YASKAWA

AC Servo Drives

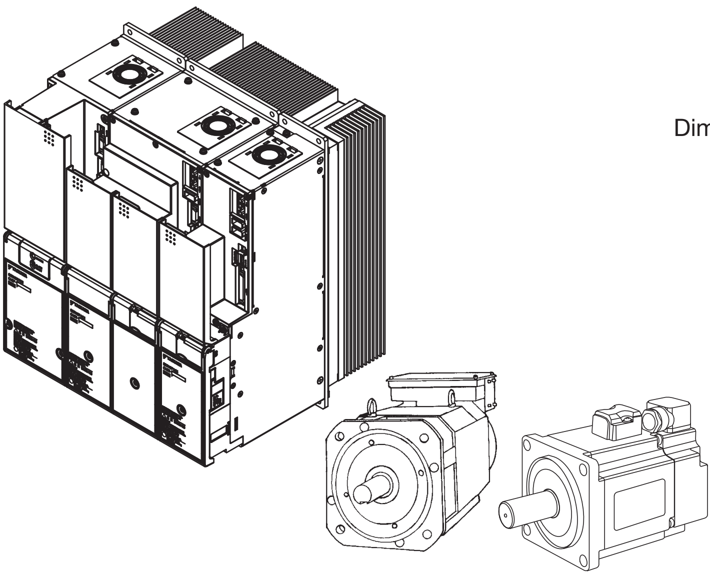
# Σ-V-SD Series

# USER'S MANUAL
# Design and Maintenance

## Rotational Motor
## EtherCAT (CoE) Communications Reference

UAK□J-□□C□□ Spindle motor
SGMGV-□□□8□□□ Servomotor
CACP-JU□□□3□ Power regeneration converter
CACR-JU□□□□C□ SERVOPACK





MANUAL NO. SIEP S800000 94I

# About this Manual

This manual describes information required for designing, testing, adjusting, and maintaining Σ-V-SD Series servo drives.

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

## ■ Description of Technical Terms

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

| Term | Meaning |
|---|---|
| Spindle Motor | Σ-V-SD Series UAKAJ and UAKBJ motor |
| Servomotor | Σ-V-SD Series SGMGV servomotor |
| Power Regeneration Converter | Σ-V-SD Series CACP-JU converter |
| SERVOPACK | Σ-V-SD Series CACR-JU servo amplifier |
| SERVOPACK for One Axis | A SERVOPACK that can control one motor |
| SERVOPACK for Two Axes | A SERVOPACK that can control two motors |
| Σ-V-SD Driver | A power regeneration converter and a SERVOPACK |
| Servo Drive | A set including a servomotor (or a spindle motor) and a Σ-V-SD driver |
| Servo System | A complete system that consists of a servo drive, a host controller, and peripheral devices |
| Servo ON | The power to the motor ON |
| Servo OFF | The power to the motor OFF |
| Base Block (BB) | The power supply to motor is turned OFF by shutting off the base current to the power transistor in the current amplifier. |
| Servo Lock | A state in which the motor is stopped and is in position loop with a position reference of 0. |
| DC-bus Voltage | The main circuit DC voltage (between P and N terminals) in a power regeneration converter and a SERVOPACK |

## ■ IMPORTANT Explanations

The following icon is displayed for explanations requiring special attention.

IMPORTANT

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

## ■ Notation Used in this Manual

- Notation for Reverse Signals

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

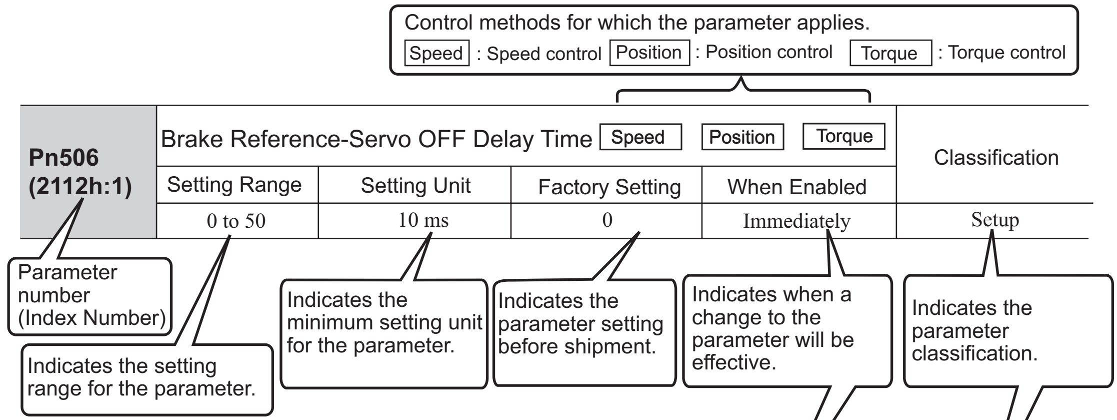
Notation Example

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

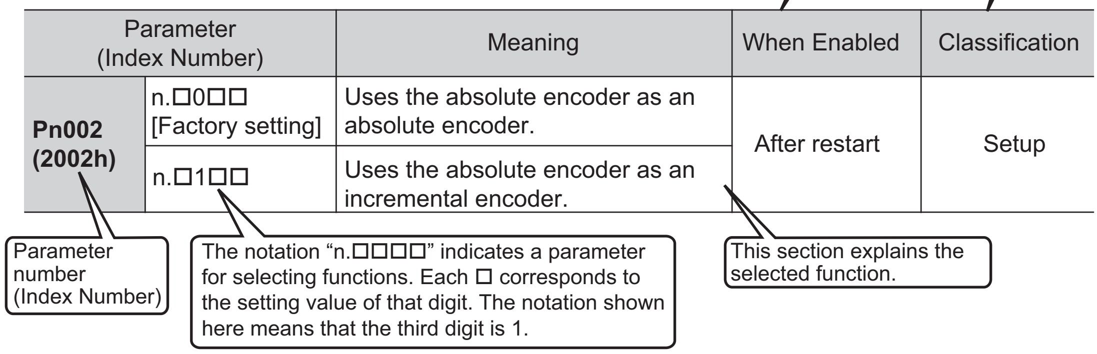
- Notation for Parameters

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

- Parameters for Numeric Settings




- Parameters for Selecting Functions




- Notation for Index Numbers of EtherCAT (CoE) Commands

When an EtherCAT (CoE) command consists of an index number and a subindex number, the index and sub-index numbers are separated by a colon.

Notation Example

2030h:1

Subindex number (1)

Index number (2030h)

- Notation for Index Numbers of Servo Parameters

The index numbers for a SERVOPACK for one axis and axis 1 of a SERVOPACK for two axes are given for the index numbers of the servo parameters. The index numbers for axis 2 of a SERVOPACK for two axes can be calculated by adding 400h to the index numbers for axis 1.

