 Examples of Servo System Configurations

This section describes examples of basic servo system configuration.

### 1.5.1 Connecting to SGDV-□□□FE1A SERVOPACK

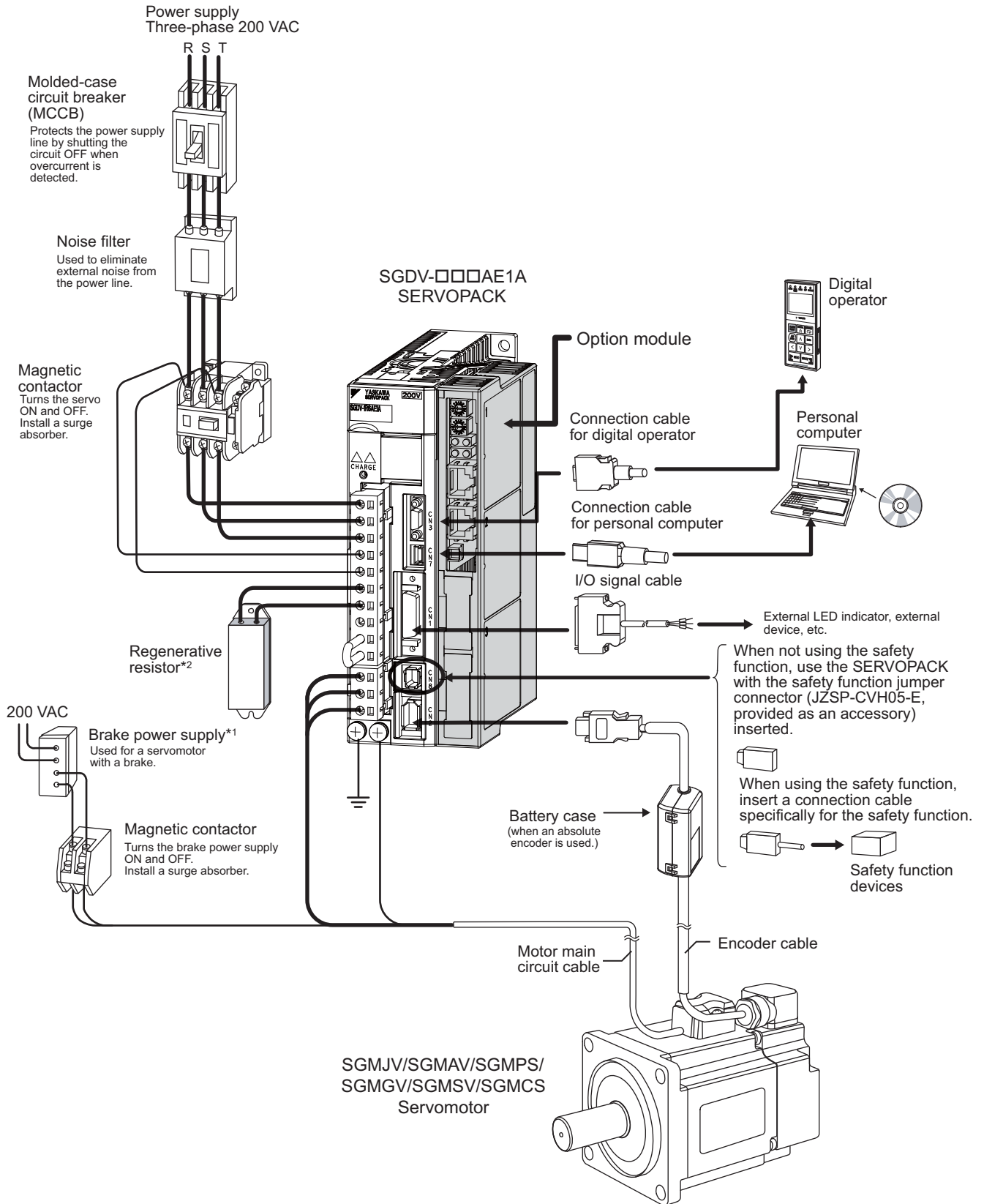


\*1. Use a 24-VDC power supply. (not included.)

\*2. Before connecting an external regenerative resistor to the SERVOPACK, refer to 3.7 *Regenerative Resistors Connections*.

## 1.5.2 Connecting to SGD□□□AE1A SERVOPACK

### (1) Using a Three-phase, 200-V Power Supply



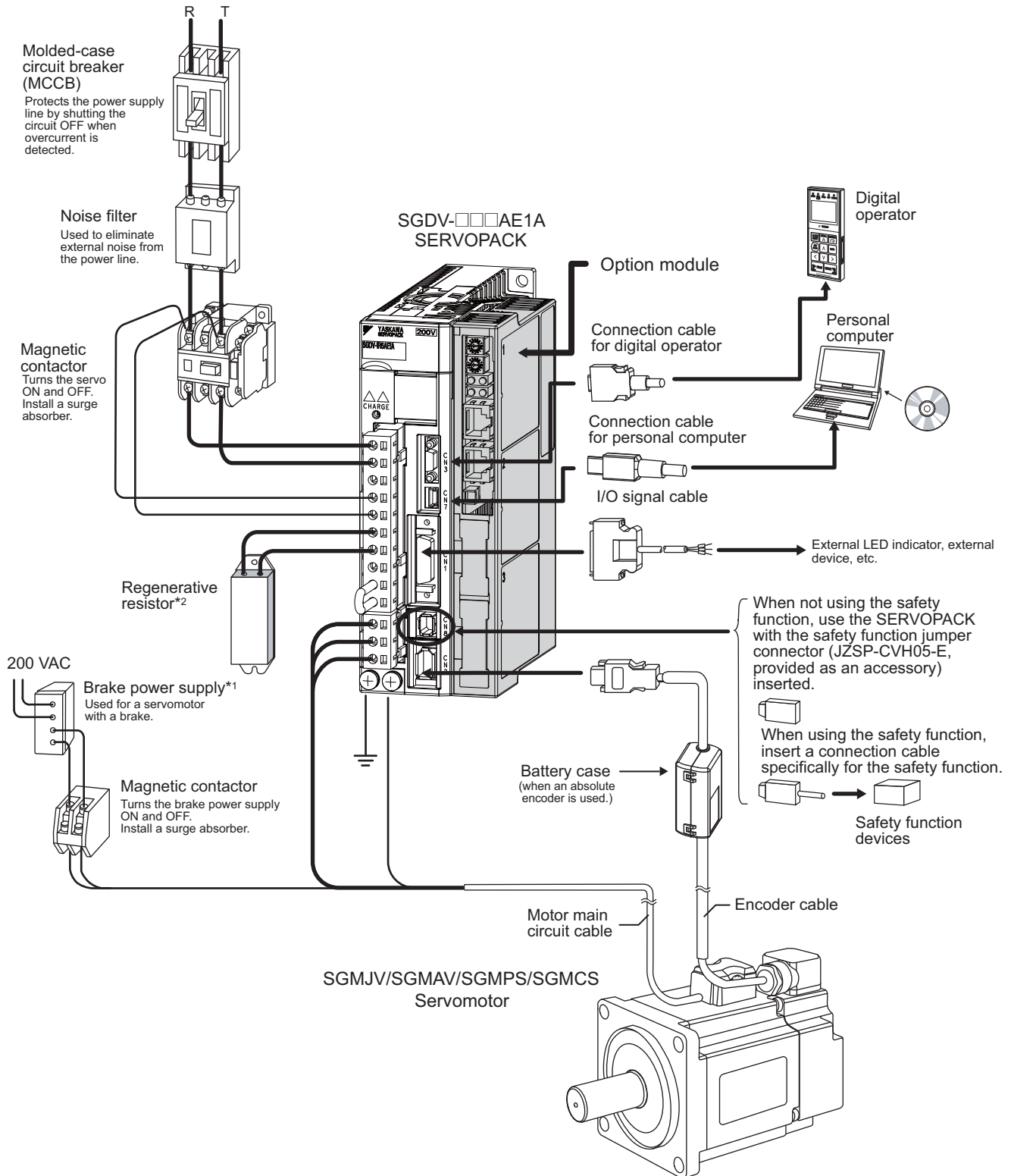
\*1. Use a 24-VDC power supply. (not included.)

\*2. Before connecting an external regenerative resistor to the SERVOPACK, refer to 3.7 *Regenerative Resistors Connections*.

(2) Using a Single-phase, 200-V Power Supply

The  $\Sigma$ -V Series SERVOPACK for a 200-V power supply input has input specifications for a three-phase power supply, but some models can also be used with a single-phase 200-V power supply. For details, refer to 3.1.4 Using the SERVOPACK with Single-phase, 200-V Power Input.

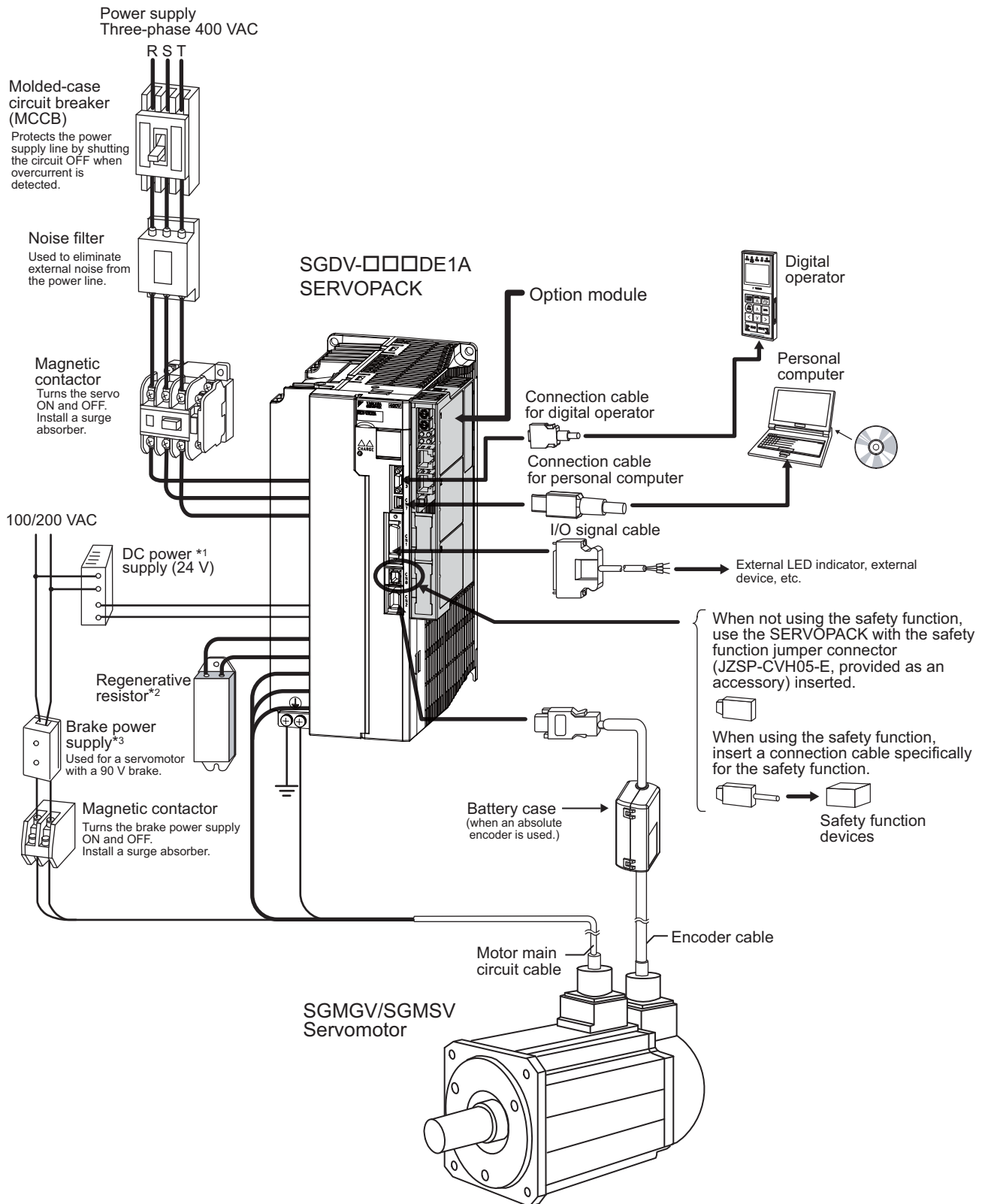
Power supply  
Single-phase 200 VAC



\*1. Use a 24-VDC power supply. (not included.)

\*2. Before connecting an external regenerative resistor to the SERVOPACK, refer to 3.7 Regenerative Resistors Connections.

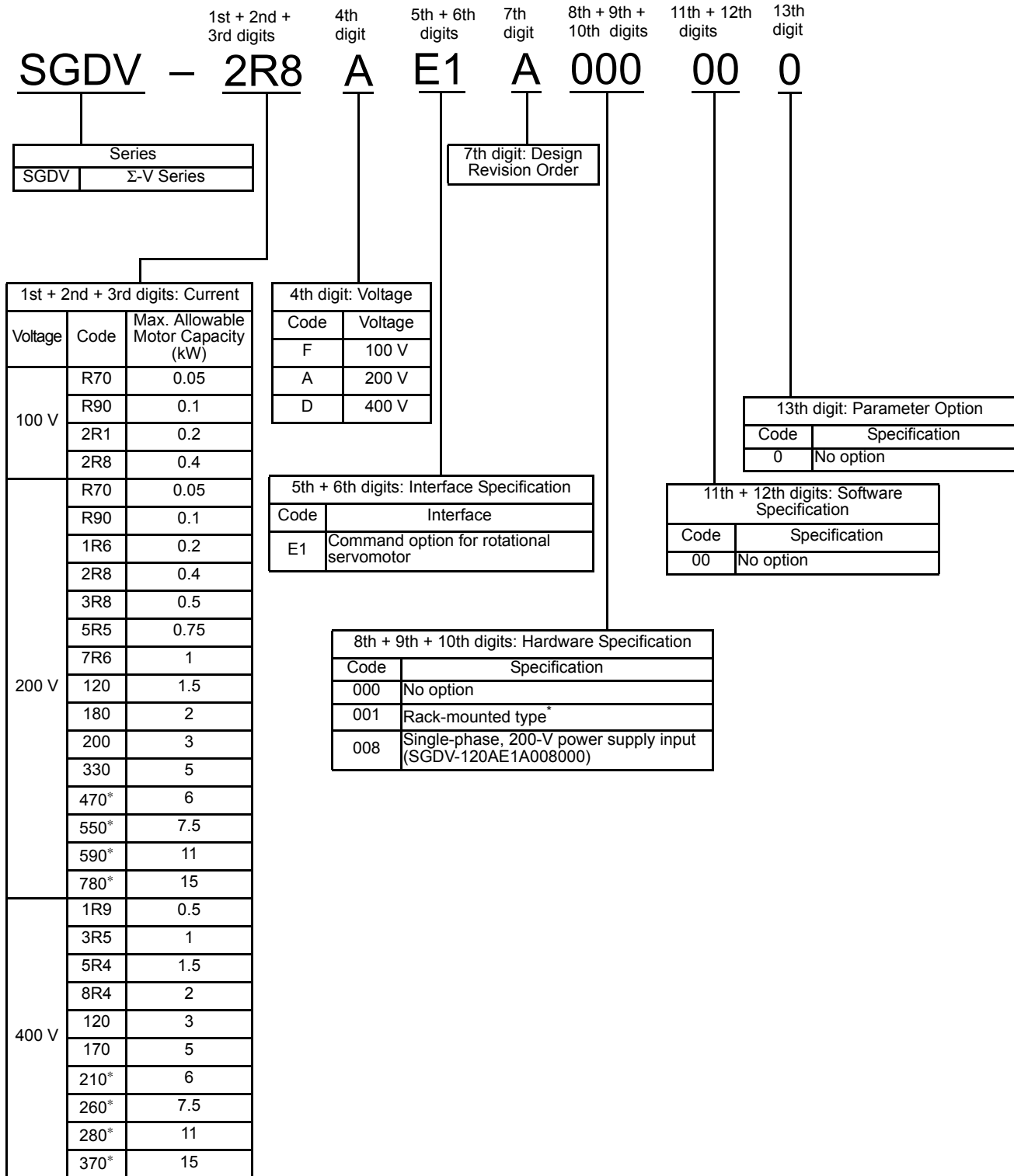
### 1.5.3 Connecting to SGD□□□DE1A SERVOPACK



- \*1. Use a 24-VDC power supply with double insulation or reinforced insulation. (The power supply is not included)
- \*2. Before connecting an external regenerative resistor to the SERVOPACK, refer to 3.7 *Regenerative Resistors Connections*.
- \*3. Use a following power supply for 90-V brake. For details, refer to *Σ-V series Product Catalog* (KAEP S800000 42).
  - For 200-V input voltage: LPSE-2H01-E
  - For 100-V input voltage: LPDE-1H01-E

## 1.6 SERVOPACK Model Designation

Select the SERVOPACK according to the applied servomotor.



\* The SGDV-470A, 550A, 590A, 780A, 210D, 260D, 280D, and 370D have air ducts for ventilation.  
 Note: If the option codes for the 8th to the 13th digits are all zero, the zeroes 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 terminal block and connector screws. | Tighten any loose screws.  |

### (2) SERVOPACK's Parts Replacement Schedule

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

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

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

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



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## Panel Display and Operation of Digital Operator





|  |     |
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| 2.1.1 Status Display .....               | 2-2 |
| 2.1.2 Alarm and Warning Display .....    | 2-2 |
| 2.1.3 Hard Wire Base Block Display ..... | 2-2 |
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| 2.2 Utility Function Mode (Fn□□□) .....  | 2-3 |
| 2.3 Parameter (Pn□□□) Operation .....    | 2-4 |
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## 2.1 Panel Display

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

### 2.1.1 Status Display

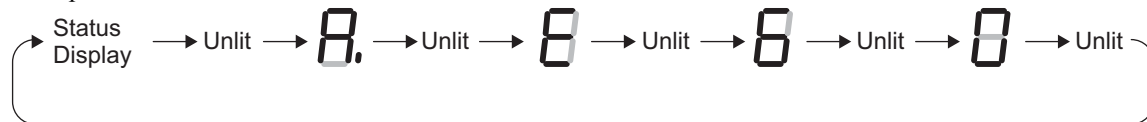
The display shows the following status.

| Display  | Meaning  |
|--|--|
|   | Rotation Detection (/TGON)<br>Lights if motor speed exceeds the value set in Pn502. (Factory setting: 20 min <sup>-1</sup> ) |
|   | Base Block<br>Lights for base block.   |
|   | Reference Input<br>Lights when a reference is being input.   |
|  | Command Option Module Communications Status Display<br>Lights when communications with the command option module are normal. |

### 2.1.2 Alarm and Warning Display

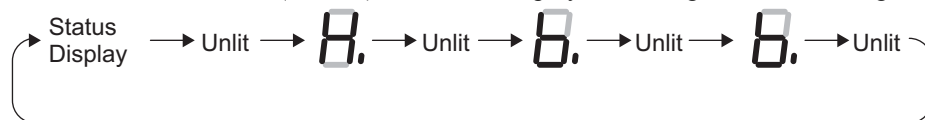
If an alarm or warning occurs, the display will change in the following order.

Example: Alarm A.E60



### 2.1.3 Hard Wire Base Block Display

If a hard wire base block (HWBB) occurs, the display will change in the following order.



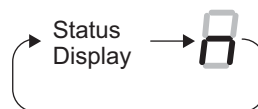
### 2.1.4 Displays during Overtravel

The display will change as shown below during overtravel.

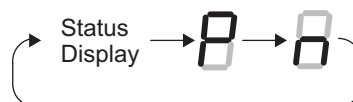
Forward run prohibited (P-OT signal input ON):



Reverse run prohibited (N-OT signal input ON):



Forward/reverse run prohibited (P-OT/N-OT signal input ON):


























## 2.2 Utility Function Mode (Fn□□□)

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

The digital operator displays numbers beginning with Fn.

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

| Step      | Display after Operation   | Keys   | Description  |           |   |   |       |        |    |  |        |     |
|-----------|---|--|--|-----------|---|---|-------|--------|----|--|--------|-----|
| 1         | <pre>BB      -FUNCTION- Fn002:JOG Fn003:Z-Search Fn004:Program JOG Fn005:Prm Init</pre>             | <br>  | Open the Utility Function Mode main menu and select Fn003.   |           |   |   |       |        |    |  |        |     |
| 2         | <pre>BB      -Z-Search- Un000= 00000 Un002= 00000 Un003=00774 Un00D=00000000</pre>                  |   | <p>Press the  Key.</p> <p>The display changes to the execution display of Fn003. If the display does not change and “NO-OP” is displayed in the status display, change the following settings.</p> <ul style="list-style-type: none"> <li>• If Write Prohibited is set in Fn010:<br/>→ Change the Write Prohibited setting.</li> <li>• If a servo ON command has been entered:<br/>→Send a servo OFF command.</li> </ul>  |           |   |   |       |        |    |  |        |     |
| 3         | <pre>RUN     -Z-Search- Un000= 00000 Un002= 00000 Un003=00774 Un00D=00000000</pre>                  |   | <p>Press the  Key.</p> <p>“RUN” is displayed in the status display, and power will be applied to the servomotor.</p> <p>If “NO-OP” is displayed, one of the following statuses will be displayed:</p> <ul style="list-style-type: none"> <li>• Main circuit power supply OFF</li> <li>• Alarm</li> <li>• Hard wire base block</li> </ul>   |           |   |   |       |        |    |  |        |     |
| 4         | <pre>RUN     -Complete- Un000= 00000 Un002= 00000 Un003=00000 Un00D=00001D58</pre>                  |    | <p>Pressing the  Key will rotate the motor in the forward direction. Pressing the  Key will rotate the motor in the reverse direction. The rotation of the servomotor changes according to the setting of Pn000.0.</p> <table border="1"> <thead> <tr> <th>Parameter</th> <th> key (Forward)</th> <th> key (Reverse)</th> </tr> </thead> <tbody> <tr> <td>Pn000</td> <td>n.□□□0</td> <td>CW</td> </tr> <tr> <td></td> <td>n.□□□1</td> <td>CCW</td> </tr> </tbody> </table> <p>Note: Direction when viewed from the load of the servomotor.</p> <p>Press the  or  Key until the motor stops. If the origin search completed normally, “-Complete-” is displayed in the upper right corner.</p> | Parameter |  key (Forward) |  key (Reverse) | Pn000 | n.□□□0 | CW |  | n.□□□1 | CCW |
| Parameter |  key (Forward) |  key (Reverse)  |  |           |   |   |       |        |    |  |        |     |
| Pn000     | n.□□□0  | CW   |  |           |   |   |       |        |    |  |        |     |
|           | n.□□□1  | CCW  |  |           |   |   |       |        |    |  |        |     |
| 5         | <pre>BB      -Z-Search- Un000= 00000 Un002= 00000 Un003=00774 Un00D=00001D58</pre>                  |   | <p>When the origin search is completed, press the  Key.</p> <p>“BB” is displayed in the status display, and the servomotor turns OFF. The display “-Complete-” changes to “-Z-Search-” in the upper right corner.</p>   |           |   |   |       |        |    |  |        |     |
| 6         | <pre>BB      -FUNCTION- Fn002:JOG Fn003:Z-Search Fn004:Program JOG Fn005:Prm Init</pre>             |   | <p>Press the  Key.</p> <p>The display returns to the Utility Function Mode main menu.</p> <p>This completes the operation.</p>  |           |   |   |       |        |    |  |        |     |

## 2.3 Parameter (Pn□□□) Operation

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

### 2.3.1 Parameter Classifications

The Σ-V-series SERVOPACKs have two types of parameters: setup parameters for the basic settings required for operation and tuning parameters for adjusting servo performance.

| Classification    | Meaning  | Display Method  | Setting Method   |
|-------------------|--|---|--|
| Setup parameters  | Parameters required for setup                          | Normally displayed.<br>(Pn00B.0 = 0, factory setting) | Set each parameter.  |
| Tuning parameters | Parameters for tuning of control gain and other values | Set Pn00B.0 to 1.                                     | The user is generally not required to set these parameters individually. |

Also, there are two notation methods for parameters: “numeric parameters” for which numeric values are set and “selection parameters” for which functions are selected.

The following sections describe each explanation method and setting method.

### 2.3.2 Parameter Notation

#### (1) Notation for Numeric Parameters

Control mode for which the parameter is valid.

Speed : Speed control

Position : Position control

Torque : Torque control

| Pn406 | Emergency Stop Torque |              |                 | <input type="checkbox"/> Speed | <input type="checkbox"/> Position | <input type="checkbox"/> Torque |
|-------|-----------------------|--------------|-----------------|--------------------------------|-----------------------------------|---------------------------------|
|       | Setting Range         | Setting Unit | Factory Setting | When Enabled                   | Classification                    |                                 |
|       | 0 to 800%             | 1%           | 800%            | Immediately                    | Setup                             |                                 |

The number of the parameter.

Indicates setting range for the parameter.

Indicates minimum setting unit for the parameter.

Indicates parameter value before shipment (factory setting).

Indicates if the power has to be turned OFF and ON again to validate setting changes.

Indicates the parameter classification.

#### (2) Notation for Selection Parameters

| Parameter | Meaning | When Enabled  | Classification |
|-----------|---------|---------------|----------------|
| Pn50A     | n.2□□□  | After restart | Setup          |
|           | n.8□□□  |               |                |

The number of the parameter.





























n.□□□□ indicates the function selection. The numbers in the boxes indicate the set values for each digit. This example indicates the 4th digit is 8.

This section explains the details of the function selection.

### 2.3.3 Parameter Setting Methods





















#### (1) Setting Method for Numeric Parameters

The following example shows how to change the setting of parameter Pn304 (JOG speed) to 1000 min<sup>-1</sup>.

| Step | Display after Operation  | Keys   | Description  |
|------|--|--|--|
| 1    | BB -PRM/MON-<br>Un000= 00000<br>Un002= 00000<br>Un008= 00000<br>Un00D=00000000         |   | Press the  Key to select the Parameter/Monitor Mode.  |
| 2    | BB -PRM/MON-<br>Un000= 00000<br>Un002= 00000<br>Un008= 00000<br>Un00D=00000000         |    | Press the  or  Key to move the cursor to “Un.”   |
| 3    | BB -PRM/MON-<br>Pn000=n.0000<br>Un002= 00000<br>Un008= 00000<br>Un00D=00000000         |    | Press the  or  Key to change “Un” to “Pn.”   |
| 4    | BB -PRM/MON-<br>Pn000=n.0000<br>Un002= 00000<br>Un008= 00000 pulse<br>Un00D=00000000   |    | Press the  Key to move the cursor to the column on the right of “Pn.”   |
| 5    | BB -PRM/MON-<br>Pn304=00500<br>Un002= 00000<br>Un008= 00000<br>Un00D=00000000          |  <br>  | Press the arrow keys to display “Pn304”.<br>To move the cursor:  ,  Key<br>To change the settings:  ,  Key |
| 6    | BB -PRM/MON-<br>Pn304=0050 <u>0</u><br>Un002= 00000<br>Un008= 00000<br>Un00D=00000000  |   | Press the  Key to move the cursor to the one’s place of Pn304.  |
| 7    | BB -PRM/MON-<br>Pn304=00 <u>5</u> 00<br>Un002= 00000<br>Un008= 00000<br>Un00D=00000000 |   | Press the  Key twice to move the cursor to the hundred’s place of Pn304.  |
| 8    | BB -PRM/MON-<br>Pn304=01 <u>0</u> 00<br>Un002= 00000<br>Un008= 00000<br>Un00D=00000000 |   | Press the  Key five times to change the setting to “1000.”  |
| 9    | BB -PRM/MON-<br>Pn304=01000<br>Un002= 00000<br>Un008= 00000<br>Un00D=00000000          |   | Press the  Key to write the settings.   |

## (2) Setting Method for Selection Parameters

The following example shows how to use application function selection switch 1 (Pn001) to change the setting for the stopping method at servo OFF and alarm occurrence from stopping using DB (Pn001 = n.0000) to stopping without DB (Pn001 = n.0002).

| Step | Display after Operation   | Keys  | Description  |
|------|---|---|--|
| 1    | <pre> BB          -PRM/MON- Un000= 00000 Un002= 00000 Un008= 00000 Un00D=00000000           </pre>        |    | Press the  Key to select the Parameter/Monitor Mode.  |
| 2    | <pre> BB          -PRM/MON- Un00<u>0</u>= 00000 Un002= 00000 Un008= 00000 Un00D=00000000           </pre> |   | Press the  or  Key to move the cursor to "Un." |
| 3    | <pre> BB          -PRM/MON- Pn00<u>0</u>=n.0000 Un002= 00000 Un008= 00000 Un00D=00000000           </pre> |   | Press the  or  Key to change "Un" to "Pn."     |
| 4    | <pre> BB          -PRM/MON- Pn00<u>0</u>=n.0000 Un002= 00000 Un008= 00000 Un00D=00000000           </pre> |    | Press the  Key three times to move the cursor to the left of "=".   |
| 5    | <pre> BB          -PRM/MON- Pn00<u>1</u>=n.0000 Un002= 00000 Un008= 00000 Un00D=00000000           </pre> |    | Press the  Key to display "Pn001."  |
| 6    | <pre> BB          -PRM/MON- Pn001=n.000<u>0</u> Un002= 00000 Un008= 00000 Un00D=00000000           </pre> |    | Press the  Key to move the cursor to the right edge.  |
| 7    | <pre> BB          -PRM/MON- Pn001=n.000<u>2</u> Un002= 00000 Un008= 00000 Un00D=00000000           </pre> |    | Press the  Key twice to change the setting of "n.0000" to "n.0002."   |
| 8    | <pre> BB          -PRM/MON- Pn001=n.000<u>2</u> Un002= 00000 Un008= 00000 Un00D=00000000           </pre> |    | Press the  Key to write the settings.   |

## 2.4 Monitor Mode (Un□□□)

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

For details, refer to *7.2 Monitor Displays*.

The digital operator display numbers begin with Un.

The following four Un numbers are displayed with the factory settings.

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

← Shows the setting of Un000 (motor speed) as 0 min<sup>-1</sup>.

## Wiring and Connection

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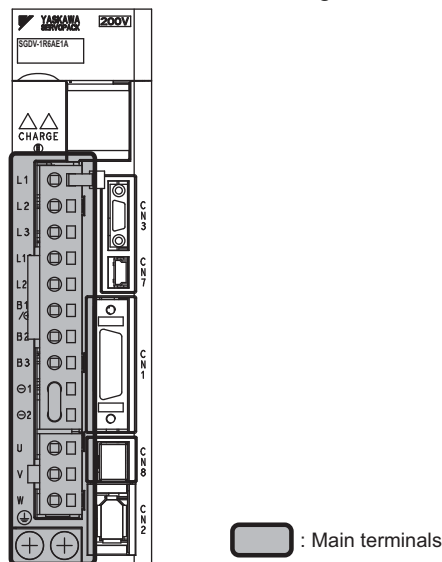
## 3.1 Main Circuit Wiring

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

This section also describes the general precautions for wiring and precautions under special environments.

### 3.1.1 Main Circuit Terminals

The names and specifications are shown in the following table.



| Terminal Symbols | Name   | Model SGD□-□□□□  | Description  |
|------------------|--|--|--|
| L1, L2           | Main circuit input terminals   | □□□F   | Single-phase 100 to 115 V, +10% to -15% (50/60 Hz)   |
| L1, L2, L3       |  | □□□A   | Three-phase 200 to 230 V, +10% to -15% (50/60 Hz)  |
|                  |  | □□□D   | Three-phase 380 to 480 V, +10% to -15% (50/60 Hz)  |
| L1C, L2C         | Control power input terminals  | □□□F   | Single-phase 100 to 115 V, +10% to -15% (50/60 Hz)   |
|                  |  | □□□A   | Single-phase 200 to 230 V, +10% to -15% (50/60 Hz)   |
| 24 V, 0 V        |  | □□□D   | 24 VDC, ±15%   |
| B1/ ⊕, B2*1      | External regenerative resistor terminals                             | R70F, R90F, 2R1F, 2R8F, R70A, R90A, 1R6A, 2R8A                               | If the regenerative capacity is insufficient, connect an external regenerative resistor (option) between B1/ ⊕ and B2.   |
|                  |  | 3R8A, 5R5A, 7R6A, 120A, 180A, 200A, 330A, 1R9D, 3R5D, 5R4D, 8R4D, 120D, 170D | Remove the lead or short bar that is short-circuiting between B2 and B3, and connect an external regenerative resistor between B1/ ⊕ and B2 only if the internal regenerative capacity is insufficient. Purchase an external regenerative resistor separately. |
|                  |  | 470A, 550A, 590A, 780A, 210D, 260D, 280D, 370D                               | Connect a regenerative resistor unit between B1/ ⊕ and B2. Purchase a regenerative resistor unit separately.   |
| ⊕ 1, ⊕ 2*2       | DC reactor connection terminal for power supply harmonic suppression | □□□A<br>□□□D   | If a countermeasure against power supply harmonic waves is needed, connect a DC reactor between ⊕ 1 and ⊕ 2.   |

| Terminal Symbols | Name                            | Model SGDV-□□□□   | Description                             |
|------------------|---------------------------------|---|---|
| B1/ ⊕            | Main circuit plus terminal      | □□□A<br>□□□D  | Use when DC power supply input is used. |
| ⊖ 2 or ⊖         | Main circuit minus terminal     | □□□A<br>□□□D  |   |
| U, V, W          | Servomotor connection terminals | Use for connecting to the servomotor.   |   |
| ⊕                | Ground terminals (x2)           | Use for connecting the power supply ground terminal and servomotor ground terminal. |   |

\*1. Do not short-circuit the B1/ ⊕ and B2 terminals. Doing so may damage the SERVOPACK.

\*2. The ⊖ 1 and ⊖ 2 terminals are short-circuited with a jumper at the factory.

### 3.1.2 Using a Standard Power Supply Input (Single-phase 100-V, Three-phase 200-V, or Three-phase 400-V)

#### (1) Wire Types

Use the following type of wire for main circuit.

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

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


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

| AWG Size | Nominal Cross Section Diameter (mm <sup>2</sup> ) | Configuration (Number of Wires/mm <sup>2</sup> ) | Conductive Resistance (Ω/km) | Allowable Current at Surrounding Air Temperature (A) |      |      |
|----------|---|--|------------------------------|--|------|------|
|          |   |  |                              | 30°C   | 40°C | 50°C |
| 20       | 0.5   | 19/0.18  | 39.5                         | 6.6  | 5.6  | 4.5  |
| 19       | 0.75  | 30/0.18  | 26.0                         | 8.8  | 7.0  | 5.5  |
| 18       | 0.9   | 37/0.18  | 24.4                         | 9.0  | 7.7  | 6.0  |
| 16       | 1.25  | 50/0.18  | 15.6                         | 12.0   | 11.0 | 8.5  |
| 14       | 2.0   | 7/0.6  | 9.53                         | 23   | 20   | 16   |
| 12       | 3.5   | 7/0.8  | 5.41                         | 33   | 29   | 24   |
| 10       | 5.5   | 7/1.0  | 3.47                         | 43   | 38   | 31   |
| 8        | 8.0   | 7/1.2  | 2.41                         | 55   | 49   | 40   |
| 6        | 14.0  | 7/1.6  | 1.35                         | 79   | 70   | 57   |
| 4        | 22.0  | 7/2.0  | 0.85                         | 91   | 81   | 66   |

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

**(2) SERVOPACK Main Circuit Wire**

This section describes the wire used for the SERVOPACK main circuit.

|   |   |
|---|---|
| <br><b>IMPORTANT</b> | 1. Wire sizes are selected for three cables per bundle at 40°C surrounding air temperature with the rated current.                                |
|   | 2. Use a wire with a minimum withstand voltage of 600 V for the main circuit.   |
|   | 3. If wires are bundled in PVC or metal ducts, take into account the reduction of the allowable current.  |
|   | 4. Use a heat-resistant wire under high surrounding air or panel temperatures, where polyvinyl chloride insulated wires will rapidly deteriorate. |

■ Single-phase, 100 V

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

■ Three-phase, 200 V

| Terminal Symbols | Name  | SERVOPACK Model SGD□V-□□□A |     |     |        |     |     |        |        |        |        |         |         |         |     |     |
|------------------|---|----------------------------|-----|-----|--------|-----|-----|--------|--------|--------|--------|---------|---------|---------|-----|-----|
|                  |   | R70                        | R90 | 1R6 | 2R8    | 3R8 | 5R5 | 7R6    | 120    | 180    | 200    | 330     | 470     | 550     | 590 | 780 |
| L1, L2, L3       | Main circuit power input terminals                  | HIV1.25                    |     |     | HIV2.0 |     |     |        | HIV3.5 |        | HIV5.5 | HIV8.0  | HIV14.0 | HIV22.0 |     |     |
| L1C, L2C         | Control power input terminals                       | HIV1.25                    |     |     |        |     |     |        |        |        |        |         |         |         |     |     |
| U, V, W          | Servomotor connection terminals                     | HIV1.25                    |     |     | HIV2.0 |     |     |        | HIV3.5 | HIV5.5 | HIV8.0 | HIV14.0 |         | HIV22.0 |     |     |
| B1/⊕, B2         | External regenerative resistor connection terminals | HIV1.25                    |     |     |        |     |     | HIV2.0 | HIV3.5 | HIV5.5 | HIV8.0 |         | HIV22.0 |         |     |     |
| ⊕                | Ground terminal                                     | HIV2.0 or higher           |     |     |        |     |     |        |        |        |        |         |         |         |     |     |

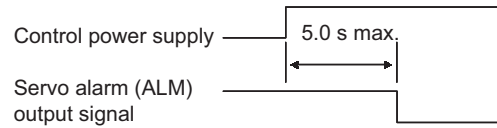
■ Three-phase, 400 V

| Terminal Symbols  | Name  | SERVOPACK Model SGD□V-□□□D |     |     |        |     |        |        |        |        |        |         |
|-------------------|---|----------------------------|-----|-----|--------|-----|--------|--------|--------|--------|--------|---------|
|                   |   | 1R9                        | 3R5 | 5R4 | 8R4    | 120 | 170    | 210    | 260    | 280    | 370    |         |
| L1, L2, L3        | Main circuit power input terminals                  | HIV1.25                    |     |     | HIV2.0 |     |        | HIV3.5 |        | HIV5.5 | HIV8.0 | HIV14.0 |
| 24 V, 0 V         | Control power input terminals                       | HIV1.25                    |     |     |        |     |        |        |        |        |        |         |
| U, V, W           | Servomotor connection terminals                     | HIV1.25                    |     |     | HIV2.0 |     |        | HIV3.5 | HIV5.5 |        | HIV8.0 | HIV14.0 |
| B1/⊕, B2 (B1, B2) | External regenerative resistor connection terminals | HIV1.25                    |     |     |        |     | HIV2.0 | HIV3.5 |        | HIV5.5 | HIV8.0 |         |
| ⊕                 | Ground terminal                                     | HIV2.0 or higher           |     |     |        |     |        |        |        |        |        |         |

### (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 is output.
- The ALM signal is output for five seconds max. (1Ry is OFF) when the power is turned ON. Take this into consideration when designing the power ON sequence. Also, use this relay to turn off the main power for the SERVOPACK.



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



**IMPORTANT**

- When turning ON the control power supply and the main circuit power supply, turn them ON at the same time or after the control power supply. When turning OFF the power supplies, first turn the power for the main circuit OFF and then turn OFF the control power supply.

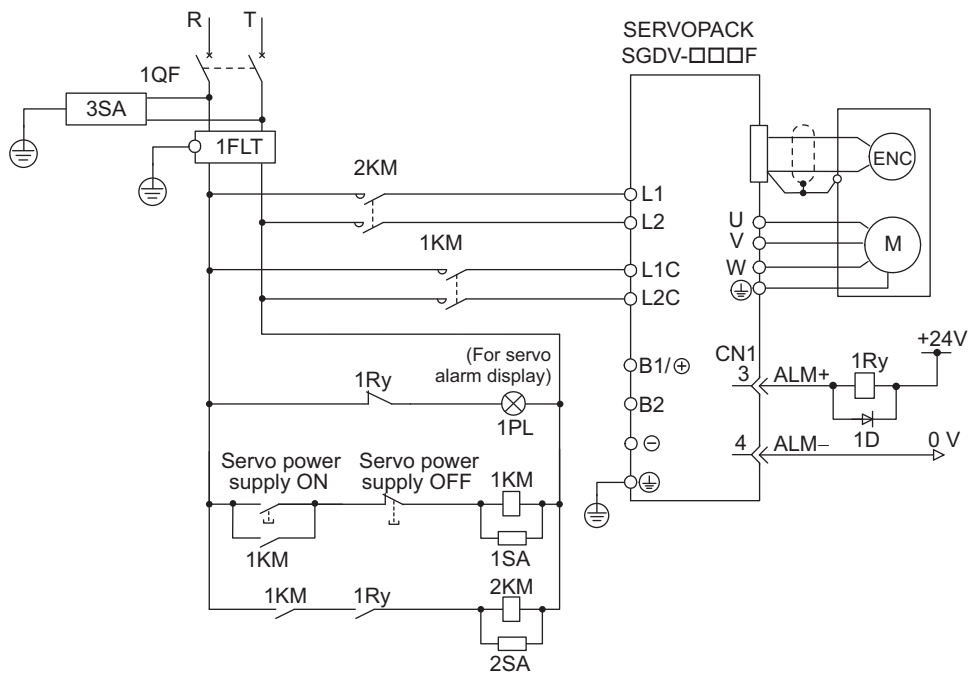
The typical main circuit wiring examples are shown below.



**WARNING**

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

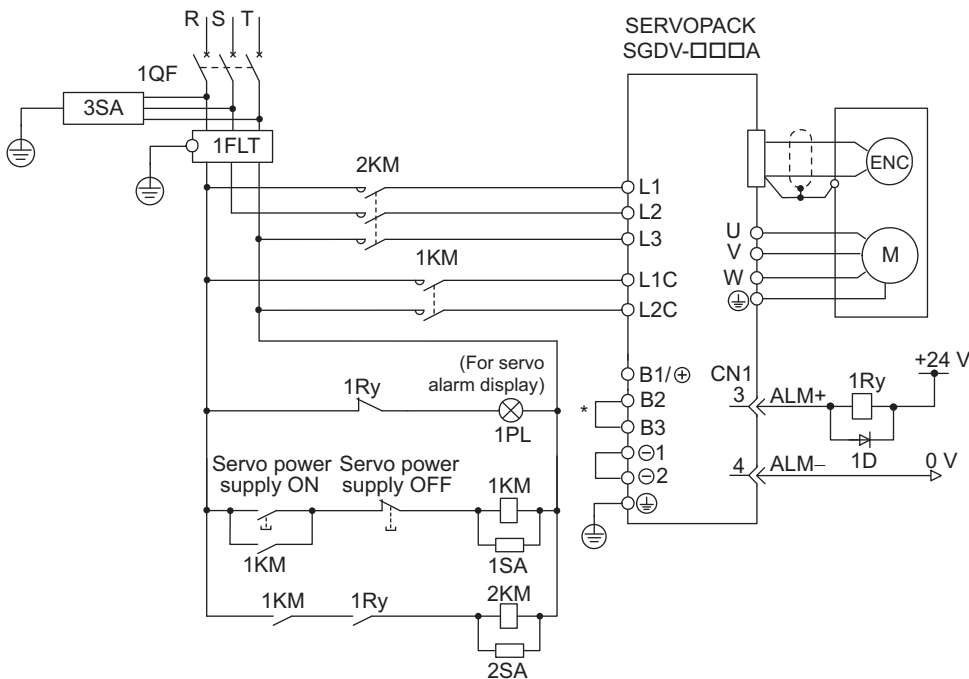
■ Single-phase 100 V, SGDV-□□□F (SGDV-R70F, R90F, 2R1F, 2R8F)



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

■ Three-phase 200 V, SGDV-□□□A

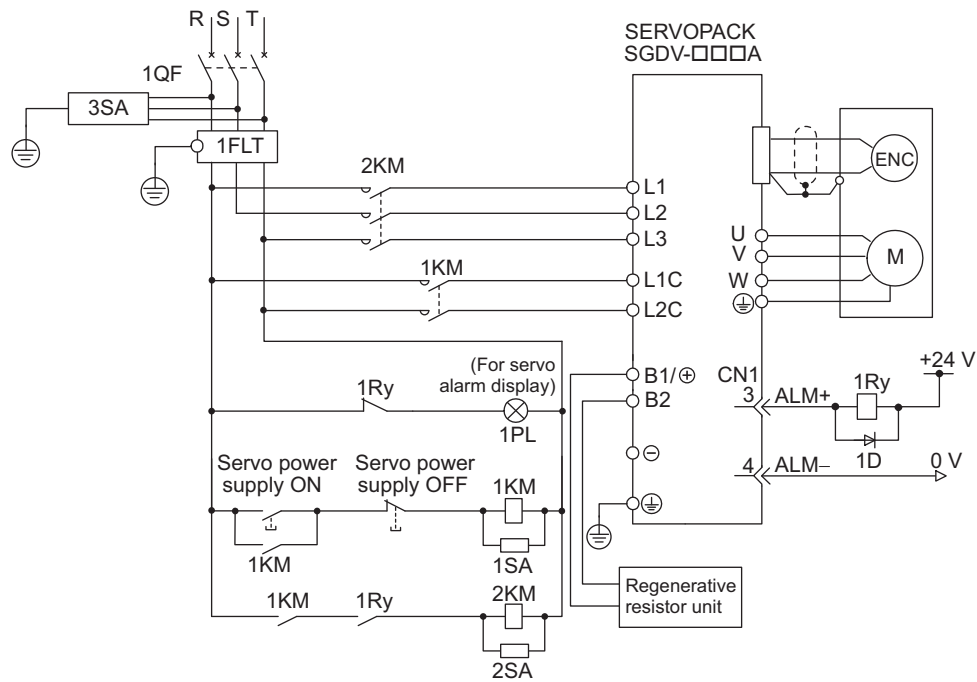
- SGDV-R70A, R90A, 1R6A, 2R8A, 3R8A, 5R5A, 7R6A, 120A, 180A, 200A, 330A



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

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

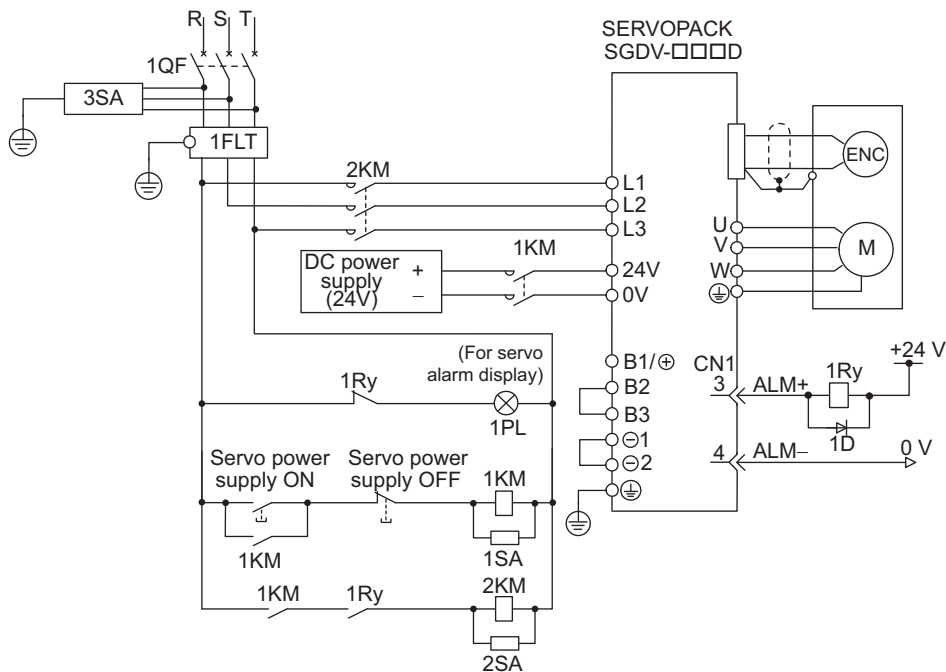
- SGDV-470A, 550A, 590A, 780A



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

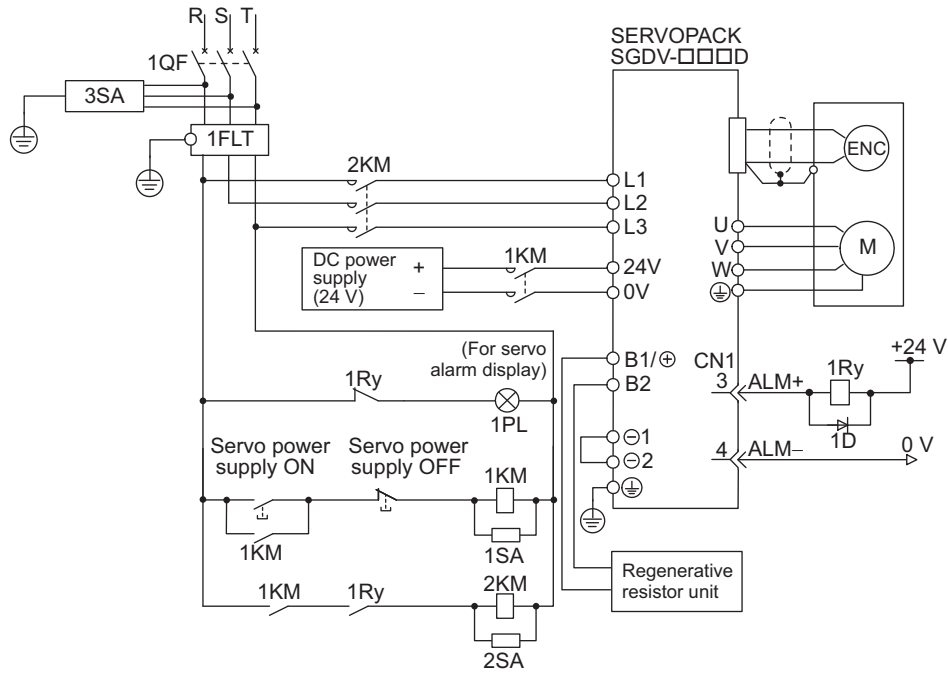
■ Three-phase 400 V, SGDV-□□□D

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



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

- SGD V-210D, 260D, 280D, 370D



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

#### (4) Power Supply Capacities and Power Losses

The following table gives the power capacities and power losses of the SERVOPACK.

| Main Circuit Power Supply | Maximum Applicable Motor Capacity [kW] | SERVO-<br>PACK<br>Model<br>SGDV- | Power Supply Capacity per SERVOPACK [kVA] | Output Current [Arms] | Main Circuit Power Loss [W] | Regenerative Resistor Power Loss [W] | Control Circuit Power Loss [W] | Total Power Loss [W] |
|---------------------------|--|----------------------------------|---|-----------------------|-----------------------------|--------------------------------------|--------------------------------|----------------------|
| Single-phase, 100-V       | 0.05                                   | R70F                             | 0.2                                       | 0.66                  | 5.4                         | -                                    | 17                             | 22.4                 |
|                           | 0.1                                    | R90F                             | 0.3                                       | 0.91                  | 7.8                         |                                      |                                | 24.8                 |
|                           | 0.2                                    | 2R1F                             | 0.7                                       | 2.1                   | 14.4                        |                                      |                                | 31.4                 |
|                           | 0.4                                    | 2R8F                             | 1.4                                       | 2.8                   | 25.6                        |                                      |                                | 42.6                 |
| Three-phase, 200-V        | 0.05                                   | R70A                             | 0.2                                       | 0.66                  | 5.1                         | -                                    | 17                             | 22.1                 |
|                           | 0.1                                    | R90A                             | 0.3                                       | 0.91                  | 7.3                         |                                      |                                | 24.3                 |
|                           | 0.2                                    | 1R6A                             | 0.6                                       | 1.6                   | 13.5                        |                                      |                                | 30.5                 |
|                           | 0.4                                    | 2R8A                             | 1   | 2.8                   | 24.0                        |                                      |                                | 41.0                 |
|                           | 0.5                                    | 3R8A                             | 1.4                                       | 3.8                   | 20.1                        | 8                                    | 17                             | 45.1                 |
|                           | 0.75                                   | 5R5A                             | 1.6                                       | 5.5                   | 43.8                        |                                      |                                | 68.8                 |
|                           | 1.0                                    | 7R6A                             | 2.3                                       | 7.6                   | 53.6                        | 10                                   | 22                             | 78.6                 |
|                           | 1.5                                    | 120A                             | 3.2                                       | 11.6                  | 65.8                        |                                      |                                | 97.8                 |
|                           | 2.0                                    | 180A                             | 4   | 18.5                  | 111.9                       | 16                                   | 22                             | 149.9                |
|                           | 3.0                                    | 200A                             | 5.9                                       | 19.6                  | 113.8                       |                                      |                                | 161.4                |
|                           | 5.0                                    | 330A                             | 7.5                                       | 32.9                  | 263.7                       | 36                                   | 27                             | 326.7                |
|                           | 6.0                                    | 470A                             | 10.7                                      | 46.9                  | 279.4                       | (180) *1                             | 33                             | 312.4                |
|                           | 7.5                                    | 550A                             | 14.6                                      | 54.7                  | 357.8                       | (350) *2                             |                                | 390.8                |
|                           | 11                                     | 590A                             | 21.7                                      | 58.6                  | 431.7                       |                                      | 48                             | 479.7                |
| 15                        | 780A                                   | 29.6                             | 78  | 599.0                 | 647.0                       |                                      |                                |                      |
| Three-phase, 400-V        | 0.5                                    | 1R9D                             | 1.1                                       | 1.9                   | 24.6                        | 14                                   | 21                             | 59.6                 |
|                           | 1.0                                    | 3R5D                             | 2.3                                       | 3.5                   | 46.1                        |                                      |                                | 81.1                 |
|                           | 1.5                                    | 5R4D                             | 3.5                                       | 5.4                   | 71.3                        |                                      |                                | 106.3                |
|                           | 2.0                                    | 8R4D                             | 4.5                                       | 8.4                   | 77.9                        | 28                                   | 25                             | 130.9                |
|                           | 3.0                                    | 120D                             | 7.1                                       | 11.9                  | 108.7                       |                                      |                                | 161.7                |
|                           | 5.0                                    | 170D                             | 11.7                                      | 16.5                  | 161.1                       | 36                                   | 24                             | 221.1                |
|                           | 6.0                                    | 210D                             | 12.4                                      | 20.8                  | 172.7                       | (180) *3                             | 27                             | 199.7                |
|                           | 7.5                                    | 260D                             | 14.4                                      | 25.7                  | 218.6                       |                                      |                                | 245.6                |
|                           | 11                                     | 280D                             | 21.9                                      | 28.1                  | 294.6                       | (350) *4                             | 30                             | 324.6                |
|                           | 15                                     | 370D                             | 30.6                                      | 37.2                  | 403.8                       |                                      |                                | 433.8                |

\*1. For the optional JUSP-RA04-E regenerative resistor unit.

\*2. For the optional JUSP-RA05-E regenerative resistor unit.

\*3. For the optional JUSP-RA18-E regenerative resistor unit.

\*4. For the optional JUSP-RA19-E regenerative resistor unit.

Note 1. SGD V-R70F, -R90F, -2R1F, -2R8F, -R70A, -R90A, -1R6A, and -2R8A SERVOPACKs do not have built-in regenerative resistors. If the regenerative energy exceeds the specified value, connect an external regenerative resistor (optional).

2. SGD V-470A, -550A, -590A, -780A, -210D, -260D, -280D, -370D SERVOPACKs do not have built-in regenerative resistors. Be sure to connect a regenerative resistor unit (optional) or an external regenerative resistor (optional). For selection details, refer to 3.7 *Regenerative Resistors Connections*.

3. Regenerative resistor power losses are allowable losses. Take the following action if the actual power loss exceeds the allowable power loss.

- Remove the lead or short bar that is short-circuiting the SERVOPACK main circuit terminal B2 and B3. (SGDV-3R8A, -5R5A, -7R6A, -120A, -180A, -200A, -330A, or 400-V class SERVOPACKs.)
- Install an external regenerative resistor (optional). For selection details, refer to 3.7 *Regenerative Resistors Connections*.



## (5) Molded-case Circuit Breaker and Fuse Capacities

The following table describes the molded-case circuit breaker and fuse capacities of the SERVOPACK.

| Main Circuit Power Supply | Maximum Applicable Motor Capacity [kW] | SERVOPACK Model SGD V- | Power Supply Capacity per SERVOPACK [kVA] | Current Capacity    |                        | Inrush Current      |                        |
|---------------------------|--|------------------------|---|---------------------|------------------------|---------------------|------------------------|
|                           |  |                        |   | Main Circuit [Arms] | Control Circuit [Arms] | Main Circuit [A0-p] | Control Circuit [A0-p] |
| Single-phase, 100-V       | 0.05                                   | R70F                   | 0.2                                       | 1.5                 | 0.38                   | 16.5                | 35                     |
|                           | 0.1                                    | R90F                   | 0.3                                       | 2.5                 |                        |                     |                        |
|                           | 0.2                                    | 2R1F                   | 0.7                                       | 5                   |                        |                     |                        |
|                           | 0.4                                    | 2R8F                   | 1.4                                       | 10                  |                        |                     |                        |
| Three-phase, 200-V        | 0.05                                   | R70A                   | 0.2                                       | 1.0                 | 0.2                    | 33                  | 70                     |
|                           | 0.1                                    | R90A                   | 0.3                                       | 1.0                 |                        |                     |                        |
|                           | 0.2                                    | 1R6A                   | 0.6                                       | 2.0                 |                        |                     |                        |
|                           | 0.4                                    | 2R8A                   | 1   | 3.0                 |                        |                     |                        |
|                           | 0.5                                    | 3R8A                   | 1.4                                       | 3.0                 |                        |                     |                        |
|                           | 0.75                                   | 5R5A                   | 1.6                                       | 6.0                 |                        |                     |                        |
|                           | 1.0                                    | 7R6A                   | 2.3                                       | 6.0                 | 0.25                   | 33                  | 33                     |
|                           | 1.5                                    | 120A                   | 3.2                                       | 7.3                 |                        |                     |                        |
|                           | 2.0                                    | 180A                   | 4   | 9.7                 |                        |                     |                        |
|                           | 3.0                                    | 200A                   | 5.9                                       | 15                  |                        |                     |                        |
|                           | 5.0                                    | 330A                   | 7.5                                       | 25                  | 0.3                    | 65.5                | 33                     |
|                           | 6.0                                    | 470A                   | 10.7                                      | 29                  |                        |                     |                        |
|                           | 7.5                                    | 550A                   | 14.6                                      | 37                  |                        |                     |                        |
|                           | 11                                     | 590A                   | 21.7                                      | 54                  | 0.45                   | 109                 | 48                     |
| 15                        | 780A                                   | 29.6                   | 73  |                     |                        |                     |                        |
| Three-phase, 400-V        | 0.5                                    | 1R9D                   | 1.1                                       | 1.4                 | 1.2                    | 17                  | -                      |
|                           | 1.0                                    | 3R5D                   | 2.3                                       | 2.9                 |                        |                     |                        |
|                           | 1.5                                    | 5R4D                   | 3.5                                       | 4.3                 |                        |                     |                        |
|                           | 2.0                                    | 8R4D                   | 4.5                                       | 5.8                 | 1.4                    | 34                  |                        |
|                           | 3.0                                    | 120D                   | 7.1                                       | 8.6                 |                        |                     |                        |
|                           | 5.0                                    | 170D                   | 11.7                                      | 14.5                |                        | 1.5                 |                        |
|                           | 6.0                                    | 210D                   | 12.4                                      | 17.4                |                        |                     |                        |
|                           | 7.5                                    | 260D                   | 14.4                                      | 21.7                |                        |                     |                        |
|                           | 11                                     | 280D                   | 21.9                                      | 31.8                | 1.7                    |                     |                        |
| 15                        | 370D                                   | 30.6                   | 43.4                                      |                     |                        |                     |                        |

Note 1. To comply with the low voltage directive, connect a fuse to the input side. Select the fuse or molded-case circuit breaker for the input side from among models that are compliant with UL standards.

The table above also provides the net values of current capacity and inrush current. Select a fuse and a molded-case circuit breaker which meet the breaking characteristics shown below.

- Main circuit, control circuit: No breaking at three-times the current values of the table for 5 s.
- Inrush current: No breaking at the same current values of the table for 20 ms.

2. In accordance with UL standards, the following restrictions apply.

| SERVOPACK Model SGD V- | Restrictions   |
|------------------------|--|
| 180A, 200A             | Available rated current for molded-case circuit breaker: 40 A or less  |
| 330A                   | <ul style="list-style-type: none"> <li>• Available rated current for non-time delay fuse: 70 A or less</li> <li>• Available rated current for time delay fuse: 40 A or less</li> <li>• Do not use single wires.</li> </ul> |

| SERVOPACK<br>Model SGD V- | Restrictions   |
|---------------------------|--|
| 470A, 550A                | <ul style="list-style-type: none"> <li>• Available rated current for molded-case circuit breaker: 60 A or less</li> <li>• Available rated current for non-time delay fuse or time delay fuse: 60 A or less</li> </ul>  |
| 590A, 780A                | <ul style="list-style-type: none"> <li>• Available rated current for molded-case circuit breaker: 100 A or less</li> <li>• Available rated current for non-time delay fuse or time delay fuse: 100 A or less</li> </ul> (Available rated current for class J non-time delay or faster fuse: 125 A or less) |
| 210D, 260D                | <ul style="list-style-type: none"> <li>• Available rated current for molded-case circuit breaker: 60 A or less</li> <li>• Available rated current for non-time delay fuse: 60 A or less</li> <li>• Available rated current for time delay fuse: 35 A or less</li> </ul>                                    |
| 280D, 370D                | <ul style="list-style-type: none"> <li>• Available rated current for molded-case circuit breaker: 80 A or less</li> <li>• Available rated current for non-time delay fuse: 125 A or less</li> <li>• Available rated current for time delay fuse: 75 A or less</li> </ul>                                   |

### 3.1.3 General Precautions for Wiring



IMPORTANT

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

- The SERVOPACK connects directly to a commercial power supply; it is not isolated through a transformer or other device.

Always use a molded-case circuit breaker (1QF) or fuse to protect the servo system from accidents involving different power system voltages or other accidents.

Install a ground fault detector.

- The SERVOPACK does not have a built-in protective circuit for grounding. To configure a safer system, install a ground fault detector against overloads and short-circuiting, or install a ground fault detector combined with a molded-case circuit breaker.

Do not turn power ON and OFF frequently.

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

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

Use the connecting cables specified in the *Σ-V Series Product Catalog* (KAEP S800000 42). Design and arrange the system so that each cable will be as short as possible.

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

Observe the following precautions when wiring the ground.

- Use a cable as thick as possible (at least 2.0 mm<sup>2</sup>).
- Grounding to a resistance of 100 Ω or less for SERVOPACKs with a power supply of 100 V or 200 V and 10 Ω or less for SERVOPACKs with a power supply of 400 V is recommended.
- Be sure to ground at only one point.
- Ground the servomotor directly if the servomotor is insulated from the machine.

The signal cable conductors are as thin as 0.2 mm<sup>2</sup> or 0.3 mm<sup>2</sup>. Do not impose excessive bending force or tension.

### 3.1.4 Using the SERVOPACK with Single-phase, 200-V Power Input

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

The following models use single-phase 200 V power input.

SGDV-R70A, R90A, 1R6A, 2R8A, 5R5A

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

The SGDV-120AE1A008000 SERVOPACK has specifications for a single-phase, 200-V power supply, and so a single-phase, 200-V power supply can be used without changing the parameters.

#### (1) Parameter Setting

##### ■ Single-phase Power Input Selection

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

#### WARNING

- If single-phase 200 V is input to a SGDV-R70A, -R90A, -1R6A, -2R8A, or -5R5A SERVOPACK with a single-phase power input without changing the setting of Pn00B.2 to 1 (single-phase power input supported), a main circuit cable open phase alarm (A.F10) will be detected.
- The SERVOPACK models, SGDV-R70A, -R90A, -1R6A, -2R8A, and -5R5A, support single-phase 200 V power input. If a single-phase 200 V is input to the SERVOPACK models that do not support single-phase power input, the main circuit cable open phase alarm (A.F10) will be detected.
- When using a single-phase 200 V power supply, the SGDV-R70A, -R90A, -1R6A, -2R8A, or -5R5A SERVOPACK may not be able to produce the same servomotor torque-speed characteristics as using a three-phase 200 V power input. Refer to the diagram of each motor torque-speed characteristics in  $\Sigma$ -V Series Product Catalog (KAEP S800000 42).

#### (2) Main Circuit Power Input

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

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

| Terminal Symbols | Name                               | Model SGDV-□□□A         | Rating   |
|------------------|------------------------------------|-------------------------|--|
| L1, L2           | Main circuit power input terminals | R70, R90, 1R6, 2R8, 5R5 | Single-phase 200 V to 230 V <sup>+10%</sup> <sub>-15%</sub> , (50/60 Hz) |
|                  |                                    | 120* <sup>2</sup>       | Single-phase 220 V to 230 V <sup>+10%</sup> <sub>-15%</sub> , (50/60 Hz) |
| L3* <sup>1</sup> | —                                  | R70, R90, 1R6, 2R8, 5R5 | None   |

\*1. Do not use L3 terminal.

\*2. The official model number is SGDV-120AE1A008000.

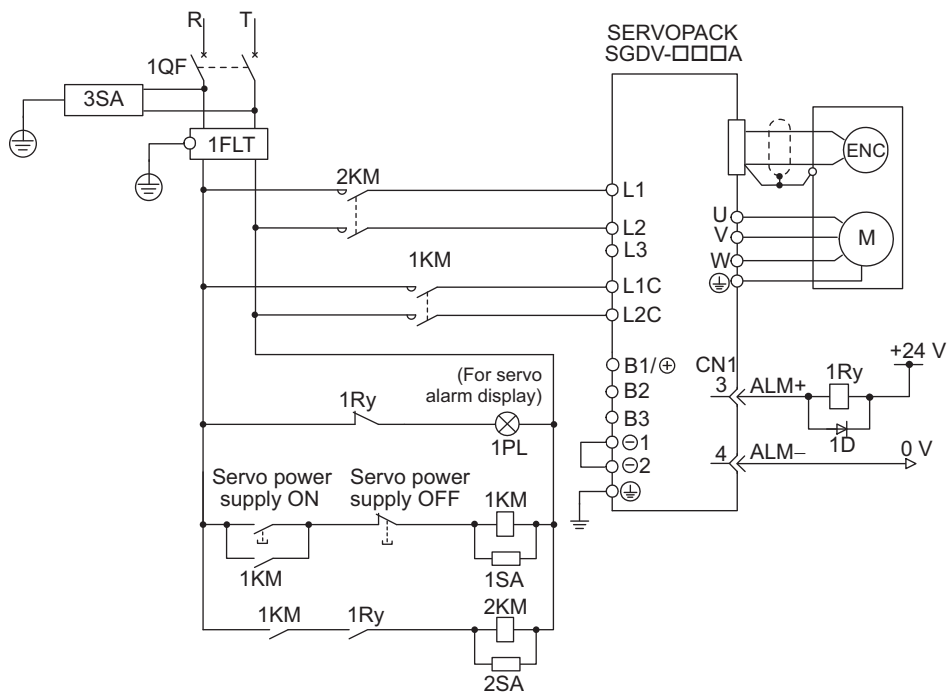
(3) SERVOPACK Main Circuit Wire

| Terminal Symbols | Name  | Model SGD□V-□□□A |     |     |        |        |        |
|------------------|---|------------------|-----|-----|--------|--------|--------|
|                  |   | R70              | R90 | 1R6 | 2R8    | 5R5    | 120*   |
| L1, L2           | Main circuit power input terminals                  | HIV1.25          |     |     | HIV2.0 |        | HIV3.5 |
| L1C, L2C         | Control power supply input terminals                | HIV1.25          |     |     |        |        |        |
| U, V, W          | Motor connection terminals                          | HIV1.25          |     |     |        | HIV2.0 |        |
| B1/⊕, B2         | External regenerative resistor connection terminals | HIV1.25          |     |     |        |        |        |
| ⊖                | Ground terminals                                    | HIV2.0 or higher |     |     |        |        |        |

\* The official model name is SGD□V-120AE1A008000.

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

- SERVOPACK SGD□V-R70A, R90A, 1R6A, 2R8A, 5R5A, and 120AE1A008000 with Single-phase 200 V Input



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

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

## (5) Power Supply Capacities and Power Losses

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

| Main Power Supply   | Maximum Applicable Servomotor Capacity [kW] | SERVOPACK Model SGD V- | Power Supply Capacity per SERVOPACK [kVA] | Output Current [Arms] | Main Circuit Power Loss [W] | Regenerative Resistor Power Loss [W] | Control Circuit Power Loss [W] | Total Power Loss [W] |
|---------------------|---|------------------------|---|-----------------------|-----------------------------|--------------------------------------|--------------------------------|----------------------|
| Single-phase, 200 V | 0.05  | R70A                   | 0.2                                       | 0.66                  | 5.2                         | -                                    | 17                             | 22.2                 |
|                     | 0.1   | R90A                   | 0.3                                       | 0.91                  | 7.4                         |                                      |                                | 24.4                 |
|                     | 0.2   | 1R6A                   | 0.7                                       | 1.6                   | 13.7                        |                                      |                                | 30.7                 |
|                     | 0.4   | 2R8A                   | 1.2                                       | 2.8                   | 24.9                        |                                      |                                | 41.9                 |
|                     | 0.75  | 5R5A                   | 1.9                                       | 5.5                   | 52.7                        | 8                                    | 77.7                           |                      |
|                     | 1.5   | 120A*                  | 4   | 11.6                  | 68.2                        | 10                                   | 22                             | 100.2                |

\* The official model name is SGD V-120AE1A008000.

Note 1. SGD V-R70A, R90A, 1R6A, and 2R8A SERVOPACKs do not have built-in regenerative resistors. If the regenerative energy exceeds the specified value, connect an external regenerative resistor.

2. Regenerative resistor power losses are allowable losses. Take the following action if the actual power losses exceeds the allowable power loss.

- Remove the wire connecting terminals B2 and B3 of the SERVOPACK main circuit terminals or remove the short bar (SGD V-5R5A, 120A).
- Install an external regenerative resistor between the external regenerative resistor connection terminals B1/ ⊕ and B2

3. External regenerative resistors are options.

## (6) Molded-case Circuit Breaker and Fuse Capacities

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

| Main Power Supply   | Maximum Applicable Servomotor Capacity [kW] | SERVOPACK Model SGD V- | Power Supply Capacity per SERVOPACK [kVA] | Current Capacity    |                        | Inrush Current      |                        |
|---------------------|---|------------------------|---|---------------------|------------------------|---------------------|------------------------|
|                     |   |                        |   | Main Circuit [Arms] | Control Circuit [Arms] | Main Circuit [A0-p] | Control Circuit [A0-p] |
| Single-phase, 200 V | 0.05  | R70A                   | 0.2                                       | 2                   | 0.2                    | 33                  | 70                     |
|                     | 0.1   | R90A                   | 0.3                                       | 2                   |                        |                     |                        |
|                     | 0.2   | 1R6A                   | 0.7                                       | 3                   |                        |                     |                        |
|                     | 0.4   | 2R8A                   | 1.2                                       | 5                   |                        |                     |                        |
|                     | 0.75  | 5R5A                   | 1.9                                       | 9                   | 0.25                   | 33                  |                        |
|                     | 1.5   | 120A*                  | 4   | 16                  |                        |                     |                        |

\* The official model name is SGD V-120AE1A008000.

Note 1. To comply with the low voltage directive, connect a fuse to the input side. Select the fuse for the input side from among models that are compliant with UL standards.

The table above also provides the net values of current capacity and inrush current. Select a fuse and a molded-case circuit breaker which meet the breaking characteristics shown below.

- Main circuit, control circuit: No breaking at three times the current values shown in the table for 5 s.
  - Inrush current: No breaking at the current values shown in the table for 20 ms.
2. The following usage restrictions apply to the UL installation certification conditions for the SGD V-120AE1A008000 SERVOPACK.
- Available rated current for molded-case circuit breaker: 40 A or less.


### 3.1.5 Using the SERVOPACK with a DC Power Input

#### (1) Parameter Settings

When using the SERVOPACK with a DC power input, set parameter Pn001.2 to 1.

| Parameter    | Meaning | When Enabled  | Classification |
|--------------|---------|---------------|----------------|
| <b>Pn001</b> | n.□0□□  | After restart | Setup          |
|              | n.□1□□  |               |                |

Observe the following precautions when using a DC power input.

|  <b>WARNING</b>   |
|--|
| <ul style="list-style-type: none"> <li>• Either AC or DC power can be input to the 200 V, 400 V SERVOPACKs. Always set Pn001.2 to 1 to specify a DC power input before inputting DC power. Only AC power can be input to the 100 V SERVOPACKs. If DC power is input without changing the parameter setting, the SERVOPACK's internal elements will burn and may cause fire or equipment damage.</li> <li>• With a DC power input, time is required to discharge electricity after the main power supply is turned OFF. A high residual voltage may remain in the SERVOPACK after the power supply is turned OFF. Be careful not to get an electric shock.</li> <li>• Install fuses on the wires if DC power is used.</li> <li>• Servomotor returns a regenerated energy to the power supply. The SERVOPACK that can use a DC power supply is not capable of processing the regenerated energy. Provide measures to process the regenerated energy on the power supply.</li> <li>• With a DC power input, connect an external inrush current limit circuit.<br/>Failure to observe this caution may result in damage to the product.</li> </ul> |

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

- Three-phase, 200-V SGD□V-□□□A (□□□ = R70, R90, 1R6, 2R8, 3R8, 5R5, 7R6, 120, 180, 200, 330)

| Terminal Symbols | Name                                | Specification  |
|------------------|-------------------------------------|----------------|
| B1/ ⊕            | Main circuit plus terminal          | 270 to 320 VDC |
| ⊖ 2              | Main circuit minus terminal         | 0 VDC          |
| L1C, L2C         | Control power supply input terminal | 200 to 230 VAC |

- Three-phase, 200-V SGD□V-□□□A (□□□ = 470, 550, 590, 780)

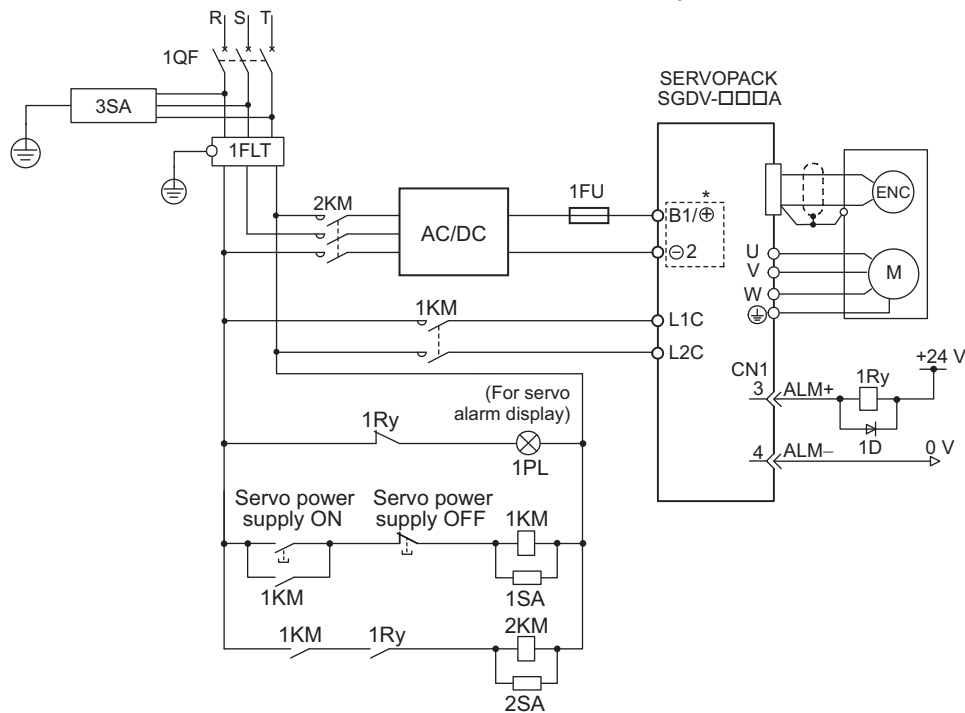
| Terminal Symbols | Name                                | Specification  |
|------------------|-------------------------------------|----------------|
| B1/ ⊕            | Main circuit plus terminal          | 270 to 320 VDC |
| ⊖                | Main circuit minus terminal         | 0 VDC          |
| L1C, L2C         | Control power supply input terminal | 200 to 230 VAC |

- Three-phase, 400-V SGD□V-□□□D (□□□ = 1R9, 3R5, 5R4, 8R4, 120, 170, 210, 260, 280, 370)

| Terminal Symbols | Name                                | Specification  |
|------------------|-------------------------------------|----------------|
| B1/ ⊕            | Main circuit plus terminal          | 513 to 648 VDC |
| ⊖ 2              | Main circuit minus terminal         | 0 VDC          |
| 24 V, 0 V        | Control power supply input terminal | 24 VDC (±15%)  |

### (3) Wiring Examples with DC Power Supply Input

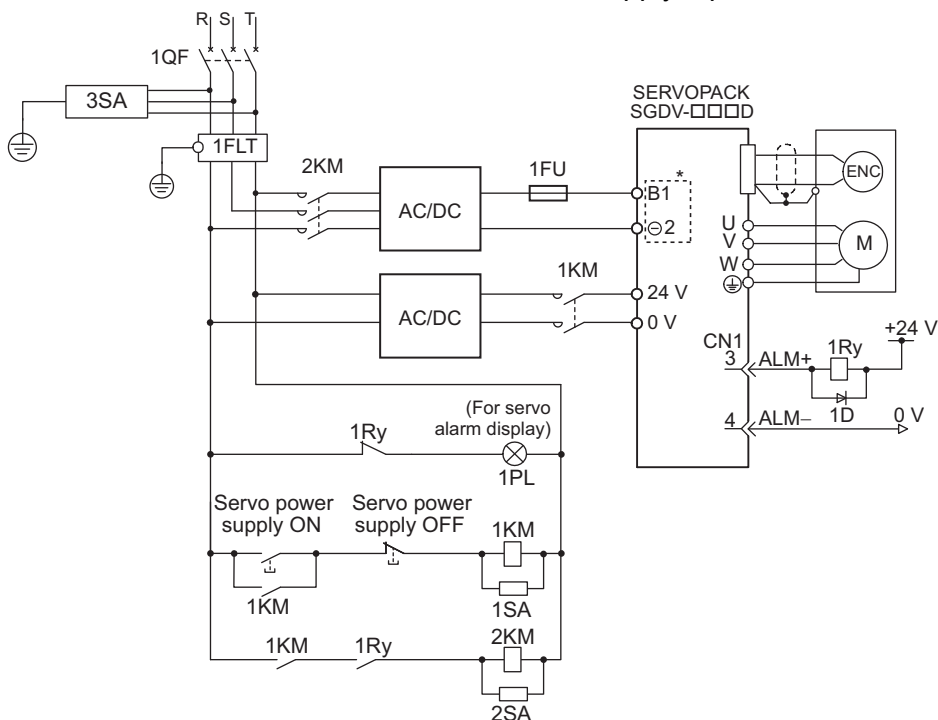
#### ■ SERVOPACK SGDV-□□□A with 200-V Power Supply Input



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

\* Terminal names differ from model of SERVOPACK. Refer to (1) Parameter Settings.

#### ■ SERVOPACK SGDV-□□□D with 400-V Power Supply Input



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

\* Terminal names differ from model of SERVOPACK. Refer to (1) Parameter Settings.



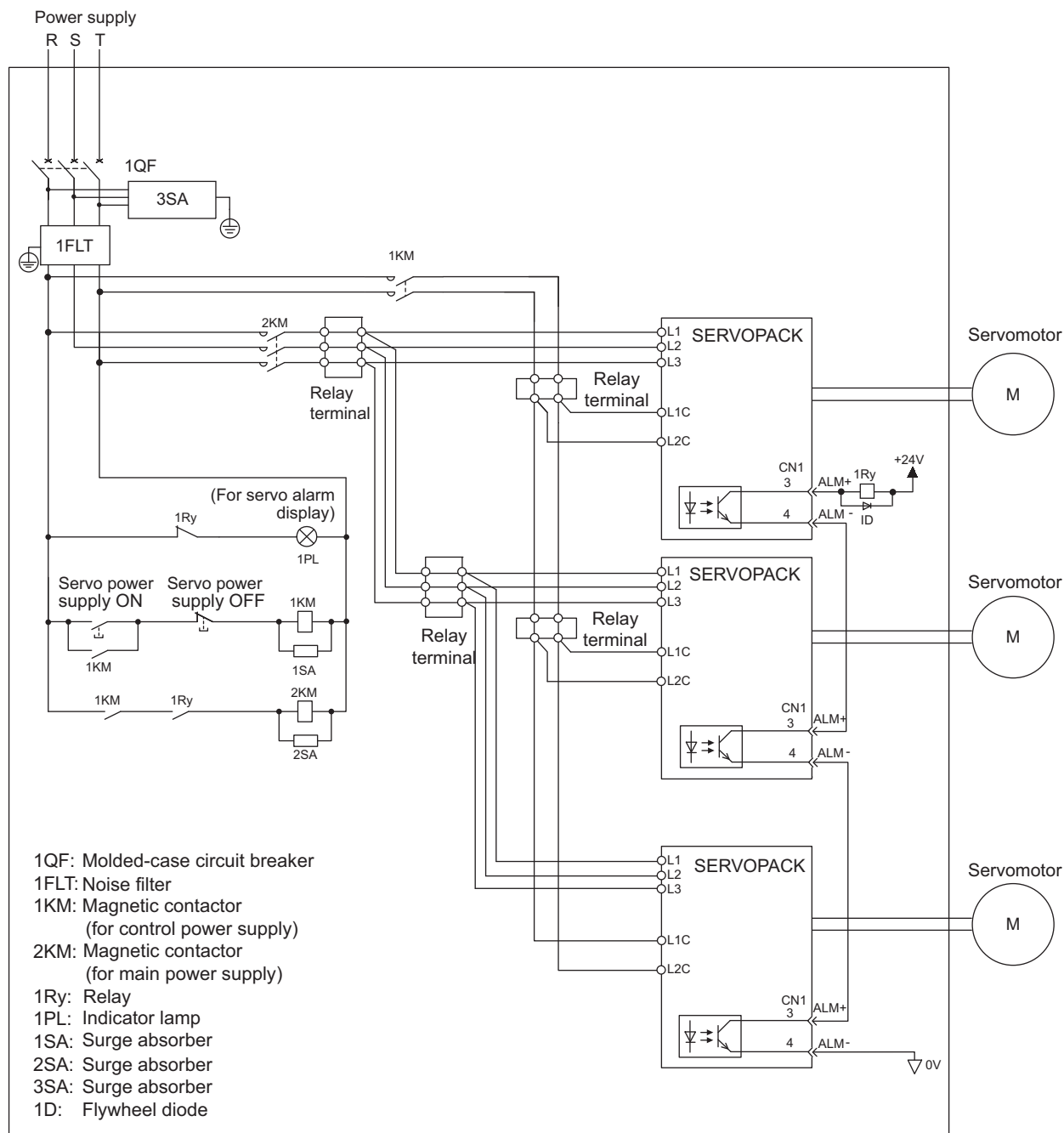
### 3.1.6 Using More Than One SERVOPACK

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

#### (1) Wiring Example

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

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



#### (2) Precautions

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

## 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

| Signal | Pin No. | Name   | Function  | Reference Section |
|--------|---------|--|---|-------------------|
| /SI3   | 9       | Command option module input 3                  | Connects the external input signal* used in the command option module.  | –                 |
| P-OT   | 7       | Forward run prohibited                         | Overtravel prohibited: Stops servomotor when movable part travels beyond the allowable range of motion.   | 4.2.2             |
| N-OT   | 8       | Reverse run prohibited                         |   |                   |
| /SI4   | 10      | Command option module input 4                  | Connects the external input signal* used in the command option module.  | –                 |
| /SI5   | 11      | Command option module input 5                  |   |                   |
| /SI6   | 12      | Command option module input 6                  |   |                   |
| +24VIN | 6       | Control power supply input for sequence signal | Control power supply input for sequence signals. Allowable voltage fluctuation range: 11 to 25 V<br>Note: The +24-V power supply is not included. | 3.4.1             |
| BAT(+) | 14      | Battery (+) input                              | Connecting pin for the absolute encoder backup battery.   | –                 |
| BAT(-) | 15      | Battery (-) input                              |   |                   |
| /SI0   | 13      | General-purpose input                          | Connects the external input signal* used in the command option module.  | –                 |

\* Refer to the manual of the connected command option module for information on how to allocate and use I/O signals.  
Note 1. The functions allocated to /SI3, P-OT, N-OT, /SI4, /SI5, and /SI6 input signals can be changed by using the parameters. Refer to 3.3.1 *Input Signal Allocations*.

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

#### (2) Output Signals

| Signal          | Pin No.         | Name                   | Function   | Reference Section |
|-----------------|-----------------|------------------------|--|-------------------|
| ALM+            | 3               | Servo alarm output     | Turns OFF when an error is detected.   | –                 |
| ALM-            | 4               |                        |  |                   |
| /BK+<br>(/SO1+) | 1               | Brake output           | Controls the brake. The brake is released when the signal turns ON.<br>Allocation can be changed to general-purpose output signals (/SO1+, /SO1-). | 4.2.3             |
| /BK-<br>(/SO1-) | 2               |                        |  |                   |
| /SO2+           | 23              | General-purpose output | General-purpose output signals<br>Note: Set the parameters to allocate functions.  | –                 |
| /SO2-           | 24              |                        |  |                   |
| /SO3+           | 25              |                        |  |                   |
| /SO3-           | 26              |                        |  |                   |
| FG              | Connector shell | Frame ground           | Connected to frame ground if the shield wire of the I/O signal cable is connected to the connector shell.  | –                 |

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

### 3.2.2 Safety Function Signal (CN8) Names and Functions

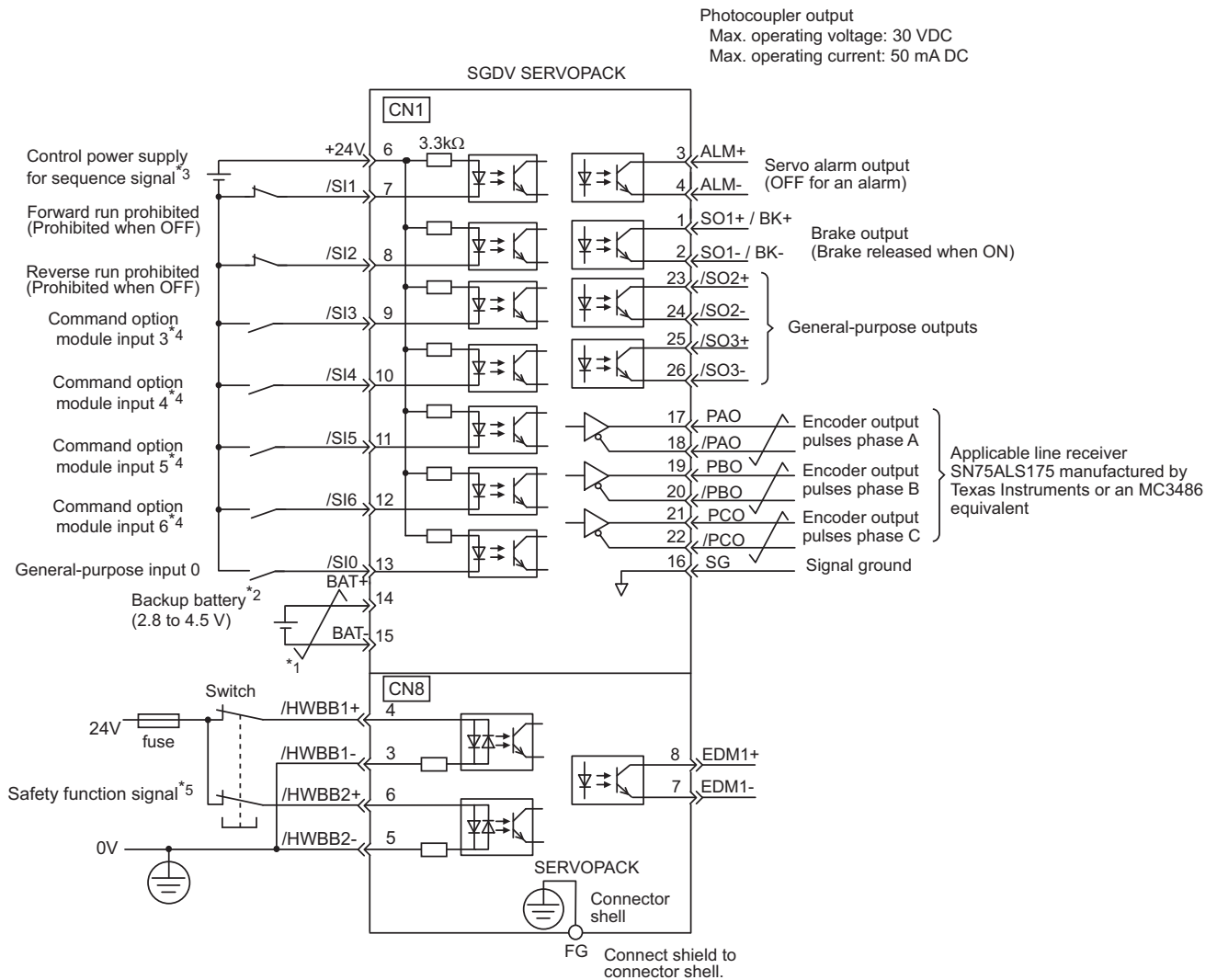
The following table shows the terminal layout of safety function signals (CN8).

| Signal  | Pin No. | Name                              | Function  |
|---------|---------|-----------------------------------|---|
| /HWBB1- | 3       | Hard wire base block input 1      | Hard wire base block input<br>Base block (motor current off) when<br>OFF                                  |
| /HWBB1+ | 4       |                                   |   |
| /HWBB2- | 5       | Hard wire base block input 2      |   |
| /HWBB2+ | 6       |                                   |   |
| EDM1-   | 7       | Monitored circuit status output 1 | ON when the /HWBB1 and<br>the /HWBB2 signals are input and the<br>SERVOPACK enters a base block<br>state. |
| EDM1+   | 8       |                                   |   |
| -       | 1*      | -                                 | -   |
| -       | 2*      | -                                 | -   |

\* Do not use pins 1 and 2. They are connected to the internal circuits.

### 3.2.3 Example of I/O Signal Connections

The following diagram shows a typical connection example.



- \*1. represents twisted-pair wires.
- \*2. Connect when using an absolute encoder. When the encoder cable for the battery case is connected, do not connect a backup battery.
- \*3. The 24 VDC power supply is not included. Use a power supply with double insulation or reinforced insulation.
- \*4. For details, refer to the manual of the connected command option module.
- \*5. To turn the servomotor power ON, a safety device must be connected and the wiring to activate the safety function must be done. When not using the safety function, use the SERVOPACK with the plug (JZSP-CVH05-E, provided as an accessory) inserted into the CN8.

Note: The functions allocated to the input signals /SI3, P-OT, N-OT, /SI0, /SI4, /SI5, and /SI6 and the output signals /SO1, /SO2, and /SO3 can be changed by using the parameters. Refer to 3.3.1 *Input Signal Allocations* and 3.3.2 *Output Signal Allocation*.

### 3.3 I/O Signal Allocations

This section describes the I/O signal allocations.

#### 3.3.1 Input Signal Allocations

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>

| Input Signal Names and Parameters        | Validity Level | Input Signal | CN1 Pin Numbers |          |   |   |    |    |    | Connection Not Required (SERVOPACK judges the connection) |            |
|--|----------------|--------------|-----------------|----------|---|---|----|----|----|---|------------|
|  |                |              | 13              | 7        | 8 | 9 | 10 | 11 | 12 | Always ON   | Always OFF |
| Forward Run Prohibited<br><b>Pn50A.3</b> | H              | P-OT         | 0               | <b>1</b> | 2 | 3 | 4  | 5  | 6  | 7   | 8          |
|  | L              | /P-OT        | 9               | A        | B | C | D  | E  | F  |   |            |

| Input Signal Names and Parameters                 | Validity Level | Input Signal | CN1 Pin Numbers |          |          |          |          |    |    | Connection Not Required (SERVOPACK judges the connection) |            |
|---|----------------|--------------|-----------------|----------|----------|----------|----------|----|----|---|------------|
|   |                |              | 13              | 7        | 8        | 9        | 10       | 11 | 12 | Always ON   | Always OFF |
| Forward Run Prohibited<br><b>Pn50A.3</b>          | H              | P-OT         | 0               | <b>1</b> | 2        | 3        | 4        | 5  | 6  | 7   | 8          |
|   | L              | /P-OT        | 9               | A        | B        | C        | D        | E  | F  |   |            |
| Reverse Run Prohibited<br><b>Pn50B.0</b>          | H              | N-OT         | 0               | 1        | <b>2</b> | 3        | 4        | 5  | 6  | 7   | 8          |
|   | L              | /N-OT        | 0               | A        | B        | C        | D        | E  | F  |   |            |
| Forward External Torque Limit<br><b>Pn50B.2</b>   | L              | /P-CL        | 0               | 1        | 2        | 3        | 4        | 5  | 6  | 7   | <b>8</b>   |
|   | H              | P-CL         | 9               | A        | B        | C        | D        | E  | F  |   |            |
| Reserve External Torque Limit<br><b>Pn50B.3</b>   | L              | /N-CL        | 0               | 1        | 2        | 3        | 4        | 5  | 6  | 7   | <b>8</b>   |
|   | H              | N-CL         | 9               | A        | B        | C        | D        | E  | F  |   |            |
| Command Option Module Input 3*1<br><b>Pn511.0</b> | L              | /SI3         | 0               | 1        | 2        | <b>3</b> | 4        | 5  | 6  | 7   | 8          |
|   | H              | SI3          | 9               | A        | B        | C        | D        | E  | F  |   |            |
| Command Option Module Input 4*1<br><b>Pn511.1</b> | L              | /SI4         | *2              | *2       | *2       | *2       | <b>4</b> | 5  | 6  | 7   | 8          |
|   | H              | SI4          | *2              | *2       | *2       | *2       | D        | E  | F  |   |            |

| Input Signal Names and Parameters                             | Validity Level | Input Signal | CN1 Pin Numbers |    |    |    |    |    |    | Connection Not Required (SERVOPACK judges the connection) |            |
|---|----------------|--------------|-----------------|----|----|----|----|----|----|---|------------|
|   |                |              | 13              | 7  | 8  | 9  | 10 | 11 | 12 | Always ON   | Always OFF |
| Command Option Module Input 5 <sup>*1</sup><br><b>Pn511.2</b> | L              | /SI5         | *2              | *2 | *2 | *2 | 4  | 5  | 6  | 7   | 8          |
|   | H              | SI5          | *2              | *2 | *2 | *2 | D  | E  | F  |   |            |
| Command Option Module Input 6 <sup>*1</sup><br><b>Pn511.3</b> | L              | /SI6         | *2              | *2 | *2 | *2 | 4  | 5  | 6  | 7   | 8          |
|   | H              | SI6          | *2              | *2 | *2 | *2 | D  | E  | F  |   |            |

\*1. For details, refer to the manual of the connected command option module.