Example:

Parameter number: Pn100

= Index number for axis 1: 2040h

↓ Add 400h to calculate the index number for axis 2.

= Index number for axis 2: 2440h

## ■ Trademarks

- EtherCAT® is a registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.
- Other product names and company names are the trademarks or registered trademarks of the respective company. "TM" and the ® mark do not appear with product or company names in this manual.

## ■ Manuals Related to the Σ-V-SD Series

Refer to the following manuals as required.

| Name | Selecting Models and Peripheral Devices | Ratings and Specifications | System Design | Panels and Wiring | Trial Operation | Trial Operation and Servo Adjustment | Maintenance and Inspection |
|---|---|---|---|---|---|---|---|
| Σ-V-SD Series<br>User's Manual<br>Design and Maintenance<br>Rotational Motor/<br>EtherCAT (CoE)<br>Communications Reference<br>(this manual) | ✓ | ✓ | | ✓ | ✓ | ✓ | ✓ |
| Σ-V-SD Series<br>User's Manual<br>For Command Profile<br>Rotational Motor/<br>EtherCAT (CoE)<br>Communications Reference<br>(SIEP S800000 95) | | | ✓ | | ✓ | ✓ | |
| Σ-V-SD Series<br>Safety Precautions<br>(TOBP C710829 04) | ✓ | | | ✓ | | | ✓ |
| AC SERVOMOTOR<br>Safety Precautions<br>(TOBP C2300200 00) | | | | ✓ | | | ✓ |
| Σ-V-SD Series<br>Safety Precautions<br>Base Mounting Unit<br>(TOMP C710829 08) | ✓ | | | | | | ✓ |

## ■ Safety Information

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

| | |
|---|---|
| ⚠ WARNING | Indicates precautions that, if not heeded, could possibly result in loss of life or serious injury. |
| ⚠ CAUTION | Indicates precautions that, if not heeded, could result in relatively serious or minor injury, damage to the product, or faulty operation.<br>In some situations, the precautions indicated could have serious consequences if not heeded. |
| PROHIBITED | Indicates prohibited actions that must not be performed. For example, this symbol would be used to indicate that fire is prohibited as follows:  |
| MANDATORY | Indicates compulsory actions that must be performed. For example, this symbol would be used to indicate that grounding is compulsory as follows:  |

# Safety Precautions

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

## ⚠ WARNING

- **Never touch the rotating parts of the motor during operation or adjustments.**
  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 power regeneration converters and SERVOPACKs.**
  Failure to observe this warning may result in electric shock.
- **Do not remove the cover of power supply terminal while the power is ON.**
  Failure to observe this warning may result in electric shock.
- **Do not touch terminals before the main-circuit capacitor has had time to discharge after the power has been turned OFF because high voltage may still remain in the power regeneration converter and SERVOPACK. Refer to *7.2.1 Main Circuit* for the details of discharge time of main-circuit capacitor.**
  Residual voltage may cause electric shock.
- **Do not touch terminals while the charge indicator is lit.**
  Residual voltage may cause electric shock.
  After the charge indicator goes out, check the voltage on the DC bus line (i.e., between the P and N terminals) with a voltage tester before you perform wiring or inspection work.
- **Do not touch terminals before the main-circuit capacitor has had time to discharge after voltage resistance test. Refer to *7.2.1 Main Circuit* for the details of discharge time of main-circuit capacitor.**
  Residual voltage may cause electric shock.
- **Make sure that trial operation was completed successfully before you make adjustments.**
  Failure to observe this warning may result in injury or damage to the product.
- **Follow the procedures and instructions for the trial operation as noted in the applicable manual for that product.**
  Malfunctions that occur after the motor is connected to the equipment not only damage the equipment, but may also cause an accident resulting in death or injury.
- **The output range of multiturn data for Σ-V-SD driver absolute detection system differs from that for conventional systems (15-bit encoder and 12-bit encoder). Especially when “Infinite length positioning system” of Σ series is to be configured with Σ-V-SD series, be sure to make the system modification.**
- **When you set up the absolute encoder, the multiturn data will change to between minus two and plus two turns. This will cause the reference position of the machine to change. Adjust the reference position at the host controller to the correct position after you perform the setup.**
  If the machine is operated without aligning the position in the host controller, unintended operation may occur and may result in injuries or damage to the machine. Be careful when starting the machine to ensure that this does not occur.
- **The multiturn limit value must be changed only for special applications.**
  Changing it inappropriately or unintentionally can be dangerous.
- **If the Multiturn Limit Disagreement alarm occurs, check the setting of parameter Pn205 in the SERVOPACK to be sure that it is correct.**
  If the multiturn limit value setting is implemented while an incorrect value is set in Pn205, an incorrect value will be set in the encoder. The alarm will disappear even if an incorrect value is set, but incorrect positions will be detected, resulting in a dangerous situation where the machine will move to unexpected positions.
- **Do not remove the front cover, cables, connectors, or optional items on the foreside while the power is ON.**
  Failure to observe this warning may result in electric shock.
- **Do not damage, press, exert excessive force or place heavy objects on the cables.**
  Failure to observe this warning may result in electric shock, stopping operation of the product, or fire.
- **Do not modify the product.**
  Failure to observe this warning may result in injury, damage to the product, or fire.

## ⚠ WARNING

- Provide an appropriate braking device on the machine side to ensure safety. A holding brake for a servomotor with brake is not a braking device for ensuring safety.
  Failure to observe this warning may result in injury.
- Do not come close to the machine immediately after resetting momentary power loss to avoid an unexpected restart. Take appropriate measures to ensure safety against an unexpected restart.
  Failure to observe this warning may result in injury.
- Refer to the SigmaWin for Σ-V-SD (MT) Operation Manual before you make adjustments.
  Failure to observe this warning may result in injury or damage to the product.

- Connect the ground terminal to electrical codes (ground resistance: 100 Ω or less for a power regeneration converter and a SERVOPACK with a 200 V power supply. 10 Ω or less for a power regeneration converter and 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 Hard Wire Base Block 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 or damage to the product.

## ■ Storage and Transportation

## ⚠ CAUTION

- Do not store or install the product in the following places.
  - Locations subject to direct sunlight.
  - Locations subject to temperatures outside the range specified in the storage/installation temperature conditions.
  - Locations subject to humidity outside the range specified in the storage/installation humidity conditions.
  - Locations subject to condensation as the result of extreme changes in temperature.
  - Locations subject to corrosive or flammable gases.
  - Locations subject to dust, salts, or iron dust.
  - Locations subject to exposure to water, oil, or chemicals.
  - Locations subject to shock or vibration.

  Failure to observe this caution may result in fire, electric shock, or damage to the product.
- Do not hold the motors by the cable, motor shaft, or encoder while transporting it.
  Failure to observe this caution may result in injury or malfunction.
- Do not hold the power regeneration converters and SERVOPACKs by the front cover or terminal cover while moving them.
  Failure to observe this caution may result in damage to the covers or in a greater possibility of the products being dropped and damaged.
- 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 products 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 or malfunction.
- Do not cover the inlet or outlet ports and prevent any foreign objects from entering the product.
  Failure to observe this caution may cause internal elements to deteriorate resulting in malfunction or fire.
- Be sure to install the product in the correct direction.
  Failure to observe this caution may result in malfunction.
- Provide the specified clearances between the power regeneration converter and the inside surface of the control panel and between the SERVOPACK and the inside surface of the control panel, and keep both the converter and the SERVOPACK sufficiently separated from all 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.
- Provide at least 100 mm between the machine and the side of the motor that is opposite from the load (i.e., the side where cooling air is exhausted) to ensure sufficient flow of cooling air to the cooling fan.
  If there is not sufficient airflow, the motor temperature fault protective function may operate even at the rated load.
- Do not allow water, oil, or other liquids to come in direct contact with the motor. If there is a chance that water, oil, or other liquids may come into direct contact with the motor, install a protective cover.
  If water, oil, or other liquids enter the motor, the resistance will be lowered and a ground fault may occur.
- Install the motor on a sturdy mounting bed, base, stand or other structure.
  The weight of the motor and the dynamic load during operation are placed on the installation structure and may cause vibration if the structure is not sturdy enough.

## ■ Wiring

### ⚠ CAUTION

- Be sure to wire correctly and securely.
  Failure to observe this caution may result in motor overrun, injury, or malfunction.
- Install the I/O signal cables and encoder cable at least 30 cm away from the motor's main circuit cable. Never place them in the same duct or bundle them together.
  Placing these cables too close to each other may result in malfunction.
- The maximum wiring length is 3 m for I/O signal cables, 20 m for encoder cables or motor main circuit cables, and 10 m for control power supply cables (+24 V, 0 V).
- To extend the encoder cable past 20 m, always use an extension encoder cable.
- If the main circuit cable length of the servomotor exceeds 20 m, the voltage drop along the cable will increase greatly and the intermittent duty zone of the torque-motor speed characteristics will be reduced.
- Use twisted-pair shielded wires or multi-core twisted pair shielded wires for input/output signal cables and the encoder cables.
- When you connect the cables, do not touch with your bare hands the motor connector pins or the encoder connector pins that are provided with the motor.
  Particularly the encoder may be damaged by static electricity.
- Take appropriate and sufficient countermeasures for each when installing systems in the following locations.
  - Locations subject to static electricity or other forms of noise.
  - Locations subject to strong electromagnetic fields and magnetic fields.
  - Locations subject to possible exposure to radioactivity.
  - Locations close to power supplies.

  Failure to observe this caution may result in damage to the product.
- Wiring or inspection must be performed by a technical expert.
- Do not connect a commercial power supply to the U, V, or W motor connection terminals.
  Failure to observe this caution may result in injury or fire.

## ⚠ CAUTION

- Do not connect the motor directly to a commercial power supply.
  The motor may be damaged. Connect the motor to the correct SERVOPACK.
- Securely connect the power supply terminal screws and motor connection terminal screws.
  Failure to observe this caution may result in fire.
- Do not touch the power terminals before the main-circuit capacitor has had time to discharge because high voltage may still remain in the power regeneration converter and SERVOPACK. Refer to *7.2.1 Main Circuit* for the details of discharge time of main-circuit capacitor.
  First make sure the charge indicator is turned OFF and that the DC-bus (symbol: P and N) voltage value is correct by using a tester or other device before wiring or starting an inspection.
- Observe the following precautions when wiring main circuit terminal blocks.
  - Do not turn the servo drive power ON until all wiring, including the main circuit terminal blocks has been completed.
  - If the main circuit terminal is the connector, remove the connector from the SERVOPACK prior to wiring.
  - Insert only one wire per insertion slot on the terminal block and the connector.
  - Make sure that the core wire is not electrically shorted to adjacent core wires.
- Always use the specified power supply voltage.
  An incorrect voltage may result in fire.
- Make sure that the polarity is correct.
  Incorrect polarity may cause ruptures or damage.
- Take appropriate measures to ensure that the input power supply is supplied within the specified voltage fluctuation range. Be particularly careful in places where the power supply is unstable.
  An incorrect power supply may result in damage to the product.
- Install external breakers or other safety devices against short-circuiting in external wiring.
  Failure to observe this caution may result in fire.
- For the control power supply, use a 24-VDC power supply with double insulation or reinforced insulation against primary. Make sure that the output holding time is 100 ms or more.
- Do not reverse the polarity of the battery when connecting it.
  Failure to observe this caution may damage the battery, power regeneration converter, SERVOPACK, and motor or cause it to explode.
- Install the battery at the power regeneration converter.
  It is dangerous to install batteries at encoder cable, because that sets up a loop circuit between the batteries.
- The motor does not provide overheating protection. If complying with NEC (National Electric Code) is necessary, implement overheating protection for the motor. However, overheating protection is not required if you use a SGMGV servomotor or UAKAJ spindle motor. (This is because continuous operation is possible within the ratings and SERVOPACK protection will function if the ratings are exceeded.)

### ■ Operation

## ⚠ CAUTION

- Always use the motor and SERVOPACK in one of the specified combinations.
  Failure to observe this caution may result in fire or malfunction.
- Conduct trial operation on the motor alone with the motor shaft disconnected from machine to avoid any unexpected accidents.
  Failure to observe this caution may result in injury.
- During trial operation, confirm that the holding brake works correctly. Furthermore, secure system safety against problems such as signal line disconnection.
- Before starting operation with a machine connected, change the 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.
- Avoid frequently turning the power ON and OFF.
  Since the Σ-V-SD driver have a capacitor in the power supply, a high charging current flows when power is turned ON. Frequently turning the power ON and OFF causes main power devices like capacitors and fuses in the power regeneration converter and the SERVOPACK to deteriorate more quickly, resulting in unexpected problems.
- Forced stop function with forward/reverse overtravel is not effective during JOG mode operation and zero point search using SigmaWin for Σ-V-SD (MT).