\*2. Allocation is not possible.



### IMPORTANT

- Inverting the polarity of the Forward Run Prohibited, and Reverse Run Prohibited signals will prevent the holding brake from working in case of their signal line disconnections. If such setting is absolutely necessary, confirm the operation and observe safety precautions.
- If two or more signals are allocated to the same input circuit, a signal is output with or logic circuit input signal level is valid for all allocated signals.

### 3.3.2 Output Signal Allocation

Output signals are allocated as shown in the following table.

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) |
|--|---------------|-----------------|---------|---------|-------------------|
|  |               | 1/(2)           | 23/(24) | 25/(26) |                   |
| Positioning Completion<br><b>Pn50E.0</b> | /COIN         | 1               | 2       | 3       | 0                 |

| Output Signal Names and Parameters                   | Output Signal                    | CN1 Pin Numbers |          |                                      | Invalid (not use) |
|--|----------------------------------|-----------------|----------|--------------------------------------|-------------------|
|  |                                  | 1/ (2)          | 23/ (24) | 25/ (26)                             |                   |
| Positioning Completion<br><b>Pn50E.0</b>             | /COIN                            | 1               | 2        | 3                                    | 0                 |
| Speed Coincidence Detection<br><b>Pn50E.1</b>        | /V-CMP                           | 1               | 2        | 3                                    | 0                 |
| Rotation Detection<br><b>Pn50E.2</b>                 | /TGON                            | 1               | 2        | 3                                    | 0                 |
| Servo Ready<br><b>Pn50E.3</b>                        | /S-RDY                           | 1               | 2        | 3                                    | 0                 |
| Torque Limit Detection<br><b>Pn50F.0</b>             | /CLT                             | 1               | 2        | 3                                    | 0                 |
| Speed Limit Detection<br><b>Pn50F.1</b>              | /VLT                             | 1               | 2        | 3                                    | 0                 |
| Brake<br><b>Pn50F.2</b>                              | /BK                              | 1               | 2        | 3                                    | 0                 |
| Warning<br><b>Pn50F.3</b>                            | /WARN                            | 1               | 2        | 3                                    | 0                 |
| Near<br><b>Pn510.0</b>                               | /NEAR                            | 1               | 2        | 3                                    | 0                 |
| Output signal polarity inversion<br><b>Pn512.0=1</b> | Polarity inversion of CN1-1(2)   |                 |          | 0<br>(Not invert at factory setting) |                   |
| Output signal polarity inversion<br><b>Pn512.1=1</b> | Polarity inversion of CN1-23(24) |                 |          |                                      |                   |
| Output signal polarity inversion<br><b>Pn512.2=1</b> | Polarity inversion of CN1-25(26) |                 |          |                                      |                   |



#### IMPORTANT

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

### 3.4 Connection to Host Controller

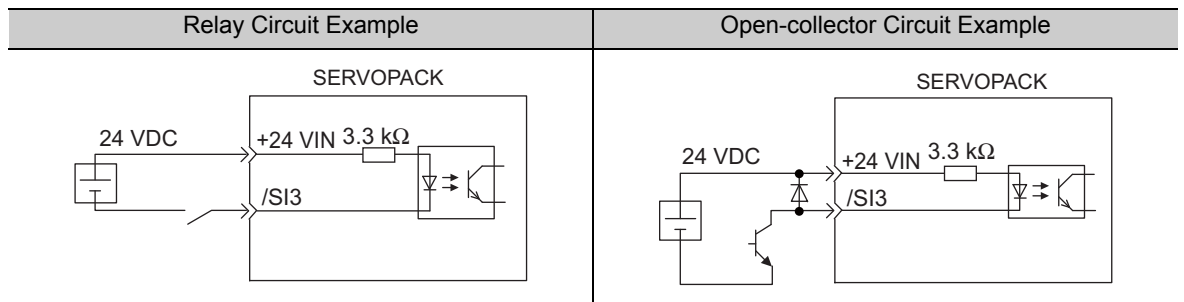
This section shows examples of SERVOPACK I/O signal connection to the host controller.

#### 3.4.1 Sequence Input Circuits

##### (1) Photocoupler Input Circuit

CN1 connector terminals 6 to 13 are explained below.

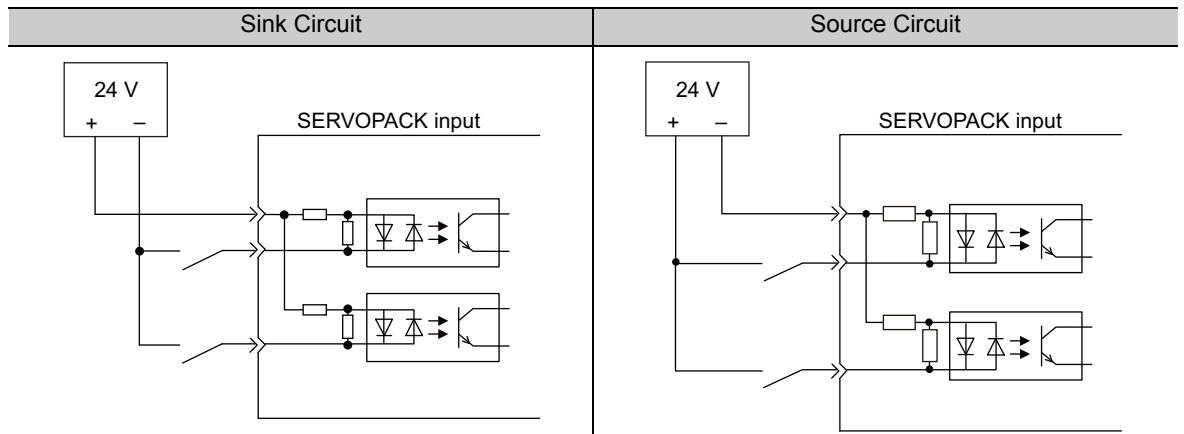
The sequence input circuit interface connects through a relay or open-collector transistor circuit. Select a low-current relay if a relay is used. Otherwise, a faulty contact will result.



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

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

- Note:
- The connection example in section 3.2.3 shows the connection using the sink circuit.
  - The polarity for turning the input signal ON or OFF differs between the sink circuit and the source circuit.

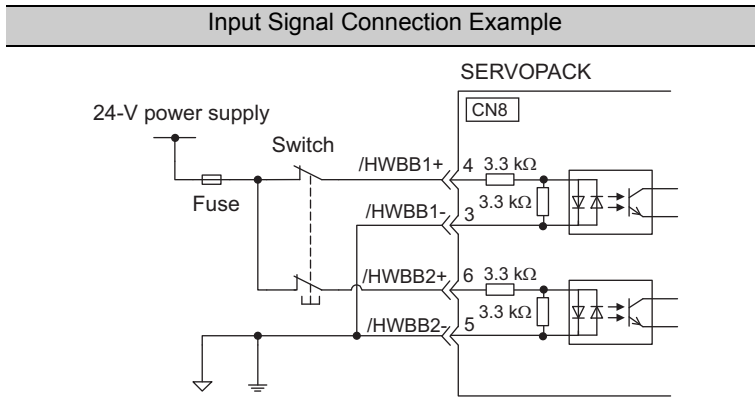


| Input Signal Polarities |                |               |         | Input Signal Polarities |                |               |         |
|-------------------------|----------------|---------------|---------|-------------------------|----------------|---------------|---------|
| Signal                  | 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    |



## (2) Safety Input Circuit

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



### 3.4.2 Sequence Output Circuits

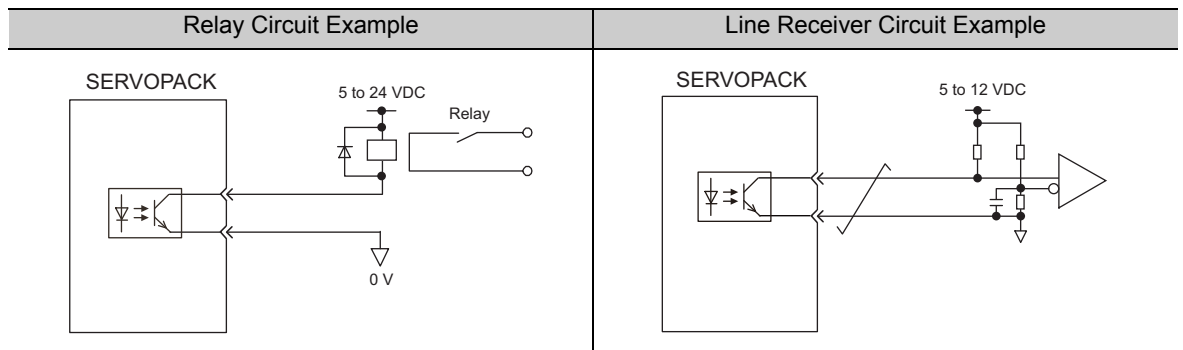
The following diagrams show examples of how output circuits can be connected the SERVOPACK.

Incorrectly wiring the sequence output circuit or applying a different voltage may result in failure of or damage to the SERVOPACK.

IMPORTANT

#### (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.



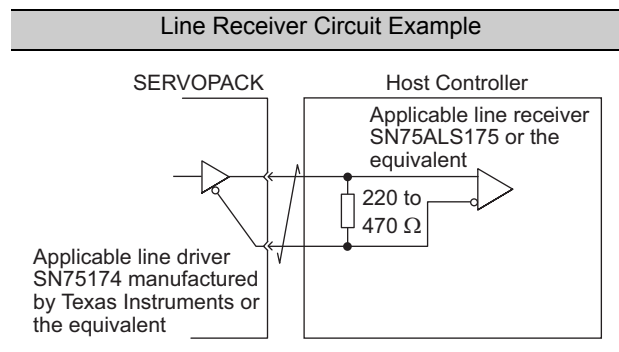
Note: The maximum allowable voltage and current capacities for photocoupler output circuits are as follows.

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

#### (2) Line Driver Output Circuit

CN1 connector terminals, 17-18 (phase-A signal), 19-20 (phase-B signal), and 21-22 (phase-C signal) are explained below.

Encoder serial data converted to two-phase (phases A and B) pulse output signals (PAO, /PAO, PBO, /PBO) and origin pulse signals (PCO, /PCO) are output via line-driver output circuits. Connect the line-driver output circuit through a line receiver circuit at the host controller.

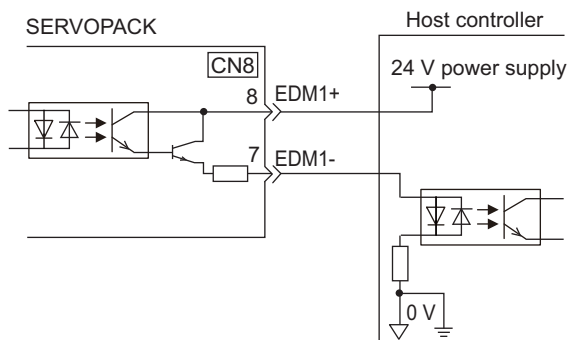


### (3) Safety Output Circuit

External device monitor (EDM1), an output signal of safety function, is explained below.

#### ■ Connection Example

The following figure shows a connection example for the EDM1 output signal.



#### ■ Specifications

| Type   | Signal Name | Pin No.        | Input Status | Meaning   |
|--------|-------------|----------------|--------------|---|
| Output | EDM1        | CN8-8<br>CN8-7 | ON           | The /HWBB1 signal and /HWBB2 signal are both operating normally.  |
|        |             |                | OFF          | Both the /HWBB1 signal and /HWBB2 signal are not operating normally or either of the two is not operating normally. |

Electrical characteristics of EDM1 signal are as follows.

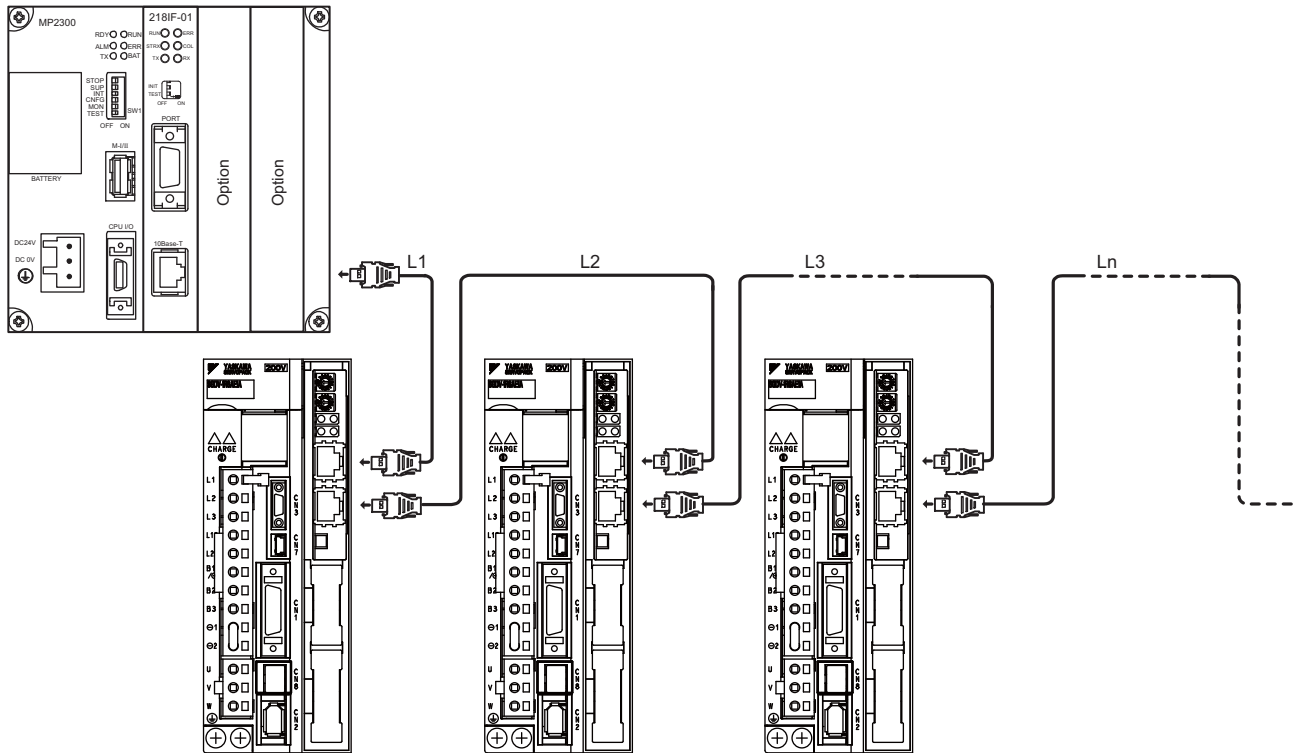
| Items                      | Characteristic | Remarks  |
|----------------------------|----------------|--|
| Maximum Allowable Voltage  | 30 VDC         | —  |
| Maximum Current            | 50 mADC        | —  |
| Maximum Voltage Drop at ON | 1.0 V          | Voltage between EDM1+ to EDM1- at current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

### 3.5 Wiring Communications Using Command Option Modules

The following diagram shows an example of connections between a host controller and a SERVOPACK using communications with command option modules.

Connect the connector of the communications cable to the command option module.

For details, refer to the manual of the connected command option module.



## 3.6 Encoder Connections

This section shows the names and functions of the encoder signals (CN2) and describes examples of encoder connection.

### 3.6.1 Encoder Signal (CN2) Names and Functions

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

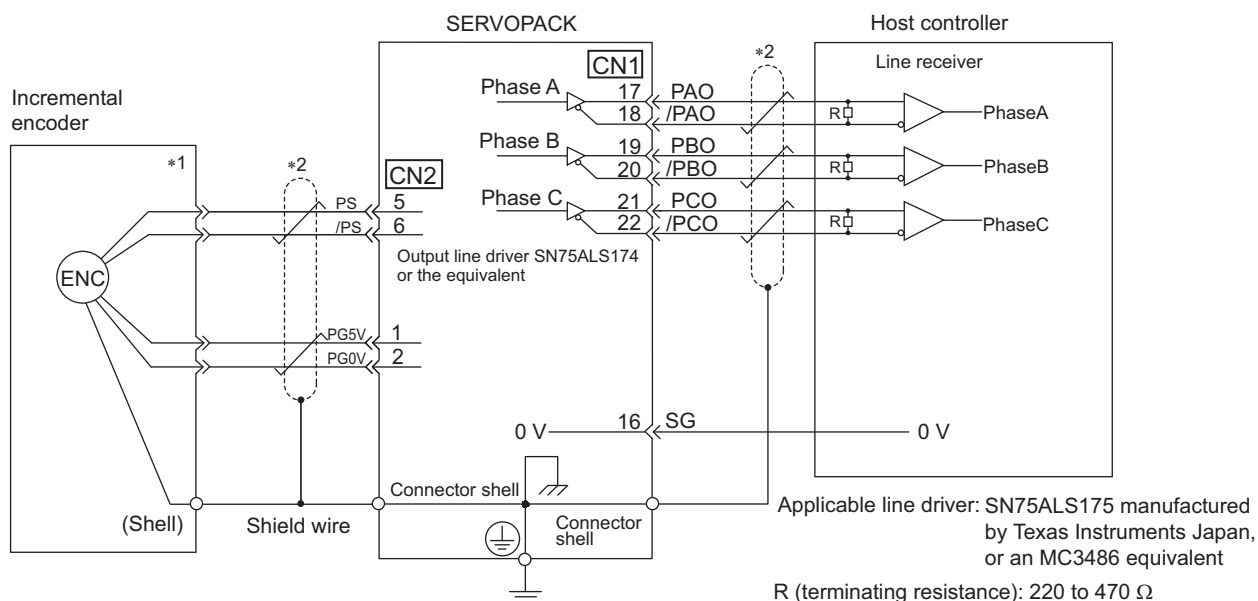
| Signal    | Pin No. | Function                  |
|-----------|---------|---------------------------|
| PG 5 V    | 1       | Encoder power supply +5 V |
| PG 0 V    | 2       | Encoder power supply 0 V  |
| BAT (+) * | 3       | Battery (+)               |
| BAT (-) * | 4       | Battery (-)     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

\* If an incremental encoder is used, these signals do not need to be connected.

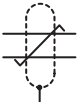
### 3.6.2 Examples of Encoder Connection

The following diagrams show examples of connecting an encoder, SERVOPACK, and host controller.

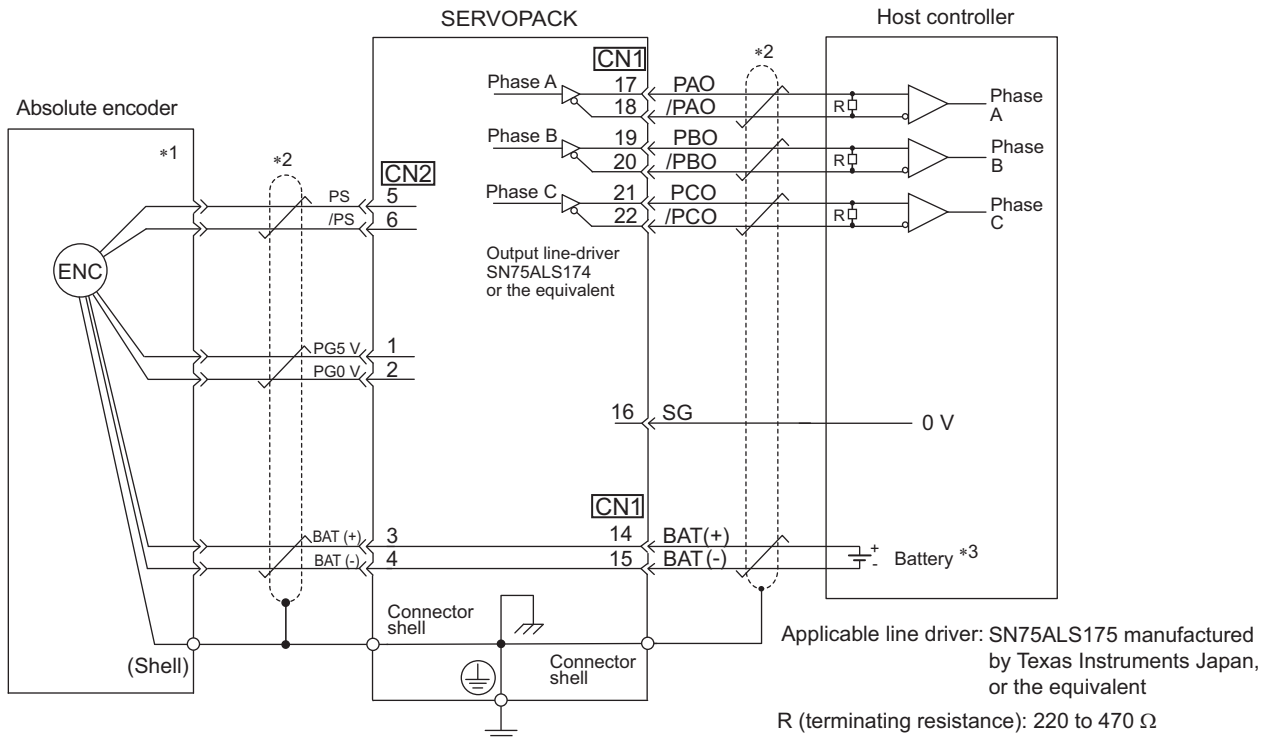
#### (1) Incremental Encoder




\*1. The pin numbers for the connector wiring of the incremental encoder depend on the servomotor.

\*2.  : represents twisted-pair wires.

(2) Absolute Encoder



\*1. The pin numbers for the connector wiring of the absolute encoder depend on the servomotor.

\*2.  : represents twisted-pair wires.

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

## 3.7 Regenerative Resistors Connections

If the ability to absorb regenerative energy is insufficient, connect an external regenerative resistor in the following manner and set the regenerative resistor capacity in Pn600. As for precautions on selecting a regenerative resistor and its specifications, refer to  *$\Sigma V$  series Product Catalog* (KAEP S800000 42).

### ! WARNING

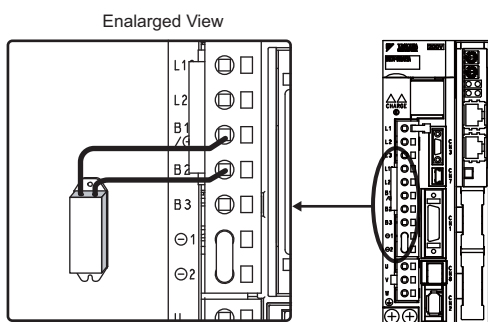
- Be sure to connect the regenerative resistor correctly.  
Failure to observe this warning may result in fire or damage to the product.

### 3.7.1 Connecting Regenerative Resistors

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

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

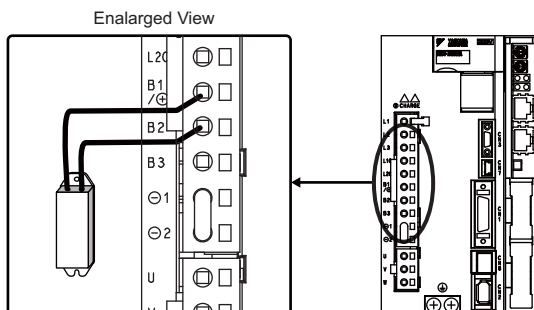
Install an external regenerative resistor between the B1/⊕ and B2 terminals. Make the settings for the regenerative resistor after it is connected. For information setting the regenerative resistor, refer to 3.7.2 *Setting Regenerative Resistor Capacity*.



#### (2) SERVOPACKs: Model SGDV-3R8A, 5R5A, 7R6A, 120A, 180A, 200A, 330A, 1R9D, 3R5D, 5R4D, 8R4D, 120D, 170D

Disconnect the wiring between the SERVOPACK's B2 and B3 terminals and connect an external regenerative resistor between the B1/⊕ and B2 terminals. Make the settings for the regenerative resistor after it is connected. For information setting the regenerative resistor, refer to 3.7.2 *Setting Regenerative Resistor Capacity*.

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



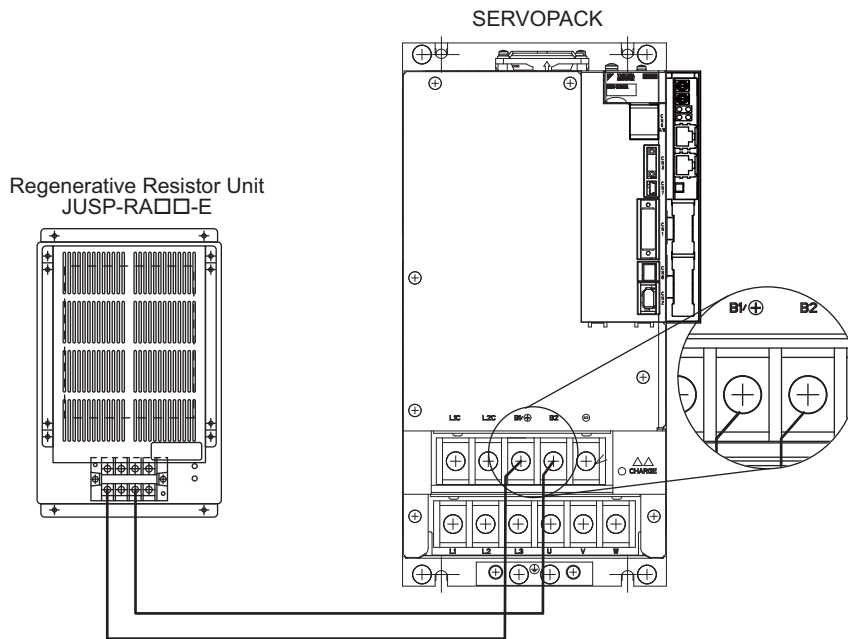
## (3) SERVOPACKs: Model SGDV-470A, 550A, 590A, 780A, 210D, 260D, 280D, 370D

No built-in regenerative resistor is provided, so an external regenerative resistor unit is required. The regenerative resistor units are as follows:

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

Connect a regenerative resistor unit between the B1 and B2 terminals.


When using a regenerative resistor unit, use the factory setting for Pn600. If a non-Yaskawa regenerative resistor is used, make the setting for Pn600.





### 3.7.2 Setting Regenerative Resistor Capacity

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

|   |
|---|
|  <b>WARNING</b>  |
| <ul style="list-style-type: none"> <li>If parameter Pn600 is set to 0 while an external regenerative resistor is connected, the generative overload alarm (A.320) may not be detected. If the generative overload alarm (A.320) is not detected correctly, the external regenerative resistor may be damaged and an injury or fire may result.</li> </ul> |

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

Be sure to set this parameter when installing an external regenerative resistor to the SERVOPACK.

When set to the factory setting of “0,” the SERVOPACK’s built-in resistor has been used.


Set the regenerative resistor capacity within tolerance value. When the set value is improper, alarm A.320 is detected.

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

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

Example: Set 20 W (100 W × 20 %) for the 100 W external regenerative resistor with natural convection cooling method:

$$Pn600 = 2 \text{ (units: 10 W)}$$

|   |   |
|---|---|
|  | <ol style="list-style-type: none"> <li>When the external regenerative resistors for power are used at the rated load ratio, the resistor temperature increases to between 200 °C and 300 °C. The resistors must be used at or below the rated values. Check with the manufacturer for the resistor’s load characteristics.</li> <li>For safety, use the external resistors with thermostiches.</li> </ol> |
|---|---|

**IMPORTANT**

## 3.8 Noise Control and Measures for Harmonic Suppression

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

### 3.8.1 Wiring for Noise Control



#### 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. It may receive switching noise from these high-speed switching elements if wiring or grounding around the SERVOPACK is not appropriate. Take measures against noise if the equipment is to be used near private houses or if there is concern about radio interference.
- Refer to *2.4 EMC Installation Conditions* in the  $\Sigma$ -V Series User's Manual Setup Rotational Motor (SIEP S800000 43) if installation conditions of the EMC directive must be satisfied.

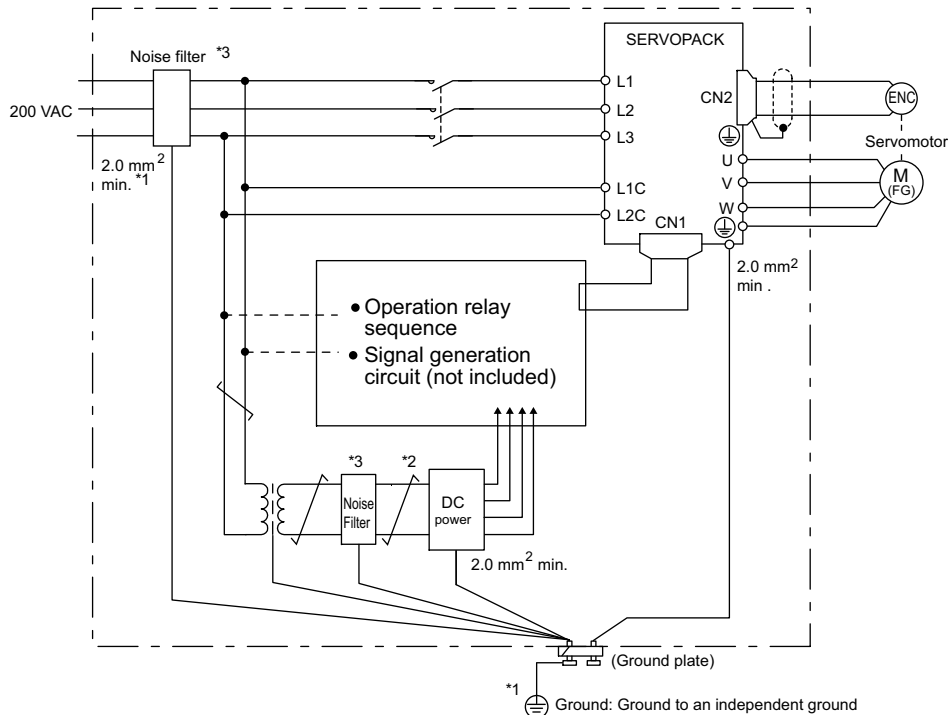
The SERVOPACK uses microprocessors and so it is susceptible to noise from peripheral devices. To prevent noise influence between the SERVOPACK and peripheral devices, take the following actions as required:

- 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.
- The distance between a power line (servomotor main circuit cable) and a signal line must be at least 30 cm. Do not put the power and signal lines in the same duct or bundle them together.
- Do not share the power supply with an electric welder or electrical discharge machine. When the SERVOPACK is placed near a high-frequency generator, install a noise filter on the input side of the power supply line. As for the wiring of noise filter, refer to *(1) Noise Filter*.
- 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 with a thickness of at least 2.0 mm<sup>2</sup> (preferably, plain stitch cooper wire).

\*2.  should be twisted-pair wires.

\*3. When using a noise filter, follow the precautions in 3.8.2 *Precautions on Connecting Noise Filter*.

## (2) Correct Grounding

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

### ■ Grounding the Motor Frame

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

If the servomotor is grounded via the machine, a switching noise current will flow from the SERVOPACK 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 Line

If the I/O signal lines are affected by noise, ground the 0 V (SG) terminal of I/O signal. If the main circuit wiring for the motor is in a metal conduit, ground the conduit and its junction box. For all grounding, ground at one point only.

### 3.8.2 Precautions on Connecting Noise Filter

This section describes the precautions on installing a noise filter.

#### (1) Noise Filter for Brake Power Supply

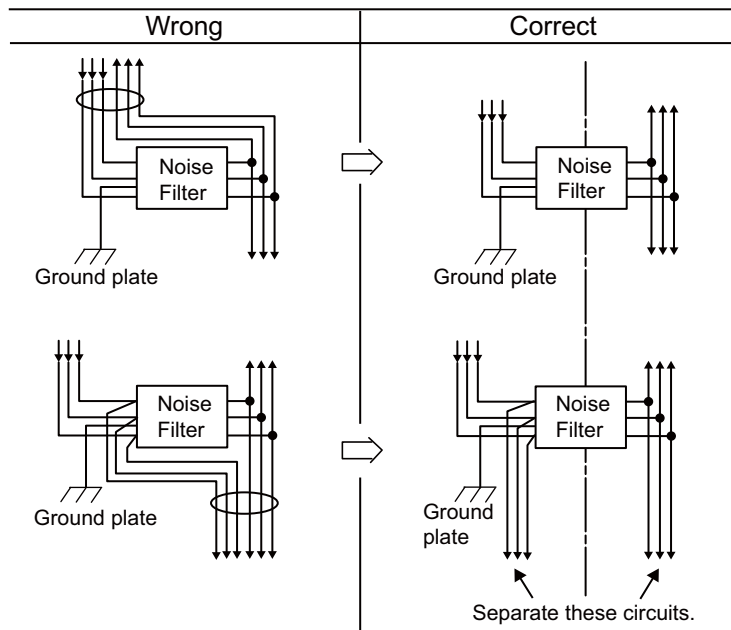
Use the following noise filter at the brake power input for 400 W or less servomotors with holding brakes.

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

#### (2) Precautions on Using Noise Filters

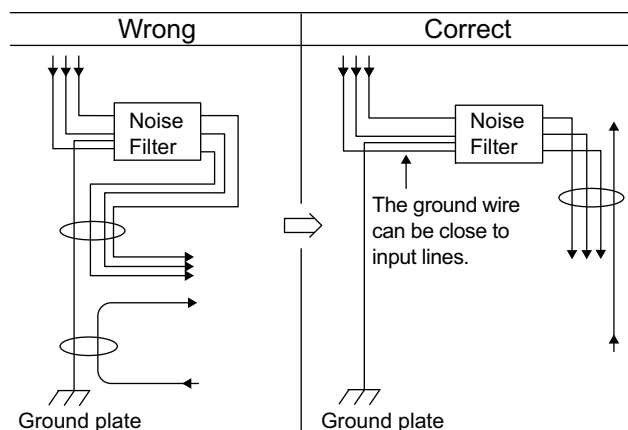
Always observe the following installation and wiring instructions.

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

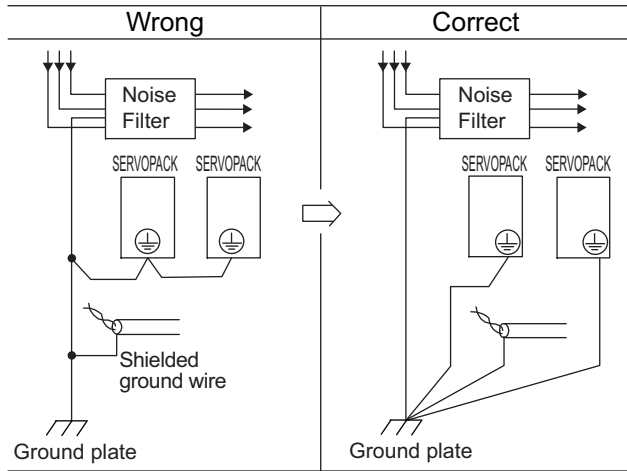


Separate the noise filter ground wire from the output lines.

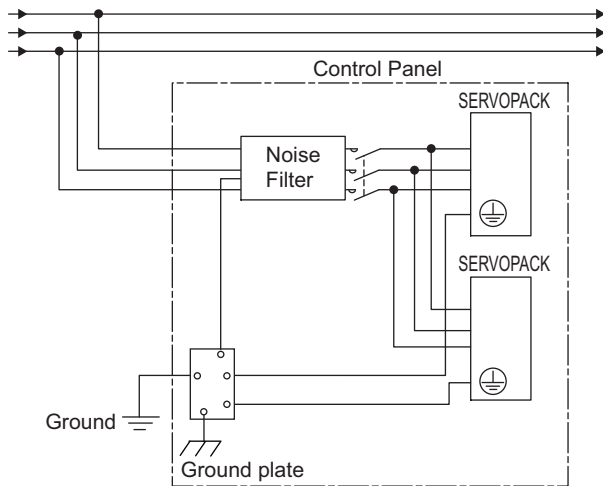
Do not put the noise filter ground wire, output lines and other signal lines, in the same duct or bundle them together.



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

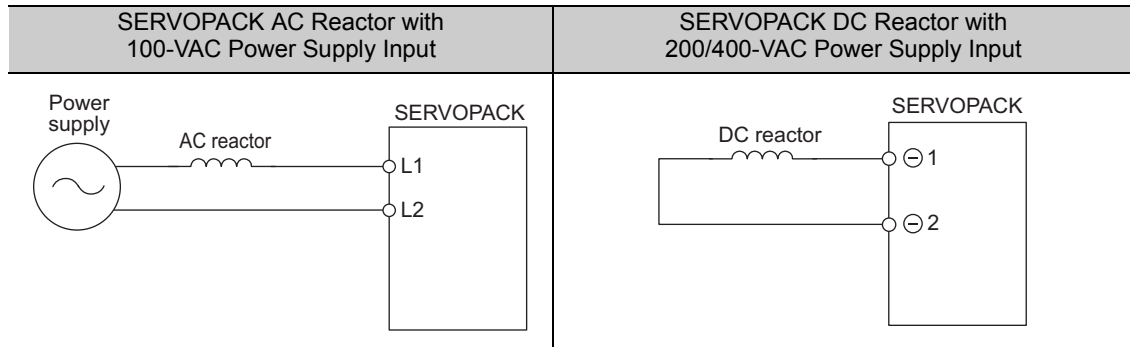


If a noise filter is located inside a control panel, connect the noise filter ground wire and the ground wires from other devices inside the control panel to the ground plate for the control panel first, then ground these wires.



### 3.8.3 Connecting AC/DC Reactor for Harmonic Suppression

The SERVOPACK has reactor connection terminals for power supply harmonic suppression. As for the precautions on selecting an AC or DC reactor and its specifications, refer to *Σ-V series Product Catalog* (KAEP S800000 42). Connect a reactor as shown in the following diagram.



- Note 1. Connection terminals for DC reactor ⊖1 and ⊖2 are short-circuited at shipment. Remove the lead wire for short-circuit, and connect a DC reactor.
2. AC and DC reactors are not provided. (option)
  3. A SERVOPACK with a single-phase, 100-V power supply input cannot be connected to a DC reactor.

|        |   |      |
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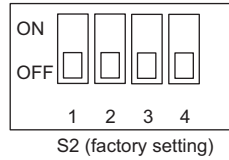


## 4.1 Option Module Function Settings

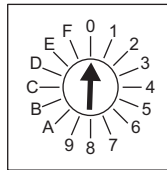
This section describes how to set the option module functions.

### 4.1.1 Setting Switches S1 and S2 for Option Module Functions

The S1 and S2 Switches are used to make the settings for the Option Module Functions.



S2 (factory setting)



S1 (factory settings)

For details on S1 and S2 switches, refer to the manual of the connected command option module.

## 4.2 Settings for Common Basic Functions

This section explains the settings for the common basic functions.

### 4.2.1 Inspection and Checking before Operation

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

#### (1) Servomotors

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

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

Note: If a motor with an oil seal is used, check whether the oil shield is damaged and if there is an oil coat. When performing operation on a servomotor that has been stored for a long period of time, perform the maintenance and inspection according to the procedures described in *1.7 Inspection and Maintenance*.

#### (2) SERVOPACKs

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

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

#### (3) Operating the Servomotor Alone

JOG operation of the SERVOPACK enables checking servomotor operation using speed control without connection to the host controller. For details, refer to the  *$\Sigma$ -V Series Users Manual Setup Rotational Motor* (SIEP S800000 43). For details on how to perform operation using the command option module functions, refer to the manual of the connected command option module.

### 4.2.2 Servomotor Rotation Direction

The servomotor rotation direction can be reversed with parameter Pn000 without changing the polarity of the speed/position reference.

This causes the travel direction of the motor change, but the encoder pulse output polarity does not change.

“Forward rotation” is counterclockwise (CCW) when viewed from the drive end.

| Parameter | Forward/Reverse Reference   | Motor Rotation Direction and Encoder Output Pulses | Enabled Overtravel (OT) |
|-----------|---|--|-------------------------|
| Pn000     | n.□□□0<br>Standard setting<br><br>(Forward reference = forward rotation)<br>[Factory setting] |  | P-OT                    |
|           | Reverse reference   |  | N-OT                    |
|           | n.□□□1<br><br>(Forward reference = reverse rotation)  |  | P-OT                    |
|           | Reverse reference   |  | N-OT                    |

Note: The figures in the table above show the trace waveforms for the Un monitor and SigmaWin+. For the analog monitor (CN5) output, the waveform of the Un monitor is inverted.

### 4.2.3 Overtravel

The overtravel limit function forces movable machine parts to stop by turning on a limit switch if they exceed the allowable range of motion.

For an application requiring rotation such as a disc table or a conveyor, an overtravel function is not necessary. No wiring for overtravel input signals is required.

**CAUTION**

- **Installing Limit Switches**  
 Connect limit switches as shown below to prevent damage to the devices during linear motion. It is recommended using normally closed contacts for the limit switches to ensure safe operation in the event of a faulty contact or a disconnection in the contact.

- **When using the servomotor on a vertical axis**  
 The workpiece may fall in the overtravel condition because the /BK signal is ON to release the brake. To prevent this, always set the zero clamp after stopping with Pn001 = n.□□1□. Refer to (4) *Motor Stopping Method When Overtravel is Used* in this section.

#### (1) Signal Setting

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

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

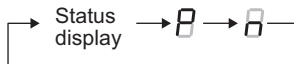
#### (2) Overtravel Displays

The following will be displayed on the panel display on the front of the SERVOPACK if overtravel occurs.

① Forward Overtravel (P-OT)



③ Forward and Reverse Overtravel



② Reverse Overtravel (N-OT)



### (3) 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 |
|--------------|--------|---|---------------|----------------|
| <b>Pn50A</b> | n.1□□□ | Inputs the Forward Run Prohibited (P-OT) signal from CN1-7.<br>[Factory setting]        | After restart | Setup          |
|              | n.8□□□ | Disables the Forward Run Prohibited (P-OT) signal.<br>Allows constant forward rotation. |               |                |
| <b>Pn50B</b> | n.□□□2 | Inputs the Reverse Run Prohibited (N-OT) signal from CN1-8.<br>[Factory setting]        |               |                |
|              | n.□□□8 | Disables the Reverse Run Prohibited (N-OT) signal.<br>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.

### (4) Motor Stopping Method When Overtravel is Used

There are three motor stopping methods when an overtravel is used.

- Dynamic brake  
By short-circuiting the electric circuits, the servomotor comes to a quick stop.
- Decelerate to stop  
Stops by using deceleration (braking) torque.
- Coast to a stop  
Stops naturally, with no control, by using the friction resistance of the motor in operation.

After stopping, there are two modes.

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

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

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

- A servomotor under torque control cannot be decelerated to a stop. The servomotor is stopped with the dynamic braking (DB) or coasts to a stop according to the setting of Pn001.0. After the servomotor stops, the servomotor will enter a coast state.
- For details on stopping methods after the servo OFF command is received or an alarm occurs, refer to 4.2.8 *Stopping Servomotor after Receiving Servo OFF Command or Alarm Occurrence*.

#### ■ When Motor Stopping Method is Set to Decelerate to Stop

Emergency stop torque can be set with Pn406.

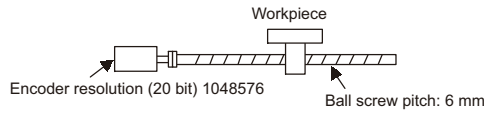
| Pn406 | Emergency Stop Torque |              |                 |              | Classification |
|-------|-----------------------|--------------|-----------------|--------------|----------------|
|       | Setting Range         | Setting Unit | Speed           | Position     |                |
|       |                       |              | 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.

### 4.2.4 Electronic Gear

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

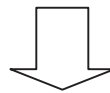
To move a workpiece 10 mm:



#### When the Electronic Gear is Not Used:

- ① Calculate the revolutions.  
1 revolution is 6 mm. Therefore,  $10 \div 6 = 1.6666$  revolutions.
- ② Calculate the required reference pulses.  
1048576 pulses is 1 revolution. Therefore,  $1.6666 \times 1048576 = 1746928$  pulses.
- ③ Input 1746928 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 (10000μm),  
1 pulse = 1μm, so  $10000 \div 1 = 10000$  pulses.  
Input 10000 pulses as reference pulses.

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

#### (1) Electric Gear Ratio

Set the electric gear ratio using Pn20E and Pn210.

|              |   |              |                 |               |                |
|--------------|---|--------------|-----------------|---------------|----------------|
| <b>Pn20E</b> | Electronic Gear Ratio (Numerator) <span style="float: right;">Position</span>   |              |                 |               | Classification |
|              | Setting Range   | Setting Unit | Factory Setting | When Enabled  |                |
|              | 1 to 1073741824<br>( $2^{30}$ )   | 1            | 4               | After restart | Setup          |
| <b>Pn210</b> | Electronic Gear Ratio (Denominator) <span style="float: right;">Position</span> |              |                 |               | Classification |
|              | Setting Range   | Setting Unit | Factory Setting | When Enabled  |                |
|              | 1 to 1073741824<br>( $2^{30}$ )   | 1            | 1               | After restart | Setup          |

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

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

### Encoder Resolution

Encoder resolution can be checked with servomotor model designation.

SGM□V-□□□□□□□□

| Symbol | Specification      | Encoder Resolutions |
|--------|--------------------|---------------------|
| 3      | 20-bit absolute    | 1048576             |
| D      | 20-bit incremental | 1048576             |
| A      | 13-bit incremental | 8192                |

SGMPS -□□□□□□□□

| Symbol | Specification      | Encoder Resolutions |
|--------|--------------------|---------------------|
| 2      | 17-bit absolute    | 131072              |
| C      | 17-bit incremental | 131072              |



**IMPORTANT**

Electronic gear ratio setting range:  $0.001 \leq \text{Electronic gear ratio (B/A)} \leq 4000$

If the electronic gear ratio is outside this range, a parameter setting error (A.040) will be output.

### (2) Procedure for Setting the Electronic Gear Ratio

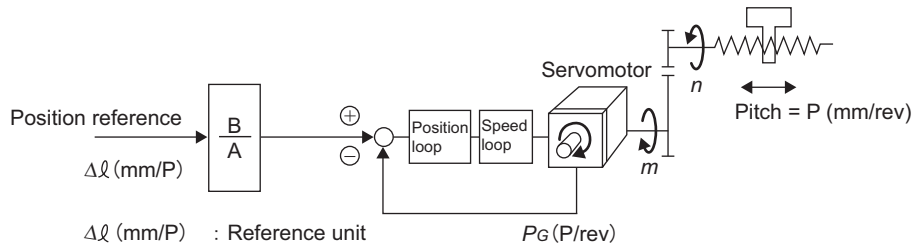
Set value electric gear differs depending on the machine specifications. Use the following procedure to set the electronic gear ratio.

| Step | Operation   |
|------|---|
| 1    | Check machine specifications.<br>Check the gear ratio, ball screw pitch, and pulley diameter.   |
| 2    | Check the encoder resolution.<br>Check the encoder resolution for the servomotor used.  |
| 3    | Determine the reference unit used.<br>Determine the reference unit from the host controller, considering the machine specifications and positioning accuracy.   |
| 4    | Calculate the travel distance per load shaft revolution.<br>Calculate the number of reference units necessary to turn the load shaft one revolution based on the previously determined reference units. |
| 5    | Calculate the electronic gear ratio.<br>Use the electronic gear ratio equation to calculate the ratio (B/A).  |
| 6    | Set parameters.<br>Set parameters Pn20E and Pn210 using the calculated values.  |
| 7    | Turn OFF the power and ON again to enable the settings.   |



### (3) Electronic Gear Ratio Equation

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



$\Delta l$  (mm/P) : Reference unit

$P_G$  (P/rev) : Encoder resolution

$P$  (mm/rev) : Ball screw pitch

$\frac{n}{m}$  : Gear ratio (m is the rotation of the motor and n is the rotation of the load shaft.)

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

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

Set A and B with the following parameters.

**A**: Pn210    **B**: Pn20E

### (4) Electronic Gear Ratio Setting Examples

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

| Step | Operation  | Load Configuration  |  |  |
|------|--|---|--|--|
|      |  | Ball Screw  | Disc Table   | Belt and Pulley  |
|      |  | Reference unit: 0.001 mm<br>  | Reference unit: 0.01°<br>  | Reference unit: 0.005 mm<br>Load shaft<br>Gear ratio: 1/50<br>   |
| 1    | Check machine specifications.                            | <ul style="list-style-type: none"> <li>Ball screw pitch: 6 mm</li> <li>Gear ratio: 1/1</li> </ul> | <ul style="list-style-type: none"> <li>Rotation angle per revolution: 360°</li> <li>Gear ratio: 1/100</li> </ul> | <ul style="list-style-type: none"> <li>Pulley diameter: 100 mm (pulley circumference: 314 mm)</li> <li>Gear ratio: 1/50</li> </ul> |
| 2    | Check the encoder resolution.                            | 1048576 (20-bit)  | 1048576 (20-bit)   | 1048576 (20-bit)   |
| 3    | Determine the reference unit used.                       | Reference unit: 0.001 mm (1 μm)   | Reference unit: 0.01°  | Reference unit: 0.005 mm (5 μm)  |
| 4    | Calculate the travel distance per load shaft revolution. | 6 mm/0.001 mm=6000  | 360°/0.01°=36000   | 314 mm/0.005 mm=62800  |
| 5    | Calculate the electronic gear ratio.                     | $\frac{B}{A} = \frac{1048576}{6000} \times \frac{1}{1}$   | $\frac{B}{A} = \frac{1048576}{36000} \times \frac{100}{1}$   | $\frac{B}{A} = \frac{1048576}{62800} \times \frac{50}{1}$  |
| 6    | Set parameters.  | Pn20E: 1048576  | Pn20E: 104857600   | Pn20E: 52428800  |
|      |  | Pn210: 6000   | Pn210: 36000   | Pn210: 62800   |

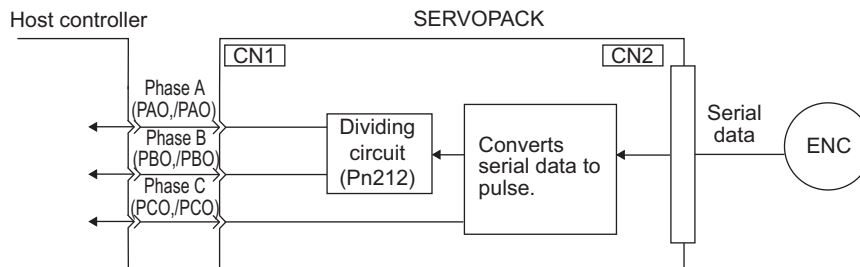
## 4.2.5 Encoder Output Pulses

Encoder output pulse is the signal which processes the encoder output inside the SERVOPACK and then outputs externally in the form of 2-phase pulses (phase A and B) with 90° phase differential. It is used as the feedback of position.

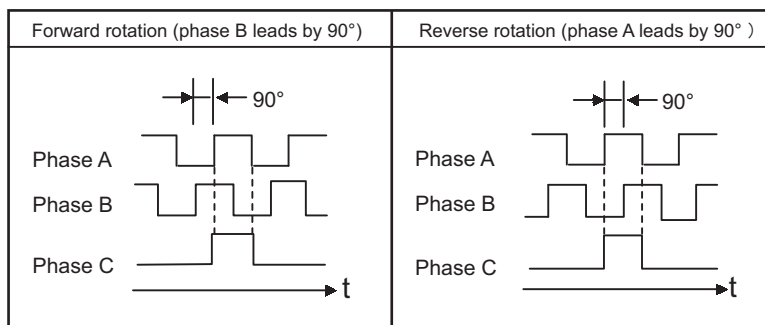
Signals and output phase form are as shown below.

### (1) Signals

| Type   | Signal Name | Connector Pin Number | Name                           | Remarks  |
|--------|-------------|----------------------|--------------------------------|--|
| Output | PAO         | CN1-17               | Encoder output pulse: phase A  | Output pulses per motor rotation set in the encoder output pulses (Pn212), and phase A and phase B are different from each other in phase by an electric angle of 90°. |
|        | /PAO        | CN1-18               | Encoder output pulse: phase /A |  |
|        | PBO         | CN1-19               | Encoder output pulse: phase B  |  |
|        | /PBO        | CN1-20               | Encoder output pulse: phase /B |  |
|        | PCO         | CN1-21               | Encoder output pulse: phase C  | One pulse is output per motor rotation.  |
|        | /PCO        | CN1-22               | Encoder output pulse: phase /C |  |



### (2) Output Phase Form



Note: The pulse width of the (Phase C origin pulse) changes according to the setting of the Pn212 and becomes the same as that for phase A.

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



#### IMPORTANT

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

## 4.2.6 Encoder Output Pulse Setting

Set the encoder output pulse using the following parameter.

| Pn212 | Encoder Output Pulses        |              |                                |                                   | Classification |                                 |
|-------|------------------------------|--------------|--------------------------------|-----------------------------------|----------------|---------------------------------|
|       |                              |              | <input type="checkbox"/> Speed | <input type="checkbox"/> Position |                | <input type="checkbox"/> Torque |
|       | Setting Range                | Setting Unit | Factory Setting                | When Enabled                      |                |                                 |
|       | 16 to 1073741824( $2^{30}$ ) | 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 according to the system specifications of the machine or host controller.

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

| Setting Range of Encoder Output Pulses (P/Rev) | Setting Unit (pulse) | Encoder Resolution |         |         | Upper Limit of Servomotor Speed ( $\text{min}^{-1}$ ) |
|--|----------------------|--------------------|---------|---------|---|
|  |                      | 13 bits            | 17 bits | 20 bits |   |
| 16 to 2048                                     | 1                    | ✓                  | ✓       | ✓       | 6000  |
| 16 to 16384                                    | 1                    | –                  | ✓       | ✓       | 6000  |
| 16386 to 32768                                 | 2                    | –                  | ✓       | ✓       | 3000  |
| 32772 to 65536                                 | 4                    | –                  | –       | ✓       | 1500  |
| 65544 to 131072                                | 8                    | –                  | –       | ✓       | 750   |
| 131088 to 262144                               | 16                   | –                  | –       | ✓       | 375   |

Note 1. The setting range varies with the encoder resolution for the servomotor used.

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

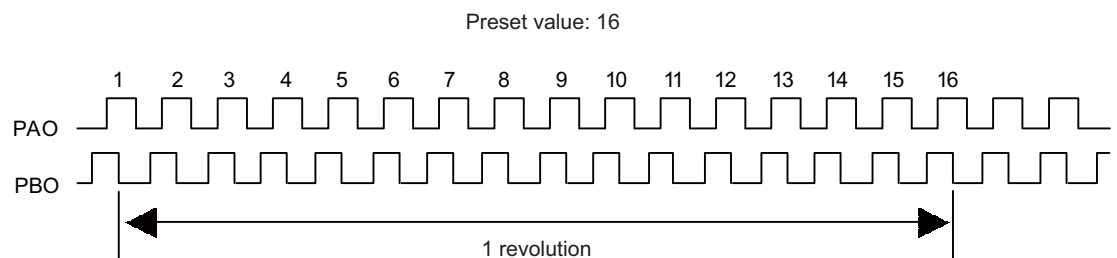
Pn212 = 25001 (P/Rev) is not accepted. The alarm A.041 is output because the setting unit differs from that in the above table.

2. The upper limit of the pulse frequency is approx. 1.6 Mpps.

The servomotor speed is limited by the setting value of the number of the output pulse for Pn212.

An overspeed of encoder output pulse rate (A.511) will occur if the motor speed exceeds the upper limit specified in the above table.

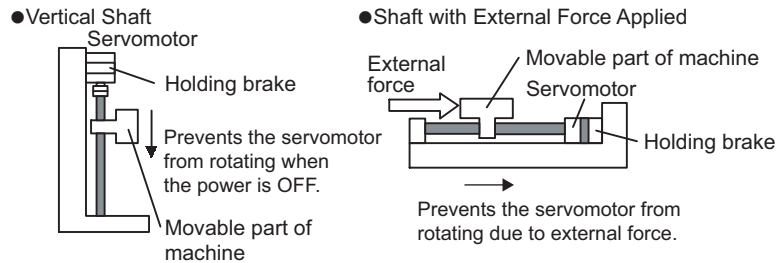
Output Example: When Pn212 = 16 (16-pulse output per one revolution), PAO and PBO are output as shown below.




### 4.2.7 Holding Brakes

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

The holding brake is used in the following cases.

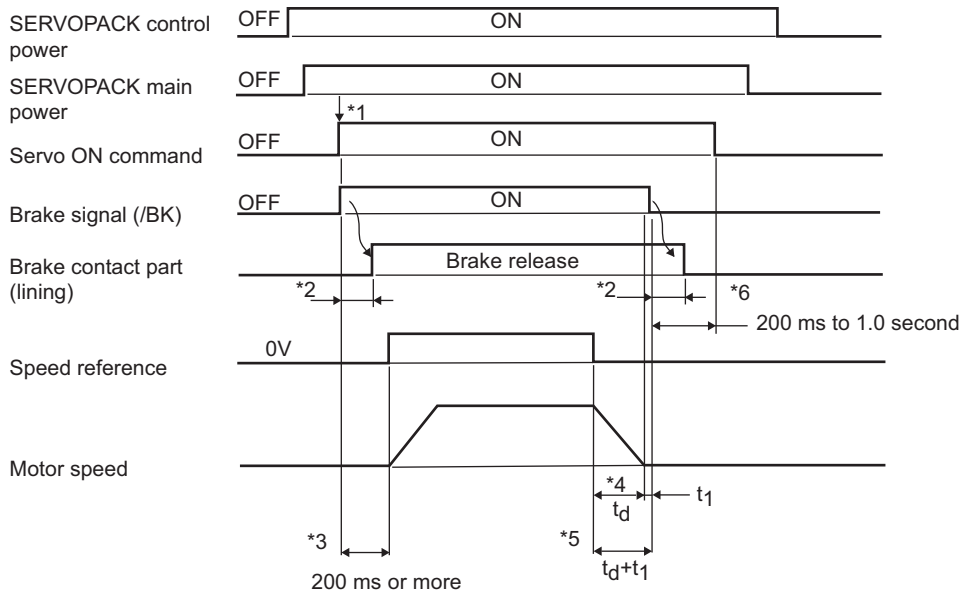




**IMPORTANT**

- 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 motor.
- Turn OFF the servomotor power and activate the holding brake at the same time.

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



- \*1. The servo ON command and the brake signal (/BK) are output at the same time.
- \*2. The operation delay time of the brake depends on the model. For details, refer to *Brake Operation Delay Time* shown below.
- \*3. Allow a period of 200 ms before the speed reference is input after the brake power supply is turned ON.
- \*4. The servomotor stop time is shown by  $t_d$ . Use the following formula for the calculation of  $t_d$ .

$$t_d = \frac{(J_M + J_L) \times N_M}{(T_P + T_L)} \times \frac{2\pi}{60} \text{ (sec)}$$

$J_M$  : Rotor moment of inertia ( $\text{kg}\cdot\text{m}^2$ )     $J_L$  : Load moment of inertia ( $\text{kg}\cdot\text{m}^2$ )

$N_M$  : Motor rotational speed ( $\text{min}^{-1}$ )     $T_P$  : Motor deceleration torque ( $\text{N}\cdot\text{m}$ )

$T_L$  : Load torque ( $\text{N}\cdot\text{m}$ )

- \*5. Always turn OFF the brake power supply after the servomotor comes to a stop. Usually, set  $t_d+t_1$  to 1 or 2 seconds.
- \*6. 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.

Brake Operation Delay Time

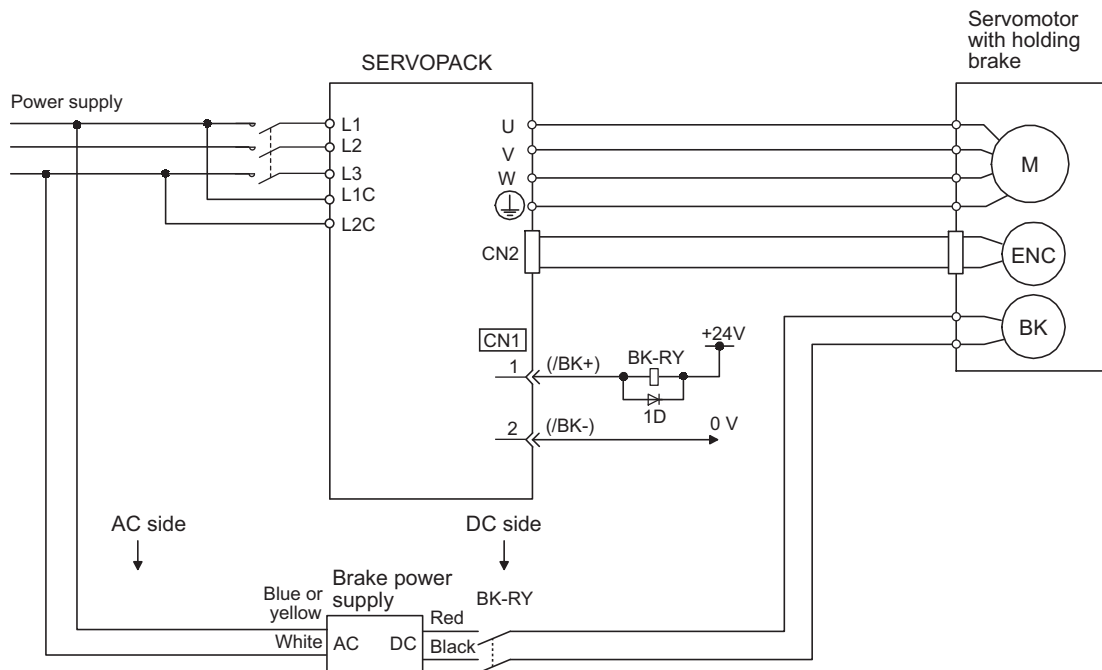
| Model            | Voltage           | Brake Release Time (ms) | Brake Applied Time (ms)   |
|------------------|-------------------|-------------------------|---------------------------|
| SGMJV-A5 to 04   | 24 VDC            | 60                      | 100                       |
| SGMJV-08         |                   | 80                      | 100                       |
| SGMAV-A5 to 04   |                   | 60                      | 100                       |
| SGMAV-06 to 10   |                   | 80                      | 100                       |
| SGMPS-01, 08, 15 |                   | 20                      | 100                       |
| SGMPS-02, 04     |                   | 40                      | 100                       |
| SGMGV-03 to 20   | 24 VDC,<br>90 VDC | 100                     | 80                        |
| SGMGV-30, 44     |                   | 170                     | 100 (24 VDC), 80 (90 VDC) |
| SGMGV-55, 75, 1A |                   | 170                     | 80                        |
| SGMGV-1E         |                   | 250                     | 80                        |
| SGMSV-10 to 25   |                   | 170                     | 80                        |
| SGMSV-30 to 50   |                   | 100                     | 80                        |

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

(1) Wiring Example

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


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



BK-RY: Brake control relay

Brake power supply for 90 V Input voltage 200-V models: LPSE-2H01-E  
Input voltage 100-V models: LPDE-1H01-E

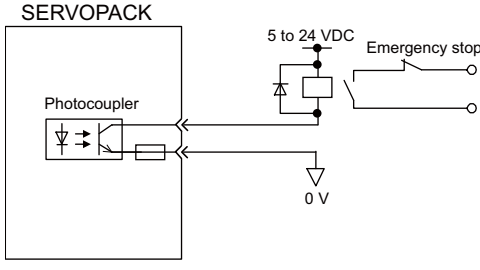
A 24 VDC power supply is not included.



**IMPORTANT**

- For the holding brake operation circuit, construct the relay circuit so that the brake operates for an emergency stop.

**Relay Circuit Example**




**(2) Signal Setting**

This output signal controls the brake.

The /BK signal turns OFF when an alarm is detected or the servomotor power is OFF. The brake OFF timing can be adjusted with Pn506.

The allocation of the /BK signal can be changed. Refer to (3) Brake Signals (/BK) Allocation for details.

| Type   | Name | Connector Pin Number | Setting    | Meaning             |
|--------|------|----------------------|------------|---------------------|
| Output | /BK  | CN1-1, CN1-2         | ON (close) | Releases the brake. |
|        |      |                      | OFF (open) | Applies the brake.  |




**IMPORTANT**

The /BK signal remains ON during overtravel. The brake is released.

**(3) Brake Signals (/BK) Allocation**

Use the parameter Pn50F.2 to allocate the /BK signal.

| Parameter    |        | Connector Pin Number |            | Meaning   | When Enabled  | Classification |
|--------------|--------|----------------------|------------|---|---------------|----------------|
|              |        | + Terminal           | - Terminal |   |               |                |
| <b>Pn50F</b> | n.□0□□ | -                    | -          | The /BK signal is not used.   | After restart | Setup          |
|              | n.□1□□ | CN1-1                | CN1-2      | The /BK signal is output from output terminal CN1-1, 2. [Factory setting] |               |                |
|              | n.□2□□ | CN1-23               | CN1-24     | The /BK signal is output from output terminal CN1-23, 24.                 |               |                |
|              | n.□3□□ | CN1-25               | CN1-26     | The /BK signal is output from output terminal CN1-25, 26.                 |               |                |



**IMPORTANT**

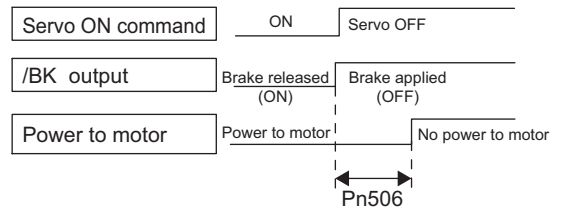
When multiple signals are allocated to the same output terminal, the signals are output with OR logic. For the /BK signal, do not use the output terminal that is already being used for another signal.

#### (4) Brake ON Timing after the Servomotor Stops

When the servomotor stops, the /BK signal turns OFF at the same time as the servo ON command is turned OFF. The Pn506 parameter can be used to change the timing at which the servo ON command turns OFF and power is not supplied to the motor.

|       |   |              |                 |              |                |
|-------|---|--------------|-----------------|--------------|----------------|
| Pn506 | Brake Reference-Servo OFF Delay Time <span style="float:right">Speed Position Torque</span> |              |                 |              | Classification |
|       | Setting Range   | Setting Unit | Factory Setting | When Enabled |                |
|       | 0 to 50   | 10 ms        | 0               | Immediately  | Setup          |

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



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

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

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

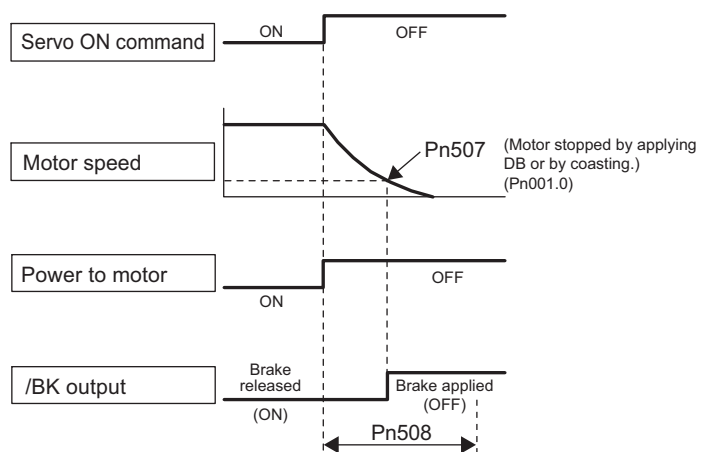
Note: If the servomotor is set so that it comes to a zero-speed stop for an alarm, follow the information in (4) Brake ON Timing after the Servomotor Stops after the motor comes to a stop for a zero position reference.

|       |   |                     |                 |              |                |
|-------|---|---------------------|-----------------|--------------|----------------|
| Pn507 | Brake Reference Output Speed Level <span style="float:right">Speed Position Torque</span>               |                     |                 |              | Classification |
|       | Setting Range   | Setting Unit        | Factory Setting | When Enabled |                |
|       | 0 to 10000  | 1 min <sup>-1</sup> | 100             | Immediately  | Setup          |
| Pn508 | Waiting Time for Brake Signal When Motor Running <span style="float:right">Speed Position Torque</span> |                     |                 |              | Classification |
|       | Setting Range   | Setting Unit        | Factory Setting | When Enabled |                |
|       | 10 to 100   | 10 ms               | 50              | Immediately  | Setup          |

##### /BK Signal Output Conditions When Servomotor Running

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

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





### IMPORTANT

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

## 4.2.8 Stopping Servomotor after Receiving Servo OFF Command or Alarm Occurrence

The stopping method can be selected after the servo OFF command is received or an alarm occurs.



### IMPORTANT

- Dynamic braking (DB) is used for emergency stops. The DB circuit will operate frequently if the power is turned ON and OFF with a reference input applied, which may result in deterioration of the internal elements in the SERVOPACK.  
Use speed input references or position references to start and stop the servomotor.
- If the main circuit power supply (L1, L2, and L3) or the control power supply (L1C, L2C or 24V, 0V depending on the SERVOPACK model) is turned OFF before the servo OFF command is received, the stopping method for servomotor cannot be set by parameters.  
If turning OFF the main circuit power supply before the servo OFF command is received, the servomotor will be stopped by dynamic braking.  
If turning OFF the control power supply before the servo OFF command is received, the stopping method will vary with the SERVOPACK model. Two stopping methods are available.
  - Coasting  
Applicable models: SGD V-330A, 470A, 550A, 590A, 780A, 280D, 370D
  - Dynamic braking  
Applicable models: All SERVOPACKs other than those listed for coasting.
- If the servomotor must be stopped during operation by coasting rather than by dynamic braking when the main circuit power supply or the control power supply is OFF, arrange the sequence externally so the current will be cut off for wires U, V, and W.
- To minimize the coasting distance of the motor to come to a stop, the zero-speed stopping method is factory-set for alarms to which the zero-speed stop method is applicable. The DB stopping method may be more suitable than the zero-speed stopping method, however, depending on the application. Change the method to the DB stopping method as required by the application.  
For example, for multiple axes coupling operation (a twin-drive operation), machinery damage may result if a zero-speed stop alarm occurs for one of the coupled shafts and the other shaft stops by dynamic brake. In such cases, change the method to the DB stopping method.



### (1) Stopping Method for Servomotor After Servo OFF Command is Received

Use Pn001.0 to select the stopping method for the servomotor after the servo OFF command is received.

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

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

### (2) Stopping Method for Servomotor When an Alarm Occurs

There are two type of alarms (Gr.1 and Gr.2), depending on the stopping method when an alarm occurs.

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

The stopping method for the servomotor for a Gr.1 alarm is set to Pn001.0.

The stopping method for the servomotor for a Gr.2 alarm is set to Pn00B.1.

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

#### ■ Stopping Method for Servomotor for Gr.1 Alarms

The stopping method of the servomotor when a Gr.1 alarm occurs is the same as that for the servomotor after the servo OFF command is received.

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

### ■ Stopping Method for Servomotor for Gr.2 Alarms

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

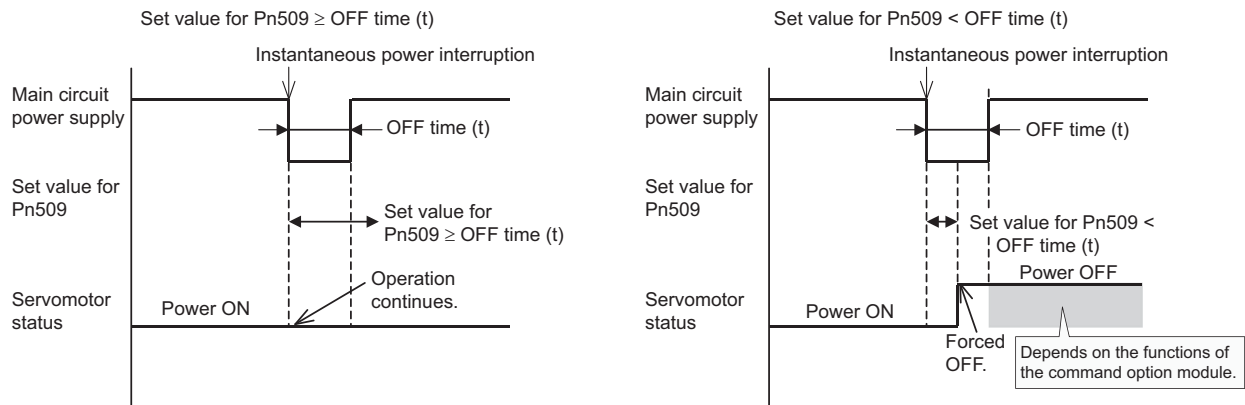
Note: The setting of Pn00B.1 is effective for position control and speed control. Pn00B.1 will be ignored for torque control and only the setting of Pn001.0 will be valid.

### 4.2.9 Instantaneous Power Interruption Settings

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

| Pn509 | Instantaneous Power Cut Hold Time |              |                 |              | Classification |        |
|-------|-----------------------------------|--------------|-----------------|--------------|----------------|--------|
|       |                                   |              | Speed           | Position     |                | Torque |
|       | Setting Range                     | Setting Unit | Factory Setting | When Enabled |                |        |
|       | 20 to 1000                        | 1 ms         | 20              | Immediately  | Setup          |        |

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



#### IMPORTANT

- The holding time of the control power supply for the 200 V SERVOPACK is approximately 100 ms, but the time of the control power supply for the 100 V SERVOPACKs is approximately 65 ms. If the control power supply makes control impossible during an instantaneous power interruption, the same operation will be performed as for normally turning OFF the power supply, and the setting of the parameter will be ignored.
- The holding time of the main circuit power supply varies with the output of the SERVOPACK. If the load on the servomotor is large and an undervoltage alarm (A.410) occurs, the parameter will be ignored.
- The holding time of the control power supply (24 VDC) for the 400 V SERVOPACKs depends on the capability of the power supply (not included). Check the power supply before using the application.

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

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

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

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

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



#### IMPORTANT

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

#### <Control Power Supply Restrictions>

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

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

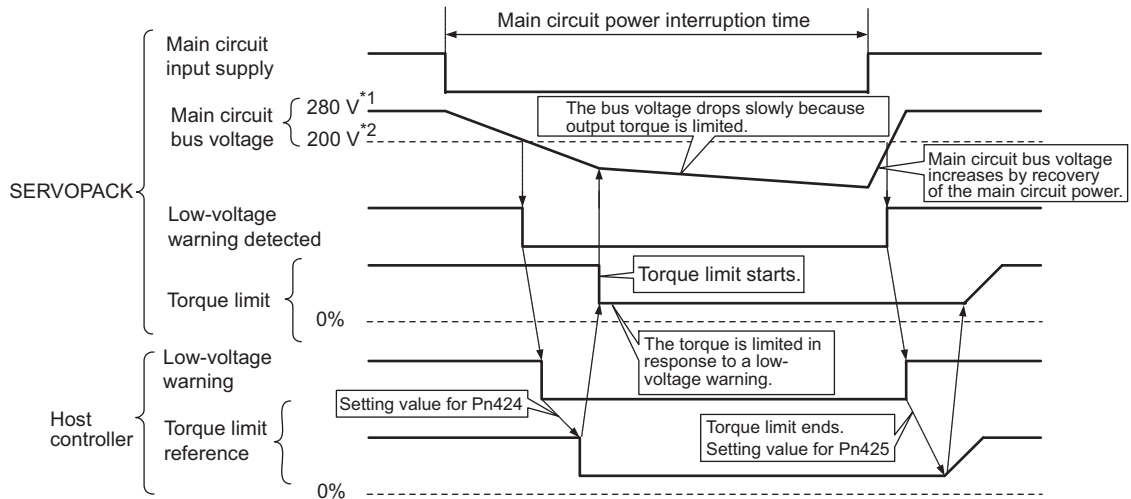
- Set the host controller and SERVOPACK torque limit so that a torque reference that exceeds the specified acceleration will not be output when the power supply for the main circuit is restored.
- Do not limit the torque to values lower than the holding torque for the vertical axis.
- This function controls torque within the range of the SERVOPACK's capability when the power is cut. It is not intended for use under all load and operating conditions. Use the actual device to set parameters while confirming correct operation.
- Setting the Instantaneous Power Cut Hold Time (P.509) lengthens the amount of time from when the power supply is turned OFF until the power actually stops flowing to the motor. Send the servo OFF command to stop flowing the power to the motor.

### (1) Execution Method

This function can be executed either with the host controller or independently with the SERVOPACK. Pn008.1 is used to specify whether the function is executed with the host controller or independently with the SERVOPACK.

#### ■ Execution with Host Controller (Pn008=n.□□1□)

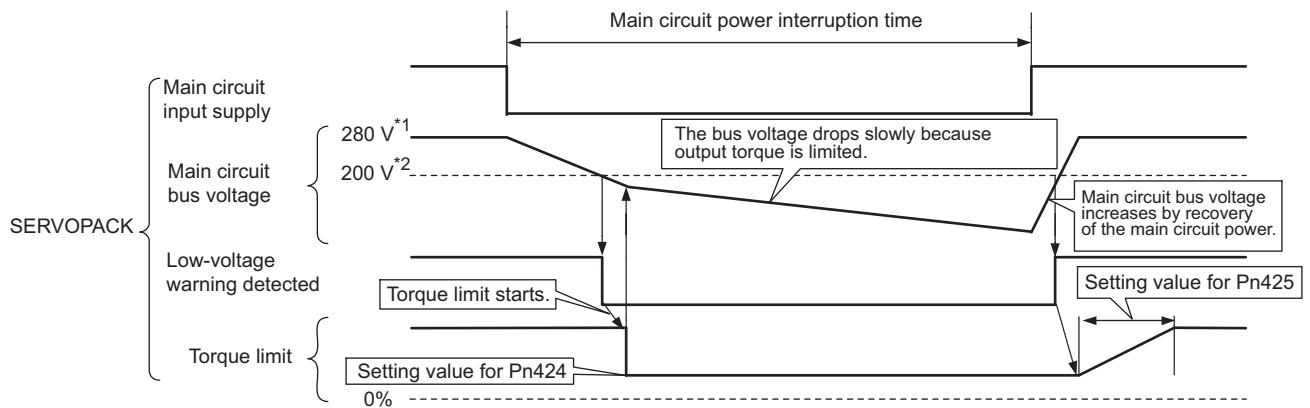
The host controller limits the torque in response to a low-voltage warning. The torque is no longer limited when the low-voltage warning is cleared.



\*1 560 V for 400 V power supply.  
\*2 400 V for 400 V power supply.

#### ■ Execution Independently with SERVOPACK (Pn008=n.□□2□)

The torque is limited in the SERVOPACK in response to a low-voltage warning. The SERVOPACK stops limiting the torque in the set time (Pn425) when the low-voltage warning is cleared.



\*1 560 V for 400 V power supply.  
\*2 400 V for 400 V power supply.

## (2) Related Parameters

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

|       |   |              |                 |              |                |
|-------|---|--------------|-----------------|--------------|----------------|
| Pn424 | Torque Limit at Main Circuit Voltage Drop <input type="checkbox"/> Speed <input type="checkbox"/> Position <input type="checkbox"/> Torque                  |              |                 |              | Classification |
|       | Setting Range   | Setting Unit | Factory Setting | When Enabled |                |
|       | 0 to 100  | 1% *         | 50              | Immediately  | Setup          |
| Pn425 | Release Time for Torque Limit at Main Circuit Voltage Drop <input type="checkbox"/> Speed <input type="checkbox"/> Position <input type="checkbox"/> Torque |              |                 |              | Classification |
|       | Setting Range   | Setting Unit | Factory Setting | When Enabled |                |
|       | 0 to 1000   | 1 ms         | 100             | Immediately  | Setup          |

\* The setting unit is a percentage of the rated torque.

|       |  |              |                 |              |                |
|-------|--|--------------|-----------------|--------------|----------------|
| Pn509 | Instantaneous Power Cut Hold Time <input type="checkbox"/> Speed <input type="checkbox"/> Position <input type="checkbox"/> Torque |              |                 |              | Classification |
|       | Setting Range  | Setting Unit | Factory Setting | When Enabled |                |
|       | 20 to 1000   | 1 ms         | 20              | Immediately  | Setup          |

Note: When using SEMI F47 function, set 1000 ms.

### 4.2.11 Setting Motor Overload Detection Level

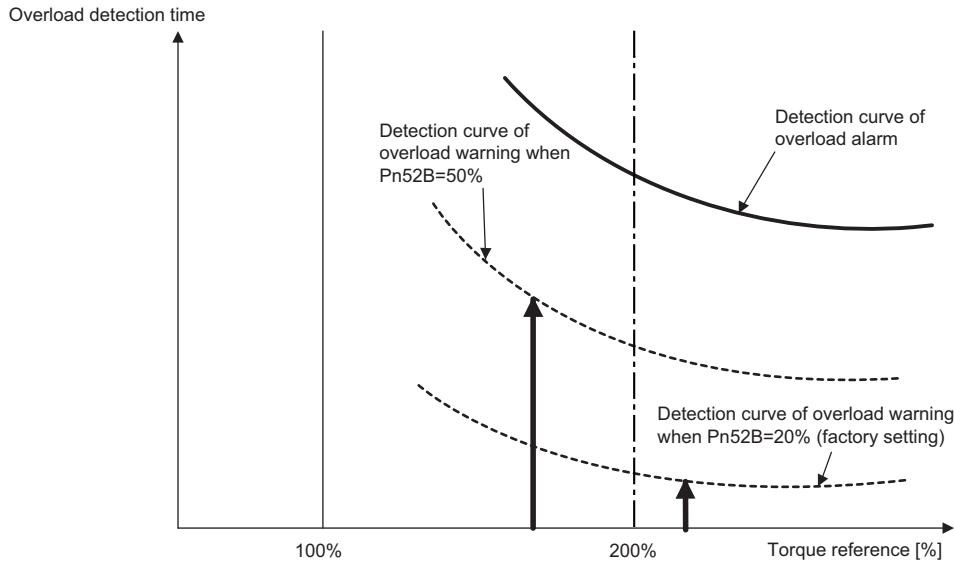
In this SERVOPACK, the detection timing of the overload warning (A.910) and overload (continuous overload) alarm (A.720) can be changed.

The overload characteristics and the detection level of the overload (instantaneous overload) alarm (A.710) cannot be changed.

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

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

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



Note: For details, refer to ●Overload Characteristics listed in the section for the relevant servomotor in the  $\Sigma V$  Series Product Catalog (KAEP S800000 42).

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

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

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

$$\text{Motor base current} \times \text{Derating of base current at detecting overload of motor (Pn52C)} = \text{Derated motor base current}$$

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

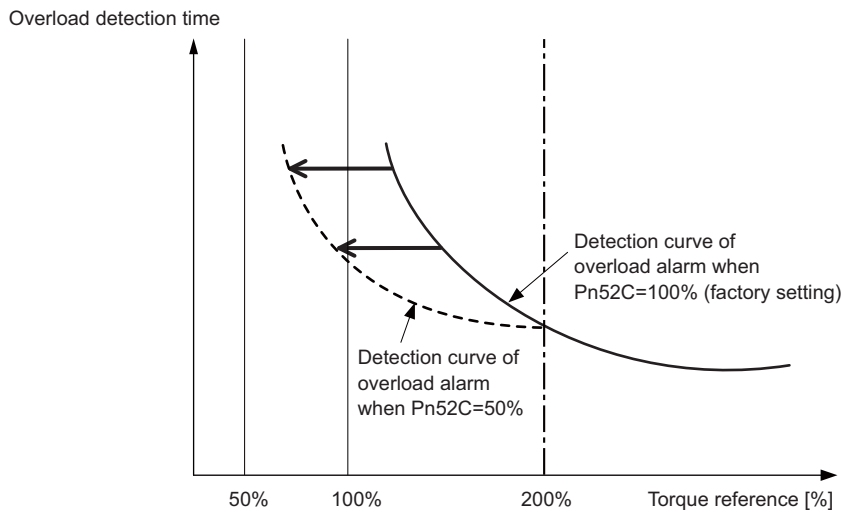
The following graph shows an example of the detection of an overload alarm when Pn52C is set to 50%. The calculation for the overload alarm of motors starts at 50% of the motor base current and then an overload alarm will be detected earlier.

Changing the setting of Pn52C will change the detection timing of the overload alarm, so the time required to detect the overload warning will also be changed.

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 (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 motor from overloading.



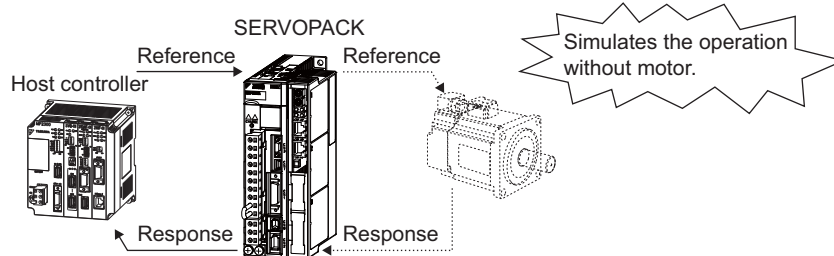
Note: For details, refer to ● *Overload Characteristics* listed in the section for the relevant servomotor in the *Σ-V Series Product Catalog (KAEP S800000 42)*.

| Pn52C | Derating of Base Current at Detecting Overload of Motor <input type="checkbox"/> Speed <input type="checkbox"/> Position <input type="checkbox"/> Torque <input type="checkbox"/> |              |                 |               | Classification |
|-------|---|--------------|-----------------|---------------|----------------|
|       | Setting Range   | Setting Unit | Factory Setting | When Enabled  |                |
|       | 10 to 100   | 1%           | 100             | After restart |                |



## 4.3 Test Without Motor Function

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



### 4.3.1 Related Parameters

The following parameters are used for the test without motor.

| Parameter | Meaning  | When Enabled  | Classification |
|-----------|--|---------------|----------------|
| n.□□□0    | Disables the test without motor. [Factory setting]                                     | After restart | Setup          |
| n.□□□1    | Enables the test without motor.  |               |                |
| n.□□0□    | Sets 13 bits as encoder resolution for the test without motor. [Factory setting]       |               |                |
| n.□□1□    | Sets 20 bits as encoder resolution for the test without motor.                         |               |                |
| n.□0□□    | Sets incremental encoder as encoder type for the test without motor. [Factory setting] |               |                |
| n.□1□□    | Sets absolute encoder* as encoder type for the test without motor.                     |               |                |

\* Absolute encoder is only for rotational servomotors. External encoders such as encoders for fully-closed loop control are used as incremental encoders regardless of the setting of Pn00C.2.

### 4.3.2 Limitations

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

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

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

| Fn No. | Contents  | Can be used or not  |                 |
|--------|---|---------------------|-----------------|
|        |   | Motor not connected | Motor connected |
| Fn000  | Alarm history display   | ○                   | ○               |
| Fn002  | JOG operation   | ○                   | ○               |
| Fn003  | Origin search   | ○                   | ○               |
| Fn004  | Program JOG operation   | ○                   | ○               |
| Fn005  | Initializing parameter settings   | ○                   | ○               |
| Fn006  | Clearing alarm history  | ○                   | ○               |
| Fn008  | Absolute encoder multi-turn reset and encoder alarm reset                               | ×                   | ○               |
| Fn00C  | Offset adjustment of analog monitor output  | ○                   | ○               |
| Fn00D  | Gain adjustment of analog monitor output  | ○                   | ○               |
| Fn00E  | Automatic offset-signal adjustment of motor current detection signal                    | ×                   | ○               |
| Fn00F  | Manual offset-signal adjustment of motor current detection signal                       | ×                   | ○               |
| Fn010  | Write prohibited setting  | ○                   | ○               |
| Fn011  | Servomotor model display  | ○                   | ○               |
| Fn012  | Software version display  | ○                   | ○               |
| Fn013  | Multi-turn limit value setting change when a multi-turn limit disagreement alarm occurs | ×                   | ○               |
| Fn014  | Resetting configuration error of option module  | ○                   | ○               |
| Fn01B  | Vibration detection level initialization  | ×                   | ×               |
| Fn01E  | Display of SERVOPACK and servomotor ID  | ○                   | ○               |
| Fn01F  | Display of servomotor ID in feedback option   | ○                   | ○               |
| Fn020  | Origin setting  | ×                   | ○               |
| Fn030  | Software reset  | ○                   | ○               |
| Fn200  | Tuning-less level setting   | ×                   | ×               |
| Fn201  | Advanced autotuning   | ×                   | ×               |
| Fn202  | Advanced autotuning by reference  | ×                   | ×               |
| Fn203  | One-parameter tuning  | ×                   | ×               |
| Fn204  | Anti-resonance control adjustment function  | ×                   | ×               |
| Fn205  | Vibration suppression function  | ×                   | ×               |
| Fn206  | EasyFFT   | ×                   | ×               |
| Fn207  | Online vibration monitor  | ×                   | ×               |

○: can be used

×: cannot be used

### 4.3.3 Digital Operator Display during Testing without Motor

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

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

(Example: Test without motor in progress)

| Display | Status  |
|---------|---|
| *RUN    | Power is supplied to the motor.                 |
| *BB     | Power to the motor is OFF.                      |
| *PT NT  | Forward or reverse run is prohibited.           |
| *P-OT   | Running in the forward direction is prohibited. |
| *N-OT   | Running in the reverse direction is prohibited. |
| *HBB    | In hard-wire base block (safety) state.         |

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

## 4.4 Limiting Torque

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

| Limiting Method                         | Description  | Reference Section   |
|---|--|---|
| Internal torque limit                   | Always limits torque by setting the parameter.   | 4.4.1   |
| External torque limit                   | Limits torque by input signal from the host controller.  | 4.4.2   |
| Torque limit with command option module | Limits torque by inputting a desired torque limit command to the command option module from the host controller. | Refer to the manual of the command option module to be connected. |

### 4.4.1 Internal Torque Limit

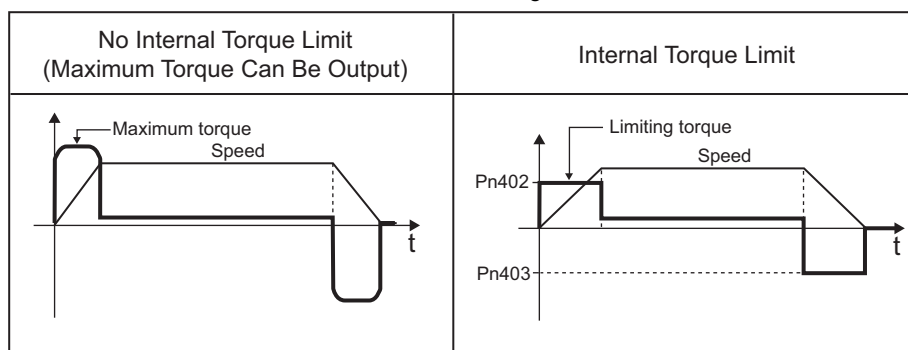
This function always limits maximum output torque by setting values of following parameters.

|              |  |              |                 |              |                |
|--------------|--|--------------|-----------------|--------------|----------------|
| <b>Pn402</b> | Forward Torque Limit <span style="float: right;">Speed <input type="checkbox"/> Position <input type="checkbox"/> Torque <input type="checkbox"/></span> |              |                 |              | Classification |
|              | Setting Range  | Setting Unit | Factory Setting | When Enabled |                |
|              | 0 to 800   | 1%           | 800             | Immediately  |                |
| <b>Pn403</b> | Reverse Torque Limit <span style="float: right;">Speed <input type="checkbox"/> Position <input type="checkbox"/> Torque <input type="checkbox"/></span> |              |                 |              | Classification |
|              | Setting Range  | Setting Unit | Factory Setting | When Enabled |                |
|              | 0 to 800   | 1%           | 800             | Immediately  |                |

The setting unit is a percentage of the rated torque.

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

Trace Waveform of SigmaWin+



Note: The waveform reverses in case of analog monitor (CN5) output.

## 4.4.2 External Torque Limit

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

### (1) Input Signals

| Type  | Signal Name | Connector Pin Number | Setting | Meaning                           | Limit value  |
|-------|-------------|----------------------|---------|-----------------------------------|--|
| Input | /P-CL       | Must be allocated    | ON      | Forward external torque limit ON  | The value set in Pn402 or Pn404 (whichever is smaller) |
|       |             |                      | OFF     | Forward external torque limit OFF | Pn402  |
| Input | /N-CL       | Must be allocated    | ON      | Reverse external torque limit ON  | The value set in Pn403 or Pn405 (whichever is smaller) |
|       |             |                      | OFF     | Reverse external torque limit OFF | Pn403  |

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

### (2) Related Parameters

Set the following parameters for external torque limit.