## ⚠ CAUTION

- Make sure that the motor constants for the spindle motors being used match the parameters of the SERVOPACKs before supplying power when driving spindle motors by using Σ-V-SD series SERVOPACK.
  Failure to observe this caution may result in injury, fire, and damage to the product.
- When using the servomotor for a vertical axis, install the safety devices to prevent workpieces to fall off due to occurrence of alarm or overtravel. Set the servomotor so that it will stop in the zero clamp state at occurrence of overtravel.
  Failure to observe this caution may cause workpieces to fall off due to overtravel.
- Do not touch the power regeneration converter and SERVOPACK heat sinks or servomotor while the 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, clear 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 holding brake on the servomotor for braking.
  Failure to observe this caution may result in malfunction.
- The servomotor stopping method of turning the main-circuit or control-circuit power OFF without turning the servo OFF during operation can not be set in Parameter Pn001.
  Refer to *8.4.4 Stopping Servomotor after SV_OFF Command or Alarm Occurrence* for details.
- Do not establish communications with the host controller while running SigmaWin for Σ-V-SD (MT), because an alarm or warning might be issued.
  If an alarm or warning is issued, any process currently being executed might be aborted and the system might also be stopped.
  Only when using the following functions, communications with the host controller is allowed while running SigmaWin for Σ-V-SD (MT).
  <functions for use with SigmaWin for Σ-V-SD (MT) that require communications with the host controller during use>
  - Advanced autotuning by reference
  - One-parameter tuning
  - Anti-resonance control adjustment function

  <functions for use with SigmaWin for Σ-V-SD (MT) that will not result in problems if communications established with the host controller during use>
  - Parameter edit function, excluding parameter initialization
  - Monitor function
  - Alarm display function, excluding resetting alarms and clearing alarm history
  - Data trace function
- Dynamic braking (DB) is an auxiliary function used for emergency stops. It does not guarantee that the servomotor will come to a full or immediate stop as when a brake is applied. The servomotor might coast to a stop. Provide appropriate braking devices on the machine side to ensure safety.
- Do not use the servo drive under a load moment of inertia exceeding the maximum allowable value.
  Failure to observe this caution may result in damage or malfunction of resistors and power devices in the SERVOPACK.

## ■ Maintenance and Inspection

## ⚠ CAUTION

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

## Disposal Precautions

**⚠ CAUTION**

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

## General Precautions

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

- The products shown in illustrations in this manual are sometimes shown without covers or protective guards. Always replace the cover or protective guard as specified first, and then operate the products in accordance with the manual.
- The drawings presented in this manual are typical examples and may not match the product you received.
- If the manual must be ordered due to loss or damage, inform your nearest Yaskawa representative or one of the offices listed on the back of this manual.

# Warranty

## (1) Details of Warranty

### ■ Warranty Period

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

### ■ Warranty Scope

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

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

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

## (2) Limitations of Liability

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

### (3) Suitability for Use

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

### (4) Specifications Change

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

# Contents

# 1

# Outline

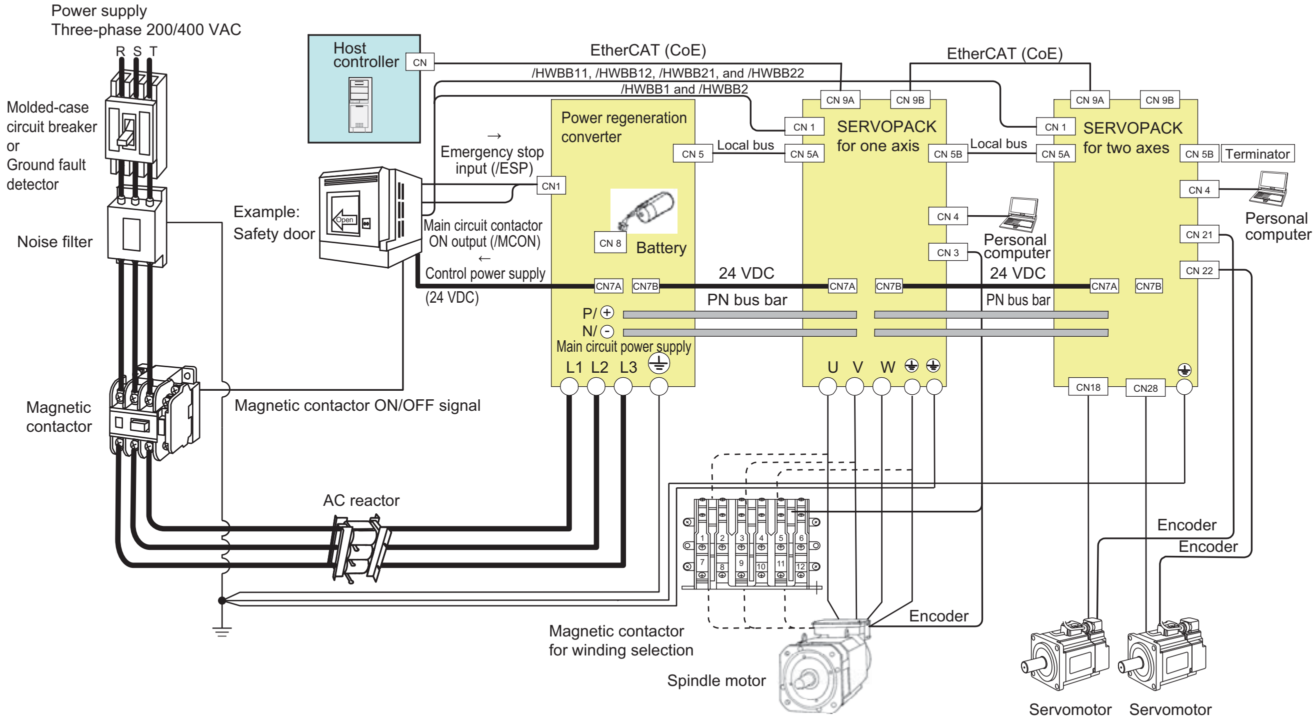
# 1.1 The Σ-V-SD Series

Σ-V-SD-series SERVOPACKs are designed for machine tool applications that require high-precision machining and saving energy.

They enable maximum utilization of machine performance in minimal time while contributing to increased productivity and equipment downsizing.

Σ-V-SD-series SERVOPACKs are available for one axis for power regeneration converters and spindle operation, and for two axes for feed axis operation.

# 1.2 System Configurations



# 1.3 Model Designation

## 1.3.1 Spindle Motor

Number of Digits: 1 2 3 4 5 6 7 8 9 10 11 12 13 14

UAKAJ-22CZ1OOE

1st + 2nd digits:
Servomotor Type

| Code | Specifications |
|---|---|
| UA | AC Spindle Motor |

3th digit: Cooling Method

| Code | Specifications |
|---|---|
| K | External fan cooled |

4th digit: Winding System

| Code | Specifications |
|---|---|
| A | Single winding |
| B | Winding selection |

5th digit: Series

| Code | Specifications |
|---|---|
| J | Σ-V-SD Series |

7th + 8th digits:
50% ED Rating (S3)

| Code | Specifications (kW) |
|---|---|
| 04*1 | 3.7 |
| 06 | 5.5 |
| 08 | 7.5 |
| 11 | 11 |
| 15 | 15 |
| 19 | 18.5 |
| 22 | 22 |
| 30*2 | 30 |
| 37*1, *2 | 37 |
| 45*1 | 45 |

9th digit:
Design Revision Order

| Code | Specifications |
|---|---|
| C | Standard |

10th digit: Encoder Specifications

| Code | Specifications |
|---|---|
| Z | Pulse encoder (standard) |
| S | Serial encoder *3 |

11th digit: Mounting

| Code | Specifications |
|---|---|
| 1 | Flange type |
| 3 | Foot-mounted type |

12th digit: Shaft End

| Code | Specifications |
|---|---|
| O<br>Blank | Straight with key and tap |
| N | Straight without key and tap |

13th digit: Lead Wire Orientation

| Code | Specifications |
|---|---|
| O<br>Blank | Left when viewed from the load side |

14th digit: Input Voltage

| Code | Specifications |
|---|---|
| Blank | Three-phase 200 VAC |
| E | Three-phase 400 VAC |

*1. Available only for single winding models.
*2. Available only for three-phase 200 VAC models.
*3. For details about serial encoders, contact your Yaskawa representative.

Outline

1

## 1.3.2 Servomotor

Number of Digits: 1 2 3 4 5 6 7 8 9 10 11 12 13

**SGMGV-30D8A21**

1st + 2nd + 3rd + 4th + 5th digits: Series

| Specifications |
|---|
| Σ-V Series<br>Servomotor SGMGV<br>(medium inertia) |

7th + 8th digits: Rated Output

| Code | Specifications (kW) |
|---|---|
| 05 | 0.45 |
| 09 | 0.85 |
| 13 | 1.3 |
| 20 | 1.8 |
| 30 | 2.9 |
| 44 | 4.4 |
| 55 | 5.5 |
| 75 | 7.5 |

9th digit: Power Supply Voltage

| Code | Specifications |
|---|---|
| A | Three-phase 200 VAC |
| D | Three-phase 400 VAC |

10th digit: Serial Encoder

| Code | Specifications |
|---|---|
| 8 | 20-bit absolute encoder with capacitor for backup |

11th digit: Design Revision Order

| Code | Specifications |
|---|---|
| A | Standard |
| M | High speed |

12th digit: Shaft End

| Code | Specifications |
|---|---|
| 2 | Straight |
| 6 | Straight with key and tap |

13th digit: Options

| Code | Specifications |
|---|---|
| 1 | Without options |
| B | With holding brake (90 VDC) |
| C | With holding brake (24 VDC) |
| D | With oil seal and holding brake (90 VDC) |
| E | With oil seal and holding brake (24 VDC) |
| S | With oil seal |

### 1.3.3 Σ-V-SD Series Driver

#### (1) Power Regeneration Converter

Number of Digits: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19

**CACP-JU 22 A 3 □ □ □□□□□□**

1st + 2nd + 3rd + 4th + 5th + 6th + 7th digits: Series

| Code | Specifications |
|---|---|
| CACP-JU | Σ-V-SD Series Power Regeneration Converter |

8th + 9th digits: 50% ED Rating

| Code | Specifications (kW) |
|---|---|
| 15 | 15 |
| 19 | 18.5 |
| 22 | 22 |
| 30*1 | 30 |
| 37*1 | 37 |
| 45 | 45 |

10th digit: Input Voltage

| Code | Specifications |
|---|---|
| A | Three-phase 200 VAC |
| D | Three-phase 400 VAC |

11th digit: Regeneration Method

| Code | Specifications |
|---|---|
| 3 | 120-degree conduction |

12th digit: Design Revision Order *2
A, B, C • • •

13th digit: Mounting

| Code | Specifications |
|---|---|
| Blank | Duct-ventilated |
| B | Base-mounted |

14th to 19th digits: Custom-made *3

| Code | Specifications |
|---|---|
| Blank | Standard |

*1. Available only for three-phase 200 VAC models.
*2. Models that conform to UL standards have design revision order B or later. For details, refer to *10.2 Models in Compliance with Standards*.
*3. For details about custom-made converters, contact your Yaskawa representative.

## (2) SERVOPACK for One Axis

Number of Digits: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

**C A C R - J U 1 0 2 A C A □ □ □ □ □ □ □**

1st + 2nd + 3rd + 4th + 5th + 6th + 7th digits: Series

| Code | Specifications |
|---|---|
| CACR-JU | Σ-V-SD Series SERVOPACK |

8th + 9th + 10th digits: Rated Output Current

| Code | Specifications (Arms) | Input Voltage |
|---|---|---|
| 028 | 28 | 270 VDC |
| 036 | 36 | |
| 065 | 65 | |
| 084 | 84 | |
| 102 | 102 | |
| 125 | 125 | |
| 196 | 196 | |
| 014 | 14 | 540 VDC |
| 018 | 18 | |
| 033 | 32.5 | |
| 042 | 42 | |
| 051 | 51 | |
| 098 | 98 | |

11th digit: Input Voltage

| Code | Specifications |
|---|---|
| A | 270 VDC |
| D | 540 VDC |

12th digit: Interface Specifications

| Code | Specifications |
|---|---|
| C | EtherCAT (CoE) |

13th digit: Design Revision Order
A, B, C • • •

14th digit: Mounting

| Code | Specifications |
|---|---|
| Blank | Duct-ventilated |
| B | Base-mounted |

15th to 20th digits: Custom-made*

| Code | Specifications |
|---|---|
| Blank | Standard |

* For details about custom-made converters, contact your Yaskawa representative.

### (3) SERVOPACK for Two Axes

Number of Digits: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

CACR-JUM25ACA□□□□□□□

1st + 2nd + 3rd + 4th + 5th + 6th + 7th digits: Series

| Code | Specifications |
|---|---|
| CACR-JU | Σ-V-SD Series SERVOPACK |

8th + 9th digits: Number of Axes

| Code | Specifications |
|---|---|
| M2 | Two axes |

10th digit: Output Current
Input Voltage 270 VDC

| Code | Specifications (Arms) | |
|---|---|---|
| | Axis 1 | Axis 2 |
| 3 | 11.6 | 11.6 |
| 4 | 18.5 | 18.5 |
| 5 | 24.8 | 24.8 |

Input Voltage 540 VDC

| Code | Specifications (Arms) | |
|---|---|---|
| | Axis 1 | Axis 2 |
| 3 | 5.4 | 5.4 |
| 4 | 8.4 | 8.4 |
| 5 | 11.9 | 11.9 |

11th digit: Input Voltage

| Code | Specifications |
|---|---|
| A | 270 VDC |
| D | 540 VDC |

12th digit: Interface Specifications

| Code | Specifications |
|---|---|
| C | EtherCAT (CoE) |

13th digit: Design Revision Order
A, B, C • • •

14th digit: Mounting

| Code | Specifications |
|---|---|
| Blank | Duct-ventilated |
| B[*1] | Base-mounted |

15th to 20th digits: Custom-made [*2]

| Code | Specifications |
|---|---|
| Blank | Standard |

*1. Base mounting units are applicable only to CACR-JUM2□ACAB SERVOPACKs with a three-phase, 200 VAC input voltage.
*2. For details about custom-made converters, contact your Yaskawa representative.