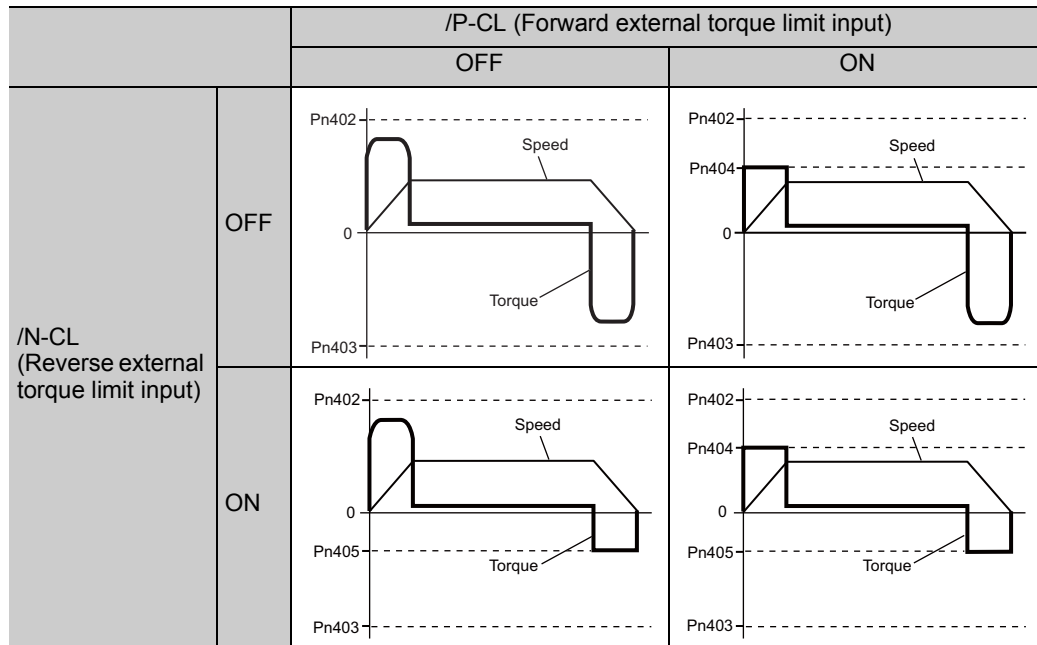
|              |  |              |                 |              |                |
|--------------|--|--------------|-----------------|--------------|----------------|
| <b>Pn404</b> | Forward External Torque Limit <span style="float: right;">[Speed] [Position] [Torque]</span> |              |                 |              | Classification |
|              | Setting Range  | Setting Unit | Factory Setting | When Enabled |                |
|              | 0 to 800   | 1%           | 100             | Immediately  | Setup          |
| <b>Pn405</b> | Reverse External Torque Limit <span style="float: right;">[Speed] [Position] [Torque]</span> |              |                 |              | 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.

### (3) Changes in Output Torque during External Torque Limiting

Changes in output torque when external torque limit is set to 800% are shown with the waveform of Un monitor or SigmaWin+.

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



Note: The waveform reverses in case of analog monitor (CN5) output.

### 4.4.3 Checking Output Torque Limiting during Operation

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

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

For the allocation method, refer to 3.3.2 *Output Signal Allocation*.

## 4.5 Absolute Encoders

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



**IMPORTANT**

The output range of rotational serial data for the  $\Sigma$ -V series absolute detection system differs from that for previous systems ( $\Sigma$ -series SGD/SGDA/SGDB). When an infinite length positioning system of the conventional type is to be configured with the  $\Sigma$ -V series, be sure to make the following system modification.

| Servomotor Model  | Resolution       | Output Range of Rotational Serial Data | Action when Limit Is Exceeded  |
|---|------------------|--|--|
| $\Sigma$ Series<br>SGD<br>SGDA<br>SGDB  | 12-bit<br>15-bit | -99999 to<br>+ 99999                   | <ul style="list-style-type: none"> <li>When the upper limit (+99999) is exceeded in the forward direction, the rotational serial data is 0.</li> <li>When the lower limit (-99999) is exceeded in the reverse direction, the rotational serial data is 0.</li> </ul>             |
| $\Sigma$ -II, $\Sigma$ -III, $\Sigma$ -V Series<br>SGDM<br>SGDH<br>SGDS<br>SGDV | 17-bit<br>20-bit | -32768 to<br>+ 32767                   | <ul style="list-style-type: none"> <li>When the upper limit (+32767) is exceeded in the forward direction, the rotational serial data is -32768.*</li> <li>When the lower limit (-32768) is exceeded in the reverse direction, the rotational serial data is +32767.*</li> </ul> |

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

### 4.5.1 Encoder Resolutions

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

| Servomotor Model                      | Encoder Resolution |
|---------------------------------------|--------------------|
| SGMPS                                 | 17-bit             |
| SGMAV / SGMJV / SGMGV / SGMSV / SGMCS | 20-bit             |

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

| Parameter    | Meaning | When Enabled  | Classification |
|--------------|---------|---------------|----------------|
| <b>Pn002</b> | n.□0□□  | After restart | Setup          |
|              | n.□1□□  |               |                |

The back-up battery is not required when using the absolute encoder as an incremental encoder.

### 4.5.2 Absolute Encoder Data Backup

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

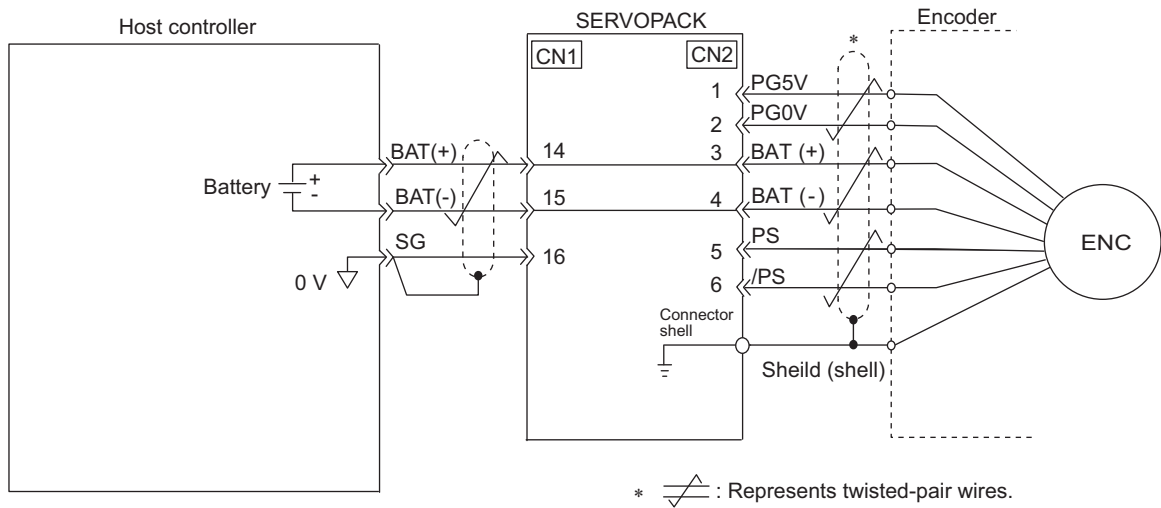
Install the battery in the host controller or the SERVOPACK.

⊘ PROHIBITED

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

#### ■ Installing the Battery at the Host Controller

Connect the battery to the host controller, referring the following diagram. Use an ER6VC3 battery (3.6 V, 2000 mAh: manufactured by Toshiba Battery Co., Ltd.) or an equivalent.





### 4.5.3 Battery Replacement

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

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

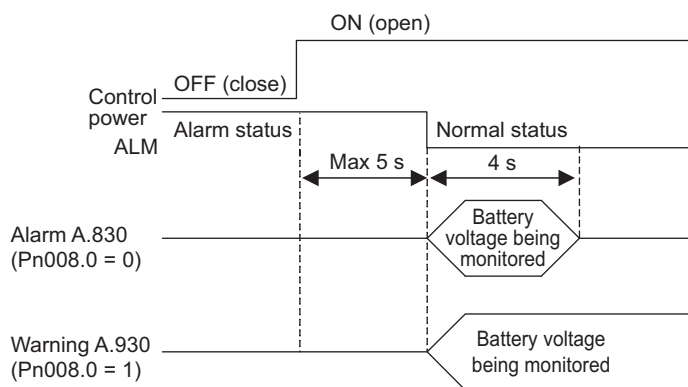
Use Pn008 to set either an alarm (A.830) or a warning (A.930).

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

- If Pn008.0 is set to 0, an ALM signal is sent for a maximum of 5 seconds, and then the battery voltage is checked for 4 seconds when the power is turned ON.

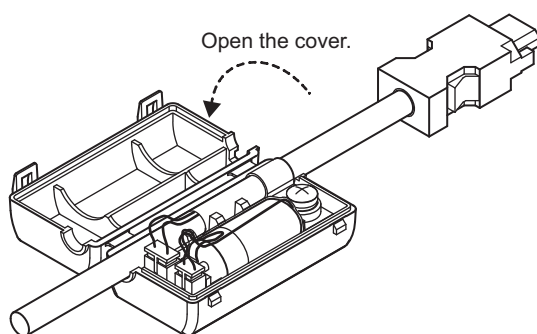
Note: After those initial 4 second, no alarm will be displayed even if the battery voltage drops to approximately 2.7 V.

- If Pn008.0 is set to 1, the battery voltage will constantly be monitored.

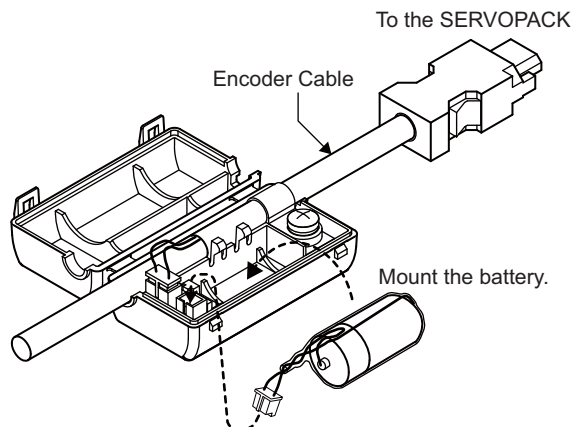


#### (1) Battery Replacement Procedure

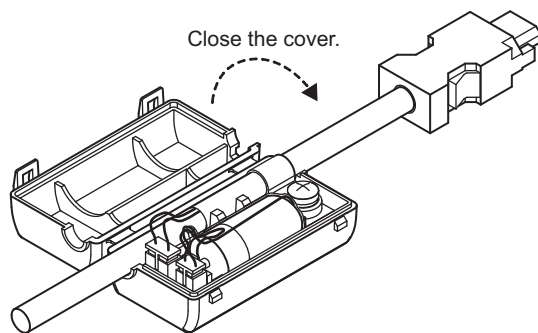
1. Turn ON only the SERVOPACK control power supply.
2. Open the battery case cover. (Example: cable with battery and connectors at both ends)



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



4. Close the battery case cover.



5. After replacing the battery, turn OFF the SERVOPACK power to cancel the absolute encoder battery error (A.830).
6. Turn ON the SERVOPACK power back again.
7. Check that the error display is cancelled and it operates without any problems.

**IMPORTANT**

Make sure the SERVOPACK's control power is on when replacing the battery or disconnecting the encoder cable.  
If the power is turned off, the data of the absolute encoder will be deleted.

## 4.5.4 Absolute Encoder Setup (Initialization)

### ⚠ CAUTION

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

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

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














Setup the absolute encoder with Fn008.

#### (1) Precautions on Setup

- Setup the encoder when the servomotor power is OFF.
- The encoder backup error (A.810) and the encoder checksum error (A.820) cannot be reset by using the SERVOPACK alarm reset. Be sure to perform setup using Fn008.
- Any other alarms that monitor the inside of the encoder (A.8□□) should be canceled by turning OFF the power, then canceling the alarm.

#### (2) Procedure for Setup

Follow the steps below to setup the absolute encoder.

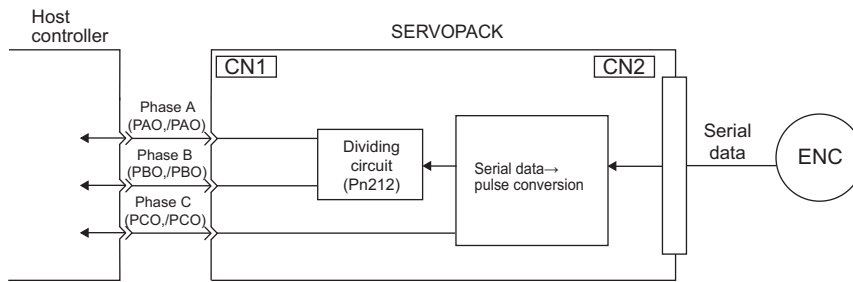
| Step | Display after Operation   | Keys   | Description   |
|------|---|--|---|
| 1    | <pre> BB      —FUNCTION— Fn006:AlmHist Clr Fn008:Mturn Clr Fn009:Ref Adj Fn00A:Vel Adj           </pre> | <br>  | Press the  key and select Fn008.   |
| 2    | <pre> BB Multiturn Clear PGCL1           </pre>   |   | Press the  key to view the execution display of Fn008.<br>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 status and reset. |
| 3    | <pre> BB Multiturn Clear PGCL5           </pre>   | <br>   | Keep pressing the  Key until “PGCL1” is changed to “PGCL5.”  |
| 4    | <pre> DONE Multiturn Clear PGCL5           </pre>   |   | Press the  Key to setup the absolute encoder. After completing the setup, “BB” in the status display changes to “DONE.”  |
| 5    | <pre> BB      —FUNCTION— Fn006:AlmHist Clr Fn008:Mturn Clr Fn009:Ref Adj Fn00A:Vel Adj           </pre> |   | Press the  Key to return to the display of the procedure 1.  |
| 6    | Turn OFF the power and then turn it ON again to make the setting valid.                                 |  |   |

### 4.5.5 Absolute Encoder 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 Signals

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



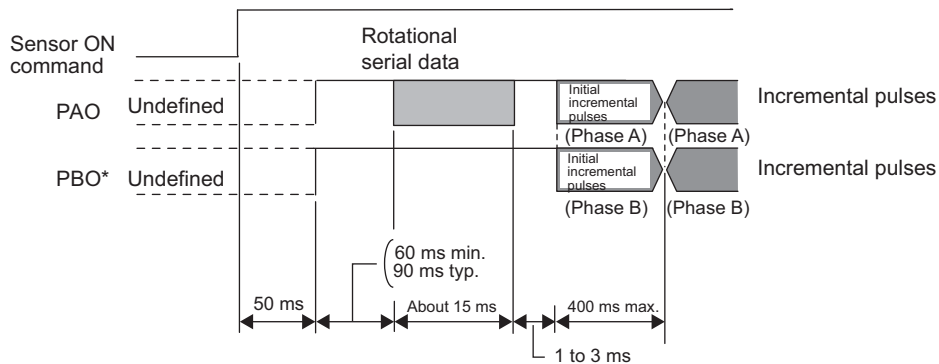
| Signal Name | Status            | Contents   |
|-------------|-------------------|--|
| PAO         | At initialization | Rotational serial data<br>Initial incremental pulses |
|             | Normal time       | Incremental pulses                                   |
| PBO         | At initialization | Initial incremental pulses                           |
|             | Normal time       | Incremental pulses                                   |
| PCO         | Always            | Origin pulses  |

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

#### (2) Absolute Encoder Transmission Sequence and Contents

##### ■ Absolute Encoder Transmission Sequence

1. Send the sensor ON command from the host controller.
2. After 100 ms, set the system to serial data reception-waiting-state. Clear the incremental pulse up/down counter to zero.
3. Receive eight characters of rotational serial data.
4. The system enters a normal incremental operation state about 400 ms after the last rotational serial data is received.



\* In case of reverse rotation mode (Pn000.0 = 1), the output polarity for PBO signal inverts.

Rotational serial data:

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

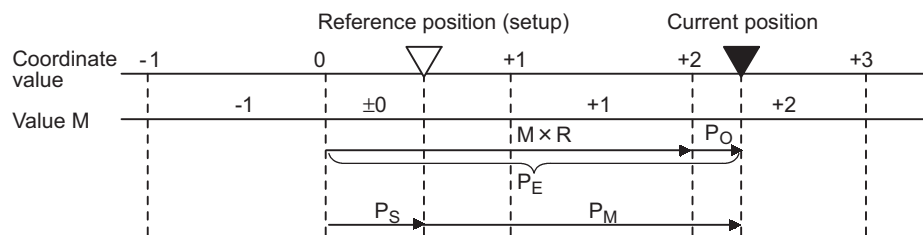
Initial incremental pulses:

Outputs pulses at the same pulse rate as when the motor shaft rotates from the origin to the current position at about  $1.215 \text{ min}^{-1}$  (for 20 bits when the encoder output pulses (Pn212) are at the factory setting).

When the encoder output pulses (Pn212) are not same as the factory setting, use the following formula.

$$\frac{6.528 \times 10^8}{2 \text{ (encoder resolution)} \times 2} \times \text{Pn212}$$

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



Final absolute data  $P_M$  is calculated by following formula.

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

$$P_S = M_S \times R + P_S'$$

$$P_M = P_E - P_S$$

| Signal | Meaning  |
|--------|--|
| $P_E$  | Current value read by encoder  |
| $M$    | Rotational 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  |
| $P_S'$ | Initial incremental pulses read at setup   |
| $P_M$  | Current value required for the user's system.  |
| $R$    | Number of pulses per encoder revolution (pulse count after dividing, value of Pn212) |

### (3) Rotational Data Specifications

The number of revolutions is output from PAO signal.

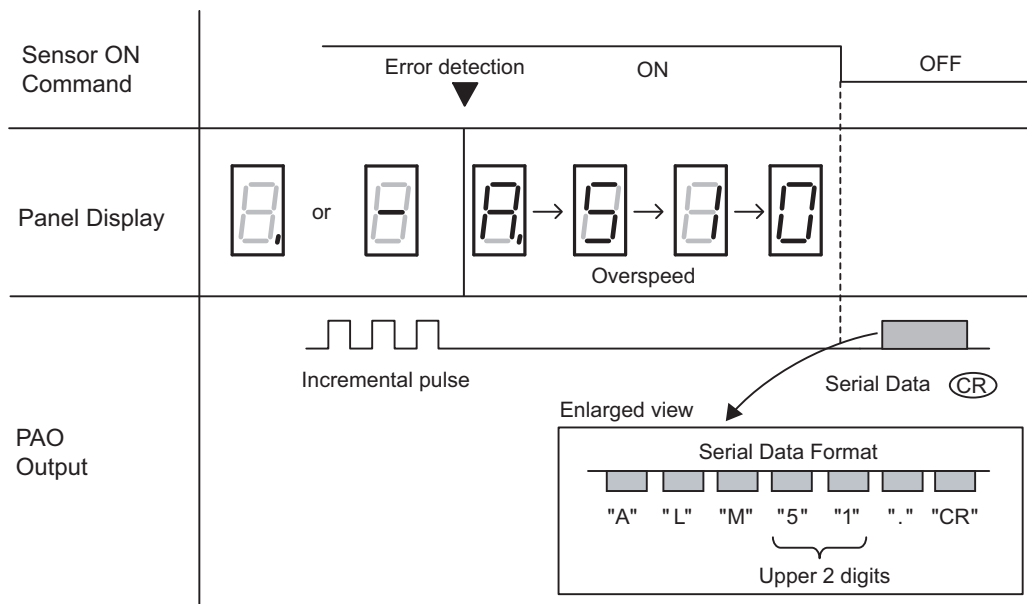
| Data Transfer Method | Start-stop Synchronization (ASYNC)   |
|----------------------|--|
| Baud rate            | 9600 bps   |
| Start bits           | 1 bit  |
| Stop bits            | 1 bit  |
| Parity               | Even   |
| Character code       | ASCII 7-bit code   |
| Data format          | 8 characters, as shown below.<br><div style="text-align: center;"> </div> <p>Note:</p> <ul style="list-style-type: none"> <li>• Data is "P+00000" (CR) or "P-00000" (CR) when the number of revolutions is zero.</li> <li>• The allowable range of the rotational serial data is "+32767" to "-32768." When the value is outside the allowable range, the data changes from "+32767" to "-32768" or from "-32768" to "+32767." When changing the multiturn limit, the range changes. For details, refer to 4.5.6 Multiturn Limit Setting.</li> </ul> |

### (4) Transferring Alarm Contents

If an absolute encoder is used, the contents of alarms detected by the SERVOPACK can be transmitted in serial data to the host controller from the PAO output when the sensor ON command is changed from ON to OFF.

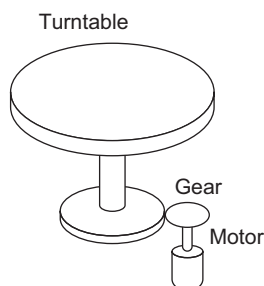
Note: Sensor ON command cannot be received while the servomotor power is ON.

An example of alarm contents output is shown below.



### 4.5.6 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.

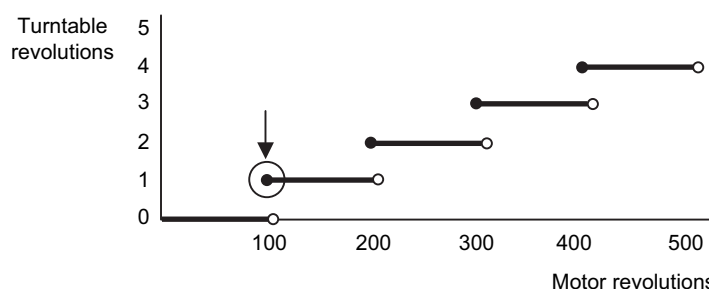
For a machine with a gear ratio of  $m:n$ , as shown above, the lowest common multiple (LCM) of  $m:n$  minus 1 will be the setting for the multiturn limit setting (Pn205).

Multiturn limit setting (Pn205) = LCM-1

The case in which the relationship between the turntable revolutions and motor revolutions is  $m = 3$  and  $n = 300$  is shown in the following graph.

The lowest common multiple of  $m$  and  $n$  is 300.

$$\text{Pn205} = 300 - 1 = 299$$



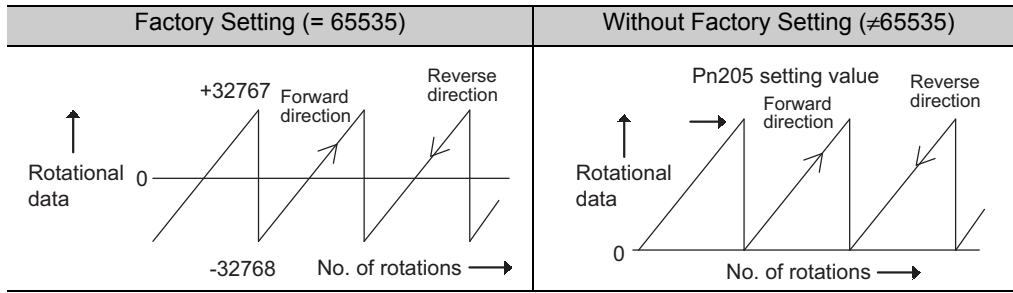
|              |  |              |                 |               |                |
|--------------|--|--------------|-----------------|---------------|----------------|
| <b>Pn205</b> | Multiturn Limit <span style="float: right;">Speed   Position   Torque</span> |              |                 |               | Classification |
|              | Setting Range  | Setting Unit | Factory Setting | When Enabled  |                |
|              | 0 to 65535   | 1 Rev        | 65535           | After restart |                |

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.



Note:

A direct-drive servomotor with the standard specifications has a single-turn absolute encoder mounted. It is possible to directly connect the servomotor and the load, and so absolute values can be created at the load by using only the angle of the motor shaft even when constructing an absolute value detection system. Therefore, encoder multiturn data is not required.

### 4.5.7 Multi-turn Limit Disagreement (A.CC0)

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

| Alarm Display | Alarm Name                    | Alarm Code Output | Meaning   |
|---------------|-------------------------------|-------------------|---|
| A.CC0         | Multi-turn Limit Disagreement | OFF (H)           | Different multi-turn limits have been set in the encoder and SERVOPACK. |

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

| Step | Display after Operation   | Keys            | Description   |
|------|---|-----------------|---|
| 1    | A. CC0 —FUNCTION—<br>Fn012: Soft Ver<br>Fn013: MturnLmSet<br>Fn014: Opt Init<br>Fn01B: Vibl_vl Init | MODE/SET<br>▲ ▼ | Press the  Key to select Fn013.   |
| 2    | A. CC0<br>Multiturn Limit<br>Set<br>Start : [DATA]<br>Return : [SET]                                | DATA            | Press the  Key to display the execution display of Fn013.<br>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.  |
| 4    | DONE<br>Multiturn Limit<br>Set<br>Start : [DATA]<br>Return : [SET]                                  | DATA            | Press the  Key to set the multi-turn limit value. When the setting is completed, “BB” in the status display changes to “DONE.”<br>Note: If the  Key is pressed instead of the  Key, the multi-turn limit value will not be reset and the display will return to the display of procedure 1. |
| 5    | A. CC0 —FUNCTION—<br>Fn012: Soft Ver<br>Fn013: MturnLmSet<br>Fn014: Opt Init<br>Fn01B: Vibl_vl Init | MODE/SET        | Press the  Key to return to the display the procedure 1.  |
| 6    | Turn OFF the power and then turn it ON again to make the setting valid.                             |                 |   |

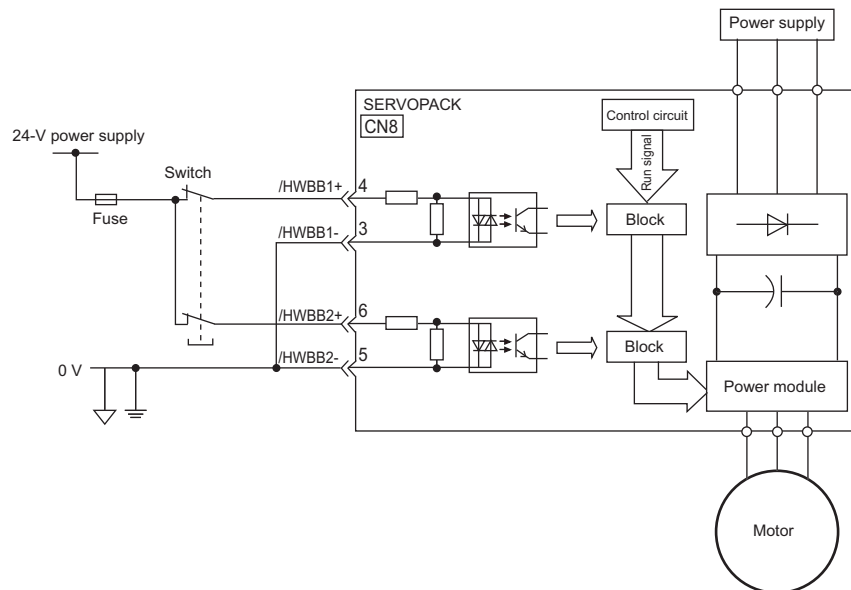


## 4.6 Safety Function

The safety function is incorporated in the SERVOPACK to reduce the risk associated with the machine by protecting workers from injury and by securing safe machine operation. Especially when working in hazardous areas inside the safeguard, as for machine maintenance, it can be used to avoid adverse machine movement.

### 4.6.1 Hard Wire Base Block (HWBB) Function

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



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

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

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

#### (1) Risk Assessment

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

EN954-1 Category3  
IEC61508-1 to 4 SIL2

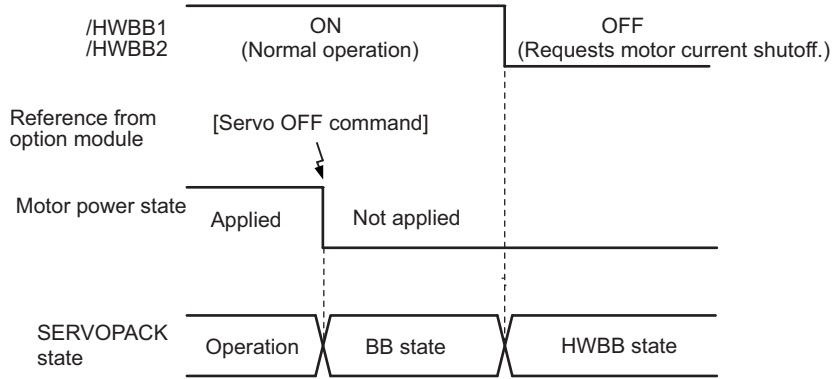
The following risks can be estimated even if the HWBB function is used. These risks must be included in the risk assessment.

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

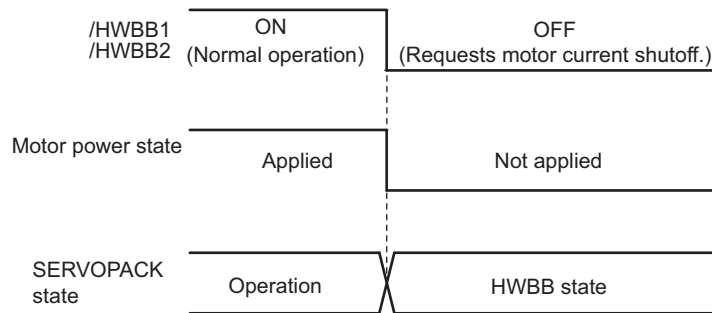
## (2) Hard Wire Base Block (HWBB) State

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

The HWBB function operates after the servomotor power is turned OFF.

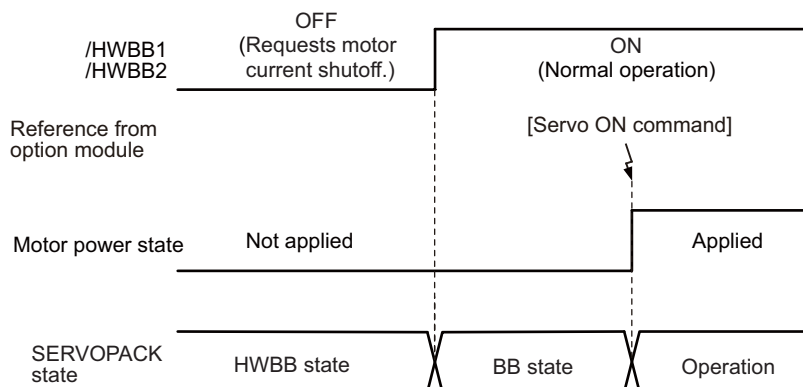


The HWBB function operates during servomotor operation.



### (3) Resetting the HWBB State

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



To return to normal operation status:

If a servo ON command has been sent while the SERVOPACK is in the HWBB status,

1. Turn on both /HWBB1 and /HWBB2 signals.
2. Send any command other than a servo ON command, such as a servo OFF command, to change the status of the SERVOPACK from a hard wire base block (HWBB) to a base block (BB).
3. Resend a servo ON command.

Note: Even if the servomotor power is turned OFF by turning OFF the main circuit power, the HWBB status is retained until a servo OFF command is input.

### (4) Error Detection in HWBB Signal


If only the /HWBB1 or /HWBB2 signal is input, an A.Eb1 alarm (Safety Function Signal Input Timing Error) will occur unless the other signal is input within 10 seconds. This makes it possible to detect failures, such as disconnection of the HWBB signals.

#### ⚠ CAUTION

- The A.Eb1 alarm (Safety Function Signal Input Timing Error) is not related to the safety function. Keep this in mind in the system design.

### (5) Connection Example and Specifications of Input Signals (HWBB Signals)

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



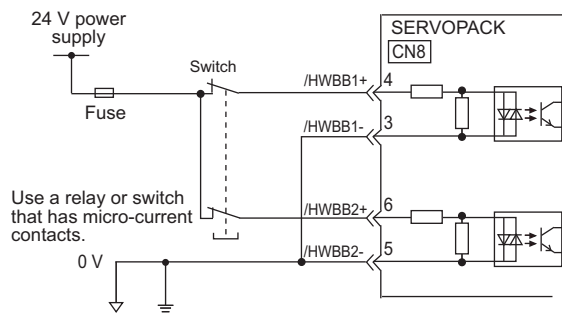
**IMPORTANT**

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

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

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

#### ■ Connection Example



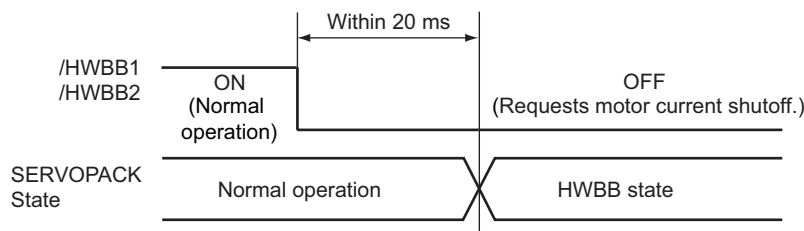
#### ■ Specifications

| Type  | Signal Name | Pin Number | State | Meaning                         |
|-------|-------------|------------|-------|---------------------------------|
| Input | /HWBB1      | CN8-4      | ON    | Does not use the HWBB function. |
|       |             | CN8-3      | OFF   | Uses the HWBB function.         |
|       | /HWBB2      | CN8-6      | ON    | Does not use the HWBB function. |
|       |             | CN8-5      | OFF   | Uses the HWBB function.         |

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

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

If the HWBB function is requested by turning OFF the /HWBB1 and /HWBB2 input signals on the two channels, power supply to the motor will be turned OFF within 20 ms (see below).



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

## (6) Operation with Utility Functions

The HWBB function works while the SERVOPACK operates in utility function mode.

If any of the following utility functions is being used with the /HWBB1 and /HWBB2 signals turned OFF, the SERVOPACK cannot be operated by turning ON the /HWBB1 and /HWBB2 signals. Cancel the utility function first, and then set the SERVOPACK to the utility function mode again and restart operation.

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

## (7) Brake Signal (/BK)

When the /HWBB1 or /HWBB2 signal is OFF and the HWBB function operates, the brake signal (/BK) will turn OFF. At that time, Pn506 (Brake Reference - Servo OFF Delay Time) will be disabled. Therefore, the servomotor may be moved by external force until the actual brake becomes effective after the brake signal (/BK) turns OFF.

Note: The brake signal output is not related to safety functions. Be sure to design the system so that the system will not be put into danger if the brake signal fails in the HWBB state. Moreover, if a servomotor with a brake is used, keep in mind that the brake for the servomotor is used only to stop the motor from moving and it cannot be used to brake the motor.

## (8) Dynamic Brake

If the dynamic brake is enabled in Pn001.0 (stopping method after servomotor power OFF), the servomotor will come to a stop under the control of the dynamic brake when the HWBB function works while the /HWBB1 or /HWBB2 signal is OFF.

Note: The dynamic brake is not related to safety function. Be sure to design the system so that the system will not be put into danger if the servomotor coasts to a stop in the HWBB state. Usually, use a sequence in which the HWBB state occurs after the servomotor is stopped using a command.

### CAUTION

If the application frequently uses the HWBB function, do not use the dynamic brake to stop the motor, or otherwise element deterioration in the SERVOPACK may result. Use a sequence in which the HWBB state occurs after the servomotor has come to a stop.

### 4.6.2 External Device Monitor (EDM1)

The external device monitor (EDM1) functions to monitor failures in the HWBB function. Connect the monitor to feedback signals to the safety unit. The relation of the EDM1, /HWBB1, and /HWBB2 signals is shown below.

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

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

#### ■ Failure Detection Signal for EDM1 Signal

Detection of failures in the EDM1 circuit can be checked using the status of the 3 signals in the table. Failures can be detected if the failure status can be confirmed, such as when the power supply is turned ON.




### WARNING

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

### (1) Connection Example and Specifications of EDM1 Output Signal

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



**IMPORTANT**

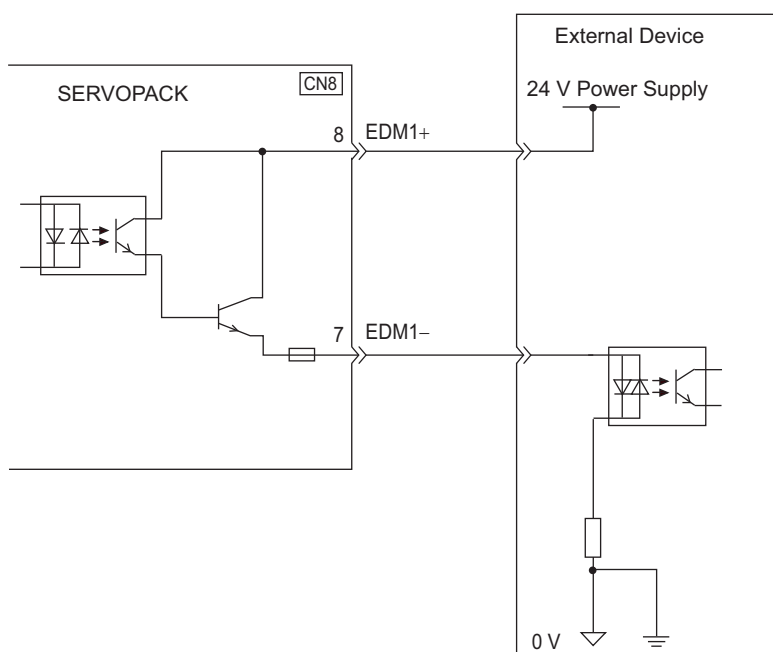
For safety function signal connections, the input signal is the 0V common and the output signal is the source output. This is opposite to other signals described in this manual. To avoid confusion, the ON and OFF status of signals for safety functions are defined as follows:

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

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

#### ■ Connection Example

EDM1 output signal is used for source circuit.



#### ■ Specifications

| Type   | Signal Name | Pin No.        | State | Meaning   |
|--------|-------------|----------------|-------|---|
| Output | EDM1        | CN8-8<br>CN8-7 | ON    | The /HWBB1 signal and /HWBB2 signal are both operating normally.  |
|        |             |                | OFF   | Both the /HWBB1 signal and /HWBB2 signal are not operating normally or either of the two is not operating normally. |

Electrical characteristics of EDM1 signal are as follows.

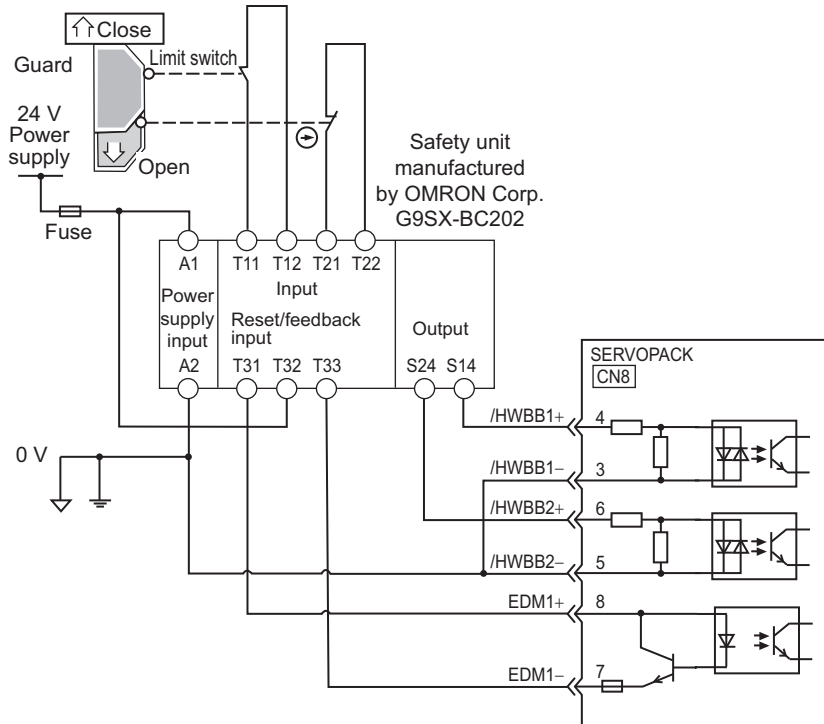
| Items                      | Characteristics | Remarks   |
|----------------------------|-----------------|---|
| Maximum Allowable Voltage  | 30 VDC          | —   |
| Maximum Current            | 50 mADC         | —   |
| Maximum Voltage Drop at ON | 1.0 V           | Voltage between EDM1+ to EDM1-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

### 4.6.3 Application Example of Safety Functions

An example of using safety functions is shown below.

#### (1) Connection Example

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



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

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

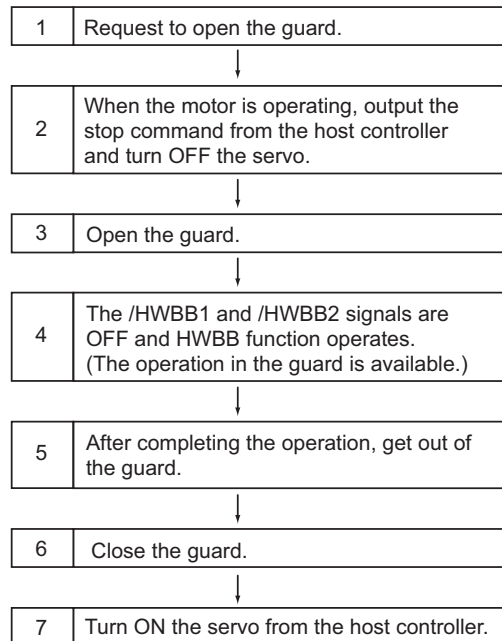
#### (2) Failure Detection Method

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

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



## (3) Usage Example

**4.6.4** Confirming Safety Functions

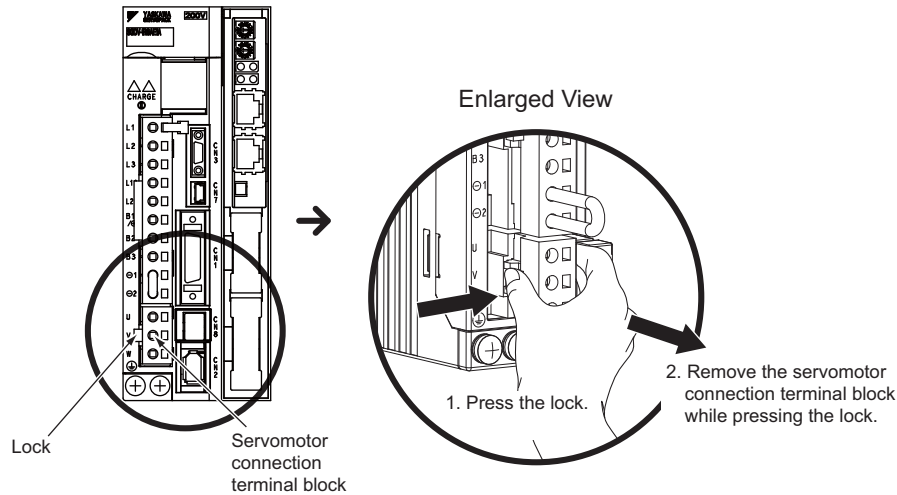
When starting the equipment or replacing the SERVOPACK for maintenance, be sure to conduct the following confirmation test on the HWBB function after wiring.

- When the /HWBB1 and/or /HWBB2 signals turn OFF, check that the digital operator displays “Hbb” and that the motor does not operate.
- Check the ON/OFF states of the /HWBB1 and /HWBB2 signals with bits 0 and 1 of Un015.  
→ If the ON/OFF states of the signals do not coincide with the display, an error in the external device, disconnection or short-circuiting of the external wiring, or a failure in the SERVOPACK must be considered. Find the cause and correct the problem.
- Check with the display of the feedback circuit input of the connected device to confirm that the EDM1 signal is OFF while in normal operation.

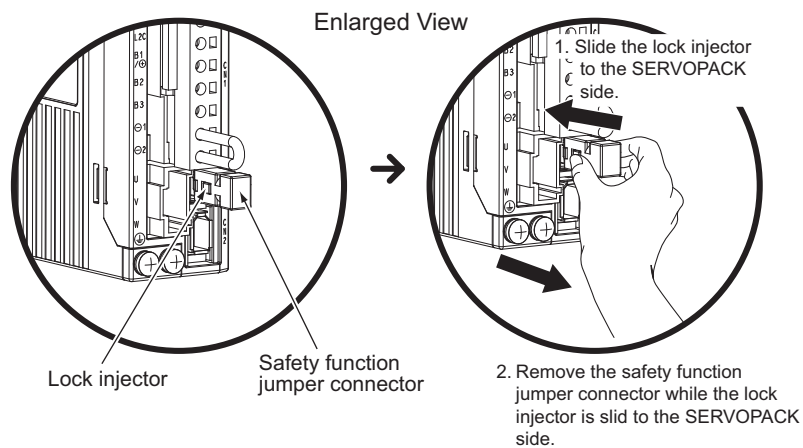
## 4.6.5 Connecting a Safety Device

Connect a safety device using the following procedure.

1. Remove the servomotor connection terminal block while pressing the lock.



2. Slide the lock injector of the safety function jumper connector to the SERVOPACK side to unlock and remove the safety function jumper connector.



Note: The safety function jumper connector may be damaged if it is removed without being unlocking.

3. Connect a safety device to CN8.

Note: When not using the safety function, use the SERVOPACK with the safety function jumper connector (JZSP-CVH05-E provided as an accessory) inserted in CN8. If the SERVOPACK is used without the jumper connector inserted into CN8, no current will flow to the motor and no torque will be output. In this case, "Hbb" will be displayed on the Digital Operator.

### 4.6.6 Precautions for Safety Functions

#### WARNING

- To check that the HWBB function satisfies the safety requirements of the system, be sure to conduct a risk assessment of the system.  
Incorrect use of the machine may cause injury.
- The motor rotates if there is external force (e.g., gravity in a vertical axis) when the HWBB function is operating. Therefore, use an appropriate device independently, such as a mechanical brake, that satisfies safety requirements.  
Incorrect use of the machine may cause injury.
- While the HWBB function is operating, the motor may rotate within an electric angle of 180° or less as a result of a SERVOPACK failure. Use the HWBB function for applications only after checking that the rotation of the motor will not result in a dangerous condition.  
Incorrect use of the machine may cause injury.
- The dynamic brake and the brake signal are not related to safety functions. Be sure to design the system that these failures will not cause a dangerous condition when the HWBB function operates.  
Incorrect use of the machine may cause injury.
- The SERVOPACK with its signals for a safety function must be connected to a device that meets safety standards.  
Incorrect use of the machine may cause injury.
- If the HWBB function is used for an emergency stop, turn OFF the power supply to the motor with independent electric or mechanical parts.  
Incorrect use of the machine may cause injury.
- The HWBB function does not turn OFF the power supply to the SERVOPACK or electrically isolate the SERVOPACK. When maintaining the SERVOPACK, be sure to turn OFF the power supply to the SERVOPACK independently.  
Failure to observe this warning may cause an electric shock.

## Adjustments

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## 5.1 Adjustments and Basic Adjustment Procedure

This section describes adjustments and the basic adjustment procedure.

### 5.1.1 Adjustments

Tuning is performed to optimize the responsiveness of the SERVOPACK.

The responsiveness is determined by the servo gain that is set in the SERVOPACK.

The servo gain is set using a combination of parameters. These parameters influence each other. Therefore, the servo gain must be set considering the balance between the set values.

Generally, the responsiveness of a machine with high rigidity can be improved by increasing the servo gain. If the servo gain of a machine with low rigidity is increased, however, the machine will vibrate and the responsiveness may not be improved.

It is possible to suppress the vibration with a variety of vibration suppression functions in the SERVOPACK.

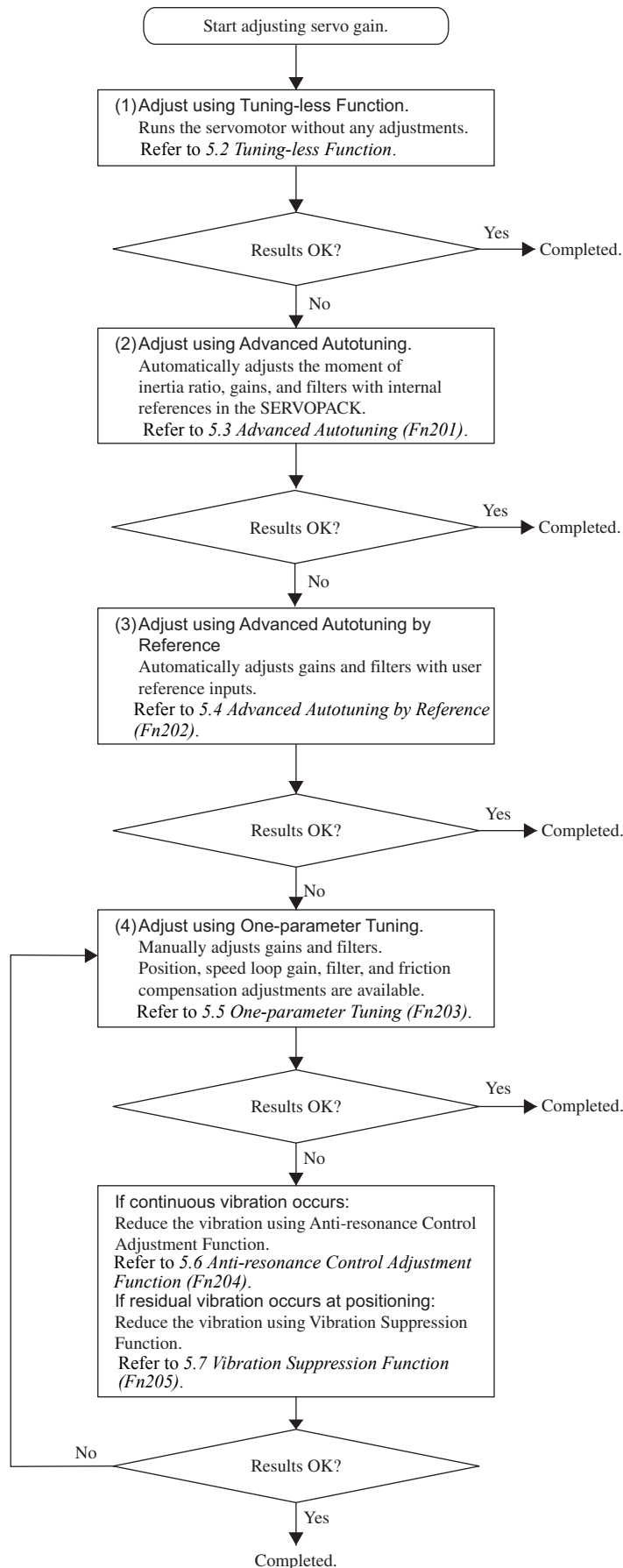
The servo gains are factory-set to stable values. The following utility function can be used to adjust the servo gain to increase the responsiveness of the machine in accordance with the actual conditions. With this function, these parameters will be adjusted automatically and the need to adjust them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

This section describes the following utility adjustment functions.

| Utility Function for Adjustment                    | Outline  | Applicable Control Mode |
|--|--|-------------------------|
| Tuning-less Level 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. <ul style="list-style-type: none"> <li>• Moment of inertia ratio</li> <li>• Gains (position loop gain, speed loop gain, etc.)</li> <li>• Filters (torque reference filter, notch filter)</li> <li>• Friction compensation</li> <li>• Anti-resonance control adjustment function</li> <li>• Vibration suppression</li> </ul> | 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. <ul style="list-style-type: none"> <li>• Gains (position loop gain, speed loop gain, etc.)</li> <li>• Filters (torque reference filter, notch filter)</li> <li>• Friction compensation</li> <li>• Anti-resonance control adjustment function</li> <li>• Vibration suppression</li> </ul>             | Position                |
| One-parameter Tuning (Fn203)                       | The following parameters are automatically adjusted with the position, speed reference input from the host controller while the machine is in operation. <ul style="list-style-type: none"> <li>• Gains (position loop gain, speed loop gain, etc.)</li> <li>• Filters (torque reference filter, notch filter)</li> <li>• Friction compensation</li> <li>• Anti-resonance control adjustment function</li> </ul>                                       | 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                |

## 5.1.2 Basic Adjustment Procedure

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



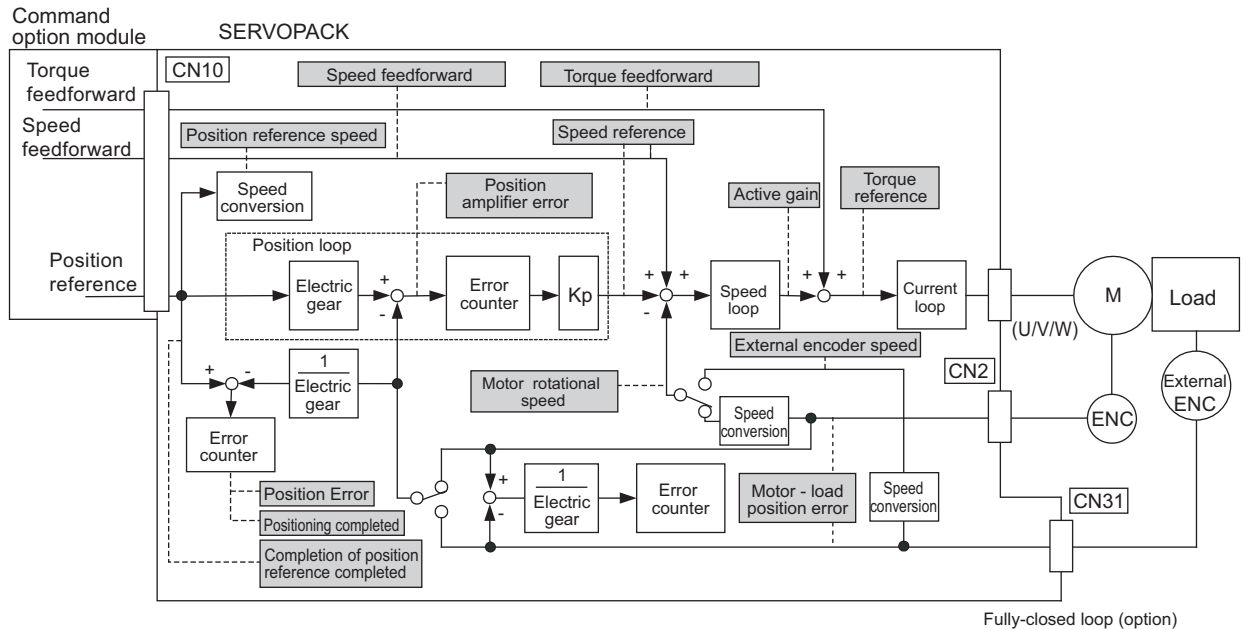
### 5.1.3 Monitoring Analog Signals

Check the operating status and signal waveform when adjusting the servo gain. Connect a measuring instrument, such as a memory recorder, to connector CN5 on the SERVOPACK to monitor analog signal waveform.

The settings and parameters for monitoring analog signals are described in the following sections.

#### (1) Monitor Signal

The analog signals that can be monitored are shaded in the following diagram.



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

| Parameter      | Description    |                                  |  |   |
|----------------|----------------|----------------------------------|--|---|
|                | Monitor Signal | Measurement Gain                 | Remarks  |   |
| Pn006<br>Pn007 | n.□□00         | Motor speed                      | 1 V/1000 min <sup>-1</sup> *                                 | Pn007 Factory Setting                           |
|                | n.□□01         | Speed reference                  | 1 V/1000 min <sup>-1</sup> *                                 | —   |
|                | n.□□02         | Torque reference                 | 1 V/100% rated torque  | Pn006 Factory Setting                           |
|                | n.□□03         | Position error                   | 0.05 V/reference unit  | 0 V at speed/torque control                     |
|                | n.□□04         | Position amplifier error         | 0.05 V/encoder pulse unit                                    | Position error after electronic gear conversion |
|                | n.□□05         | Position reference speed         | 1 V/1000 min <sup>-1</sup> *                                 | —   |
|                | n.□□06         | Reserved                         | —  | —   |
|                | n.□□07         | Motor-load position error        | 0.01 V/reference unit  | —   |
|                | n.□□08         | Positioning completed            | Positioning completed: 5 V<br>Positioning not completed: 0 V | —   |
|                | n.□□09         | Speed feedforward                | 1 V/1000 min <sup>-1</sup> *                                 | —   |
|                | n.□□0A         | Torque feedforward               | 1 V/100% rated torque  | —   |
|                | n.□□0B         | Active gain                      | 1 st gain: 1 V<br>2 nd gain: 2 V                             | —   |
|                | n.□□0C         | Completion of position reference | Completed: 5 V<br>Not completed: 0 V                         | —   |
|                | n.□□0D         | External encoder speed           | 1 V/1000 min <sup>-1</sup>                                   | Value at motor shaft                            |

\* When using an SGMCS direct-drive servomotor, the motor speed will be automatically set to 1 V/100 min<sup>-1</sup>.



**(2) Setting Monitor Factor**

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

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

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

**(3) Related Parameters**

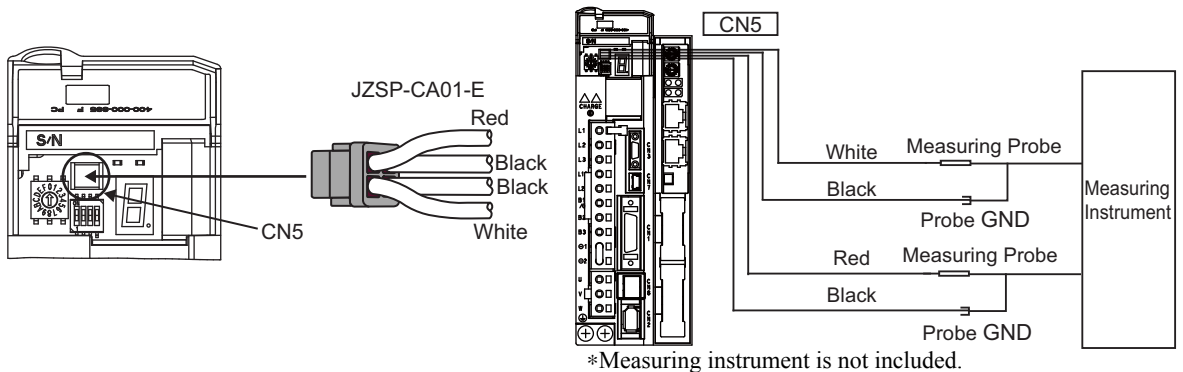
Use the following parameters to change the monitor factor and the offset.

|              |  |              |                 |              |                |
|--------------|--|--------------|-----------------|--------------|----------------|
| <b>Pn550</b> | Analog Monitor 1 Offset Voltage <span style="float:right">Speed Position Torque</span>   |              |                 |              | Classification |
|              | Setting Range  | Setting Unit | Factory Setting | When Enabled |                |
|              | -10000 to 10000  | 0.1 V        | 0               | Immediately  | Setup          |
| <b>Pn551</b> | Analog Monitor 2 Offset Voltage <span style="float:right">Speed Position Torque</span>   |              |                 |              | Classification |
|              | Setting Range  | Setting Unit | Factory Setting | When Enabled |                |
|              | -10000 to 10000  | 0.1 V        | 0               | Immediately  | Setup          |
| <b>Pn552</b> | Analog Monitor Magnification (×1) <span style="float:right">Speed Position Torque</span> |              |                 |              | Classification |
|              | Setting Range  | Setting Unit | Factory Setting | When Enabled |                |
|              | -10000 to 10000  | 0.01 times   | 100             | Immediately  | Setup          |
| <b>Pn553</b> | Analog Monitor Magnification (×1) <span style="float:right">Speed Position Torque</span> |              |                 |              | Classification |
|              | Setting Range  | Setting Unit | Factory Setting | When Enabled |                |
|              | -10000 to 10000  | 0.01 times   | 100             | Immediately  | Setup          |

### (4) Connector CN5 for Analog Monitor

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

#### ■ Connection Example



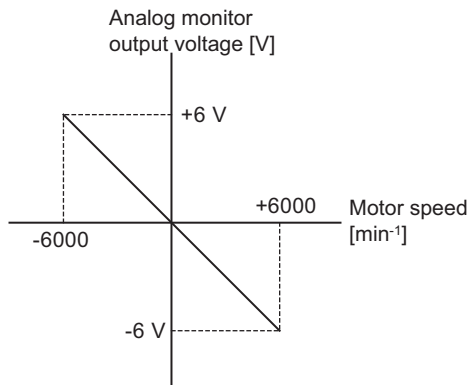
| Line Color      | Signal Name      | Factory Setting                           |
|-----------------|------------------|---|
| White           | Analog monitor 1 | Torque reference: 1 V/100% rated torque   |
| Red             | Analog monitor 2 | Motor speed: 1 V/1000 min <sup>-1</sup> * |
| Black (2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

\* When using an SGMCS direct-drive servomotor, the motor speed will be automatically set to 1 V/100 min<sup>-1</sup>.

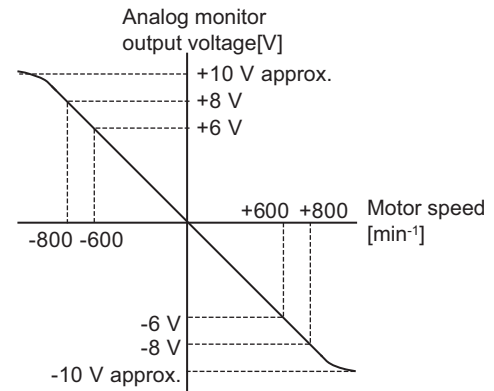
#### <Example>

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

When multiplier is set to × 1:



When multiplier is set to × 10:



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

### 5.1.4 Safety Precautions on Adjustment of Servo Gains

#### CAUTION

- If adjusting the servo gains, observe the following precautions.
  - Do not touch the rotating section of the motor while the servomotor power is ON.
  - Before starting the servomotor, make sure that the emergency-stop circuit works correctly.
  - Make sure that a trial run has been performed without any trouble.
  - Install a safety brake on the machine.

Yaskawa recommends that the following protective functions of the SERVOPACK are set to the correct settings before starting to adjust the servo gains.

#### (1) Overtravel Function

Set the overtravel function. For details on how to set the overtravel function, refer to 4.2.3 *Overtravel*.

#### (2) Torque Limit

Calculate the torque required to operate the machine. Set the torque limits so that the output torque will not be greater than required. Setting the torque limits can reduce the amount of shock applied to the machine in collisions and other cases.

If the torque is set below the level of torque required to operate the machine, overshooting or vibration may occur.

#### (3) Excessive Position Error Alarm Level

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

For the optimum setting, the servomotor will be stopped after the error occurs if the servomotor performs unpredictably after receiving a reference.

The position error is the difference between the position reference and the actual position. The position error can be calculated from the position loop gain (Pn102) and the motor speed with the following equation.

$$\text{Position Error} = \frac{\text{Motor Speed} [\text{min}^{-1}]}{60} \times \frac{\text{Encoder Resolution}^{*1}}{\text{Pn102} (1/\text{s})^{*2}}$$

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

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

\*1. Refer to 4.2.4 *Electronic Gear*.

\*2. To check the setting for Pn102, set the parameter display to “Displays all parameters” (Pn00B.0 = 1).

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

If the servomotor’s maximum number of rotations is  $6000 \text{ min}^{-1}$  and Pn102 equals 40 with an encoder resolution of 20-bit (1048576), the setting of Pn520 is calculated as shown with the following equation.

$$\begin{aligned} \text{Pn520} &= \frac{6000}{60} \times \frac{1048576}{40} \times 2 \\ &= 2621440 \times 2 \\ &= 5242880 \text{ (The factor setting of Pn520)} \end{aligned}$$

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 raise the allowable level of the position errors.

### ■ Related Parameter

| Pn520 | Excessive Position Error Alarm Level <span style="float: right;">Position</span> |                  |                 |              | Classification |
|-------|--|------------------|-----------------|--------------|----------------|
|       | Setting Range  | Setting Unit     | Factory Setting | When Enabled |                |
|       | 1 to 1073741823<br>( $2^{30}-1$ )  | 1 reference unit | 5242880         | Immediately  | Setup          |

### ■ Related Alarm

| Alarm Display | Alarm Name                    | Alarm Contents   |
|---------------|-------------------------------|--|
| A.d00         | Position Error Pulse Overflow | This alarm occurs when the number of position error pulses exceeds the value set for parameter Pn520 (Excessive Position Error Alarm Level). |

#### (4) Vibration Detection Function

Set the vibration detection function to an appropriate value. For details on how to set the vibration detection function, refer to *6.16 Vibration Detection Level Initialization (Fn01B)*.

#### (5) Excessive Position Error Alarm Level at Servo ON

If the servomotor is turned ON when position error pulses remain, the servomotor will return to the home position and reset the number of pulses to zero. To prevent the servomotor from moving suddenly, select the appropriate level for the Excessive Position Error alarm when the servomotor is ON to restrict operation of the servomotor.

### ■ Related Parameters

| Pn526 | Excessive Position Error Alarm Level at Servo ON <span style="float: right;">Position</span> |                  |                 |              | Classification |
|-------|--|------------------|-----------------|--------------|----------------|
|       | Setting Range  | Setting Unit     | Factory Setting | When Enabled |                |
|       | 1 to 1073741823<br>( $2^{30}-1$ )  | 1 reference unit | 5242880         | Immediately  | Setup          |

| Pn528 | Excessive Position Error Warning Level at Servo ON <span style="float: right;">Position</span> |              |                 |              | Classification |
|-------|--|--------------|-----------------|--------------|----------------|
|       | Setting Range  | Setting Unit | Factory Setting | When Enabled |                |
|       | 10 to 100  | 1%           | 100             | Immediately  | Setup          |

| Pn529 | Speed Limit Level at Servo ON <span style="float: right;">Position</span> |                     |                 |              | Classification |
|-------|---|---------------------|-----------------|--------------|----------------|
|       | Setting Range   | Setting Unit        | Factory Setting | When Enabled |                |
|       | 0 to 10000  | 1 min <sup>-1</sup> | 10000           | Immediately  | Setup          |

### ■ Related Alarm

| Alarm Display | Alarm Name   | Alarm Contents   |
|---------------|--|--|
| A.d01         | Position Error Pulse Overflow Alarm at Servo ON                | Occurs if the servo ON command is received when the number of position error pulses is greater than the set value of Pn526.  |
| A.d02         | Position Error Pulse Overflow Alarm by Speed Limit at Servo ON | After a position error pulse has been input, Pn529 limits the speed if the servo ON command is received. If Pn529 limits the speed in such a state, this alarm occurs when the position references are input and the number of position error pulses exceeds the value set for parameter Pn520 (Excessive Position Error Alarm Level). |

When an alarm occurs, refer to *9 Troubleshooting* and take the corrective actions.

## 5.2 Tuning-less Function

The tuning-less function is enabled in the factory settings. Do not disable this function for normal applications. If resonance is generated or excessive vibration occurs during position control, refer to *5.2.2 Tuning-less Levels Setting (Fn200) Procedure* and reduce the set value of Pn170.2 for the tuning-less adjustment level and the set value in Pn170.3 for the tuning-less load level.

### CAUTION

- The tuning-less function is enabled in the factory settings. A sound may be heard for a moment when the servomotor power is turned ON for the first time after the SERVOPACK is mounted to the machine. This sound does not indicate any problems; it means that the automatic notch filter was set. The sound will not be heard from the next time the servomotor power is turned ON. For details on the automatic notch filter, refer to (3) *Automatically Setting the Notch Filter* on the next page.
- Set the mode to 2 in Fn200 if a 13-bit encoder is used with the load moment of inertia ratio set to x10 or higher.
- The servomotor may vibrate if the load moment of inertia ratio exceeds the allowable moment of inertia of the servomotor.  
If vibration occurs, set the mode to 2 in Fn200 or lower the adjustment level.

### 5.2.1 Tuning-less Function

The tuning-less function obtains a stable response without adjustment regardless of the type of machine or changes in the load.

#### (1) Enabling/Disabling Tuning-less Function

The following parameter is used to enable or disable the tuning-less function.

| Parameter | Meaning | When Enabled  | Classification  |   |
|-----------|---------|---------------|---|---|
| Pn170     | n.□□□0  | After restart | Setup   |   |
|           | n.□□□1  |               |   | Disables tuning-less function.                  |
|           | n.□□0□  |               |   | Enables tuning-less function. [Factory setting] |
|           | n.□□1□  |               |   | Used as speed control. [Factory setting]        |
|           |         |               | 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.

| Control Function                                   | Availability                         | Remarks  |
|--|--------------------------------------|--|
| Vibration detection level initialization (Fn01B)   | Available                            |  |
| Advanced autotuning (Fn201)                        | Available<br>(Some conditions apply) | <ul style="list-style-type: none"> <li>• This function can be used when the moment of inertia is calculated.</li> <li>• While this function is being used, the tuning-less function cannot be used temporarily.</li> </ul> |
| 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 temporarily.  |
| Friction compensation                              | Not available                        |  |
| Gain switching                                     | Not available                        |  |
| Offline Moment of Inertia Setting *                | Not available                        |  |

| Control Function      | Availability | Remarks   |
|-----------------------|--------------|---|
| Mechanical analysis * | Available    | While this function is being used, the tuning-less function cannot be used temporarily. |

\* Operate using SigmaWin+.

### (3) Automatically Setting the Notch Filter

Usually, set this function to Auto Setting. (The notch filter is factory-set to Auto Setting.)

If this function is set to Auto Setting, vibration will be detected automatically and the notch filter will be set.

Set this function to Not Auto Setting only if you do not change the notch filter setting before executing tuning-less function.

| Parameter    | Meaning | When Enabled  | Classification        |
|--------------|---------|---|-----------------------|
| <b>Pn460</b> | n.□0□□  | Does not set the 2nd notch filter automatically.              | Immediately<br>Tuning |
|              | n.□1□□  | Sets the 2nd notch filter automatically.<br>[Factory setting] |                       |

### (4) Tuning-less Level Settings

Two tuning-less levels are available: the tuning-less adjustment level and tuning-less load level. Both level can be set in the Fn200 utility function and in the Pn170 parameter.

#### ■ Tuning-less Adjustment Level

The servo gain can be adjusted between rigidity level 4 (high gain) and rigidity level 0 (low gain) by changing the tuning-less adjustment level with the utility function and parameter settings.

##### a) By using the utility function

To change the setting, refer to 5.2.2 *Tuning-less Levels Setting (Fn200) Procedure*.

| Tuning Level | Meaning                            |
|--------------|------------------------------------|
| Level 0      | Rigidity level 0                   |
| Level 1      | Rigidity level 1                   |
| Level 2      | Rigidity level 2                   |
| Level 3      | Rigidity level 3                   |
| Level 4      | Rigidity level 4 [Factory setting] |

##### b) By using the parameter

| Parameter    | Meaning | When Enabled | Classification |
|--------------|---------|--------------|----------------|
| <b>Pn170</b> | n.□0□□  | Immediately  | Setup          |
|              | n.□1□□  |              |                |
|              | n.□2□□  |              |                |
|              | n.□3□□  |              |                |
|              | n.□4□□  |              |                |

### ■ Tuning-less Load Level

The servo gain can be adjusted by using the utility function and parameter settings to change the load level in accordance with the size of the load.

a) By using the utility function

To change the setting, refer to *5.2.2 Tuning-less Levels Setting (Fn200) Procedure*.

| Load Level | Meaning                              |
|------------|--------------------------------------|
| Mode 0     | Load level: Low                      |
| Mode 1     | Load level: Medium [Factory setting] |
| Mode 2     | Low level: High                      |

b) By using by the parameter

| Parameter    | Meaning | When Enabled                                  | Classification |       |
|--------------|---------|---|----------------|-------|
| <b>Pn170</b> | n.0□□□  | Load level: Low (Mode 0)                      | Immediately    | Setup |
|              | n.1□□□  | Load level: Medium (Mode 1) [Factory setting] |                |       |
|              | n.2□□□  | Low level: High (Mode 2)                      |                |       |

## 5.2.2 Tuning-less Levels Setting (Fn200) Procedure

### CAUTION

To ensure safety, perform tuning-less function in a state where the SERVOPACK can come to an emergency stop at anytime.

The following procedure is used for setting the tuning-less levels.

Setting tuning-less Levels is performed from the digital operator (optional), or SigmaWin+.

The operating procedure from the Digital Operator is described here.



















For the basic operation of the digital operator, refer to *Σ-V series User's Manual, Operation of Digital Operator* (SIEP S800000 55).

### (1) Before Performing Tuning-less Function





Check the following settings before performing the tuning-less function, or otherwise “NO-OP” will be displayed during the tuning-less operation.

- The tuning-less function must be enabled. (Pn170.0 = 1)
- The write prohibited setting (Fn010) must not be set.

### (2) Operating Procedure with Digital Operator

| Step | Display after Operation  | Keys   | Operation  |
|------|--|--|--|
| 1    | <pre> RUN      -FUNCTION- Fn080: Pole Detect Fn200: TuneLvl Set Fn201: AAT Fn202: Ref-AAT           </pre>         | <br>  | Press the  Key to view the main menu for the utility function mode.<br>Use the  or  Key to move through the list, select Fn200.   |
| 2    | <pre> RUN      -TuneLvlSet- Mode=1           </pre>  |   | Press the  Key to display the tuning-less mode setting screen.<br>Notes:<br>If the display does not switch and “NO-OP” is displayed, the write prohibited setting is set in Fn010. Change the setting in Fn010 and press the key again after enabling writing. <ul style="list-style-type: none"> <li>• 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.</li> <li>• If a high-frequency noise is heard, press the  Key and change to the mode setting to 0.</li> <li>• The tuning mode can be also changed in Pn170.3.</li> </ul> |
| 3    | <pre> RUN      -TuneLvlSet- Level=4           </pre>   |   | Press the  Key to display the tuning level setting screen.  |
| 4    | <pre> RUN      -TuneLvlSet- Level=4 NF2           </pre> <p style="text-align: center;">↑<br/>2nd notch filter</p> |  <br> | Press the  or  Key to select the tuning level. Select the tuning level from 0 to 4. The larger the value, the higher the gain is and the better response performance will be. (The factory setting is 4.)<br>Notes: <ul style="list-style-type: none"> <li>• Vibration may occur if the tuning level is too high. Lower the tuning level if vibration occurs.</li> <li>• If a high-frequency noise is heard, press the  Key to automatically set a notch filter for the vibration frequency.</li> <li>• The tuning level can be also changed in Pn170.2.</li> </ul>   |



| Step | Display after Operation                                | Keys  | Operation  |
|------|--|---|--|
| 5    | <pre> RUN  --TuneLv1Set-- Level = 4 </pre>             |  | Press the  Key. "DONE" will blink on the status display for approx. 2 s and then "RUN" will be displayed. The settings will be saved in the SERVO-PACK. |
| 6    | <pre> RUN  --FUNCTION-- Fn030 Fn200 Fn201 Fn202 </pre> |  | Press the  Key to complete the tuning-less operation. The screen in step 1 will appear again.   |

Note: If the gain level is changed, the automatically set notch filter will be canceled. If vibration occurs, however, the notch filter will be set again.

### (3) Alarm and Corrective Actions

The autotuning alarm (A.521) will occur if resonance is generated or excessive vibration occurs during position control.

#### ■ Resonance Sound

Take one of the following actions to correct the problem.

- Reduce the setting of the tuning adjustment level or load level.
- Reduce the setting of Pn170.3 or Pn170.2.

#### ■ Excessive Vibration during Position Control

Take one of the following actions to correct the problem.

- Increase the setting of the tuning load level or reduce the setting of the tuning adjustment level.
- 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 setting 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. 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                       | Pn100     | ○                                | ○        | ○  |
|   | 2nd Speed Loop Gain                   | Pn104     | ○                                | ○        | ○  |
|   | Speed Loop Integral Time Constant     | Pn101     | ×                                | ○        | ○  |
|   | 2nd Speed Loop Integral Time Constant | Pn105     | ×                                | ○        | ○  |
|   | Position Loop Gain                    | Pn102     | ×                                | ○        | ○  |
|   | 2nd position Loop Gain                | Pn106     | ×                                | ○        | ○  |
|   | Moment of Inertia Ratio               | Pn103     | ○                                | ○        | ○  |
| Advanced Control                            | Friction Compensation Switch          | Pn408.3   | ×                                | ×        | ×  |
|   | Anti-resonance Control Switch         | Pn160.0   | ×                                | ×        | ×  |
| Gain Switching                              | Gain Switching Switch                 | Pn139.0   | ×                                | ×        | ×  |

Note: ○: Available  
×: Not available

## 5.3 Advanced Autotuning (Fn201)

This section describes the adjustments with advanced autotuning.



### IMPORTANT

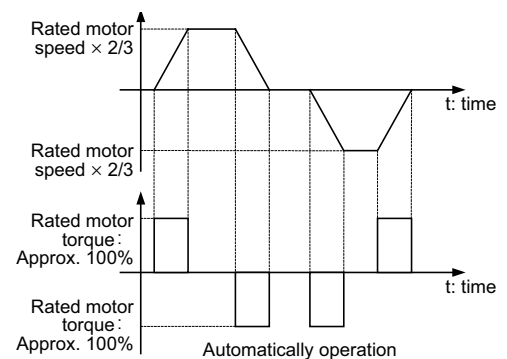
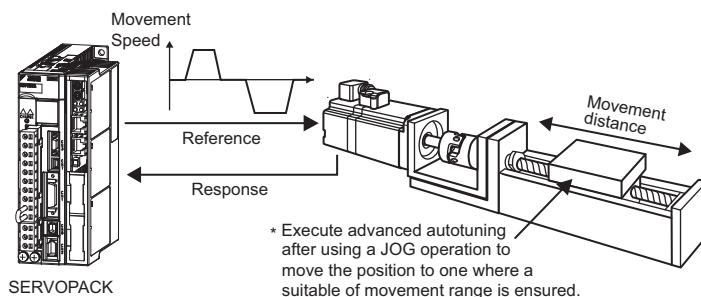
- Advanced autotuning starts adjustments based on the set speed loop gain (Pn100). Therefore, precise adjustments cannot be made if there is vibration when starting adjustments. In this case, make adjustments after setting a fully stable gain using one-parameter tuning (Fn203).
- Before performing advanced 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 operation conditions, such as the machine load or drive system, are changed by resetting Jcalc to ON to calculate the load moment of inertia after advanced autotuning, then change the related parameters to disable any values that were adjusted before performing advanced autotuning once again. If advanced autotuning is performed without changing the parameters, machine vibration may occur, resulting in damage to the machine.
  - Pn00B.0 = 1 (Displays all parameters.)
  - Pn140.0 = 0 (Does not use model following control.)
  - Pn160.0 = 0 (Does not use anti-resonance control.)
  - Pn408 = n.00□0 (Does not use friction compensation, 1st notch filter, or 2nd notch filter.)

### 5.3.1 Advanced Autotuning

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

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

- Motor speed: Rated motor speed  $\times 2/3$
- Acceleration torque: Approximately 100% of rated motor torque  
The acceleration torque varies with the influence of the load moment of inertia ratio (Pn103), machine friction, and external disturbance.
- Movement distance: The travel distance can be set freely. The distance is factory-set to a value equivalent to 3 motor rotations.  
For an SGMCS direct drive servomotor, the distance is factory-set to a value equivalent to 0.3 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 5.3.3 *Related Parameters* for parameters used for adjustments.



## CAUTION

- Because advanced autotuning adjusts the SERVOPACK during automatic operation, vibration or overshooting may occur. To ensure safety, perform advanced autotuning in a state where the SERVOPACK can come to an emergency stop at any time.

### (1) Before Performing Advanced Autotuning

Check the following settings before performing advanced autotuning.

- A message (NO-OP) indicating that no operations are possible will be displayed, if all of the following conditions are not met.
  - The main circuit power supply must be ON.
  - The servomotor power must be OFF.
  - The forward run prohibited (P-OT) and the reverse run prohibited (N-OT) signals must not be in an overtravel state.
  - Torque control must not be selected.
  - Automatic gain switching must be disabled.
  - Gain setting 2 must not be selected.
  - Test without motor function must not be enabled. (Pn00C.0 = 0)
  - All alarms and warning must be cleared.
  - The hardwire base block (HWBB) must be disabled.
- Observe the following condition to ensure operation.
  - The write prohibited setting (Fn010) must not be set.

Note: 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)

### (2) When Advanced Autotuning Cannot be Performed

Advanced autotuning cannot be performed normally under the following conditions. If any of the following conditions exists, perform advanced autotuning by reference or one-parameter tuning.

Refer to 5.4 *Advanced Autotuning by Reference (Fn202)* and 5.5 *One-parameter Tuning (Fn203)* for details.

- The machine system can work only in a single direction.
- The operating range is within 0.5 rotations (Also for SGMCS direct drive motors, the operating range is within 0.05 rotations).

### (3) When Advanced Autotuning Cannot be Adjusted

Advanced autotuning may not be performed normally under the following conditions. If the result of autotuning is not satisfactory, perform advanced autotuning by reference or one-parameter tuning.

Refer to 5.4 *Advanced Autotuning by Reference (Fn202)* and 5.5 *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 load is low and vibration occurs when positioning is performed.
- The position integration function is used.
- P control operation (proportional control) is performed.

Note: If a setting is made for calculating the moment of inertia, an error will result when P control operation is 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.

|   |   |
|---|---|
| <br><b>IMPORTANT</b> | <ul style="list-style-type: none"> <li>• Advanced autotuning makes adjustments based on the positioning completed width (Pn522). If the SERVOPACK is operated in position control, 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, use the factory settings.</li> <li>• Unless the positioning completed signal (/COIN) is turned ON within approximately 3 seconds after positioning has been completed, "WAITING" will blink. Furthermore, unless the positioning completed signal (/COIN) is turned ON within approximately 10 seconds, "Error" will blink for 2 seconds and tuning will be aborted.</li> </ul> |
|---|---|

Change only the overshoot detection level (Pn561) to finely adjust the without changing the positioning completed width (Pn522). Because Pn561 is set by default to 100%, the allowable amount of overshooting is the same amount as that for the positioning completed width.

When Pn561 is set to 0%, the amount of overshooting can be adjusted to prevent any overshooting in the positioning completed width. If the setting of Pn561 is changed, however, the positioning time may be extended.

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


### 5.3.2 Advanced Autotuning Procedure

The following procedure is used for advanced autotuning.









Advanced autotuning is performed from the Digital Operator (option) or SigmaWin+.











The operating procedure from the Digital Operator is described here.

















For the basic operations of the Digital Operator, refer to the *Σ-V series User's Manual, Operation of Digital Operator* (SIEP S800000 55).

|   |
|---|
|  <b>CAUTION</b>  |
| <ul style="list-style-type: none"> <li>• 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.</li> </ul> |

#### (1) Operating Procedure

| Step | Display after Operation   | Keys   | Operation   |
|------|---|--|---|
| 1    | <pre> BB      — FUNCTION — Fn200: TuneLvl Set Fn201: AAT Fn202: Ref-AAT Fn203: OnePrmTun                     </pre>         | <br>  | <p>Press the  Key to view the main menu for the utility function mode.</p> <p>Use the  or  Key to move through the list, select Fn201.</p> |
| 2    | <pre> — Status Display BB      Advanced AT Jcalc=ON Mode=2 Type=2 Stroke=+00800000 (0003. 0) rev                     </pre> |   | <p>Press the  Key to display the initial setting screen for advanced autotuning.</p> <p>If the display does not switch and "NO-OP" is displayed, take corrective actions after checking the settings given in 5.3.1 (1) <i>Before Performing Advanced Autotuning</i>.</p>  |

| Step | Display after Operation  | Keys   | Operation  |
|------|--|--|--|
| 3    | <pre> BB      Advanced AT Jcalc=ON Mode=2  Type=2 Stroke=+00800000       (0003.0) rev </pre>   |  <br> | Press the  ,  or  Key and set the items in steps 3-1 to 3-4. |
| 3-1  | <p>■Calculating Moment of Inertia<br/> Select the mode to be used.<br/> Usually, set Jcalc to ON.<br/> Jcalc = ON: Moment of inertia calculated [Factory setting]<br/> Jcalc = OFF: Moment of inertia not calculated<br/> Note:<br/> If the moment of inertia is already known from the machine specifications, set the value in Pn103 and set Jcalc to OFF.</p>   |  |  |
| 3-2  | <p>■Mode Selection<br/> Select the mode.<br/> Mode = 1: Makes adjustments considering responsiveness and stability. (Standard level)<br/> Mode = 2: Makes adjustments for positioning. [Factory setting]<br/> Mode = 3: Makes adjustments for positioning, giving priority to overshooting suppression.<br/> Note: The mode is always set to 1 if a 13-bit encoder is used (applicable servomotor: SGMJV-□□□A□□□).</p>   |  |  |
| 3-3  | <p>■Type Selection<br/> 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 rigid type.<br/> Type = 1: For belt drive mechanisms.<br/> Type = 2: For ball screw drive mechanisms [Factory setting].<br/> Type = 3: For rigid systems, such as a gear.</p>   |  |  |
| 3-4  | <p>■STROKE (Travel Distance) Setting<br/> Travel distance setting range:<br/> The travel distance setting range is from -99990000 to +99990000. 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.<br/> Initial value:<br/> About 3 rotations*<br/> * If the servomotor's encoder resolution is 1048576 (20-bit), the STROKE (travel distance) will be set to +800000. If the electric gear ratio is set to the factory setting (Pn20E = 4, Pn210 = 1), the initial value is calculated as shown with the following equation.</p> $\frac{800000}{1048576} \times \frac{4}{1} \doteq 3 \text{ rotations}$ <p>Notes:</p> <ul style="list-style-type: none"> <li>Set the number of motor rotations to at least 0.5; otherwise, "Error" will be displayed and the travel distance cannot be set.</li> <li>To calculate the moment of inertia and ensure precise tuning, it is recommended to set the number of motor rotations to around 3.</li> <li>For an SGMCS direct-drive servomotor, the factory setting for the number of motor rotations is 0.3 or equivalent.</li> </ul> |  |  |
| 4    | <pre> BB      Advanced AT Pn103=00100 Pn100=0040.0 Pn101=0020.00 Pn102=0040.0 </pre>   |   | Press the  Key. The advanced autotuning execution screen will be displayed.  |
| 5    | <pre> RUN     Advanced AT Pn103=00100 Pn100=0040.0 Pn101=0020.00 Pn141=0050.0 </pre>   |   | Press the  Key. The servomotor power will be ON and the display will change from "BB" to "RUN."<br>Note:<br>If the mode is set to 2 or 3, the "Pn102" display will change to the "Pn141."  |

| Step | Display after Operation   | Keys  | Operation  |
|------|---|---|--|
| 6    | <pre>ADJ      Advanced  AT Pn103=00300 Pn100=0040.0 Pn101=0020.00 Pn141=0050.0</pre> <p>Display example:<br/>After the moment of inertia is calculated.</p> |       | <p>Calculates the moment of inertia.</p> <p>Press the  Key if a positive (+) value is set in STROKE (travel distance), or press the  Key if a negative (-) value is set. Calculation of the moment of inertia ratio will start. While the moment of inertia is being calculated, the set value for Pn103 will blink, and the “RUN” display will change to blinking “ADJ.”</p> <p>When the calculation has been completed, the set value will stop blinking and the calculated moment of inertia ratio will be displayed. The servomotor power will remain ON, but the auto run operation will enter HOLD status.</p> <p>Notes:</p> <ul style="list-style-type: none"> <li>• The wrong key for the set travel direction is pressed, the calculation will not start.</li> <li>• If the moment of inertia is not calculated, the set value for Pn103 will be displayed but not blink.</li> <li>• If “NO-OP” or “Error” are displayed, press the  Key to cancel the function. Refer to (2) <i>Failure in Operation</i> and take a corrective action to enable operation.</li> </ul> |
| 7    |   |       | <p>After the motor is temporarily stopped, press the  Key to save the calculated value of the moment of inertia ratio in the SERVOPACK. Then, “DONE” will blink for approx. 1 second, and “ADJ” will be displayed. In the case of calculating the moment of inertia only, press the  Key.</p>  |
| 8    | <pre>ADJ      Advanced  AT Pn103=00300 Pn100=0100.0 Pn101=0006.36 Pn141=0150.0</pre>  |   | <p>■ Gain Adjustment</p> <p>When the  or  Key is pressed according to the sign (+ or -) of the value set for STROKE (travel distance), the calculated value of the moment of inertia ratio will be written to the SERVOPACK and the auto run operation will restart. While the servomotor is running, the notch filter, the torque reference filter, and gains will be automatically set. “ADJ” will blink during the auto setting operation.</p> <p>Note: Precise adjustments cannot be made and “Error” will be displayed as the status if there is vibration when starting adjustments. If that occurs, make adjustments using one-parameter tuning (Fn203).</p>  |
| 9    | <pre>ADJ      Advanced  AT Pn103=00300 Pn100=0100.0 Pn101=0006.36 Pn141=0150.0</pre>  |   | <p>When the adjustment has been completed normally, the servomotor power will turn OFF, and “END” will blink for approx. 2 seconds and “ADJ” will be displayed on the status display.</p>  |
| 10   | <pre>BB      Advanced  AT Pn103=00300 Pn100=0100.0 Pn101=0006.36 Pn141=0150.0</pre>   |    | <p>Press the  Key. The adjusted values will be written to the SERVOPACK, “DONE” will blink for approx. 2 seconds, and “BB” will be displayed.</p> <p>Note: To not save the values, press the  Key. The display will return to the display in step 1.</p>   |
| 11   | To enable the change in the setting, turn OFF the power and ON again.   |   |  |

## (2) Failure in Operation

### ■ If “NO-OP” is shown

| 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. | Turn OFF the automatic gain switching.        |
| The HWBB function operated.                    | Cancel the HWBB function.                     |

■ If “Errors” is shown

| Error  | Probable Cause  | Corrective Actions   |
|--|---|--|
| The gain adjustment was not successfully completed.  | <ul style="list-style-type: none"> <li>Machine vibration is occurring or the positioning completed signal (/COIN) is repeatedly turning ON and OFF.</li> </ul>    | <ul style="list-style-type: none"> <li>Increase the set value for Pn522.</li> <li>Change the mode from 2 to 3.</li> <li>If machine vibration occurs, suppress the vibration with the anti-resonance control adjustment function and the vibration suppression function.</li> </ul> |
| An error occurred during the calculation of the moment of inertia.   | Refer to the following table ■ <i>Errors during Calculation of Moment of Inertia</i> .  |  |
| Travel distance setting error  | The travel distance is set to approximately 0.5 rotation (0.05 rotation for SGMCS servomotor) or less, which is less than the minimum adjustable travel distance. | Increase the travel distance. It is recommended to set the number of motor rotations to around 3.  |
| 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 the proportional control (P control) is being used.  | <ul style="list-style-type: none"> <li>Increase the set value for Pn522.</li> <li>If P control is used, turn OFF the /P-CON signal.</li> </ul>   |
| A setting error occurred in the moment of inertia calculation when the tuning-less function was activated.                           | Jcalc was set to OFF, so the moment of inertia was not calculated and the tuning-less function was activated.   | <ul style="list-style-type: none"> <li>Turn OFF the tuning-less function.</li> <li>Set Jcalc to ON, so the moment of inertia will be calculated.</li> </ul>  |

■ Errors 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 | Cause  | Corrective Action   |
|---------------|--|---|
| Err1          | The SERVOPACK started calculating the moment of inertia, but the calculation was not completed.              | <ul style="list-style-type: none"> <li>Increase the speed loop gain (Pn100).</li> <li>Increase the STROKE (travel distance).</li> </ul>                             |
| 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 calculation starting level of the moment of inertia (Pn324).   |
| Err4          | The torque limit was reached.  | <ul style="list-style-type: none"> <li>Increase the torque limit value.</li> <li>Double the calculation starting level of the moment of inertia (Pn324).</li> </ul> |
| Err5          | While calculating the moment of inertia, the speed control was set to proportional control with P-CON input. | Operate the SERVOPACK with PI control while calculating the moment of inertia.  |

### (3) Related Functions

#### ■ Notch Filter

Usually, set this function to Auto Setting. (The notch filter is factory-set to Auto Setting.)  
If this function is set to Auto Setting, vibration will be detected automatically and the notch filter will be set.

Set this function to Not Auto Setting only if you do not change the notch filter setting before executing advanced autotuning.

| Parameter    |        | Function  | When Enabled | Classification |
|--------------|--------|---|--------------|----------------|
| <b>Pn460</b> | n.□□□0 | Does not set the 1st notch filter automatically.              | Immediately  | Tuning         |
|              | n.□□□1 | Sets the 1st notch filter automatically.<br>[Factory setting] |              |                |
|              | n.□0□□ | Does not set the 2nd notch filter automatically.              |              |                |
|              | n.□1□□ | Sets the 2nd notch filter automatically.<br>[Factory setting] |              |                |

#### ■ Anti-Resonance Control Adjustment Function

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 |
|--------------|--------|---|---------------|----------------|
| <b>Pn160</b> | n.□□0□ | Does not use the anti-resonance control automatically.              | After restart | Tuning         |
|              | n.□□1□ | Uses the anti-resonance control automatically.<br>[Factory setting] |               |                |

#### ■ Vibration Suppression

The vibration suppression function suppresses transitional vibration at frequency as low as 1 to 100 Hz that is generated mainly when positioning if the machine stand vibrates.

Usually, set this function to Auto Setting. (The vibration suppression function is factory-set to Auto Setting.)  
When this function is set to Auto Setting, vibration will be automatically detected during advanced autotuning and model following control with vibration suppression will be automatically adjusted and set.  
Set this function to Not Auto Setting only if you do not change the setting for model following control with vibration suppression before executing advanced autotuning.

Note: This function uses model following control. Therefore, the function can be executed only if the mode is set to 2 or 3.

#### Related Parameters

| Parameter    |        | Function   | When Enabled | Classification |
|--------------|--------|--|--------------|----------------|
| <b>Pn140</b> | n.□0□□ | Does not use the vibration suppression function automatically.           | Immediately  | Tuning         |
|              | n.□1□□ | Uses the vibration suppression function automatically. [Factory setting] |              |                |



### ■ Friction Compensation


This function compensates for changes in the following conditions.

- Changes in the viscous resistance of the lubricant, such as the grease, on the sliding parts of the machine
- Changes in the load resistance resulting from fluctuations in the machine assembly
- Secular changes in the load resistance

Conditions to which friction compensation is applicable depend on the mode. The friction compensation setting in Pn408.3 applies when the mode is 1.

| Friction Compensation Selecting |                             | Mode   |   |   |
|---------------------------------|-----------------------------|--|---|---|
|                                 |                             | Mode = 1   | Mode = 2  | Mode = 3  |
| Pn408                           | n.0□□□<br>[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.    | Adjusted with the friction compensation function. | Adjusted with the friction compensation function. |

### ■ Feedforward

|  |  |
|--|--|
| <br><b>IMPORTANT</b> | <ul style="list-style-type: none"> <li>• Model following control is used to make optimum feedforward settings in the servo. Therefore, model following control from the host controller is not used together with either the speed feedforward input or torque feedforward input. An improper speed feedforward input or torque feedforward input may result in overshooting.</li> </ul> |
|--|--|

If Pn140 is set to the factory setting and the mode setting is changed to 2 or 3, the feedforward gain (Pn109) (refer to 5.9.1) will become unavailable.

The following settings are required if model following control is used from the host controller (through the command option module) together with the speed feedforward input or torque feedforward input.

| Parameter | Function   | When Enabled | Classification |
|-----------|--|--------------|----------------|
| Pn140     | n.0□□□<br>Model following control is not used together with speed/torque feedforward input.<br>[Factory setting] | Immediately  | Tuning         |
|           | n.1□□□<br>Model following control is used together with speed/torque feedforward input.                          |              |                |

### 5.3.3 Related Parameters

The following parameters are set automatically by using advanced autotuning function.

| Parameter    | Name   |
|--------------|--|
| <b>Pn100</b> | Speed Loop Gain  |
| <b>Pn101</b> | Speed Loop Integral Time Constant                      |
| <b>Pn102</b> | Position Loop Gain                                     |
| <b>Pn121</b> | Friction Compensation Gain                             |
| <b>Pn123</b> | Friction Compensation Coefficient                      |
| <b>Pn124</b> | Friction Compensation Frequency Correction             |
| <b>Pn125</b> | Friction Compensation Gain Correction                  |
| <b>Pn141</b> | Model Following Control Gain                           |
| <b>Pn143</b> | Model Following Control Bias (Forward Direction)       |
| <b>Pn144</b> | Model Following Control Bias (Reverse Direction)       |
| <b>Pn145</b> | Vibration Suppression 1 Frequency A                    |
| <b>Pn146</b> | Vibration Suppression 1 Frequency B                    |
| <b>Pn147</b> | Model Following Control Speed Feedforward Compensation |
| <b>Pn161</b> | Anti-Resonance Frequency                               |
| <b>Pn163</b> | Anti-Resonance Damping Gain                            |
| <b>Pn401</b> | 1st Step 1st Torque Reference Filter Time Constant     |
| <b>Pn408</b> | Notch Filter Selection/Friction Compensation Selection |
| <b>Pn409</b> | 1st Notch Filter Frequency                             |
| <b>Pn40A</b> | 1st Notch Filter Q Value                               |
| <b>Pn40C</b> | 2nd Notch Filter Frequency                             |
| <b>Pn40D</b> | 2nd Notch Filter Q Value                               |

## 5.4 Advanced Autotuning by Reference (Fn202)

This section describes the adjustments with advanced autotuning by reference.



**IMPORTANT**

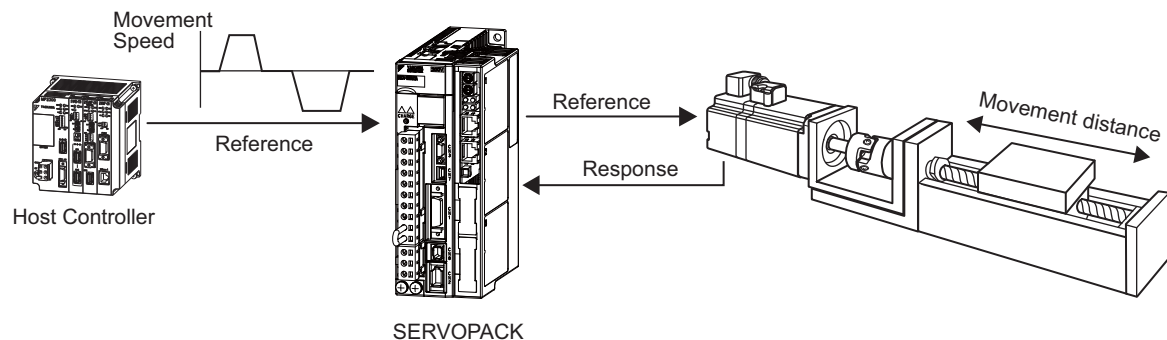
- Advanced autotuning by reference starts adjustments based on the set speed loop gain (Pn100). Therefore, precise adjustments cannot be made if there is vibration when starting adjustments. In this case, make adjustments after setting a fully stable gain using one-parameter tuning (Fn203).

### 5.4.1 Advanced Autotuning by Reference

Advanced autotuning by reference is used to automatically achieve optimum tuning of the SERVOPACK in response to the user reference inputs from the host controller.

Advanced autotuning by reference is performed generally to fine-tune the SERVOPACK after advanced autotuning of the SERVOPACK has been performed.

If the load moment of inertia ratio is set correctly is Pn103, advanced autotuning by reference can be performed without performing advanced autotuning.



Advanced autotuning by reference performs the following adjustments.

- Gains (e.g., position loop gain and speed loop gain)
- Filters (torque reference filter and notch filter)
- Friction compensation
- Anti-resonance control
- Vibration suppression

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

For information on how to input operation references, refer to the manual of the connected command option module.



**CAUTION**

- Because advanced autotuning by reference adjusts the SERVOPACK during automatic operation, vibration or overshooting may occur. To ensure safety, perform advanced autotuning by reference in a state where the SERVOPACK can come to an emergency stop at any time.
- Be sure to set a suitable value for the moment of inertia ratio (Pn103) using advanced autotuning before advanced autotuning by reference is performed. If the setting greatly differs from the actual moment of inertia ratio, normal control of the SERVOPACK may not be possible, and vibration may result.

## (1) Before Performing Advanced Autotuning by Reference

Check the following settings before performing advanced autotuning by reference.

- a) A message (NO-OP) indicating that no operations are possible will be displayed, if all of the following conditions are not met.
- The main circuit power supply must be ON.
  - The servomotor power must be OFF.
  - The forward run prohibited (P-OT) and the reverse run prohibited (N-OT) signal must not be in an over-travel state.
  - Position control must be selected while the servomotor power is ON.
  - Torque control must not be selected.
  - The tuning-less function must be disabled.
  - Automatic gain switching must be disabled.
  - Gain setting 2 must not be selected.
  - Test without motor function must not be enabled. (Pn00C.0 = 0)
  - All alarms and warning must be cleared.
  - The hardwire base block (HWBB) must be off.
- b) Observe the following condition to ensure operation.
- The write prohibited setting (Fn010) must not be set.

## (2) When Advanced Autotuning by Reference Cannot Be Adjusted

Advanced autotuning by reference may not be performed normally under the following conditions. If the result of autotuning is not satisfactory, perform one-parameter tuning. Refer to *5.5 One-parameter Tuning (Fn203)* for details.

- The travel distance in response to references from the host controller is the same as or smaller than the set positioning completed width (Pn522).
- The motor speed in response to references from the host controller is the same as or 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 shorter.
- The rigidity of the load is low and vibration occurs when positioning is performed.
- The position integration function is used.
- P control operation (proportional control) is performed.
- The mode switch is used.
- The positioning completed width (Pn522) is too small.



### IMPORTANT

- Advanced autotuning by reference makes 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 blink. Furthermore, unless the positioning completed signal (/COIN) is turned ON within approximately 10 seconds, "Error" will blink for 2 seconds and tuning will be aborted.

Change only the overshoot detection level (Pn561) to finely adjust the without changing the positioning completed width (Pn522). Because Pn561 is set by default to 100%, the allowable amount of overshooting is the same amount as that for the positioning completed width.

When Pn561 is set to 0%, the amount of overshooting can be adjusted 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 |              |                 |              | Classification |        |
|-------|---------------------------|--------------|-----------------|--------------|----------------|--------|
|       | Setting Range             | Setting Unit | Speed           | Position     |                | Torque |
|       |                           |              | Factory Setting | When Enabled |                |        |
|       | 0 to 100                  | 1%           | 100             | Immediately  |                | Setup  |

## 5.4.2 Advanced Autotuning by Reference Procedure





















The following procedure is used for advanced autotuning by reference.




Advanced autotuning by reference is performed from the Digital Operator (option) or SigmaWin+.

The operating procedure from the Digital Operator is described here.

For basic operations of the Digital Operator, refer to the *Σ-V series User's Manual, Operation of Digital Operator* (SIEP S800000 55).

### (1) Operating Procedure

| Step | Display after Operation  | Keys   | Operation   |
|------|--|--|---|
| 1    | <pre> BB      —FUNCTION— Fn201: AAT Fn202: Ref-AAT Fn203: OnePrmTun Fn204: A-Vib Sup </pre>  | <br>      | <p>Press the  Key to view the main menu for the utility function mode.</p> <p>Use the  or  Key to move through the list, select Fn202.</p> |
| 2    | <pre> Status Display BB      Advanced AT Mode=3 Type=2 </pre>  |   | <p>Press the  Key to display the initial setting screen for advanced autotuning by reference.</p> <p>Note: If the display does not switch and “NO-OP” is displayed, take corrective action after checking the items given in 5.4.1 (1) Before Performing Advanced Autotuning by Reference.</p>                   |
| 3    | <pre> BB      Advanced AT Mode=3 Type=2 </pre>   |  <br> | <p>Press the   or  Key and set the items in steps 3-1 and 3-2.</p>  |
| 3-1  | <p>■Mode Selection</p> <p>Select the mode.</p> <p>Mode = 1: Makes adjustments considering responsiveness and stability. (Standard level)</p> <p>Mode = 2: Makes adjustments for positioning. [Factory setting]</p> <p>Mode = 3: Makes adjustments for positioning, giving priority to overshooting suppression.</p> <p>Note: The mode is always set to 1 if a 13-bit encoder is used (applicable servomotor: SGMJV-□□□A□□□).</p> |  |   |
| 3-2  | <p>■Type Selection</p> <p>Select the type according to the machine element to be driven.</p> <p>If there is noise or the gain does not increase, better results may be obtained by changing the rigid type.</p> <p>Type = 1: For belt drive mechanisms.</p> <p>Type = 2: For ball screw drive mechanisms [Factory setting].</p> <p>Type = 3: For rigid systems, such as a gear.</p>  |  |   |
| 4    | <pre> BB      Advanced AT Pn103=00000 Pn100=0040.0 Pn101=0020.00 Pn141=0050.0 </pre>   |   | <p>Press the  Key. The advanced autotuning execution screen will be displayed.</p> <p>Note: If the mode is set to 2 or 3, the “Pn102” display will change to the “Pn141”.</p>  |
| 5    | <pre> RUN    Advanced AT Pn103=00300 Pn100=0040.0 Pn101=0020.00 Pn141=0050.0 </pre>  |  | <p>Input a servo ON command.</p>  |
| 6    | <pre> ADJ    Advanced AT Pn103=00300 Pn100=0100.0 Pn101=0006.36 Pn141=0150.0 </pre>  |    | <p>Start to adjust using  or  Key. “ADJ” will blink on the status display.</p> <p>Note: Adjustment cannot be performed during “BB” is shown on the status display.</p>  |
| 7    | <pre> ADJ    Advanced AT Pn103=00300 Pn100=0100.0 Pn101=0006.36 Pn141=0150.0 </pre>  |  | <p>When the adjustment has been completed normally, “END” will blink for approx. 2 seconds and “ADJ” will be displayed on the status display.</p>   |

| Step | Display after Operation  | Keys  | Operation  |
|------|--|---|--|
| 8    | <pre> RUN      Advanced AT P n 103=00300 P n 100=0100. 0 P n 101=0006. 36 P n 141=0150. 0 </pre> |  | <p>Press the  Key. The adjusted values will be written to the SERVOPACK, "DONE" will blink for approx. 2 seconds, and then "RUN" will be displayed.</p> <p>Note: To not save the values set in step 6, press the  Key. The display will return to the display in step 1.</p> |
| 9    | To enable the change in the setting, turn OFF the power and ON again.                            |   |  |

## (2) Failure in Operation

### ■ If "NO-OP" is shown

| 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. | Turn OFF the automatic gain switching.        |
| The HWBB function operated.                    | Cancel the HWBB function.                     |

### ■ If "Error" is shown

| Error  | Probable Cause   | Corrective Actions   |
|--|--|--|
| The gain adjustment was not successfully completed.  | Machine vibration is occurring or the positioning completed signal (/COIN) is repeatedly turning ON and OFF. | <ul style="list-style-type: none"> <li>• Increase the set value for Pn522.</li> <li>• Change the mode from 2 to 3.</li> <li>• If machine vibration occurs, suppress the vibration with the anti-resonance control adjustment function and the vibration suppression function.</li> </ul> |
| 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 the proportional control (P control) is being used.         | <ul style="list-style-type: none"> <li>• Increase the set value for Pn522.</li> <li>• If P control is used, turn OFF the /P-CON signal.</li> </ul>   |

### (3) Related Functions

#### ■ Notch Filter

Usually, set this function to Auto Setting. (The notch filter is factory-set to Auto Setting.)  
If this function is set to Auto Setting, vibration will be detected automatically and the notch filter will be set.

Set this function to Not Auto Setting only if you do not change the notch filter setting before executing advanced autotuning by reference.

| Parameter    |        | Function  | When Enabled | Classification |
|--------------|--------|---|--------------|----------------|
| <b>Pn460</b> | n.□□□0 | Does not set the 1st notch filter automatically.              | Immediately  | Tuning         |
|              | n.□□□1 | Sets the 1st notch filter automatically.<br>[Factory setting] |              |                |
|              | n.□0□□ | Does not set the 2nd notch filter automatically.              |              |                |
|              | n.□1□□ | Sets the 2nd notch filter automatically.<br>[Factory setting] |              |                |

#### ■ Anti-Resonance Control Adjustment Function

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 |
|--------------|--------|---|---------------|----------------|
| <b>Pn160</b> | n.□□0□ | Does not use the anti-resonance control automatically.              | After restart | Tuning         |
|              | n.□□1□ | Uses the anti-resonance control automatically.<br>[Factory setting] |               |                |

#### ■ Vibration Suppression

The vibration suppression function suppresses transitional vibration at frequency as low as 1 to 100 Hz that is generated mainly when positioning if the machine stand vibrates.

Usually, set this function to Auto Setting. (The vibration suppression function is factory-set to Auto Setting.)  
When this function is set to Auto Setting, vibration will be automatically detected during advanced autotuning by reference and model following control with vibration suppression will be automatically adjusted and set.  
Set this function to Not Auto Setting only if you do not change the setting for model following control with vibration suppression before executing advanced autotuning by reference.

Note: This function uses model following control. Therefore, the function can be executed only if the mode is set to 2 or 3.

#### Related Parameters

| Parameter    |        | Function   | When Enabled | Classification |
|--------------|--------|--|--------------|----------------|
| <b>Pn140</b> | n.□0□□ | Does not use the vibration suppression function automatically.           | Immediately  | Tuning         |
|              | n.□1□□ | Uses the vibration suppression function automatically. [Factory setting] |              |                |

## ■ Friction Compensation

This function compensates for changes in the following conditions.

- Changes in the viscous resistance of the lubricant, such as the grease, on the sliding parts of the machine
- Changes in the load resistance resulting from fluctuations in the machine assembly
- Secular changes in the load resistance

Conditions to which friction compensation is applicable depend on the mode. The friction compensation setting in Pn408.3 applies when the mode is 1.

| Friction Compensation Selecting |                             | Mode = 1   | Mode = 2  | Mode = 3  |
|---------------------------------|-----------------------------|--|---|---|
| Pn408                           | n.0□□□<br>[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.    | Adjusted with the friction compensation function. | Adjusted with the friction compensation function. |

## ■ Feedforward



**IMPORTANT**

- Model following control is used to make optimum feedforward settings in the servo. Therefore, model following control is not used from the host controller together with either the speed feedforward input or torque feedforward input. An improper speed feedforward input or torque feedforward input may result in overshooting.

If Pn140 is set to the factory setting and the mode setting is changed to 2 or 3, the feedforward reference (Pn109) (refer to 5.9.1) will be lost.

The following settings are required if model following control is used from the host controller (through the command option module) together with the speed feedforward input or torque feedforward input.

| Parameter | Function                    | When Enabled | Classification |
|-----------|-----------------------------|--------------|----------------|
| Pn140     | n.0□□□<br>[Factory setting] | Immediately  | Tuning         |
|           | n.1□□□                      |              |                |



### 5.4.3 Related Parameters

The following parameters are set automatically by using advanced autotuning by reference. Manual adjustments are not required.

| Parameter    | Name   |
|--------------|--|
| <b>Pn100</b> | Speed Loop Gain  |
| <b>Pn101</b> | Speed Loop Integral Time Constant                      |
| <b>Pn102</b> | Position Loop Gain                                     |
| <b>Pn121</b> | Friction Compensation Gain                             |
| <b>Pn123</b> | Friction Compensation Coefficient                      |
| <b>Pn124</b> | Friction Compensation Frequency Correction             |
| <b>Pn125</b> | Friction Compensation Gain Correction                  |
| <b>Pn141</b> | Model Following Control Gain                           |
| <b>Pn143</b> | Model Following Control Bias (Forward Direction)       |
| <b>Pn144</b> | Model Following Control Bias (Reverse Direction)       |
| <b>Pn145</b> | Vibration Suppression 1 Frequency A                    |
| <b>Pn146</b> | Vibration Suppression 1 Frequency B                    |
| <b>Pn147</b> | Model Following Control Speed Feedforward Compensation |
| <b>Pn161</b> | Anti-Resonance Frequency                               |
| <b>Pn163</b> | Anti-Resonance Damping Gain                            |
| <b>Pn401</b> | 1st Step 1st Torque Reference Filter Time Constant     |
| <b>Pn408</b> | Notch Filter Selection/Friction Compensation Selection |
| <b>Pn409</b> | 1st Notch Filter Frequency                             |
| <b>Pn40A</b> | 1st Notch Filter Q Value                               |
| <b>Pn40C</b> | 2nd Notch Filter Frequency                             |
| <b>Pn40D</b> | 2nd Notch Filter Q Value                               |

## 5.5 One-parameter Tuning (Fn203)

This section describes the adjustments with one-parameter tuning.

### 5.5.1 One-parameter Tuning

One-parameter tuning is used to manually make tuning level adjustments during operation with a position reference or speed reference input from the host controller.

One-parameter tuning enables automatically setting related servo gain settings to balanced conditions by adjusting one or two autotuning levels.

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 *5.5.4 Related Parameters* for parameters used for adjustments.

For information on how to input position references or speed references, refer to the manual of the connected command option module.

Perform one-parameter tuning if satisfactory responsiveness is not obtained with advanced autotuning or advanced autotuning by reference.

To fine-tune each servo gain after one-parameter tuning, refer to *5.8 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.
- Be sure to set a suitable value for the moment of inertia ratio (Pn103) using advanced autotuning before one-parameter tuning is performed. If the setting greatly differs from the actual moment of inertia ratio, normal control of the SERVOPACK may not be possible, and vibration may result.

#### (1) Before Performing One-parameter Tuning

Check the following settings before performing one-parameter tuning.

- a) A message (NO-OP) indicating that no operations are possible will be displayed, if all of the following conditions are not met.
  - The tuning-less function must not be enabled.
  - Test without motor function must not be enabled. (Pn00C.0 = 0)
- b) Observe the following condition to ensure operation.
  - The write prohibited setting (Fn010) must not be set.
  - The tuning mode must be set to 0 or 1 in speed control.

#### (2) Usage Restrictions

The tuning mode is restricted to 0 or 1 if speed control is used.

## 5.5.2 One-parameter Tuning Procedure

The following procedure is used for one-parameter tuning.

Operation procedures will vary in accordance with the tuning mode being used.























- When the tuning mode is set to 0 with priority given to stability or when the tuning mode is set to 1 with priority given to responsiveness, refer to (1) *Setting the Tuning Mode to 0 or 1*.
- When the tuning mode is set to 2 or 3 for adjustments in positioning, refer to (2) *Setting the Tuning Mode to 2 or 3*.


















One-parameter tuning is performed from the Digital Operator (option) or SigmaWin+.

The operating procedure from the Digital Operator is described here.























For basic operations of the Digital Operator, refer to the  $\Sigma V$  series *User's Manual, Operation of Digital Operator* (SIEP S800000 55).

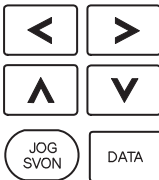
















### (1) Setting the Tuning Mode to 0 or 1

| Step | Display after Operation  | Keys   | Operation   |
|------|--|--|---|
| 1    | <pre> RUN      —FUNCTION— Fn202:Ref-AAT Fn203:OnePrmTun Fn204:A-Vib Sup Fn205:Vib Sup           </pre>   | <br>      | Press the  Key to view the main menu for the utility function mode.<br>Use the  or  Key to move through the list, select Fn203.  |
| 2    | <pre> — Status Display — [ ] —OnePrmTun— Pn103=00300           </pre>  |   | Press the  Key to display the moment of inertia ratio set in Pn103 at present. To change the setting, move the cursor with the  or  Key and change the set value with the  or  Key.<br>Note: If the display does not switch and “NO-OP” is displayed, take corrective action after checking the items given in 5.5.1 (1) <i>Before Performing One-parameter Tuning</i> . |
| 3    | <pre> BB      —OnePrmTun— Setting Tuning Mode = 2 Type = 2           </pre>  |   | Press the  Key to display the initial setting screen for one-parameter tuning.   |
| 4    | <pre> BB      —OnePrmTun— Setting Tuning Mode = 2 Type = 2           </pre>  |  <br> | Press the  ,  or  Key and set the items in steps 4-1 and 4-2.  |
| 4-1  | <p><b>■Tuning Mode Selection</b><br/>           Select the tuning Mode. Select the tuning mode 0 or 1.<br/>           Tuning Mode = 0: Makes adjustments giving priority to stability.<br/>           Tuning Mode = 1: Makes adjustments giving priority to responsiveness.<br/>           Tuning Mode = 2: Makes adjustments for positioning.<br/>           Tuning Mode = 3: Makes adjustments for positioning, giving priority to overshooting suppression.</p> |  |   |
| 4-2  | <p><b>■Type Selection</b><br/>           Select the type according to the machine element to be driven.<br/>           If there is noise or the gain does not increase, better results may be obtained by changing the rigid type.<br/>           Type = 1: For belt drive mechanisms.<br/>           Type = 2: For ball screw drive mechanisms [Factory setting].<br/>           Type = 3: For rigid systems, such as a gear.</p>                                 |  |   |
| 5    |  |  | Input a servo ON command from the host controller. The display will change from “BB” to “RUN.”  |
| 6    | <pre> RUN      —OnePrmTun— Pn100=0040.0 Pn101=0020.00 Pn102=0040.0           </pre>  |   | Press the  Key to display the set value.   |

| Step | Display after Operation  | Keys  | Operation   |
|------|--|---|---|
| 7    | <pre> RUN  -OnePrmTun-       LEVEL = 0050       NF1 NF2  ARES </pre>   |    | <p>Adjust the responsiveness by changing the level. After pressing the  Key, the present level will be displayed. Move the cursor with the  or  Keys and adjust the level with  or  Keys, and press the  Key.</p> <p>The higher the level, the greater the responsiveness will be. If the value is too large, however, vibration will occur.</p> <p>If that occurs, press the  Key. The SERVOPACK will automatically detect the vibration frequencies and make notch filter or anti-resonance control settings.</p> <p>When the notch filter is set, “NF1” or “NF2” will be displayed on the bottom row.</p> <p>When anti-resonance control is set, “ARES” is displayed.</p> <p>Note: If the vibration is great, the vibration frequency will be detected even if the  Key is not pressed and a notch filter or anti-resonance control will be set.</p> |
| 8    | <pre> RUN  -OnePrmTun- P n 1 0 0 = 0 0 5 0 . 0 P n 1 0 1 = 0 0 1 6 . 0 P n 1 0 2 = 0 0 5 0 . 0 </pre>                                    |    | <p>Press the  Key. A confirmation screen is displayed after level adjustment.</p>  |
| 9    | <pre> RUN  -OnePrmTun- P n 1 0 0 = 0 0 5 0 . 0 P n 1 0 1 = 0 0 1 6 . 0 P n 1 0 2 = 0 0 5 0 . 0 </pre>                                    |  | <ul style="list-style-type: none"> <li>Press the  Key. The adjusted values will be written to the SERVOPACK. “DONE” will be displayed for approx. 2 seconds, and then “RUN” will be displayed.</li> <li>Not to save the values set in step 7, press the  Key.</li> <li>The screen in step 7 will appear with the  Key.</li> </ul>   |
| 10   | <pre> RUN  -FUNCTION- F n 2 0 2 : R e f - A A T F n 2 0 3 : O n e P r m T u n F n 2 0 4 : A - V i b S u p F n 2 0 5 : V i b S u p </pre> |  | <p>Press the  Key to complete the one-parameter tuning operation. The screen in step 1 will appear again.</p>  |

## (2) Setting the Tuning Mode to 2 or 3

| Step | Display after Operation   | Keys   | Operation  |
|------|---|--|--|
| 1    | <pre> RUN  —FUNCTION— Fn202:Ref-AAT Fn203:OnePrmTun Fn204:A-Vib Sup Fn205:Vib Sup </pre>  | <br>  | <p>Press the  Key to view the main menu for the utility function mode.</p> <p>Use the  or  Key to move through the list, select Fn203.</p>  |
| 2    | <pre> BB  —OnePrmTun— Pn103=00300 </pre>  |   | <p>Press the  Key to display the moment of inertia ratio set in Pn103 at present. To change the setting, move the cursor with the  or  Key and change the set value with the  or  Key.</p> <p>Note: If the display does not switch and “NO-OP” is displayed, take corrective action after checking the items given in 5.5.1 (1) Before Performing One-parameter Tuning.</p> |
| 3    | <pre> BB  —OnePrmTun— Setting Tuning Mode = 2 Type = 2 </pre>   |   | <p>Press the  Key to display the initial setting screen for one-parameter tuning.</p>   |
| 4    | <pre> BB  —OnePrmTun— Setting Tuning Mode = 2 Type = 2 </pre>   |  <br> | <p>Press the ,  or  Key and set the items in steps 4-1 and 4-2.</p>   |
| 4-1  | <p>■Tuning Mode Selection</p> <p>Select the tuning Mode. Select the tuning mode 2 or 3.</p> <p>Tuning Mode = 0: Makes adjustments giving priority to stability.</p> <p>Tuning Mode = 1: Makes adjustments giving priority to responsiveness.</p> <p>Tuning Mode = 2: Makes adjustments for positioning.</p> <p>Tuning Mode = 3: Makes adjustments for positioning, giving priority to overshooting suppression.</p> |  |  |
| 4-2  | <p>■Type Selection</p> <p>Select the type according to the machine element to be driven.</p> <p>If there is noise or the gain does not increase, better results may be obtained by changing the rigid type.</p> <p>Type = 1: For belt drive mechanisms.</p> <p>Type = 2: For ball screw drive mechanisms [Factory setting].</p> <p>Type = 3: For rigid systems, such as a gear.</p>                                 |  |  |
| 5    |   |  | <p>Input an servo ON command from the host controller. The display will change from “BB” to “RUN.”</p>   |
| 6    | <pre> RUN  —OnePrmTun— Pn100=0040.0 Pn101=0020.00 Pn141=0050.0 </pre>   |   | <p>Press the  Key to display the set value.</p>   |

| Step | Display after Operation  | Keys  | Operation   |
|------|--|---|---|
| 7    | <pre> RUN  --OnePrmTun-- FF LEVEL=0050.0 FB LEVEL=0040.0  NF1  NF2  ARES </pre>                |    | <p>Adjust the responsiveness by changing the FF and FB levels.</p> <p>Press the  Key to display the present level. Move the cursor with the  Key and change the set value with the  or  Keys.</p> <p>After the setting is changed, press the  Key.</p> <p>The higher the level, the greater the responsiveness will be. If the value is too large, however, vibration will occur.</p> <p>If that occurs, press the  Key. The SERVOPACK will automatically detect the vibration frequencies and make notch filter or anti-resonance control settings. When the notch filter is set, “NF1” or “NF2” will be displayed on the bottom row.</p> <p>When the anti-resonance control is set, “ARES” is displayed.</p> <p>Notes:</p> <ul style="list-style-type: none"> <li>• If the vibration is great, the vibration frequency will be detected even if the  Key is not pressed and a notch filter or anti-resonance control will be set.</li> <li>• The higher the FF level, the shorter the positioning time will be. If the level is too high, however, overshooting will occur.</li> <li>• If the FF level is changed when the servomotor is stopped and no reference is input, this new value will be effective, and the servomotor’s responsiveness will be changed. To safely adjust the FF level, wait until all operations have been completed and check the responsiveness. When the FF level is changed largely, vibration may occur because the responsiveness is changed rapidly.</li> <li>• The message, “FF LEVEL”, blinks until the machine reaches the effective FF level. If the servomotor does not stop approximately 10 seconds after the FF level is changed, the setting is no longer effective and will automatically return to the previous setting.</li> <li>• If the vibration is too small, the SERVOPACK may not automatically detect the vibration frequencies. If so, press the  Key to forcibly start the detection.</li> </ul> |
| 8    | <pre> RUN  --OnePrmTun-- Pn100=0040.0 Pn101=0020.00 Pn141=0050.0 NF1 </pre>                    |  | <p>Press the  Key. A confirmation screen is displayed after level adjustment.</p>  |
| 9    | <pre> RUN  --OnePrmTun-- Pn100=0040.0 Pn101=0020.00 Pn141=0050.0 NF1 </pre>                    |  | <ul style="list-style-type: none"> <li>• Press the  Key. The adjusted values will be written to the SERVOPACK, “DONE” will be displayed for approx. 2 seconds, and then “RUN” will be displayed.</li> <li>• Not to save the values set in step 7, press the  Key.</li> </ul> <p>The screen in step 7 will appear with the  Key.</p>  |
| 10   | <pre> RUN  --FUNCTION-- Fn202: Ref-AAT Fn203: OnePrmTun Fn204: A-Vib Sup Fn205: Vib Sup </pre> |  | <p>Press the  Key to complete the one-parameter tuning operation. The screen in step 1 will appear again.</p>  |

### (3) Related Functions

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 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 |
|--------------|--------|---|--------------|----------------|
| <b>Pn460</b> | n.□□□0 | Does not set the 1st notch filter automatically.              | Immediately  | Tuning         |
|              | n.□□□1 | Sets the 1st notch filter automatically.<br>[Factory setting] |              |                |
|              | n.□0□□ | Does not set the 2nd notch filter automatically.              |              |                |
|              | n.□1□□ | Sets the 2nd notch filter automatically.<br>[Factory setting] |              |                |

#### ■ Anti-Resonance Control Adjustment Function

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 |
|--------------|--------|---|---------------|----------------|
| <b>Pn160</b> | n.□□0□ | Does not use the anti-resonance control automatically.              | After restart | Tuning         |
|              | n.□□1□ | Uses the anti-resonance control automatically.<br>[Factory setting] |               |                |

“ARES” will blink on the digital operator when anti-resonance control adjustment function is set.

```

RUN      —OnePrmTun—
FF LEVEL = 0050
FB LEVEL = 0040

NF1 NF2  ARES
  
```

#### ■ Friction Compensation

This function compensates for changes in the following conditions.

- Changes in the viscous resistance of the lubricant, such as the grease, on the sliding parts of the machine
- Changes in the load resistance resulting from fluctuations in the machine assembly
- Secular changes in the load resistance

Conditions to which friction compensation is applicable depend on the tuning mode. The friction compensation setting in Pn408.3 applies when the mode is 0 or 1.

| Friction Compensation Selecting |                             | Mode   |  |   |   |
|---------------------------------|-----------------------------|--|--|---|---|
|                                 |                             | Tuning Mode = 0                                      | Tuning Mode = 1                                      | Tuning Mode = 2                                   | Tuning Mode = 3                                   |
| <b>Pn408</b>                    | n.0□□□<br>[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



### IMPORTANT

- Model following control is used to make optimum feedforward settings in the servo. Therefore, model following control from the host controller is not used together with either the speed feedforward input or torque feedforward input. An improper speed feedforward input or torque feedforward input may result in overshooting.

If Pn140 is set to the factory setting and the mode setting is changed to 2 or 3, the feedforward gain (Pn109) (refer to 5.9.1) will be lost.

The following settings are required if model following control is used from the host controller (through the command option module) together with speed feedforward input or torque feedforward input.

| Parameter    |        | Function   | When Enabled | Classification |
|--------------|--------|--|--------------|----------------|
| <b>Pn140</b> | n.0□□□ | Model following control is not used together with speed/torque feedforward input.<br>[Factory setting] | Immediately  | Tuning         |
|              | n.1□□□ | Model following control is used together with speed/torque feedforward input.                          |              |                |



### 5.5.3 One-parameter Tuning Example

The following procedure is used for one-parameter tuning on the condition that the tuning mode is set to 2, or 3. This mode is used to reduce positioning time.

| Step | Measuring Instrument Display Example | Operation   |
|------|--------------------------------------|---|
| 1    |                                      | <p>Measure the positioning time after setting the moment of inertia ratio (Pn103) correctly. Tuning will be completed if the specifications are met here. Save the tuning results in the SERVOPACK.</p>   |
| 2    |                                      | <p>The positioning time will become shorter if the FF level is increased. The tuning will be completed if the specifications are met. Save the tuning results in the SERVOPACK. If overshooting occurs before the specifications are met, go to step 3.</p>   |
| 3    |                                      | <p>Overshooting will be reduced if the FB level is increased. If the overshooting is solved, go to step 4.</p>  |
| 4    |                                      | <p>The graph shows overshooting generated with the FF level increased in step 3. In this state, the overshooting occurs, but the positioning setting time is short. The tuning will be completed if the specifications are met. Save the adjustment results in the SERVOPACK. If overshooting occurs before the specifications are met, repeat steps 3 and 4.<br/>If vibration occurs before the overshooting is eliminated, suppress the vibration by the notch filter and anti-resonance control.<br/>Note: The vibration frequencies may not be detected if the vibration is too small. If that occurs, press the  Key to forcibly detect the vibration frequencies.</p> |
| 5    |                                      | <p>Save the adjustment results in the SERVOPACK.</p>  |

### 5.5.4 Related Parameters

The following parameters are set automatically by using one-parameter tuning. Manual adjustments are not required.

| Parameter    | Name   |
|--------------|--|
| <b>Pn100</b> | Speed Loop Gain  |
| <b>Pn101</b> | Speed Loop Integral Time Constant                      |
| <b>Pn102</b> | Position Loop Gain                                     |
| <b>Pn121</b> | Friction Compensation Gain                             |
| <b>Pn123</b> | Friction Compensation Coefficient                      |
| <b>Pn124</b> | Friction Compensation Frequency Correction             |
| <b>Pn125</b> | Friction Compensation Gain Correction                  |
| <b>Pn141</b> | Model Following Control Gain                           |
| <b>Pn143</b> | Model Following Control Bias (Forward Direction)       |
| <b>Pn144</b> | Model Following Control Bias (Reverse Direction)       |
| <b>Pn147</b> | Model Following Control Speed Feedforward Compensation |
| <b>Pn161</b> | Anti-Resonance Frequency                               |
| <b>Pn163</b> | Anti-Resonance Damping Gain                            |
| <b>Pn401</b> | 1st Step 1st Torque Reference Filter Time Constant     |
| <b>Pn408</b> | Notch Filter Selection/Friction Compensation Selection |
| <b>Pn409</b> | 1st Notch Filter Frequency                             |
| <b>Pn40A</b> | 1st Notch Filter Q Value                               |
| <b>Pn40C</b> | 2nd Notch Filter Frequency                             |
| <b>Pn40D</b> | 2nd Notch Filter Q Value                               |

## 5.6 Anti-resonance Control Adjustment Function (Fn204)

This section describes how to adjust the anti-resonance control.

### 5.6.1 Anti-resonance Control Adjustment Function

The anti-resonance control adjustment function increases the effectiveness of the vibration suppression after one-parameter tuning.

The anti-resonance control adjustment function (Pn204) is an effective way to control the frequent vibration between 100 Hz and 1000 Hz when the control gain increases.

Perform one-parameter tuning (Fn203) or use another method to increase the responsiveness after performing this function. If the vibration 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 enabled or disabled. Enable the function in a state where the machine can come to an emergency stop at any time to ensure the safety operation of the machine.
- Be sure to set a suitable value for the moment of inertia ratio (Pn103) using advanced autotuning before executing the anti-resonance control adjustment function. If the setting greatly differs from the actual moment of inertia ratio, normal control of the SERVOPACK may not be possible, and vibration may result.



#### IMPORTANT

- This function detects vibration between 100 and 1,000 Hz. Vibration will not be detected for frequencies outside of this range, and instead, "F----" will be displayed. If that occurs, use one-parameter tuning with tuning mode 2 selected to automatically set a notch filter or use the vibration suppression function (Fn205).
- Vibration can be reduced more effectively by increasing the present damping gain (Pn163). The amplitude of vibration may become larger if the damping gain is excessively high. Increase the vibration gain from about 0% to 200% in 10% increments while checking the effect of vibration reduction. If the effect of vibration reduction is still insufficient at a gain of 200%, cancel the setting, and lower the control gain using a different method, such as one-parameter tuning.

### (1) Before Performing Anti-Resonance Control Adjustment Function

Check the following settings before performing anti-resonance control adjustment function.

- a) A message (NO-OP) indicating that no operations are possible will be displayed, if all of the following conditions are not met.
  - The tuning-less function must not be enabled.
  - Test without motor function must not be enabled. (Pn00C.0=0)
  - Torque control must not be selected.
- b) Observe the following condition to ensure operation.
  - The write prohibited setting (Fn010) must not be set.

### 5.6.2 Anti-resonance Control Adjustment Function Operating Procedure

With this function, a control reference is sent, and the function is executed while vibration is occurring.

Anti-resonance control adjustment function is performed from the Digital Operator (option) or SigmaWin+.















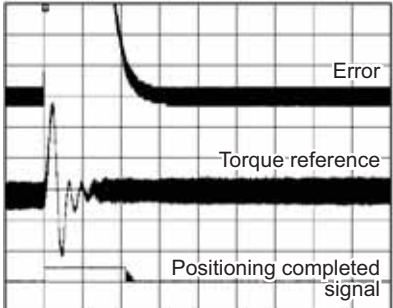
The following three methods can be used for the anti-resonance control adjustment function. Select and use the best method.

1. With Undetermined Vibration Frequency Before Adjusting the Anti-resonance Control
2. With Determined Vibration Frequency Before Adjusting the Anti-resonance Control
3. For Fine-tuning After Adjusting the Anti-resonance Control











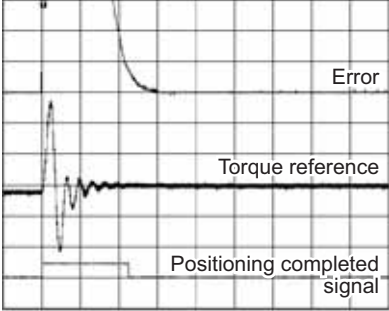














The operating procedures from the Digital Operator are described here.

Refer to the *Σ-V series User's Manual, Operation of Digital Operator (SIEP S800000 55)* for basic key operations of the Digital Operator.















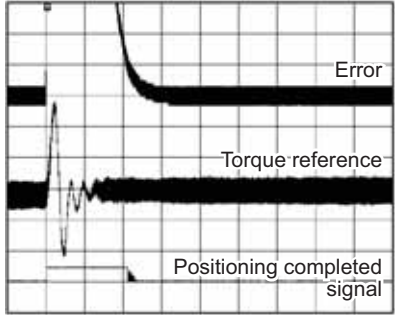










#### (1) With Undetermined Vibration Frequency Before Adjusting the Anti-resonance Control

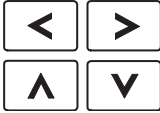




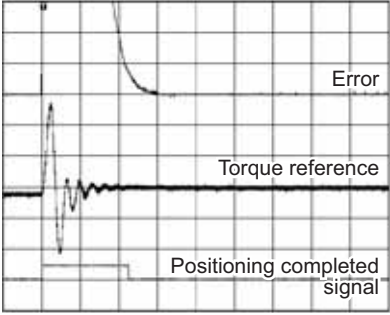


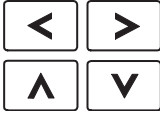








| Step | Display after Operation   | Keys   | Operation  |
|------|---|--|--|
| 1    | <pre> RUN      --FUNCTION-- Fn203: OnePrmTun Fn204: A-Vib Sup Fn205: Vib Sup Fn206: Easy FFT                     </pre> | <br>  | <p>Press the  Key to view the main menu for the utility function mode.</p> <p>Use the  or  Key to move through the list, select Fn204.</p>  |
| 2    | <pre> -- Status Display RUN      -- Vib Sup -- Tuning Mode = 0                     </pre>                               |   | <p>Press the  Key to display the initial setting screen for tuning mode.</p> <p>Note: If the display does not switch and “NO-OP” is displayed, take corrective action after checking the items given in 5.6.1 (1) Before Performing Anti-resonance Control Adjustment Function.</p>   |
| 3    | <pre> RUN      -- Vib Sup -- Tuning Mode = 0                     </pre>   |    | <p>Press the  or  Key and select the tuning mode “0”.</p>  |
| 4    | <pre> RUN      -- Vib Sup -- freq = ---- Hz damp = 0000                     </pre>                                      |   | <p>Press the  Key while “Tuning Mode = 0” is displayed. The screen shown on the left will appear. The detection of vibration frequencies will start and “freq” will blink. Return to step 3 if vibration is not detected.</p> <p>Note: If a vibration is not detected even though a vibration has occurred, lower the vibration detection sensibility (Pn311). When this parameter is lowered, the detection sensitivity will be increased. Vibration may not be detected accurately if too small value is set.</p> |
| 5    | <pre> RUN      -- Vib Sup -- freq = 0400 Hz damp = 0000                     </pre>                                      |  | <p>The vibration frequency will be displayed if vibration is detected.</p>  <p style="text-align: center;">Waveform</p>   |

5.6.2 Anti-resonance Control Adjustment Function Operating Procedure

































| Step | Display after Operation   | Keys  | Operation  |
|------|---|---|--|
| 6    | <pre> RUN      - Vib Sup - freq = 0400 Hz damp = 0000                     </pre>  |    | Press the  Key. The cursor will move to “damp,” and the blinking of “freq” will stop.   |
| 7    | <pre> RUN      - Vib Sup - freq = 0400 Hz damp = 0120                     </pre>  |             | Move the cursor with the  or  Keys and press the  or  Keys to set the damping gain.<br><br> <p style="text-align: center;">Waveform</p> <p>Note: Increase the damping gain from about 0% to 200% in 10% increments while checking the effect of vibration reduction. If vibration reduction is still insufficient at a gain of 200%, cancel the setting, and lower the control gain by using a different method, such as one-parameter tuning.</p> |
| 8    | <pre> RUN      - Vib Sup - freq = 0400 Hz damp = 0120                     </pre>  |    | If fine-tuning of the frequency is necessary, press the  Key. The cursor will move from “damp” to “freq”. If fine-tuning is not necessary, skip step 9 and go to step 10.   |
| 9    | <pre> RUN      - Vib Sup - freq = 0420 Hz damp = 0120                     </pre>  |     | Move the cursor with the  or  Keys and press the  or  Keys to fine-tune the frequency.   |
| 10   | <pre> RUN      - Vib Sup - freq = 0420 Hz damp = 0120                     </pre>  |    | Press  Key to save the settings. “DONE” will blink for approx. 2 seconds and “RUN” will be displayed.  |
| 11   | <pre> RUN      - FUNCTION - Fn203: OnePrmTun Fn204: A-Vib Sup Fn205: Vib Sup Fn206: Easy FFT                     </pre> |    | Press the  Key to complete the anti-resonance control adjustment function. The screen in step 1 will appear again.  |

## (2) With Determined Vibration Frequency Before Adjusting the Anti-resonance Control

| Step | Display after Operation   | Keys   | Operation  |
|------|---|--|--|
| 1    | <pre> RUN      -FUNCTION- Fn203:OnePrmTun Fn204:A-Vib Sup Fn205:Vib Sup Fn206:Easy FFT           </pre> | <br>    | <p>Press the  Key to view the main menu for the utility function mode.</p> <p>Use the  or  Key to move through the list, select Fn204.</p>  |
| 2    | <pre> RUN      - Vib Sup - Tuning Mode = 0           </pre>   |   | <p>Press the  Key to display the initial setting screen for tuning mode.</p> <p>Note: If the display does not switch and “NO-OP” is displayed, take corrective action after checking the items given in 5.6.1 (1) Before Performing Anti-Resonance Control Adjustment Function.</p>   |
| 3    | <pre> RUN      -FUNCTION- Tuning Mode = 1           </pre>  |    | <p>Press the  or  Key and select the tuning mode “1”.</p>  |
| 4    | <pre> RUN      - Vib Sup - freq = 0100 Hz damp = 0000           </pre>                                  |    | <p>Press the  Key while “Tuning Mode = 1” is displayed. The screen shown on the left will appear and “freq” will blink.</p>  <p style="text-align: center;">Waveform</p>  |
| 5    | <pre> RUN      - Vib Sup - freq = 0100 Hz damp = 0000           </pre>                                  |  <br>  | <p>Move the cursor with the  or  Keys and press the  or  Keys to adjust the frequency.</p> |
| 6    | <pre> RUN      - Vib Sup - freq = 0400 Hz damp = 000<u>0</u>           </pre>                           |   | <p>Press the  Key. The cursor will move to “damp”.</p>  |

| Step | Display after Operation   | Keys  | Operation  |
|------|---|---|--|
| 7    | <pre> RUN      - Vib Sup - freq = 0400 Hz damp = 0020 </pre>  |    | <p>Move the cursor with the  or  Key and press the  or  Key to adjust the damping gain.</p>  <p><b>Waveform</b></p> <p>Note: Increase the damping gain from about 0% to 200% in 10% increments while checking the effect of vibration reduction. If vibration reduction is still insufficient at a gain of 200%, cancel the setting, and lower the control gain by using a different method, such as one-parameter tuning.</p> |
| 8    | <pre> RUN      - Vib Sup - freq = 0400 Hz damp = 0120 </pre>  |   | <p>If fine-tuning of the frequency is necessary, press the  Key. The cursor will move from “damp” to “freq”. If fine-tuning is not necessary, skip step 9 and go to step 10.</p>   |
| 9    | <pre> RUN      - Vib Sup - freq = 0400 Hz damp = 0120 </pre>  |  | <p>Move the cursor with  or  Keys and press the  or  Keys to fine-tune the frequency.</p>  |
| 10   | <pre> RUN      - Vib Sup - freq = 0400 Hz damp = 0120 </pre>  |  | <p>Press  Key to save the settings. “DONE” will blink for approx. 2 seconds and “RUN” will be displayed.</p>   |
| 11   | <pre> RUN      - FUNCTION - Fn203: OnePrmTun Fn204: A-Vib Sup Fn205: Vib Sup Fn206: Easy FFT </pre> |  | <p>Press the  Key to complete the anti-resonance control adjustment function. The screen in step 1 will appear again.</p>   |

## (3) For Fine-tuning After Adjusting the Anti-resonance Control

| Step | Display after Operation   | Keys   | Operation   |
|------|---|--|---|
| 1    | <pre> RUN      —FUNCTION— Fn203: OnePrmTun Fn204: A-Vib Sup Fn205: Vib Sup Fn206: Easy FFT           </pre> | <br>    | <p>Press the  Key to view the main menu for the utility function mode.</p> <p>Use the  or  Key to move through the list, select Fn204.</p>   |
| 2    | <pre> RUN      —FUNCTION— Tuning Mode = 1           </pre>  |   | <p>Press the  Key to display the “Tuning Mode = 1” as shown on the left.</p> <p>Note: If the display does not switch and “NO-OP” is displayed, take corrective action after checking the items given in 5.6.1 (1) Before Performing Anti-Resonance Control Adjustment Function.</p>  |
| 3    | <pre> RUN      —Vib Sup— freq = 0400 Hz damp = 0120           </pre>  |   | <p>Press the  Key while “Tuning Mode = 1” is displayed. The screen shown on the left will appear and “damp” will blink.</p>  |
| 4    | <pre> RUN      —Vib Sup— freq = 0400 Hz damp = 01<u>5</u>0           </pre>                                 |  <br>          | <p>Move the cursor with the  or  Keys and press the  or  Keys to set the damping gain.</p> <p>Note: Increase the damping gain from about 0% to 200% in 10% increments while checking the effect of vibration reduction. If vibration reduction is still insufficient at a gain of 200%, cancel the setting, and lower the control gain by using a different method, such as one-parameter tuning.</p> |
| 5    | <pre> RUN      —Vib Sup— freq = 040<u>0</u> Hz damp = 0150           </pre>                                 |   | <p>If fine-tuning of the frequency is necessary, press the  Key. The cursor will move from “damp” to “freq”. If fine-tuning is not necessary, skip step 6 and go to step 7.</p>  |
| 6    | <pre> RUN      —Vib Sup— freq = 04<u>2</u>0 Hz damp = 0150           </pre>                                 |  <br>  | <p>Select a digit with  or  Keys, and press the  or  Keys to fine-tune the frequency.</p>   |
| 7    | <pre> RUN      —Vib Sup— freq = 0420 Hz damp = 015<u>0</u>           </pre>                                 |   | <p>Press  Key to save the settings. “DONE” will blink for approx. 2 seconds and “RUN” will be displayed.</p>   |
| 8    | <pre> RUN      —FUNCTION— Fn203: OnePrmTun Fn204: A-Vib Sup Fn205: Vib Sup Fn206: Easy FFT           </pre> |   | <p>Press the  Key to complete the anti-resonance control adjustment function. The screen in step 1 will appear again.</p>  |

## 5.6.3 Related Parameters

Pn160 and Pn161 are set automatically. The other parameters are not set automatically but the respective set values in the parameters will apply.

| Parameter    | Name   |
|--------------|--|
| <b>Pn160</b> | Anti-resonance Control Related Switch              |
| <b>Pn161</b> | Anti-resonance Frequency                           |
| <b>Pn162</b> | Anti-resonance Gain Compensation                   |
| <b>Pn163</b> | Anti-resonance Damping Gain                        |
| <b>Pn164</b> | Anti-resonance Filter Time Constant 1 Compensation |
| <b>Pn165</b> | Anti-resonance Filter Time Constant 2 Compensation |



## 5.7 Vibration Suppression Function (Fn205)

This section describes the vibration suppression function.

### 5.7.1 Vibration Suppression Function

The vibration suppression function suppresses transitional vibration at frequency as low as 1 to 100 Hz that is generated mainly when positioning if the machine stand vibrates.

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.

Perform one-parameter tuning (Fn203) or use another method to increase the responsiveness after performing this function.

#### CAUTION

- If this function is executed, related parameters will be set automatically. Therefore, the response before and after using this function may vary greatly. Enable the function in a state where the machine can come to an emergency stop at any time to ensure the safety operation of the machine.
- Be sure to set a suitable value for the moment of inertia ratio (Pn103) using advanced autotuning before executing this function. If the setting greatly differs from the actual moment of inertia ratio, normal control of the SERVOPACK may not be possible, and vibration may result.



#### IMPORTANT

- 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.
- 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) Before Performing Vibration Suppression Function

Check the following settings before performing the vibration suppression function.

- a) A message (NO-OP) indicating that no operations are possible 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 not be enabled.
  - Test without motor function must not be enabled. (Pn00C.0 = 0)
- b) Observe the following condition to ensure operation.
  - The write prohibited setting (Fn010) must not be set.

### (2) Items Influencing Performance

If continuous vibration occurs when the motor 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 in accordance with the value of the positioning completed width (Pn522). Perform the detection of vibration frequencies after adjusting the remained vibration detection width (Pn560).

|       |   |              |                 |              |                |
|-------|---|--------------|-----------------|--------------|----------------|
| Pn560 | Remained Vibration Detection Width <span style="border: 1px solid black; padding: 0 5px;">Position</span> |              |                 |              | Classification |
|       | Setting Range   | Setting Unit | Factory Setting | When Enabled |                |
|       | 1 to 3000   | 0.1%         | 400             | Immediately  | Setup          |

Note: Use a set value of 10% as a guideline. The smaller the set value is, the higher the detection sensitivity will be. If the value is too small, however, the vibration may not be detected accurately.

Vibration frequencies automatically detected may vary more or less during each positioning operation. Perform positioning several times and make adjustments while checking the effect of vibration suppression.


## 5.7.2 Vibration Suppression Function Operating Procedure

The following procedure is used for vibration suppression function.

Vibration suppression function is performed from the Digital Operator (option) or SigmaWin+.

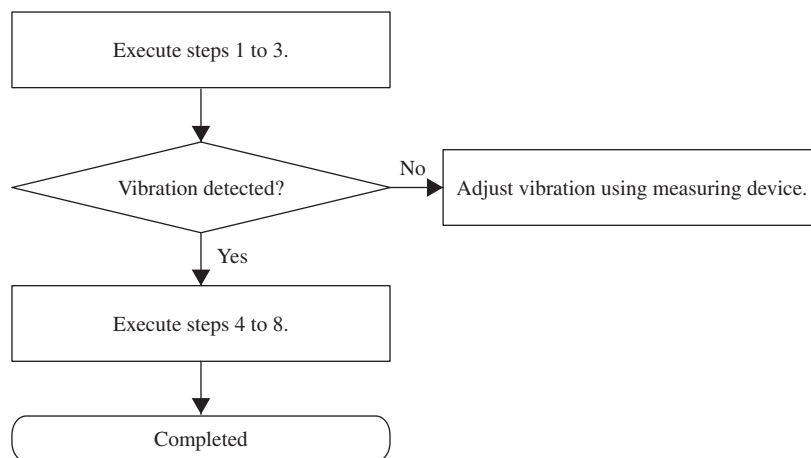
The operating procedure from the Digital Operator is described here.

For basic operations of the Digital Operator, refer to the *Σ-V series User's Manual, Operation of Digital Operator* (SIEP S800000 55).











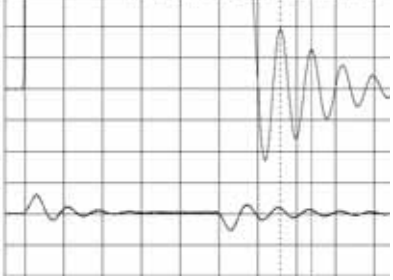








Note: If this function is aborted by pressing the  Key, the SERVOPACK will continue operating until the motor comes to a stop. After the motor stops, the set value will return to the previous value.



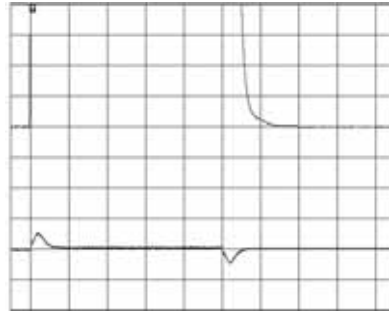




The operating flow of the vibration suppression function is shown below.


### (1) Operating Flow



(2) Operating Procedure

| Step | Display after Operation   | Keys   | Operation   |
|------|---|--|---|
| 1    | Input a control reference and take the following steps while repeating positioning.                               |  |   |
| 2    | <pre> RUN      -FUNCTION- Fn204:A-Vib Sup Fn205:Vib Sup Fn206:Easy FFT Fn207:V-Monitor                     </pre> | <br>    | <p>Press the  Key to view the main menu for the utility function mode.</p> <p>Use the  or  Key to move through the list, select Fn205.</p>   |
| 3    | <pre> RUN      -Vib Sup- Measure f=-----Hz Setting f=050.0Hz                     </pre>                           |   | <p>Press the  Key. The display shown on the left will appear.</p> <p>Measure f: Measurement frequency<br/>         Setting f: Setting frequency [Factory-set to the set value for Pn145]</p> <p>Notes:</p> <ul style="list-style-type: none"> <li>If the setting frequency and actual operating frequency are different, “Setting” will blink. The detected vibration frequency will be displayed.</li> </ul> <pre> RUN      -Vib Sup- Measure f=010.4Hz Setting f=050.0Hz                     </pre> <ul style="list-style-type: none"> <li>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.</li> </ul> <pre> RUN      -Vib Sup- Measure f=-----Hz Setting f=050.0Hz                     </pre> |
| 4    | <pre> RUN      -Vib Sup- Measure f=010.4Hz Setting f=010.4Hz                     </pre>                           |   | <p>Press the  Key. The displayed “Measure f” value will be displayed as the “Setting f” value as well.</p>  <p style="text-align: center;">Waveform</p>  |
| 5    | <pre> RUN      -Vib Sup- Measure f=010.4Hz Setting f=012.4Hz                     </pre>                           |  <br>  | <p>If the vibration is not completely suppressed, press the  or  Key to move the cursor, and press the  or  Key to fine-tune the frequency. Skip this step and go to step 7 if the fine-tuning of the frequency is not necessary.</p> <p>Note: If the setting frequency and actual operating frequency are different, “Setting” will blink.</p>   |

| Step | Display after Operation   | Keys  | Operation   |
|------|---|---|---|
| 6    | <pre> RUN      -Vib Sup- Measure f=010.4Hz Setting f=012.4Hz                     </pre>   |  | <p>Press the  Key. The “Setting f” will change to usual display and the frequency currently displayed will be set for the vibration suppression function.</p>  |
| 7    | <pre> RUN      -Vib Sup- Measure f =-----Hz Setting f =012.4Hz                     </pre> |  | <p>Press the  Key to save the settings. “DONE” will blink for approx. 2 seconds and “RUN” will be displayed.</p>   |
| 8    | <pre> RUN      -FUNCTION- Fn204 Fn205 Fn206 Fn207                     </pre>              |  | <p>Press the  Key to complete the vibration suppression function. The screen in step 1 will appear again.</p>  |



**IMPORTANT**

No settings related to the vibration suppression function will be changed during operation.


If the motor does not stop approximately 10 seconds after the setting changes, a timeout error will result and the previous setting will be enabled again.

The vibration suppression function will be enabled when the parameter is set in step 6. The motor response, however, will change when the motor comes to a stop with no reference input.

### (3) Related Function

This section describes a function related to vibration suppression.

#### ■ Feedforward



**IMPORTANT**

- Model following control is used to make optimum feedforward settings in the servo. Therefore, model following control from the host controller is not used together with either the speed feedforward input or torque feedforward input. An improper speed feedforward input or torque feedforward input may result in overshooting.

If this function is performed, the feedforward reference (Pn109) will be ignored because model following control will be enabled.

The following settings are required if model following control is used from the host controller (through the command option module) together with speed feedforward input or torque feedforward input.

| Parameter    | Function | When Enabled | Classification |
|--------------|----------|--------------|----------------|
| <b>Pn140</b> | n.0□□□   | Immediately  | Tuning         |
|              | n.1□□□   |              |                |

### 5.7.3 Related Parameters

The following parameters are set automatically by using vibration suppression function. Manual adjustments are not required.

| Parameter    | Name                                   |
|--------------|--|
| <b>Pn140</b> | Model Following Control Related Switch |
| <b>Pn141</b> | Model Following Control Gain           |
| <b>Pn145</b> | Vibration Suppression 1 Frequency A    |
| <b>Pn146</b> | Vibration Suppression 1 Frequency B    |

## 5.8 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 references, or one-parameter tuning.

- Switching gain settings
- Friction compensation
- Current Control Mode Selection
- Current Gain Level Setting
- Speed Detection Method Selection

### 5.8.1 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.

| Parameter | Function | When Enabled | Classification |
|-----------|----------|--------------|----------------|
| Pn139     | n.□□□0   | Immediately  | Tuning         |
|           | n.□□□2   |              |                |

Note: n.□□□1 is reserved. Do not set.

For the gain combinations for switching, refer to (1) *Gain Combinations for Switching*.

For the manual gain switching, refer to the manual of the connected command option module.

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<br>Speed Loop Gain     | Pn101<br>Speed Loop Integral Time Constant     | Pn102<br>Position Loop Gain     | Pn401<br>1st step<br>1st Torque Reference Filter Time Constant | Pn141*<br>Model Following Control Gain     | Pn142*<br>Model Following Control Gain Compensation     | Pn121<br>Friction Compensation Gain         |
| Gain Setting 2 | Pn104<br>2nd Speed Loop Gain | Pn105<br>2nd Speed Loop Integral Time Constant | Pn106<br>2nd Position Loop Gain | Pn412<br>1st step<br>2nd Torque Reference Filter Time Constant | Pn148*<br>2nd Model Following Control Gain | Pn149*<br>2nd Model Following Control Gain Compensation | Pn122<br>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 a command (/G-SEL1) from the command option module to switch between gain setting 1 and gain setting 2.

For details, refer to the manual of the connected command option module.

### (3) Automatic Gain Switching

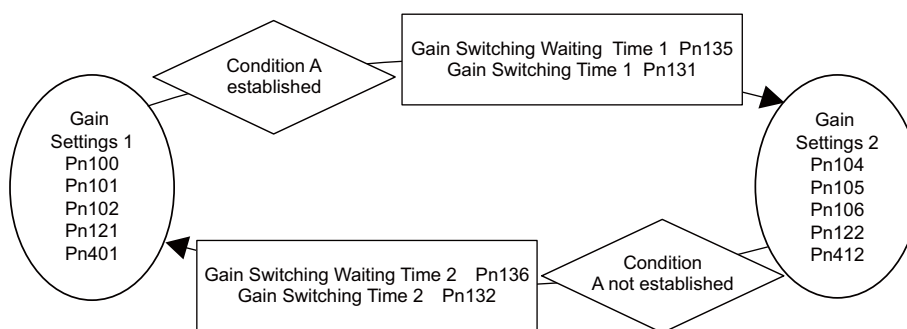
Automatic gain switching is performed under the following settings and conditions.

| Parameter Setting                               | Switching Setting            | Setting                          | Switching Wait Time                 | Switching Time              |
|---|------------------------------|----------------------------------|-------------------------------------|-----------------------------|
| <b>Pn139 = n.□□□2<br/>(Automatic Switching)</b> | Condition A established.     | Gain Setting 1 to Gain Setting 2 | Gain Switching Waiting Time 1 Pn135 | Gain Switching Time 1 Pn131 |
|   | Condition A not established. | Gain Setting 2 to Gain Setting 1 | Gain Switching Waiting Time 2 Pn136 | Gain Switching Time 2 Pn132 |

Select one of the following setting for switching condition A.

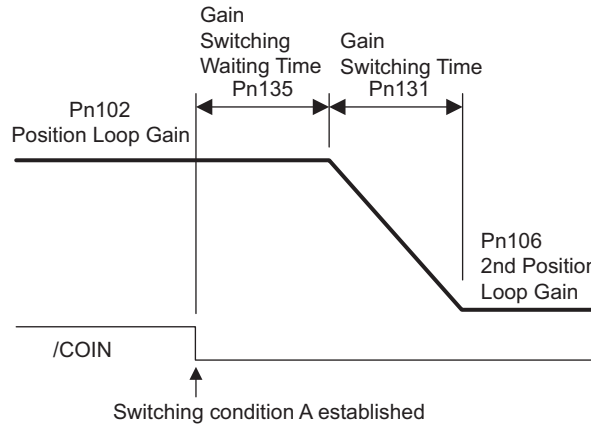
| Parameter    |        | Switching Condition A   |                             | When Enabled | Classification |
|--------------|--------|---|-----------------------------|--------------|----------------|
|              |        | Position Control  | Other than Position Control |              |                |
| <b>Pn139</b> | n.□□0□ | 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□ | Near signal mapping (/NEAR) ON  | Fixed in gain setting 1     |              |                |
|              | n.□□3□ | Near signal mapping (/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 Gain Switching Waiting Time and the Switching Time Constant

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 over 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 <span style="float:right">Speed Position</span>   |              |                 |              | Classification |
|       | Setting Range   | Setting Unit | Factory Setting | When Enabled |                |
|       | 10 to 20000   | 0.1 Hz       | 400             | Immediately  | Tuning         |
| Pn101 | Speed Loop Integral Time Constant <span style="float:right">Speed Position</span>                         |              |                 |              | Classification |
|       | Setting Range   | Setting Unit | Factory Setting | When Enabled |                |
|       | 15 to 51200   | 0.01 ms      | 2000            | Immediately  | Tuning         |
| Pn102 | Position Loop Gain <span style="float:right">Position</span>  |              |                 |              | Classification |
|       | Setting Range   | Setting Unit | Factory Setting | When Enabled |                |
|       | 10 to 20000   | 0.1/s        | 400             | Immediately  | Tuning         |
| Pn141 | Model Following Control Gain <span style="float:right">Speed Position</span>                              |              |                 |              | Classification |
|       | Setting Range   | Setting Unit | Factory Setting | When Enabled |                |
|       | 10 to 20000   | 0.1/s        | 500             | Immediately  | Tuning         |
| Pn142 | Model Following Control Gain Compensation <span style="float:right">Speed Position</span>                 |              |                 |              | Classification |
|       | Setting Range   | Setting Unit | Factory Setting | When Enabled |                |
|       | 500 to 2000   | 0.1%         | 1000            | Immediately  | Tuning         |
| Pn104 | 2nd Speed Loop Gain <span style="float:right">Speed Position</span>                                       |              |                 |              | Classification |
|       | Setting Range   | Setting Unit | Factory Setting | When Enabled |                |
|       | 10 to 20000   | 0.1 Hz       | 400             | Immediately  | Tuning         |
| Pn105 | 2nd Speed Loop Integral Time Constant <span style="float:right">Speed Position</span>                     |              |                 |              | Classification |
|       | Setting Range   | Setting Unit | Factory Setting | When Enabled |                |
|       | 15 to 51200   | 0.01 ms      | 2000            | Immediately  | Tuning         |
| Pn106 | 2nd Position Loop Gain <span style="float:right">Position</span>  |              |                 |              | Classification |
|       | Setting Range   | Setting Unit | Factory Setting | When Enabled |                |
|       | 10 to 20000   | 0.1/s        | 400             | Immediately  | Tuning         |
| Pn121 | Friction Compensation Gain <span style="float:right">Speed Position</span>                                |              |                 |              | Classification |
|       | Setting Range   | Setting Unit | Factory Setting | When Enabled |                |
|       | 10 to 1000  | 0.1%         | 100             | Immediately  | Tuning         |
| Pn122 | 2nd Gain for Friction Compensation <span style="float:right">Speed Position</span>                        |              |                 |              | Classification |
|       | Setting Range   | Setting Unit | Factory Setting | When Enabled |                |
|       | 10 to 1000  | 1%           | 100             | Immediately  | Tuning         |
| Pn148 | 2nd Model Following Control Gain <span style="float:right">Speed Position</span>                          |              |                 |              | 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 <span style="float:right">Speed Position</span>             |              |                 |              | Classification |
|       | Setting Range   | Setting Unit | Factory Setting | When Enabled |                |
|       | 500 to 2000   | 0.1 %        | 1000            | Immediately  | Tuning         |
| Pn412 | 1st step 2nd Torque Reference Filter Time Constant <span style="float:right">Speed Position Torque</span> |              |                 |              | Classification |
|       | Setting Range   | Setting Unit | Factory Setting | When Enabled |                |
|       | 0 to 65535  | 0.01 ms      | 100             | Immediately  | Tuning         |

## (5) Parameters for Automatic Gain Switching

|       |   |              |                 |              |                |
|-------|---|--------------|-----------------|--------------|----------------|
| Pn131 | Gain Switching Time 1 <span style="float:right">Speed <input type="checkbox"/> Position <input type="checkbox"/></span>         |              |                 |              | Classification |
|       | Setting Range   | Setting Unit | Factory Setting | When Enabled |                |
|       | 0 to 65535  | 1 ms         | 0               | Immediately  | Tuning         |
| Pn132 | Gain Switching Time 2 <span style="float:right">Speed <input type="checkbox"/> Position <input type="checkbox"/></span>         |              |                 |              | Classification |
|       | Setting Range   | Setting Unit | Factory Setting | When Enabled |                |
|       | 0 to 65535  | 1 ms         | 0               | Immediately  | Tuning         |
| Pn135 | Gain Switching Waiting Time 1 <span style="float:right">Speed <input type="checkbox"/> Position <input type="checkbox"/></span> |              |                 |              | Classification |
|       | Setting Range   | Setting Unit | Factory Setting | When Enabled |                |
|       | 0 to 65535  | 1 ms         | 0               | Immediately  | Tuning         |
| Pn136 | Gain Switching Waiting Time 2 <span style="float:right">Speed <input type="checkbox"/> Position <input type="checkbox"/></span> |              |                 |              | 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 | Analog Monitor | Name        | Output Value | Remarks                    |
|-----------|----------------|-------------|--------------|----------------------------|
| Pn006     | n.□□0B         | Active gain | 1 V          | Gain setting 1 is enabled. |
| Pn007     |                |             | 2 V          | Gain setting 2 is enabled. |

## 5.8.2 Friction Compensation

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

The factors causing load changes include grease viscosity resistance changes resulting from temperature changes in addition to viscous friction and regular load changes resulting from equipment variations and secular changes.

Friction compensation is automatically adjusted by the following settings.

1. The advanced autotuning level is set to mode 2 or 3.
2. The one-parameter tuning mode is set to 2 or 3.

Refer to the following description and make adjustments only if manual adjustment is required.

### (1) Required Parameter Settings

The following parameter settings are required to use friction compensation.

| Parameter    | Function | When Enabled | Classification |
|--------------|----------|--------------|----------------|
| <b>Pn408</b> | n.0□□□   | Immediately  | Setup          |
|              | n.1□□□   |              |                |

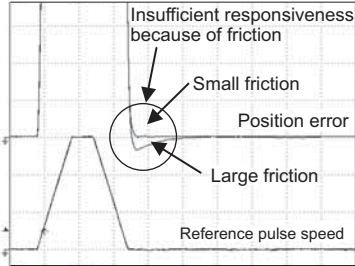
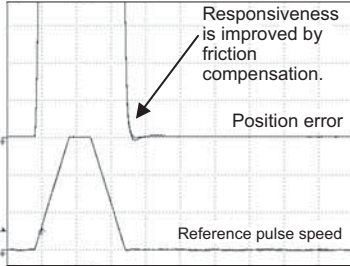
|              |  |              |                 |              |                |
|--------------|--|--------------|-----------------|--------------|----------------|
| <b>Pn121</b> | Friction Compensation Gain <span style="float: right;">Speed Position</span>                 |              |                 |              | Classification |
|              | Setting Range  | Setting Unit | Factory Setting | When Enabled |                |
|              | 10 to 1000   | 1 %          | 100             | Immediately  | Tuning         |
| <b>Pn123</b> | Friction Compensation Coefficient <span style="float: right;">Speed Position</span>          |              |                 |              | Classification |
|              | Setting Range  | Setting Unit | Factory Setting | When Enabled |                |
|              | 0 to 100   | 1 %          | 0               | Immediately  | Tuning         |
| <b>Pn124</b> | Friction Compensation Frequency Correction <span style="float: right;">Speed Position</span> |              |                 |              | Classification |
|              | Setting Range  | Setting Unit | Factory Setting | When Enabled |                |
|              | -10000 to 10000  | 0.1 Hz       | 0               | Immediately  | Tuning         |
| <b>Pn125</b> | Friction Compensation Gain Correction <span style="float: right;">Speed Position</span>      |              |                 |              | Classification |
|              | Setting Range  | Setting Unit | Factory Setting | When Enabled |                |
|              | 1 to 1000  | 1 %          | 100             | Immediately  | Tuning         |

## (2) Operating Procedure for Friction Compensation

The following procedure is used for friction compensation.

### ⚠ CAUTION

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

| Step | Operation   |
|------|---|
| 1    | <p>Set the following parameters for friction compensation to the factory setting as follows.</p> <p>Friction compensation gain (Pn121): 100<br/>Friction compensation coefficient (Pn123): 0<br/>Friction compensation frequency correction (Pn124): 0<br/>Friction compensation gain correction (Pn125): 100</p> <p>Note: Always use the factory-set values for friction compensation frequency correction (Pn124) and friction compensation gain correction (Pn125).</p>  |
| 2    | <p>To check the effect of friction compensation, increase the friction compensation coefficient (Pn123).</p> <p>Note: Normally, set the upper limit of the friction compensation coefficient (Pn123) to 95% max.</p>  |
| 3    | <p>If the friction compensation is insufficient in step 2, increase the set value in Pn121 to where the equipment does not vibrate.</p> <p>Note: The SERVOPACK may vibrate if Pn121 is set to a value the same as or higher than the resonance frequency of the equipment.<br/>If necessary, adjust Pn121 in increments of 10%.</p> <p><b>Effect of Adjustment</b><br/>The following graph shows the responsiveness with and without proper adjustment.</p> <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;">  <p>Without friction compensation</p> </div> <div style="text-align: center;">  <p>With friction compensation</p> </div> </div> <p><b>Effect of Adjustment Parameters</b></p> <p><b>Pn121: Friction Compensation Gain</b><br/>This parameter sets the responsiveness for external disturbance. The higher the set value is, the better the responsiveness will be. If the equipment has a resonance frequency, however, vibration may result if the set value is the same as or high than the resonance frequency.</p> <p><b>Pn123: Friction Compensation Coefficient</b><br/>This parameter sets the effect of friction compensation. The higher the set value is, the more effective friction compensation will be. If the set value is excessively high, however, the vibration will occur easily. Usually, set the value to 95% or less.</p> |

### 5.8.3 Current Control Mode Selection

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

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

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



IMPORTANT

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

### 5.8.4 Current Gain Level Setting

This function reduces noises by adjusting the parameter value for current control inside the SERVOPACK in accordance with the parameter value for the speed loop gain (Pn100). To change the parameter value for current control, lower the current gain level (Pn13D) so it is less than 2000% (factory setting). This function is always disabled in torque control mode (Pn000.1 = 2).

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

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



IMPORTANT

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

### 5.8.5 Speed Detection Method Selection

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

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



IMPORTANT

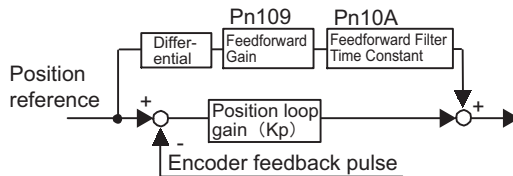
- If this function is changed, the responsiveness characteristic of the speed loop will also change. The servo must, therefore, be readjusted again.

## 5.9 Compatible Adjustment Function

The  $\Sigma$ -V series SERVOPACKs have the adjustment functions explained in sections 5.1 to 5.8 that can be used to make machine adjustments. This section explains compatible functions provided by earlier models, such as the  $\Sigma$ -III SERVOPACK.

### 5.9.1 Feedforward Reference

Applies feedforward control compensation in position control inside the SERVOPACK. Use this parameter to shorten positioning time.



|              |  |              |                 |              |                |
|--------------|--|--------------|-----------------|--------------|----------------|
| <b>Pn109</b> | Feedforward Gain <span style="float: right;">Position</span>                 |              |                 |              | Classification |
|              | Setting Range  | Setting Unit | Factory Setting | When Enabled |                |
|              | 0 to 100   | 1%           | 0               | Immediately  | Tuning         |
| <b>Pn10A</b> | Feedforward Filter Time Constant <span style="float: right;">Position</span> |              |                 |              | Classification |
|              | Setting Range  | Setting Unit | Factory Setting | When Enabled |                |
|              | 0 to 6400  | 0.01 ms      | 0               | Immediately  | Tuning         |

If the Feedforward Gain (Pn109) is set to a value that is too high, the machine may vibrate. The gain setting should be set to a value less than 80%.

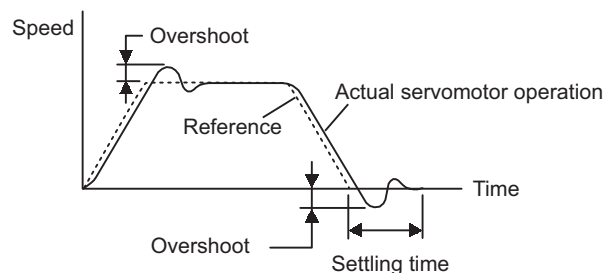
### 5.9.2 Using the Mode Switch (P/PI Switching)

Use the mode switch (P/PI switching) function in the following cases:

- To suppress overshooting during acceleration or deceleration (for speed control)
- To over overshooting during positioning and reduce the settling time (for position control)

P Control: Proportional control

PI Control: Proportional/integral control



To enable the mode switch, set Pn10B.0 to 0 to 3. The mode switch changes the speed-control mode to PI (proportional/integral) control or P (proportional) control.

Notes:

- Monitoring the speed response waveform and position error waveform is required for adjustment.
- If I-P control is selected for speed loop control, the mode switching function will be disabled.

(1) Related Parameters

Select the conditions to switch modes (P or PI control switching) by using the following parameters.

| Parameter    | Mode Switch Selection | Parameter Containing Detection Point Setting                         | When Enabled | Classification |       |
|--------------|-----------------------|--|--------------|----------------|-------|
| <b>Pn10B</b> | n.□□□0                | Uses a torque reference level for detection point. [Factory setting] | Pn10C        | Immediately    | Setup |
|              | n.□□□1                | Uses a speed reference level for detection point.                    | Pn10D        |                |       |
|              | n.□□□2                | Uses an acceleration level for detection point.                      | Pn10E        |                |       |
|              | n.□□□3                | Uses an position error pulse level for detection point.              | Pn10F        |                |       |
|              | n.□□□4                | Does not use mode switch function.                                   | —            |                |       |

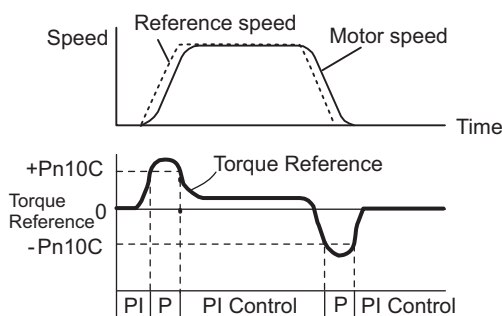
■ Parameters to set the detection point

|              |  |                        |                 |              |                |
|--------------|--|------------------------|-----------------|--------------|----------------|
| <b>Pn10C</b> | Mode Switch (Torque Reference) <span style="float:right">Speed <input type="checkbox"/> Position <input type="checkbox"/></span> |                        |                 |              | Classification |
|              | Setting Range  | Setting Unit           | Factory Setting | When Enabled |                |
|              | 0 to 800   | 1%                     | 200             | Immediately  | Tuning         |
| <b>Pn10D</b> | Mode Switch (Speed Reference) <span style="float:right">Speed <input type="checkbox"/> Position <input type="checkbox"/></span>  |                        |                 |              | Classification |
|              | Setting Range  | Setting Unit           | Factory Setting | When Enabled |                |
|              | 0 to 10000   | 1 min <sup>-1</sup>    | 0               | Immediately  | Tuning         |
| <b>Pn10E</b> | Mode Switch (Acceleration) <span style="float:right">Speed <input type="checkbox"/> Position <input type="checkbox"/></span>     |                        |                 |              | Classification |
|              | Setting Range  | Setting Unit           | Factory Setting | When Enabled |                |
|              | 0 to 30000   | 1 min <sup>-1</sup> /s | 0               | Immediately  | Tuning         |
| <b>Pn10F</b> | Mode Switch (Position Error Pulse) <span style="float:right">Position <input type="checkbox"/></span>                            |                        |                 |              | Classification |
|              | Setting Range  | Setting Unit           | Factory Setting | When Enabled |                |
|              | 0 to 10000   | 1 reference unit       | 0               | Immediately  | Tuning         |

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

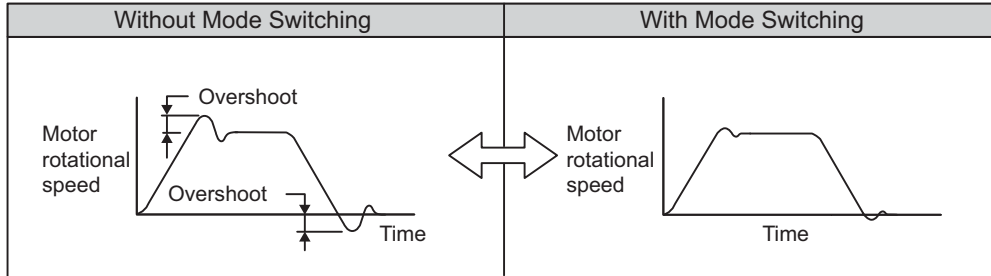
■ Using the Torque Reference Level to Switch Modes (Factory Setting)

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



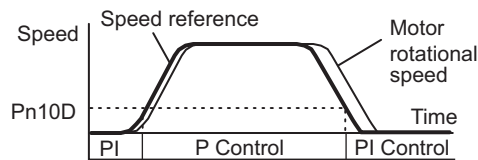
<Example>

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



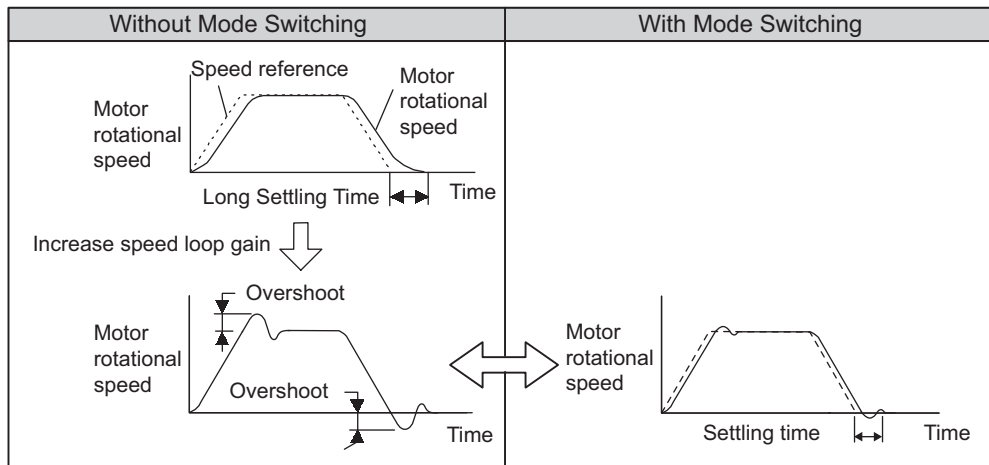
■ Using the Speed Reference Level to Switch Modes

With this setting, the speed loop is switched to P control when the value of speed reference input exceeds the speed set in Pn10D.



<Example>

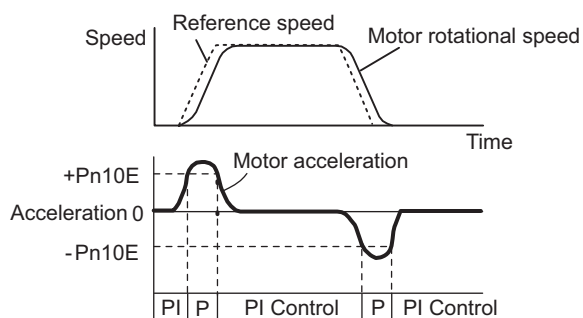
In this example, the mode switch is used to reduce the settling time. It is necessary to increase the speed loop gain to reduce the settling time. Using the mode switch suppresses overshooting when speed loop gain is increased.





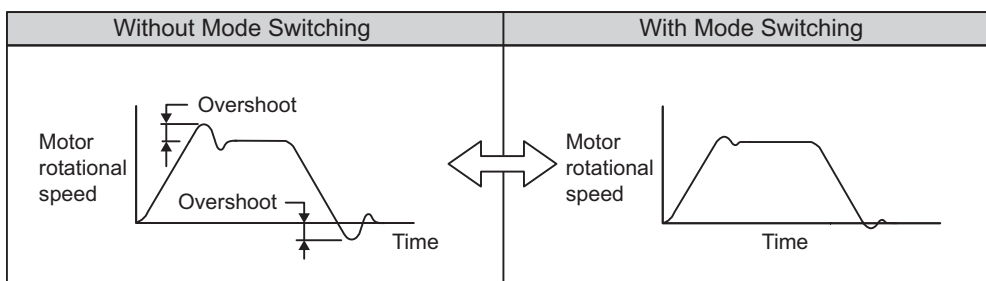
■ Using the Acceleration Level to Switch Modes

With this setting, the speed loop is switched to P control when the speed reference exceeds the acceleration rate set in Pn10E.



<Example>

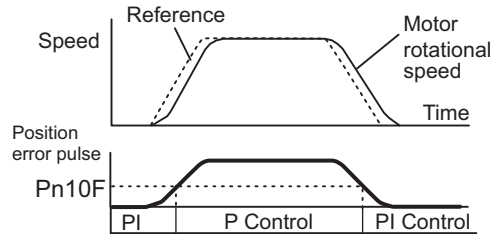
If the mode switch function is not being used and the SERVOPACK is always operated with PI control, the speed of the motor may overshoot due to torque saturation during acceleration or deceleration. The mode switch function suppresses torque saturation and eliminates the overshooting of the motor rotational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



## ■ Using the Position Error Pulse Level to Switch Modes

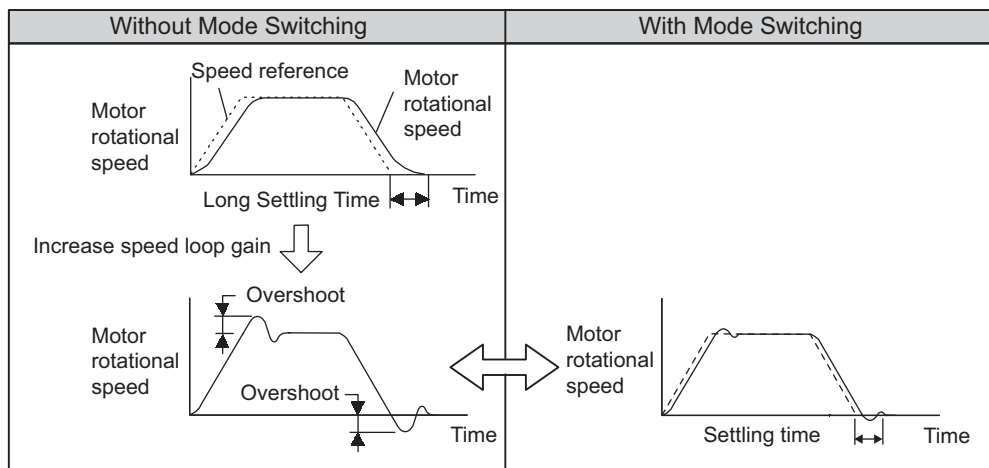
With this setting, the speed loop is switched to P control when the position error pulse exceeds the value set in Pn10F.

This setting is effective with position control only.



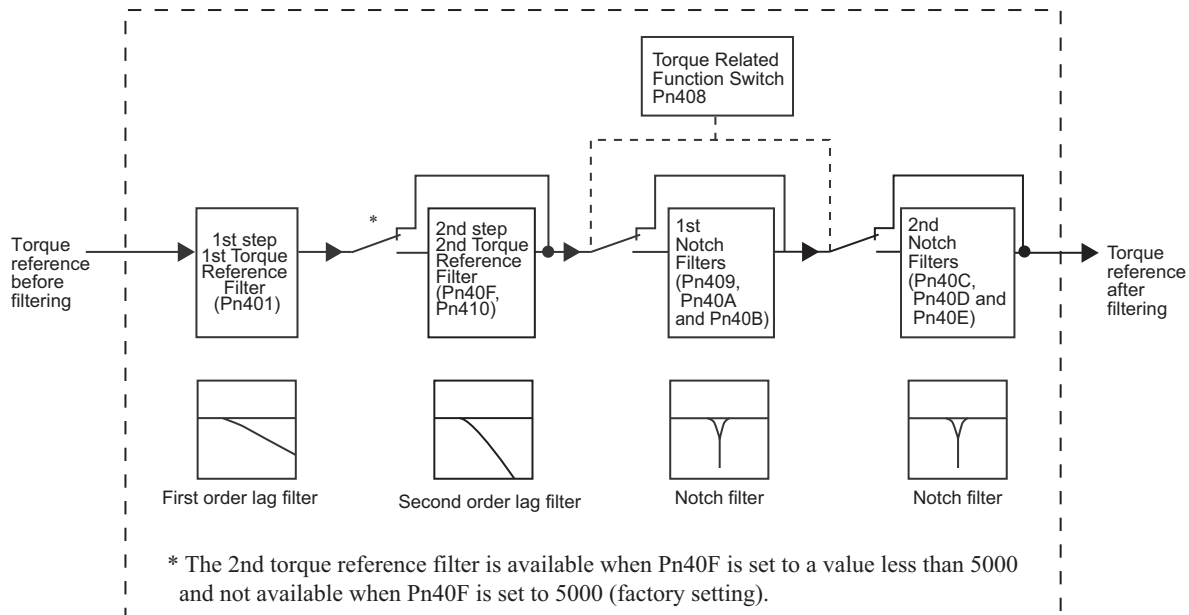
### <Example>

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



### 5.9.3 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. This may stop the vibration. The lower the value, the better the speed control response will be, but there is a lower limit that depends on the machine conditions.

|              |                                      |              |                 |              |                |        |
|--------------|--------------------------------------|--------------|-----------------|--------------|----------------|--------|
| <b>Pn401</b> | 1st Step 1st Torque Reference Filter |              |                 |              | Classification |        |
|              | Time Constant                        |              | Speed           | Position     |                | Torque |
|              | Setting Range                        | Setting Unit | Factory Setting | When Enabled |                |        |
|              | 0 to 65535                           | 0.01 ms      | 100             | Immediately  | Tuning         |        |

#### ■ Torque Reference Filter Guide

- Use the speed loop gain (Pn100 [Hz]) and the torque filter time constant (Pn401 [ms]).  
 Adjusted value for stable control:  $Pn401 [ms] \leq 1000 / (2\pi \times Pn100 [Hz] \times 4)$   
 Critical gains:  $Pn401 [ms] < 1000 / (2\pi \times Pn100 [Hz] \times 1)$

| Parameter | Meaning | When Enabled                                 | Classification |        |
|-----------|---------|--|----------------|--------|
| Pn408     | n.□□□0  | Disables 1st notch filter. [Factory setting] | Immediately    | Tuning |
|           | n.□□□1  | Uses 1st notch filter.                       |                |        |
|           | n.□0□□  | Disables 2nd notch filter. [Factory setting] |                |        |
|           | n.□1□□  | Uses 2nd notch filter.                       |                |        |

|       |   |              |                 |              |                |
|-------|---|--------------|-----------------|--------------|----------------|
| Pn40C | 2nd Notch Filter Frequency <span style="float:right">Speed Position Torque</span>                     |              |                 |              | Classification |
|       | Setting Range   | Setting Unit | Factory Setting | When Enabled |                |
|       | 50 to 5000  | 1 Hz         | 5000            | Immediately  | Tuning         |
| Pn40D | 2nd Notch Filter Q Value <span style="float:right">Speed Position Torque</span>                       |              |                 |              | Classification |
|       | Setting Range   | Setting Unit | Factory Setting | When Enabled |                |
|       | 50 to 1000  | 0.01         | 70              | Immediately  | Tuning         |
| Pn40E | 2nd Notch Filter Depth <span style="float:right">Speed Position Torque</span>                         |              |                 |              | Classification |
|       | Setting Range   | Setting Unit | Factory Setting | When Enabled |                |
|       | 0 to 1000   | 0.001        | 0               | Immediately  | Tuning         |
| Pn40F | 2nd Step 2nd Torque Reference Filter Frequency <span style="float:right">Speed Position Torque</span> |              |                 |              | 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 <span style="float:right">Speed Position Torque</span>   |              |                 |              | Classification |
|       | Setting Range   | Setting Unit | Factory Setting | When Enabled |                |
|       | 50 to 1000  | 0.01         | 50              | 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 frequency (Pn409 or Pn40C) only when the motor is stopped. Vibration may occur if the notch filter frequency is changed when the motor is rotating.

### 5.9.4 Position Integral Time Constant

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

|       |   |              |                 |              |                |
|-------|---|--------------|-----------------|--------------|----------------|
| Pn11F | Position Integral Time Constant <span style="float:right">Position</span> |              |                 |              | Classification |
|       | Setting Range   | Setting Unit | Factory Setting | When Enabled |                |
|       | 0 to 50000  | 0.1 ms       | 0               | Immediately  | Tuning         |

## Utility Functions (Fn□□□)

|   |      |
|---|------|
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| 6.3 JOG Operation (Fn002)   | 6-4  |
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## 6.1 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 |
|--------------|---|-------------------|
| Fn000        | Alarm history display   | 6.2               |
| Fn002        | JOG operation   | 6.3               |
| Fn003        | Origin search   | 6.4               |
| Fn004        | Program JOG operation   | 6.5               |
| Fn005        | Initializing parameter settings   | 6.6               |
| Fn006        | Clearing alarm history  | 6.7               |
| Fn008        | Absolute encoder multi-turn reset and encoder alarm reset                               | 4.5.4             |
| Fn00C        | Offset adjustment of analog monitor output  | 6.8               |
| Fn00D        | Gain adjustment of analog monitor output  | 6.9               |
| Fn00E        | Automatic offset-signal adjustment of motor current detection signal                    | 6.10              |
| Fn00F        | Manual offset-signal adjustment of motor current detection signal                       | 6.11              |
| Fn010        | Write prohibited setting  | 6.12              |
| Fn011        | Servomotor model display  | 6.13              |
| Fn012        | Software version display  | 6.14              |
| Fn013        | Multi-turn limit value setting change when a multi-turn limit disagreement alarm occurs | 4.5.7             |
| Fn014        | Resetting configuration error of option module  | 6.15              |
| Fn01B        | Vibration detection level initialization  | 6.16              |
| Fn01E        | Display of SERVOPACK and servomotor ID  | 6.17              |
| Fn01F        | Display of servomotor ID in feedback option module                                      | 6.18              |
| Fn020        | Origin setting  | 6.19              |
| Fn030        | Software reset  | 6.20              |
| Fn200        | Tuning-less level setting   | 5.2.2             |
| Fn201        | Advanced autotuning   | 5.3.2             |
| Fn202        | Advanced autotuning by reference  | 5.4.2             |
| Fn203        | One-parameter tuning  | 5.5.2             |
| Fn204        | Anti-resonance control adjustment function  | 5.6.2             |
| Fn205        | Vibration suppression function  | 5.7.2             |
| Fn206        | EasyFFT   | 6.21              |
| Fn207        | Online vibration monitor  | 6.22              |

- Note 1. If the write prohibited setting (Fn010) is enabled, “NO-OP” is displayed on the status display of the digital operator if the user attempts to execute the above utility functions. To execute these utility functions, set Fn010 to write permitted. For details, refer to 6.12 *Write Prohibited Setting (Fn010)*.
2. If the utility functions given above are executed using SigmaWin+ or the option module, “NO-OP” will be displayed if an attempt is made to execute the utility function using the digital operator.

## 6.2 Alarm History Display (Fn000)

This function displays the alarm history to check the ten latest alarms.

The latest ten alarm numbers and time stamps\* can be checked.

\* Time Stamps

A function that measures the ON times of the control power supply and main circuit power supply in 100-ms units and displays the operating time when an alarm occurs. The time stamp operates around the clock for approximately 13 years.