Outline

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# 2

# Compatible Devices

# 2.1 Combinations

## 2.1.1 SERVOPACK for One Axis and Motor

| SERVOPACK Model | Input Voltage | Spindle Motor | | Servomotor | | Max. Allowable Motor Capacity (kW) | |
|---|---|---|---|---|---|---|---|
| | | UAKAJ- | UAKBJ- | SGMGV- | | Spindle Motor (50% ED/ continuous rating) | Servomotor |
| | | Single Winding | Winding Selection | Standard | High Speed | | |
| CACR-JU028ACA | 270 VDC | 04, 06 | 06 | 09A*, 13A, 20A, 30A | 09A*, 13A | 5.5/3.7 | 3.0 |
| CACR-JU036ACA | | 08 | 08 | 30A, 44A | 20A, 30A | 7.5/5.5 | 5.0 |
| CACR-JU065ACA | | 11, 15 | 11, 15 | 55A | 44A | 15/11, 11/7.5 | 6.0 |
| CACR-JU084ACA | | 19 | 19 | 75A | – | 18.5/15 | 7.5 |
| CACR-JU102ACA | | 22 | 22 | – | 55A, 75A | 22/18.5 | – |
| CACR-JU125ACA | | 30 | 30 | – | – | 30/22 | – |
| CACR-JU196ACA | | 37, 45 | – | – | – | 45/37 | – |
| CACR-JU014DCA | 540 VDC | 04, 06 | 06 | 09D*, 13D, 20D, 30D | 09D*, 13D | 5.5/3.7 | 3.0 |
| CACR-JU018DCA | | 08 | 08 | 30D, 44D | 20D, 30D | 7.5/5.5 | 5.0 |
| CACR-JU033DCA | | 11, 15 | 11, 15 | 55D | 44D | 15/11, 11/7.5 | 6.0 |
| CACR-JU042DCA | | 19 | 19 | 75D | 55D | 18.5/15 | 7.5 |
| CACR-JU051DCA | | 22 | 22 | – | 75D | 22/18.5 | – |
| CACR-JU098DCA | | 45 | – | – | – | 45/37 | – |

* Contact your Yaskawa representative to use this motor.

## 2.1.2 SERVOPACK for Two Axes and Motor

| SERVOPACK Model | Input Voltage | Spindle Motor | Servomotor | | Max. Allowable Motor Capacity (kW) | |
|---|---|---|---|---|---|---|
| | | | SGMGV- | | Spindle Motor (50% ED/ continuous rating) | Servomotor |
| | | | Standard | High Speed | | |
| CACR-JUM23ACA | 270 VDC | – | 05A*, 09A, 13A | 05A*, 09A | – | 1.5 |
| CACR-JUM24ACA | | – | 20A | 13A | – | 2.0 |
| CACR-JUM25ACA | | – | 30A | – | – | 3.0 |
| CACR-JUM23DCA | 540 VDC | – | 05D*, 09D, 13D | 05D*, 09D | – | 1.5 |
| CACR-JUM24DCA | | – | 20D | 13D | – | 2.0 |
| CACR-JUM25DCA | | – | 30D | – | – | 3.0 |

* Contact your Yaskawa representative to use this motor.

## 2.1.3 Power Regeneration Converter, SERVOPACK, and Motor

Some restrictions apply when using combinations of a power regeneration converter, SERVOPACKs, and motors. Use the information in the following table when determining the combination of devices.

- The total continuous output of motors must be equal to or less than the continuous output capacity of the power regeneration converter.*1
- The total output of motors must be less than the instantaneous maximum output capacity of the power regeneration converter.*1
- The total continuous rated output capacity of SERVOPACKs*2 must be equal to or less than the continuous output capacity of the power regeneration converter*1 multiplied by 2.5.
- The total number of SERVOPACKs used must be equal to or less than ten (This is not the number of axes.)
- The total number of charge constants of SERVOPACKs*2 must be equal to or less than the allowable charge constant of the power regeneration converter.*1

*1. The continuous output capacity, the instantaneous maximum output capacity, and the allowable charge constant for individual models of power regeneration converters are shown in this table.

| Power Regeneration Converter Model | Continuous Output Capacity (kW) | | Instantaneous Maximum Output Capacity (kW) | Allowable Charge Constant |
|---|---|---|---|---|
| | Ambient Temperature 40°C or less | Ambient Temperature 40 to 55°C | | |
| CACP-JU15A3☐ | 11 | 7.7 | 37.5 | 132 |
| CACP-JU19A3☐ | 15 | 10.5 | 46.3 | 147 |
| CACP-JU22A3☐ | 18.5 | 12.95 | 55 | 162 |
| CACP-JU30A3☐ | 22 | 15.4 | 75 | 192 |
| CACP-JU37A3B | 30 | 23.1 | 92.5 | 390 |
| CACP-JU45A3B | 37 | 25.9 | 112.5 | 390 |
| CACP-JU15D3☐ | 11 | 7.7 | 37.5 | 33 |
| CACP-JU19D3☐ | 15 | 10.5 | 46.3 | 37 |
| CACP-JU22D3☐ | 18.5 | 12.95 | 55 | 41 |
| CACP-JU45D3B | 37 | 25.9 | 112.5 | 118 |

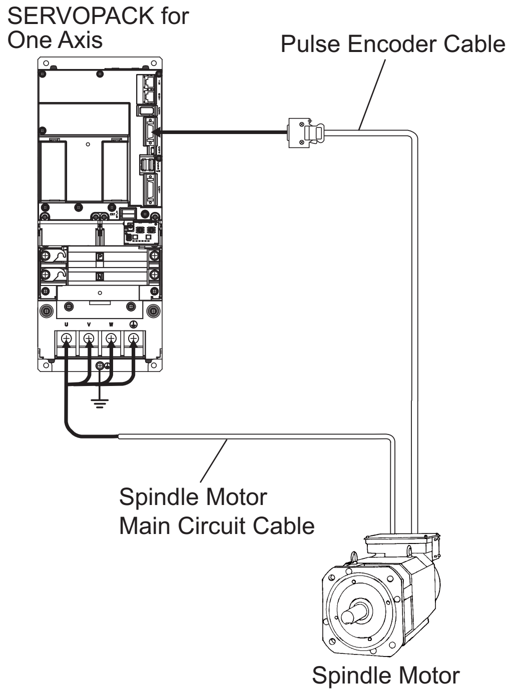
*2. The continuous rated capacity and charge constant for individual models of SERVOPACKs is shown in this table. These are not product specifications. Use this information to calculate to determine whether or not the selected combination of devices complies with the recommended operating conditions described above.

| SERVOPACK Model | Continuous Rated Capacity (kW) | Charge Constant |
|---|---|---|
| CACR-JUM23ACA | 3 | 10 |
| CACR-JUM24ACA | 4 | 14 |
| CACR-JUM25ACA | 6 | 20 |
| CACR-JU028ACA | 3.7 | 16 |
| CACR-JU036ACA | 5.5 | 24 |
| CACR-JU065ACA | 11 | 40 |
| CACR-JU084ACA | 15 | 52 |
| CACR-JU102ACA | 18.5 | 64 |
| CACR-JU125ACA | 22 | 64 |
| CACR-JU196ACA | 37 | 102 |
| CACR-JUM23DCA | 3 | 4 |
| CACR-JUM24DCA | 4 | 4 |
| CACR-JUM25DCA | 6 | 5 |
| CACR-JU014DCA | 3.7 | 4 |
| CACR-JU018DCA | 5.5 | 6 |
| CACR-JU033DCA | 11 | 10 |
| CACR-JU042DCA | 15 | 13 |
| CACR-JU051DCA | 18.5 | 16 |
| CACR-JU098DCA | 37 | 26 |

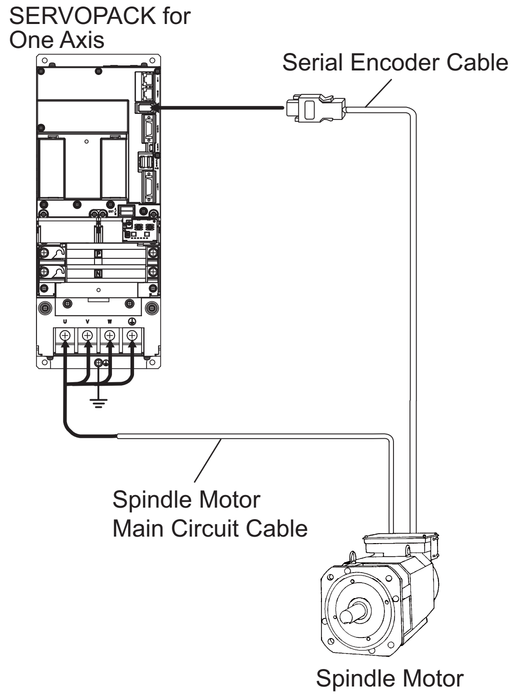
# 2.2 Selecting Cables

## 2.2.1 Spindle Motor

<Wiring example when using a pulse encoder>




<Wiring example when using a serial encoder>




### (1) Main Circuit Cable

The main circuit cable for the spindle motor must be assembled by customers. The main circuit cable for the spindle motor consists of the following two parts.

- Cable-end connectors to SERVOPACKs
- Cable

Note: All models of spindle motors have screw terminals for the connection of main-circuit cables. For details, refer to *7.1.2 (1) Main Circuit Cable Wiring*.

Use the following information on specifications to select appropriate parts.

#### ■ Specifications for cable-end connectors to SERVOPACKs

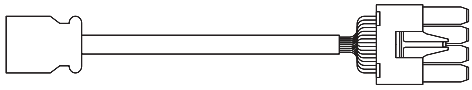
| SERVOPACK Model | Connector Housing Model | Electrical Contact Model | Wire Size | Manufacturer |
|---|---|---|---|---|
| CACR-JU028ACA | 1-917807-2 | 1318697-6 | AWG8 | Tyco Electronics Japan G.K. |
| CACR-JU036ACA | DK-5200S-04R | DK-5RECLLP1 (D3) | AWG8 | DDK Ltd. |
| CACR-JU014DCA | 1-917807-2 | 316041-6 | AWG12 | Tyco Electronics Japan G.K. |
| CACR-JU018DCA | DK-5200S-04R | DK-5RECMLP1-100 | AWG10 | DDK Ltd. |

Note: For other SERVOPACKs, they have screw terminals. For details, refer to *7.2.1 (1) Wire Sizes and Tightening Torques*.

#### ■ Cables

A 600 V heat-resistant vinyl cable is recommended. Select an appropriate size of cable for the motor and the SERVOPACK used. For details, refer to *7.1.2 (1) Main Circuit Cable Wiring* and *7.2.1 (1) Wire Sizes and Tightening Torques*.

## (2) Pulse Encoder Cable

| Name | Length | Order No. | External Appearance |
|---|---|---|---|
| Pulse Encoder Cable for Spindle Motor | 2 m | JZSP-CJP00-02-E |   |
| | 3 m | JZSP-CJP00-03-E | |
| | 5 m | JZSP-CJP00-05-E | |
| | 10 m | JZSP-CJP00-10-E | |
| | 15 m | JZSP-CJP00-15-E | |
| | 20 m | JZSP-CJP00-20-E | |

Use the following information to select appropriate parts when assembling a pulse encoder cable.

### ■ Specifications for cable-end connectors to SERVOPACKs

| Name | Model | Manufacturer |
|---|---|---|
| Connector Plug | 54331-0201 | Molex Japan LLC |
| Electrical Contact | 54306-2019 | |

Note: This cable-end connector is equivalent to and can be used as substitute for the 10120-6000EL connector made by 3M Japan Limited.

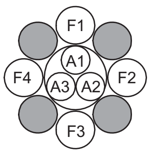
### ■ Specifications for cable-end connectors to spindle motors

The cable-end connector to the spindle motor is stored in the motor's terminal box upon delivery.

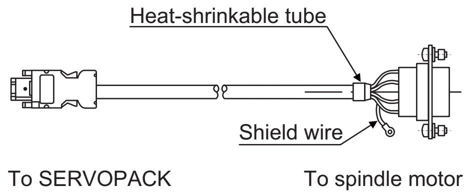
| Name | | Model | Manufacturer |
|---|---|---|---|
| Connector | | ELP-12V | J.T.S Mfg. Co., Ltd. |
| Electrical Contact | Other pins | LLF-01T-P1.3E* | |
| | No.10 pin | LLF-41T-P1.3E* | |

* The YC-202 crimping tool is required. Contact J.T.S. Mfg. Co., Ltd. for more information.