<Example of Time Stamps>













If 36000 is displayed,

360000 [ms] = 3600 [s]

= 60 [min]

= 1 [h] Therefore, the total number of operating hours is 1.

Follow the steps below to confirm the alarm histories.

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

<Notes>

- If the same alarm occurs again more than one hour later, a record of this alarm is also saved.
- The message "□: \_\_\_" indicates that no alarm occurs.
- Delete the alarm history using the parameter Fn006. The alarm history is not cleared on alarm reset or when the SERVOPACK power is turned OFF.

## 6.3 JOG Operation (Fn002)

JOG operation is used to check the operation of the servomotor under speed control without connecting the SERVOPACK to the host.

### CAUTION

While the SERVOPACK is in JOG operation, the overtravel function will be disabled. Consider the operating range of the machine when performing JOG operation for the SERVOPACK.

#### (1) Settings before Operation

The following settings are required before performing JOG operation.



















- If a servo ON command is input, send a servo OFF command.
- Considering the operating range of the machine, set the JOG operation speed in Pn304.

| Pn304 | JOG Speed     |                       |                 |              | Classification |
|-------|---------------|-----------------------|-----------------|--------------|----------------|
|       | Setting Range | Setting Unit          | Factory Setting | When Enabled |                |
|       | 0 to 10000    | 1 min <sup>-1</sup> * | 500             | Immediately  |                |













\* When using an SGMCS direct drive motor, the setting unit will be automatically changed to 0.1 min<sup>-1</sup>

#### (2) Operating Procedure

Follow the steps below to set the JOG speed. The following example is given when the rotating direction of servomotor is set as Pn000.0 = 0 (Forward rotation by forward reference).

| Step | Display Example  | Keys   | Description   |
|------|--|--|---|
| 1    | <pre> BB      -FUNCTION- Fn000: Alm History Fn002: JOG Fn003: Z-Search Fn004: Program JOG           </pre> | <br><br>  | Press the  Key to open the Utility Function Mode main menu and select Fn002.   |
| 2    | <pre> BB      -JOG- Pn304=00500 Un000= 00000 Un002= 00000 Un00D=00000000           </pre>                  |   | Press the  Key. The display is switched to the execution display of Fn002.<br>Note: If the display is not switched and “NO-OP” is displayed in the status display, change the following settings. (Refer to 6.12.)<br>• If Write Prohibited is set in Fn010:<br>→ Cancel the Write Prohibited setting.<br>• If a servo ON command is input:<br>→ Send a servo OFF command. |
| 3    | <pre> BB      -JOG- Pn304=0050<u>0</u> Un000= 00000 Un002= 00000 Un00D=00000000           </pre>           |   | Press the  Key.<br>The cursor moves to the setting side (the right side) of Pn304 (JOG speed).   |
| 4    | <pre> BB      -JOG- Pn304=01<u>0</u>00 Un000= 00000 Un002= 00000 Un00D=00000000           </pre>           | <br><br><br> | Press the  or  Key and the  or  Key to set the JOG speed to 1000 min <sup>-1</sup> .                        |
| 5    | <pre> BB      -JOG- Pn304=01000 Un000= 00000 Un002= 00000 Un00D=00000000           </pre>                  |   | Press the  Key.<br>The setting value is entered, and the cursor moves to the parameter number side (the left side).  |



| Step | Display Example  | Keys  | Description  |
|------|--|---|--|
| 6    | <pre> RUN                -JOG- Pn304=01000 Un000= 00000 Un002= 00000 Un00D=00000000 </pre>                 |    | Press the  Key.<br>“RUN” is displayed in the status display, and power is applied to the servomotor.  |
| 7    | <pre> RUN                -JOG- Pn304=01000 Un000= 00000 Un002= 00000 Un00D=00000000 </pre>                 |   | The servomotor will rotate at the present speed set in Pn304 while the  Key (for forward rotation) or  Key (for reverse rotation) is pressed.<br> Forward<br> Reverse |
| 8    | <pre> BB                -JOG- Pn304=01000 Un000= 00000 Un002= 00000 Un00D=00000000 </pre>                  |    | After having confirmed the correct motion of servomotor, press the  Key.<br>“BB” is displayed in the status display, and power is not applied to the servomotor.  |
| 9    | <pre> BB                -FUNCTION- Fn000: Alm History Fn002: JOG Fn003: Z-Search Fn004: Program JOG </pre> |    | Press the  Key to return to the Utility Function Mode main menu.  |
| 10   | After JOG operation, turn OFF the power and then turn ON again.  |   |  |

## 6.4 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.

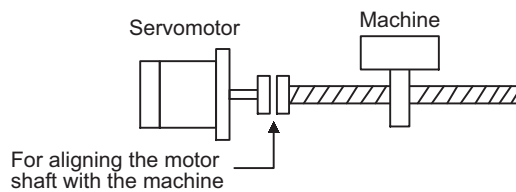
### CAUTION

- 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 mode is used when the motor shaft needs to be aligned to the machine.

Motor speed at the time of execution:  $60 \text{ min}^{-1}$

(For SGMCS direct drive motors, the speed at the time of execution is  $6 \text{ min}^{-1}$ )











### (1) Settings before Operation

















The following settings are required before performing an origin search.

- If a servo ON command is input, send a servo OFF command.

### (2) Operating Procedure

Follow the steps below to execute the origin search.

| Step | Display Example   | Keys  | Description   |
|------|---|---|---|
| 1    | <pre> BB      —FUNCTION— Fn002 : JOG Fn003 : Z-Search Fn004 : Program JOG Fn005 : Prm Init           </pre> | <br><br> | Press the  Key to open the Utility Function Mode main menu and select Fn003.   |
| 2    | <pre> BB      —Z-Search— Un000 = 00000 Un002 = 00000 Un003 = 00774 Un00D = 00000000           </pre>        |    | Press the  Key. The display is switched to the execution display of Fn003.<br>Note: If the display is not switched and “NO-OP” is displayed in the status display, change the following settings. (Refer to 6.12.)<br><ul style="list-style-type: none"> <li>• If Write Prohibited is set in Fn010:<br/>→ Cancel the Write Prohibited setting.</li> <li>• If a servo ON command is input:<br/>→ Send a servo OFF command.</li> </ul> |
| 3    | <pre> BB      —Z-Search— Un000 = 00000 Un002 = 00000 Un003 = 00774 Un00D = 00000000           </pre>        |    | Press the  Key.<br>“RUN” is displayed in the status display, and power is applied to the servomotor.<br>Note: If the servomotor is already at the zero position, “-Complete-” is displayed.  |

| Step      | Display Example   | Keys  | Description  |           |  |   |   |       |        |     |    |        |    |     |
|-----------|---|---|--|-----------|--|---|---|-------|--------|-----|----|--------|----|-----|
| 4         | <pre> RUN      -Complete- Un000= 00000 Un002= 00000 Un003=00000 Un00D=00001D58 </pre>         |   | <p>Pressing the  Key will rotate the motor in the forward direction. Pressing the  Key will rotate the motor in the reverse direction. The rotation of the servomotor changes according to the setting of Pn000.0.</p> <table border="1"> <thead> <tr> <th colspan="2">Parameter</th> <th> key (Forward)</th> <th> key (Reverse)</th> </tr> </thead> <tbody> <tr> <td rowspan="2">Pn000</td> <td>n.□□□0</td> <td>CCW</td> <td>CW</td> </tr> <tr> <td>n.□□□1</td> <td>CW</td> <td>CCW</td> </tr> </tbody> </table> <p>Note: Direction when viewed from the load of the servomotor.</p> <p>Press the  or  Key until the motor stops. If the origin search is completed normally, “-Complete-” is displayed on the right top on the screen.</p> | Parameter |  |  key (Forward) |  key (Reverse) | Pn000 | n.□□□0 | CCW | CW | n.□□□1 | CW | CCW |
| Parameter |   |  key (Forward)   |  key (Reverse)  |           |  |   |   |       |        |     |    |        |    |     |
| Pn000     | n.□□□0  | CCW   | CW   |           |  |   |   |       |        |     |    |        |    |     |
|           | n.□□□1  | CW  | CCW  |           |  |   |   |       |        |     |    |        |    |     |
| 5         | <pre> BB      -Z-Search- Un000= 00000 Un002= 00000 Un003=00774 Un00D=00001D58 </pre>          |    | <p>When the origin search is completed, press the  Key.</p> <p>“BB” is displayed in the status display, and power will not be applied to the servomotor. The display “-Complete-” changes to “-Z-Search-”</p>   |           |  |   |   |       |        |     |    |        |    |     |
| 6         | <pre> BB      -FUNCTION- Fn002: JOG Fn003: Z-Search Fn004: Program JOG Fn005: Prm Init </pre> |    | <p>Press the  Key to return to the Utility Function Mode main menu.</p>   |           |  |   |   |       |        |     |    |        |    |     |
| 7         | After origin search operation, turn OFF the power and then turn ON again.                     |   |  |           |  |   |   |       |        |     |    |        |    |     |

## 6.5 Program JOG Operation (Fn004)

The Program JOG Operation is a utility function, that allows continuous automatic operation determined by the preset operation pattern, movement distance, movement speed, acceleration/deceleration time, waiting time, and number of time 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) Settings before Operation

The following settings are required before performing a program JOG operation.

- Consider the machine operation range and safe operation when setting the movement distance and speed correctly.
- If a servo ON command has been input, send a servo OFF command.
- The main power is supplied.
- No alarm is detected.
- The overtravel does not occur.
- HWBB function is disable.

Note:

- The functions that are applicable for position control, such as position reference filter, can be used.
- The overtravel function is enabled in this function.

### (2) Related Parametersf

|       |   |                       |                 |              |                |
|-------|---|-----------------------|-----------------|--------------|----------------|
| Pn530 | Program JOG Operation Related Switch <span style="float:right">Speed Position Torque</span>       |                       |                 |              | Classification |
|       | Setting Range   | Setting Unit          | Factory Setting | When Enabled |                |
|       | 0000 to 0005  | –                     | 0000            | Immediately  | Setup          |
| Pn531 | Program JOG Movement Distance <span style="float:right">Speed Position Torque</span>              |                       |                 |              | Classification |
|       | Setting Range   | Setting Unit          | Factory Setting | When Enabled |                |
|       | 1 to 1073741824(2 <sup>30</sup> )   | 1 reference unit      | 32768           | Immediately  | Setup          |
| Pn533 | Program JOG Movement Speed <span style="float:right">Speed Position Torque</span>                 |                       |                 |              | Classification |
|       | Setting Range   | Setting Unit          | Factory Setting | When Enabled |                |
|       | 1 to 10000  | 1 min <sup>-1</sup> * | 500             | Immediately  | Setup          |
| Pn534 | Program JOG Acceleration/Deceleration Time <span style="float:right">Speed Position Torque</span> |                       |                 |              | Classification |
|       | Setting Range   | Setting Unit          | Factory Setting | When Enabled |                |
|       | 2 to 10000  | 1 ms                  | 100             | Immediately  | Setup          |
| Pn535 | Program JOG Waiting Time <span style="float:right">Speed Position Torque</span>                   |                       |                 |              | 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 <span style="float:right">Speed Position Torque</span>    |                       |                 |              | Classification |
|       | Setting Range   | Setting Unit          | Factory Setting | When Enabled |                |
|       | 0 to 1000   | 1 time                | 1               | Immediately  | Setup          |

\* When using an SGMCS direct drive motor, the setting unit will be automatically changed to 0.1 min<sup>-1</sup>

| Parameter | Contents | Factory Setting  |   |
|-----------|----------|--|---|
| Pn530     | n.□□□0   | (Waiting time Pn535 → Forward movement Pn531) × Number of times of movement Pn536  | 0 |
|           | n.□□□1   | (Waiting time Pn535 → Reverse movement Pn531) × Number of times of movement Pn536  |   |
|           | n.□□□2   | (Waiting time Pn535 → Forward movement Pn531) × Number of times of movement Pn536<br>(Waiting time Pn535 → Reverse movement Pn531) × Number of times of movement Pn536 |   |
|           | n.□□□3   | (Waiting time Pn535 → Reverse movement Pn531) × Number of times of movement Pn536<br>(Waiting time Pn535 → Forward movement Pn531) × Number of times of movement Pn536 |   |
|           | n.□□□4   | (Waiting time Pn535 → Forward movement Pn531 → Waiting time Pn535 → Reverse movement Pn531) × Number of times of movement Pn536  |   |
|           | n.□□□5   | (Waiting time Pn535 → Reverse movement Pn531 → Waiting time Pn535 → Forward movement Pn531) × Number of times of movement Pn536  |   |

Note: For details of Pn530, refer to (3) Setting Infinite Time Operation and (4) Program JOG Operation Patterns.

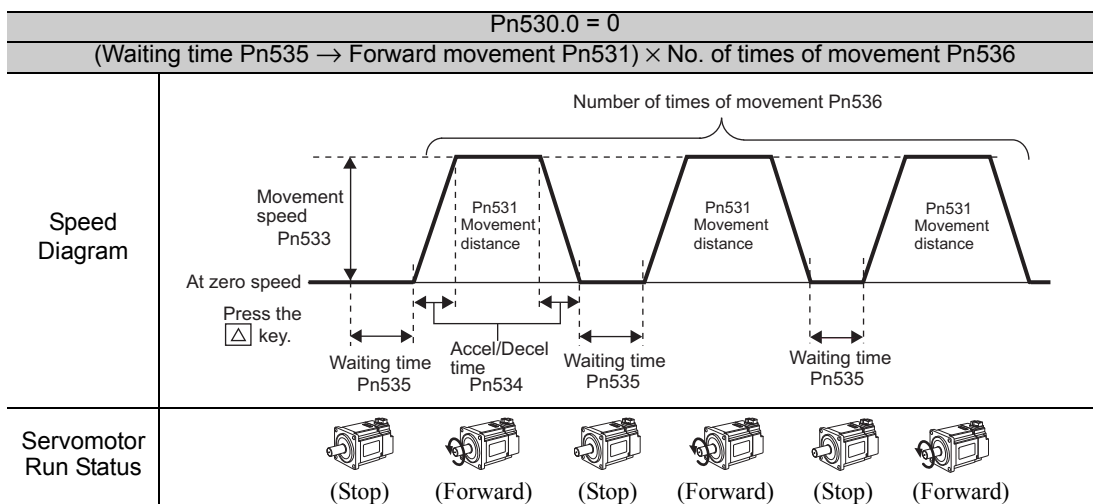
### (3) Setting Infinite Time Operation

- When 0, 1, 4 or 5 is set to Pn530.0, setting 0 to Pn536 (Number of Times of Program JOG Movement) enables infinite time operation.
- Program JOG operation pattern follows the setting of Pn530.0. Only number of times of program JOG movement is infinite. For details, refer to (4) Program JOG Operation Patterns.
- To stop infinite time operation, press the JOG/SVON Key to turn the servomotor power OFF.

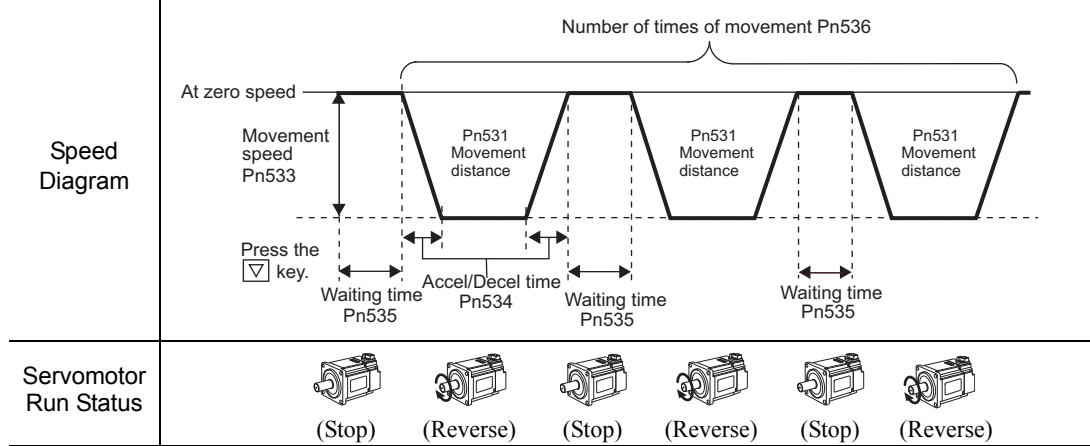
Note: 2 or 3 is set to Pn530.0, infinite time operation is disabled.  
0 or 1 is set to Pn530.0, movement is one direction. Take note of movable range.

### (4) Program JOG Operation Patterns

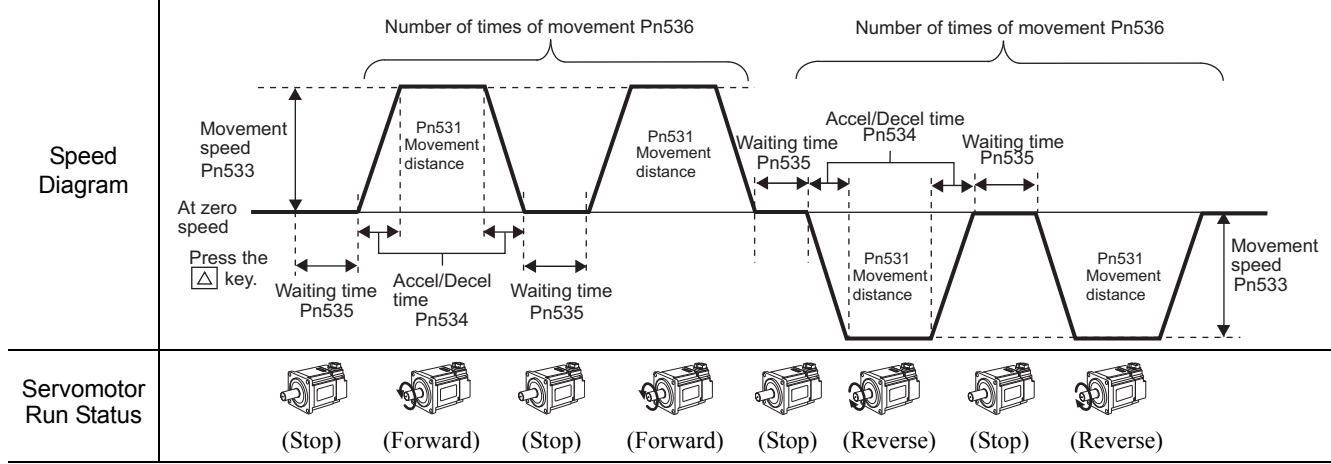
The following example is given when the rotating direction of the servomotor is set as Pn000.0 = 0 (Forward rotation by forward reference).



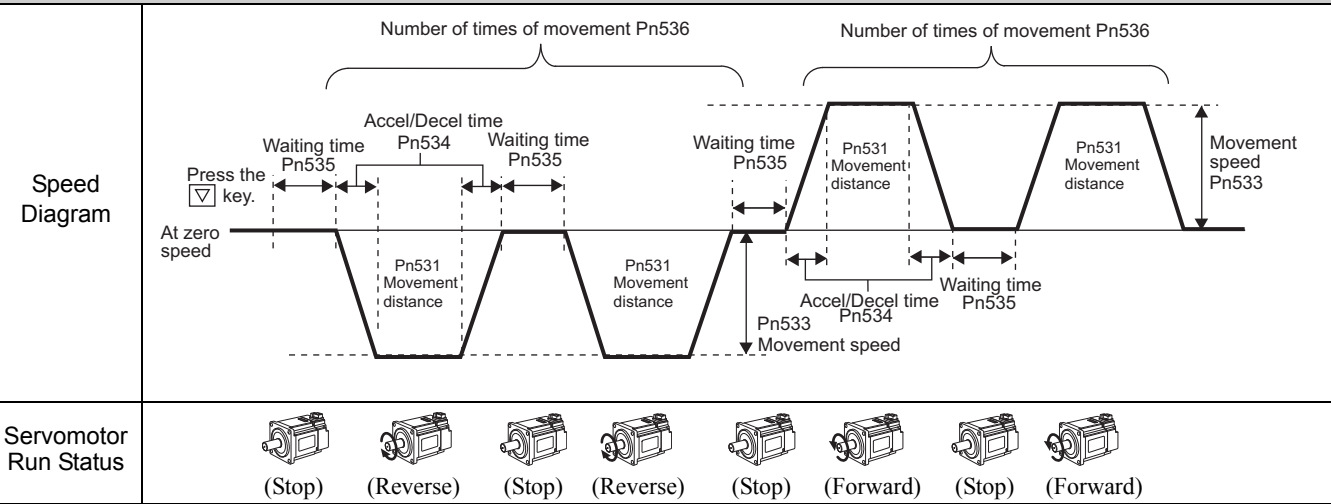
**Pn530.0 = 1**  
 (Waiting time Pn535 → Reverse movement Pn531) × No. of times of movement Pn536



**Pn530.0 = 2**  
 (Waiting time Pn535 → Forward movement Pn531) × No. of times of movement Pn536  
 (Waiting time Pn535 → Reverse movement Pn531) × No. of times of movement Pn536

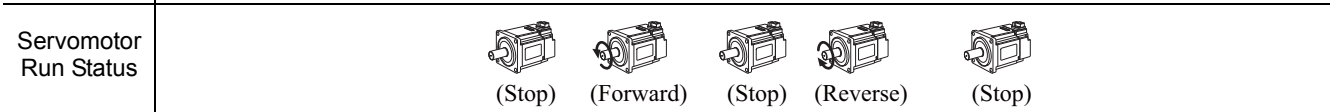
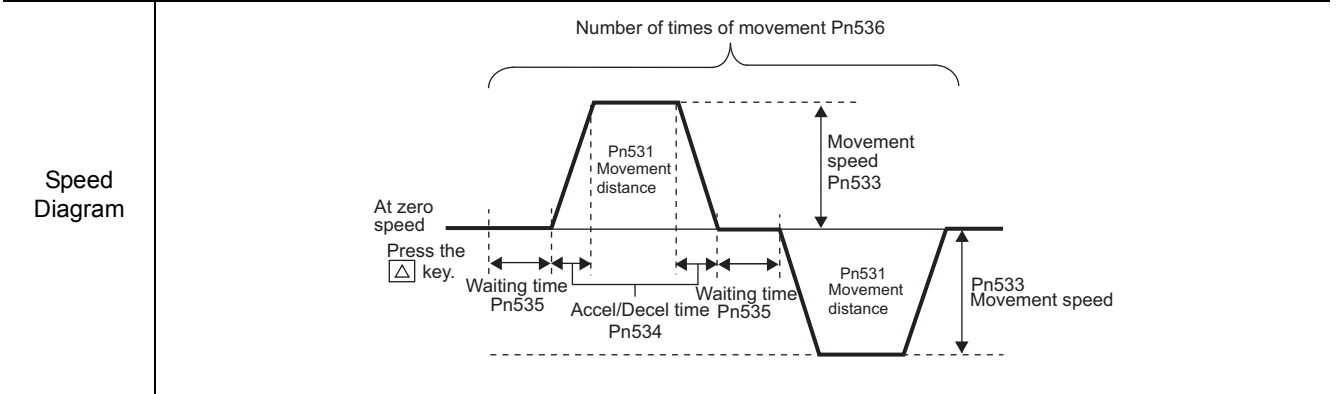


**Pn530.0 = 3**  
 (Waiting time Pn535 → Reverse movement Pn531) × No. of times of movement Pn536  
 (Waiting time Pn535 → Forward movement Pn531) × No. of times of movement Pn536

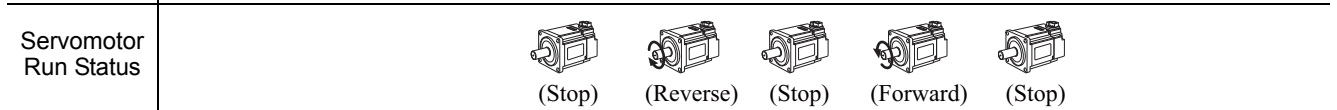
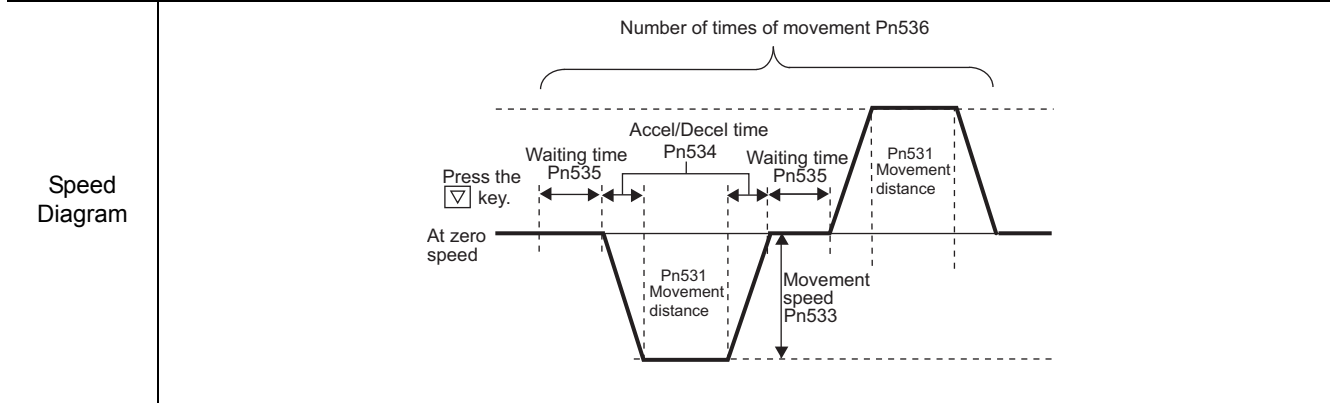


Note: When 3 is set to Pn530.0, infinite time operation is disabled.

**Pn530.0 = 4**  
 (Waiting time Pn535 → Forward movement Pn531 → Waiting time Pn535 → Reverse movement Pn531)  
 × No. of times of movement Pn536


























**Pn530.0 = 5**  
 (Waiting time Pn535 → Reverse movement Pn531 → Waiting time Pn535 → Forward movement Pn531)  
 × No. of times of movement Pn536



## (5) Operating Procedure


Follow the steps below to perform the program JOG operation after setting a program for JOG operation.

| Step | Display Example   | Keys   | Description   |
|------|---|--|---|
| 1    | <pre>BB      -FUNCTION- Fn003: Z-Search Fn004: Program JOG Fn005: Prm Init Fn006: AlmHist Clr</pre> | <br>  | Press the  Key to open the Utility Function Mode main menu and select Fn004.   |
| 2    | <pre>BB      -PRG JOG- Pn531=00032768 Pn533=00500 Pn534=00100 Pn536=00001</pre>                     |   | Press the  Key. The display is switched to the execution display of Fn004.<br>Note: If the display is not switched and “NO-OP” is displayed in the status display, change the following settings. (Refer to 6.12.)<br><ul style="list-style-type: none"> <li>• If Write Prohibited is set in Fn010:<br/>→ Cancel the Write Prohibited setting.</li> <li>• If a servo ON command is input:<br/>→ Send a servo OFF command.</li> </ul>   |
| 3    | <pre>BB      -PRG JOG- Pn531=00032768 Pn533=00500 Pn534=00100 Pn536=00001</pre>                     |   | Press the  Key to select a parameter to be set. In this example, Pn536 has been selected.  |
| 4    | <pre>BB      -PRG JOG- Pn531=00032768 Pn533=00500 Pn534=00100 Pn536=00001</pre>                     |   | Press the  Key to move the cursor to the setting side (the right side) of Pn536.   |
| 5    | <pre>BB      -PRG JOG- Pn531=00032768 Pn533=00500 Pn534=00100 Pn536=00010</pre>                     |    | Press the  or  Key to change “1” to “10.”   |
| 6    | <pre>RUN     -PRG JOG- Pn531=00032768 Pn533=00500 Pn534=00100 Pn536=00010</pre>                     |   | Press the  Key to turn the servomotor power ON. The status of the display changes to “RUN”.  |
|      |   |    | Press the  (forward movement start) or  (reverse movement start) Key according to the first movement direction of the preset operation pattern for one second, the servomotor starts moving after the preset waiting time in Pn535.<br>Note: Pressing the  Key again changes the status to “BB” (Servomotor power OFF) and stops movement even during operation. |
| 7    | <pre>END     -PRG JOG- Pn531=00032768 Pn533=00500 Pn534=00100 Pn536=00010</pre>                     |   | When the set program JOG operation movement is completed, “END” will be displayed for one second, and then “RUN” will be displayed.<br>Press the  Key. The servomotor enters BB status and the display returns to the Utility Function Mode main menu.   |
| 8    | After program JOG operation, turn OFF the power and then turn ON again.                             |  |   |












## 6.6 Initializing Parameter Settings (Fn005)

This function is used when returning to the factory settings after changing parameter settings.

|   |   |
|---|---|
| <br><b>IMPORTANT</b> | <ul style="list-style-type: none"> <li>• Be sure to initialize the parameter settings while the servomotor power is OFF.</li> <li>• After initialization, turn OFF the power supply and then turn ON again to validate the settings.</li> <li>• The parameters of the option module will not be initialized. For information on how to initialize the parameters of the option module, refer to the manual of the connected option module.</li> </ul> |
|---|---|

Follow the steps below to initialize the parameter setting.










| Step | Display Example  | Keys   | Description  |
|------|--|--|--|
| 1    | <pre>BB      -FUNCTION- Fn004: Program JOG Fn005: Prm Init Fn006: AlmHist Clr Fn008: Mturn Clr</pre> | <br>  | Press the  Key to open the Utility Function Mode main menu and select Fn005.  |
| 2    | <pre>BB Parameter Init Start : [DATA] Return : [SET]</pre>   |    | Press the  Key. The display is switched to the execution display of Fn005.<br>Note: If the display is not switched and “NO-OP” is displayed in the status display, change the following settings. (Refer to 6.12.) <ul style="list-style-type: none"> <li>• If Write Prohibited is set in Fn010:<br/>→ Cancel the Write Prohibited setting.</li> <li>• If a servo ON command is input:<br/>→ Send a servo OFF command.</li> </ul>                       |
| 3    | <pre>BB Parameter Init Start : [DATA] Return : [SET]</pre>   |   | Press the  Key to initialize parameters. During initialization, “Parameter Init” is blinking in the display. After the initialization is completed, “Parameter Init” stops blinking and the status display changes as follows: “BB” to “DONE.”<br>Note: Press the  Key not to initialize parameters. The display returns to the Utility Function Mode main menu. |
| 4    | Turn OFF the power and then turn it ON again to validate the new setting.                            |  |  |

## 6.7 Clearing Alarm History (Fn006)

The clear alarm history function deletes all of the alarm history recorded in the SERVOPACK.

Note: The alarm history can be deleted only with this function. The alarm history is not deleted when the alarm reset is executed or the main circuit power supply of the SERVOPACK is turned OFF.

Follow the steps below to clear the alarm history.

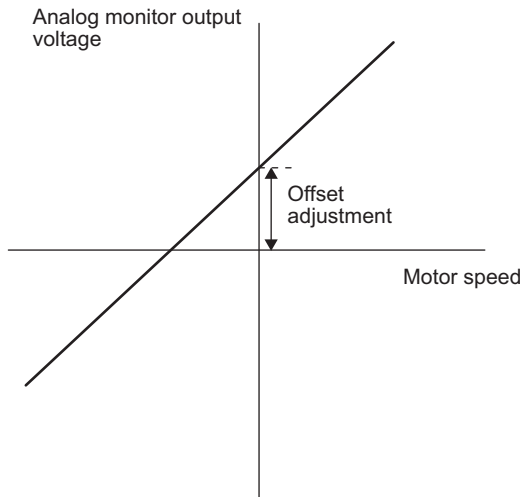
| Step | Display Example  | Keys   | Description   |
|------|--|--|---|
| 1    | <pre>BB      -FUNCTION- Fn005:Prm Init Fn006:AlmHist Clr Fn008:Mturn Clr Fn009:Ref Adj</pre> | <br>  | Press the  Key to open the Utility Function Mode main menu and select Fn006.   |
| 2    | <pre>BB Alarm History   Data Clear   Start : [DATA]   Return: [SET]</pre>                    |   | Press the  Key. The display is switched to the execution display of Fn006.<br>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. (Refer to 6.12.)   |
| 3    | <pre>DONE Alarm History   Data Clear   Start : [DATA]   Return: [SET]</pre>                  |    | Press the  Key to clear the alarm history.<br>While clearing the data, “DONE” is displayed in the status display. After the data has been successfully cleared, “BB” is displayed.<br>Note: Press the  Key not to clear the alarm history. The display returns to the Utility Function Mode main menu. |

## 6.8 Offset Adjustment of Analog Monitor Output (Fn00C)

This function is used to manually adjust the offsets for the analog monitor outputs (torque reference monitor output and motor speed monitor output). The offsets for the torque reference monitor output and motor speed monitor output can be adjusted individually. The offset values are factory-set before shipping. Therefore, the user need not usually use this function.

### (1) Adjustment Example

An example of offset adjustment to the motor speed monitor is shown below.









| Item                  | Specifications    |
|-----------------------|-------------------|
| Zero-adjustment Range | -2.4 V to + 2.4 V |
| Adjustment Unit       | 18.9 mV/LSB       |















#### <Notes>

- Offset adjustment cannot be made if write protection is set in Fn010.
- The adjustment value will not be initialized when parameter settings are initialized using Fn005.
- Make offset adjustment with a measuring instrument connected, so that the analog monitor output is zero. An example of settings for a zero analog monitor output is shown below.
  - While the motor is not turned ON, set the monitor signal to the torque reference.
  - In speed control, set the monitor signal to the position error.

### (2) Operating Procedure

Follow the steps below to perform the offset adjustment of analog monitor output.

| Step | Display Example   | Keys   | Description   |
|------|---|--|---|
| 1    | <pre>BB      -FUNCTION- Fn00B:Trq Adj Fn00C:MonZero Adj Fn00D:MonGain Adj Fn00E:Cur AutoAdj</pre> | <br>  | Press the  Key to open the Utility Function Mode main menu and select Fn00C.   |
| 2    | <pre>BB      -Zero ADJ- CH1=-0000<u>2</u> CH2= 00001 Un002= 00000 Un000= 00000</pre>              |   | Press the  Key. The display is switched to the execution display of Fn00C.<br>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. (Refer to 6.12.) |

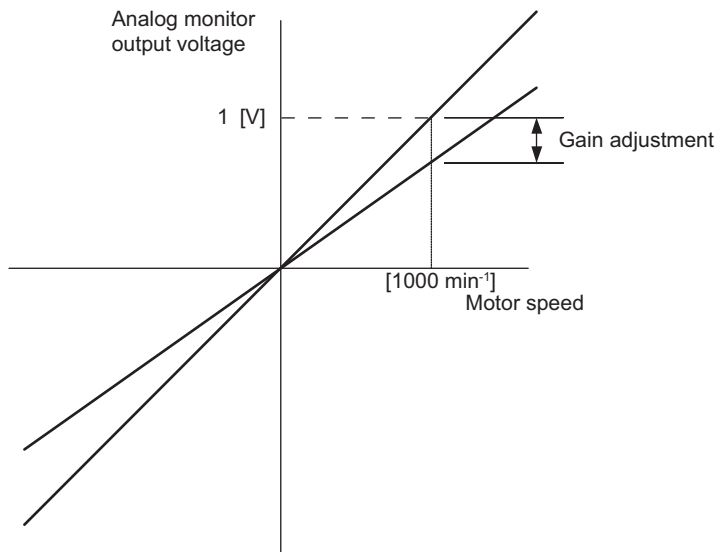
| Step | Display Example   | Keys  | Description  |
|------|---|---|--|
| 3    | <pre> BB      -Zero ADJ- CH1=-0000<u>5</u> CH2= 00001 Un002= 00000 Un000= 00000 </pre>                  |   | <p>Press the  or  Key to adjust the offset of CH1 (torque reference monitor).<br/>Adjust the offset so that the measurement instrument reading is as close to 0 V as possible.</p> |
| 4    | <pre> BB      -Zero ADJ- CH1=-00005 CH2= 0000<u>1</u> Un002= 00000 </pre>                               |    | <p>After the offset adjustment of CH1 has completed,<br/>Press the  Key. The cursor moves to CH2 side.</p>  |
| 5    | <pre> BB      -Zero ADJ- CH1=-00005 CH2= 0000<u>6</u> Un002= 00000 Un000= 00000 </pre>                  |   | <p>Press the  or  Key to adjust the offset of CH2.<br/>Adjust the offset so that the measurement instrument reading is as close to 0 V as possible.</p>                            |
| 6    | <pre> DONE    -Zero ADJ- CH1=-00005 CH2= 0000<u>6</u> Un002= 00000 Un000= 00000 </pre>                  |    | <p>After having completed the offset adjustment both for CH1 and CH2, press the  Key.<br/>The adjustment results are saved in the SERVO-PACK. "DONE" is displayed in the status display after saving is completed.</p>  |
| 7    | <pre> BB      -FUNCTION- Fn00B: Trq Adj Fn00C: MonZero Adj Fn00D: MonGain Adj Fn00E: Cur AutoAdj </pre> |    | <p>Press the  Key to return to the Utility Function Mode main menu.</p>   |

## 6.9 Gain Adjustment of Analog Monitor Output (Fn00D)

This function is used to manually adjust the gains for the analog monitor outputs (torque reference monitor output and motor speed monitor output). The gains for the torque reference monitor output and motor speed monitor output can be adjusted individually. The gain values are factory-set before shipping. Therefore, the user need not usually use this function.

### (1) Adjustment Example

An example of gains adjustment to the motor speed monitor is shown below.



| Item                  | Specifications |
|-----------------------|----------------|
| Gain-adjustment Range | 50% to 150%    |
| Adjustment Unit       | 0.4%/LSB       |

The gain adjustment width is made with a 100% output set as a center value (adjustment range: 50% to 150%). A setting example is shown below.

<Setting the Set Value to -125>

$$100\% + (-125 \times 0.4) = 50\%$$

Therefore, the monitor output voltage is 0.5 times as high.

<Setting the Set Value to 125>

$$100\% + (125 \times 0.4) = 150\%$$





















Therefore, the monitor output voltage is 1.5 times as high.

<Notes>

- Gain adjustment cannot be made if write protection is set in Fn010.
- The adjustment value will not be initialized when parameter settings are initialized using Fn005.

## (2) Operating Procedure

Follow the steps below to perform the gain adjustment of analog monitor output.

| Step | Display Example   | Keys   | Description   |
|------|---|--|---|
| 1    | <pre> BB      -FUNCTION- Fn00C: MonZero Adj Fn00D: MonGain Adj Fn00E: Cur AutoAdj Fn00F: Cur ManuAdj </pre> | <br>  | Press the  Key to open the Utility Function Mode main menu and select Fn00D.   |
| 2    | <pre> BB      -Gain ADJ- CH1=-0000<u>1</u> CH2=-00001 Un002= 00000 Un000= 00000 </pre>                      |   | Press the  Key. The display is switched to the execution display of Fn00D.<br><ul style="list-style-type: none"> <li>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. (Refer to 6.12.)</li> </ul> |
| 3    | <pre> BB      -Gain ADJ- CH1= 0012<u>5</u> CH2=-00001 Un002= 00000 Un000= 00000 </pre>                      |    | Press the  or  Key to adjust the gain adjustment width of CH1 (torque reference monitor).   |
| 4    | <pre> BB      -Gain ADJ- CH1= 00125 CH2=-0000<u>1</u> Un002= 00000 Un000= 00000 </pre>                      |   | After the gain adjustment of CH1, press the  Key. The cursor moves to CH2 side.  |
| 5    | <pre> BB      -Gain ADJ- CH1= 00125 CH2=-0012<u>5</u> Un002= 00000 Un000= 00000 </pre>                      |    | Press the  or  Key to adjust the gain adjustment width of CH2 (motor speed monitor).  |
| 6    | <pre> DONE   -Gain ADJ- CH1= 00125 CH2=-0012<u>5</u> Un002= 00000 Un000= 00000 </pre>                       |   | After having completed the adjustment both for CH1 and CH2, press the  Key. The adjustment results are saved in the SERVO-PACK. After the saving is completed, “DONE” is displayed in the status display.  |
| 7    | <pre> BB      -FUNCTION- Fn00C: MonZero Adj Fn00D: MonGain Adj Fn00E: Cur AutoAdj Fn00F: Cur ManuAdj </pre> |   | Press the  Key to return to the Utility Function Mode main menu.   |

## 6.10 Automatic Offset-Signal Adjustment of the Motor Current Detection (Fn00E)











Perform this adjustment only if highly accurate adjustment is required for reducing torque ripple caused by current offset. Basically, the user need not perform this adjustment.



IMPORTANT


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

Follow the steps below.





















| Step | Display Example   | Keys   | Description  |
|------|---|--|--|
| 1    | <pre>BB      -FUNCTION- Fn00D: MonGain Adj Fn00E: Cur AutoAdj Fn00F: Cur ManuAdj Fn010: Prm Protect</pre> | <br>  | Press the  Key to open the Utility Function Mode main menu and select Fn00E.  |
| 2    | <pre>BB Auto Offset-ADJ of Motor Current Start : [DATA] Return : [SET]</pre>                              |    | Press the  Key. The display is switched to the execution display of Fn00E.<br>Note: If the display is not switched and “NO-OP” is displayed in the status display, change the following settings. (Refer to 6.12.) <ul style="list-style-type: none"> <li>• If Write Prohibited is set in Fn010:<br/>→ Cancel the Write Prohibited setting.</li> <li>• If a servo ON command is input:<br/>→ Send a servo OFF command.</li> </ul> |
| 3    | <pre>DONE Auto Offset-ADJ of Motor Current Start : [DATA] Return : [SET]</pre>                            |    | Press the  Key to start the automatic offset-signal adjustment of motor current detection.<br>When the adjustment is completed, “DONE” is displayed in the status display.<br>Note: Press the  Key to cancel the automatic adjustment. The display returns to the Utility Function Mode main menu.   |

## 6.11 Manual Offset-Signal Adjustment of the Motor Current Detection (Fn00F)

Use this function only if the torque ripple is still high after the automatic offset adjustment of the motor current detection signal (Fn00E).

|   |   |
|---|---|
| <br><b>IMPORTANT</b> | <p>If this function is executed carelessly, it may worsen the characteristics. Observe the following precautions when performing manual servo tuning.</p> <ul style="list-style-type: none"> <li>• Run the servomotor at a speed of approximately 100 min<sup>-1</sup>.</li> <li>• Adjust the offset until the torque reference monitor ripple is minimized, monitoring the torque reference by using the analog monitor.</li> <li>• Adjust the phase-U and phase-V offsets alternately several times until these offsets are well balanced.</li> </ul> |
|---|---|

Follow the steps below.

| Step | Display Example   | Keys   | Description  |
|------|---|--|--|
| 1    | <pre> RUN      -FUNCTION- Fn00F: Cur ManuAdj Fn010: Prm Protect Fn011: Motor Info Fn012: Soft Ver           </pre>  | <br>  | Press the  Key to open the Utility Function Mode main menu and select Fn00F.  |
| 2    | <pre> RUN Manual Offset-ADJ of Motor Current ZADJIU= 0000<u>9</u> ZADJIV= 00006           </pre>  |   | Press the  Key. The display is switched to the execution display of Fn00F.<br>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. (Refer to 6.12.)   |
| 3    | <pre> RUN Manual Offset-ADJ of Motor Current ZADJIU= 0001<u>9</u> ZADJIV= 00006           </pre>  |    | Press the  or  Key to adjust the offset amount of phase-U.<br>Adjust the offset amount by 10 in the direction that the torque ripple is reduced.<br>Adjustment range: -512 to +511 |
| 4    | <pre> RUN Manual Offset-ADJ of Motor Current ZADJIU= 00019 ZADJIV= 0000<u>6</u>           </pre>  |   | Press the  Key. The cursor moves to the phase-V side.   |
| 5    | <pre> RUN Manual Offset-ADJ of Motor Current ZADJIU= 00019 ZADJIV= 0001<u>6</u>           </pre>  |    | Press the  or  Key to adjust the offset amount of phase-V.<br>Adjust the offset amount by 10 in the direction that the torque ripple is reduced.<br>Adjustment range: -512 to +511 |
| 6    | Repeat the above operations (phase-U and -V alternately) until adjusting the offset amounts both for phase-U and -V in both directions cannot reduce the torque ripple any more. Then, perform the same operation by adjusting by smaller amount. |  |  |
| 7    | <pre> DONE Manual Offset-ADJ of Motor Current ZADJIU= 00019 ZADJIV= 0001<u>6</u>           </pre>   |   | Press the  Key to save the result of adjustment in the SERVOPACK.<br>When the saving is completed, “DONE” is displayed in the status display.   |
| 8    | <pre> RUN      -FUNCTION- Fn00F: Cur ManuAdj Fn010: Prm Protect Fn011: Motor Info Fn012: Soft Ver           </pre>  |   | Press the  Key to return to the Utility Function Mode main menu.  |



## 6.12 Write Prohibited Setting (Fn010)

Prohibiting writing prevents writing parameters by mistake.

The following operations can be write-protected using the Fn010 parameter.

- Parameter settings from the digital operator (Pn□□□)
- Utility functions shown in (1) *Utility Functions That Can Be Write-protected* (Fn□□□)

### (1) Utility Functions That Can Be Write-protected

| Function No. | Function  | Write Prohibited Setting | Reference Section |
|--------------|---|--------------------------|-------------------|
| Fn000        | Alarm history display   | ×                        | 6.2               |
| Fn002        | JOG operation   | ○                        | 6.3               |
| Fn003        | Origin search   | ○                        | 6.4               |
| Fn004        | Program JOG operation   | ○                        | 6.5               |
| Fn005        | Initializing parameter settings   | ○                        | 6.6               |
| Fn006        | Clearing alarm history  | ○                        | 6.7               |
| Fn008        | Absolute encoder multi-turn reset and encoder alarm reset                               | ○                        | 4.5.4             |
| Fn00C        | Manual zero adjustment of analog monitor output   | ○                        | 6.8               |
| Fn00D        | Manual gain adjustment of analog monitor output   | ○                        | 6.9               |
| Fn00E        | Automatic offset-signal adjustment of motor current detection signal                    | ○                        | 6.10              |
| Fn00F        | Manual offset-signal adjustment of motor current detection signal                       | ○                        | 6.11              |
| Fn010        | Write prohibited setting  | –                        | 6.12              |
| Fn011        | Servomotor model display  | ×                        | 6.13              |
| Fn012        | Software version display  | ×                        | 6.14              |
| Fn013        | Multi-turn limit value setting change when a Multi-turn Limit Disagreement alarm occurs | ○                        | 4.5.7             |
| Fn014        | Resetting configuration error of option module  | ○                        | 6.15              |
| Fn01B        | Vibration detection level initialization  | ○                        | 6.16              |
| Fn01E        | Display of SERVOPACK and servomotor ID  | ×                        | 6.17              |
| Fn01F        | Display of servomotor ID in feedback option module                                      | ×                        | 6.18              |
| Fn020        | Origin setting  | ×                        | 6.19              |
| Fn030        | Software reset  | ×                        | 6.20              |
| Fn200        | Tuning-less level setting   | ○                        | 5.2.2             |
| Fn201        | Advanced autotuning   | ○                        | 5.3.2             |
| Fn202        | Advanced autotuning by reference  | ○                        | 5.4.2             |
| Fn203        | One-parameter tuning  | ○                        | 5.5.2             |
| Fn204        | Anti-resonance control adjustment function  | ○                        | 5.6.2             |
| Fn205        | Vibration suppression function  | ○                        | 5.7.2             |
| Fn206        | EasyFFT   | ○                        | 6.21              |
| Fn207        | Online vibration monitor  | ○                        | 6.22              |

Note 1. ○: Possible, ×: Impossible














2. If the write prohibited setting (Fn010) is enabled, “NO-OP” is displayed on the status display of the Digital Operator if the user attempts to execute the above utility functions. To execute these utility functions, set Fn010 to write permitted by using the procedure shown in (2) *Operating Procedure*.

## (2) Operating Procedure

Follow the steps below to set “write prohibited” or “write permitted.”

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 Example   | Keys   | Description  |
|------|---|--|--|
| 1    | <pre> BB      -FUNCTION- Fn00F:Cur ManuAdj Fn010:Prm Protect Fn011:Motor Info Fn012:Soft Ver           </pre> | <br>  | Press the  Key to open the Utility Function Mode main menu and select Fn010.  |
| 2    | <pre> BB Parameter Write Protect  P. 000<u>0</u>           </pre>   |   | Press the  Key. The display switches to the execution display of Fn010.   |
| 3    | <pre> BB Parameter Write Protect  P. 000<u>1</u>           </pre>   |    | Press the  Key to select one of the following settings.<br>P.0000: Write permitted [Factory setting]<br>P.0001: Write prohibited      |
| 4    | <pre> DONE Parameter Write Protect  P. 000<u>1</u>           </pre>   |   | Press the  Key to save the setting value in the SERVOPACK. When the saving is completed, “DONE” is displayed in the status display. |
| 5    | <pre> BB      -FUNCTION- Fn00F:Cur ManuAdj Fn010:Prm Protect Fn011:Motor Info Fn012:Soft Ver           </pre> |   | Press the  Key to return to the Utility Function Mode main menu.  |
| 6    | Turn OFF the power and then turn it ON again to validate the new setting.                                     |  |  |

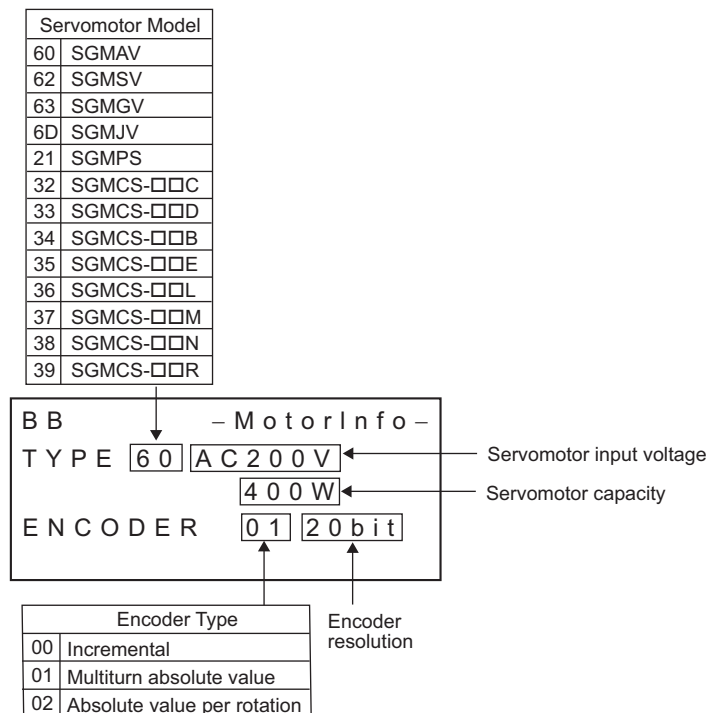
## 6.13 Servomotor Model Display (Fn011)

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

Follow the steps below.

| Step | Display Example   | Keys   | Description   |
|------|---|--|---|
| 1    | <pre> RUN      -FUNCTION- Fn010:Prm Protect Fn011:Motor Info Fn012:Soft Ver Fn013:MturnLmSet           </pre> | <br>  | Press the  Key to open the Utility Function Mode main menu and select Fn011. |
| 2    | <pre> BB      -MotorInfo- TYPE 60 AC200V           400W ENCORDER 01 20bit           </pre> <p>(Example)</p>   |   | Press the  Key to switch to the display of Fn011.                            |
| 3    | <pre> RUN      -FUNCTION- Fn010:Prm Protect Fn011:Motor Info Fn012:Soft Ver Fn013:MturnLmSet           </pre> |   | Press the  Key to return to the Utility Function Mode main menu.             |

















### ■ Display Designation



## 6.14 Software Version Display (Fn012)

Select Fn012 to check the SERVOPACK and encoder software version numbers.

Follow the steps below.

| Step | Display Example   | Keys  | Description   |
|------|---|---|---|
| 1    | <pre>BB      -FUNCTION- Fn011:Motor Info Fn012:Soft Ver Fn013:MturnLmSet Fn014:Opt Init</pre> | <br><br> | Press the  Key to open the Utility Function Mode main menu and select Fn012.   |
| 2    | <pre>BB      -Soft Ver- DRIVER Ver.=0001 ENCODER Ver.=0003</pre>                              |    | Press the  Key. The software versions of the SERVOPACK and the connected encoder will be displayed.<br>Note: If the servomotor is not connected, “Not connect” is displayed under “ENCODER” instead of the version number. |
| 3    | <pre>BB      -Soft Ver- OPTION ENCODER Ver.=0001</pre>  |    | Press the  Key. The software version of the external encoder will be displayed.<br>Note: If an external encoder is not connected, “Not connect” will be displayed.   |
| 4    | <pre>BB      -Soft Ver- COMMAND Ver.=0001</pre>   |   | Press the  Key. The software version of the command option module will be displayed.<br>Note: If a command option module is not connected, “Not connect” will be displayed.  |
| 5    | <pre>BB      -Soft Ver- SAFETY Ver.=0001</pre>  |    | Press the  Key. The software version of the safety option module will be displayed.<br>Note: If a safety option module is not connected, “Not connect” will be displayed.  |
| 6    | <pre>BB      -Soft Ver- FEEDBACK Ver.=0001</pre>  |    | Press the  Key. The software version of the feedback option module will be displayed.<br>Note: If a feedback option module is not connected, “Not connect” will be displayed.  |
| 7    | <pre>BB      -FUNCTION- Fn011:Motor Info Fn012:Soft Ver Fn013:MturnLmSet Fn014:Opt Init</pre> |    | Press the  Key to return to the Utility Function Mode main menu.   |

## 6.15 Resetting Configuration Error of Option Module (Fn014)

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

This function resets the following alarms.

- Command Option Module Unmatched Error (A.E80)
- Feedback Option Module Detection Failure (A.E72)
















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

Note 1. The alarms above can be cleared only by this function. These alarms cannot be cleared by alarm reset or turning OFF the main circuit power supply.

2. Before clearing the alarm, perform corrective action for the alarm.

### (1) Operating Procedure

Follow the steps below.

| Step | Display Example   | Keys   | Description  |
|------|---|--|--|
| 1    | <pre> BB      -FUNCTION- Fn013:MturnLmSet Fn014:Opt Init Fn01B:Vibl_vl Init Fn01E:SvMotOp ID           </pre> | <br>        | Press the  Key to open the Utility Function Mode main menu and select Fn014.  |
| 2    | <pre> BB      -Opt Init- 01:Command Opt 02:Safety Opt 03:Feedback Opt           </pre>                        |   | Press the  Key. The display changes to the execution display of Fn014.  |
| 3    | <pre> BB      -Opt Init- Command Opt Initialize Start :[DATA] Return:[SET]           </pre>                   |  <br> | Press the  or  Key to select an option module to be cleared.<br>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. (Refer to 6.12.) |
| 4    | <pre> DONE   -Opt Init- Command Opt Initialize Start :[DATA] Return:[SET]           </pre>                    |   | Press the  Key to clear the configuration error of the option module.   |
| 5    | <pre> RUN     -FUNCTION- Fn013:MturnLmSet Fn014:Opt Init Fn01B:Vibl_vl Init Fn01E:SvMotOp ID           </pre> |   | Press the  key to return to the Utility Function Mode main menu.  |
| 5    | Turn OFF the power and then turn it ON again to validate the new setting.                                     |  |  |

## 6.16 Vibration Detection Level Initialization (Fn01B)

This function detects vibration when servomotor is connected to a machine and automatically adjusts the vibration detection level (Pn312) to output more exactly the vibration alarm (A.520) and warning (A.911).

Use this function if the vibration alarm (A.520) or warning (A.911) is not output correctly when a vibration above the factory setting vibration detection level (Pn312) is detected. In other cases, it is not necessary to use this function.

The vibration detection function detects vibration elements according to the motor speed.


| Parameter | Meaning | When Enabled  | Classification |       |
|-----------|---------|---|----------------|-------|
| Pn310     | n.□□□0  | Does not detect vibration. (Factory setting)            | Immediately    | Setup |
|           | n.□□□1  | Outputs the warning (A.911) when vibration is detected. |                |       |
|           | n.□□□2  | Outputs the alarm (A.520) when vibration is detected.   |                |       |

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).

$$\text{Detection level} = \frac{\text{Vibration detection level (Pn312}[\text{min}^{-1}]) \times \text{Detection sensibility (Pn311}[\%])}{100}$$

### <Remarks>

The vibration alarm or warning detection sensibility differs depending on the machine conditions. In this case, a detection sensibility fine adjustment can be set in the detection sensibility Pn311.
















**IMPORTANT**

- The vibration may not be detected 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 operation condition for which the vibration detection level should be set.
- Execute this function to set the vibration detection level while the motor speed reaches at least 10% of its maximum.

### (1) Operating Procedure


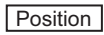


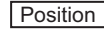

Follow the steps to adjust the parameter Pn312.

| Step | Display Example   | Keys   | Description   |
|------|---|--|---|
| 1    | <pre> RUN      -FUNCTION- Fn014: Opt Init Fn01B: Vibl_vl Init Fn01E: SvMotOp ID Fn01F: FBOP Mot ID           </pre> | <br>  | Press the  Key to open the Utility Function Mode main menu and select Fn01B.   |
| 2    | <pre> RUN Vibration Detect Level Init Start : [DATA] Return: [SET]           </pre>                                 |   | Press the  Key. The display is switched to the execution display of Fn01B.<br>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. (Refer to 6.12.) |

| Step | Display Example   | Keys  | Description   |
|------|---|---|---|
| 3    | <pre> RUN Vibration Detect Level Init  Init </pre>  |  | <p>Press the  Key.</p> <p>“Init” is displayed blinking, and the vibration level is detected and adjusted. Continues adjustment until the  Key is pressed again.</p> <p>Notes:</p> <ul style="list-style-type: none"> <li>• Operate the SERVOPACK with the references that will be used for actual operation.</li> <li>• If the servomotor is rotating at 10% or less of the maximum speed, “Error” will be displayed.</li> </ul> |
| 4    | <pre> DONE Vibration Detect Level Init  DONE </pre>   |  | <p>Press the  Key. The display changes from “Init” to “DONE,” and the setting becomes enabled.</p>   |
| 5    | <pre> RUN      -FUNCTION- Fn014:Opt Init Fn01B:Vibl_vl Init Fn01E:SvMotOp ID Fn01F:FB OpMot ID </pre> |  | <p>Press the  key to return to the Utility Function Mode main menu.</p>  |

## (2) Related Parameters

Use the following parameters as required.

|              |   |                     |                 |              |                |
|--------------|---|---------------------|-----------------|--------------|----------------|
| <b>Pn311</b> | Vibration Detection Sensibility    |                     |                 |              | Classification |
|              | Setting Range   | Setting Unit        | Factory Setting | When Enabled |                |
|              | 50 to 500   | 1%                  | 100             | Immediately  | Tuning         |
| <b>Pn312</b> | Vibration Detection Level       |                     |                 |              | Classification |
|              | Setting Range   | Setting Unit        | Factory Setting | When Enabled |                |
|              | 0 to 5000   | 1 min <sup>-1</sup> | 50              | Immediately  | Tuning         |

Note: Vibration Detection Level (Pn312) is set by Fn01B automatically, so it is not necessary to adjust it.

## 6.17 Display of SERVOPACK and Servomotor ID (Fn01E)

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

Note that the ID information of some option modules is not stored in the SERVOPACK. “Not available” will be displayed for these option modules.

The following items can be displayed.

| ID                      | Items to be Displayed   |
|-------------------------|---|
| SERVOPACK               | <ul style="list-style-type: none"> <li>• SERVOPACK model</li> <li>• SERVOPACK serial number</li> <li>• SERVOPACK manufacturing date</li> <li>• SERVOPACK input voltage (V)</li> <li>• Maximum applicable motor capacity (W)</li> <li>• Maximum applicable motor rated current (Arms)</li> </ul> |
| Servomotor              | <ul style="list-style-type: none"> <li>• Servomotor model</li> <li>• Servomotor order number</li> <li>• Servomotor manufacturing date</li> <li>• Servomotor input voltage (V)</li> <li>• Servomotor capacity (W)</li> <li>• Servomotor rated current (Arms)</li> </ul>                          |
| Encoder                 | <ul style="list-style-type: none"> <li>• Encoder model</li> <li>• Encoder serial number</li> <li>• Encoder manufacturing date</li> <li>• Encoder type/resolution</li> </ul>   |
| Command Option Module*  | <ul style="list-style-type: none"> <li>• Command option module model</li> <li>• Command option module serial number</li> <li>• Command option module manufacturing date</li> <li>• Command option module ID number</li> </ul>   |
| Safety Option Module*   | <ul style="list-style-type: none"> <li>• Safety option module model</li> <li>• Safety option module serial number</li> <li>• Safety option module manufacturing date</li> <li>• Safety option module ID number</li> </ul>   |
| Feedback Option Module* | <ul style="list-style-type: none"> <li>• Feedback option module model</li> <li>• Feedback option module serial number (Reserved area)</li> <li>• Feedback option module manufacturing date</li> <li>• Feedback option module ID</li> </ul>  |

\* If an option module is not connected, “Not connect” will be displayed after the module name.



## 6.18 Display of Servomotor ID in Feedback Option Module (Fn01F)

This function displays ID information for servomotor and encoder in feedback option module connected to the SERVOPACK.

The following items can be displayed.

| ID             | Items to be Displayed   |
|----------------|---|
| Servomotor     | <ul style="list-style-type: none"> <li>• Servomotor model</li> <li>• Servomotor order number</li> <li>• Servomotor input voltage (V)</li> <li>• Servomotor capacity (W)</li> <li>• Servomotor rated current (Arms)</li> </ul> |
| Encoder        | <ul style="list-style-type: none"> <li>• Encoder model</li> <li>• Encoder serial number</li> <li>• Encoder type/resolution (Two types of resolution display available: Number of bits and pulses/rev.)</li> </ul>             |
| Parameter file | <ul style="list-style-type: none"> <li>• Parameter file source ID (14 characters)</li> <li>• Parameter file version (4 digits hexadecimal display)</li> </ul>   |

## 6.19 Origin Setting (Fn020)

When using an external encoder for fully-closed loop control, this function is used to set the current position of external encoder as the origin (zero point position).

This function sets current scale position as origin when using the absolute external encoder.

Use the following product as an absolute external encoder.

Absolute separate linear scale (made by Mitutoyo Corporation)

ABS ST780A series















Model ABS ST78□A

### (1) Settings before Operation

The following settings are required before setting origin.


- If a servo ON command is input, send a servo OFF command.

### (2) Operating Procedure

| Step | Display Example  | Keys   | Description   |
|------|--|--|---|
| 1    | <pre> BB      - FUNCTION - Fn01F:FBOPMot ID Fn020:S-Orig Set Fn030:Soft Reset Fn080:Pole Detect           </pre> | <br>  | Press the  Key to open the Utility Function Mode main menu and select Fn020.   |
| 2    | <pre> BB Scale Origin Set ORGSET1           </pre>   |   | Press the  Key. The display is switched to the execution display of Fn020.<br>Note: If the display is not switched and “NO-OP” is displayed in the status display, change the following settings. <ul style="list-style-type: none"> <li>• If Write Prohibited is set in Fn010:<br/>→ Cancel the Write Prohibited setting.</li> <li>• If a servo ON command is input:<br/>→ Send a servo OFF command.</li> </ul> |
| 3    | <pre> BB Scale Origin Set ORGSET5           </pre>   |    | Press the  or  Key to select one of five origins: ORGSET1 to ORGSET5.   |
| 4    | <pre> BB Scale Origin Set           </pre>   |   | Press the  key to start setting the origin. The message, “Scale Origin Set,” blinks while the origin is being set. After the origin has been successfully set, the displayed status changes as follows:<br>“BB”→“DONE”→“BB”  |
| 5    | <pre> BB      - FUNCTION - Fn01F:FBOPMot ID Fn020:S-Orig Set Fn030:Soft Reset Fn080:Pole Detect           </pre> |   | Press the  Key to return to the Utility Function Mode main menu.   |
| 6    | Turn OFF the power and then turn it ON again to validate the new setting.  |  |   |

## 6.20 Software Reset (Fn030)

This function enables resetting the SERVOPACK internally from software. The operation of turning OFF the power and then turning ON again to validate the setting can be omitted by executing this function.

|   |   |
|---|---|
| <br><b>IMPORTANT</b> | <ul style="list-style-type: none"> <li>• Starts software reset operation when the servomotor power is OFF.</li> <li>• 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.</li> </ul> |
|---|---|















### (1) Setting before Operation

The following settings are required before executing the software reset function.

- If a servo ON command is input, send a servo OFF command.

### (2) Operating Procedure

Follow the steps below to reset the SERVOPACK internally.

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

## 6.21 EasyFFT (Fn206)

EasyFFT sends a frequency waveform reference from the SERVOPACK to the servomotor and rotates the servomotor at minimal speed a number of times over a certain period, thus causing machine vibration. The SERVOPACK detects the resonance frequency from the generated vibration and makes notch filter settings according to the resonance frequency detection. The notch filter is effective for the elimination of high-frequency vibration and noise.

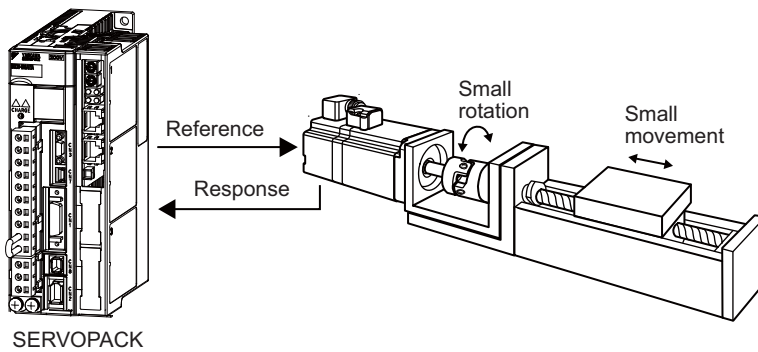
### ⚠ WARNING

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

### ⚠ CAUTION

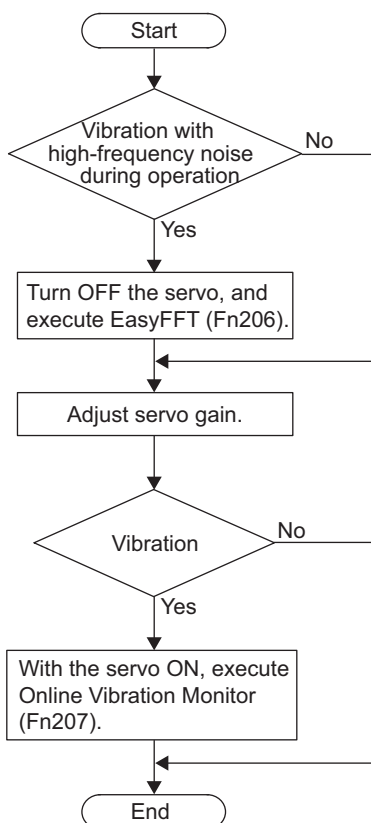
- Use the EasyFFT when the servo gain is low, such as in the initial stage of servo adjustment. If EasyFFT is executed after increasing the gain, the servo system may vibrate depending on the machine characteristics or gain balance.

Machine vibration may be suppressed by setting a notch filter according to the detected vibration frequency.



In addition to this function, Online Vibration Monitor (Fn207) can be used to detect machine vibration and automatically make notch filter settings. Use the following flowchart to determine which function should be used.

When using mainly for servo gain adjustment, etc.


























### IMPORTANT





- Starts EasyFFT when the servomotor power is OFF.
- Do not input the reference from outside because EasyFFT outputs the special reference from the SERVOPACK.

## (1) Operating Procedure

Follow the steps below.

| Step | Display Example  | Keys   | Description  |
|------|--|--|--|
| 1    | <pre> BB      -FUNCTION- Fn205:Vib Sup Fn206:Easy FFT Fn207:V-Monitor Fn000:Alm History           </pre> | <br>  | Press the  Key to open the Utility Function Mode main menu and select Fn206.  |
| 2    | <pre> BB      -Easy FFT- Setting Input = 0.15%           </pre>  |   | Press the  Key. The display is switched to the execution display of Fn206.<br>Note: If the display is not switched and “NO-OP” is displayed in the status display, change the following settings. (Refer to 6.12.) <ul style="list-style-type: none"> <li>•If Write Prohibit is set in Fn010:<br/>→ Cancel the Write Prohibited setting.</li> <li>•If a servo ON command is input:<br/>→ Send a servo OFF command.</li> </ul> |

| Step | Display Example  | Keys  | Description  |
|------|--|---|--|
| 3    | <pre> BB      -Easy FFT- Setting Input = 015% </pre>                                 |       | <p>The cursor is on the setting of "Input." Press the  or  Key to set the sweep torque reference amplitude (Pn456)<br/>Setting range: 1 to 800.</p> <p>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.</p>   |
| 4    | <pre> RUN      -Easy FFT- Ready Input = 015% </pre>                                  |    | <p>Press the  Key to turn the servomotor power ON. The display "BB" and "Setting" changes to "RUN" and "Ready."</p>   |
| 5    | <pre> RUN      -Easy FFT- Measure Input = 015% </pre>                                |       | <p>Press the  (forward run start) Key or  (reverse run start) Key to run the servomotor and start the frequency measurement. "Measure" is displayed blinking during the measurement.</p> <p>Within a quarter turn, the servomotor will move forward and then in reverse several times. The total operation time is between 1 and 45 seconds.</p> <p>Note: The actions of the servomotor are very minute in this operation. Also at the same time, the servomotor emits a noise. To ensure safety, do not enter the working envelope of the motor.</p>  |
| 6    | <pre> RUN      -Easy FFT- Result Input = 015 % Res = 1250 Hz Filter 1 1375 Hz </pre> |    | <p>When the detection has completed normally, the result and the notch filter value to be set are displayed.</p> <p>Press the  Key to turn OFF the power to the servomotor.</p> <p>&lt; Important &gt;</p> <p>If 2 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.</p> <p>Notes:</p> <ul style="list-style-type: none"> <li>• If a notch filter has been set and is being used, "*" is displayed on the second line.</li> <li>• If the first notch filter has been set, the second notch filter value is displayed. If the first and second notch filters have been set, only the result of frequency detection is displayed.</li> <li>• If the  Key is pressed while the servomotor is running, the servomotor will stop, and the frequency detection will be canceled.</li> <li>• If the detection is not completed normally, "No Measure" is displayed.</li> </ul> |
| 7    | <pre> RUN      -Easy FFT- Ready Input = 015% </pre>                                  |   | <p>Press the  Key to exit the EasyFFT function at this stage. The power to the servomotor is turned OFF and the display returns to the Utility Function Mode main menu.</p> <p>Press the  Key to return to "Ready" display.</p>  |

| Step | Display Example  | Keys  | Description  |
|------|--|---|--|
| 8    | <pre> Done      -Easy FFT- Result Input = 015 % Res =    1250 Hz Filter1 1375 Hz </pre>            |  | <p>Press the  Key after the normal completion of frequency detection. The notch filter frequencies are updated to the optimum values. If the first notch filter frequency has been set, set the second notch filter frequency (Pn 40C) to Pn 408.0 = 1.</p> <p>Notes:</p> <ul style="list-style-type: none"> <li>• If the second stage notch filter frequency has already been set (Pn408.2 = 1), the notch filter frequency cannot be set.</li> <li>• If the frequency detected by this function is not used, set the notch filter to be invalid (Pn408.0 = 0).</li> </ul> |
| 9    | <pre> BB      -FUNCTION- Fn205: Vib Sup Fn206: Easy FFT Fn207: V-Monitor Fn000: Alm History </pre> |  | Press the  Key to return to the Utility Function Mode main menu.  |
| 10   | Turn OFF the power and then turn ON again to validate the setting.                                 |   |  |

## (2) Related Parameters

The Easy FFT related parameters are listed below. These parameters will be automatically set and the user need not set them manually.

| Parameter    | Meaning | When Enabled                                 | Classification |       |
|--------------|---------|--|----------------|-------|
| <b>Pn408</b> | n.□□□0  | Disables 1st notch filter. (Factory setting) | Immediately    | Setup |
|              | n.□□□1  | Uses 1st notch filter.                       |                |       |
|              | n.□0□□  | Disables 2nd notch filter. (Factory setting) |                |       |
|              | n.□1□□  | Uses 2nd notch filter.                       |                |       |

| <b>Pn409</b> | 1st Notch Filter Frequency |              |                 |              | Classification |
|--------------|----------------------------|--------------|-----------------|--------------|----------------|
|              | Setting Range              | Setting Unit | Factory Setting | When Enabled |                |
|              | 50 to 5000                 | 1 Hz         | 5000            | Immediately  | Tuning         |

| <b>Pn40C</b> | 2nd Notch Filter Frequency |              |                 |              | Classification |
|--------------|----------------------------|--------------|-----------------|--------------|----------------|
|              | Setting Range              | Setting Unit | Factory Setting | When Enabled |                |
|              | 50 to 5000                 | 1 Hz         | 5000            | Immediately  | Tuning         |

| <b>Pn456</b> | Sweep Torque Reference Amplitude |              |                 |              | Classification |
|--------------|----------------------------------|--------------|-----------------|--------------|----------------|
|              | Setting Range                    | Setting Unit | Factory Setting | When Enabled |                |
|              | 1 to 800                         | 1%           | 15              | Immediately  | Tuning         |

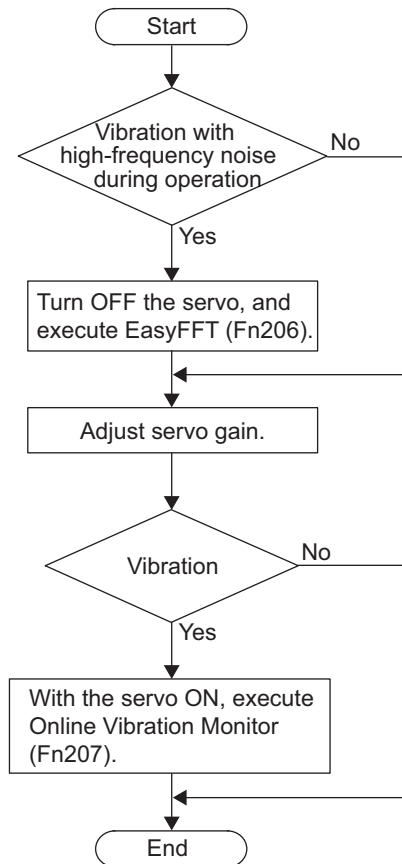
## 6.22 Online Vibration Monitor (Fn207)

The machine vibration can sometimes be suppressed by setting a notch filter or torque reference filter for the vibration frequencies.

When online, vibration frequencies caused by machine resonance will be detected and the frequency that has the highest peak will be displayed on the Panel Operator. The effective torque reference filter or notch filter frequency for the vibration frequency will be automatically selected 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 which function should be used.














When using mainly for servo gain adjustment, etc.





## (1) Operating Procedure

Follow the steps below.

| Step | Display Example   | Keys   | Description   |
|------|---|--|---|
| 1    | <pre> RUN      -FUNCTION- Fn206:Easy FFT Fn207:V-Monitor Fn000:Alm History Fn001:JOG           </pre> | <br>  | Press the  Key to open the Utility Function Mode main menu and select Fn207.   |
| 2    | <pre> RUN      -V-MONITOR- Measure F1=----- F2=----- F3=-----           </pre>                        |   | Press the  Key. The display is switched to the execution display of Fn207.<br>Note: If the display is not switched and “NO-OP” is displayed in the status display, the Write Prohibit is set in Fn010. Check the setting and reset. (Refer to 6.12.)   |
| 3    | <pre> RUN      -V-MONITOR- Measure F1=----- F2=----- F3=-----           </pre>                        |   | Press the  Key for 1 second.<br>The message, “Measure,” blinks, and vibration detection will start.  |
| 4    | <pre> RUN      -V-MONITOR- Measure F1= 0850 [Hz] F2= 1600 [Hz] F3= 0225 [Hz]           </pre>         |  | When the vibration detection has completed, “Measure” stops blinking and the detection ends automatically. When the detection has completed normally, the vibrations with three largest peak values in vibration frequency are displayed for F1, F2, and F3.<br>Notes: <ul style="list-style-type: none"> <li>Press the  Key to quit the online vibration monitor function. The display returns to the Utility Function Mode main menu.</li> <li>Three detected frequencies can be displayed. For a vibration with undetectable peak frequency, “----” is displayed. If no frequency was detected, “----” is displayed for F1, F2, and F3.</li> <li>If the frequency could not be successfully detected, “NO MONITOR” is displayed.</li> </ul> |
| 5    | <pre> DONE     -V-MONITOR- SETTING DONE F1= 0850 [Hz] F2= 1600 [Hz] F3= 0225 [Hz]           </pre>    |   | After the detection has normally completed, press the  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.   |
| 6    | <pre> RUN      -FUNCTION- Fn206:Easy FFT Fn207:V-Monitor Fn000:Alm History Fn001:JOG           </pre> |   | Press the  Key to return to the Utility Function Mode main menu.   |

## (2) Related Parameters

The following parameters are set automatically by using online vibration monitor.

| Parameter    | Meaning  |
|--------------|--|
| <b>Pn401</b> | 1st Step 1st Primary Torque Reference Filter Time Constant |
| <b>Pn408</b> | Torque Related Function Switch                             |
| <b>Pn409</b> | 1st Notch Filter Frequency                                 |

---

## Monitor Modes (Un□□□)

|                                 |     |
|---------------------------------|-----|
| 7.1 List of Monitor Modes ..... | 7-2 |
| 7.2 Monitor Displays .....      | 7-3 |

## 7.1 List of Monitor Modes

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

Refer to the following table.

| Parameter No. | Content of Display   | Unit                       |
|---------------|--|----------------------------|
| Un000         | Motor rotating speed   | min <sup>-1</sup>          |
| Un001         | Speed reference (for speed control)  | min <sup>-1</sup>          |
| Un002         | Internal torque reference (in percentage to the rated torque)  | %                          |
| Un003         | Electric angle 1   | pulse (encoder resolution) |
| Un004         | Electric angle 2   | deg                        |
| Un005         | Input signal monitor   | –                          |
| Un006         | Output signal monitor  | –                          |
| Un007         | Reference speed (for position control)   | min <sup>-1</sup>          |
| Un008         | Position error (for position control)  | reference unit             |
| Un009         | Accumulated load ratio (in percentage to the rated torque: effective torque in cycle of 10 seconds)                                  | %                          |
| Un00A         | Regenerative load ratio (in percentage to the processable regenerative power: regenerative power consumption in cycle of 10 seconds) | %                          |
| Un00B         | Power consumed by DB resistance (in percentage to the processable power at DB activation: displayed in cycle of 10 seconds)          | %                          |
| Un00C         | Reference counter  | reference unit             |
| Un00D         | Feedback pulse counter   | pulse (encoder resolution) |
| Un00E         | Fully-closed feedback pulse counter  | pulse (encoder resolution) |
| Un012         | Total operation time   | 100 ms                     |
| Un013         | Feedback pulse counter   | reference unit             |
| Un014         | Effective gain monitor (gain setting 1 = 1, gain setting 2 = 2)  | –                          |
| Un015         | Safety I/O signal monitor  | –                          |
| Un020         | Motor rated rotational speed   | min <sup>-1</sup>          |
| Un021         | Motor maximum rotational speed   | min <sup>-1</sup>          |

## 7.2 Monitor Displays

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

The following four Un numbers are displayed as the factory settings.

| BB            | -PRM/MON-  |
|---------------|------------|
| Un00 <u>0</u> | = 00000    |
| Un00 <u>2</u> | = 00000    |
| Un00 <u>8</u> | = 00000    |
| Un00 <u>D</u> | = 00000000 |

← Indicates that the value of Un000 (motor speed) is 0 min<sup>-1</sup>.

To view other Un numbers, press the  or  Key to scroll through the list in monitor mode.

|                                      |   |
|--------------------------------------|---|
| Motor speed                          | Un00 <u>0</u> = 00000   |
|                                      | <input type="button" value="▼"/> <input type="button" value="▲"/> <input type="button" value="↓"/> <input type="button" value="↑"/> |
| Speed reference                      | Un00 <u>1</u> = 00000   |
|                                      | <input type="button" value="▼"/> <input type="button" value="▲"/> <input type="button" value="↓"/> <input type="button" value="↑"/> |
| Internal torque reference            | Un00 <u>2</u> = 00000   |
|                                      | <input type="button" value="▼"/> <input type="button" value="▲"/> <input type="button" value="↓"/> <input type="button" value="↑"/> |
| Electric angle 1                     | Un00 <u>3</u> = 00000   |
|                                      | <input type="button" value="▼"/> <input type="button" value="▲"/> <input type="button" value="↓"/> <input type="button" value="↑"/> |
| Electric angle 2 (angle from origin) | Un00 <u>4</u> = 00090   |
|                                      | <input type="button" value="▼"/> <input type="button" value="▲"/> <input type="button" value="↓"/> <input type="button" value="↑"/> |
|                                      | <input type="button" value="▼"/> <input type="button" value="▲"/> <input type="button" value="⋮"/> <input type="button" value="↑"/> |
| Feedback pulse counter               | Un00 <u>D</u> = 00000000  |

## Fully-closed Loop Control

|   |      |
|---|------|
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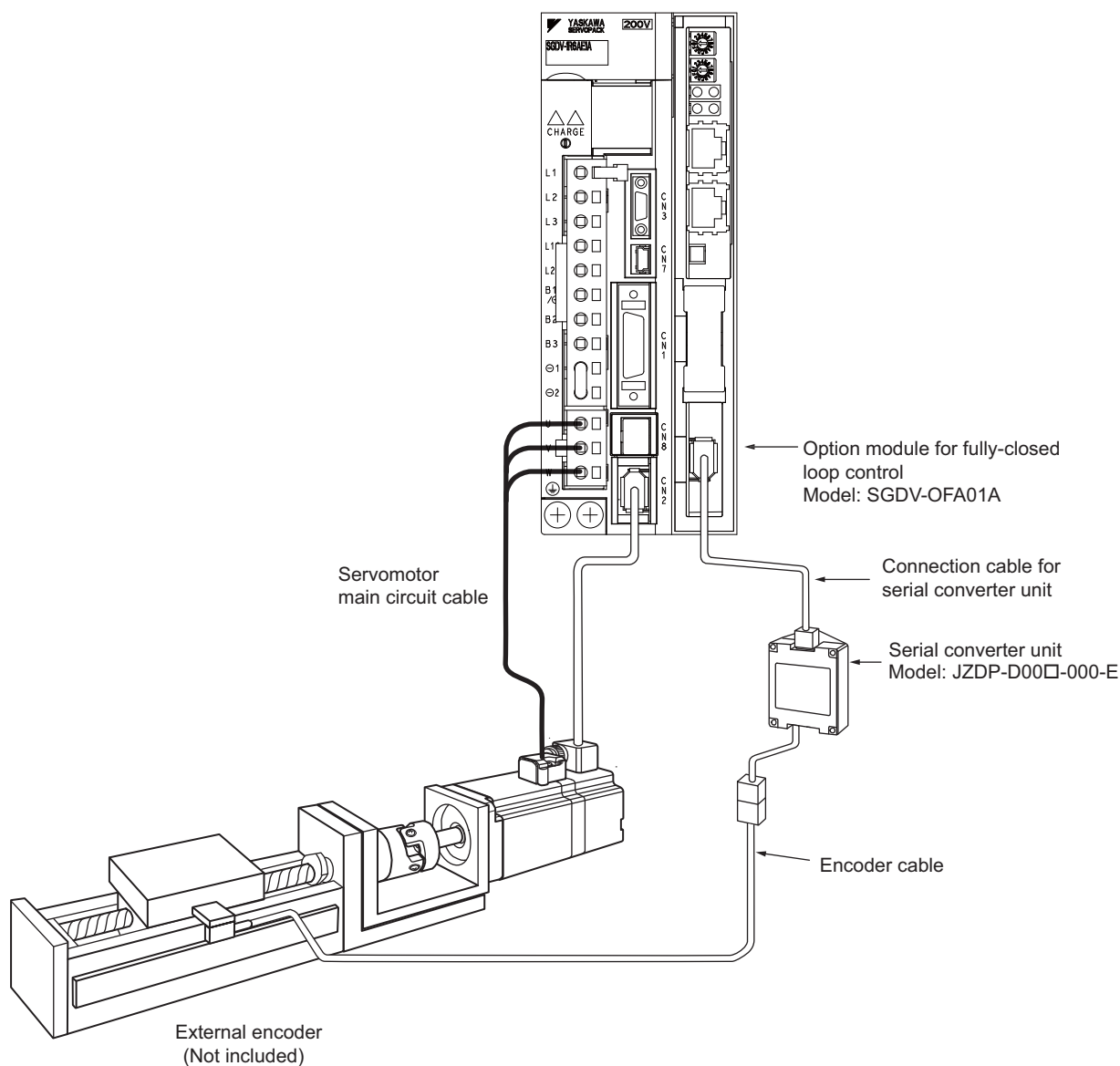
## 8.1 System Configuration and Connection Example for SERVOPACK with Fully-closed Loop Control

This section describes the system configuration and connection example for the SERVOPACK with fully-closed loop control.

Refer to the manual of the option module for information on support for fully-closed loop control.

### 8.1.1 System Configuration

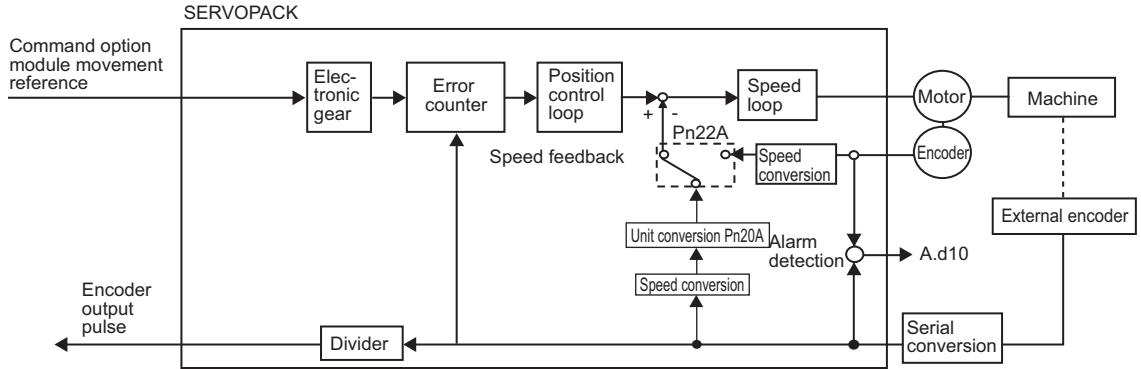
The following figure shows the system configuration for fully-closed loop control.



### 8.1.2 Internal Configuration of Fully-closed Loop Control

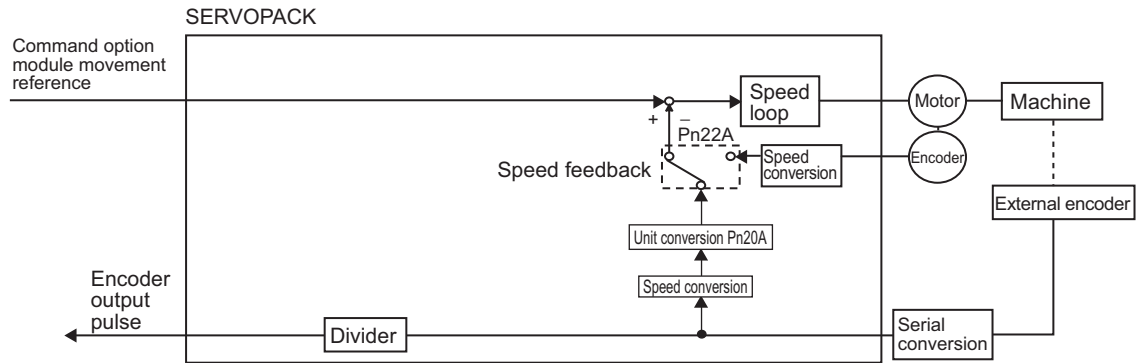
Internal configuration of fully-closed loop control is shown below.

■ With Position Control



Note: Either an incremental or an absolute encoder can be used. When the absolute encoder is used, set 1 to Pn002.2 (use the absolute encoder as an incremental encoder).

■ With Speed Control



**8.1.3 Serial Converter Unit**

(1) Model: JZDP-D00□-000-E

## (2) Characteristics and Specifications

|                            | Items                                      | Specifications   |
|----------------------------|--|--|
| Electrical Characteristics | Power Supply Voltage                       | +5.0V±5%, ripple content 5% max.   |
|                            | Current Consumption *1                     | 120 mA Typ. 350 mA Max.  |
|                            | Signal Resolution                          | Input 2-phase sine wave: 1/256 pitch   |
|                            | Max. Response Frequency                    | 250 kHz  |
|                            | Analog Input Signals *2<br>(cos, sin, Ref) | Differential input amplitude: 0.4 V to 1.2 V<br>Input signal level: 1.5 V to 3.5 V     |
|                            | Output Signal *3                           | Position data, alarms  |
|                            | Output Method                              | Serial data communications   |
|                            | Output Circuit                             | Balanced type transceiver (SN75LBC176 or the equivalent), internal end resistor: 120 Ω |
| Mechanical Characteristics | Approx. Mass                               | 150 g  |
|                            | Vibration Resistance                       | 98 m/s <sup>2</sup> max. (10 to 2500 Hz) in three directions                           |
|                            | Shock Resistance                           | 980 m/s <sup>2</sup> , (11 ms) two times in three directions                           |
| Environmental Conditions   | Surrounding Air Temperature                | 0 °C to 55 °C  |
|                            | Storage Temperature                        | -20 °C to +80 °C   |
|                            | Humidity                                   | 20 % to 90 %RH (without condensation)  |

\*1. The current consumption of the external encoder is not included in this value.

The current consumption of the external encoder must be taken into consideration for the current capacity of host controller that supplies the power.

\*2. Input a value within the specified range. Otherwise, incorrect position information is output, and the device may be damaged.

\*3. The transmission is enabled 100 to 300 ms after the power turns ON.

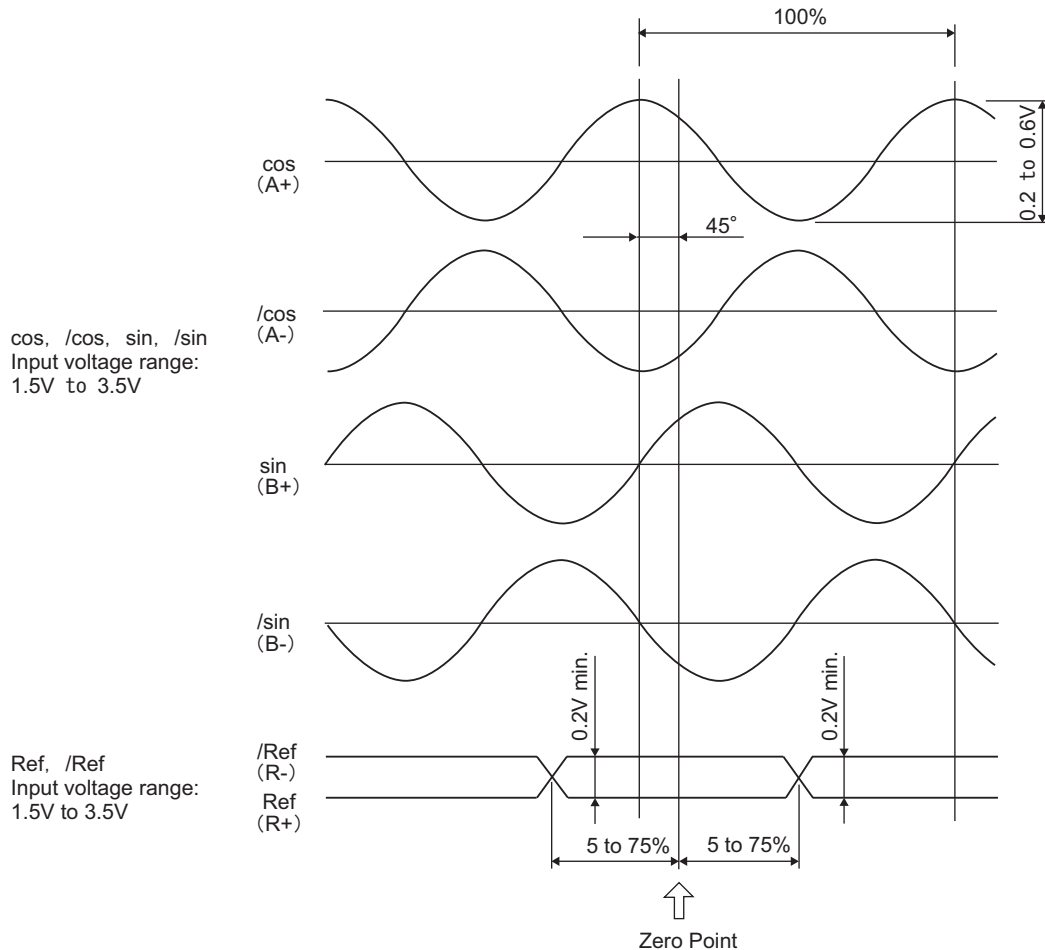


### (3) Analog Signal Input Timing

The following figure shows the input timing of the analog signals.

When the cos and sin signals are shifted 180 degrees, the differential signals are the /cos and /sin signals. The specifications of the cos, /cos, sin, and /sin signals are identical except for the phase.

Input the signals Ref and /Ref so that they shall cross each other as shown in the figure because they are input into the converter. When they are crossed, the output data will be counted up.

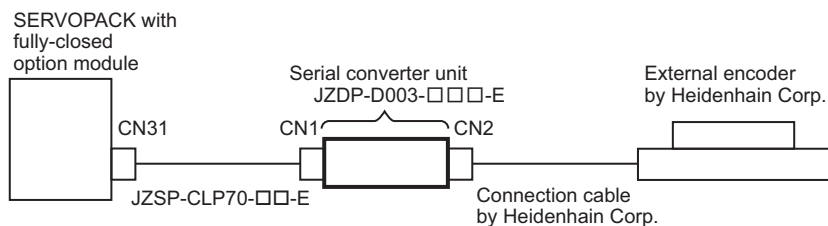


#### IMPORTANT

- Never perform insulation resistance and withstand voltage tests.
- When analog signals are input to the serial converter unit, noise influence on the analog signals affects the unit's ability to output correct position information. The analog cable must be as short as possible and shielded.
- Do not connect or disconnect the unit while power is being supplied, or the unit may be damaged.
- When using multiple axes, use a shield cable for each axis. Do not use a shield cable for multiple axes.

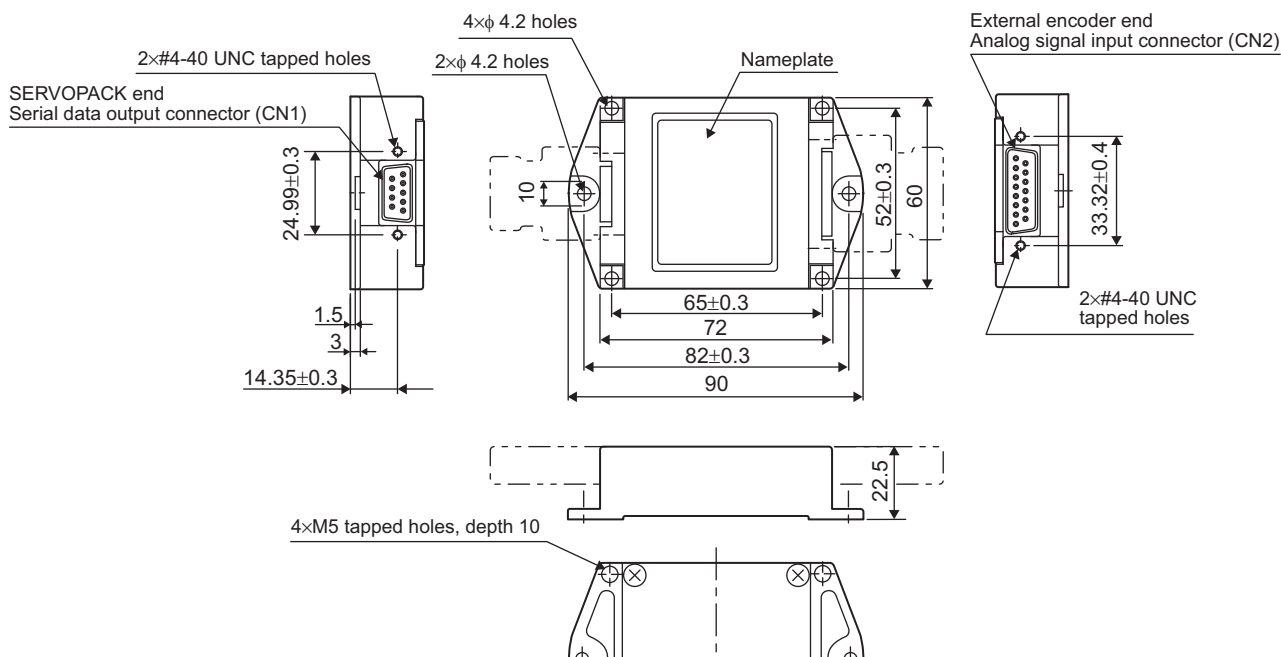
### 8.1.4 Connection Example of External Encoder by Heidenhain

#### (1) Connection Example



#### (2) Specifications of Serial Converter Unit (JZDP-D003-□□□-E)

Units: mm



| Pin No. | Signal          |
|---------|-----------------|
| 1       | +5V             |
| 2       | S-phase output  |
| 3       | Empty           |
| 4       | Empty           |
| 5       | 0V              |
| 6       | /S-phase output |
| 7       | Empty           |
| 8       | Empty           |
| 9       | Empty           |
| Case    | Shield          |

**CN1**  
SERVOPACK end  
Serial data output

17-series connector  
model:  
17LE-13090-27-FA  
(socket) by DDK Ltd.

| Pin No. | Signal          |
|---------|-----------------|
| 1       | cos input (A+)  |
| 2       | 0V              |
| 3       | sin input (B+)  |
| 4       | +5V             |
| 5       | Empty           |
| 6       | Empty           |
| 7       | /Ref input (R-) |
| 8       | Empty           |
| 9       | /cos input (A-) |
| 10      | 0V sensor       |
| 11      | /sin input (B-) |
| 12      | 5V sensor       |
| 13      | Empty           |
| 14      | Ref input (R+)  |
| 15      | Empty           |
| Case    | Shield          |

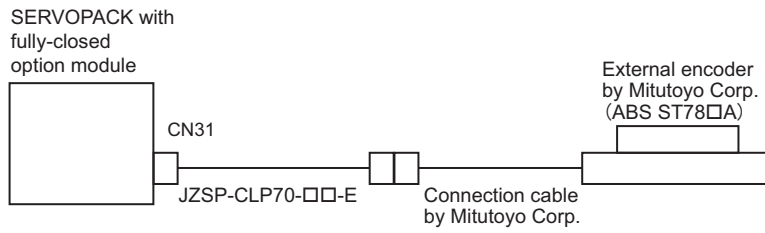
**CN2**  
External encoder end  
Analog signal input

17-series connector  
model:  
17LE-13150-27-FA  
(socket) by DDK Ltd.

- Note 1. Do not use the empty pins.  
 2. The external encoder (analog 1V<sub>p-p</sub> output, D-sub 15-pin) manufactured by Heidenhain Corp. can be directly connected.

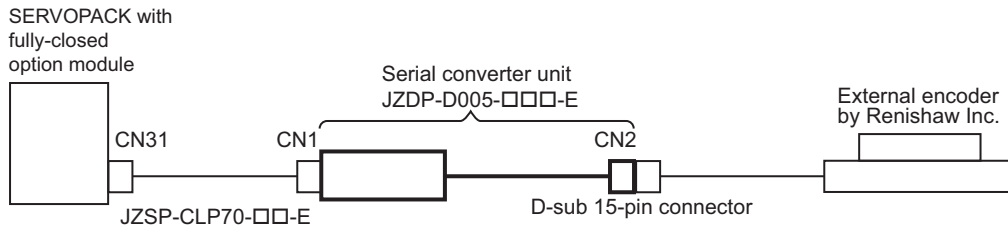
### 8.1.5 Connection Example of External Encoder by Mitutoyo

The serial converter unit is not needed when using the external encoder made by Mitutoyo Corporation.

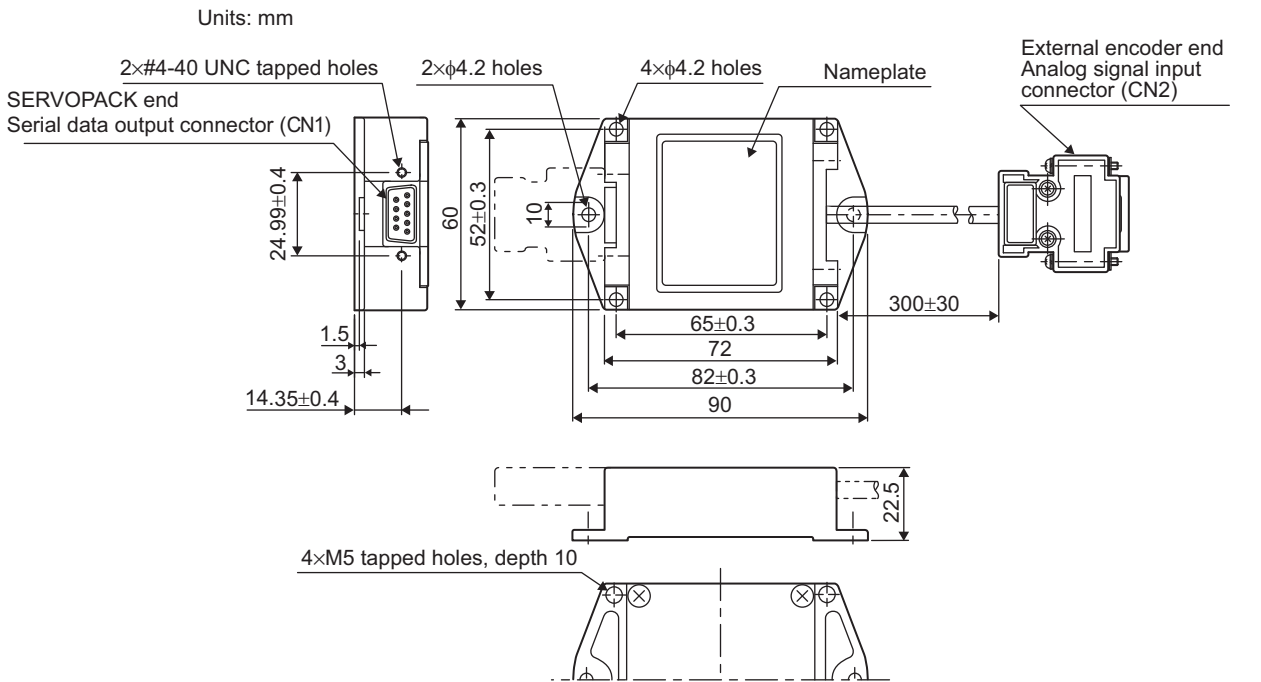


### 8.1.6 Connection Example of External Encoder by Renishaw

#### (1) Connection Example



#### (2) Specifications of Serial Converter Unit (JZDP-D005-□□□E)



| Pin No. | Signal          |
|---------|-----------------|
| 1       | +5V             |
| 2       | S-phase output  |
| 3       | Empty           |
| 4       | Empty           |
| 5       | 0V              |
| 6       | /S-phase output |
| 7       | Empty           |
| 8       | Empty           |
| 9       | Empty           |
| Case    | Shield          |

SERVOPACK does not have the function to process Vq signals.

**CN1**  
SERVOPACK end  
Serial data output

17-series connector model:  
17LE-13090-27-FA  
(socket) by DDK Ltd.

| Pin No. | Signal           |
|---------|------------------|
| 1       | /cos input (V1-) |
| 2       | /sin input (V2-) |
| 3       | Ref input (V0+)  |
| 4       | +5V              |
| 5       | 5Vs              |
| 6       | Empty            |
| 7       | Empty            |
| 8       | Empty            |
| 9       | cos input (V1+)  |
| 10      | sin input (V2+)  |
| 11      | /Ref input (V0-) |
| 12      | 0V               |
| 13      | 0Vs              |
| 14      | Empty            |
| 15      | Inner (0V)       |
| Case    | Shield           |

**CN2**  
External encoder end  
Analog signal input

17-series connector model:  
17JE-13150-02 (D8C)A-CG  
(socket) by DDK Ltd.

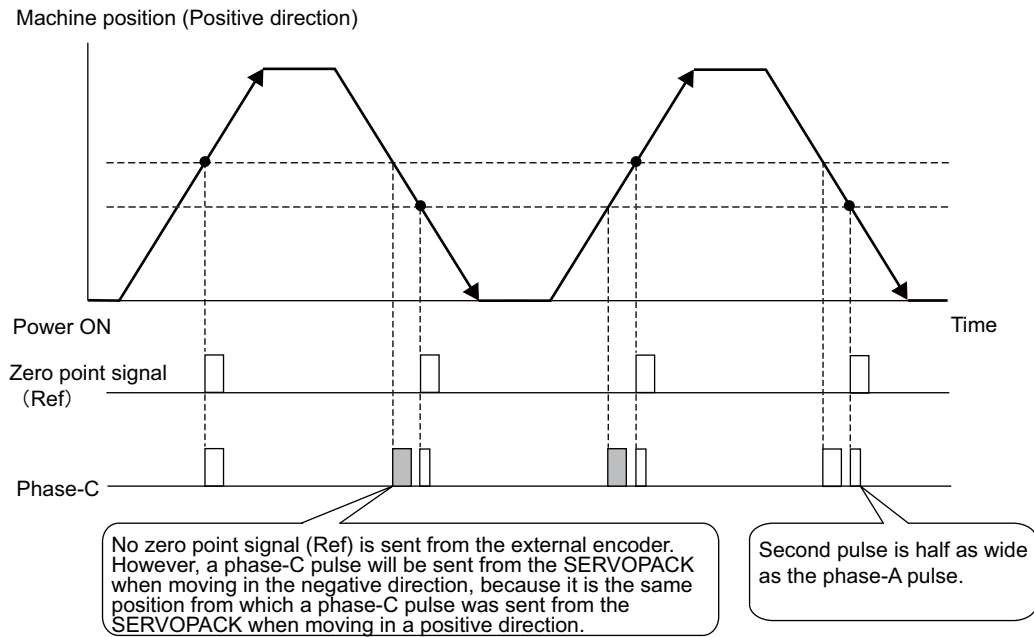
- Note 1. Do not use empty pins.  
 2. The external encoder (analog 1Vp-p output, D-sub 15-pin) by Renishaw Inc. can be directly connected. However, the BID and DIR signals are not connected.  
 3. Use the external encoder end connector to change the zero point specifications of the external encoder.

### 8.1.7 Encoder Output Pulse Signals from SERVOPACK with an External Encoder by Renishaw

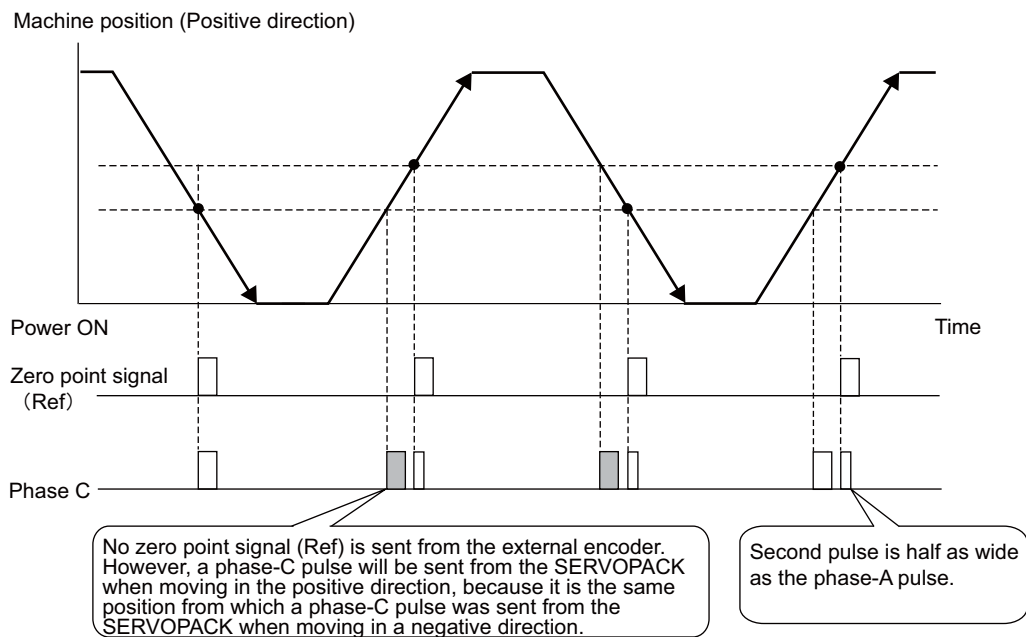
The output position of the zero point signal (Ref) may vary in some models of the external encoder made by Renishaw.

If using an external encoder by Renishaw, the phase-C pulses of the SERVOPACK are output at two positions. For details on the specifications of the zero-point signals for a external encoder, refer to the manual for the Renishaw external encoder.

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



#### (2) When Passing the 1st Zero Point Signal (Ref) in Negative Direction after Power ON



## 8.2 SERVOPACK Startup Procedures with Fully-closed Loop Control

The following table outlines the procedures to start the SERVOPACK with fully-closed loop control.

| Step | Method  | Description   | Required Parameter Settings   | Reference                    |
|------|---|---|---|------------------------------|
| 1    | <p>Check combined operation using semi-closed position control without load.</p> <p>Check the following items:</p> <ul style="list-style-type: none"> <li>• Power supply circuit wiring</li> <li>• Servomotor wiring</li> <li>• Encoder wiring</li> <li>• I/O wiring with host controller</li> <li>• Servomotor rotation direction, speed, and rotation amount</li> <li>• Operation of protective functions for brake and overtravel</li> </ul> | <p>Make parameter settings and check the following items so that operation is performed correctly in semi-closed position control (Pn002.3 = 0) with no load.</p> <ul style="list-style-type: none"> <li>• Is there no error in the SERVOPACK?</li> <li>• Is JOG operation performed correctly with the servomotor alone?</li> <li>• Do the I/O signals turn ON and OFF correctly?</li> <li>• Is power applied to the servomotor after the servo ON signal has been input?</li> <li>• Does the servomotor operate correctly after a position reference has been input from the host controller?</li> </ul>                      | <ul style="list-style-type: none"> <li>• Basic Function Select Switch 0 (Pn000)</li> <li>• Application Function Select Switch 1 (Pn001)</li> <li>• External Encoder Usage Method (Pn002.3)</li> <li>• Electronic Gear Ratio (Numerator) (Pn20E)</li> <li>• Electronic Gear Ratio (Denominator) (Pn210)</li> <li>• Input Signal Selection (Pn50A, Pn50B, Pn511)</li> <li>• Output Signal Selection (Pn50E, Pn50F, Pn510)</li> </ul>  | SERVOPACK or host controller |
| 2    | <p>Check operation using semi-closed position control with the machinery and the servomotor combined.</p> <p>Check Items:</p> <ul style="list-style-type: none"> <li>• Initial responsiveness in combination with machinery</li> <li>• Direction, distance, and speed of machine's movement using references from the host controller</li> </ul>  | <p>Mount the SERVOPACK onto the machinery. Set the moment of inertia ratio at Pn103 by using advanced autotuning.</p> <p>Then, check that the machine's movement direction, movement distance, and movement speed are performed the same as specified by the references from the host controller.</p>   | <ul style="list-style-type: none"> <li>• Moment of inertia ratio (Pn103)</li> </ul>   | Host controller              |
| 3    | <p>Check the linear scale.</p> <p>Check the following item:</p> <ul style="list-style-type: none"> <li>• Is the linear scale signal read correctly?</li> </ul>  | <p>Make the parameter settings for fully-closed control, move the machine by hand without power applied to the servomotor, and check the following conditions with a digital operator or SigmaWin+.</p> <ul style="list-style-type: none"> <li>• Does the fully-closed feedback pulse counter (Un00E) count up when movement is in the forward direction of the servomotor?</li> <li>• Are the machine's movement distance and count in the fully-closed feedback pulse counter (Un00E) almost the same visually?</li> </ul> <p>Note: Unit for the fully-closed feedback pulse counter (Un00E): 1 pulse = Linear pitch/256.</p> | <ul style="list-style-type: none"> <li>• External Encoder Usage (Pn002.3)</li> <li>• Number of External Encoder Pitches (Pn20A)</li> <li>• Electronic Gear Ratio (Numerator) (Pn20E)</li> <li>• Electronic Gear Ratio (Denominator) (Pn210)</li> <li>• Encoder Output Resolution (Pn281)</li> <li>• Excessive Error Level between Servomotor and Load Positions (Pn51B)</li> <li>• Positioning Completed Width (Pn522)</li> <li>• Multiplier per One Fully-closed Rotation (Pn52A)</li> </ul> | —                            |
| 4    | <p>Perform program JOG operation.</p> <p>Check the following item:</p> <p>Does the fully-closed system operate correctly with the servomotor alone?</p>   | <p>Perform program JOG operation and check that the movement distance is the same as the reference value (Pn531).</p> <p>Note: Check operation by gradually increasing the speed from a low speed to the usage speed.</p>   | <ul style="list-style-type: none"> <li>• Program JOG Operation Parameters (Pn530 to Pn536)</li> </ul>   | SERVOPACK                    |
| 5    | <p>Run the SERVOPACK.</p> <p>Check the following item:</p> <p>Does the fully-closed system, including the host controller, operate correctly?</p>   | <p>Enter a position reference and check if the SERVOPACK is operating correctly.</p> <p>Note: Check operation by gradually increasing the speed from a low speed to the actual speed being used.</p>  | —   | Host controller              |

## 8.3 Settings for Fully-closed Loop Control

This section describes the setting for fully-closed loop control.

### 8.3.1 Setting Order

The basic setting order of related parameters is shown below.

If the SERVOPACK is in speed control or torque control, perform steps 1 through 4.

If the SERVOPACK is in position control, perform steps 1 through 8.

| Step | Setting Contents  | Set Parameters  | Reference |
|------|---|-----------------|-----------|
| 1    | Set the motor rotating direction.   | Pn000.0/Pn002.3 | 8.3.2     |
| 2    | Set the number of pitches for the external encoder.                       | Pn20A           | 8.3.3     |
| 3    | Set the number of output pulses of (PAO, PBO and PCO) from the SERVOPACK. | Pn281           | 8.3.4     |
| 4    | Set the absolute external encoder data reception sequence.                | –               | 8.3.5     |
| 5    | Set the electronic gear.  | Pn20E/Pn210     | 8.3.6     |
| 6    | Set the alarm detection.  | Pn51B/Pn52A     | 8.3.7     |
| 7    | Set the analog monitor signal.  | Pn006/Pn007     | 8.3.8     |
| 8    | Set the speed feedback method during fully-closed loop control.           | Pn22A           | 8.3.9     |

### 8.3.2 Motor Rotation Direction

Set the motor rotation direction. To perform fully-closed loop control, it is necessary to set the motor rotation direction with both Pn000.0 (motor rotating direction) and Pn002.3 (external encoder usage method).

#### (1) Parameter Pn000.0

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

| Parameter | Forward/Reverse Reference   | Motor Rotation Direction and Encoder Output Pulses | Enabled Overtravel |
|-----------|---|--|--------------------|
| Pn000     | n.□□□0<br>Standard setting<br><br>(Forward reference = forward rotation)<br>[Factory setting] |  | P-OT               |
|           | Reverse reference   |  | N-OT               |
|           | n.□□□1<br><br>(Forward reference = reverse rotation)  |  | P-OT               |
|           | Reverse reference   |  | N-OT               |

The figures in the table above show the trace waveforms for the Un monitor and SigmaWin+. For analog monitor (CN5) output, the waveform of the Un monitor is inverted.

#### (2) Parameter Pn002.3

| Parameter | Name   | Meaning                | When Enabled  | Classification |       |
|-----------|--------|------------------------|---|----------------|-------|
| Pn002     | n.0□□□ | External Encoder Usage | Do not use. [Factory setting] *1                        | After restart  | Setup |
|           | n.1□□□ |                        | Use external encoder in forward rotation direction. *2  |                |       |
|           | n.2□□□ |                        | Reserved (Do not set).                                  |                |       |
|           | n.3□□□ |                        | Use external encoder in reversed rotation direction. *3 |                |       |
|           | n.4□□□ |                        | Reserved (Do not set).                                  |                |       |

\*1. The mode will be switched to semi-closed position control if Pn002.3 is set to 0.

\*2. The direction for which the external encoder is counted up counterclockwise is defined as forward rotation.

\*3. The direction for which the external encoder is counted up clockwise is defined as forward rotation.



(3) Relation between Motor Rotating Direction and External Encoder Pulse Direction

Refer to the table below.

| Parameter                                    |   |                          | Pn002.3 (External Encoder Usage) |                       |                       |                       |
|--|---|--------------------------|----------------------------------|-----------------------|-----------------------|-----------------------|
|  |   |                          | 1                                |                       | 3                     |                       |
| <b>Pn000.0</b><br>(Motor rotating direction) | 0 | Reference direction      | Forward run reference            | Reverse run reference | Forward run reference | Reverse run reference |
|  |   | Motor rotating direction | CCW                              | CW                    | CCW                   | CW                    |
|  |   | External encoder output  | cos lead                         | sin lead              | sin lead              | cos lead              |
|  |   | Encoder output pulse     | Phase B lead                     | Phase A lead          | Phase A lead          | Phase B lead          |
|  | 1 | Reference direction      | Forward run reference            | Reverse run reference | Forward run reference | Reverse run reference |
|  |   | Motor rotating direction | CW                               | CCW                   | CW                    | CCW                   |
|  |   | External encoder output  | sin lead                         | cos lead              | cos lead              | sin lead              |
|  |   | Encoder output pulse     | Phase B lead                     | Phase A lead          | Phase A lead          | Phase B lead          |

- Set Pn002.3 to 1 if the output of the external encoder is cos lead and the motor is turning counterclockwise; set Pn002.3 to 3 if it is sin lead. When Pn000.0 is set to 0 and Pn002.3 to 1, manually turn the motor counterclockwise. If the Fully-closed Feedback Pulse Counter (Un00E) counts up, set Pn002.3 to 1. If the Un00E counts down, set Pn002.3 to 3.
- If Pn002.3 is set to 1, encoder output pulse is phase B lead if the motor runs forward. If Pn002.3 is set to 3, it is phase A lead if the motor turns forward.

**8.3.3 Sine Wave Pitch (Frequency) for an External Encoder**

Set Pn20A to the number of external encoder pitches per motor rotation.

(1) Setting Example

|  |
|--|
| Specifications<br>External encoder lead: 20 μm<br>Ball screw lead: 30 mm |
|--|

If the external encoder is connected directly to the servomotor, the set value will be 1500 (30 mm/0.02 mm = 1500).

Note: If there is a fraction, round off the digits below the decimal point.

(2) Related Parameter

|              |  |              |                 |               |                |
|--------------|--|--------------|-----------------|---------------|----------------|
| <b>Pn20A</b> | Number of External Encoder Pitches <span style="float: right;">Position</span> |              |                 |               | Classification |
|              | Setting Range  | Setting Unit | Factory Setting | When Enabled  |                |
|              | 4 to 1048576   | 1 pitch/Rev  | 32768           | After restart | Setup          |

(3) Error

The number of external pitches causes little error in the position loop gain (Kp), feedforward, and position reference monitor unless the number of encoder pitches is an integer. This has no influence on the accuracy of positioning, thus does not cause position error.

### 8.3.4 Number of Encoder Output Pulses (PAO, PBO, and PCO) from the SERVOPACK

Set the position resolution to Pn281. Set the number of phase A and phase B edges.

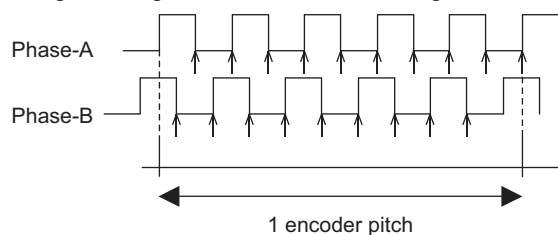
#### (1) Setting Example

|  |
|--|
| Specifications                           |
| External encoder pitch: 20 $\mu\text{m}$ |
| Ball screw lead: 30 mm                   |
| Speed: 1600 $\text{min}^{-1}$            |

If the output of a single pulse (multiplied by 4) is 1  $\mu\text{m}$ , the set value will be 20.

If the output of a single pulse (multiplied by 4) is 0.5  $\mu\text{m}$ , the set value will be 40.

The pulse output will have the following waveform if the set value is 20.



“↑” shows the edge position. In this example, the set value is 20 therefore the number of ↑ is 20.

Note: The upper limit frequency of the encoder signal output (multiplied by 4) is 6.4 Mpps. Do not allow the upper limit frequency to exceed 6.4 Mpps. If exceeds, the alarm A.511 (overspeed of encoder output pulse rate) is output.

Example:

The maximum speed is 1600  $\text{min}^{-1}$ , and so the frequency of the encoder signal output will be as follows if the set value is 20:

$$\frac{16000 \text{ min}^{-1}}{0.001 \text{ mm}} = 1600000 = 1.6 \text{ Mpps}$$

Because 1.6 Mpps is less than 6.4 Mpps, this value can be used.

#### (2) Related Parameter

| Pn281 | Encoder Output Resolution |              |                 |               | Classification |
|-------|---------------------------|--------------|-----------------|---------------|----------------|
|       | Setting Range             | Setting Unit | Factory Setting | When Enabled  |                |
|       | 1 to 4096                 | 1 P/pitch    | 20              | After restart | Setup          |

#### (3) Phase-C Pulse Output Specifications

The pulse width of phase-C (origin pulse) varies according to the encoder output resolution (Pn281), and will become the same as the pulse width of phase-A.

Output timing for the phase-C pulse is in one of the following patterns.

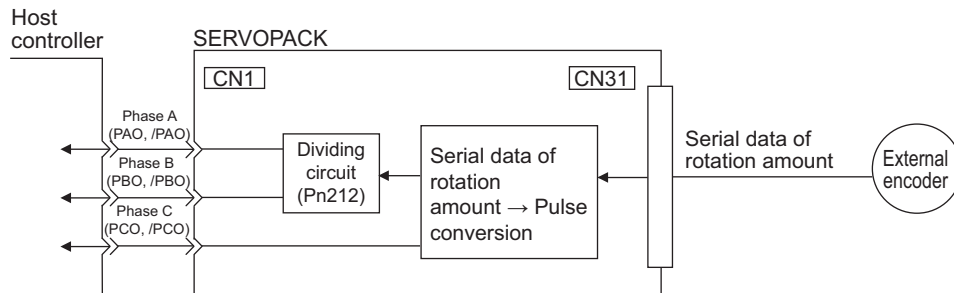
- In synchronization with the phase-A rising edge
- In synchronization with the phase-A falling edge
- In synchronization with the phase-B rising edge
- In synchronization with the phase-B falling edge

### 8.3.5 Absolute External Encoder Reception Sequence

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

#### (1) Outline of Absolute Signals

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



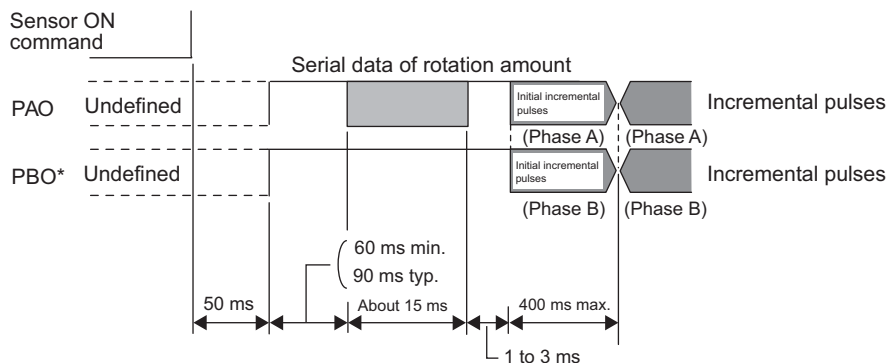
| Signal Name | Status            | Contents   |
|-------------|-------------------|--|
| PAO         | At initialization | Serial data of rotation amount<br>Initial incremental pulses |
|             | Normal time       | Incremental pulses   |
| PBO         | At initialization | Initial incremental pulses                                   |
|             | Normal time       | Incremental pulses   |
| PCO         | Always            | Origin pulses  |

Note: Do not reset the counter using the output of the PCO signal if the host controller receives the data of the absolute encoder.

## (2) Absolute Encoder Transmission Sequence and Contents

### ■ Absolute Encoder Transmission Sequence

1. Send the sensor ON command from the host controller.
2. After 100 ms, set the system to serial data of rotation amount reception-waiting-state. Clear the incremental pulse up/down counter to zero.
3. Receive eight characters of rotational serial data.
4. The system enters a normal incremental operation state about 400 ms after the last rotational serial data is received.



\* In the case of reverse rotation mode (Pn000.0 = 1), the output polarity for PBO signal inverts.

### ■ Contents

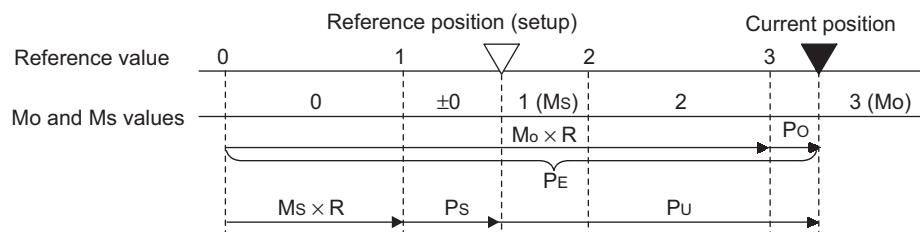
Serial data:

The current position pulses divided by Pn281 are output in serial data.

One serial data is a value equivalent to 1048576 pulses.

Initial incremental pulses:

The current position pulses divided by Pn281 are output in pulses. The number of output pulses is between 0 to 1048576, and the output speed is approximately 1.48 μs per pulse.



Final absolute data  $P_U$  is calculated by following formula.

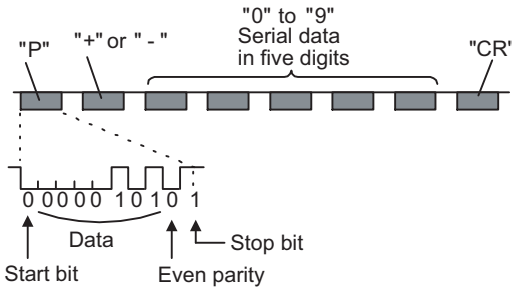
$$P_E = M_O \times R + P_O$$

$$P_U = P_E - M_S \times R - P_S$$

| Signal | Meaning  |
|--------|--|
| $P_E$  | Current position of external encoder                       |
| $M_O$  | Serial data of current position                            |
| $P_O$  | Number of initial incremental pulses of current position   |
| $M_S$  | Serial data of reference position                          |
| $P_S$  | Number of initial incremental pulses of reference position |
| $P_U$  | Current value required for the user's system               |
| R      | 1048576  |

### (3) Serial Data Specifications

The number of revolutions is output from the PAO signal.

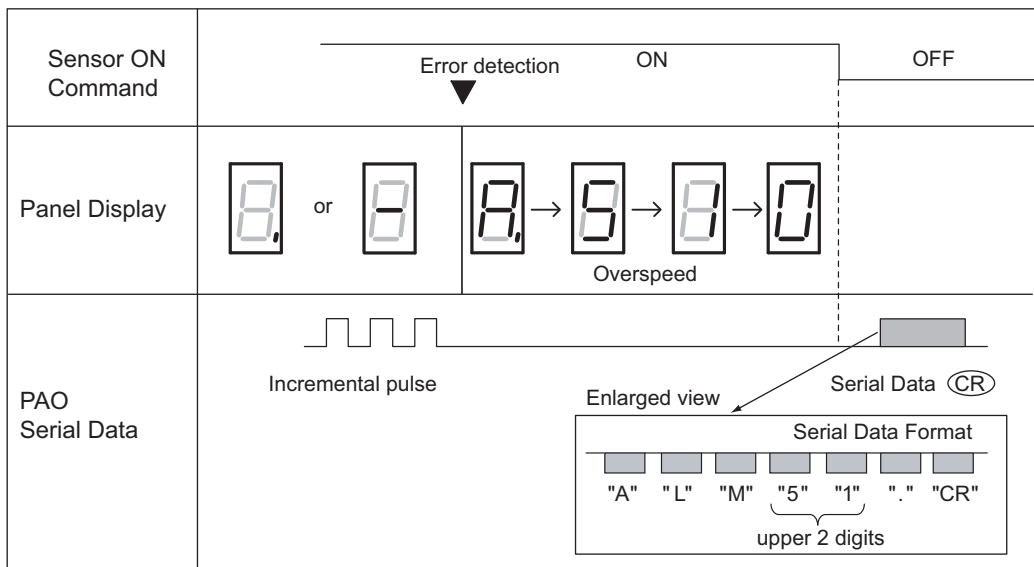
| Data Transfer Method   | Start-stop Synchronization (ASYNC)  |
|--|---|
| Baud rate  | 9600 bps  |
| Start bits   | 1 bit   |
| Stop bits  | 1 bit   |
| Parity   | Even  |
| Character code   | ASCII 7-bit code  |
| Data format  | 8 characters, as shown below.<br> |
| <p>Note:</p> <ul style="list-style-type: none"> <li>• Data is "P+00000" (CR) or "P-00000" (CR) when the position is zero.</li> <li>• The allowable range of the rotational serial data is "+32767" to "-32768." When the value is outside the allowable range, the data changes from "+32767" to "-32768" or from "-32768" to "+32767." When changing multiturn limit, the range changes. For details, refer to 4.5.6 <i>Multiturn Limit Setting</i>.</li> </ul> |   |

### (4) Transferring Alarm Contents

If an absolute encoder is used, the contents of alarms detected by the SERVOPACK can be transmitted in serial data to the host controller from the PAO output when the sensor ON command is changed from ON to OFF.

Note: The sensor ON command cannot be received while the servomotor power is ON.

An example of alarm contents output is shown below.



### 8.3.6 Electronic Gear

Set the electronic gear. For details on the electronic gear setting, refer to 4.2.4 *Electronic Gear*.

When using a serial converter unit, set the encoder resolution as follows.

- For the encoder manufactured by Heidenhain Corp.: Pn20A set value × 256
- For the encoder manufactured by Renishaw Inc.: Pn20A set value × 256
- For the encoder manufactured by Mitutoyo Corp.: Pn20A set value × 512

#### <Example>

Use Pn20E as numerator B and Pn210 as denominator A to set the travel distance for each position reference pulse. The travel distance can be calculated by the following equation. Set Pn20E and Pn210 to integral values.

$$\frac{B}{A} = \frac{\text{Pn20E}}{\text{Pn210}} = \frac{\text{Travel distance per position reference pulse (reference unit)} \times 256}{\text{External encoder pitch}}$$

For example, if the travel distance for each position reference pulse is 0.2 μm, then the electric gear ratio is calculated as follows.

$$\frac{B}{A} = \frac{\text{Pn20E}}{\text{Pn210}} = \frac{0.2 \times 256}{20} = \frac{512}{200}$$

### 8.3.7 Alarm Detection

Set the alarm detection (Pn51B/Pn52A).

#### (1) Excessive Error Level between the Motor and Load Positions (Pn51B)

This setting detects the difference between the external encoder position and the encoder position. If the detected difference is above the set level, alarm A.d10 (Motor-load Position Error Pulse Overflow) will be output.

| Pn51B | Excessive Error Level Between Servomotor and Load Positions <span style="float: right;">Position</span> |                  |                 |              | Classification |
|-------|---|------------------|-----------------|--------------|----------------|
|       | Setting Range   | Setting Unit     | Factory Setting | When Enabled |                |
|       | 0 to 1073741824 (2 <sup>30</sup> )  | 1 reference unit | 1000            | Immediately  | Setup          |

Note: When Pn51B is set to 0, “Motor-load Position Error Pulse Overflow (A.d10)” is not detected.

## (2) Multiplier per One Fully-closed Rotation (Pn52A)

Set the coefficient of the deviation between the external encoder and the motor per rotation. This function can be used to prevent the motor from running out of control due to damage to the external encoder or to detect slippage of the belt.

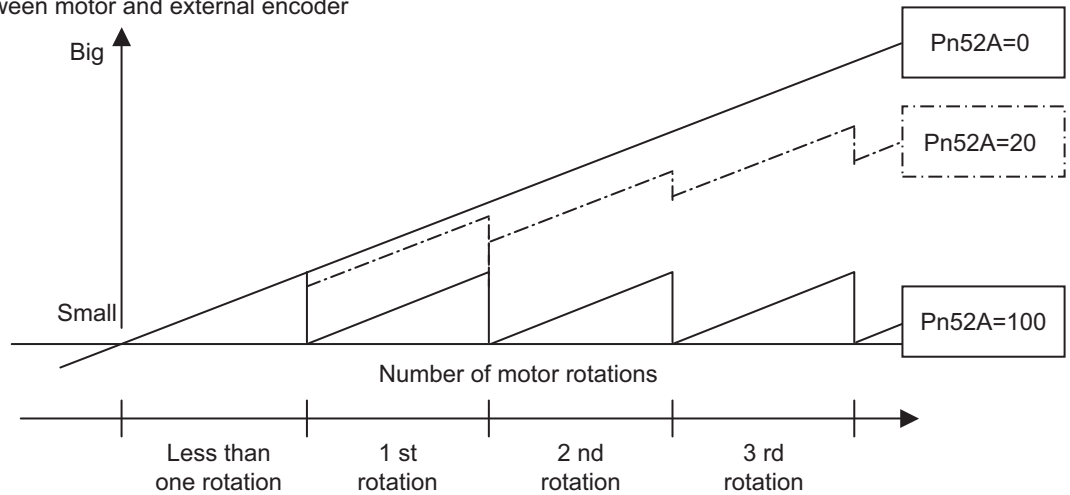
### ■ Setting Example

Increase the value if the belt slips or is twisted excessively.

If the set value is 0, the external encoder value will be read as it is.

The factory setting is 20. In this case, the second rotation will start with the deviation per motor rotation multiplied by 0.8. (Refer to the following figure.)

Error between motor and external encoder



### ■ Related Parameter

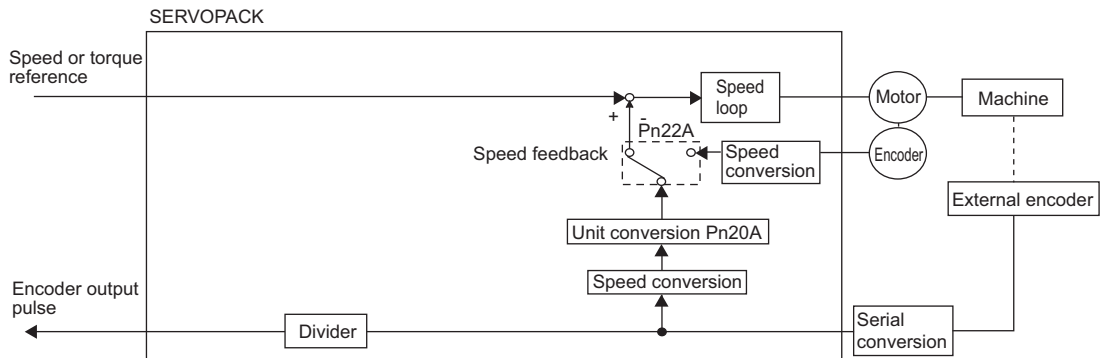
|              |   |              |                 |              |                |
|--------------|---|--------------|-----------------|--------------|----------------|
| <b>Pn52A</b> | Multiplier per One Fully-closed Rotation <span style="border: 1px solid black; padding: 2px;">Position</span> |              |                 |              | Classification |
|              | Setting Range   | Setting Unit | Factory Setting | When Enabled |                |
|              | 0 to 100  | 1%           | 20              | Immediately  | Setup          |

## 8.3.8 Analog Monitor Signal

Set the following analog monitor signals.

| Parameter    | Name   | Meaning  | When Enabled | Classification |
|--------------|--------|--|--------------|----------------|
| <b>Pn006</b> | n.□□07 | Analog Monitor 1 Signal Selection<br>Position error between servomotor and load [0.01 V/1 reference unit]<br>* Factory setting: n.□□02 | Immediately  | Setup          |
| <b>Pn007</b> | n.□□07 | Analog Monitor 2 Signal Selection<br>Position error between servomotor and load [0.01 V/1 reference unit]<br>* Factory setting: n.□□00 |              |                |

### 8.3.9 Speed Feedback Method during Fully-closed Loop Control



Use Pn22A.3 to select the speed feedback method during fully-closed loop control. Normally, set Pn22A.3 to 0 (Uses motor encoder speed.). Set Pn22A.3 to 1 (Uses external encoder speed.) when connecting a direct drive motor and high-resolution external encoder.

| Parameter    | Meaning | When Enabled  | Classification |
|--------------|---------|---------------|----------------|
| <b>Pn22A</b> | n.0□□□  | After restart | Setup          |
|              | n.1□□□  |               |                |

Note: This parameter cannot be used when Pn002.3 is set to 0.



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## Troubleshooting

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## 9.1 Troubleshooting

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

If an alarm occurs, the servomotor can be stopped by doing either of the following operations.

#### ■ Alarm Stopping Method

Gr.1: The servomotor is stopped according to the settings in Pn001.0 if an alarm occurs. Pn001.0 is factory-set to stop the servomotor by applying the DB.

Gr.2: The servomotor is stopped according to the setting in Pn00B.1 if an alarm occurs. Pn00B.1 is factory-set to stop the servomotor by setting the speed reference to "0." The servomotor under torque control will always use the Gr.1 method to stop. By setting Pn00B.1 to 1, the servomotor stops using the same method as Gr.1. When coordinating a number of servomotors, use this alarm stop method to prevent machine damage that may result due to differences in the stop method.

#### ■ Alarm Reset Capability

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 Display | Alarm Name  | Meaning  | Servomotor Stop Method | Alarm Reset |
|---------------|---|--|------------------------|-------------|
| A.020         | Parameter Checksum Error                          | The data of the parameter in the SERVOPACK is incorrect.   | Gr.1                   | N/A         |
| A.021         | Parameter Format Error                            | The data format of the parameter in the SERVOPACK is incorrect.  | Gr.1                   | N/A         |
| A.022         | System Checksum Error                             | The data of the parameter in the SERVOPACK is incorrect.   | Gr.1                   | N/A         |
| A.030         | Main Circuit Detector Error                       | Detection data for power circuit is incorrect.   | Gr.1                   | Available   |
| A.040         | Parameter Setting Error                           | The parameter setting is outside the allowable setting range.  | Gr.1                   | N/A         |
| A.041         | Encoder Output Pulse Setting Error                | The encoder output pulse setting (pulse unit) (Pn212) is outside the allowable setting range or 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.044         | Fully-closed Loop Control Parameter Setting Error | The settings of the fully-closed option module and Pn00B.3, Pn002.3 do not match.  | Gr.1                   | N/A         |
| A.04A         | Parameter Setting Error 2                         | There is an error in settings of parameters reserved by the system.  | 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 unsupported device unit was connected.   | Gr.1                   | N/A         |
| A.0b0         | Cancelled Servo ON Command Alarm                  | The host controller reference was sent to turn the Servo ON after the Servo ON function was used with the utility function.              | Gr.1                   | Available   |
| A.100         | Overcurrent or Heat Sink Overheated               | An overcurrent flowed through the IGBT. Heat sink of the SERVOPACK was overheated.   | Gr.1                   | N/A         |
| A.300         | Regeneration Error                                | Regenerative circuit or regenerative resistor is faulty.   | Gr.1                   | Available   |
| A.320         | Regenerative Overload                             | Regenerative energy exceeds regenerative resistor capacity.  | Gr.2                   | Available   |
| A.330         | Main Circuit Power Supply Wiring Error            | <ul style="list-style-type: none"> <li>Setting of AC input/DC input is incorrect.</li> <li>Power supply wiring is incorrect.</li> </ul>  | Gr.1                   | Available   |
| A.400         | Overvoltage                                       | Main circuit DC voltage is excessively high.   | Gr.1                   | Available   |

| Alarm Display  | Alarm Name                                     | Meaning  | Servomotor Stop Method | Alarm Reset |
|----------------|--|--|------------------------|-------------|
| A.410          | Undervoltage                                   | Main circuit DC voltage is excessively low.  | Gr.2                   | Available   |
| A.450          | Main-Circuit Capacitor Overvoltage             | The capacitor of the main circuit has deteriorated or is faulty.   | Gr.1                   | N/A         |
| A.510          | Overspeed                                      | The servomotor speed is over the maximum allowable speed.  | Gr.1                   | Available   |
| A.511          | Overspeed of Encoder Output Pulse Rate         | The set value of the encoder output pulse (Pn212) exceeds the speed limit.                                       | Gr.1                   | Available   |
| A.520          | Vibration Alarm                                | Vibration at the motor speed was detected.   | Gr.1                   | Available   |
| A.521          | Autotuning Alarm                               | Vibration was detected while performing tuning-less function.  | Gr.1                   | Available   |
| A.710          | Overload: High Load                            | The motor was operating for several seconds to several tens of seconds under a torque largely exceeding ratings. | Gr.2                   | Available   |
| A.720          | Overload: Low Load                             | The motor was operating continuously under a torque largely exceeding ratings.                                   | Gr.1                   | Available   |
| A.730<br>A.731 | Dynamic Brake Overload                         | When the dynamic brake was applied, rotational energy exceeded the capacity of dynamic brake resistor.           | Gr.1                   | Available   |
| A.740          | Overload of Surge Current Limit Resistor       | The main circuit power was frequently turned ON and OFF.   | Gr.1                   | Available   |
| A.7A0          | Heat Sink Overheated                           | The temperature of the SERVOPACK heat sink exceeded 100°C.   | Gr.2                   | Available   |
| A.7AB          | Built-in Fan in SERVOPACK Stopped              | The fan inside the SERVOPACK stopped.  | Gr.1                   | Available   |
| A.810          | Encoder Backup Error                           | All the power supplies for the absolute encoder have failed and position data was cleared.                       | Gr.1                   | N/A         |
| 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 is lower than the specified value after the control power supply is turned ON.               | Gr.1                   | Available   |
| A.840          | Encoder Data Error                             | Data in the encoder is incorrect.  | Gr.1                   | N/A         |
| A.850          | Encoder Overspeed                              | The encoder was rotating at high speed when the power was turned ON.   | Gr.1                   | N/A         |
| A.860          | Encoder Overheated                             | The internal temperature of encoder is too high.   | Gr.1                   | N/A         |
| A.8A0*         | External Encoder Error                         | External encoder is faulty.  | Gr.1                   | Available   |
| A.8A1*         | External Encoder Error of Module               | Serial converter unit is faulty.   | Gr.1                   | Available   |
| A.8A2*         | External Encoder Error of Sensor (Incremental) | External encoder is faulty.  | Gr.1                   | Available   |
| A.8A3*         | External Encoder Error of Position (Absolute)  | The external encoder position data is incorrect.   | Gr.1                   | Available   |
| A.8A5*         | Encoder Overspeed                              | The overspeed from the external encoder occurred.  | Gr.1                   | Available   |
| A.8A6*         | Encoder Overheated                             | The overheat from the external encoder occurred.   | Gr.1                   | Available   |
| A.b31          | Current Detection Error1 (Phase-U)             | The current detection circuit for phase-U is faulty.   | Gr.1                   | N/A         |
| A.b32          | Current Detection Error 2 (Phase-V)            | The current detection circuit for phase-V is faulty.   | Gr.1                   | N/A         |
| A.b33          | Current Detection Error 3 (Current detector)   | The detection circuit for the current is faulty.   | Gr.1                   | N/A         |
| A.bF0          | System Alarm 0                                 | "Internal program error 0" occurred in the SERVOPACK.  | Gr.1                   | N/A         |
| A.bF1          | System Alarm 1                                 | "Internal program error 1" occurred in the SERVOPACK.  | Gr.1                   | N/A         |
| A.bF2          | System Alarm 2                                 | "Internal program error 2" occurred in the SERVOPACK.  | Gr.1                   | N/A         |
| A.bF3          | System Alarm 3                                 | "Internal program error 3" occurred in the SERVOPACK.  | Gr.1                   | N/A         |
| A.bF4          | System Alarm 4                                 | "Internal program error 4" occurred in the SERVOPACK.  | Gr.1                   | N/A         |
| A.C10          | Servo Overrun Detected                         | The servomotor ran out of control.   | Gr.1                   | Available   |

## 9.1.1 List of Alarms

| Alarm Display | Alarm Name  | Meaning  | Servomotor Stop Method | Alarm Reset |
|---------------|---|--|------------------------|-------------|
| <b>A.C80</b>  | Absolute Encoder Clear Error and Multi-turn Limit Setting Error | The multi-turn for the absolute encoder was not properly cleared or set.   | Gr.1                   | N/A         |
| <b>A.C90</b>  | Encoder Communications Error                                    | Communications between the SERVOPACK and the encoder is not possible.  | Gr.1                   | N/A         |
| <b>A.C91</b>  | Encoder Communications Position Data Error                      | An encoder position data calculation error occurred.   | Gr.1                   | N/A         |
| <b>A.C92</b>  | Encoder Communications Timer Error                              | An error occurs in the communications timer between the encoder and the SERVOPACK.   | Gr.1                   | N/A         |
| <b>A.CA0</b>  | Encoder Parameter Error   | Encoder parameters are faulty.   | Gr.1                   | N/A         |
| <b>A.Cb0</b>  | Encoder Echoback Error  | Contents of communications with encoder is incorrect.  | Gr.1                   | N/A         |
| <b>A.CC0</b>  | Multi-turn Limit Disagreement                                   | Different multi-turn limits have been set in the encoder and the SERVOPACK.  | Gr.1                   | N/A         |
| <b>A.CF1*</b> | Feedback Option Module Communications Error (Reception error)   | Reception from the feedback option module is faulty.   | Gr.1                   | N/A         |
| <b>A.CF2*</b> | Feedback Option Module Communications Error (Timer stop)        | Timer for communications with the feedback option module is faulty.  | Gr.1                   | N/A         |
| <b>A.d00</b>  | Position Error Pulse Overflow                                   | Position error pulses exceeded the value set for parameter (Pn520) (Excessive Position Error Alarm Level).   | Gr.1                   | Available   |
| <b>A.d01</b>  | Position Error Pulse Overflow Alarm at Servo ON                 | Position error pulses accumulated too much.  | Gr.1                   | Available   |
| <b>A.d02</b>  | Position Error Pulse Overflow Alarm by Speed Limit at Servo ON  | After a position error pulse has been input, Pn529 limits the speed if the servo ON command is received. If Pn529 limits the speed in such a state, this alarm occurs when the position references are input and the number of position error pulses exceeds the value set for parameter Pn520 (Excessive Position Error Alarm Level). | Gr.2                   | Available   |
| <b>A.d10*</b> | Motor-load Position Error Pulse Overflow                        | Position error between motor and load is excessive when fully-closed position control is used.   | Gr.2                   | Available   |
| <b>A.E00</b>  | Command Option Module IF Initialization Timeout Error           | Communications initialization failed between the SERVOPACK and the command option module.  | Gr.2                   | Available   |
| <b>A.E02</b>  | Command Option Module IF Synchronization Error 1                | A synchronization error occurred between the SERVOPACK and the command option module.  | Gr.1                   | Available   |
| <b>A.E03</b>  | Command Option Module IF Communications Data Error              | An error occurred in the data of communications between the SERVOPACK and the command option module.   | Gr.1                   | Available   |
| <b>A.E40</b>  | Command Option Module IF Communications Setting Error           | An error occurred in establishing communications (settings) between the SERVOPACK and the command option module.   | Gr.2                   | Available   |
| <b>A.E50</b>  | Command Option Module IF Synchronization Error 2                | A error occurred in synchronization between the SERVOPACK and the command option module.   | Gr.2                   | Available   |
| <b>A.E51</b>  | Command Option Module IF Synchronization Establishment Error    | A error occurred in establishing communications between the SERVOPACK and the command option module.   | Gr.2                   | Available   |
| <b>A.E60</b>  | Command Option Module IF Data Communications Error              | A error occurred in communications between the SERVOPACK and the command option module.  | Gr.2                   | Available   |
| <b>A.E61</b>  | Command Option Module IF Synchronization Error 3                | There was a change in timing of synchronization between the SERVOPACK and the command option module.   | Gr.2                   | Available   |
| <b>A.E70</b>  | Command Option Module Detection Failure                         | Detection of the command option module failed.   | Gr.1                   | N/A         |
| <b>A.E71</b>  | Safety Option Module Detection Failure                          | Detection of the safety option module failed.  | Gr.1                   | N/A         |
| <b>A.E72*</b> | Feedback Option Module Detection Failure                        | Detection of the feedback option module failed.  | Gr.1                   | N/A         |

| Alarm Display | Alarm Name                                     | Meaning   | Servomotor Stop Method | Alarm Reset |
|---------------|--|---|------------------------|-------------|
| <b>A.E73</b>  | Unsupported Command Option Module              | An unsupported command option module was connected.   | Gr.1                   | N/A         |
| <b>A.E74</b>  | Unsupported Safety Option Module               | An unsupported safety option module was connected.  | Gr.1                   | N/A         |
| <b>A.E75*</b> | Unsupported Feedback Option Module             | An unsupported feedback option module was connected.  | Gr.1                   | N/A         |
| <b>A.E80</b>  | Command Option Module Unmatched Error          | The command option module was replaced with a different model.                              | Gr.1                   | N/A         |
| <b>A.EA2</b>  | DRV Alarm 2 (SERVOPACK WDC error)              | A DRV 0 error of the SERVOPACK occurred.  | Gr.2                   | Available   |
| <b>A.Eb1</b>  | Safety Device Signal Input Timing Error        | There is an error in the timing of the safety function input signal.                        | Gr.1                   | N/A         |
| <b>A.ED1</b>  | Command Option Module IF Command Timeout Error | Processing of reference from the command option module was not completed.                   | Gr.2                   | Available   |
| <b>A.F10</b>  | Main Circuit Cable Open Phase                  | With the main power supply ON, voltage was low for more than 1 second in phase-R, -S or -T. | Gr.2                   | Available   |
| <b>CPF00</b>  | Digital Operator Transmission Error 1          | Digital operator (JUSP-OP05A) fails to communicate with the SERVOPACK (e.g., CPU error).    | –                      | N/A         |
| <b>CPF01</b>  | Digital Operator Transmission Error 2          |   | –                      | N/A         |
| <b>A.--</b>   | Not an error                                   | Normal operation status   | –                      | –           |

\* This alarm may occur when a fully-closed option module is mounted.

## 9.1.2 Troubleshooting of Alarms

When an error occurs in SERVOPACKs, an alarm is displayed such as A.□□□ and CPF□□ on the panel operator. Refer to the following table to identify the cause of an alarm and the action to be taken.

Contact your Yaskawa representative if the problem cannot be solved by the described corrective action.

| Alarm:<br>Alarm Name   | Cause   | Investigative Actions   | Corrective Actions  |
|--|---|---|---|
| A.020:<br>Parameter Checksum Error<br>(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 initialize the parameter (Fn005).  |
|  | The power supply went OFF while changing a parameter setting.   | Note the circumstances when the power supply went OFF.  | Initialize the parameter (Fn005) and then set the parameter again.  |
|  | The number of times that parameters were written exceeded the limit.                                      | Were the parameters frequently changed through the host controller?   | The SERVOPACK may be faulty. Repair or replace the SERVOPACK.<br>Reconsider the method of writing parameters.                         |
|  | Malfunction caused by noise from the AC power supply or grounding line, static electricity noise, etc.    | Turn the power supply ON and OFF several times. If the alarm still occurs, there may be noise interference.   | Take countermeasures against noise.   |
|  | Gas, water drops, or cutting oil entered the SERVOPACK and caused failure of the internal components.     | Check the installation conditions.  | The SERVOPACK may be faulty. Replace the SERVOPACK.   |
|  | A SERVOPACK fault occurred.   | Turn the power supply ON and OFF several times. If the alarm still occurs, the SERVOPACK is faulty.           | The SERVOPACK may be faulty. Replace the SERVOPACK.   |
| A.021:<br>Parameter Format Error<br>(The parameter data format in the SERVOPACK is incorrect.)       | The software version of SERVOPACK that caused the alarm is older than that of the written parameter.      | Check Fn012 to see if the set software version agrees with that of the SERVOPACK. If not, an alarm may occur. | Write the parameter of another SERVOPACK of the same model with the same software version. Then turn the power OFF and then ON again. |
|  | A SERVOPACK fault occurred.   | —   | The SERVOPACK may be faulty. Replace the SERVOPACK.   |
| A.022:<br>System Checksum Error<br>(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 an utility function.  | Note the circumstances when the power supply went OFF.  | The SERVOPACK may be faulty. Replace the SERVOPACK.   |
|  | A SERVOPACK fault occurred.   | Turn the power supply ON and OFF several times. If the alarm still occurs, the SERVOPACK is faulty.           | The SERVOPACK may be faulty. Replace the SERVOPACK.   |
| A.030:<br>Main Circuit Detector Error  | A SERVOPACK fault occurred.   | —   | The SERVOPACK may be faulty. Replace the SERVOPACK.   |
| A.040:<br>Parameter Setting Error<br>(The parameter setting was out of the allowable setting range.) | The SERVOPACK and servomotor capacities do not match each other.  | Check the combination of SERVOPACK and servomotor capacities.   | Select the proper combination of SERVOPACK and servomotor capacities.   |
|  | A SERVOPACK fault occurred.   | —   | The SERVOPACK may be faulty. Replace the SERVOPACK.   |
|  | The parameter setting is out of the specified range.  | Check the setting ranges of the parameters that have been changed.  | Set the parameter to a value within the specified range.  |
|  | The electronics gear ratio is out of the setting range.   | Check the electronic gear ratio. The ratio must satisfy:<br>$0.001 < (Pn20E/Pn210) < 4000$ .                  | Set the electronic gear ratio in the range: $0.001 < (Pn20E/Pn210) < 4000$ .  |
| A.041:<br>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.   |

| Alarm:<br>Alarm Name  | Cause   | Investigative Actions  | Corrective Actions  |
|---|---|--|---|
| A.042:<br>Parameter<br>Combination Error  | The speed of program JOG operation (Fn004) is lower than the setting range after having changed the electronic gear ratio (Pn20E/Pn210) or the servomotor.  | Check that the detection conditions *1 is satisfied.   | Reduce the electronic gear ratio (Pn20E/Pn210).   |
|   | The speed of program JOG operation (Fn004) is lower than the setting range after having changed the setting of Pn533 "Program JOG Movement Speed."          | Check that the detection conditions *1 is satisfied.   | Increase the setting for Pn533 "Program JOG Movement Speed."  |
|   | The moving speed during advanced autotuning is lower than the setting range after having changed the electronic gear ratio (Pn20E/Pn210) or the servomotor. | Check that the detection conditions *1 is satisfied.   | Reduce the electronic gear ratio (Pn20E/Pn210).   |
| A.044:<br>Fully-closed Loop<br>Control Parameter<br>Setting Error                           | The setting of the option module does not match with that of Pn002.3.   | Check the settings of Pn002.3.   | The setting of option module must be compatible with the settings of Pn002.3.   |
| A.04A:<br>Parameter Setting<br>Error 2  | A parameter reserved by the system was changed.   | —  | Set the following reserved parameters to the factory settings.<br>Pn200.2<br>Pn207.1<br>Pn50A.0<br>Pn50A.1<br>Pn50A.2<br>Pn50C<br>Pn50D |
| A.050:<br>Combination Error<br>(The SERVOPACK and servomotor capacities do not correspond.) | The SERVOPACK and servomotor capacities do not match each other.  | Check the capacities if they satisfy the following equation:<br>$1/4 \leq (\text{Servomotor capacity})/(\text{SERVOPACK capacity}) \leq 4$ . | 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.   |

$$*1. \quad Pn533 [\text{min}^{-1}] \times \frac{2 (\text{encoder resolution})}{6 \times 10^5} \leq \frac{Pn20E}{Pn210}$$

| Alarm:<br>Alarm Name  | Cause   | Investigative Actions  | Corrective Actions  |
|---|---|--|---|
| A.051:<br>Unsupported Device Alarm  | An unsupported serial converter unit, serial encoder, or external encoder is connected to the SERVOPACK.                        | Check the product specifications.  | Select the correct combination of units.  |
| A.0b0:<br>Cancelled Servo ON Command Alarm  | After executing the utility function to turn ON the power to the motor, the Servo ON command was sent from the host controller. | –  | Turn the SERVOPACK power supply OFF and then ON again or perform a software reset.  |
| A.100:<br>Overcurrent or Heat Sink Overheated<br>(An overcurrent flowed through the IGBT or heat sink of SERVOPACK overheated.) | Incorrect wiring or contact fault of main circuit cable or motor main circuit cable.  | Check the wiring. Refer to 3.1 <i>Main Circuit Wiring</i> .  | Correct the wiring.   |
|   | Short-circuit or ground fault of main circuit cable or motor main circuit cable.  | Check for short-circuits across the servomotor terminal phase-U, -V, and -W, or between the grounding and servomotor terminal U, V, or W. Refer to 3.1 <i>Main Circuit Wiring</i> .                      | Some cables may be damaged. Replace damaged cables.   |
|   | Short-circuit or ground fault inside the servomotor.  | Check for short-circuits across the servomotor terminal phase-U, -V, and -W, or between the grounding and servomotor terminal U, V, or W. Refer to 3.1 <i>Main Circuit Wiring</i> .                      | The servomotor may be faulty. Replace the servomotor.   |
|   | Short-circuit or ground fault inside the SERVOPACK.   | Check for short-circuits across the servomotor connection terminals U, V, and W on the SERVOPACK, or between the grounding and terminal U, V, or W. Refer to 3.1 <i>Main Circuit Wiring</i> .            | The SERVOPACK may be faulty. Replace the SERVOPACK.   |
|   | Incorrect wiring or contact fault of the regenerative resistor.   | Check the wiring. Refer to 3.7 <i>Regenerative Resistors Connections</i> .   | Correct the wiring.   |
|   | The dynamic brake (DB: Emergency stop executed from the SERVOPACK) was frequently activated, or the DB overload alarm occurred. | Check the resistor power consumption monitor Un00B to see how many times the DB has been used. Or, check the alarm trace back monitor Fn000 to see if the DB overload alarm A.730 or A.731 was reported. | Change the SERVOPACK model, operation conditions, or the mechanism so that the DB does not need to be used so frequently.                 |
|   | The generated regenerative energy exceeded the SERVOPACK regenerative energy processing capacity.                               | Check the regenerative load ratio monitor Un00A to see how many times the regenerative resistor has been used.   | Check the operation condition including overload, and reconsider the regenerative resistor value.   |
|   | The SERVOPACK regenerative resistance is too small.   | Check the regenerative load ratio monitor Un00A to see how many times the regenerative resistor has been used.   | Change the regenerative resistance value to a value larger than the SERVOPACK minimum allowable resistance value.                         |
|   | A heavy load was applied while the servomotor was stopped or running at low-speed.  | Check to see if the operating conditions are outside servo drive specifications.   | Reduce the load applied to the servomotor or increase the operation speed.  |
|   | Malfunction caused by noise interference.   | Improve the wiring or installation environment, such as by reducing noise, and check to see if the alarm recurs.   | Take countermeasures for noise, such as correct wiring of the FG. Use an FG wire size equivalent to the SERVOPACK main circuit wire size. |
| A SERVOPACK fault occurred.   | –   | Turn the power supply OFF and then ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.  |   |



| Alarm:<br>Alarm Name  | Cause   | Investigative Actions  | Corrective Actions   |
|---|---|--|--|
| A.300:<br>Regeneration Error  | Regenerative resistor capacity (Pn600) is set to a value other than 0 for a SGDVR70, -R90, -1R6, or -2R8 SERVOPACK, and an external regenerative resistor is not connected.     | Check the external regenerative resistor connection and the value of the Pn600.                            | Connect the external regenerative resistor, or set Pn600 to 0 if no regenerative resistor is required.   |
|   | The jumper between the power supply terminals B2 and B3 is removed.   | Confirm that a jumper is mounted between the power supply terminals B2 and B3.                             | Correctly mount a jumper.  |
|   | The external regenerative resistor is incorrectly wired, or is removed or disconnected.   | Check the external regenerative resistor connection.   | Correctly connect the external regenerative resistor.  |
|   | A SERVOPACK fault occurred.   | –  | While the main circuit power supply is OFF, turn the control power supply OFF and then turn ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.       |
| A.320:<br>Regenerative Overload   | The power supply voltage exceeds the specified limit.   | Measure the power supply voltage.  | Set the power supply voltage within the specified range.   |
|   | Incorrect external regenerative resistance.<br>Insufficient SERVOPACK capacity or regenerative resistor capacity.<br>Or, regenerative power has been continuously flowing back. | Check the operation condition or the capacity using the capacity selection Software SigmaJunma-Size+, etc. | Change the regenerative resistance, regenerative resistor capacity, or SERVOPACK capacity. Reconsider the operation conditions using the capacity selection software SigmaJunmaSize+, etc. |
|   | Regenerative power continuously flowed back because negative load was continuously applied.   | Check the load to the servomotor during operation.   | Reconsider the system including servo, machine, and operation conditions.  |
|   | The setting of parameter Pn600 is smaller than the external regenerative resistor's capacity.   | Check the external regenerative resistor connection and the value of the Pn600.                            | Set the Pn600 to a correct value.  |
|   | The external regenerative resistance is too high.   | Check the regenerative resistance.   | Change the regenerative resistance to a correct value or use an external regenerative resistor of appropriate capacity.  |
|   | A SERVOPACK fault occurred.   | –  | The SERVOPACK may be faulty. Replace the SERVOPACK.  |
|   | A.330:<br>Main Circuit Power Supply Wiring Error<br>(Detected when the power to the main circuit is turned ON.)   | The regenerative resistor disconnected when the SERVOPACK power voltage was increased.                     | Measure the resistance of the regenerative resistor.   |
| In the AC power input mode, DC power was supplied.  |   | Check the power supply to see if it is a DC power supply.  | Correct the settings to match the actual power supply specifications.  |
| In the DC power input mode, AC power was supplied.  |   | Check the power supply to see if it is a AC power supply.  | Correct the settings to match the actual power supply specifications.  |
| Regenerative resistor capacity (Pn600) is not set to 0 even though the regenerative resistor is disconnected. |   | Is the regenerative resistor connected?<br>If it is, check the regenerative resistor capacity.             | Set Pn600 to 0.  |
| A SERVOPACK fault occurred.   |   | –  | The SERVOPACK may be faulty. Replace the SERVOPACK.  |

| Alarm:<br>Alarm Name  | Cause   | Investigative Actions   | Corrective Actions  |
|---|---|---|---|
| A.400:<br>Overvoltage<br>(Detected in the SERVOPACK's main circuit power supply section.) | <ul style="list-style-type: none"> <li>For 100 VAC SERVOPACKs: The AC power supply voltage exceeded 145 V.</li> <li>For 200 VAC SERVOPACKs: The AC power supply voltage exceeded 290 V.</li> <li>For 400 VAC SERVOPACKs: The AC power supply voltage exceeded 580 V.</li> <li>For 200 VAC SERVOPACKs with DC power supply input: The power supply voltage exceeded 410 V.</li> <li>For 400 VAC SERVOPACKs with DC power supply input: The power supply voltage exceeded 820 V.</li> </ul> | Measure the power supply voltage.   | Set AC/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, turn the power supply ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK. |
|   | Acceleration/deceleration was executed under the following conditions. <ul style="list-style-type: none"> <li>The AC power supply voltage of 100 VAC SERVOPACK was in the range between 115 V and 135 V.</li> <li>The AC power supply voltage of 200 VAC SERVOPACK was in the range between 230 V and 270 V.</li> <li>The AC power supply voltage of 400 VAC SERVOPACK was in the range between 480 V and 560 V.</li> </ul>   | Check the power supply voltage and the speed and torque during operation. | Set AC power supply voltage within the specified range.   |
|   | The external regenerative resistance is too high for the actual operation conditions.   | Check the operation conditions and the regenerative resistance.           | Select a regenerative resistance value appropriate for the operation conditions and load.   |
|   | The moment of inertia 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.                       |

| Alarm:<br>Alarm Name  | Cause   | Investigative Actions   | Corrective Actions   |
|---|---|---|--|
| A.410:<br>Undervoltage<br>(Detected in the SERVOPACK main circuit power supply section.)  | <ul style="list-style-type: none"> <li>For 100 VAC SERVOPACKs:<br/>The power supply voltage is 49 V or less.</li> <li>For 200 VAC SERVOPACKs:<br/>The power supply voltage is 120 V or less.</li> <li>For 400 VAC SERVOPACKs:<br/>The power supply voltage is 240 V or less.</li> </ul> | Measure the power supply voltage.   | Set the power supply voltage within the specified range.   |
|   | The power supply voltage dropped during operation.  | Measure the power supply voltage.   | Increase the power supply capacity.  |
|   | Occurrence of instantaneous power interruption.   | Measure the power supply voltage.   | When the instantaneous power cut hold time Pn509 is set, decrease the setting.   |
|   | The SERVOPACK fuse is blown out.  | —   | Replace the SERVOPACK, connect an AC/DC reactor, and run the SERVOPACK.  |
|   | A SERVOPACK fault occurred.   | —   | The SERVOPACK may be faulty. Replace the SERVOPACK.  |
| A.450:<br>Main-Circuit Capacitor Overvoltage  | A SERVOPACK fault occurred.   | —   | Replace the SERVOPACK.   |
| A.510:<br>Overspeed<br>(The servomotor speed exceeds the maximum.)  | The order of phases U, V, and W in the servomotor wiring is incorrect.  | Check the servomotor wiring.  | Confirm that the servomotor is correctly wired.  |
|   | A reference value exceeding the overspeed detection level was input.  | Check the input value.  | Reduce the reference value or adjust the gain.   |
|   | The motor speed exceeded the maximum.   | Check the servomotor speed waveform.  | Reduce the speed reference input gain, adjust the servo gain, or reconsider the operation conditions.  |
|   | A SERVOPACK fault occurred.   | —   | The SERVOPACK may be faulty. Replace the SERVOPACK.  |
| A.511:<br>Overspeed of Encoder Output Pulse Rate  | The encoder output pulse output frequency exceeded the limit.   | Check the encoder output pulse output setting.  | Decrease the setting of the encoder output pulse (Pn212).  |
|   | The encoder output pulse output frequency exceeded the limit because the servomotor speed was too high.   | Check the encoder output pulse output setting and servomotor speed.                                     | Decrease the servomotor speed.   |
| A.520:<br>Vibration Alarm   | Abnormal vibration was detected at the servomotor rotation speed.   | Check for abnormal noise from the servomotor, and check the speed and torque waveform during operation. | Reduce the servomotor speed or reduce the speed loop gain (Pn100).   |
|   | The moment of inertia ratio (Pn103) value is greater than the actual value or is greatly changed.   | Check the moment of inertia ratio.  | Set the moment of inertia ratio (Pn103) to an appropriate value.   |
| A.521:<br>Autotuning Alarm<br>(Vibration was detected while executing the advanced autotuning, one-parameter tuning, EasyFFT, or tuning-less function.) | The servomotor vibrated considerably while performing tuning-less function (factory setting).   | Check the servomotor speed waveform.  | Reduce the load so that the moment of inertia ratio falls within the allowable value, or raise the tuning level or reduce the gain level using the tuning-less function (Fn200). |
|   | The servomotor vibrated considerably during advanced autotuning, one-parameter tuning, or EasyFFT.  | Check the servomotor speed waveform.  | Check the operation procedure of corresponding function and take a corrective action.  |

| Alarm:<br>Alarm Name  | Cause  | Investigative Actions  | Corrective Actions  |
|---|--|--|---|
| A.710:<br>A.720:<br>Overload<br>A.710: High Load<br>A.720: Low Load   | Incorrect wiring or contact fault of servomotor and encoder.   | Check the wiring.  | Confirm that the servomotor and encoder are correctly wired.  |
|   | Operation beyond the overload protection characteristics.  | Check the servomotor overload characteristics and executed run command.  | Reconsider the load conditions and operation conditions. Or, increase the servomotor capacity.  |
|   | Excessive load was applied during operation because the servomotor was not driven due to mechanical problems.                        | Check the executed run command and servomotor speed.   | Remove the mechanical problems.   |
|   | A SERVOPACK fault occurred.  | –  | The SERVOPACK may be faulty. Replace the SERVOPACK.   |
| A.730:<br>A.731:<br>Dynamic Brake Overload<br>(An excessive power consumption of dynamic brake was detected.)   | The servomotor rotates because of external force.  | Check the operation status.  | Take measures to ensure the servomotor will not rotate because of external force.   |
|   | The rotating energy at a DB stop exceeds the DB resistance capacity.   | Check the DB resistor power consumption monitor (Un00B) to see how many times the DB has been used.  | <ul style="list-style-type: none"> <li>• Reduce the servomotor reference speed.</li> <li>• Reduce the moment of inertia ratio.</li> <li>• Reduce the number of times of the DB stop operation.</li> </ul> |
|   | A SERVOPACK fault occurred.  | –  | The SERVOPACK may be faulty. Replace the SERVOPACK.   |
| A.740:<br>Overload of Surge Current Limit Resistor<br>(The main circuit power is turned ON/OFF too frequently.) | The inrush current limit resistor operation frequency at the main circuit power supply ON/OFF operation exceeds the allowable range. | –  | Reduce the frequency of turning the main circuit power supply ON/OFF.   |
|   | A SERVOPACK fault occurred.  | –  | The SERVOPACK may be faulty. Replace the SERVOPACK.   |
| A.7A0:<br>Heat Sink Overheated<br>(Detected when the heat sink temperature exceeds 100°C.)                      | The surrounding air temperature is too high.   | Check the surrounding air temperature using a thermostat.  | Decrease the surrounding air temperature by improving the SERVOPACK installation conditions.  |
|   | The overload alarm has been reset by turning OFF the power too many times.   | Check the alarm trace back monitor (Fn000) to see if the overload alarm was reported.  | Change the method for resetting the alarm.  |
|   | Excessive load or operation beyond the regenerative energy processing capacity.  | Check the accumulated load ratio monitor Un009 to see the load during operation, and the regenerative load ratio monitor Un00A to see the regenerative energy processing capacity. | Reconsider the load and operation conditions.   |
|   | Incorrect SERVOPACK installation orientation or/and insufficient space around the SERVOPACK.   | Check the SERVOPACK installation conditions.   | Install the SERVOPACK correctly as specified.   |
|   | A SERVOPACK fault occurred.  | –  | The SERVOPACK may be faulty. Replace the SERVOPACK.   |
| A.7AB:<br>Built-in Fan in SERVOPACK Stopped   | The fan inside the SERVOPACK stopped.  | Check for foreign matter or debris inside the SERVOPACK.   | Remove foreign matter or debris from the SERVOPACK. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.  |

| Alarm:<br>Alarm Name  | Cause  | Investigative Actions  | Corrective Actions  |
|---|--|--|---|
| A.810:<br>Encoder Backup Error<br>(Detected on the encoder side)<br>(Only when an absolute encoder is connected.)         | Alarm occurred when the power to the absolute encoder was initially turned ON.   | Check to see if the power was turned ON initially.   | Set up the encoder (Fn008).   |
|   | The encoder cable was disconnected, and was connected again.   | Check to see if the power was turned ON initially.   | Confirm the connection and set up the encoder (Fn008).  |
|   | The power from both the control power supply (+5 V) and the battery power supply from the SERVOPACK is not being supplied. | Check the encoder connector battery or the connector contact status.                         | Replace the battery or take similar measures to supply power to the encoder, and set up the encoder (Fn008).  |
|   | An absolute encoder fault occurred.  | –  | If the alarm cannot be reset by setting up the encoder again, replace the servomotor.   |
|   | A SERVOPACK fault occurred.  | –  | The SERVOPACK may be faulty. Replace the SERVOPACK.   |
| A.820:<br>Encoder Checksum Error<br>(Detected on the encoder side.)   | An encoder fault occurred.   | –  | Set up the encoder again using Fn008. If the alarm still occurs, the servomotor may be faulty. Replace the servomotor.                                      |
|   | A SERVOPACK fault occurred.  | –  | The SERVOPACK may be faulty. Replace the SERVOPACK.   |
| A.830:<br>Absolute Encoder Battery Error<br>(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:<br>Encoder Data Error<br>(Detected on the encoder side.)   | An encoder fault occurred.   | –  | Turn the power supply OFF and then ON again. If the alarm still occurs, the servomotor may be faulty. 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. |
| A.850:<br>Encoder Overspeed<br>(Detected when the control power supply was turned ON.)<br>(Detected on the encoder side.) | The servomotor was running at $200 \text{ min}^{-1}$ or higher when the control power supply was turned ON.                | Check the speed monitor (Un000) to confirm the servomotor speed when the power is turned ON. | Reduce the servomotor speed to a value less than $200 \text{ min}^{-1}$ , and turn ON the control power supply.   |
|   | An encoder fault occurred.   | –  | Turn the power supply OFF and then ON again. If the alarm still occurs, the servomotor may be faulty. Replace the servomotor.                               |
|   | A SERVOPACK fault occurred.  | –  | Turn the power supply OFF and then ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.                                 |

| Alarm:<br>Alarm Name   | Cause  | Investigative Actions   | Corrective Actions  |
|--|--|---|---|
| A.860:<br>Encoder Overheated<br>(Only when an absolute encoder is connected.)<br>(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 of the servomotor must be 40°C or less.   |
|  | The servomotor load is greater than the rated load.  | Check the accumulated load ratio monitor (Un009) to see the load.   | The servomotor load must be within the specified range.   |
|  | An encoder fault occurred.   | —   | Turn the power supply OFF and then ON again. If the alarm still occurs, the servomotor may be faulty. Replace the servomotor. |
|  | A SERVOPACK fault occurred.  | —   | Turn the power supply OFF and then ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.   |
| A.8A0*2:<br>External Encoder Error of Scale  | Setting of the zero point position of absolute external encoder failed because the servomotor rotated. | Before setting the zero point position, use the fully-closed feedback counter monitor (Un00E) to confirm that the servomotor is not rotating. | The servomotor must be stopped while setting the zero point position.   |
|  | An external encoder fault occurred.  | —   | Replace the external encoder.   |
| A.8A1*2:<br>External Encoder Error of Module   | An external encoder fault occurred.  | —   | Replace the external encoder.   |
|  | A serial converter unit fault occurred.  | —   | Replace the serial converter unit.  |
| A.8A2*2:<br>External Encoder Error of Sensor (Incremental)   | An external encoder fault occurred.  | —   | Replace the external encoder.   |
| A.8A3*2:<br>External Encoder Error of Position (Absolute)  | An absolute external encoder fault occurred.   | —   | The absolute external encoder may be faulty. Refer to the encoder manufacturer's instruction manual for corrective actions.   |
| A.8A5*2:<br>Encoder Overspeed  | The overspeed from the external encoder occurred.  | —   | Replace the external encoder.   |
| A.8A6*2:<br>Encoder Overheated   | The overheat from the external encoder occurred.   | —   | Replace the external encoder.   |
| A.b31:<br>Current Detection Error 1 (Phase-U)  | The current detection circuit for phase U is faulty.   | —   | Turn the power supply OFF and then ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.   |
| A.b32:<br>Current Detection Error 2 (Phase-V)  | The current detection circuit for phase V is faulty.   | —   | Turn the power supply OFF and then ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.   |
| A.b33:<br>Current Detection Error 3 (Current detector)   | The detection circuit for the current is faulty.   | —   | Turn the power supply OFF and then ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.   |
|  | The servomotor main circuit cable is disconnected.   | Check for disconnection of the motor main circuit cable.  | Correct the servomotor wiring.  |
| A.bF0:<br>System Alarm 0   | A SERVOPACK fault occurred.  | —   | Turn the power supply OFF and then ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.   |

\*2. This alarm may occur when a fully-closed option module is mounted.

| Alarm:<br>Alarm Name   | Cause   | Investigative Actions                       | Corrective Actions  |
|--|---|---|---|
| A.bF1:<br>System Alarm 1   | A SERVOPACK fault occurred.   | —   | Turn the power supply OFF and then ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.   |
| A.bF2:<br>System Alarm 2   | A SERVOPACK fault occurred.   | —   | Turn the power supply OFF and then ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.   |
| A.bF3:<br>System Alarm 3   | A SERVOPACK fault occurred.   | —   | Turn the power supply OFF and then ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.   |
| A.bF4:<br>System Alarm 4   | A SERVOPACK fault occurred.   | —   | Turn the power supply OFF and then ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.   |
| A.C10:<br>Servo Overrun<br>Detected<br>(Detected when the servomotor power is ON.) | The order of phases U, V, and W in the servomotor wiring is incorrect.  | Check the servomotor wiring.                | Confirm that the servomotor is correctly wired.   |
|  | An encoder fault occurred.  | —   | If the alarm still occurs after turning the power OFF and then ON again, even though the servomotor is correctly wired, the servomotor may be faulty. Replace the servomotor. |
|  | A SERVOPACK fault occurred.   | —   | Turn the power supply OFF and then ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.   |
| A.C80:<br>Absolute Encoder<br>Clear Error and Multi-<br>turn Limit Setting Error   | An encoder fault occurred.  | —   | Turn the power supply OFF and then ON again. If the alarm still occurs, the servomotor may be faulty. Replace the servomotor.   |
|  | A SERVOPACK fault occurred.   | —   | Turn the power supply OFF and then ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.   |
| A.C90:<br>Encoder<br>Communications Error  | Contact fault of encoder connector or incorrect encoder wiring.   | Check the encoder connector contact status. | Re-insert the encoder connector and confirm that the encoder is correctly wired.  |
|  | Encoder cable disconnection or short-circuit.<br>Or, incorrect cable impedance.   | Check the encoder cable.                    | Use the encoder cable with the specified rating.  |
|  | <ul style="list-style-type: none"> <li>• Corrosion caused by improper temperature, humidity, or gas.</li> <li>• Short-circuit caused by intrusion of water drops or cutting oil.</li> <li>• Connector contact fault caused by vibration.</li> </ul> | 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 to avoid noise interference (Separate the encoder cable from the servomotor main circuit cable, improve grounding, etc.)                |
|  | A SERVOPACK fault occurred.   | —   | Connect the servomotor to another SERVOPACK, and turn ON the control power. If no alarm occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.                           |

| Alarm:<br>Alarm Name                                       | Cause  | Investigative Actions                  | Corrective Actions  |
|--|--|--|---|
| A.C91:<br>Encoder<br>Communications<br>Position Data Error | The noise interference occurred on the input/output signal line because the encoder cable is bent and the sheath is damaged. | Check the encoder cable and connector. | Confirm that there is no problem with the encoder cable layout.   |
|  | The encoder cable is bundled with a high-current line or near a high-current line.   | Check the encoder cable layout.        | Confirm that there is no surge voltage on the encoder cable.  |
|  | The FG potential varies because of influence from machines on the servomotor side, such as the welder.                       | Check the encoder cable layout.        | Properly ground the device to separate from the encoder side FG.  |
| A.C92:<br>Encoder<br>Communications<br>Timer Error         | Noise interference occurred on the input/output signal line from the encoder.  | –                                      | Take countermeasures against noise.   |
|  | Excessive vibration and shocks were applied to the encoder.  | Check the operating environment.       | Reduce the machine vibration or correctly install the servomotor.   |
|  | An encoder fault occurred.   | –                                      | Turn the power supply OFF and then ON again. If the alarm still occurs, the servomotor may be faulty. Replace the servomotor. |
|  | A SERVOPACK fault occurred.  | –                                      | Turn the power supply OFF and then ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.   |
| A.CA0:<br>Encoder Parameter<br>Error                       | An encoder fault occurred.   | –                                      | Turn the power supply OFF and then ON again. If the alarm still occurs, the servomotor may be faulty. Replace the servomotor. |
|  | A SERVOPACK fault occurred.  | –                                      | Turn the power supply OFF and then ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.   |
| A.Cb0:<br>Encoder Echoback<br>Error                        | The encoder wiring and contact are incorrect.  | Check the encoder wiring.              | Correct the encoder wiring.   |
|  | Noise interference occurred due to incorrect encoder cable specifications.   | –                                      | Use tinned annealed copper twisted-pair or shielded twisted-pair cable with a core of at least 0.12 mm <sup>2</sup> .         |
|  | Noise interference occurred because the wiring distance for the encoder cable is too long.                                   | –                                      | The wiring distance must be 20 m max.   |
|  | The FG potential varies because of influence from machines on the servomotor side, such as the welder.                       | Check the encoder cable and connector. | Make the grounding for the machine separately from encoder side FG.   |
|  | Excessive vibration and shocks were applied to the encoder.  | Check the operating environment.       | Reduce the machine vibration or correctly install the servomotor.   |
|  | An encoder fault occurred.   | –                                      | Turn the power supply OFF and then ON again. If the alarm still occurs, the servomotor may be faulty. Replace the servomotor. |
|  | A SERVOPACK fault occurred.  | –                                      | Turn the power supply OFF and then ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.   |



| Alarm:<br>Alarm Name  | Cause  | Investigative Actions  | Corrective Actions  |
|---|--|--|---|
| A.CC0:<br>Multi-turn Limit<br>Disagreement  | When using a direct-drive (DD) servomotor, the multi-turn limit value (Pn205) is different from that of the encoder.                                 | Check the value of the Pn205.  | Correct the setting of Pn205 (0 to 65535).  |
|   | The multi-turn limit value of the encoder is different from that of the SERVOPACK. Or, the multi-turn limit value of the SERVOPACK has been changed. | Check the value of the Pn205 of the SERVOPACK.                             | Execute Fn013 at the occurrence of alarm.   |
|   | A SERVOPACK fault occurred.  | –  | Turn the power supply OFF and then ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.                                   |
| A.CF1*2:<br>Feedback Option<br>Module<br>Communications Error<br>(Reception error)  | Wiring of cable between serial converter unit and SERVOPACK is incorrect or contact is faulty.   | Check the external encoder wiring.   | Correct the cable wiring.   |
|   | The specified cable is not used between serial converter unit and SERVOPACK.   | Confirm the external encoder wiring specifications.                        | Use the specified cable.  |
|   | Cable between serial converter unit and SERVOPACK is too long.   | Measure the external encoder cable length.                                 | Use 20 m cable max.   |
|   | Sheath of cable between serial converter unit and SERVOPACK is broken.   | Check the external encoder cable.  | Replace the cable.  |
| A.CF2*2:<br>Feedback Option<br>Module<br>Communications Error<br>(Timer stop)   | Noise interferes with the cable between serial converter unit and SERVOPACK.   | –  | Correct the wiring around serial converter unit, e.g., separating input/output signal line from main circuit cable or grounding.                              |
|   | A serial converter unit fault occurred.  | –  | Replace the serial converter unit.  |
|   | A SERVOPACK fault occurred.  | –  | Replace the SERVOPACK.  |
| A.d00:<br>Position Error Pulse<br>Overflow<br>(Position error exceeded the value set in the excessive position error alarm level (Pn520)) | The contact in the servomotor U, V, and W wirings is faulty.   | Check the motor main circuit cable connection.                             | Confirm that there is no contact fault in the motor wiring of encoder wiring.   |
|   | The frequency of the position reference is too high.   | Reduce the reference frequency, and operate the SERVOPACK.                 | Reduce the position reference frequency or reference acceleration. Or, reconsider the electronic gear ratio.  |
|   | The position reference acceleration is too fast.   | Reduce the reference acceleration, and operate the SERVOPACK.              | Apply the smoothing function, such as using position reference acceleration/deceleration time constant (Pn216).   |
|   | Setting of the Pn520 (Excessive Position Error Alarm Level) is low against the operating condition.  | Check the alarm level (Pn520) to see if it is set to an appropriate value. | Set the Pn520 to proper value.  |
|   | A SERVOPACK fault occurred.  | –  | Turn the power supply OFF and then ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.                                   |
| A.d01:<br>Position Error Pulse<br>Overflow Alarm at<br>Servo ON   | The servo ON command is received when the number of position error pulses is greater than the set value of Pn526.                                    | Check the error counter monitor (Un008) while the servomotor power is OFF. | Make the setting so that the position error pulse is cleared when the servo is OFF. Or, correct the excessive position error alarm level at servo ON (Pn526). |

\*2. This alarm may occur when a fully-closed option module is mounted.

| Alarm:<br>Alarm Name  | Cause  | Investigative Actions  | Corrective Actions  |
|---|--|--|---|
| A.d02:<br>Position Error Pulse<br>Overflow Alarm by<br>Speed Limit at Servo<br>ON | After a position error pulse has been input, Pn529 limits the speed if the servo ON command is received. If Pn529 limits the speed in such a state, this alarm occurs when the position references are input and the number of position error pulses exceeds the value set for parameter Pn520 (Excessive Position Error Alarm Level). | –  | Make the setting so that the position error pulse is cleared when the servo is OFF.<br>Or, correct the excessive position error alarm level (Pn520).<br>Or, adjust the speed limit level (Pn529) when servo turns ON. |
| A.d10*2:<br>Motor-load Position<br>Error Pulse Overflow                           | Motor rotation direction and external encoder installation direction are opposite.   | Check the servomotor rotation direction and the external encoder installation direction. | Install the external encoder in the opposite direction, or reverse the setting of the external encoder usage method (Pn002.3).  |
|   | Mounting of the load (e.g., stage) and external encoder joint installation are incorrect.  | Check the external encoder mechanical connection.  | Check the mechanical joints.  |
| A.E00:<br>Command Option<br>Module IF Initialization<br>Timeout Error             | The connection between the SERVOPACK and the command option module is faulty.  | Check the connection between the SERVOPACK and the command option module.                | Correctly connect the command option module.  |
|   | A command option module fault occurred.  | –  | Replace the command option module.  |
|   | A SERVOPACK fault occurred.  | –  | Replace the SERVOPACK.  |
| A.E02:<br>Command Option<br>Module IF<br>Synchronization Error<br>1               | The timing of synchronization between the servomotor and command option module changed due to change in the communications cycle of the host controller connected to the command option module.  | –  | Turn the power supply OFF and then ON again. If the alarm occurs again, restart communications processing from the host controller.   |
|   | The connection between the SERVOPACK and the command option module is faulty.  | Check the connection between the SERVOPACK and the command option module.                | Correctly connect the command option module.  |
|   | A command option module fault occurred.  | –  | Replace the command option module.  |
|   | A SERVOPACK fault occurred.  | –  | Replace the SERVOPACK.  |
| A.E03:<br>Command Option<br>Module IF<br>Communications Data<br>Error             | An error occurred due to noise in the communications between the SERVOPACK and the command option module.  | –  | Take measures against noise.  |
|   | The connection between the SERVOPACK and the command option module is faulty.  | Check the connection between the SERVOPACK and the command option module.                | Correctly connect the command option module.  |
|   | A command option module fault occurred.  | –  | Replace the command option module.  |
|   | A SERVOPACK fault occurred.  | –  | Replace the SERVOPACK.  |
| A.E40:<br>Command Option<br>Module IF<br>Communications<br>Setting Error          | A command option module fault occurred.  | –  | Replace the command option module.  |

\*2. The alarm may occur when a fully-closed option module is mounted.

| Alarm:<br>Alarm Name  | Cause   | Investigative Actions   | Corrective Actions   |
|---|---|---|--|
| A.E50:<br>Command Option<br>Module IF<br>Synchronization Error<br>2             | The timing of synchronization between the servomotor and command option module changed due to change in the communications cycle of the host controller connected to the command option module. | —   | Turn the power supply OFF and then ON again. If the alarm occurs again, restart communications processing from the host controller.                          |
| A.E51:<br>Command Option<br>Module IF<br>Synchronization<br>Establishment Error | A command option module fault occurred.   | —   | Replace the command option module.   |
| A.E60:<br>Command Option<br>Module IF Data<br>Communications Error              | An error occurred due to noise in the communications between the SERVOPACK and the command option module.   | —   | Take measures against noise.   |
|   | The connection between the SERVOPACK and the command option module is faulty.   | Check the connection between the SERVOPACK and the command option module. | Correctly connect the command option module.   |
|   | A command option module fault occurred.   | —   | Replace the command option module.   |
|   | A SERVOPACK fault occurred.   | —   | Replace the SERVOPACK.   |
| A.E61:<br>Command Option<br>Module IF<br>Synchronization Error<br>3             | The timing of synchronization between the servomotor and command option module changed due to change in the communications cycle of the host controller connected to the command option module. | —   | Turn the power supply OFF and then ON again. If the alarm occurs again, restart communications processing from the host controller.                          |
|   | The connection between the SERVOPACK and the command option module is faulty.   | Check the connection between the SERVOPACK and the command option module. | Correctly connect the command option module.   |
|   | A command option module fault occurred.   | —   | Replace the command option module.   |
|   | A SERVOPACK fault occurred.   | —   | Replace the SERVOPACK.   |
| A.E70:<br>Command Option<br>Module Detection<br>Failure                         | The connection between the SERVOPACK and the command option module is faulty.   | Check the connection between the SERVOPACK and the command option module. | Correctly connect the command option module.   |
|   | The command option module is not connected.   | —   | Correctly connect the command option module.   |
|   | A command option module fault occurred.   | —   | Replace the command option module.   |
|   | A SERVOPACK fault occurred.   | —   | Replace the SERVOPACK.   |
| A.E71:<br>Safety Option Module<br>Detection Failure                             | The connection between the SERVOPACK and the safety option module is faulty.  | Check the connection between the SERVOPACK and the safety option module.  | Correctly connect the safety option module.  |
|   | The safety option module was disconnected.  | —   | Execute Fn014 (Resetting configuration error of option module) with using the digital operator or SigmaWin+ and turn the power supply OFF and then ON again. |
|   | A safety option module fault occurred.  | —   | Replace the safety option module.  |
|   | A SERVOPACK fault occurred.   | —   | Replace the SERVOPACK.   |

| Alarm:<br>Alarm Name   | Cause   | Investigative Actions  | Corrective Actions  |
|--|---|--|---|
| A.E72*2:<br>Feedback Option<br>Module Detection<br>Failure     | The connection between the SERVOPACK and the feedback option module is faulty.  | Check the connection between the SERVOPACK and the feedback option module.                   | Correctly connect the feedback option module.   |
|  | The feedback option module was disconnected.  | —  | Execute Fn014 (Resetting configuration error of option module) with the digital operator or SigmaWin+ and turn the power supply OFF and then ON again.  |
|  | A feedback option module fault occurred.  | —  | Replace the feedback option module.   |
|  | A SERVOPACK fault occurred.   | —  | Replace the SERVOPACK.  |
| A.E73:<br>Unsupported Option<br>Module                         | A command option module fault occurred.   | —  | Replace the command option module.  |
|  | A unsupported command option module was connected.  | Refer to the catalog of the connected command option module.                                 | Connect a compatible command option module.   |
| A.E74:<br>Unsupported Safety<br>Option Module                  | A safety option module fault occurred.  | —  | Replace the safety option module.   |
|  | A unsupported safety option module was connected.   | Refer to the catalog of the connected safety option module.                                  | Connect a compatible safety option module.  |
| A.E75*2:<br>Unsupported<br>Feedback Option<br>Module           | A feedback option module fault occurred.  | —  | Replace the feedback option module.   |
|  | A unsupported feedback option module was connected.   | Refer to the catalog of the connected feedback option module or the manual of the SERVOPACK. | Connect a compatible feedback option module.  |
| A.E80:<br>Command Option<br>Module Unmatched<br>Error          | The command option module was replaced with a different model.  | —  | Execute Fn014 (Resetting configuration error of option module) with the digital operator or SigmaWin+ and turn the power supply OFF and then ON again.  |
| A.EA2:<br>DRV Alarm 2<br>(SERVOPACK WDC<br>error)              | The timing of synchronization between the servomotor and command option module changed due to change in the communications cycle of the host controller connected to the command option module. | —  | Turn the power supply OFF and then ON again. If the alarm occurs again, restart communications processing from the host controller.   |
|  | The connection between the SERVOPACK and the command option module is faulty.   | Check the connection between the SERVOPACK and the command option module.                    | Correctly connect the command option module.  |
|  | A command option module fault occurred.   | —  | Replace the command option module.  |
|  | A SERVOPACK fault occurred.   | —  | Replace the SERVOPACK.  |
| A.Eb1:<br>Safety Function Signal<br>Input Timing Error         | The lag between activations of the input signals /HWBB1 and /HWBB2 for the HWBB function is 10 seconds or more.   | Measure the time lag between the /HWBB1 and /HWBB2 signals.                                  | The host controller output signal circuits or devices for /HWBB1 and /HWBB2 or the SERVOPACK input signal circuits may be faulty. Alternatively, the input signal cables may be disconnected. Repair or replace them. |
| A.ED1:<br>Command Option<br>Module IF Command<br>Timeout Error | Processing of the sensor ON command from the command option module is not completed.  | —  | Input a servo ON command when the motor is stopped.   |
|  | Processing of the sensor ON command from the command option module is not completed.  | —  | Check that the encoder is connected correctly and input a sensor ON command when the motor is stopped.  |

\*2. The alarm may occur when a fully-closed option module is mounted.

| Alarm:<br>Alarm Name  | Cause   | Investigative Actions  | Corrective Actions   |
|---|---|--|--|
| A.F10:<br>Main Circuit Cable<br>Open Phase<br>(With the main power supply ON, voltage was low for more than 1 second in an R, S, or T phase.)<br>(Detected when the main power supply was turned ON.) | The three-phase power supply wiring is incorrect.   | Check the power supply wiring.                                     | Confirm that the power supply is correctly wired.  |
|   | The three-phase power supply is unbalanced.   | Measure the voltage at each phase of the three-phase power supply. | Balance the power supply by changing phases.   |
|   | A single-phase power is input without setting Pn00B.2 (power supply method for three-phase SERVOPACK) to 1 (single-phase power supply). | Check the power supply and the parameter setting.                  | Match the parameter setting to the power supply.   |
|   | A SERVOPACK fault occurred.   | –  | Turn the power supply OFF and then ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.                          |
| CPF00:<br>Digital Operator<br>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:<br>Digital Operator<br>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.   | –  | Turn the power supply OFF and then ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.                          |

## 9.2 Warning Displays

The following sections describe troubleshooting in response to warning displays.

The warning name, warning meaning, and warning code output are listed in order of the warning numbers in *9.2.1 List of Warnings*.

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

### 9.2.1 List of Warnings

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

| Warning Display | Warning Name                                    | Meaning   |
|-----------------|---|---|
| A.900           | Position Error Pulse Overflow                   | Position error pulse exceeded the parameter settings (Pn520×Pn51E/100).   |
| A.901           | Position Error Pulse Overflow Alarm at Servo ON | When the servo turns ON, the position error pulses exceeded the parameter setting (Pn526×Pn528/100).  |
| A.910           | Overload  | This warning occurs before the overload alarms (A.710 or A.720) occur. If the warning is ignored and operation continues, an overload alarm may occur.                            |
| A.911           | Vibration                                       | Abnormal vibration at the motor speed was detected. The detection level is the same as A.520. Set whether to output an alarm or warning by “Vibration Detection Switch” of Pn310. |
| A.920           | Regenerative Overload                           | This warning occurs before the regenerative overload alarm (A.320) occurs. If the warning is ignored and operation continues, a regenerative overload alarm may occur.            |
| A.921           | Dynamic Brake Overload                          | This warning occurs before Dynamic Brake Overload (A.731) alarm occurs. If the warning is ignored and operation continues, a dynamic brake overload alarm may occur.              |
| A.930           | Absolute Encoder Battery Error                  | This warning occurs when the absolute encoder battery voltage is lowered.   |
| A.94A           | Command Option Module IF Data Setting Warning 1 | This warning occurs when there is an error in a parameter number sent to the SERVOPACK from the host controller or command option module.   |
| A.94B           | Command Option Module IF Data Setting Warning 2 | This warning occurs when out-of-range data is sent to the SERVOPACK from the host controller or command option module.  |
| A.94C           | Command Option Module IF Data Setting Warning 3 | This warning occurs when there is an error in the parameter data sent to in the SERVOPACK from the host controller or command option module.                                      |
| A.94D           | Command Option Module IF Data Setting Warning 4 | This warning occurs when there is an error in the data size sent to the SERVOPACK from the host controller or command option module.  |
| A.94E           | Command Option Module IF Data Setting Warning 5 | This warning occurs when there is an error in the latch mode settings sent to the SERVOPACK from the host controller or command option module.                                    |
| A.95A           | Command Option Module IF Command Warning 1      | This warning occurs when the host controller or command option module outputs an operating command when the operation execution conditions in the SERVOPACK have not been met.    |
| A.95B           | Command Option Module IF Command Warning 2      | This warning occurs when there is an error in the reference output from the command option module to the SERVOPACK.   |
| A.95D           | Command Option Module IF Command Warning 4      | This warning occurs when a latch command is output from the command option module to the SERVOPACK during latch operation.  |
| A.95E           | Command Option Module IF Command Warning 5      | This warning occurs when an unallowed command combination is output to the SERVOPACK from the command option module.  |
| A.95F           | Command Option Module IF Command Warning 6      | This warning occurs when there is an error in the command output to the SERVOPACK from the command option module.   |
| A.960           | Command Option Module IF Communications Warning | This warning occurs when an error occurred in communications between the SERVOPACK and command option module.   |

| Warning Display | Warning Name | Meaning   |
|-----------------|--------------|---|
| <b>A.971</b>    | Undervoltage | This warning occurs before Undervoltage (A.410) alarm occurs. If the warning is ignored and operation continues, an undervoltage alarm may occur. |

- Note 1. Set Pn001.3 = 1 (Outputs both Alarm Codes and Warning Codes) to output warning codes.  
2. If Pn008.2 = 1 (Do not detect warning) is selected, no warnings will be detected.

## 9.2.2 Troubleshooting of Warnings

Refer to the following table to identify the cause of a warning and the action to be taken. Contact your Yaskawa representative if the problem cannot be solved by the described corrective action.

| Warning Display | Warning Name   | Situation at Warning Occurrence  | Cause  | Corrective Actions  |
|-----------------|--|--|--|---|
| A.900           | Position Error Pulse Overflow                        | Wiring of the servomotor U, V, or W line is incorrect.   | Check the wiring of the cable for motor main circuit.  | Check whether there is any loose connection in motor wiring or encoder wiring.  |
|                 |  | The SERVOPACK gain is too low.   | Check the SERVOPACK gain.  | Increase the servo gain by using the function such as advanced autotuning.  |
|                 |  | The position reference acceleration is too high.   | Lower the position reference acceleration.   | Apply a smoothing function, such as a position reference acceleration/deceleration time constant (Pn216).   |
|                 |  | The excessive position error alarm level (Pn520) is too low for the operating conditions.  | Check the excessive position error alarm level (Pn520).  | Set an appropriate value for the Pn520.   |
|                 |  | A SERVOPACK fault occurred.  | —  | Turn the power supply OFF and then ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.   |
| A.901           | Position Error Pulse Overflow Alarm at Servo ON      | When the servomotor power was OFF, the servomotor moved without clearing the counter for position error pulses. The number of position error pulses exceeded the maximum number of pulses allowed. | —  | Make the setting so that the position error pulse is cleared when the servo is OFF.<br>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 | The servomotor or encoder wiring is incorrect or the connection is faulty.   | Check the wiring.  | Correct the servomotor and encoder wiring if they are wrong.  |
|                 |  | The servomotor is in excess of the overload protective characteristics.  | Check the overload characteristics of the servomotor and reference input.                                      | Reconsider the load and operation conditions.<br>Or, check the servomotor capacity.   |
|                 |  | The servomotor is not driven due to a mechanical factor and the operating load has become excessive.   | Check the reference input and motor speed.   | Improve the mechanical factor.  |
|                 |  | A SERVOPACK fault occurred.  | —  | The SERVOPACK may be faulty. Replace the SERVOPACK.   |
| A.911           | Vibration  | Abnormal vibration was detected while the motor was rotating.  | Check whether unusual sound is generated from the motor, and check the speed and torque waveform of the motor. | Lower the motor rotation speed or the lower the servo gain by using the function such as one-parameter tuning.  |
|                 |  | The moment of inertia ratio (Pn103) is larger than the actual value or greatly changes.  | Check the moment of inertia ratio.   | Set an appropriate value for the moment of inertia (Pn103).   |



| Warning Display | Warning Name   | Situation at Warning Occurrence  | Cause  | Corrective Actions  |
|-----------------|--|--|--|---|
| A.920           | Regenerative Overload:<br>Warning before the alarm A.320 occurs  | The power supply voltage exceeds the specified range.  | Measure the power supply voltage.  | Set the power supply voltage within the specified range.  |
|                 |  | The external regenerative resistance, servo amplifier capacity, or regenerative resistor capacity is insufficient or a continuous regenerative state occurs. | Check the operating conditions or capacity using the capacity selection software SigmaJunmaSize+, etc. | Change the regenerative resistance, regenerative resistor capacity, or SERVOPACK capacity. Reconsider the operating conditions using the capacity selection software SigmaJunmaSize+, etc.    |
|                 |  | Regenerative power continuously flowed back because negative load was continuously applied.  | Check the load on the servomotor during operation.   | Reconsider the system including the servo, machine, and operation conditions.   |
| A.921           | Dynamic Brake Overload:<br>Warning before the alarm A.731 occurs   | The servomotor is driven by an external force.   | Check the operating conditions.  | Do not drive the motor with external force.   |
|                 |  | The rotating energy at a DB stop exceeds the DB resistance capacity.   | Check the operating frequency of the DB with power consumed by DB resistance monitor (Un00B).          | <ul style="list-style-type: none"> <li>Reduce the servomotor reference speed.</li> <li>Reduce the moment of inertia.</li> <li>Reduce the number of times of the DB stop operation.</li> </ul> |
|                 |  | A SERVOPACK fault occurred.  | —  | The SERVOPACK may be faulty. Replace the SERVOPACK.   |
| A.930           | Absolute Encoder Battery Error<br>(The absolute encoder battery voltage is lower than the specified value.)<br>(Only when an absolute encoder is connected.) | The battery connection is incorrect.   | Check the battery connection.  | Connect the battery correctly.  |
|                 |  | 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.94A           | Command Option Module IF Data Setting Warning 1  | An incorrect parameter number was sent to the SERVOPACK from the host controller or command option module.   | —  | Specify the correct parameter number.   |
| A.94B           | Command Option Module IF Data Setting Warning 2  | Out-of-range data was sent to the SERVOPACK from the host controller or command option module.   | —  | Specify the value of the parameter within the allowable range.  |
| A.94C           | Command Option Module IF Data Setting Warning 3  | Incorrect parameter data was sent to the SERVOPACK from the host controller or command option module.  | —  | Specify the value of the parameter within the allowable range.  |
| A.94D           | Command Option Module IF Data Setting Warning 4  | The incorrect parameter size was sent to the SERVOPACK from the host controller or command option module.  | —  | Specify the correct parameter size.   |

| Warning Display | Warning Name                                    | Situation at Warning Occurrence  | Cause   | Corrective Actions   |
|-----------------|---|--|---|--|
| A.94E           | Command Option Module IF Data Setting Warning 5 | Incorrect latch mode settings were sent to the SERVOPACK from the host controller or command option module.  | —   | Set a proper value for the latch mode.                       |
| A.95A           | Command Option Module IF Command Warning 1      | The host controller or command option module sent a operating command when the operation execution conditions in the SERVOPACK had not been satisfied. | —   | Send a command after the operation conditions are satisfied. |
| A.95B           | Command Option Module IF Command Warning 2      | The command option module sent a command that is not supported by the SERVOPACK.   | —   | Send a command that is supported by the SERVOPACK.           |
| A.95D           | Command Option Module IF Command Warning 4      | A latch command was sent from the command option module during latch operation.  | —   | Review the input sequence for the latch command.             |
| A.95E           | Command Option Module IF Command Warning 5      | An unallowed command combination was output to the SERVOPACK from the command option module.   | —   | Send a command that can be combined.                         |
| A.95F           | Command Option Module IF Command Warning 6      | The command option module sent a command that is not supported by the SERVOPACK.   | —   | Send a command that is supported by the SERVOPACK.           |
| A.960           | Command Option Module IF Communications Warning | An error occurred in communications between the SERVOPACK and command option module due to noise.  | —   | Take measures against noise.                                 |
|                 |   | The connection between the SERVOPACK and the command option module is faulty.  | Check the connection between the SERVOPACK and the command option module. | Correctly connect the command option module.                 |
|                 |   | A command option module fault occurred.  | —   | Replace the command option module.                           |
|                 |   | A SERVOPACK fault occurred.  | —   | Replace the SERVOPACK.                                       |

| Warning Display | Warning Name | Situation at Warning Occurrence   | Cause                             | Corrective Actions   |
|-----------------|--------------|---|-----------------------------------|--|
| A.971           | Undervoltage | <ul style="list-style-type: none"> <li>For 100-VAC SERVOPACKs:<br/>The AC power supply voltage is 60 V or below.</li> <li>For 200-VAC SERVOPACKs:<br/>The AC power supply voltage is 140 V or below.</li> <li>For 400-VAC SERVOPACKs:<br/>The AC power supply voltage is 280 V or below.</li> </ul> | Measure the power supply voltage. | Use a power supply voltage within the specified range.               |
|                 |              | The power supply voltage dropped during operation.  | Measure the power supply voltage. | Increase the power supply capacity.                                  |
|                 |              | An instantaneous power failure occurred.  | Measure the power supply voltage. | Lower the instantaneous power cut hold time (Pn509).                 |
|                 |              | The fuse in the SERVOPACK is burned out.  | –                                 | Replace the SERVOPACK and connect an AC/DC reactor to the SERVOPACK. |
|                 |              | A SERVOPACK fault occurred.   | –                                 | The SERVOPACK may be faulty. Replace the SERVOPACK.                  |

## 9.3 Troubleshooting Malfunction Based on Operation and Conditions of the Servomotor

Troubleshooting for the malfunctions based on the operation and conditions of the servomotor is provided in this section.

Be sure to turn OFF the servo system before troubleshooting items outlined in bold in the table.

| Problem  | Probable Cause  | Investigative Actions   | Corrective Actions  |
|--|---|---|---|
| Servomotor Does Not Start                        | The control power supply is not ON.   | Check voltage between power supply terminals.   | Correct the power circuit.  |
|  | The main circuit power supply is not ON.  | Check the voltage between power supply terminals.   | Correct the power circuit.  |
|  | Wiring of I/O signal connector CN1 faulty or disconnected.  | Check if the connector CN1 is properly inserted and connected.                              | Correct the connector CN1 connection.   |
|  | Servomotor or encoder wiring disconnected.  | Check the wiring.   | Correct the wiring.   |
|  | Overloaded  | Run under no load and check the load status.  | Reduce load or replace with larger capacity servomotor.   |
|  | Setting for Pn50A, Pn50B and Pn511 "Input Signal Selection" is incorrect.                         | Check settings of parameters Pn50A, Pn50B and Pn511.  | Correct the settings for Pn50A, Pn50B and Pn511 "Input Signal Selection."   |
|  | Encoder type differs from parameter setting (Pn002.2).  | Check setting of parameter Pn002.2.   | Set parameter Pn002.2 to the encoder type being used.   |
|  | A servo ON command was not input.   | Check the command sent from the host controller.  | Send a servo ON command.  |
|  | A sensor ON command was not input.  | Check the command sent from the host controller.  | Send the command in the correct sequence to the SERVOPACK.  |
|  | 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.  |
|  | The safety input signal (/HWBB1 or /HWBB2) remains OFF.   | Check the /HWBB1 or /HWBB2 input signal.  | Set the /HWBB1 or /HWBB2 input signal to ON.<br>When not using the safety function, mount the safety function jumper connector (provided as an accessory) on the CN8. |
| A SERVOPACK fault occurred.                      | –   | Replace the SERVOPACK.  |   |
| Servomotor Moves Instantaneously, and then Stops | Servomotor wiring is incorrect.   | Check the servomotor wiring.  | Correct the wiring.   |
|  | Encoder wiring is incorrect.  | Check the encoder wiring.   | Correct the wiring.   |
| Servomotor Speed Unstable                        | Wiring connection to servomotor is defective.   | Check connections of main circuit cable (phases-U, -V, and -W) and encoder connectors.      | Tighten any loose terminals or connectors.  |
| Servomotor Rotates Without Reference Input       | A SERVOPACK fault occurred.   | –   | Replace the SERVOPACK.  |
| Dynamic Brake Does Not Operate                   | Setting for Pn001 is incorrect.   | Check the setting of parameter Pn001.0.   | Correct the parameter setting.  |
|  | DB resistor disconnected  | Check if excessive moment of inertia, motor overspeed, or DB frequently activated occurred. | Replace the SERVOPACK, and lighten the load to avoid disconnection.   |
|  | DB drive circuit fault  | –   | There is a defective component in the DB circuit. Replace the SERVOPACK.  |

| Problem   | Probable Cause  | Investigative Actions   | Corrective Actions  |
|---|---|---|---|
| Abnormal Noise from Servomotor                            | The servomotor largely vibrated during execution of tuning-less function.               | Check the servomotor 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 level 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 input/output signal cable specifications            | The input/output signal cables must be tinned annealed copper twisted-pair or shielded twisted-pair cables with a core of 0.12 mm <sup>2</sup> min. | Use the specified input signal wires.   |
|   | Noise interference due to length of input/output signal cable.                          | Check the length of the input/output cable.   | The input/output cable length must be no more than 3 m.   |
|   | Noise interference due to incorrect encoder cable specifications.                       | The encoder cable must be tinned annealed copper twisted-pair or shielded twisted-pair cables with a core of 0.12 mm <sup>2</sup> min.              | Use the specified encoder cable.  |
|   | Noise interference due to length of encoder cable wiring                                | Check the length of the encoder cable.  | The encoder cable must be no more than 20 m.  |
|   | Noise interference due to damaged encoder cable   | Check if the encoder cable is damaged or bent.  | Replace the encoder cable and modify the encoder cable layout.  |
|   | Excessive noise to the encoder cable  | Check if the encoder cable is bundled with high-current line or near a high-current line.   | Correct the encoder cable layout so that no surge is applied.   |
|   | FG potential varies because of influence of machines such as welders at the servomotor. | Check if the machines are correctly grounded.   | Ground machines correctly, and prevent diversion to the FG at the PG side.  |
|   | SERVOPACK pulse counting error due to noise interference                                | Check if there is noise interference on the input/output signal line from the encoder.  | Take measures against noise in the encoder wiring.  |
|   | Excessive vibration and shock to the encoder  | Check if vibration from the machine occurred or servomotor installation is incorrect (mounting surface accuracy, fixing, alignment, etc.).          | Reduce vibration from the machine, or secure the servomotor installation.   |
| An encoder fault occurred.                                | –   | Replace the servomotor.   |   |
| Servomotor Vibrates at Frequency of Approx. 200 to 400 Hz | 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 value (Pn100).<br>Factory setting: Kv = 40.0 Hz   | Reduce the speed loop gain (Pn100).   |
|   | Position loop gain value (Pn102) too high.  | Check the position loop gain value (Pn102).<br>Factory setting: Kp = 40.0/s   | Reduce the position loop gain (Pn102).  |
|   | Incorrect speed loop integral time constant (Pn101) setting                             | Check the speed loop integral time constant (Pn101).<br>Factory setting: Ti = 20.0 ms   | Correct the speed loop integral time constant (Pn101) setting.  |
|   | Incorrect moment of inertia ratio data (Pn103)  | Check the moment of inertia ratio setting (Pn103).  | Correct the moment of inertia ratio (Pn103) setting.  |

| Problem   | Probable Cause  | Investigative Actions  | Corrective Actions   |
|---|---|--|--|
| High Rotation 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 value (Pn100).<br>Factory setting: $K_v = 40.0$ Hz   | Reduce the speed loop gain (Pn100).  |
|   | Position loop gain value (Pn102) too high   | Check the position loop gain value (Pn102).<br>Factory setting: $K_p = 40.0/s$   | Reduce the position loop gain (Pn102).                                     |
|   | Incorrect speed loop integral time constant (Pn101) setting                             | Check the speed loop integral time constant (Pn101).<br>Factory setting: $T_i = 20.0$ ms   | Correct the speed loop integral time constant setting (Pn101).             |
|   | Incorrect moment of inertia ratio data (Pn103)  | Check the moment of inertia ratio setting (Pn103).   | Correct the moment of inertia ratio setting (Pn103).                       |
| 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 is next turned ON.) | Noise interference due to improper encoder cable specifications                         | The encoder cable must be tinned annealed copper twisted-pair or shielded twisted-pair cables with a core of $0.12 \text{ mm}^2$ min.      | Use encoder cable with the specified specifications.                       |
|   | Noise interference due to length of encoder cable.                                      | Check the encoder cable length.  | The encoder cable length must be no more than 20 m.                        |
|   | Noise interference due to damaged encoder cable   | Check if the encoder cable is bent or if its sheath is damaged.  | Replace the encoder cable and correct the encoder cable layout.            |
|   | Excessive noise interference at the encoder cable                                       | Check if the encoder cable is bundled with a high-current line or near high-current line.  | Change the encoder cable layout so that no surge is applied.               |
|   | FG potential varies because of influence of machines such as welders at the servomotor. | Check if the machines are correctly grounded.  | Ground machines correctly, and prevent diversion to the FG at the PG side. |
|   | SERVOPACK pulse counting error due to noise interference                                | Check if there is noise interference on the input/output signal line from the encoder.   | Take measures against noise in the encoder wiring.                         |
|   | Excessive vibration and shock to the encoder  | Check if vibration from the machine occurred or servomotor installation is incorrect (mounting surface accuracy, fixing, alignment, etc.). | Reduce vibration from the machine, or secure the servomotor installation.  |
|   | An encoder fault occurred.  | –  | Replace the servomotor.  |
|   | A SERVOPACK fault occurred. (The pulse count does not change.)                          | –  | Replace the SERVOPACK.   |
|   | Host controller multi-turn data reading error   | Check the error detection at the host controller.  | Correct the error detection section of the host controller.                |
| Check if the host controller is executing data parity checks.   |   | Execute a multi-turn data parity check.  |  |
| Check noise in the input/output signal line between the SERVOPACK and the host controller.  |   | Take measures against noise, and again execute a multiturn data parity check.  |  |

| 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 Pn50A and Pn50B.  | Set the parameters correctly.  |
|   | Forward or reverse run prohibited signal is malfunctioning.   | Check the fluctuation of the input signal external power supply (+24 V) voltage.   | Stabilize the external power supply (+24 V) voltage.                       |
|   |   | Check if the overtravel limit switch operates correctly.   | Stabilize the operation of the overtravel limit switch.                    |
|   |   | Check if the overtravel limit switch wiring is correct. (check for damaged cables or loose screws.)  | Correct the overtravel limit switch wiring.                                |
|   | Incorrect forward or reverse run prohibited signal (P-OT/N-OT) allocation (parameters Pn50A.3, Pn50B.0) | Check if the P-OT signal is allocated in Pn50A.3.  | If another signal is allocated in Pn50A.3, select P-OT.                    |
|   |   | Check if the N-OT signal is allocated in Pn50B.0.  | If another signal is allocated in Pn50B.0, select N-OT.                    |
|   | Incorrect servomotor stop method selection  | Check Pn001.0 and Pn001.1 when the servomotor power is OFF.  | Select a servo mode stop method other than “coast to stop.”                |
| Check Pn001.0 and Pn001.1 when in torque control.   |   | Select a servo mode stop method other than “coast to stop.”  |  |
| Improper Position to Stop 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.           |
| Position Error (Without Alarm)                      | Noise interference due to improper encoder cable specifications   | The encoder cable must be tinned annealed copper twisted-pair or shielded twisted-pair cable with a core of 0.12 mm <sup>2</sup> min.                      | Use encoder cable with the specified specifications.                       |
|   | Noise interference due to length of encoder cable   | Check the encoder cable length.  | The encoder cable length must be less than 20 m.                           |
|   | Noise influence due to damaged encoder cable  | Check if the encoder cable is bent or if its sheath is damaged.  | Replace the encoder cable and correct the encoder cable layout.            |
|   | Excessive noise interference to encoder cable   | Check if the encoder cable is bundled with a high-current line or near a high-current line.  | Change the encoder cable layout so that no surge is applied.               |
|   | FG potential varies because of influence of machines such as welders at the servomotor.                 | Check if the machines are correctly grounded.  | Ground machines correctly, and prevent diversion to the FG at the PG side. |
|   | SERVOPACK pulse count error due to noise  | Check if the input/output signal line from the encoder is influenced by noise.   | Take measures against noise in the encoder wiring.                         |
|   | Excessive vibration and shock to the encoder  | Check if vibration from the machine occurred or servomotor installation is incorrect (mounting surface accuracy, fixing, alignment, etc.).                 | Reduce the machine vibration or mount the servomotor securely.             |
|   | Unsecured coupling between machine and servomotor   | Check if a position error occurs at the coupling between machine and servomotor.   | Secure the coupling between the machine and servomotor.                    |
|   | Noise interference due to improper I/O signal cable specifications                                      | The I/O signal cable must be twisted-pair or shielded twisted-pair cable with a core of 0.12 mm <sup>2</sup> min. and tinned annealed copper twisted wire. | Use input signal cable with the specified specifications.                  |

| Problem                                       | Probable Cause  | Investigative Actions                       | Corrective Actions   |
|---|---|---|--|
| Position Error<br>(Without Alarm)<br>(cont'd) | 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 less than 3 m.                     |
|   | An encoder fault occurred. (The pulse count does not change.) | –   | Replace the servomotor.  |
|   | A SERVOPACK fault occurred.                                   | –   | Replace the SERVOPACK.   |
| Servomotor<br>Overheated                      | Ambient temperature too high                                  | Measure the servomotor ambient temperature. | Lower the ambient 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 servomotor. |



# 10

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## Appendix

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## 10.1 List of Parameters

### 10.1.1 Utility Functions

The following table lists the available utility functions.

| Parameter No. | Function  | Reference Section |
|---------------|---|-------------------|
| Fn000         | Alarm history display   | 6.2               |
| Fn002         | JOG operation   | 6.3               |
| Fn003         | Origin search   | 6.4               |
| Fn004         | Program JOG operation   | 6.5               |
| Fn005         | Initializing parameter settings   | 6.6               |
| Fn006         | Clearing alarm history  | 6.7               |
| Fn008         | Absolute encoder multi-turn reset and encoder alarm reset                               | 4.5.4             |
| Fn00C         | Offset adjustment of analog monitor output  | 6.8               |
| Fn00D         | Gain adjustment of analog monitor output  | 6.9               |
| Fn00E         | Automatic offset-signal adjustment of motor current detection                           | 6.10              |
| Fn00F         | Manual offset-signal adjustment of motor current detection                              | 6.11              |
| Fn010         | Write prohibited setting  | 6.12              |
| Fn011         | Servomotor model display  | 6.13              |
| Fn012         | Software version display  | 6.14              |
| Fn013         | Multi-turn limit value setting change when a multi-turn limit disagreement alarm occurs | 4.5.7             |
| Fn014         | Resetting configuration error of option module  | 6.15              |
| Fn01B         | Vibration detection level initialization  | 6.16              |
| Fn01E         | Display of SERVOPACK and servomotor ID  | 6.17              |
| Fn01F         | Display of servomotor ID in feedback option module                                      | 6.18              |
| Fn020         | Origin setting  | 6.19              |
| Fn030         | Software reset  | 6.20              |
| Fn200         | Tuning-less level setting   | 5.2.2             |
| Fn201         | Advanced autotuning   | 5.3.2             |
| Fn202         | Advanced autotuning by reference  | 5.4.2             |
| Fn203         | One-parameter tuning  | 5.5.2             |
| Fn204         | Anti-resonance control adjustment function  | 5.6.2             |
| Fn205         | Vibration suppression function  | 5.7.2             |
| Fn206         | EasyFTT   | 6.21              |
| Fn207         | Online vibration monitor  | 6.22              |

Note: A setting may be write-prohibited if the digital operator displays “NO-OP” when any of the above utility function is executed. For details, refer to 6.12 *Write Prohibited Setting (Fn010)*.

## 10.1.2 Parameters

| Parameter No.  | Name   | Setting Range  | Units        | Factory Setting | When Enabled  | Classification | Reference Section |   |
|--|--|--|--------------|-----------------|---------------|----------------|-------------------|---|
| Pn000  | Basic Function Select Switch 0   | 0000 to 00B3   | –            | 0000            | After restart | Setup          | –                 |   |
|  |  |  |              |                 |               |                |                   |   |
|  | <b>Direction Selection</b> (Refer to 4.2.2)  |  |              |                 |               |                |                   |   |
|  | 0  | Forward reference for forward rotation.  |              |                 |               |                |                   |   |
|  | 1  | Forward reference for reverse rotation. (Reverse rotation mode)  |              |                 |               |                |                   |   |
|  | 2 to 3   | Reserved (Do not change.)  |              |                 |               |                |                   |   |
|  | Reserved (Do not change.)  |  |              |                 |               |                |                   |   |
|  | Reserved (Do not change.)  |  |              |                 |               |                |                   |   |
|  | Reserved (Do not change.)  |  |              |                 |               |                |                   |   |
|  | Pn001  | Application Function Select Switch 1   | 0000 to 1122 | –               | 0000          | After restart  | Setup             | – |
|  |  |  |              |                 |               |                |                   |   |
| <b>Servomotor power OFF or Alarm Gr.1 Stop Mode</b> (Refer to 4.2.8) |  |  |              |                 |               |                |                   |   |
| 0  |  | Stops the motor by applying DB (dynamic brake).  |              |                 |               |                |                   |   |
| 1  |  | Stops the motor by applying dynamic brake (DB) and then releases DB.   |              |                 |               |                |                   |   |
| 2  |  | Makes the motor coast to a stop state without using the dynamic brake (DB).  |              |                 |               |                |                   |   |
| <b>Overtravel (OT) Stop Mode</b> (Refer to 4.2.3)                    |  |  |              |                 |               |                |                   |   |
| 0  |  | Same setting as Pn001.0 (Stops the motor by applying DB or by coasting).   |              |                 |               |                |                   |   |
| 1  |  | Sets the torque of Pn406 to the maximum value, decelerate 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. |              |                 |               |                |                   |   |
| <b>AC/DC Power Input Selection</b> (Refer to 3.1.5)                  |  |  |              |                 |               |                |                   |   |
| 0  | Not applicable to DC power input: Input AC power supply through L1, L2 (, and L3) terminals.                         |  |              |                 |               |                |                   |   |
| 1  | Applicable to DC power input: Input DC power supply between B1/ + and –, or input DC power supply between B1 and –2. |  |              |                 |               |                |                   |   |
| Reserved (Do not change.)  |  |  |              |                 |               |                |                   |   |

| Parameter No.  | Name   | Setting Range  | Units        | Factory Setting | When Enabled  | Classification | Reference Section   |  |    |   |   |   |  |                             |                           |  |  |  |    |  |  |                           |   |  |    |   |   |   |  |  |    |  |                              |   |  |  |                           |   |   |   |                           |
|--|--|--|--------------|-----------------|---------------|----------------|---|--|----|---|---|---|--|-----------------------------|---------------------------|--|--|--|----|--|--|---------------------------|---|--|----|---|---|---|--|--|----|--|------------------------------|---|--|--|---------------------------|---|---|---|---------------------------|
| Pn002  | Application Function Select Switch 2   | 0000 to 4113   | –            | 0000            | After restart | Setup          | –   |  |    |   |   |   |  |                             |                           |  |  |  |    |  |  |                           |   |  |    |   |   |   |  |  |    |  |                              |   |  |  |                           |   |   |   |                           |
|  | <div style="display: flex; align-items: flex-start;"> <div style="margin-right: 20px;"> <p>n. <input type="checkbox"/> <sup>4th digit</sup></p> <p><input type="checkbox"/> <sup>3rd digit</sup></p> <p><input type="checkbox"/> <sup>2nd digit</sup></p> <p><input type="checkbox"/> <sup>1st digit</sup></p> </div> <table border="1"> <tr> <td colspan="2" style="background-color: #cccccc;">Torque Limit Reference Selection for Command Option Module*1</td> </tr> <tr> <td>0</td> <td>Disables the torque limit reference from the command option module.</td> </tr> <tr> <td>1</td> <td>Enables the torque limit reference from the command option module.</td> </tr> <tr> <td>2</td> <td>Reserved (Do not change.)</td> </tr> <tr> <td>3</td> <td>Enables torque limit reference from the command option module when external input signals P-CL and N-CL are enabled.</td> </tr> <tr> <td colspan="2" style="background-color: #cccccc;">Speed Limit Reference Selection for Command Option Module*1</td> </tr> <tr> <td>0</td> <td>Disables the speed limit reference when torque limit is used from the command option module.</td> </tr> <tr> <td>1</td> <td>Enables the speed limit reference when torque limit is used from the command option module.</td> </tr> <tr> <td colspan="2" style="background-color: #cccccc;">Absolute Encoder Usage <span style="float: right;">(Refer to 4.5.1)</span></td> </tr> <tr> <td>0</td> <td>Uses absolute encoder as an absolute encoder.</td> </tr> <tr> <td>1</td> <td>Uses absolute encoder as an incremental encoder.</td> </tr> <tr> <td colspan="2" style="background-color: #cccccc;">External Encoder Usage <span style="float: right;">(Refer to 8.3.2)</span></td> </tr> <tr> <td>0</td> <td>Do not use external encoder.</td> </tr> <tr> <td>1</td> <td>Uses external encoder in forward rotation direction.</td> </tr> <tr> <td>2</td> <td>Reserved (Do not change.)</td> </tr> <tr> <td>3</td> <td>Uses external encoder in reversed rotation direction.</td> </tr> <tr> <td>4</td> <td>Reserved (Do not change.)</td> </tr> </table> </div> |  |              |                 |               |                |   | Torque Limit Reference Selection for Command Option Module*1 |    | 0   | Disables the torque limit reference from the command option module. | 1   | Enables the torque limit reference from the command option module. | 2                           | Reserved (Do not change.) | 3  | Enables torque limit reference from the command option module when external input signals P-CL and N-CL are enabled. | Speed Limit Reference Selection for Command Option Module*1                      |    | 0  | Disables the speed limit reference when torque limit is used from the command option module. | 1                         | Enables the speed limit reference when torque limit is used from the command option module. | Absolute Encoder Usage <span style="float: right;">(Refer to 4.5.1)</span> |    | 0   | Uses absolute encoder as an absolute encoder. | 1   | Uses absolute encoder as an incremental encoder. | External Encoder Usage <span style="float: right;">(Refer to 8.3.2)</span> |    | 0  | Do not use external encoder. | 1   | Uses external encoder in forward rotation direction. | 2  | Reserved (Do not change.) | 3 | Uses external encoder in reversed rotation direction. | 4 | Reserved (Do not change.) |
|  | Torque Limit Reference Selection for Command Option Module*1   |  |              |                 |               |                |   |  |    |   |   |   |  |                             |                           |  |  |  |    |  |  |                           |   |  |    |   |   |   |  |  |    |  |                              |   |  |  |                           |   |   |   |                           |
|  | 0  | Disables the torque limit reference from the command option module.  |              |                 |               |                |   |  |    |   |   |   |  |                             |                           |  |  |  |    |  |  |                           |   |  |    |   |   |   |  |  |    |  |                              |   |  |  |                           |   |   |   |                           |
|  | 1  | Enables the torque limit reference from the command option module.   |              |                 |               |                |   |  |    |   |   |   |  |                             |                           |  |  |  |    |  |  |                           |   |  |    |   |   |   |  |  |    |  |                              |   |  |  |                           |   |   |   |                           |
|  | 2  | Reserved (Do not change.)  |              |                 |               |                |   |  |    |   |   |   |  |                             |                           |  |  |  |    |  |  |                           |   |  |    |   |   |   |  |  |    |  |                              |   |  |  |                           |   |   |   |                           |
|  | 3  | Enables torque limit reference from the command option module when external input signals P-CL and N-CL are enabled. |              |                 |               |                |   |  |    |   |   |   |  |                             |                           |  |  |  |    |  |  |                           |   |  |    |   |   |   |  |  |    |  |                              |   |  |  |                           |   |   |   |                           |
|  | Speed Limit Reference Selection for Command Option Module*1  |  |              |                 |               |                |   |  |    |   |   |   |  |                             |                           |  |  |  |    |  |  |                           |   |  |    |   |   |   |  |  |    |  |                              |   |  |  |                           |   |   |   |                           |
|  | 0  | Disables the speed limit reference when torque limit is used from the command option module.                         |              |                 |               |                |   |  |    |   |   |   |  |                             |                           |  |  |  |    |  |  |                           |   |  |    |   |   |   |  |  |    |  |                              |   |  |  |                           |   |   |   |                           |
|  | 1  | Enables the speed limit reference when torque limit is used from the command option module.                          |              |                 |               |                |   |  |    |   |   |   |  |                             |                           |  |  |  |    |  |  |                           |   |  |    |   |   |   |  |  |    |  |                              |   |  |  |                           |   |   |   |                           |
|  | Absolute Encoder Usage <span style="float: right;">(Refer to 4.5.1)</span>   |  |              |                 |               |                |   |  |    |   |   |   |  |                             |                           |  |  |  |    |  |  |                           |   |  |    |   |   |   |  |  |    |  |                              |   |  |  |                           |   |   |   |                           |
|  | 0  | Uses absolute encoder as an absolute encoder.  |              |                 |               |                |   |  |    |   |   |   |  |                             |                           |  |  |  |    |  |  |                           |   |  |    |   |   |   |  |  |    |  |                              |   |  |  |                           |   |   |   |                           |
|  | 1  | Uses absolute encoder as an incremental encoder.   |              |                 |               |                |   |  |    |   |   |   |  |                             |                           |  |  |  |    |  |  |                           |   |  |    |   |   |   |  |  |    |  |                              |   |  |  |                           |   |   |   |                           |
|  | External Encoder Usage <span style="float: right;">(Refer to 8.3.2)</span>   |  |              |                 |               |                |   |  |    |   |   |   |  |                             |                           |  |  |  |    |  |  |                           |   |  |    |   |   |   |  |  |    |  |                              |   |  |  |                           |   |   |   |                           |
|  | 0  | Do not use external encoder.   |              |                 |               |                |   |  |    |   |   |   |  |                             |                           |  |  |  |    |  |  |                           |   |  |    |   |   |   |  |  |    |  |                              |   |  |  |                           |   |   |   |                           |
|  | 1  | Uses external encoder in forward rotation direction.   |              |                 |               |                |   |  |    |   |   |   |  |                             |                           |  |  |  |    |  |  |                           |   |  |    |   |   |   |  |  |    |  |                              |   |  |  |                           |   |   |   |                           |
|  | 2  | Reserved (Do not change.)  |              |                 |               |                |   |  |    |   |   |   |  |                             |                           |  |  |  |    |  |  |                           |   |  |    |   |   |   |  |  |    |  |                              |   |  |  |                           |   |   |   |                           |
|  | 3  | Uses external encoder in reversed rotation direction.  |              |                 |               |                |   |  |    |   |   |   |  |                             |                           |  |  |  |    |  |  |                           |   |  |    |   |   |   |  |  |    |  |                              |   |  |  |                           |   |   |   |                           |
|  | 4  | Reserved (Do not change.)  |              |                 |               |                |   |  |    |   |   |   |  |                             |                           |  |  |  |    |  |  |                           |   |  |    |   |   |   |  |  |    |  |                              |   |  |  |                           |   |   |   |                           |
|  | Pn006  | Application Function Select Switch 6   | 0000 to 005F | –               | 0002          | Immediately    | Setup   | –  |    |   |   |   |  |                             |                           |  |  |  |    |  |  |                           |   |  |    |   |   |   |  |  |    |  |                              |   |  |  |                           |   |   |   |                           |
| <div style="display: flex; align-items: flex-start;"> <div style="margin-right: 20px;"> <p>n. <input type="checkbox"/> <sup>4th digit</sup></p> <p><input type="checkbox"/> <sup>3rd digit</sup></p> <p><input type="checkbox"/> <sup>2nd digit</sup></p> <p><input type="checkbox"/> <sup>1st digit</sup></p> </div> <table border="1"> <tr> <td colspan="2" style="background-color: #cccccc;">Analog Monitor 1 Signal Selection <span style="float: right;">(Refer to 5.1.3)</span></td> </tr> <tr> <td>00</td> <td>Motor speed (1 V/1000 min<sup>-1</sup>)</td> </tr> <tr> <td>01</td> <td>Speed reference (1 V/1000 min<sup>-1</sup>)</td> </tr> <tr> <td>02</td> <td>Torque reference (1 V/100%)</td> </tr> <tr> <td>03</td> <td>Position error (0.05 V/1 reference unit)</td> </tr> <tr> <td>04</td> <td>Position amplifier error (after electronic gears) (0.05 V/ 1 encoder pulse unit)</td> </tr> <tr> <td>05</td> <td>Position reference speed (1 V/1000 min<sup>-1</sup>)</td> </tr> <tr> <td>06</td> <td>Reserved (Do not change.)</td> </tr> <tr> <td>07</td> <td>Motor-load position error (0.01 V/1 reference unit)</td> </tr> <tr> <td>08</td> <td>Positioning completion (positioning completed: 5 V, positioning not completed: 0 V)</td> </tr> <tr> <td>09</td> <td>Speed feedforward (1 V/1000 min<sup>-1</sup>)</td> </tr> <tr> <td>0A</td> <td>Torque feedforward (1 V/100%)</td> </tr> <tr> <td>0B</td> <td>Active gain (1st gain: 1 V, 2nd gain: 2 V)</td> </tr> <tr> <td>0C</td> <td>Completion of position reference (completed: 5 V, not completed: 0 V)</td> </tr> <tr> <td>0D</td> <td>External encoder speed (1 V/1000 min<sup>-1</sup>)</td> </tr> <tr> <td colspan="2" style="background-color: #cccccc;">Reserved (Do not change.)</td> </tr> <tr> <td colspan="2" style="background-color: #cccccc;">Reserved (Do not change.)</td> </tr> </table> </div> |  |  |              |                 |               |                | Analog Monitor 1 Signal Selection <span style="float: right;">(Refer to 5.1.3)</span> |  | 00 | Motor speed (1 V/1000 min <sup>-1</sup> ) | 01  | Speed reference (1 V/1000 min <sup>-1</sup> ) | 02   | Torque reference (1 V/100%) | 03                        | Position error (0.05 V/1 reference unit) | 04   | Position amplifier error (after electronic gears) (0.05 V/ 1 encoder pulse unit) | 05 | Position reference speed (1 V/1000 min <sup>-1</sup> ) | 06   | Reserved (Do not change.) | 07  | Motor-load position error (0.01 V/1 reference unit)                        | 08 | Positioning completion (positioning completed: 5 V, positioning not completed: 0 V) | 09  | Speed feedforward (1 V/1000 min <sup>-1</sup> ) | 0A   | Torque feedforward (1 V/100%)  | 0B | Active gain (1st gain: 1 V, 2nd gain: 2 V) | 0C                           | Completion of position reference (completed: 5 V, not completed: 0 V) | 0D   | External encoder speed (1 V/1000 min <sup>-1</sup> ) | Reserved (Do not change.) |   | Reserved (Do not change.)                             |   |                           |
| Analog Monitor 1 Signal Selection <span style="float: right;">(Refer to 5.1.3)</span>  |  |  |              |                 |               |                |   |  |    |   |   |   |  |                             |                           |  |  |  |    |  |  |                           |   |  |    |   |   |   |  |  |    |  |                              |   |  |  |                           |   |   |   |                           |
| 00   |  | Motor speed (1 V/1000 min <sup>-1</sup> )  |              |                 |               |                |   |  |    |   |   |   |  |                             |                           |  |  |  |    |  |  |                           |   |  |    |   |   |   |  |  |    |  |                              |   |  |  |                           |   |   |   |                           |
| 01   |  | Speed reference (1 V/1000 min <sup>-1</sup> )  |              |                 |               |                |   |  |    |   |   |   |  |                             |                           |  |  |  |    |  |  |                           |   |  |    |   |   |   |  |  |    |  |                              |   |  |  |                           |   |   |   |                           |
| 02   |  | Torque reference (1 V/100%)  |              |                 |               |                |   |  |    |   |   |   |  |                             |                           |  |  |  |    |  |  |                           |   |  |    |   |   |   |  |  |    |  |                              |   |  |  |                           |   |   |   |                           |
| 03   |  | Position error (0.05 V/1 reference unit)   |              |                 |               |                |   |  |    |   |   |   |  |                             |                           |  |  |  |    |  |  |                           |   |  |    |   |   |   |  |  |    |  |                              |   |  |  |                           |   |   |   |                           |
| 04   |  | Position amplifier error (after electronic gears) (0.05 V/ 1 encoder pulse unit)                                     |              |                 |               |                |   |  |    |   |   |   |  |                             |                           |  |  |  |    |  |  |                           |   |  |    |   |   |   |  |  |    |  |                              |   |  |  |                           |   |   |   |                           |
| 05   |  | Position reference speed (1 V/1000 min <sup>-1</sup> )   |              |                 |               |                |   |  |    |   |   |   |  |                             |                           |  |  |  |    |  |  |                           |   |  |    |   |   |   |  |  |    |  |                              |   |  |  |                           |   |   |   |                           |
| 06   |  | Reserved (Do not change.)  |              |                 |               |                |   |  |    |   |   |   |  |                             |                           |  |  |  |    |  |  |                           |   |  |    |   |   |   |  |  |    |  |                              |   |  |  |                           |   |   |   |                           |
| 07   |  | Motor-load position error (0.01 V/1 reference unit)  |              |                 |               |                |   |  |    |   |   |   |  |                             |                           |  |  |  |    |  |  |                           |   |  |    |   |   |   |  |  |    |  |                              |   |  |  |                           |   |   |   |                           |
| 08   |  | Positioning completion (positioning completed: 5 V, positioning not completed: 0 V)                                  |              |                 |               |                |   |  |    |   |   |   |  |                             |                           |  |  |  |    |  |  |                           |   |  |    |   |   |   |  |  |    |  |                              |   |  |  |                           |   |   |   |                           |
| 09   |  | Speed feedforward (1 V/1000 min <sup>-1</sup> )  |              |                 |               |                |   |  |    |   |   |   |  |                             |                           |  |  |  |    |  |  |                           |   |  |    |   |   |   |  |  |    |  |                              |   |  |  |                           |   |   |   |                           |
| 0A   |  | Torque feedforward (1 V/100%)  |              |                 |               |                |   |  |    |   |   |   |  |                             |                           |  |  |  |    |  |  |                           |   |  |    |   |   |   |  |  |    |  |                              |   |  |  |                           |   |   |   |                           |
| 0B   |  | Active gain (1st gain: 1 V, 2nd gain: 2 V)   |              |                 |               |                |   |  |    |   |   |   |  |                             |                           |  |  |  |    |  |  |                           |   |  |    |   |   |   |  |  |    |  |                              |   |  |  |                           |   |   |   |                           |
| 0C   |  | Completion of position reference (completed: 5 V, not completed: 0 V)  |              |                 |               |                |   |  |    |   |   |   |  |                             |                           |  |  |  |    |  |  |                           |   |  |    |   |   |   |  |  |    |  |                              |   |  |  |                           |   |   |   |                           |
| 0D   |  | External encoder speed (1 V/1000 min <sup>-1</sup> )   |              |                 |               |                |   |  |    |   |   |   |  |                             |                           |  |  |  |    |  |  |                           |   |  |    |   |   |   |  |  |    |  |                              |   |  |  |                           |   |   |   |                           |
| Reserved (Do not change.)  |  |  |              |                 |               |                |   |  |    |   |   |   |  |                             |                           |  |  |  |    |  |  |                           |   |  |    |   |   |   |  |  |    |  |                              |   |  |  |                           |   |   |   |                           |
| Reserved (Do not change.)  |  |  |              |                 |               |                |   |  |    |   |   |   |  |                             |                           |  |  |  |    |  |  |                           |   |  |    |   |   |   |  |  |    |  |                              |   |  |  |                           |   |   |   |                           |

\*1. For details on this function, refer to the manual of the connected command option module.

| Parameter No.  | Name   | Setting Range  | Units  | Factory Setting | When Enabled                              | Classification                                     | Reference Section                             |  |   |    |  |  |  |   |  |   |  |    |   |                  |   |                          |   |    |                               |    |  |    |  |    |  |                           |  |                           |  |  |  |  |  |  |  |
|--|--|--|--|-----------------|---|--|---|--|---|----|--|--|--|---|--|---|--|----|---|------------------|---|--------------------------|---|----|-------------------------------|----|--|----|--|----|--|---------------------------|--|---------------------------|--|--|--|--|--|--|--|
| Pn007  | Application Function Select Switch 7   | 0000 to 005F   | –  | 0000            | Immediately                               | Setup  | –   |  |   |    |  |  |  |   |  |   |  |    |   |                  |   |                          |   |    |                               |    |  |    |  |    |  |                           |  |                           |  |  |  |  |  |  |  |
|  | <div style="display: flex; justify-content: space-around; align-items: flex-start;"> <div style="text-align: center;">           4th digit<br/> <input type="checkbox"/> </div> <div style="text-align: center;">           3rd digit<br/> <input type="checkbox"/> </div> <div style="text-align: center;">           2nd digit<br/> <input type="checkbox"/> </div> <div style="text-align: center;">           1st digit<br/> <input type="checkbox"/> </div> </div> <p>n. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/></p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th colspan="2">Analog Monitor 2 Signal Selection (Refer to 5.1.3)</th> </tr> </thead> <tbody> <tr><td>00</td><td>Motor speed (1 V/1000 min<sup>-1</sup>)</td></tr> <tr><td>01</td><td>Speed reference (1 V/1000 min<sup>-1</sup>)</td></tr> <tr><td>02</td><td>Torque reference (1 V/100%)</td></tr> <tr><td>03</td><td>Position error (0.05 V/1 reference unit)</td></tr> <tr><td>04</td><td>Position amplifier error (after electronic gears) (0.05 V/ 1 encoder pulse unit)</td></tr> <tr><td>05</td><td>Position reference speed (1 V/1000 min<sup>-1</sup>)</td></tr> <tr><td>06</td><td>Reserved (Do not change.)</td></tr> <tr><td>07</td><td>Motor-load position error (0.01 V/1 reference unit)</td></tr> <tr><td>08</td><td>Positioning completion (positioning completed: 5 V, positioning not completed: 0 V)</td></tr> <tr><td>09</td><td>Speed feedforward (1 V/1000 min<sup>-1</sup>)</td></tr> <tr><td>0A</td><td>Torque feedforward (1 V/100%)</td></tr> <tr><td>0B</td><td>Active gain (1st gain: 1 V, 2nd gain: 2 V)</td></tr> <tr><td>0C</td><td>Completion of position reference (completed: 5 V not completed: 0 V)</td></tr> <tr><td>0D</td><td>External encoder speed (1 V/1000 min<sup>-1</sup>)</td></tr> <tr><td colspan="2">Reserved (Do not change.)</td></tr> <tr><td colspan="2">Reserved (Do not change.)</td></tr> </tbody> </table> | Analog Monitor 2 Signal Selection (Refer to 5.1.3)   |  | 00              | Motor speed (1 V/1000 min <sup>-1</sup> ) | 01   | Speed reference (1 V/1000 min <sup>-1</sup> ) | 02   | Torque reference (1 V/100%)                                   | 03 | Position error (0.05 V/1 reference unit) | 04   | Position amplifier error (after electronic gears) (0.05 V/ 1 encoder pulse unit) | 05  | Position reference speed (1 V/1000 min <sup>-1</sup> ) | 06  | Reserved (Do not change.)                    | 07 | Motor-load position error (0.01 V/1 reference unit) | 08               | Positioning completion (positioning completed: 5 V, positioning not completed: 0 V) | 09                       | Speed feedforward (1 V/1000 min <sup>-1</sup> ) | 0A | Torque feedforward (1 V/100%) | 0B | Active gain (1st gain: 1 V, 2nd gain: 2 V) | 0C | Completion of position reference (completed: 5 V not completed: 0 V) | 0D | External encoder speed (1 V/1000 min <sup>-1</sup> ) | Reserved (Do not change.) |  | Reserved (Do not change.) |  |  |  |  |  |  |  |
|  | Analog Monitor 2 Signal Selection (Refer to 5.1.3)   |  |  |                 |   |  |   |  |   |    |  |  |  |   |  |   |  |    |   |                  |   |                          |   |    |                               |    |  |    |  |    |  |                           |  |                           |  |  |  |  |  |  |  |
|  | 00   | Motor speed (1 V/1000 min <sup>-1</sup> )  |  |                 |   |  |   |  |   |    |  |  |  |   |  |   |  |    |   |                  |   |                          |   |    |                               |    |  |    |  |    |  |                           |  |                           |  |  |  |  |  |  |  |
|  | 01   | Speed reference (1 V/1000 min <sup>-1</sup> )  |  |                 |   |  |   |  |   |    |  |  |  |   |  |   |  |    |   |                  |   |                          |   |    |                               |    |  |    |  |    |  |                           |  |                           |  |  |  |  |  |  |  |
|  | 02   | Torque reference (1 V/100%)  |  |                 |   |  |   |  |   |    |  |  |  |   |  |   |  |    |   |                  |   |                          |   |    |                               |    |  |    |  |    |  |                           |  |                           |  |  |  |  |  |  |  |
|  | 03   | Position error (0.05 V/1 reference unit)   |  |                 |   |  |   |  |   |    |  |  |  |   |  |   |  |    |   |                  |   |                          |   |    |                               |    |  |    |  |    |  |                           |  |                           |  |  |  |  |  |  |  |
|  | 04   | Position amplifier error (after electronic gears) (0.05 V/ 1 encoder pulse unit)   |  |                 |   |  |   |  |   |    |  |  |  |   |  |   |  |    |   |                  |   |                          |   |    |                               |    |  |    |  |    |  |                           |  |                           |  |  |  |  |  |  |  |
|  | 05   | Position reference speed (1 V/1000 min <sup>-1</sup> )   |  |                 |   |  |   |  |   |    |  |  |  |   |  |   |  |    |   |                  |   |                          |   |    |                               |    |  |    |  |    |  |                           |  |                           |  |  |  |  |  |  |  |
|  | 06   | Reserved (Do not change.)  |  |                 |   |  |   |  |   |    |  |  |  |   |  |   |  |    |   |                  |   |                          |   |    |                               |    |  |    |  |    |  |                           |  |                           |  |  |  |  |  |  |  |
|  | 07   | Motor-load position error (0.01 V/1 reference unit)  |  |                 |   |  |   |  |   |    |  |  |  |   |  |   |  |    |   |                  |   |                          |   |    |                               |    |  |    |  |    |  |                           |  |                           |  |  |  |  |  |  |  |
|  | 08   | Positioning completion (positioning completed: 5 V, positioning not completed: 0 V)  |  |                 |   |  |   |  |   |    |  |  |  |   |  |   |  |    |   |                  |   |                          |   |    |                               |    |  |    |  |    |  |                           |  |                           |  |  |  |  |  |  |  |
|  | 09   | Speed feedforward (1 V/1000 min <sup>-1</sup> )  |  |                 |   |  |   |  |   |    |  |  |  |   |  |   |  |    |   |                  |   |                          |   |    |                               |    |  |    |  |    |  |                           |  |                           |  |  |  |  |  |  |  |
|  | 0A   | Torque feedforward (1 V/100%)  |  |                 |   |  |   |  |   |    |  |  |  |   |  |   |  |    |   |                  |   |                          |   |    |                               |    |  |    |  |    |  |                           |  |                           |  |  |  |  |  |  |  |
|  | 0B   | Active gain (1st gain: 1 V, 2nd gain: 2 V)   |  |                 |   |  |   |  |   |    |  |  |  |   |  |   |  |    |   |                  |   |                          |   |    |                               |    |  |    |  |    |  |                           |  |                           |  |  |  |  |  |  |  |
|  | 0C   | Completion of position reference (completed: 5 V not completed: 0 V)   |  |                 |   |  |   |  |   |    |  |  |  |   |  |   |  |    |   |                  |   |                          |   |    |                               |    |  |    |  |    |  |                           |  |                           |  |  |  |  |  |  |  |
|  | 0D   | External encoder speed (1 V/1000 min <sup>-1</sup> )   |  |                 |   |  |   |  |   |    |  |  |  |   |  |   |  |    |   |                  |   |                          |   |    |                               |    |  |    |  |    |  |                           |  |                           |  |  |  |  |  |  |  |
|  | Reserved (Do not change.)  |  |  |                 |   |  |   |  |   |    |  |  |  |   |  |   |  |    |   |                  |   |                          |   |    |                               |    |  |    |  |    |  |                           |  |                           |  |  |  |  |  |  |  |
|  | Reserved (Do not change.)  |  |  |                 |   |  |   |  |   |    |  |  |  |   |  |   |  |    |   |                  |   |                          |   |    |                               |    |  |    |  |    |  |                           |  |                           |  |  |  |  |  |  |  |
|  | Pn008  | Application Function Select Switch 8   | 0000 to 7121   | –               | 4000                                      | After restart                                      | Setup   | –  |   |    |  |  |  |   |  |   |  |    |   |                  |   |                          |   |    |                               |    |  |    |  |    |  |                           |  |                           |  |  |  |  |  |  |  |
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| Lowered Battery Voltage Alarm/Warning Selection (Refer to 4.5.4) |  |  |  |                 |   |  |   |  |   |    |  |  |  |   |  |   |  |    |   |                  |   |                          |   |    |                               |    |  |    |  |    |  |                           |  |                           |  |  |  |  |  |  |  |
| 0  |  | Outputs alarm (A.830) for lowered battery voltage.   |  |                 |   |  |   |  |   |    |  |  |  |   |  |   |  |    |   |                  |   |                          |   |    |                               |    |  |    |  |    |  |                           |  |                           |  |  |  |  |  |  |  |
| 1  |  | Outputs warning (A.930) for lowered battery voltage.   |  |                 |   |  |   |  |   |    |  |  |  |   |  |   |  |    |   |                  |   |                          |   |    |                               |    |  |    |  |    |  |                           |  |                           |  |  |  |  |  |  |  |
| Function Selection for Insufficient voltage (Refer to 4.2.10)    |  |  |  |                 |   |  |   |  |   |    |  |  |  |   |  |   |  |    |   |                  |   |                          |   |    |                               |    |  |    |  |    |  |                           |  |                           |  |  |  |  |  |  |  |
| 0  |  | Disables detection of insufficient voltages.   |  |                 |   |  |   |  |   |    |  |  |  |   |  |   |  |    |   |                  |   |                          |   |    |                               |    |  |    |  |    |  |                           |  |                           |  |  |  |  |  |  |  |
| 1  |  | Detects warning and limits torque by host controller.  |  |                 |   |  |   |  |   |    |  |  |  |   |  |   |  |    |   |                  |   |                          |   |    |                               |    |  |    |  |    |  |                           |  |                           |  |  |  |  |  |  |  |
| 2  |  | Detects warning and limits torque by Pn424 and Pn425.  |  |                 |   |  |   |  |   |    |  |  |  |   |  |   |  |    |   |                  |   |                          |   |    |                               |    |  |    |  |    |  |                           |  |                           |  |  |  |  |  |  |  |
| Warning Detection Selection (Refer to 9.2.1)                     |  |  |  |                 |   |  |   |  |   |    |  |  |  |   |  |   |  |    |   |                  |   |                          |   |    |                               |    |  |    |  |    |  |                           |  |                           |  |  |  |  |  |  |  |
| 0  | Detects warning.   |  |  |                 |   |  |   |  |   |    |  |  |  |   |  |   |  |    |   |                  |   |                          |   |    |                               |    |  |    |  |    |  |                           |  |                           |  |  |  |  |  |  |  |
| 1  | Does not detect warning.   |  |  |                 |   |  |   |  |   |    |  |  |  |   |  |   |  |    |   |                  |   |                          |   |    |                               |    |  |    |  |    |  |                           |  |                           |  |  |  |  |  |  |  |
| Reserved (Do not change.)  |  |  |  |                 |   |  |   |  |   |    |  |  |  |   |  |   |  |    |   |                  |   |                          |   |    |                               |    |  |    |  |    |  |                           |  |                           |  |  |  |  |  |  |  |

| Parameter No.  | Name  | Setting Range   | Units            | Factory Setting | When Enabled  | Classification | Reference Section |   |  |
|--|---|---|------------------|-----------------|---------------|----------------|-------------------|---|--|
| <b>Pn009</b>   | Application Function Select Switch 9              | 0000 to 0111  | –                | 0010            | After restart | Tuning         | –                 |   |  |
|  |   |   |                  |                 |               |                |                   |   |  |
|  | Reserved (Do not change.)                         |   |                  |                 |               |                |                   |   |  |
|  | Current Control Method Selection (Refer to 5.8.3) |   |                  |                 |               |                |                   |   |  |
|  | 0   | Current control method 1  |                  |                 |               |                |                   |   |  |
|  | 1   | Current control method 2  |                  |                 |               |                |                   |   |  |
|  | Speed Detection Method Selection (Refer to 5.8.5) |   |                  |                 |               |                |                   |   |  |
|  | 0   | Speed detection 1   |                  |                 |               |                |                   |   |  |
|  | 1   | Speed detection 2   |                  |                 |               |                |                   |   |  |
|  | Reserved (Do not change.)                         |   |                  |                 |               |                |                   |   |  |
|  | <b>Pn00B</b>                                      | Application Function Select Switch B                                    | 0000 to 1111     | –               | 0000          | After restart  | Setup             | – |  |
|  |   |   |                  |                 |               |                |                   |   |  |
|  |   | Parameter Display Selection (Refer to 2.3)                              |                  |                 |               |                |                   |   |  |
|  |   | 0   | Setup parameters |                 |               |                |                   |   |  |
|  |   | 1   | All parameters   |                 |               |                |                   |   |  |
| Alarm Gr.2 Stop Method Selection (Refer to 4.2.8)              |   |   |                  |                 |               |                |                   |   |  |
| 0  |   | Stops the motor by setting the speed reference to "0".                  |                  |                 |               |                |                   |   |  |
| 1  |   | Same setting as Pn001.0 (Stops the motor by applying DB or by coasting) |                  |                 |               |                |                   |   |  |
| Power Supply Method for Three-phase SERVOPACK (Refer to 3.1.4) |   |   |                  |                 |               |                |                   |   |  |
| 0  |   | Three-phase power supply  |                  |                 |               |                |                   |   |  |
| 1  |   | Single-phase power supply   |                  |                 |               |                |                   |   |  |
| Semi-closed Encoder Usage Method                               |   |   |                  |                 |               |                |                   |   |  |
| 0  |   | Uses the encoder connected to the SERVOPACK.                            |                  |                 |               |                |                   |   |  |
| 1  |   | Uses the encoder connected to the feedback option module.               |                  |                 |               |                |                   |   |  |

| Parameter No.             | Name  | Setting Range | Units   | Factory Setting | When Enabled  | Classification | Reference Section |
|---------------------------|---|---------------|---------|-----------------|---------------|----------------|-------------------|
| <b>Pn00C</b>              | Application Function Select Switch C                        | 0000 to 0111  | –       | 0000            | After restart | Setup          | –                 |
|                           |   |               |         |                 |               |                |                   |
|                           | <b>Selection of Test without Motor</b> (Refer to 4.3.3)     |               |         |                 |               |                |                   |
|                           | 0   Disables Test without motor.                            |               |         |                 |               |                |                   |
|                           | 1   Enables Test without motor.                             |               |         |                 |               |                |                   |
|                           | <b>Encoder Resolution for Test without Motor</b>            |               |         |                 |               |                |                   |
|                           | 0   13 bits   |               |         |                 |               |                |                   |
|                           | 1   20 bits   |               |         |                 |               |                |                   |
|                           | <b>Encoder Type for Test without Motor</b> (Refer to 4.3.3) |               |         |                 |               |                |                   |
|                           | 0   Incremental encoder                                     |               |         |                 |               |                |                   |
| 0   Absolute encoder      |   |               |         |                 |               |                |                   |
| Reserved (Do not change.) |   |               |         |                 |               |                |                   |
| <b>Pn00D</b>              | Application Function Select Switch D                        | 0000 to 0001  | –       | 0000            | After restart | Setup          | –                 |
|                           |   |               |         |                 |               |                |                   |
|                           | <b>Stand-alone Mode (Test Operation) Selection</b>          |               |         |                 |               |                |                   |
|                           | 0   Enables connection with the command option module.      |               |         |                 |               |                |                   |
|                           | 1   Disables connection with the command option module.     |               |         |                 |               |                |                   |
|                           | Reserved (Do not change.)                                   |               |         |                 |               |                |                   |
| Reserved (Do not change.) |   |               |         |                 |               |                |                   |
| Reserved (Do not change.) |   |               |         |                 |               |                |                   |
| <b>Pn010</b>              | Axis Address Selection                                      | 0000 to 007F  | –       | 0001            | After restart | Setup          | –                 |
| <b>Pn100</b>              | Speed Loop Gain   | 10 to 20000   | 0.1 Hz  | 400             | Immediately   | Tuning         | 5.8.1             |
| <b>Pn101</b>              | Speed Loop Integral Time Constant                           | 15 to 51200   | 0.01 ms | 2000            | Immediately   | Tuning         |                   |
| <b>Pn102</b>              | Position Loop Gain  | 10 to 20000   | 0.1/s   | 400             | Immediately   | Tuning         |                   |
| <b>Pn103</b>              | Moment of Inertia Ratio                                     | 0 to 20000    | 1%      | 100             | Immediately   | Tuning         |                   |
| <b>Pn104</b>              | 2nd Speed Loop Gain   | 10 to 20000   | 0.1 Hz  | 400             | Immediately   | Tuning         |                   |
| <b>Pn105</b>              | 2nd Speed Loop Integral Time Constant                       | 15 to 51200   | 0.01 ms | 2000            | Immediately   | Tuning         |                   |
| <b>Pn106</b>              | 2nd Position Loop Gain                                      | 10 to 20000   | 0.1/s   | 400             | Immediately   | Tuning         |                   |
| <b>Pn109</b>              | Feedforward Gain  | 0 to 100      | 1%      | 0               | Immediately   | Tuning         | 5.9.1             |
| <b>Pn10A</b>              | Feedforward Filter Time Constant                            | 0 to 6400     | 0.01 ms | 0               | Immediately   | Tuning         |                   |

| Parameter No.             | Name  | Setting Range  | Units                  | Factory Setting | When Enabled | Classification | Reference Section |  |  |
|---------------------------|---|--|------------------------|-----------------|--------------|----------------|-------------------|--|--|
| <b>Pn10B</b>              | Application Function for Gain Select Switch   | 0000 to 5334   | –                      | 0000            | –            | –              | –                 |  |  |
|                           | <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">             4th digit<br/> <input type="checkbox"/> </div> <div style="text-align: center;">             3rd digit<br/> <input type="checkbox"/> </div> <div style="text-align: center;">             2nd digit<br/> <input type="checkbox"/> </div> <div style="text-align: center;">             1st digit<br/> <input type="checkbox"/> </div> </div> <p>n. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/></p> |  |                        |                 |              |                |                   |  |  |
|                           | Mode Switch Selection (Refer to 5.9.2)  |  |                        |                 |              | When Enabled   | Classification    |  |  |
|                           | 0   | Uses internal torque reference as the condition (Level setting: Pn10C) | Immediately            | Setup           |              |                |                   |  |  |
|                           | 1   | Uses speed reference as the condition (Level setting: Pn10D)           |                        |                 |              |                |                   |  |  |
|                           | 2   | Uses acceleration as the condition (Level setting: Pn10E)              |                        |                 |              |                |                   |  |  |
|                           | 3   | Uses position error pulse as the condition (Level setting: Pn10F)      |                        |                 |              |                |                   |  |  |
|                           | 4   | No mode switch function available                                      |                        |                 |              |                |                   |  |  |
|                           | Speed Loop Control Method   |  |                        |                 |              | When Enabled   | Classification    |  |  |
|                           | 0   | PI control   | After restart          | Setup           |              |                |                   |  |  |
| 1                         | I-P control   |  |                        |                 |              |                |                   |  |  |
| 2 and 3                   | Reserved (Do not change.)   |  |                        |                 |              |                |                   |  |  |
| Reserved (Do not change.) |   |  |                        |                 |              |                |                   |  |  |
| Reserved (Do not change.) |   |  |                        |                 |              |                |                   |  |  |
| <b>Pn10C</b>              | Mode Switch (torque reference)  | 0 to 800   | 1%                     | 200             | Immediately  | Tuning         | 5.9.2             |  |  |
| <b>Pn10D</b>              | Mode Switch (speed reference)   | 0 to 10000   | 1 min <sup>-1</sup>    | 0               | Immediately  | Tuning         |                   |  |  |
| <b>Pn10E</b>              | Mode Switch (acceleration)  | 0 to 30000   | 1 min <sup>-1</sup> /s | 0               | Immediately  | Tuning         |                   |  |  |
| <b>Pn10F</b>              | Mode Switch (position error pulse)  | 0 to 10000   | 1 reference unit       | 0               | Immediately  | Tuning         |                   |  |  |
| <b>Pn11F</b>              | Position Integral Time Constant   | 0 to 50000   | 0.1 ms                 | 0               | Immediately  | Tuning         | 5.9.4             |  |  |
| <b>Pn121</b>              | Friction Compensation Gain  | 10 to 1000   | 1%                     | 100             | Immediately  | Tuning         | 5.8.2             |  |  |
| <b>Pn122</b>              | 2nd Gain for Friction Compensation  | 10 to 1000   | 1%                     | 100             | Immediately  | Tuning         |                   |  |  |
| <b>Pn123</b>              | Friction Compensation Coefficient   | 0 to 100   | 1%                     | 0               | Immediately  | Tuning         |                   |  |  |
| <b>Pn124</b>              | Friction Compensation Frequency Correction  | -10000 to 10000  | 0.1 Hz                 | 0               | Immediately  | Tuning         |                   |  |  |
| <b>Pn125</b>              | Friction Compensation Gain Correction   | 1 to 1000  | 1%                     | 100             | Immediately  | Tuning         |                   |  |  |
| <b>Pn131</b>              | Gain Switching Time 1   | 0 to 65535   | 1 ms                   | 0               | Immediately  | Tuning         | 5.8.1             |  |  |
| <b>Pn132</b>              | Gain Switching Time 2   | 0 to 65535   | 1 ms                   | 0               | Immediately  | Tuning         |                   |  |  |
| <b>Pn135</b>              | Gain Switching Waiting Time 1   | 0 to 65535   | 1 ms                   | 0               | Immediately  | Tuning         |                   |  |  |
| <b>Pn136</b>              | Gain Switching Waiting Time 2   | 0 to 65535   | 1 ms                   | 0               | Immediately  | Tuning         |                   |  |  |



| Parameter No. | Name  | Setting Range   | Units  | Factory Setting | When Enabled | Classification | Reference Section |  |  |
|---------------|---|---|--|-----------------|--------------|----------------|-------------------|--|--|
| Pn139         | Automatic Gain Changeover Related Switch 1  | 0000 to 0052  | –  | 0000            | Immediately  | Tuning         | –                 |  |  |
|               | <div style="display: flex; justify-content: space-around; align-items: flex-start;"> <div style="text-align: center;">           4th digit<br/> <input type="checkbox"/> </div> <div style="text-align: center;">           3rd digit<br/> <input type="checkbox"/> </div> <div style="text-align: center;">           2nd digit<br/> <input type="checkbox"/> </div> <div style="text-align: center;">           1st digit<br/> <input type="checkbox"/> </div> </div> <p>n. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/></p> |   |  |                 |              |                |                   |  |  |
|               |   |   | Gain Switching Selection Switch*1 (Refer to 5.8.1)   |                 |              |                |                   |  |  |
|               |   |   | 0 Manual gain switching<br>Switches between 1st gain and 2nd gain using the gain switching reference from the command option module.   |                 |              |                |                   |  |  |
|               |   |   | 1 Reserved (Do not change.)  |                 |              |                |                   |  |  |
|               |   |   | 2 Automatic gain switching pattern 1<br>Changes automatically 1st gain to 2nd gain when the switching condition A is satisfied.<br>Changes automatically 2nd gain to 1st gain when the switching condition A is not satisfied. |                 |              |                |                   |  |  |
|               |   |   | Gain Switching Condition A (Refer to 5.8.1)  |                 |              |                |                   |  |  |
|               |   |   | 0 Positioning completion signal (/COIN) ON   |                 |              |                |                   |  |  |
|               |   |   | 1 Positioning completion signal (/COIN) OFF  |                 |              |                |                   |  |  |
|               |   |   | 2 NEAR signal (/NEAR) ON   |                 |              |                |                   |  |  |
|               |   | 3 NEAR signal (/NEAR) OFF   |  |                 |              |                |                   |  |  |
|               |   | 4 Position reference filter output = 0 and reference input OFF                          |  |                 |              |                |                   |  |  |
|               |   | 5 Position reference input ON   |  |                 |              |                |                   |  |  |
|               |   | Reserved (Do not change.)   |  |                 |              |                |                   |  |  |
|               |   | Reserved (Do not change.)   |  |                 |              |                |                   |  |  |
| Pn13D         | Current Gain Level  | 100 to 2000   | 1%   | 2000            | Immediately  | Tuning         | 5.8.4             |  |  |
| Pn140         | Model Following Control Related Switch  | 0000 to 1121  | –  | 0100            | Immediately  | Tuning         | –                 |  |  |
|               | <div style="display: flex; justify-content: space-around; align-items: flex-start;"> <div style="text-align: center;">           4th digit<br/> <input type="checkbox"/> </div> <div style="text-align: center;">           3rd digit<br/> <input type="checkbox"/> </div> <div style="text-align: center;">           2nd digit<br/> <input type="checkbox"/> </div> <div style="text-align: center;">           1st digit<br/> <input type="checkbox"/> </div> </div> <p>n. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/></p> |   |  |                 |              |                |                   |  |  |
|               |   |   | Model Following Control Selection  |                 |              |                |                   |  |  |
|               |   |   | 0 Does not use model following control.  |                 |              |                |                   |  |  |
|               |   |   | 1 Uses model following control.  |                 |              |                |                   |  |  |
|               |   |   | Vibration Suppression Selection  |                 |              |                |                   |  |  |
|               |   |   | 0 Does not perform vibration suppression.  |                 |              |                |                   |  |  |
|               |   |   | 1 Performs vibration suppression over the specified frequency.   |                 |              |                |                   |  |  |
|               |   |   | 2 Performs vibration suppression over two different kinds of frequencies.  |                 |              |                |                   |  |  |
|               |   |   | Vibration Suppression Adjustment Selection (Refer to 5.3.1, 5.4.1, 5.5.1, 5.7.1)   |                 |              |                |                   |  |  |
|               |   | 0 Does not adjust vibration suppression automatically using utility function.           |  |                 |              |                |                   |  |  |
|               |   | 1 Adjusts vibration suppression automatically using utility function.                   |  |                 |              |                |                   |  |  |
|               |   | Selection of Speed Feedforward (VFF) / Torque Feedforward (TFF) (Refer to 5.3.1, 5.4.1) |  |                 |              |                |                   |  |  |
|               |   | 0 Does not use model following control and speed/torque feedforward together.           |  |                 |              |                |                   |  |  |
|               |   | 1 Uses model following control and speed/torque feedforward together.                   |  |                 |              |                |                   |  |  |
| Pn141         | Model Following Control Gain  | 10 to 20000   | 0.1/s  | 500             | Immediately  | Tuning         | –                 |  |  |
| Pn142         | Model Following Control Gain Compensation   | 500 to 2000   | 0.1%   | 1000            | Immediately  | Tuning         | –                 |  |  |

\*1. For details on this function, refer to the manual of the connected command option module.

| Parameter No.   | Name   | Setting Range                        | Units   | Factory Setting | When Enabled  | Classification | Reference Section   |  |   |  |                                      |  |                              |
|---|--|--------------------------------------|---------|-----------------|---------------|----------------|---|--|---|--|--------------------------------------|--|------------------------------|
| <b>Pn143</b>  | Model Following Control Bias (Forward Direction)   | 0 to 10000                           | 0.1%    | 1000            | Immediately   | Tuning         | –   |  |   |  |                                      |  |                              |
| <b>Pn144</b>  | Model Following Control Bias (Reverse Direction)   | 0 to 10000                           | 0.1%    | 1000            | Immediately   | Tuning         | –   |  |   |  |                                      |  |                              |
| <b>Pn145</b>  | Vibration Suppression 1 Frequency A  | 10 to 2500                           | 0.1 Hz  | 500             | Immediately   | Tuning         | –   |  |   |  |                                      |  |                              |
| <b>Pn146</b>  | Vibration Suppression 1 Frequency B  | 10 to 2500                           | 0.1 Hz  | 700             | Immediately   | Tuning         | –   |  |   |  |                                      |  |                              |
| <b>Pn147</b>  | Model Following Control Speed Feedforward Compensation   | 0 to 10000                           | 0.1%    | 1000            | Immediately   | Tuning         | –   |  |   |  |                                      |  |                              |
| <b>Pn148</b>  | 2nd Model Following Control Gain   | 10 to 20000                          | 0.1/s   | 500             | Immediately   | Tuning         | –   |  |   |  |                                      |  |                              |
| <b>Pn149</b>  | 2nd Model Following Control Gain Compensation  | 500 to 2000                          | 0.1%    | 1000            | Immediately   | Tuning         | –   |  |   |  |                                      |  |                              |
| <b>Pn14A</b>  | Vibration Suppression 2 Frequency  | 10 to 2000                           | 0.1 Hz  | 800             | Immediately   | Tuning         | –   |  |   |  |                                      |  |                              |
| <b>Pn14B</b>  | Vibration Suppression 2 Compensation   | 10 to 1000                           | 1%      | 100             | Immediately   | Tuning         | –   |  |   |  |                                      |  |                              |
| <b>Pn14F</b>  | Reserved Parameter (Do not change.)  | –                                    | –       | 0011            | –             | –              | –   |  |   |  |                                      |  |                              |
| <b>Pn160</b>  | Anti-Resonance Control Related Switch  | 0000 to 0011                         | –       | 0010            | After restart | Tuning         | –   |  |   |  |                                      |  |                              |
|   |  |                                      |         |                 |               |                |   |  |   |  |                                      |  |                              |
|   | <table border="1"> <thead> <tr> <th colspan="2">Anti-Resonance Control Selection (Refer to 5.3.1, 5.4.1, 5.5.1, 5.7.1)</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Does not use anti-resonance control.</td> </tr> <tr> <td>1</td> <td>Uses anti-resonance control.</td> </tr> </tbody> </table> |                                      |         |                 |               |                |   | Anti-Resonance Control Selection (Refer to 5.3.1, 5.4.1, 5.5.1, 5.7.1) |   | 0  | Does not use anti-resonance control. | 1  | Uses anti-resonance control. |
|   | Anti-Resonance Control Selection (Refer to 5.3.1, 5.4.1, 5.5.1, 5.7.1)   |                                      |         |                 |               |                |   |  |   |  |                                      |  |                              |
|   | 0  | Does not use anti-resonance control. |         |                 |               |                |   |  |   |  |                                      |  |                              |
|   | 1  | Uses anti-resonance control.         |         |                 |               |                |   |  |   |  |                                      |  |                              |
| <table border="1"> <thead> <tr> <th colspan="2">Anti-Resonance Control Adjustment Selection (Refer to 5.3.1, 5.4.1, 5.5.1, 5.7.1)</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Does not use adjust anti-resonance control automatically using utility function.</td> </tr> <tr> <td>1</td> <td>Adjusts anti-resonance control automatically using utility function.</td> </tr> </tbody> </table> |  |                                      |         |                 |               |                | Anti-Resonance Control Adjustment Selection (Refer to 5.3.1, 5.4.1, 5.5.1, 5.7.1) |  | 0 | Does not use adjust anti-resonance control automatically using utility function. | 1                                    | Adjusts anti-resonance control automatically using utility function. |                              |
| Anti-Resonance Control Adjustment Selection (Refer to 5.3.1, 5.4.1, 5.5.1, 5.7.1)   |  |                                      |         |                 |               |                |   |  |   |  |                                      |  |                              |
| 0   | Does not use adjust anti-resonance control automatically using utility function.   |                                      |         |                 |               |                |   |  |   |  |                                      |  |                              |
| 1   | Adjusts anti-resonance control automatically using utility function.   |                                      |         |                 |               |                |   |  |   |  |                                      |  |                              |
| Reserved (Do not change.)   |  |                                      |         |                 |               |                |   |  |   |  |                                      |  |                              |
| Reserved (Do not change.)   |  |                                      |         |                 |               |                |   |  |   |  |                                      |  |                              |
| <b>Pn161</b>  | Anti-Resonance Frequency   | 10 to 20000                          | 0.1 Hz  | 1000            | Immediately   | Tuning         | –   |  |   |  |                                      |  |                              |
| <b>Pn162</b>  | Anti-Resonance Gain Compensation   | 1 to 1000                            | 1%      | 100             | Immediately   | Tuning         | –   |  |   |  |                                      |  |                              |
| <b>Pn163</b>  | Anti-Resonance Damping Gain  | 0 to 300                             | 1%      | 0               | Immediately   | Tuning         | –   |  |   |  |                                      |  |                              |
| <b>Pn164</b>  | Anti-Resonance Filter Time Constant 1 Compensation   | -1000 to 1000                        | 0.01 ms | 0               | Immediately   | Tuning         | –   |  |   |  |                                      |  |                              |
| <b>Pn165</b>  | Anti-Resonance Filter Time Constant 2 Compensation   | -1000 to 1000                        | 0.01 ms | 0               | Immediately   | Tuning         | –   |  |   |  |                                      |  |                              |

| Parameter No.   | Name   | Setting Range  | Units  | Factory Setting | When Enabled   | Classification | Reference Section   |                               |               |       |  |  |  |  |  |  |  |  |
|---|--|--|--|-----------------|----------------|----------------|---|-------------------------------|---------------|-------|--|--|--|--|--|--|--|--|
| Pn170   | Tuning-less Function Related Switch  | 0000 to 2411   | –  | 1401            | –              | –              | –   |                               |               |       |  |  |  |  |  |  |  |  |
|   |  |  |  |                 |                |                |   |                               |               |       |  |  |  |  |  |  |  |  |
|   | <table border="1"> <tr> <th colspan="2">Tuning-less Function Selection (Refer to 5.2)</th> <th>When Enabled</th> <th>Classification</th> </tr> <tr> <td>0</td> <td>Tuning-less function disabled</td> <td rowspan="2">After restart</td> <td rowspan="2">Setup</td> </tr> <tr> <td>1</td> <td>Tuning-less function enabled</td> </tr> </table>   |  | Tuning-less Function Selection (Refer to 5.2)      |                 | When Enabled   | Classification | 0   | Tuning-less function disabled | After restart | Setup | 1  | Tuning-less function enabled   |  |  |  |  |  |  |
|   | Tuning-less Function Selection (Refer to 5.2)  |  | When Enabled                                       | Classification  |                |                |   |                               |               |       |  |  |  |  |  |  |  |  |
|   | 0  | Tuning-less function disabled  | After restart                                      | Setup           |                |                |   |                               |               |       |  |  |  |  |  |  |  |  |
|   | 1  | Tuning-less function enabled   |  |                 |                |                |   |                               |               |       |  |  |  |  |  |  |  |  |
|   | <table border="1"> <tr> <th colspan="2">Control Method during Speed Control (Refer to 5.2)</th> <th>When Enabled</th> <th>Classification</th> </tr> <tr> <td>0</td> <td>Uses as speed control.</td> <td rowspan="2">After restart</td> <td rowspan="2">Setup</td> </tr> <tr> <td>1</td> <td>Uses as speed control and uses the host controller for position control.</td> </tr> </table> |  | Control Method during Speed Control (Refer to 5.2) |                 | When Enabled   | Classification | 0   | Uses as speed control.        | After restart | Setup | 1  | Uses as speed control and uses the host controller for position control. |  |  |  |  |  |  |
|   | Control Method during Speed Control (Refer to 5.2)   |  | When Enabled                                       | Classification  |                |                |   |                               |               |       |  |  |  |  |  |  |  |  |
|   | 0  | Uses as speed control.   | After restart                                      | Setup           |                |                |   |                               |               |       |  |  |  |  |  |  |  |  |
|   | 1  | Uses as speed control and uses the host controller for position control. |  |                 |                |                |   |                               |               |       |  |  |  |  |  |  |  |  |
| <table border="1"> <tr> <th colspan="2">Tuning-less Tuning Level (Refer to 5.2)</th> <th>When Enabled</th> <th>Classification</th> </tr> <tr> <td>0 to 4</td> <td>Sets tuning-less tuning level.</td> <td>Immediately</td> <td>Setup</td> </tr> </table>  |  | Tuning-less Tuning Level (Refer to 5.2)                                  |  | When Enabled    | Classification | 0 to 4         | Sets tuning-less tuning level.  | Immediately                   | Setup         |       |  |  |  |  |  |  |  |  |
| Tuning-less Tuning Level (Refer to 5.2)   |  | When Enabled   | Classification                                     |                 |                |                |   |                               |               |       |  |  |  |  |  |  |  |  |
| 0 to 4  | Sets tuning-less tuning level.   | Immediately  | Setup  |                 |                |                |   |                               |               |       |  |  |  |  |  |  |  |  |
| <table border="1"> <tr> <th colspan="2">Tuning-less Load Level (Refer to 5.2)</th> <th>When Enabled</th> <th>Classification</th> </tr> <tr> <td>0 to 2</td> <td>Sets tuning-less load level.</td> <td>Immediately</td> <td>Setup</td> </tr> </table>  |  | Tuning-less Load Level (Refer to 5.2)                                    |  | When Enabled    | Classification | 0 to 2         | Sets tuning-less load level.  | Immediately                   | Setup         |       |  |  |  |  |  |  |  |  |
| Tuning-less Load Level (Refer to 5.2)   |  | When Enabled   | Classification                                     |                 |                |                |   |                               |               |       |  |  |  |  |  |  |  |  |
| 0 to 2  | Sets tuning-less load level.   | Immediately  | Setup  |                 |                |                |   |                               |               |       |  |  |  |  |  |  |  |  |
| Pn190   | Reserved Parameter (Do not change.)  | –  | –  | 0010            | –              | –              | –   |                               |               |       |  |  |  |  |  |  |  |  |
| Pn200   | Reserved Parameter (Do not change.)  | –  | –  | 0100            | –              | –              | –   |                               |               |       |  |  |  |  |  |  |  |  |
| Pn205   | Multiturn Limit  | 0 to 65535   | 1 rev  | 65535           | After restart  | Setup          | 4.5.6   |                               |               |       |  |  |  |  |  |  |  |  |
| Pn207   | Position Control Function Switch   | 0000 to 2210   | –  | 0010            | After restart  | Setup          | –   |                               |               |       |  |  |  |  |  |  |  |  |
|   |  |  |  |                 |                |                |   |                               |               |       |  |  |  |  |  |  |  |  |
|   | Reserved (Do not change.)  |  |  |                 |                |                |   |                               |               |       |  |  |  |  |  |  |  |  |
|   | Reserved (Do not change.)  |  |  |                 |                |                |   |                               |               |       |  |  |  |  |  |  |  |  |
|   | Reserved (Do not change.)  |  |  |                 |                |                |   |                               |               |       |  |  |  |  |  |  |  |  |
| <table border="1"> <tr> <th colspan="2">COIN Output Timing</th> <th>When Enabled</th> <th>Classification</th> </tr> <tr> <td>0</td> <td>Outputs when the position error absolute value is the same or less than the positioning completion width (Pn522).</td> <td rowspan="3">After restart</td> <td rowspan="3">Setup</td> </tr> <tr> <td>1</td> <td>Outputs when the position error absolute value is the position completion width (Pn522) or less and the reference after position reference filtering is 0.</td> </tr> <tr> <td>2</td> <td>When the absolute value of the position error is below the positioning completed width setting (Pn522), and the position reference input is 0.</td> </tr> </table> |  | COIN Output Timing   |  | When Enabled    | Classification | 0              | Outputs when the position error absolute value is the same or less than the positioning completion width (Pn522). | After restart                 | Setup         | 1     | Outputs when the position error absolute value is the position completion width (Pn522) or less and the reference after position reference filtering is 0. | 2  | When the absolute value of the position error is below the positioning completed width setting (Pn522), and the position reference input is 0. |  |  |  |  |  |
| COIN Output Timing  |  | When Enabled   | Classification                                     |                 |                |                |   |                               |               |       |  |  |  |  |  |  |  |  |
| 0   | Outputs when the position error absolute value is the same or less than the positioning completion width (Pn522).  | After restart  | Setup  |                 |                |                |   |                               |               |       |  |  |  |  |  |  |  |  |
| 1   | Outputs when the position error absolute value is the position completion width (Pn522) or less and the reference after position reference filtering is 0.   |  |  |                 |                |                |   |                               |               |       |  |  |  |  |  |  |  |  |
| 2   | When the absolute value of the position error is below the positioning completed width setting (Pn522), and the position reference input is 0.   |  |  |                 |                |                |   |                               |               |       |  |  |  |  |  |  |  |  |
| Pn20A   | Number of External Encoder Pitch   | 4 to 1048576   | $\frac{1}{\text{pitch/rev}}$                       | 32768           | After restart  | Setup          | 8.3   |                               |               |       |  |  |  |  |  |  |  |  |
| Pn20E   | Electronic Gear Ratio (Numerator)  | 1 to 1073741824 (2 <sup>30</sup> )                                       | 1  | 4               | After restart  | Setup          | 4.2.4   |                               |               |       |  |  |  |  |  |  |  |  |
| Pn210   | Electronic Gear Ratio (Denominator)  | 1 to 1073741824 (2 <sup>30</sup> )                                       | 1  | 1               | After restart  | Setup          |   |                               |               |       |  |  |  |  |  |  |  |  |

10.1.2 Parameters

| Parameter No. | Name  | Setting Range                                       | Units               | Factory Setting | When Enabled  | Classification | Reference Section |   |                           |   |   |   |   |
|---------------|---|---|---------------------|-----------------|---------------|----------------|-------------------|---|---------------------------|---|---|---|---|
| <b>Pn212</b>  | Encoder Output Pulses   | 16 to 1073741824 (2 <sup>30</sup> )                 | 1 P/rev             | 2048            | After restart | Setup          | –                 |   |                           |   |   |   |   |
| <b>Pn216</b>  | Reserved Parameter (Do not change.)   | –   | –                   | 0               | –             | –              | –                 |   |                           |   |   |   |   |
| <b>Pn217</b>  | Reserved Parameter (Do not change.)   | –   | –                   | 0               | –             | –              | –                 |   |                           |   |   |   |   |
| <b>Pn22A</b>  | Fully-closed Control Selection Switch   | 0000 to 1003  | –                   | 0000            | After restart | Setup          | –                 |   |                           |   |   |   |   |
|               | <p>4th digit   3rd digit   2nd digit   1st digit</p> <p>n. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/></p> <p>Reserved (Do not change.)</p> <p>Reserved (Do not change.)</p> <p>Reserved (Do not change.)</p> <p>Speed Feedback Selection at Fully-closed Control (Refer to 8.3.9)</p> <table border="1"> <tr> <td>0</td> <td>Uses motor encoder speed.</td> </tr> <tr> <td>1</td> <td>Uses external encoder speed.</td> </tr> </table>   |   |                     |                 |               |                |                   | 0 | Uses motor encoder speed. | 1 | Uses external encoder speed.                        |   |   |
|               | 0   | Uses motor encoder speed.                           |                     |                 |               |                |                   |   |                           |   |   |   |   |
|               | 1   | Uses external encoder speed.                        |                     |                 |               |                |                   |   |                           |   |   |   |   |
|               |   |   |                     |                 |               |                |                   |   |                           |   |   |   |   |
|               |   |   |                     |                 |               |                |                   |   |                           |   |   |   |   |
|               |   |   |                     |                 |               |                |                   |   |                           |   |   |   |   |
| <b>Pn281</b>  | Encoder Output Resolution   | 1 to 4096   | 1 P/pitch           | 20              | After restart | Setup          | 8.3.4             |   |                           |   |   |   |   |
| <b>Pn300</b>  | Reserved Parameter (Do not change.)   | –   | –                   | 600             | –             | –              | –                 |   |                           |   |   |   |   |
| <b>Pn301</b>  | Reserved Parameter (Do not change.)   | –   | –                   | 100             | –             | –              | –                 |   |                           |   |   |   |   |
| <b>Pn302</b>  | Reserved Parameter (Do not change.)   | –   | –                   | 200             | –             | –              | –                 |   |                           |   |   |   |   |
| <b>Pn303</b>  | Reserved Parameter (Do not change.)   | –   | –                   | 300             | –             | –              | –                 |   |                           |   |   |   |   |
| <b>Pn304</b>  | JOG Speed   | 0 to 10000  | 1 min <sup>-1</sup> | 500             | Immediately   | Setup          | 6.3               |   |                           |   |   |   |   |
| <b>Pn305</b>  | Soft Start Acceleration Time  | 0 to 10000  | 1 ms                | 0               | Immediately   | Setup          | –                 |   |                           |   |   |   |   |
| <b>Pn306</b>  | Soft Start Deceleration Time  | 0 to 10000  | 1 ms                | 0               | Immediately   | Setup          |                   |   |                           |   |   |   |   |
| <b>Pn307</b>  | Reserved Parameter (Do not change.)   | –   | –                   | 40              | –             | –              | –                 |   |                           |   |   |   |   |
| <b>Pn310</b>  | Vibration Detection Switch  | 0000 to 0002  | –                   | 0000            | Immediately   | Setup          | –                 |   |                           |   |   |   |   |
|               | <p>4th digit   3rd digit   2nd digit   1st digit</p> <p>n. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/></p> <p>Vibration Detection Selection (Refer to 6.16)</p> <table border="1"> <tr> <td>0</td> <td>No detection.</td> </tr> <tr> <td>1</td> <td>Outputs warning (A.911) when vibration is detected.</td> </tr> <tr> <td>2</td> <td>Outputs alarm (A.520) when vibration is detected.</td> </tr> </table> <p>Reserved (Do not change.)</p> <p>Reserved (Do not change.)</p> <p>Reserved (Do not change.)</p> |   |                     |                 |               |                |                   | 0 | No detection.             | 1 | Outputs warning (A.911) when vibration is detected. | 2 | Outputs alarm (A.520) when vibration is detected. |
|               | 0   | No detection.                                       |                     |                 |               |                |                   |   |                           |   |   |   |   |
|               | 1   | Outputs warning (A.911) when vibration is detected. |                     |                 |               |                |                   |   |                           |   |   |   |   |
|               | 2   | Outputs alarm (A.520) when vibration is detected.   |                     |                 |               |                |                   |   |                           |   |   |   |   |
|               |   |   |                     |                 |               |                |                   |   |                           |   |   |   |   |
|               |   |   |                     |                 |               |                |                   |   |                           |   |   |   |   |
|               |   |   |                     |                 |               |                |                   |   |                           |   |   |   |   |

| Parameter No.  | Name  | Setting Range  | Units               | Factory Setting | When Enabled   | Classification | Reference Section |   |
|--|---|--|---------------------|-----------------|----------------|----------------|-------------------|---|
| <b>Pn311</b>   | Vibration Detection Sensibility                         | 50 to 500  | 1%                  | 100             | Immediately    | Tuning         | 6.16              |   |
| <b>Pn312</b>   | Vibration Detection Level                               | 0 to 5000  | 1 min <sup>-1</sup> | 50              | Immediately    | Tuning         |                   |   |
| <b>Pn324</b>   | Moment of Inertia Calculating Start Level               | 0 to 20000   | 1%                  | 300             | Immediately    | Setup          | 5.3.2             |   |
| <b>Pn400</b>   | Reserved Parameter<br>(Do not change.)                  | –  | –                   | 30              | –              | –              | –                 |   |
| <b>Pn401</b>   | 1st Step 1st Torque Reference Filter Time Constant      | 0 to 65535   | 0.01 ms             | 100             | Immediately    | Tuning         | 5.9.3             |   |
| <b>Pn402</b>   | Forward Torque Limit                                    | 0 to 800   | 1%                  | 800             | Immediately    | Setup          | –                 |   |
| <b>Pn403</b>   | Reverse Torque Limit                                    | 0 to 800   | 1%                  | 800             | Immediately    | Setup          |                   |   |
| <b>Pn404</b>   | Forward External Torque Limit                           | 0 to 800   | 1%                  | 100             | Immediately    | Setup          |                   |   |
| <b>Pn405</b>   | Reverse External Torque Limit                           | 0 to 800   | 1%                  | 100             | Immediately    | Setup          | –                 |   |
| <b>Pn406</b>   | Emergency Stop Torque                                   | 0 to 800   | 1%                  | 800             | Immediately    | Setup          | 4.2.3             |   |
| <b>Pn407</b>   | Speed Limit during Torque Control                       | 0 to 10000   | 1 min <sup>-1</sup> | 10000           | Immediately    | Setup          | –                 |   |
| <b>Pn408</b>   | Torque Related Function Switch                          | 0000 to 1111   | –                   | 0000            | –              | Setup          | –                 |   |
|  |   |  |                     |                 |                |                |                   | – |
|  | <b>1st Step Notch Filter Selection</b> (Refer to 5.9.3) |  |                     |                 | When Enabled   | Classification |                   |   |
|  | 0   | N/A  |                     |                 | Immediately    | Setup          |                   |   |
|  | 1   | Uses 1st step notch filter for torque reference.   |                     |                 |                |                |                   |   |
|  | <b>Speed Limit Selection</b>                            |  |                     |                 | When Enabled   | Classification |                   |   |
|  | 0   | Uses the smaller value between motor max. speed and parameter Pn407 as speed limit value.          |                     |                 | After restart  | Setup          |                   |   |
|  | 1   | Uses the smaller value between overspeed detection speed and parameter Pn407 as speed limit value. |                     |                 |                |                |                   |   |
|  | <b>2nd Step Notch Filter Selection</b> (Refer to 5.9.3) |  |                     |                 | When Enabled   | Classification |                   |   |
|  | 0   | N/A  |                     |                 | Immediately    | Setup          |                   |   |
| 1  | Uses 2nd step notch filter for torque reference.        |  |                     |                 |                |                |                   |   |
| <b>Friction Compensation Function Selection</b> (Refer to 5.8.2) |   |  |                     | When Enabled    | Classification |                |                   |   |
| 0  | Disables use friction compensation function.            |  |                     | Immediately     | Setup          |                |                   |   |
| 1  | Enables friction compensation function.                 |  |                     |                 |                |                |                   |   |

| Parameter No. | Name   | Setting Range  | Units               | Factory Setting     | When Enabled | Classification | Reference Section       |       |  |   |  |   |  |   |  |
|---------------|--|--|---------------------|---------------------|--------------|----------------|-------------------------|-------|--|---|--|---|--|---|--|
| <b>Pn409</b>  | 1st Notch Filter Frequency   | 50 to 5000   | 1 Hz                | 5000                | Immediately  | Tuning         | 5.9.3                   |       |  |   |  |   |  |   |  |
| <b>Pn40A</b>  | 1st Notch Filter Q Value   | 50 to 1000   | 0.01                | 70                  | Immediately  | Tuning         |                         |       |  |   |  |   |  |   |  |
| <b>Pn40B</b>  | 1st Notch Filter Depth   | 0 to 1000  | 0.001               | 0                   | Immediately  | Tuning         |                         |       |  |   |  |   |  |   |  |
| <b>Pn40C</b>  | 2nd Notch Filter Frequency   | 50 to 5000   | 1 Hz                | 5000                | Immediately  | Tuning         |                         |       |  |   |  |   |  |   |  |
| <b>Pn40D</b>  | 2nd Notch Filter Q Value   | 50 to 1000   | 0.01                | 70                  | Immediately  | Tuning         |                         |       |  |   |  |   |  |   |  |
| <b>Pn40E</b>  | 2nd Notch Filter Depth   | 0 to 1000  | 0.001               | 0                   | Immediately  | Tuning         |                         |       |  |   |  |   |  |   |  |
| <b>Pn40F</b>  | 2nd Step 2nd Torque Reference Filter Frequency   | 100 to 5000  | 1 Hz                | 5000                | Immediately  | Tuning         |                         |       |  |   |  |   |  |   |  |
| <b>Pn410</b>  | 2nd Step 2nd Torque Reference Filter Q Value   | 50 to 100  | 0.01                | 50                  | Immediately  | Tuning         |                         |       |  |   |  |   |  |   |  |
| <b>Pn412</b>  | 1st Step 2nd Torque Reference Filter Time Constant   | 0 to 65535   | 0.01 ms             | 100                 | Immediately  | Tuning         |                         |       |  |   |  |   |  |   |  |
| <b>Pn423</b>  | Reserved Parameter (Do not change.)  | –  | –                   | 0000                | –            | –              | –                       |       |  |   |  |   |  |   |  |
| <b>Pn424</b>  | Torque Limit at Main Circuit Voltage Drop  | 0 to 100   | 1%                  | 50                  | Immediately  | Setup          | 4.2.10                  |       |  |   |  |   |  |   |  |
| <b>Pn425</b>  | Release Time for Torque Limit at Main Circuit Voltage Drop   | 0 to 1000  | 1 ms                | 100                 | Immediately  | Setup          |                         |       |  |   |  |   |  |   |  |
| <b>Pn456</b>  | Sweep Torque Reference Amplitude   | 1 to 800   | 1%                  | 15                  | Immediately  | Tuning         | 6.19                    |       |  |   |  |   |  |   |  |
| <b>Pn460</b>  | Notch Filter Adjustment Switch   | 0000 to 0101   | –                   | 0101                | Immediately  | Tuning         | 5.2.1<br>5.3.1<br>5.5.1 |       |  |   |  |   |  |   |  |
|               | <p>4th digit   3rd digit   2nd digit   1st digit</p> <p>n. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/></p> <p>Notch Filter Adjustment Selection 1</p> <table border="1"> <tr> <td>0</td> <td>1st step notch filter is not adjusted automatically with utility function.</td> </tr> <tr> <td>1</td> <td>1st step notch filter is adjusted automatically with utility function.</td> </tr> </table> <p>Reserved (Do not change.)</p> <p>Notch Filter Adjustment Selection 2</p> <table border="1"> <tr> <td>0</td> <td>2nd step notch filter is not adjusted automatically with utility function.</td> </tr> <tr> <td>1</td> <td>2nd step notch filter is adjusted automatically with utility function.</td> </tr> </table> <p>Reserved (Do not change.)</p> |  |                     |                     |              |                |                         | 0     | 1st step notch filter is not adjusted automatically with utility function. | 1 | 1st step notch filter is adjusted automatically with utility function. | 0 | 2nd step notch filter is not adjusted automatically with utility function. | 1 | 2nd step notch filter is adjusted automatically with utility function. |
|               | 0  | 1st step notch filter is not adjusted automatically with utility function. |                     |                     |              |                |                         |       |  |   |  |   |  |   |  |
|               | 1  | 1st step notch filter is adjusted automatically with utility function.     |                     |                     |              |                |                         |       |  |   |  |   |  |   |  |
|               | 0  | 2nd step notch filter is not adjusted automatically with utility function. |                     |                     |              |                |                         |       |  |   |  |   |  |   |  |
|               | 1  | 2nd step notch filter is adjusted automatically with utility function.     |                     |                     |              |                |                         |       |  |   |  |   |  |   |  |
|               | <b>Pn501</b>   | Reserved Parameter (Do not change.)  | –                   | –                   | 10           | –              | –                       | –     |  |   |  |   |  |   |  |
|               | <b>Pn502</b>   | Rotation Detection Level   | 1 to 10000          | 1 min <sup>-1</sup> | 20           | Immediately    | Setup                   | –     |  |   |  |   |  |   |  |
|               | <b>Pn503</b>   | Speed Coincidence Signal Output Width                                      | 0 to 100            | 1 min <sup>-1</sup> | 10           | Immediately    | Setup                   | –     |  |   |  |   |  |   |  |
|               | <b>Pn506</b>   | Brake Reference - Servo OFF Delay Time                                     | 0 to 50             | 10 ms               | 0            | Immediately    | Setup                   | 4.2.7 |  |   |  |   |  |   |  |
| <b>Pn507</b>  | Brake Reference Output Speed Level   | 0 to 10000   | 1 min <sup>-1</sup> | 100                 | Immediately  | Setup          |                         |       |  |   |  |   |  |   |  |
| <b>Pn508</b>  | Waiting Time for Brake Signal When Motor Running   | 10 to 100  | 10 ms               | 50                  | Immediately  | Setup          |                         |       |  |   |  |   |  |   |  |
| <b>Pn509</b>  | Instantaneous Power Cut Hold time  | 20 to 1000   | 1 ms                | 20                  | Immediately  | Setup          | 4.2.9                   |       |  |   |  |   |  |   |  |

| Parameter No. | Name  | Setting Range | Units   | Factory Setting   | When Enabled  | Classification | Reference Section |  |
|---------------|---|---------------|---|---|---------------|----------------|-------------------|--|
| <b>Pn50A</b>  | Input Signal Selection 1  | 0000 to FFF1  | –   | 1881  | After restart | Setup          | –                 |  |
|               | <div style="display: flex; align-items: center;"> <div style="margin-right: 10px;">n.</div> <div style="display: flex; flex-direction: column; gap: 5px;"> <div style="display: flex; align-items: center;"> <div style="width: 15px; height: 15px; border: 1px solid black; margin-right: 5px;"></div> <div style="font-size: 8px;">4th digit</div> </div> <div style="width: 15px; height: 15px; border: 1px solid black; margin-right: 5px;"></div> <div style="font-size: 8px;">3rd digit</div> </div> <div style="display: flex; flex-direction: column; gap: 5px;"> <div style="width: 15px; height: 15px; border: 1px solid black; margin-right: 5px;"></div> <div style="font-size: 8px;">2nd digit</div> </div> <div style="display: flex; flex-direction: column; gap: 5px;"> <div style="width: 15px; height: 15px; border: 1px solid black; margin-right: 5px;"></div> <div style="font-size: 8px;">1st digit</div> </div> </div> |               |   |   |               |                |                   |  |
|               | Reserved (Do not change.)   |               |   |   |               |                |                   |  |
|               | Reserved (Do not change.)   |               |   |   |               |                |                   |  |
|               | Reserved (Do not change.)   |               |   |   |               |                |                   |  |
|               | P-OT Signal Mapping   |               |   |   |               |                | (Refer to 4.2.3)  |  |
|               |   |               | 0   | Forward run allowed when CN1-13 input signal is ON (L-level)  |               |                |                   |  |
|               |   |               | 1   | Forward run allowed when CN1-7 input signal is ON (L-level)   |               |                |                   |  |
|               |   |               | 2   | Forward run allowed when CN1-8 input signal is ON (L-level)   |               |                |                   |  |
|               |   |               | 3   | Forward run allowed when CN1-9 input signal is ON (L-level)   |               |                |                   |  |
|               |   |               | 4   | Forward run allowed when CN1-10 input signal is ON (L-level)  |               |                |                   |  |
|               |   |               | 5   | Forward run allowed when CN1-11 input signal is ON (L-level)  |               |                |                   |  |
|               |   |               | 6   | Forward run allowed when CN1-12 input signal is ON (L-level)  |               |                |                   |  |
|               |   |               | 7   | Forward run prohibited  |               |                |                   |  |
|               |   |               | 8   | Forward run allowed   |               |                |                   |  |
|               |   |               | 9   | Forward run allowed when CN1-13 input signal is OFF (H-level) |               |                |                   |  |
|               |   |               | A   | Forward run allowed when CN1-7 input signal is OFF (H-level)  |               |                |                   |  |
|               |   |               | B   | Forward run allowed when CN1-8 input signal is OFF (H-level)  |               |                |                   |  |
|               |   |               | C   | Forward run allowed when CN1-9 input signal is OFF (H-level)  |               |                |                   |  |
|               |   |               | D   | Forward run allowed when CN1-10 input signal is OFF (H-level) |               |                |                   |  |
|               |   |               | E   | Forward run allowed when CN1-11 input signal is OFF (H-level) |               |                |                   |  |
|               |   | F             | Forward run allowed when CN1-12 input signal is OFF (H-level) |   |               |                |                   |  |

| Parameter No.        | Name  | Setting Range  | Units  | Factory Setting | When Enabled  | Classification | Reference Section |                      |                     |        |   |   |   |   |  |   |  |   |   |   |   |   |   |   |   |   |                         |   |   |   |  |   |   |   |   |   |   |   |  |   |  |   |  |
|----------------------|---|--|--|-----------------|---------------|----------------|-------------------|----------------------|---------------------|--------|---|---|---|---|--|---|--|---|---|---|---|---|---|---|---|---|-------------------------|---|---|---|--|---|---|---|---|---|---|---|--|---|--|---|--|
| Pn50B                | Input Signal Selection 2  | 0000 to FFFF   | –  | 8882            | After restart | Setup          | –                 |                      |                     |        |   |   |   |   |  |   |  |   |   |   |   |   |   |   |   |   |                         |   |   |   |  |   |   |   |   |   |   |   |  |   |  |   |  |
|                      | <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;"> <p>4th digit</p> <input type="checkbox"/> </div> <div style="text-align: center;"> <p>3rd digit</p> <input type="checkbox"/> </div> <div style="text-align: center;"> <p>2nd digit</p> <input type="checkbox"/> </div> <div style="text-align: center;"> <p>1st digit</p> <input type="checkbox"/> </div> </div> <p>n.</p> |  |  |                 |               |                |                   |                      |                     |        |   |   |   |   |  |   |  |   |   |   |   |   |   |   |   |   |                         |   |   |   |  |   |   |   |   |   |   |   |  |   |  |   |  |
|                      |   |  | <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th colspan="2" style="background-color: #cccccc;">N-OT Signal Mapping</th> <th style="text-align: right;">(Refer to 4.2.3)</th> </tr> </thead> <tbody> <tr><td>0</td><td>Reverse run allowed when CN1-13 input signal is ON (L-level).</td></tr> <tr><td>1</td><td>Reverse run allowed when CN1-7 input signal is ON (L-level).</td></tr> <tr><td>2</td><td>Reverse run allowed when CN1-8 input signal is ON (L-level).</td></tr> <tr><td>3</td><td>Reverse run allowed when CN1-9 input signal is ON (L-level) .</td></tr> <tr><td>4</td><td>Reverse run allowed when CN1-10 input signal is ON (L-level).</td></tr> <tr><td>5</td><td>Reverse run allowed when CN1-11 input signal is ON (L-level).</td></tr> <tr><td>6</td><td>Reverse run allowed when CN1-12 input signal is ON (L-level).</td></tr> <tr><td>7</td><td>Reverse run prohibited.</td></tr> <tr><td>8</td><td>Reverse run allowed.</td></tr> <tr><td>9</td><td>Reverse run allowed when CN1-13 input signal is OFF (H-level).</td></tr> <tr><td>A</td><td>Reverse run allowed when CN1-7 input signal is OFF (H-level).</td></tr> <tr><td>B</td><td>Reverse run allowed when CN1-8 input signal is OFF (H-level).</td></tr> <tr><td>C</td><td>Reverse run allowed when CN1-9 input signal is OFF (H-level).</td></tr> <tr><td>D</td><td>Reverse run allowed when CN1-10 input signal is OFF (H-level).</td></tr> <tr><td>E</td><td>Reverse run allowed when CN1-11 input signal is OFF (H-level).</td></tr> <tr><td>F</td><td>Reverse run allowed when CN1-12 input signal is OFF (H-level).</td></tr> </tbody> </table> |                 |               |                |                   |                      | N-OT Signal Mapping |        | (Refer to 4.2.3)                            | 0 | Reverse run allowed when CN1-13 input signal is ON (L-level). | 1 | Reverse run allowed when CN1-7 input signal is ON (L-level). | 2 | Reverse run allowed when CN1-8 input signal is ON (L-level). | 3 | Reverse run allowed when CN1-9 input signal is ON (L-level) . | 4 | Reverse run allowed when CN1-10 input signal is ON (L-level). | 5 | Reverse run allowed when CN1-11 input signal is ON (L-level). | 6 | Reverse run allowed when CN1-12 input signal is ON (L-level). | 7 | Reverse run prohibited. | 8 | Reverse run allowed.                          | 9 | Reverse run allowed when CN1-13 input signal is OFF (H-level). | A | Reverse run allowed when CN1-7 input signal is OFF (H-level). | B | Reverse run allowed when CN1-8 input signal is OFF (H-level). | C | Reverse run allowed when CN1-9 input signal is OFF (H-level). | D | Reverse run allowed when CN1-10 input signal is OFF (H-level). | E | Reverse run allowed when CN1-11 input signal is OFF (H-level). | F | Reverse run allowed when CN1-12 input signal is OFF (H-level). |
|                      | N-OT Signal Mapping   |  | (Refer to 4.2.3)   |                 |               |                |                   |                      |                     |        |   |   |   |   |  |   |  |   |   |   |   |   |   |   |   |   |                         |   |   |   |  |   |   |   |   |   |   |   |  |   |  |   |  |
|                      | 0   | Reverse run allowed when CN1-13 input signal is ON (L-level).  |  |                 |               |                |                   |                      |                     |        |   |   |   |   |  |   |  |   |   |   |   |   |   |   |   |   |                         |   |   |   |  |   |   |   |   |   |   |   |  |   |  |   |  |
|                      | 1   | Reverse run allowed when CN1-7 input signal is ON (L-level).   |  |                 |               |                |                   |                      |                     |        |   |   |   |   |  |   |  |   |   |   |   |   |   |   |   |   |                         |   |   |   |  |   |   |   |   |   |   |   |  |   |  |   |  |
|                      | 2   | Reverse run allowed when CN1-8 input signal is ON (L-level).   |  |                 |               |                |                   |                      |                     |        |   |   |   |   |  |   |  |   |   |   |   |   |   |   |   |   |                         |   |   |   |  |   |   |   |   |   |   |   |  |   |  |   |  |
|                      | 3   | Reverse run allowed when CN1-9 input signal is ON (L-level) .  |  |                 |               |                |                   |                      |                     |        |   |   |   |   |  |   |  |   |   |   |   |   |   |   |   |   |                         |   |   |   |  |   |   |   |   |   |   |   |  |   |  |   |  |
|                      | 4   | Reverse run allowed when CN1-10 input signal is ON (L-level).  |  |                 |               |                |                   |                      |                     |        |   |   |   |   |  |   |  |   |   |   |   |   |   |   |   |   |                         |   |   |   |  |   |   |   |   |   |   |   |  |   |  |   |  |
|                      | 5   | Reverse run allowed when CN1-11 input signal is ON (L-level).  |  |                 |               |                |                   |                      |                     |        |   |   |   |   |  |   |  |   |   |   |   |   |   |   |   |   |                         |   |   |   |  |   |   |   |   |   |   |   |  |   |  |   |  |
| 6                    | Reverse run allowed when CN1-12 input signal is ON (L-level).   |  |  |                 |               |                |                   |                      |                     |        |   |   |   |   |  |   |  |   |   |   |   |   |   |   |   |   |                         |   |   |   |  |   |   |   |   |   |   |   |  |   |  |   |  |
| 7                    | Reverse run prohibited.   |  |  |                 |               |                |                   |                      |                     |        |   |   |   |   |  |   |  |   |   |   |   |   |   |   |   |   |                         |   |   |   |  |   |   |   |   |   |   |   |  |   |  |   |  |
| 8                    | Reverse run allowed.  |  |  |                 |               |                |                   |                      |                     |        |   |   |   |   |  |   |  |   |   |   |   |   |   |   |   |   |                         |   |   |   |  |   |   |   |   |   |   |   |  |   |  |   |  |
| 9                    | Reverse run allowed when CN1-13 input signal is OFF (H-level).  |  |  |                 |               |                |                   |                      |                     |        |   |   |   |   |  |   |  |   |   |   |   |   |   |   |   |   |                         |   |   |   |  |   |   |   |   |   |   |   |  |   |  |   |  |
| A                    | Reverse run allowed when CN1-7 input signal is OFF (H-level).   |  |  |                 |               |                |                   |                      |                     |        |   |   |   |   |  |   |  |   |   |   |   |   |   |   |   |   |                         |   |   |   |  |   |   |   |   |   |   |   |  |   |  |   |  |
| B                    | Reverse run allowed when CN1-8 input signal is OFF (H-level).   |  |  |                 |               |                |                   |                      |                     |        |   |   |   |   |  |   |  |   |   |   |   |   |   |   |   |   |                         |   |   |   |  |   |   |   |   |   |   |   |  |   |  |   |  |
| C                    | Reverse run allowed when CN1-9 input signal is OFF (H-level).   |  |  |                 |               |                |                   |                      |                     |        |   |   |   |   |  |   |  |   |   |   |   |   |   |   |   |   |                         |   |   |   |  |   |   |   |   |   |   |   |  |   |  |   |  |
| D                    | Reverse run allowed when CN1-10 input signal is OFF (H-level).  |  |  |                 |               |                |                   |                      |                     |        |   |   |   |   |  |   |  |   |   |   |   |   |   |   |   |   |                         |   |   |   |  |   |   |   |   |   |   |   |  |   |  |   |  |
| E                    | Reverse run allowed when CN1-11 input signal is OFF (H-level).  |  |  |                 |               |                |                   |                      |                     |        |   |   |   |   |  |   |  |   |   |   |   |   |   |   |   |   |                         |   |   |   |  |   |   |   |   |   |   |   |  |   |  |   |  |
| F                    | Reverse run allowed when CN1-12 input signal is OFF (H-level).  |  |  |                 |               |                |                   |                      |                     |        |   |   |   |   |  |   |  |   |   |   |   |   |   |   |   |   |                         |   |   |   |  |   |   |   |   |   |   |   |  |   |  |   |  |
|                      |   | Reserved (Do not change.)  |  |                 |               |                |                   |                      |                     |        |   |   |   |   |  |   |  |   |   |   |   |   |   |   |   |   |                         |   |   |   |  |   |   |   |   |   |   |   |  |   |  |   |  |
|                      |   | <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th colspan="2" style="background-color: #cccccc;">/P-CL Signal Mapping</th> </tr> </thead> <tbody> <tr><td>0</td><td>ON when CN1-13 input signal is ON (L-level)</td></tr> <tr><td>1</td><td>ON when CN1-7 input signal is ON (L-level)</td></tr> <tr><td>2</td><td>ON when CN1-8 input signal is ON (L-level)</td></tr> <tr><td>3</td><td>ON when CN1-9 input signal is ON (L-level)</td></tr> <tr><td>4</td><td>ON when CN1-10 input signal is ON (L-level)</td></tr> <tr><td>5</td><td>ON when CN1-11 input signal is ON (L-level)</td></tr> <tr><td>6</td><td>ON when CN1-12 input signal is ON (L-level)</td></tr> <tr><td>7</td><td>Sets signal ON.</td></tr> <tr><td>8</td><td>Sets signal OFF.</td></tr> <tr><td>9</td><td>OFF when CN1-13 input signal is OFF (H-level)</td></tr> <tr><td>A</td><td>OFF when CN1-7 input signal is OFF (H-level)</td></tr> <tr><td>B</td><td>OFF when CN1-8 input signal is OFF (H-level)</td></tr> <tr><td>C</td><td>OFF when CN1-9 input signal is OFF (H-level)</td></tr> <tr><td>D</td><td>OFF when CN1-10 input signal is OFF (H-level)</td></tr> <tr><td>E</td><td>OFF when CN1-11 input signal is OFF (H-level)</td></tr> <tr><td>F</td><td>OFF when CN1-12 input signal is OFF (H-level)</td></tr> </tbody> </table> |  |                 |               |                |                   | /P-CL Signal Mapping |                     | 0      | ON when CN1-13 input signal is ON (L-level) | 1 | ON when CN1-7 input signal is ON (L-level)                    | 2 | ON when CN1-8 input signal is ON (L-level)                   | 3 | ON when CN1-9 input signal is ON (L-level)                   | 4 | ON when CN1-10 input signal is ON (L-level)                   | 5 | ON when CN1-11 input signal is ON (L-level)                   | 6 | ON when CN1-12 input signal is ON (L-level)                   | 7 | Sets signal ON.   | 8 | Sets signal OFF.        | 9 | OFF when CN1-13 input signal is OFF (H-level) | A | OFF when CN1-7 input signal is OFF (H-level)                   | B | OFF when CN1-8 input signal is OFF (H-level)                  | C | OFF when CN1-9 input signal is OFF (H-level)                  | D | OFF when CN1-10 input signal is OFF (H-level)                 | E | OFF when CN1-11 input signal is OFF (H-level)                  | F | OFF when CN1-12 input signal is OFF (H-level)                  |   |  |
| /P-CL Signal Mapping |   |  |  |                 |               |                |                   |                      |                     |        |   |   |   |   |  |   |  |   |   |   |   |   |   |   |   |   |                         |   |   |   |  |   |   |   |   |   |   |   |  |   |  |   |  |
| 0                    | ON when CN1-13 input signal is ON (L-level)   |  |  |                 |               |                |                   |                      |                     |        |   |   |   |   |  |   |  |   |   |   |   |   |   |   |   |   |                         |   |   |   |  |   |   |   |   |   |   |   |  |   |  |   |  |
| 1                    | ON when CN1-7 input signal is ON (L-level)  |  |  |                 |               |                |                   |                      |                     |        |   |   |   |   |  |   |  |   |   |   |   |   |   |   |   |   |                         |   |   |   |  |   |   |   |   |   |   |   |  |   |  |   |  |
| 2                    | ON when CN1-8 input signal is ON (L-level)  |  |  |                 |               |                |                   |                      |                     |        |   |   |   |   |  |   |  |   |   |   |   |   |   |   |   |   |                         |   |   |   |  |   |   |   |   |   |   |   |  |   |  |   |  |
| 3                    | ON when CN1-9 input signal is ON (L-level)  |  |  |                 |               |                |                   |                      |                     |        |   |   |   |   |  |   |  |   |   |   |   |   |   |   |   |   |                         |   |   |   |  |   |   |   |   |   |   |   |  |   |  |   |  |
| 4                    | ON when CN1-10 input signal is ON (L-level)   |  |  |                 |               |                |                   |                      |                     |        |   |   |   |   |  |   |  |   |   |   |   |   |   |   |   |   |                         |   |   |   |  |   |   |   |   |   |   |   |  |   |  |   |  |
| 5                    | ON when CN1-11 input signal is ON (L-level)   |  |  |                 |               |                |                   |                      |                     |        |   |   |   |   |  |   |  |   |   |   |   |   |   |   |   |   |                         |   |   |   |  |   |   |   |   |   |   |   |  |   |  |   |  |
| 6                    | ON when CN1-12 input signal is ON (L-level)   |  |  |                 |               |                |                   |                      |                     |        |   |   |   |   |  |   |  |   |   |   |   |   |   |   |   |   |                         |   |   |   |  |   |   |   |   |   |   |   |  |   |  |   |  |
| 7                    | Sets signal ON.   |  |  |                 |               |                |                   |                      |                     |        |   |   |   |   |  |   |  |   |   |   |   |   |   |   |   |   |                         |   |   |   |  |   |   |   |   |   |   |   |  |   |  |   |  |
| 8                    | Sets signal OFF.  |  |  |                 |               |                |                   |                      |                     |        |   |   |   |   |  |   |  |   |   |   |   |   |   |   |   |   |                         |   |   |   |  |   |   |   |   |   |   |   |  |   |  |   |  |
| 9                    | OFF when CN1-13 input signal is OFF (H-level)   |  |  |                 |               |                |                   |                      |                     |        |   |   |   |   |  |   |  |   |   |   |   |   |   |   |   |   |                         |   |   |   |  |   |   |   |   |   |   |   |  |   |  |   |  |
| A                    | OFF when CN1-7 input signal is OFF (H-level)  |  |  |                 |               |                |                   |                      |                     |        |   |   |   |   |  |   |  |   |   |   |   |   |   |   |   |   |                         |   |   |   |  |   |   |   |   |   |   |   |  |   |  |   |  |
| B                    | OFF when CN1-8 input signal is OFF (H-level)  |  |  |                 |               |                |                   |                      |                     |        |   |   |   |   |  |   |  |   |   |   |   |   |   |   |   |   |                         |   |   |   |  |   |   |   |   |   |   |   |  |   |  |   |  |
| C                    | OFF when CN1-9 input signal is OFF (H-level)  |  |  |                 |               |                |                   |                      |                     |        |   |   |   |   |  |   |  |   |   |   |   |   |   |   |   |   |                         |   |   |   |  |   |   |   |   |   |   |   |  |   |  |   |  |
| D                    | OFF when CN1-10 input signal is OFF (H-level)   |  |  |                 |               |                |                   |                      |                     |        |   |   |   |   |  |   |  |   |   |   |   |   |   |   |   |   |                         |   |   |   |  |   |   |   |   |   |   |   |  |   |  |   |  |
| E                    | OFF when CN1-11 input signal is OFF (H-level)   |  |  |                 |               |                |                   |                      |                     |        |   |   |   |   |  |   |  |   |   |   |   |   |   |   |   |   |                         |   |   |   |  |   |   |   |   |   |   |   |  |   |  |   |  |
| F                    | OFF when CN1-12 input signal is OFF (H-level)   |  |  |                 |               |                |                   |                      |                     |        |   |   |   |   |  |   |  |   |   |   |   |   |   |   |   |   |                         |   |   |   |  |   |   |   |   |   |   |   |  |   |  |   |  |
|                      |   | <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th colspan="2" style="background-color: #cccccc;">/N-CL Signal Mapping</th> </tr> </thead> <tbody> <tr> <td>0 to F</td> <td>Same as /P-CL signal mapping</td> </tr> </tbody> </table>   |  |                 |               |                |                   | /N-CL Signal Mapping |                     | 0 to F | Same as /P-CL signal mapping                |   |   |   |  |   |  |   |   |   |   |   |   |   |   |   |                         |   |   |   |  |   |   |   |   |   |   |   |  |   |  |   |  |
| /N-CL Signal Mapping |   |  |  |                 |               |                |                   |                      |                     |        |   |   |   |   |  |   |  |   |   |   |   |   |   |   |   |   |                         |   |   |   |  |   |   |   |   |   |   |   |  |   |  |   |  |
| 0 to F               | Same as /P-CL signal mapping  |  |  |                 |               |                |                   |                      |                     |        |   |   |   |   |  |   |  |   |   |   |   |   |   |   |   |   |                         |   |   |   |  |   |   |   |   |   |   |   |  |   |  |   |  |



| Parameter No. | Name  | Setting Range   | Units  | Factory Setting                                     | When Enabled  | Classification                           | Reference Section |       |
|---------------|---|---|--|---|---|--|-------------------|-------|
| Pn50E         | Output Signal Selection 1   | 0000 to 3333  | –  | 0000  | After restart                                       | Setup                                    | 3.3.2             |       |
|               | n. <input type="checkbox"/> 4th digit<br><input type="checkbox"/> 3rd digit<br><input type="checkbox"/> 2nd digit<br><input type="checkbox"/> 1st digit | Positioning Completion Signal Mapping (/COIN)   |  | 0   | Disabled (the above signal is not used.)            |  |                   |       |
|               |   |   |  | 1   | Outputs the signal from CN1-1, 2 output terminal.   |  |                   |       |
|               |   |   |  | 2   | Outputs the signal from CN1-23, 24 output terminal. |  |                   |       |
|               |   |   |  | 3   | Outputs the signal from CN1-25, 26 output terminal. |  |                   |       |
|               |   |   | Speed Coincidence Detection Signal Mapping (/V-CMP)  |   | 0 to 3  | Same as /COIN                            |                   |       |
|               |   |   | Servomotor Rotation Detection Signal Mapping (/TGON) |   | 0 to 3  | Same as /COIN                            |                   |       |
|               |   |   | Servo Ready Signal Mapping (/S-RDY)                  |   | 0 to 3  | Same as /COIN                            |                   |       |
|               | Pn50F   | Output Signal Selection 2   | 0000 to 3333   | –   | 0100  | After restart                            | Setup             | 3.3.2 |
|               |   | n. <input type="checkbox"/> 4th digit<br><input type="checkbox"/> 3rd digit<br><input type="checkbox"/> 2nd digit<br><input type="checkbox"/> 1st digit | Torque Limit Detection Signal Mapping (/CLT)         |   | 0   | Disabled (the above signal is not used.) |                   |       |
|               |   |   | 1  | Outputs the signal from CN1-1, 2 output terminal.   |   |  |                   |       |
|               |   |   | 2  | Outputs the signal from CN1-23, 24 output terminal. |   |  |                   |       |
|               |   |   | 3  | Outputs the signal from CN1-25, 26 output terminal. |   |  |                   |       |
|               |   | Speed Limit Detection Signal Mapping (/VLT)   |  | 0 to 3  | Same as /CLT  |  |                   |       |
|               |   | Brake Signal Mapping (/BK)  |  | 0 to 3  | Same as /CLT  |  | (Refer to 4.2.7)  |       |
|               |   | Warning Signal Mapping (/WARN)  |  | 0 to 3  | Same as /CLT  |  |                   |       |

| Parameter No. | Name  | Setting Range                                 | Units | Factory Setting | When Enabled  | Classification | Reference Section |   |  |   |   |   |   |   |   |
|---------------|---|---|-------|-----------------|---------------|----------------|-------------------|---|--|---|---|---|---|---|---|
| <b>Pn510</b>  | Output Signal Selection 3   | 0000 to 0033                                  | –     | 0000            | After restart | Setup          | –                 |   |  |   |   |   |   |   |   |
|               | <div style="display: flex; align-items: flex-start;"> <div style="margin-right: 20px;"> <p>4th digit</p><input type="checkbox"/></div> <div style="margin-right: 20px;"> <p>3rd digit</p><input type="checkbox"/></div> <div style="margin-right: 20px;"> <p>2nd digit</p><input type="checkbox"/></div> <div style="margin-right: 20px;"> <p>1st digit</p><input type="checkbox"/></div> </div> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p><b>Near Signal Mapping (/NEAR)</b></p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 30px; text-align: center;">0</td> <td>Disabled (the above signal is not used.)</td> </tr> <tr> <td style="text-align: center;">1</td> <td>Outputs the signal from CN1-1, -2 terminal.</td> </tr> <tr> <td style="text-align: center;">2</td> <td>Outputs the signal from CN1-23, -24 terminal.</td> </tr> <tr> <td style="text-align: center;">3</td> <td>Outputs the signal from CN1-25, -26 terminal.</td> </tr> </table> <p>Reserved (Do not change.)</p> <p>Reserved (Do not change.)</p> <p>Reserved (Do not change.)</p> </div> |   |       |                 |               |                |                   | 0 | Disabled (the above signal is not used.) | 1 | Outputs the signal from CN1-1, -2 terminal. | 2 | Outputs the signal from CN1-23, -24 terminal. | 3 | Outputs the signal from CN1-25, -26 terminal. |
|               | 0   | Disabled (the above signal is not used.)      |       |                 |               |                |                   |   |  |   |   |   |   |   |   |
|               | 1   | Outputs the signal from CN1-1, -2 terminal.   |       |                 |               |                |                   |   |  |   |   |   |   |   |   |
|               | 2   | Outputs the signal from CN1-23, -24 terminal. |       |                 |               |                |                   |   |  |   |   |   |   |   |   |
| 3             | Outputs the signal from CN1-25, -26 terminal.   |   |       |                 |               |                |                   |   |  |   |   |   |   |   |   |

| Parameter No.  | Name  | Setting Range                                 | Units | Factory Setting | When Enabled  | Classification | Reference Section |   |   |        |   |   |   |  |   |  |                 |  |                  |   |   |   |   |   |   |                  |                  |                  |   |   |   |  |   |  |   |  |   |   |   |   |   |   |
|--|---|---|-------|-----------------|---------------|----------------|-------------------|---|---|--------|---|---|---|--|---|--|-----------------|--|------------------|---|---|---|---|---|---|------------------|------------------|------------------|---|---|---|--|---|--|---|--|---|---|---|---|---|---|
| <b>Pn511</b>   | Input Signal Selection 5  | 0000 to FFFF                                  | –     | 6543            | After restart | Setup          | –                 |   |   |        |   |   |   |  |   |  |                 |  |                  |   |   |   |   |   |   |                  |                  |                  |   |   |   |  |   |  |   |  |   |   |   |   |   |   |
|  | <div style="display: flex; align-items: center;"> <div style="margin-right: 10px;">n.</div> <div style="display: flex; gap: 10px;"> <div style="text-align: center;">4th digit<br/><input type="checkbox"/></div> <div style="text-align: center;">3rd digit<br/><input type="checkbox"/></div> <div style="text-align: center;">2nd digit<br/><input type="checkbox"/></div> <div style="text-align: center;">1st digit<br/><input type="checkbox"/></div> </div> </div>   |   |       |                 |               |                |                   |   |   |        |   |   |   |  |   |  |                 |  |                  |   |   |   |   |   |   |                  |                  |                  |   |   |   |  |   |  |   |  |   |   |   |   |   |   |
|  | <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th colspan="2" style="background-color: #cccccc;">Input Signal 3 Mapping for Command Option Module (/SI3)</th> </tr> </thead> <tbody> <tr><td style="text-align: center;">0</td><td>Inputs the signal from CN1-13 input terminal.</td></tr> <tr><td style="text-align: center;">1</td><td>Inputs the signal from CN1-7 input terminal.</td></tr> <tr><td style="text-align: center;">2</td><td>Inputs the signal from CN1-8 input terminal.</td></tr> <tr><td style="text-align: center;">3</td><td>Inputs the signal from CN1-9 input terminal.</td></tr> <tr><td style="text-align: center;">4</td><td>Inputs the signal from CN1-10 input terminal.</td></tr> <tr><td style="text-align: center;">5</td><td>Inputs the signal from CN1-11 input terminal.</td></tr> <tr><td style="text-align: center;">6</td><td>Inputs the signal from CN1-12 input terminal.</td></tr> <tr><td style="text-align: center;">7</td><td>Sets signal ON.</td></tr> <tr><td style="text-align: center;">8</td><td>Sets signal OFF.</td></tr> <tr><td style="text-align: center;">9</td><td>Inputs the reverse signal from CN1-13 input terminal.</td></tr> <tr><td style="text-align: center;">A</td><td>Inputs the reverse signal from CN1-7 input terminal.</td></tr> <tr><td style="text-align: center;">B</td><td>Inputs the reverse signal from CN1-8 input terminal.</td></tr> <tr><td style="text-align: center;">C</td><td>Inputs the reverse signal from CN1-9 input terminal.</td></tr> <tr><td style="text-align: center;">D</td><td>Inputs the reverse signal from CN1-10 input terminal.</td></tr> <tr><td style="text-align: center;">E</td><td>Inputs the reverse signal from CN1-11 input terminal.</td></tr> <tr><td style="text-align: center;">F</td><td>Inputs the reverse signal from CN1-12 input terminal.</td></tr> </tbody> </table> |   |       |                 |               |                |                   |   | Input Signal 3 Mapping for Command Option Module (/SI3) |        | 0   | Inputs the signal from CN1-13 input terminal. | 1   | Inputs the signal from CN1-7 input terminal. | 2   | Inputs the signal from CN1-8 input terminal. | 3               | Inputs the signal from CN1-9 input terminal. | 4                | Inputs the signal from CN1-10 input terminal. | 5   | Inputs the signal from CN1-11 input terminal. | 6   | Inputs the signal from CN1-12 input terminal. | 7   | Sets signal ON.  | 8                | Sets signal OFF. | 9 | Inputs the reverse signal from CN1-13 input terminal. | A | Inputs the reverse signal from CN1-7 input terminal. | B | Inputs the reverse signal from CN1-8 input terminal. | C | Inputs the reverse signal from CN1-9 input terminal. | D | Inputs the reverse signal from CN1-10 input terminal. | E | Inputs the reverse signal from CN1-11 input terminal. | F | Inputs the reverse signal from CN1-12 input terminal. |
|  | Input Signal 3 Mapping for Command Option Module (/SI3)   |   |       |                 |               |                |                   |   |   |        |   |   |   |  |   |  |                 |  |                  |   |   |   |   |   |   |                  |                  |                  |   |   |   |  |   |  |   |  |   |   |   |   |   |   |
|  | 0   | Inputs the signal from CN1-13 input terminal. |       |                 |               |                |                   |   |   |        |   |   |   |  |   |  |                 |  |                  |   |   |   |   |   |   |                  |                  |                  |   |   |   |  |   |  |   |  |   |   |   |   |   |   |
|  | 1   | Inputs the signal from CN1-7 input terminal.  |       |                 |               |                |                   |   |   |        |   |   |   |  |   |  |                 |  |                  |   |   |   |   |   |   |                  |                  |                  |   |   |   |  |   |  |   |  |   |   |   |   |   |   |
|  | 2   | Inputs the signal from CN1-8 input terminal.  |       |                 |               |                |                   |   |   |        |   |   |   |  |   |  |                 |  |                  |   |   |   |   |   |   |                  |                  |                  |   |   |   |  |   |  |   |  |   |   |   |   |   |   |
|  | 3   | Inputs the signal from CN1-9 input terminal.  |       |                 |               |                |                   |   |   |        |   |   |   |  |   |  |                 |  |                  |   |   |   |   |   |   |                  |                  |                  |   |   |   |  |   |  |   |  |   |   |   |   |   |   |
|  | 4   | Inputs the signal from CN1-10 input terminal. |       |                 |               |                |                   |   |   |        |   |   |   |  |   |  |                 |  |                  |   |   |   |   |   |   |                  |                  |                  |   |   |   |  |   |  |   |  |   |   |   |   |   |   |
|  | 5   | Inputs the signal from CN1-11 input terminal. |       |                 |               |                |                   |   |   |        |   |   |   |  |   |  |                 |  |                  |   |   |   |   |   |   |                  |                  |                  |   |   |   |  |   |  |   |  |   |   |   |   |   |   |
| 6  | Inputs the signal from CN1-12 input terminal.   |   |       |                 |               |                |                   |   |   |        |   |   |   |  |   |  |                 |  |                  |   |   |   |   |   |   |                  |                  |                  |   |   |   |  |   |  |   |  |   |   |   |   |   |   |
| 7  | Sets signal ON.   |   |       |                 |               |                |                   |   |   |        |   |   |   |  |   |  |                 |  |                  |   |   |   |   |   |   |                  |                  |                  |   |   |   |  |   |  |   |  |   |   |   |   |   |   |
| 8  | Sets signal OFF.  |   |       |                 |               |                |                   |   |   |        |   |   |   |  |   |  |                 |  |                  |   |   |   |   |   |   |                  |                  |                  |   |   |   |  |   |  |   |  |   |   |   |   |   |   |
| 9  | Inputs the reverse signal from CN1-13 input terminal.   |   |       |                 |               |                |                   |   |   |        |   |   |   |  |   |  |                 |  |                  |   |   |   |   |   |   |                  |                  |                  |   |   |   |  |   |  |   |  |   |   |   |   |   |   |
| A  | Inputs the reverse signal from CN1-7 input terminal.  |   |       |                 |               |                |                   |   |   |        |   |   |   |  |   |  |                 |  |                  |   |   |   |   |   |   |                  |                  |                  |   |   |   |  |   |  |   |  |   |   |   |   |   |   |
| B  | Inputs the reverse signal from CN1-8 input terminal.  |   |       |                 |               |                |                   |   |   |        |   |   |   |  |   |  |                 |  |                  |   |   |   |   |   |   |                  |                  |                  |   |   |   |  |   |  |   |  |   |   |   |   |   |   |
| C  | Inputs the reverse signal from CN1-9 input terminal.  |   |       |                 |               |                |                   |   |   |        |   |   |   |  |   |  |                 |  |                  |   |   |   |   |   |   |                  |                  |                  |   |   |   |  |   |  |   |  |   |   |   |   |   |   |
| D  | Inputs the reverse signal from CN1-10 input terminal.   |   |       |                 |               |                |                   |   |   |        |   |   |   |  |   |  |                 |  |                  |   |   |   |   |   |   |                  |                  |                  |   |   |   |  |   |  |   |  |   |   |   |   |   |   |
| E  | Inputs the reverse signal from CN1-11 input terminal.   |   |       |                 |               |                |                   |   |   |        |   |   |   |  |   |  |                 |  |                  |   |   |   |   |   |   |                  |                  |                  |   |   |   |  |   |  |   |  |   |   |   |   |   |   |
| F  | Inputs the reverse signal from CN1-12 input terminal.   |   |       |                 |               |                |                   |   |   |        |   |   |   |  |   |  |                 |  |                  |   |   |   |   |   |   |                  |                  |                  |   |   |   |  |   |  |   |  |   |   |   |   |   |   |
| <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th colspan="2" style="background-color: #cccccc;">Input Signal 4 Mapping for Command Option Module (/SI4)</th> </tr> </thead> <tbody> <tr><td style="text-align: center;">4</td><td>Inputs the signal from CN1-10 input terminal.</td></tr> <tr><td style="text-align: center;">5</td><td>Inputs the signal from CN1-11 input terminal.</td></tr> <tr><td style="text-align: center;">6</td><td>Inputs the signal from CN1-12 input terminal.</td></tr> <tr><td style="text-align: center;">7</td><td>Sets signal ON.</td></tr> <tr><td style="text-align: center;">8</td><td>Sets signal OFF.</td></tr> <tr><td style="text-align: center;">D</td><td>Inputs the reverse signal from CN1-10 input terminal.</td></tr> <tr><td style="text-align: center;">E</td><td>Inputs the reverse signal from CN1-11 input terminal.</td></tr> <tr><td style="text-align: center;">F</td><td>Inputs the reverse signal from CN1-12 input terminal.</td></tr> <tr><td style="text-align: center;">0 to 3<br/>9 to F</td><td>Sets signal OFF.</td></tr> </tbody> </table> |   |   |       |                 |               |                |                   | Input Signal 4 Mapping for Command Option Module (/SI4) |   | 4      | Inputs the signal from CN1-10 input terminal. | 5   | Inputs the signal from CN1-11 input terminal. | 6  | Inputs the signal from CN1-12 input terminal. | 7  | Sets signal ON. | 8  | Sets signal OFF. | D   | Inputs the reverse signal from CN1-10 input terminal. | E   | Inputs the reverse signal from CN1-11 input terminal. | F   | Inputs the reverse signal from CN1-12 input terminal. | 0 to 3<br>9 to F | Sets signal OFF. |                  |   |   |   |  |   |  |   |  |   |   |   |   |   |   |
| Input Signal 4 Mapping for Command Option Module (/SI4)  |   |   |       |                 |               |                |                   |   |   |        |   |   |   |  |   |  |                 |  |                  |   |   |   |   |   |   |                  |                  |                  |   |   |   |  |   |  |   |  |   |   |   |   |   |   |
| 4  | Inputs the signal from CN1-10 input terminal.   |   |       |                 |               |                |                   |   |   |        |   |   |   |  |   |  |                 |  |                  |   |   |   |   |   |   |                  |                  |                  |   |   |   |  |   |  |   |  |   |   |   |   |   |   |
| 5  | Inputs the signal from CN1-11 input terminal.   |   |       |                 |               |                |                   |   |   |        |   |   |   |  |   |  |                 |  |                  |   |   |   |   |   |   |                  |                  |                  |   |   |   |  |   |  |   |  |   |   |   |   |   |   |
| 6  | Inputs the signal from CN1-12 input terminal.   |   |       |                 |               |                |                   |   |   |        |   |   |   |  |   |  |                 |  |                  |   |   |   |   |   |   |                  |                  |                  |   |   |   |  |   |  |   |  |   |   |   |   |   |   |
| 7  | Sets signal ON.   |   |       |                 |               |                |                   |   |   |        |   |   |   |  |   |  |                 |  |                  |   |   |   |   |   |   |                  |                  |                  |   |   |   |  |   |  |   |  |   |   |   |   |   |   |
| 8  | Sets signal OFF.  |   |       |                 |               |                |                   |   |   |        |   |   |   |  |   |  |                 |  |                  |   |   |   |   |   |   |                  |                  |                  |   |   |   |  |   |  |   |  |   |   |   |   |   |   |
| D  | Inputs the reverse signal from CN1-10 input terminal.   |   |       |                 |               |                |                   |   |   |        |   |   |   |  |   |  |                 |  |                  |   |   |   |   |   |   |                  |                  |                  |   |   |   |  |   |  |   |  |   |   |   |   |   |   |
| E  | Inputs the reverse signal from CN1-11 input terminal.   |   |       |                 |               |                |                   |   |   |        |   |   |   |  |   |  |                 |  |                  |   |   |   |   |   |   |                  |                  |                  |   |   |   |  |   |  |   |  |   |   |   |   |   |   |
| F  | Inputs the reverse signal from CN1-12 input terminal.   |   |       |                 |               |                |                   |   |   |        |   |   |   |  |   |  |                 |  |                  |   |   |   |   |   |   |                  |                  |                  |   |   |   |  |   |  |   |  |   |   |   |   |   |   |
| 0 to 3<br>9 to F   | Sets signal OFF.  |   |       |                 |               |                |                   |   |   |        |   |   |   |  |   |  |                 |  |                  |   |   |   |   |   |   |                  |                  |                  |   |   |   |  |   |  |   |  |   |   |   |   |   |   |
| <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th colspan="2" style="background-color: #cccccc;">Input Signal 5 Mapping for Command Option Module (/SI5)</th> </tr> </thead> <tbody> <tr><td style="text-align: center;">0 to F</td><td>Same as /SI4 signal mapping.</td></tr> </tbody> </table>   |   |   |       |                 |               |                |                   | Input Signal 5 Mapping for Command Option Module (/SI5) |   | 0 to F | Same as /SI4 signal mapping.                  |   |   |  |   |  |                 |  |                  |   |   |   |   |   |   |                  |                  |                  |   |   |   |  |   |  |   |  |   |   |   |   |   |   |
| Input Signal 5 Mapping for Command Option Module (/SI5)  |   |   |       |                 |               |                |                   |   |   |        |   |   |   |  |   |  |                 |  |                  |   |   |   |   |   |   |                  |                  |                  |   |   |   |  |   |  |   |  |   |   |   |   |   |   |
| 0 to F   | Same as /SI4 signal mapping.  |   |       |                 |               |                |                   |   |   |        |   |   |   |  |   |  |                 |  |                  |   |   |   |   |   |   |                  |                  |                  |   |   |   |  |   |  |   |  |   |   |   |   |   |   |
| <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th colspan="2" style="background-color: #cccccc;">Input Signal 6 Mapping for Command Option Module (/SI6)</th> </tr> </thead> <tbody> <tr><td style="text-align: center;">0 to F</td><td>Same as /SI4 signal mapping.</td></tr> </tbody> </table>   |   |   |       |                 |               |                |                   | Input Signal 6 Mapping for Command Option Module (/SI6) |   | 0 to F | Same as /SI4 signal mapping.                  |   |   |  |   |  |                 |  |                  |   |   |   |   |   |   |                  |                  |                  |   |   |   |  |   |  |   |  |   |   |   |   |   |   |
| Input Signal 6 Mapping for Command Option Module (/SI6)  |   |   |       |                 |               |                |                   |   |   |        |   |   |   |  |   |  |                 |  |                  |   |   |   |   |   |   |                  |                  |                  |   |   |   |  |   |  |   |  |   |   |   |   |   |   |
| 0 to F   | Same as /SI4 signal mapping.  |   |       |                 |               |                |                   |   |   |        |   |   |   |  |   |  |                 |  |                  |   |   |   |   |   |   |                  |                  |                  |   |   |   |  |   |  |   |  |   |   |   |   |   |   |

| Parameter No.             | Name  | Setting Range                  | Units               | Factory Setting | When Enabled  | Classification | Reference Section |   |  |   |                          |   |                  |   |  |   |                          |   |                  |   |  |   |                          |   |                  |                           |  |
|---------------------------|---|--------------------------------|---------------------|-----------------|---------------|----------------|-------------------|---|--|---|--------------------------|---|------------------|---|--|---|--------------------------|---|------------------|---|--|---|--------------------------|---|------------------|---------------------------|--|
| <b>Pn512</b>              | Output Signal Inverse Setting   | 0000 to 0111                   | –                   | 0000            | After restart | Setup          | 3.3.2             |   |  |   |                          |   |                  |   |  |   |                          |   |                  |   |  |   |                          |   |                  |                           |  |
|                           | <p>n. <input type="checkbox"/> 4th digit   <input type="checkbox"/> 3rd digit   <input type="checkbox"/> 2nd digit   <input type="checkbox"/> 1st digit</p> <table border="1"> <tr> <td colspan="2">Output Signal Inversion for CN1-1 or -2 Terminals</td> </tr> <tr> <td>0</td> <td>Does not invert outputs.</td> </tr> <tr> <td>1</td> <td>Inverts outputs.</td> </tr> <tr> <td colspan="2">Output Signal Inversion for CN1-23 or -24 Terminals</td> </tr> <tr> <td>0</td> <td>Does not invert outputs.</td> </tr> <tr> <td>1</td> <td>Inverts outputs.</td> </tr> <tr> <td colspan="2">Output Signal Inversion for CN1-25 or -26 Terminals</td> </tr> <tr> <td>0</td> <td>Does not invert outputs.</td> </tr> <tr> <td>1</td> <td>Inverts outputs.</td> </tr> <tr> <td colspan="2">Reserved (Do not change.)</td> </tr> </table> |                                |                     |                 |               |                |                   | Output Signal Inversion for CN1-1 or -2 Terminals |  | 0 | Does not invert outputs. | 1 | Inverts outputs. | Output Signal Inversion for CN1-23 or -24 Terminals |  | 0 | Does not invert outputs. | 1 | Inverts outputs. | Output Signal Inversion for CN1-25 or -26 Terminals |  | 0 | Does not invert outputs. | 1 | Inverts outputs. | Reserved (Do not change.) |  |
|                           | Output Signal Inversion for CN1-1 or -2 Terminals   |                                |                     |                 |               |                |                   |   |  |   |                          |   |                  |   |  |   |                          |   |                  |   |  |   |                          |   |                  |                           |  |
|                           | 0   | Does not invert outputs.       |                     |                 |               |                |                   |   |  |   |                          |   |                  |   |  |   |                          |   |                  |   |  |   |                          |   |                  |                           |  |
|                           | 1   | Inverts outputs.               |                     |                 |               |                |                   |   |  |   |                          |   |                  |   |  |   |                          |   |                  |   |  |   |                          |   |                  |                           |  |
|                           | Output Signal Inversion for CN1-23 or -24 Terminals   |                                |                     |                 |               |                |                   |   |  |   |                          |   |                  |   |  |   |                          |   |                  |   |  |   |                          |   |                  |                           |  |
|                           | 0   | Does not invert outputs.       |                     |                 |               |                |                   |   |  |   |                          |   |                  |   |  |   |                          |   |                  |   |  |   |                          |   |                  |                           |  |
|                           | 1   | Inverts outputs.               |                     |                 |               |                |                   |   |  |   |                          |   |                  |   |  |   |                          |   |                  |   |  |   |                          |   |                  |                           |  |
|                           | Output Signal Inversion for CN1-25 or -26 Terminals   |                                |                     |                 |               |                |                   |   |  |   |                          |   |                  |   |  |   |                          |   |                  |   |  |   |                          |   |                  |                           |  |
|                           | 0   | Does not invert outputs.       |                     |                 |               |                |                   |   |  |   |                          |   |                  |   |  |   |                          |   |                  |   |  |   |                          |   |                  |                           |  |
| 1                         | Inverts outputs.  |                                |                     |                 |               |                |                   |   |  |   |                          |   |                  |   |  |   |                          |   |                  |   |  |   |                          |   |                  |                           |  |
| Reserved (Do not change.) |   |                                |                     |                 |               |                |                   |   |  |   |                          |   |                  |   |  |   |                          |   |                  |   |  |   |                          |   |                  |                           |  |
| <b>Pn513</b>              | Reserved Parameter (Do not change.)   | –                              | –                   | 0000            | –             | –              | –                 |   |  |   |                          |   |                  |   |  |   |                          |   |                  |   |  |   |                          |   |                  |                           |  |
| <b>Pn51B</b>              | Excessive Error Level Between Servomotor and Load Positions   | 0 to 1073741824 ( $2^{30}$ )   | 1 reference unit    | 1000            | Immediately   | Setup          | 8.3.7             |   |  |   |                          |   |                  |   |  |   |                          |   |                  |   |  |   |                          |   |                  |                           |  |
| <b>Pn51E</b>              | Excessive Position Error Warning Level  | 10 to 100                      | 1%                  | 100             | Immediately   | Setup          | 9.2.1             |   |  |   |                          |   |                  |   |  |   |                          |   |                  |   |  |   |                          |   |                  |                           |  |
| <b>Pn520</b>              | Excessive Position Error Alarm Level  | 1 to 1073741823 ( $2^{30}-1$ ) | 1 reference unit    | 5242880         | Immediately   | Setup          | 5.1.4<br>9.1.1    |   |  |   |                          |   |                  |   |  |   |                          |   |                  |   |  |   |                          |   |                  |                           |  |
| <b>Pn522</b>              | Positioning Completed Width   | 0 to 1073741824 ( $2^{30}$ )   | 1 reference unit    | 7               | Immediately   | Setup          | –                 |   |  |   |                          |   |                  |   |  |   |                          |   |                  |   |  |   |                          |   |                  |                           |  |
| <b>Pn524</b>              | NEAR Signal Width   | 1 to 1073741824 ( $2^{30}$ )   | 1 reference unit    | 1073741824      | Immediately   | Setup          | –                 |   |  |   |                          |   |                  |   |  |   |                          |   |                  |   |  |   |                          |   |                  |                           |  |
| <b>Pn526</b>              | Excessive Position Error Alarm Level at Servo ON  | 1 to 1073741823 ( $2^{30}-1$ ) | 1 reference unit    | 5242880         | Immediately   | Setup          | 9.1.1             |   |  |   |                          |   |                  |   |  |   |                          |   |                  |   |  |   |                          |   |                  |                           |  |
| <b>Pn528</b>              | Excessive Position Error Warning Level at Servo ON  | 10 to 100                      | 1%                  | 100             | Immediately   | Setup          | 9.2.1             |   |  |   |                          |   |                  |   |  |   |                          |   |                  |   |  |   |                          |   |                  |                           |  |
| <b>Pn529</b>              | Speed Limit Level at Servo ON   | 0 to 10000                     | 1 min <sup>-1</sup> | 10000           | Immediately   | Setup          | 9.1.1             |   |  |   |                          |   |                  |   |  |   |                          |   |                  |   |  |   |                          |   |                  |                           |  |
| <b>Pn52A</b>              | Multiplier per One Fully-closed Rotation  | 0 to 100                       | 1%                  | 20              | Immediately   | Tuning         | 8.3.7             |   |  |   |                          |   |                  |   |  |   |                          |   |                  |   |  |   |                          |   |                  |                           |  |
| <b>Pn52B</b>              | Overload Warning Level  | 1 to 100                       | 1%                  | 20              | Immediately   | Setup          | 4.2.11            |   |  |   |                          |   |                  |   |  |   |                          |   |                  |   |  |   |                          |   |                  |                           |  |
| <b>Pn52C</b>              | Derating of Base Current at Detecting Overload of Motor   | 10 to 100                      | 1%                  | 100             | After restart | Setup          |                   |   |  |   |                          |   |                  |   |  |   |                          |   |                  |   |  |   |                          |   |                  |                           |  |
| <b>Pn52F</b>              | Monitor Display at Power ON   | 0000 to 0FFF                   | –                   | 0FFF            | Immediately   | Setup          | –                 |   |  |   |                          |   |                  |   |  |   |                          |   |                  |   |  |   |                          |   |                  |                           |  |

| Parameter No.             | Name   | Setting Range  | Units               | Factory Setting | When Enabled | Classification | Reference Section |                                      |  |   |   |   |  |   |  |   |  |   |   |   |   |                           |  |                           |  |                           |  |
|---------------------------|--|--|---------------------|-----------------|--------------|----------------|-------------------|--------------------------------------|--|---|---|---|--|---|--|---|--|---|---|---|---|---------------------------|--|---------------------------|--|---------------------------|--|
| <b>Pn530</b>              | Program JOG Operation Related Switch   | 0000 to 0005   | –                   | 0000            | Immediately  | Setup          | 6.5               |                                      |  |   |   |   |  |   |  |   |  |   |   |   |   |                           |  |                           |  |                           |  |
|                           | <table border="1" style="margin-left: 20px;"> <thead> <tr> <th colspan="2">Program JOG Operation Related Switch</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>(Waiting time Pn535 → Forward movement Pn531) × Number of times of movement Pn536</td> </tr> <tr> <td>1</td> <td>(Waiting time Pn535 → Reverse movement Pn531) × Number of times of movements Pn536</td> </tr> <tr> <td>2</td> <td>(Waiting time Pn535 → Forward movement Pn531) × Number of times of movements Pn536<br/>(Waiting time Pn535 → Reverse movement Pn531) × Number of times of movements Pn536</td> </tr> <tr> <td>3</td> <td>(Waiting time Pn535 → Reverse movement Pn531) × Number of times of movements Pn536<br/>(Waiting time Pn535 → Forward movement Pn531) × Number of times of movements Pn536</td> </tr> <tr> <td>4</td> <td>(Waiting time Pn535 → Forward movement Pn531 → Waiting time Pn535 → Reverse movement Pn531) × Number of times of movement Pn536</td> </tr> <tr> <td>5</td> <td>(Waiting time Pn535 → Reverse movement Pn531 → Waiting time Pn535 → Forward movement Pn531) × Number of times of movement Pn536</td> </tr> <tr> <td colspan="2">Reserved (Do not change.)</td> </tr> <tr> <td colspan="2">Reserved (Do not change.)</td> </tr> <tr> <td colspan="2">Reserved (Do not change.)</td> </tr> </tbody> </table> |  |                     |                 |              |                |                   | Program JOG Operation Related Switch |  | 0 | (Waiting time Pn535 → Forward movement Pn531) × Number of times of movement Pn536 | 1 | (Waiting time Pn535 → Reverse movement Pn531) × Number of times of movements Pn536 | 2 | (Waiting time Pn535 → Forward movement Pn531) × Number of times of movements Pn536<br>(Waiting time Pn535 → Reverse movement Pn531) × Number of times of movements Pn536 | 3 | (Waiting time Pn535 → Reverse movement Pn531) × Number of times of movements Pn536<br>(Waiting time Pn535 → Forward movement Pn531) × Number of times of movements Pn536 | 4 | (Waiting time Pn535 → Forward movement Pn531 → Waiting time Pn535 → Reverse movement Pn531) × Number of times of movement Pn536 | 5 | (Waiting time Pn535 → Reverse movement Pn531 → Waiting time Pn535 → Forward movement Pn531) × Number of times of movement Pn536 | Reserved (Do not change.) |  | Reserved (Do not change.) |  | Reserved (Do not change.) |  |
|                           | Program JOG Operation Related Switch   |  |                     |                 |              |                |                   |                                      |  |   |   |   |  |   |  |   |  |   |   |   |   |                           |  |                           |  |                           |  |
|                           | 0  | (Waiting time Pn535 → Forward movement Pn531) × Number of times of movement Pn536  |                     |                 |              |                |                   |                                      |  |   |   |   |  |   |  |   |  |   |   |   |   |                           |  |                           |  |                           |  |
|                           | 1  | (Waiting time Pn535 → Reverse movement Pn531) × Number of times of movements Pn536   |                     |                 |              |                |                   |                                      |  |   |   |   |  |   |  |   |  |   |   |   |   |                           |  |                           |  |                           |  |
|                           | 2  | (Waiting time Pn535 → Forward movement Pn531) × Number of times of movements Pn536<br>(Waiting time Pn535 → Reverse movement Pn531) × Number of times of movements Pn536 |                     |                 |              |                |                   |                                      |  |   |   |   |  |   |  |   |  |   |   |   |   |                           |  |                           |  |                           |  |
|                           | 3  | (Waiting time Pn535 → Reverse movement Pn531) × Number of times of movements Pn536<br>(Waiting time Pn535 → Forward movement Pn531) × Number of times of movements Pn536 |                     |                 |              |                |                   |                                      |  |   |   |   |  |   |  |   |  |   |   |   |   |                           |  |                           |  |                           |  |
|                           | 4  | (Waiting time Pn535 → Forward movement Pn531 → Waiting time Pn535 → Reverse movement Pn531) × Number of times of movement Pn536  |                     |                 |              |                |                   |                                      |  |   |   |   |  |   |  |   |  |   |   |   |   |                           |  |                           |  |                           |  |
|                           | 5  | (Waiting time Pn535 → Reverse movement Pn531 → Waiting time Pn535 → Forward movement Pn531) × Number of times of movement Pn536  |                     |                 |              |                |                   |                                      |  |   |   |   |  |   |  |   |  |   |   |   |   |                           |  |                           |  |                           |  |
|                           | Reserved (Do not change.)  |  |                     |                 |              |                |                   |                                      |  |   |   |   |  |   |  |   |  |   |   |   |   |                           |  |                           |  |                           |  |
| Reserved (Do not change.) |  |  |                     |                 |              |                |                   |                                      |  |   |   |   |  |   |  |   |  |   |   |   |   |                           |  |                           |  |                           |  |
| Reserved (Do not change.) |  |  |                     |                 |              |                |                   |                                      |  |   |   |   |  |   |  |   |  |   |   |   |   |                           |  |                           |  |                           |  |
| <b>Pn531</b>              | Program JOG Movement Distance  | 1 to 1073741824 (2 <sup>30</sup> )   | 1 reference unit    | 32768           | Immediately  | Setup          | 6.5               |                                      |  |   |   |   |  |   |  |   |  |   |   |   |   |                           |  |                           |  |                           |  |
| <b>Pn533</b>              | Program JOG Movement Speed   | 1 to 10000   | 1 min <sup>-1</sup> | 500             | Immediately  | Setup          |                   |                                      |  |   |   |   |  |   |  |   |  |   |   |   |   |                           |  |                           |  |                           |  |
| <b>Pn534</b>              | Program JOG Acceleration/Deceleration Time   | 2 to 10000   | 1 ms                | 100             | Immediately  | Setup          |                   |                                      |  |   |   |   |  |   |  |   |  |   |   |   |   |                           |  |                           |  |                           |  |
| <b>Pn535</b>              | Program JOG Waiting Time   | 0 to 10000   | 1 ms                | 100             | Immediately  | Setup          |                   |                                      |  |   |   |   |  |   |  |   |  |   |   |   |   |                           |  |                           |  |                           |  |
| <b>Pn536</b>              | Number of Times of Program JOG Movement  | 0 to 1000  | 1 time              | 1               | Immediately  | Setup          |                   |                                      |  |   |   |   |  |   |  |   |  |   |   |   |   |                           |  |                           |  |                           |  |
| <b>Pn550</b>              | Analog Monitor 1 Offset Voltage  | -10000 to 10000  | 0.1 V               | 0.0             | Immediately  | Setup          | 5.1.3             |                                      |  |   |   |   |  |   |  |   |  |   |   |   |   |                           |  |                           |  |                           |  |
| <b>Pn551</b>              | Analog Monitor 2 Offset Voltage  | -10000 to 10000  | 0.1 V               | 0.0             | Immediately  | Setup          |                   |                                      |  |   |   |   |  |   |  |   |  |   |   |   |   |                           |  |                           |  |                           |  |
| <b>Pn552</b>              | Analog Monitor Magnification (×1)  | -10000 to 10000  | ×0.01               | 100             | Immediately  | Setup          |                   |                                      |  |   |   |   |  |   |  |   |  |   |   |   |   |                           |  |                           |  |                           |  |
| <b>Pn553</b>              | Analog Monitor Magnification (×2)  | -10000 to 10000  | ×0.01               | 100             | Immediately  | Setup          |                   |                                      |  |   |   |   |  |   |  |   |  |   |   |   |   |                           |  |                           |  |                           |  |
| <b>Pn560</b>              | Remained Vibration Detection Width   | 1 to 3000  | 0.1%                | 400             | Immediately  | Setup          | 5.7.1             |                                      |  |   |   |   |  |   |  |   |  |   |   |   |   |                           |  |                           |  |                           |  |
| <b>Pn561</b>              | Overshoot Detection Level  | 0 to 100   | 1%                  | 100             | Immediately  | Setup          | 5.3.1<br>5.4.1    |                                      |  |   |   |   |  |   |  |   |  |   |   |   |   |                           |  |                           |  |                           |  |
| <b>Pn600</b>              | Regenerative Resistor Capacity *1  | Depends on SERVOPACK Capacity *2   | 10 W                | 0               | Immediately  | Setup          | 3.7.2             |                                      |  |   |   |   |  |   |  |   |  |   |   |   |   |                           |  |                           |  |                           |  |
| <b>Pn601</b>              | Reserved (Do not change.)  | –  | –                   | 0               | –            | –              | –                 |                                      |  |   |   |   |  |   |  |   |  |   |   |   |   |                           |  |                           |  |                           |  |
| <b>Pn800 to Pn95F *3</b>  | Reserved Parameter (Do not change.)  | –  | –                   | 0               | –            | –              | –                 |                                      |  |   |   |   |  |   |  |   |  |   |   |   |   |                           |  |                           |  |                           |  |

\*1. Normally set to “0.” When using an external regenerative resistor, set the capacity (W) of the regenerative resistor.

\*2. The upper limit is the maximum output capacity (W) of the SERVOPACK.

\*3. For details on Pn800 to Pn95F, refer to the manual of the connected command option module.

## 10.2 Monitor Modes

The following list shows monitor modes available.

| Un Number | Content of Display   | Unit                       |
|-----------|--|----------------------------|
| Un000     | Motor rotating speed   | min <sup>-1</sup>          |
| Un001     | Speed reference (for speed control)  | min <sup>-1</sup>          |
| Un002     | Internal torque reference ( in percentage to the rated torque)   | %                          |
| Un003     | Electrical angle 1   | pulse (encoder resolution) |
| Un004     | Electrical angle 2   | deg                        |
| Un005     | Input signal monitor   | –                          |
| Un006     | Output signal monitor  | –                          |
| Un007     | Reference speed (for position control)   | min <sup>-1</sup>          |
| Un008     | Position error amount (for position control)   | reference unit             |
| Un009     | Accumulated load ratio (in percentage to the rated torque: effective torque in cycle of 10 seconds)                                  | %                          |
| Un00A     | Regenerative load ratio (in percentage to the processable regenerative power: regenerative power consumption in cycle of 10 seconds) | %                          |
| Un00B     | Power consumed by DB resistance (in percentage to the processable power at DB activation: display in cycle of 10 seconds)            | %                          |
| Un00C     | Reference counter  | reference unit             |
| Un00D     | Feedback pulse counter   | pulse (encoder resolution) |
| Un00E     | Fully-closed feedback pulse counter  | pulse (encoder resolution) |
| Un012     | Total operation time   | 100 ms                     |
| Un013     | Feedback pulse counter   | reference unit             |
| Un014     | Effective gain monitor (gain setting 1 = 1, gain setting 2 = 2)  | –                          |
| Un015     | Safety I/O signal monitor  | –                          |
| Un020     | Motor rated rotational speed   | min <sup>-1</sup>          |
| Un021     | Motor maximum rotational speed   | min <sup>-1</sup>          |

## 10.3 Parameter Recording Table

Use the following table for recording parameters.

Note: Pn10B, Pn170 and Pn408 have two kinds of digits: the digit which does not need the restart after changing the settings and the digit which needs the restart. The underlined digits of the factory setting in the following table show the digit which needs the restart.

| Parameter | Factory Setting        |  |  |  |  | Name  | When Enabled  |
|-----------|------------------------|--|--|--|--|---|---------------|
| Pn000     | 0000                   |  |  |  |  | Basic Function Select Switch 0                          | After restart |
| Pn001     | 0000                   |  |  |  |  | Application Function Select Switch 1                    | After restart |
| Pn002     | 0000                   |  |  |  |  | Application Function Select Switch 2                    | After restart |
| Pn006     | 0002                   |  |  |  |  | Application Function Select Switch 6                    | Immediately   |
| Pn007     | 0000                   |  |  |  |  | Application Function Select Switch 7                    | Immediately   |
| Pn008     | 4000                   |  |  |  |  | Application Function Select Switch 8                    | After restart |
| Pn009     | 0010                   |  |  |  |  | Application Function Select Switch 9                    | After restart |
| Pn00B     | 0000                   |  |  |  |  | Application Function Select Switch B                    | After restart |
| Pn00C     | 0000                   |  |  |  |  | Application Function Select Switch C                    | After restart |
| Pn00D     | 0000                   |  |  |  |  | Application Function Select Switch D                    | After restart |
| Pn010     | 0001                   |  |  |  |  | Axis Address Selection<br>(for UART/USB communications) | After restart |
| Pn100     | 40.0 Hz                |  |  |  |  | Speed Loop Gain   | Immediately   |
| Pn101     | 20.00 ms               |  |  |  |  | Speed Loop Integral Time Constant                       | Immediately   |
| Pn102     | 40.0/s                 |  |  |  |  | Position Loop Gain                                      | Immediately   |
| Pn103     | 100 %                  |  |  |  |  | Moment of Inertia Ratio                                 | Immediately   |
| Pn104     | 40.0 Hz                |  |  |  |  | 2nd Speed Loop Gain                                     | Immediately   |
| Pn105     | 20.00 ms               |  |  |  |  | 2nd Speed Loop Integral Time Constant                   | Immediately   |
| Pn106     | 40.0/s                 |  |  |  |  | 2nd Position Loop Gain                                  | Immediately   |
| Pn109     | 0 %                    |  |  |  |  | Feedforward Gain  | Immediately   |
| Pn10A     | 0.00 ms                |  |  |  |  | Feedforward Filter Time Constant                        | Immediately   |
| Pn10B     | <u>0</u> 000           |  |  |  |  | Application Function for Gain Select Switch             | –             |
| Pn10C     | 200 %                  |  |  |  |  | Mode Switch (torque reference)                          | Immediately   |
| Pn10D     | 0 min <sup>-1</sup>    |  |  |  |  | Mode Switch (speed reference)                           | Immediately   |
| Pn10E     | 0 min <sup>-1</sup> /s |  |  |  |  | Mode Switch (acceleration)                              | Immediately   |
| Pn10F     | 0 reference unit       |  |  |  |  | Mode Switch (position error pulse)                      | Immediately   |
| Pn11F     | 0.0 ms                 |  |  |  |  | Position Integral Time Constant                         | Immediately   |
| Pn121     | 100%                   |  |  |  |  | Friction Compensation Gain                              | Immediately   |
| Pn122     | 100%                   |  |  |  |  | 2nd Gain for Friction Compensation                      | Immediately   |
| Pn123     | 0%                     |  |  |  |  | Friction Compensation Coefficient                       | Immediately   |
| Pn124     | 0.0 Hz                 |  |  |  |  | Friction Compensation Frequency Correction              | Immediately   |
| Pn125     | 100%                   |  |  |  |  | Friction Compensation Gain Correction                   | Immediately   |
| Pn131     | 0 ms                   |  |  |  |  | Gain Switching Time 1                                   | Immediately   |
| Pn132     | 0 ms                   |  |  |  |  | Gain Switching Time 2                                   | Immediately   |
| Pn135     | 0 ms                   |  |  |  |  | Gain Switching Waiting Time 1                           | Immediately   |
| Pn136     | 0 ms                   |  |  |  |  | Gain Switching Waiting Time 2                           | Immediately   |
| Pn139     | 0000                   |  |  |  |  | Automatic Gain Changeover Related Switch 1              | Immediately   |

| Parameter | Factory Setting       |  |  |  |  | Name   | When Enabled  |
|-----------|-----------------------|--|--|--|--|--|---------------|
| Pn13D     | 2000%                 |  |  |  |  | Current Gain Level                                     | Immediately   |
| Pn140     | 0100                  |  |  |  |  | Model Following Control Related Switch                 | Immediately   |
| Pn141     | 50.0/s                |  |  |  |  | Model Following Control Gain                           | Immediately   |
| Pn142     | 100%                  |  |  |  |  | Model Following Control Gain Compensation              | Immediately   |
| Pn143     | 100%                  |  |  |  |  | Model Following Control Bias (Forward Direction)       | Immediately   |
| Pn144     | 100%                  |  |  |  |  | Model Following Control Bias (Reverse Direction)       | Immediately   |
| Pn145     | 50.0 Hz               |  |  |  |  | Vibration Suppression 1 Frequency A                    | Immediately   |
| Pn146     | 70.0 Hz               |  |  |  |  | Vibration Suppression 1 Frequency B                    | Immediately   |
| Pn147     | 100.0%                |  |  |  |  | Model Following Control Speed Feedforward Compensation | Immediately   |
| Pn148     | 50.0/s                |  |  |  |  | 2nd Model Following Control Gain                       | Immediately   |
| Pn149     | 100.0%                |  |  |  |  | 2nd Model Following Control Gain Compensation          | Immediately   |
| Pn14A     | 80.0 Hz               |  |  |  |  | Vibration Suppression 2 Frequency                      | Immediately   |
| Pn14B     | 100%                  |  |  |  |  | Vibration Suppression 2 Compensation                   | Immediately   |
| Pn14F     | 0011                  |  |  |  |  | Reserved Parameter                                     | –             |
| Pn160     | 0010                  |  |  |  |  | Anti-Resonance Control Related Switch                  | After restart |
| Pn161     | 100.0 Hz              |  |  |  |  | Anti-Resonance Frequency                               | Immediately   |
| Pn162     | 100%                  |  |  |  |  | Anti-Resonance Gain Compensation                       | Immediately   |
| Pn163     | 0%                    |  |  |  |  | Anti-Resonance Damping Gain                            | Immediately   |
| Pn164     | 0.00 ms               |  |  |  |  | Anti-Resonance Filter Time Constant 1 Compensation     | Immediately   |
| Pn165     | 0.00 ms               |  |  |  |  | Anti-Resonance Filter Time Constant 2 Compensation     | Immediately   |
| Pn170     | 1401                  |  |  |  |  | Tuning-less Function Related Switch                    | –             |
| Pn190     | 0010                  |  |  |  |  | Reserved Parameter                                     | –             |
| Pn200     | 0100                  |  |  |  |  | Reserved Parameter                                     | –             |
| Pn205     | 65535 Rev             |  |  |  |  | Multiturn Limit  | After restart |
| Pn207     | 0010                  |  |  |  |  | Position Control Function Switch                       | After restart |
| Pn20A     | 32768 Pitch/Rev       |  |  |  |  | Number of External Scale Pitch                         | After restart |
| Pn20E     | 4                     |  |  |  |  | Electronic Gear Ratio (Numerator)                      | After restart |
| Pn210     | 1                     |  |  |  |  | Electronic Gear Ratio (Denominator)                    | After restart |
| Pn212     | 2048 P/Rev            |  |  |  |  | Encoder Output Pulses                                  | After restart |
| Pn216     | 0                     |  |  |  |  | Reserved Parameter                                     | –             |
| Pn217     | 0                     |  |  |  |  | Reserved Parameter                                     | –             |
| Pn22A     | 0000                  |  |  |  |  | Fully-closed Control Selection Switch                  | After restart |
| Pn281     | 20 P/Pitch            |  |  |  |  | Encoder Output Resolution                              | After restart |
| Pn300     | 600                   |  |  |  |  | Reserved Parameter                                     | –             |
| Pn301     | 100                   |  |  |  |  | Reserved Parameter                                     | –             |
| Pn302     | 200                   |  |  |  |  | Reserved Parameter                                     | –             |
| Pn303     | 300                   |  |  |  |  | Reserved Parameter                                     | –             |
| Pn304     | 500 min <sup>-1</sup> |  |  |  |  | JOG Speed  | Immediately   |



| Parameter | Factory Setting         |  |  |  |  | Name   | When Enabled  |
|-----------|-------------------------|--|--|--|--|--|---------------|
| Pn305     | 0 ms                    |  |  |  |  | Soft Start Acceleration Time                               | Immediately   |
| Pn306     | 0 ms                    |  |  |  |  | Soft Start Deceleration Time                               | Immediately   |
| Pn307     | 40                      |  |  |  |  | Reserved Parameter   | –             |
| Pn310     | 0000                    |  |  |  |  | Vibration Detection Switch                                 | Immediately   |
| Pn311     | 100 %                   |  |  |  |  | Vibration Detection Sensibility                            | Immediately   |
| Pn312     | 50 min <sup>-1</sup>    |  |  |  |  | Vibration Detection Level                                  | Immediately   |
| Pn324     | 300%                    |  |  |  |  | Moment of Inertia Calculating Start Level                  | Immediately   |
| Pn400     | 30                      |  |  |  |  | Reserved Parameter   | –             |
| Pn401     | 1.00 ms                 |  |  |  |  | 1st Step 1st Torque Reference Filter Time Constant         | Immediately   |
| Pn402     | 800 %                   |  |  |  |  | Forward Torque Limit                                       | Immediately   |
| Pn403     | 800 %                   |  |  |  |  | Reverse Torque Limit                                       | Immediately   |
| Pn404     | 100 %                   |  |  |  |  | Forward External Torque Limit                              | Immediately   |
| Pn405     | 100 %                   |  |  |  |  | Reverse External Torque Limit                              | Immediately   |
| Pn406     | 800 %                   |  |  |  |  | Emergency Stop Torque                                      | Immediately   |
| Pn407     | 10000 min <sup>-1</sup> |  |  |  |  | Speed Limit during Torque Control                          | Immediately   |
| Pn408     | 0000                    |  |  |  |  | Torque Related Function Switch                             | –             |
| Pn409     | 5000 Hz                 |  |  |  |  | 1st Notch Filter Frequency                                 | Immediately   |
| Pn40A     | 0.70                    |  |  |  |  | 1st Notch Filter Q Value                                   | Immediately   |
| Pn40B     | 0.000                   |  |  |  |  | 1st Notch Filter Depth                                     | Immediately   |
| Pn40C     | 5000 Hz                 |  |  |  |  | 2nd Notch Filter Frequency                                 | Immediately   |
| Pn40D     | 0.70                    |  |  |  |  | 2nd Notch Filter Q Value                                   | Immediately   |
| Pn40E     | 0.000                   |  |  |  |  | 2nd Notch Filter Depth                                     | Immediately   |
| Pn40F     | 5000 Hz                 |  |  |  |  | 2nd Step 2nd Torque Reference Filter Frequency             | Immediately   |
| Pn410     | 0.50                    |  |  |  |  | 2nd Step 2nd Torque Reference Filter Q Value               | Immediately   |
| Pn412     | 1.00 ms                 |  |  |  |  | 1st Step 2nd Torque Reference Filter Time Constant         | Immediately   |
| Pn423     | 0000                    |  |  |  |  | Reserved Parameter   | –             |
| Pn424     | 50%                     |  |  |  |  | Torque Limit at Main Circuit Voltage Drop                  | Immediately   |
| Pn425     | 100 ms                  |  |  |  |  | Release Time for Torque Limit at Main Circuit Voltage Drop | Immediately   |
| Pn456     | 15 %                    |  |  |  |  | Sweep Torque Reference Amplitude                           | Immediately   |
| Pn460     | 0101                    |  |  |  |  | Notch Filter Adjustment Switch                             | Immediately   |
| Pn501     | 10                      |  |  |  |  | Reserved Parameter   | –             |
| Pn502     | 20 min <sup>-1</sup>    |  |  |  |  | Rotation Detection Level                                   | Immediately   |
| Pn503     | 10 min <sup>-1</sup>    |  |  |  |  | Speed Coincidence Signal Output Width                      | Immediately   |
| Pn506     | 0 ms                    |  |  |  |  | Brake Reference - Servo OFF Delay Time                     | Immediately   |
| Pn507     | 100 min <sup>-1</sup>   |  |  |  |  | Brake Reference Output Speed Level                         | Immediately   |
| Pn508     | 50 ms                   |  |  |  |  | Waiting Time for Brake Signal When Motor Running           | Immediately   |
| Pn509     | 20 ms                   |  |  |  |  | Instantaneous Power Cut Hold time                          | Immediately   |
| Pn50A     | 1881                    |  |  |  |  | Input Signal Selection 1                                   | After restart |

| Parameter       | Factory Setting              |  |  |  |  | Name  | When Enabled  |
|-----------------|------------------------------|--|--|--|--|---|---------------|
| Pn50B           | 8822                         |  |  |  |  | Input Signal Selection 2                                    | After restart |
| Pn50E           | 0000                         |  |  |  |  | Output Signal Selection 1                                   | After restart |
| Pn50F           | 0100                         |  |  |  |  | Output Signal Selection 2                                   | After restart |
| Pn510           | 0000                         |  |  |  |  | Output Signal Selection 3                                   | After restart |
| Pn511           | 6543                         |  |  |  |  | Input Signal Selection 5                                    | After restart |
| Pn512           | 0000                         |  |  |  |  | Output Signal Inverse Setting                               | After restart |
| Pn513           | 0000                         |  |  |  |  | Reserved Parameter  | –             |
| Pn51B           | 1000<br>reference unit       |  |  |  |  | Excessive Error Level Between Servomotor and Load Positions | Immediately   |
| Pn51E           | 100%                         |  |  |  |  | Excessive Position Error Warning Level                      | Immediately   |
| Pn520           | 5242880<br>reference unit    |  |  |  |  | Excessive Position Error Alarm Level                        | Immediately   |
| Pn522           | 7<br>reference unit          |  |  |  |  | Positioning Completed Width                                 | Immediately   |
| Pn524           | 1073741824<br>reference unit |  |  |  |  | NEAR Signal Width   | Immediately   |
| Pn526           | 5242880<br>reference unit    |  |  |  |  | Excessive Position Error Alarm Level at Servo ON            | Immediately   |
| Pn528           | 100 %                        |  |  |  |  | Excessive Position Error Warning Level at Servo ON          | Immediately   |
| Pn529           | 10000 min <sup>-1</sup>      |  |  |  |  | Speed Limit Level at Servo ON                               | Immediately   |
| Pn52A           | 20 %                         |  |  |  |  | Multiplier per One Fully-closed Rotation                    | Immediately   |
| Pn52B           | 20%                          |  |  |  |  | Overload Warning Level                                      | Immediately   |
| Pn52C           | 100%                         |  |  |  |  | Derating of Base Current at Detecting Overload of Motor     | After restart |
| Pn52F           | 0FFF                         |  |  |  |  | Monitor Display at Power ON                                 | Immediately   |
| Pn530           | 0000                         |  |  |  |  | Program JOG Operation Related Switch                        | Immediately   |
| Pn531           | 32768<br>reference unit      |  |  |  |  | Program JOG Movement Distance                               | Immediately   |
| Pn533           | 500 min <sup>-1</sup>        |  |  |  |  | Program JOG Movement Speed                                  | Immediately   |
| Pn534           | 100 ms                       |  |  |  |  | Program JOG Acceleration/Deceleration Time                  | Immediately   |
| Pn535           | 100 ms                       |  |  |  |  | Program JOG Waiting Time                                    | Immediately   |
| Pn536           | 1 time                       |  |  |  |  | Number of Times of Program JOG Movement                     | Immediately   |
| Pn550           | 0.0 V                        |  |  |  |  | Analog Monitor 1 Offset Voltage                             | Immediately   |
| Pn551           | 0.0 V                        |  |  |  |  | Analog Monitor 2 Offset Voltage                             | Immediately   |
| Pn552           | ×1                           |  |  |  |  | Analog Monitor Magnification (×1)                           | Immediately   |
| Pn553           | ×1                           |  |  |  |  | Analog Monitor Magnification (×2)                           | Immediately   |
| Pn560           | 40.0%                        |  |  |  |  | Remained Vibration Detection Width                          | Immediately   |
| Pn561           | 100%                         |  |  |  |  | Overshoot Detection Level                                   | Immediately   |
| Pn600           | 0 W                          |  |  |  |  | Regenerative Resistor Capacity                              | Immediately   |
| Pn601           | 0                            |  |  |  |  | Reserved Parameter  | –             |
| Pn 800 to Pn95F | 0                            |  |  |  |  | Reserved Parameter  | –             |

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## Symbols

|        |            |
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## Revision History

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

MANUAL NO. SIEP S800000 60A

Published in Japan June 2009 09-6

└─ Date of publication  
└─ Date of original publication

| Date of Publication | Rev. No. | Section | Revised Content |
|---------------------|----------|---------|-----------------|
| June 2009           | -        | -       | First edition   |

# AC Servo Drives

# $\Sigma$ -V Series

## USER'S MANUAL

### Design and Maintenance

#### Rotational Motor

#### Command Option Attachable Type

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MANUAL NO. SIEP S800000 60A

Published in Japan June 2009 09-6  
09-1