### ■ Cable specifications

| Items | Standard Type |
|---|---|
| Order No. | B9400064-1-E (3 m) |
| | B9400064-2-E (5 m) |
| | B9400064-3-E (10 m) |
| | B9400064-4-E (15 m) |
| | B9400064-5-E (20 m) |
| General Specifications | KQVV-SW:<br>AWG22×3 (three colors)<br>AWG26×4 (four twisted-pair) |
| Finished Dimensions | 7.5 mm dia. |
| Internal Configuration and Lead Color |  <br>A1: Red<br>A2: Black<br>A3: Yellow green<br>F1: Blue and white - twisted-pair wire<br>F2: Yellow and white - twisted pair wire<br>F3: Green and white - twisted pair wire<br>F4: Orange and white - twisted pair wire |
| Available Cable Lengths (Yaskawa Standards) | 3 m, 5 m, 10 m, 15 m, 20 m |

## (3) Serial Encoder Cable

| Name | Length | Order No. | External Appearance |
|---|---|---|---|
| Serial Encoder Cable for Spindle Motor | 3 m | JZSP-CJP01-03-E |   |
| | 5 m | JZSP-CJP01-05-E | |
| | 10 m | JZSP-CJP01-10-E | |
| | 15 m | JZSP-CJP01-15-E | |
| | 20 m | JZSP-CJP01-20-E | |

Use the following information to select appropriate parts when assembling a serial encoder cable.

### ■ Specifications for cable-end connectors to SERVOPACKs

| Name | Model | Manufacturer |
|---|---|---|
| Connector | 36210-0100PL | 3M Japan Limited |
| Shell | 36310-3200-008 | |

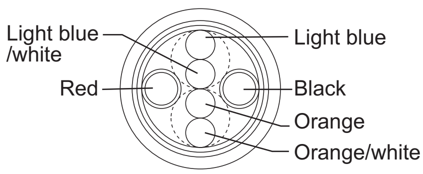
### ■ Specifications for cable-end connectors to spindle motors

The cable-end connector to the spindle motor is stored in the motor's terminal box upon delivery.

| Name | Model | Manufacturer |
|---|---|---|
| Connector | JEC-9P | J.T.S.Mfg.Co., Ltd. |
| Electrical Contact | J-SP1140* | |

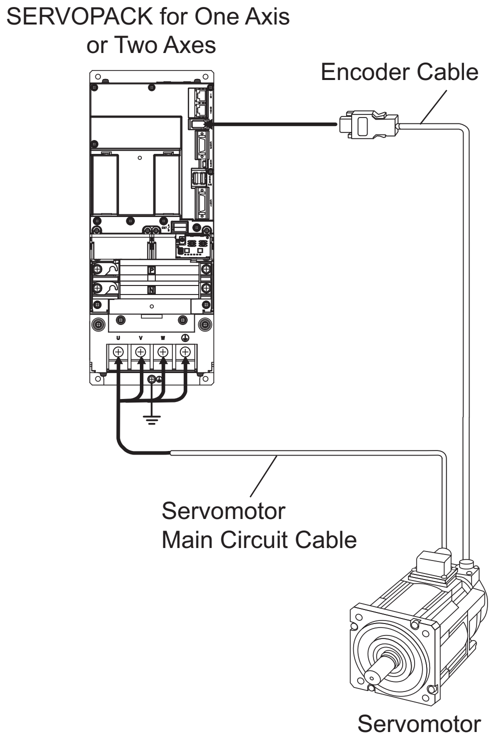
* The YRS-440 crimping tool and the DEJ-0.3 extraction tool are required. Contact J.T.S. Mfg. Co., Ltd. for more information.

### ■ Cable specifications

| Items | Standard Type |
|---|---|
| Order No. * | JZSP-CMP09-□□-E |
| Max Cable Length | 20 m |
| General Specifications | UL20276 (Rated temperature 80°C)<br>AWG22 × 2C+AWG24 × 2P<br>AWG22 (0.33 mm$^2$)<br>Outer diameter of insulating sheath: 1.15 mm dia.<br>AWG24 (0.20 mm$^2$)<br>Outer diameter of insulating sheath: 1.09 mm dia. |
| Finished Dimensions | 6.5 mm dia. |
| Internal Configuration and Lead Color |   |
| Available Cable Length (Yaskawa Standards) | 3 m, 5 m, 10 m, 15 m, 20 m |

* Specify the cable length in □□ of the order number.
Example: JZSP-CMP09-03-E (3 m)

## 2.2.2 Servomotor



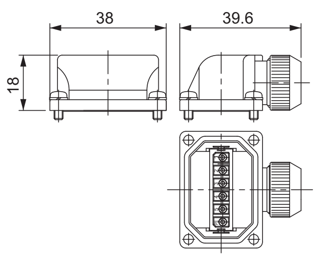

### (1) Main Circuit Cable for SGMGV-05 Servomotor

The main circuit cable must be assembled by customers. The main circuit cable consists of the following three parts.

- Cable-end connectors to servomotors
- Cable-end connectors to SERVOPACKs
- Cable

Use the following information on specifications to select appropriate parts.

#### ■ Specifications for cable-end connectors to servomotors

| Items | Specifications | External Dimensions mm |
|---|---|---|
| Order No. | JZSP-CVM9-1-E<br>(Cables are not included.) |  |
| Applicable Servomotors | SGMGV-05 | |
| Manufacturer | Japan Aviation Electronics Industry, Ltd. | |
| Instruction Manual | JAHL-50020 | |
| Plug | JNYFX06SJ3 | |
| Electrical Contact | ST-TMH-S-C1B | |
| Applicable Wire Size | AWG18 to 22 | |
| Outer Diameter of Insulating Sheath | 1.3 mm to 1.8 mm | |
| Mounting Screw | M3 pan head screw | |
| Applicable Cable Outer Diameter | 6.9 mm to 8.3 mm | |

Note: The CT160-3-TMH5B crimping tool is required. Contact Japan Aviation Electronics Industry, Ltd. for more information.

■ Specifications for cable-end connectors to SERVOPACKs

| SERVOPACK Model | Connector Housing Model | Electrical Contact Model | Wire Size | Manufacturer |
|---|---|---|---|---|
| CACR-JUM23ACA | 1-917807-2 | 316040-6 | AWG14 | Tyco Electronics Japan G.K. |
| CACR-JUM23DCA | | | | |

■ Cables

A 600 V heat-resistant vinyl cables is recommended. Select the appropriate size of cable for the servomotor and the SERVOPACK used.

For details, refer to *7.1.2 (1) Main Circuit Cable Wiring* and *7.2.1 (1) Wire Sizes and Tightening Torques*.

## (2) Main Circuit Cable for SGMGV-09 to -75 Servomotors

The main circuit cable must be assembled by customers. The main circuit cable consists of the following three parts.

- Cable-end connectors to servomotors
- Cable-end connectors to SERVOPACKs
- Cable

Use the following information on specifications to select appropriate parts.

■ Specifications for cable-end connectors to servomotors

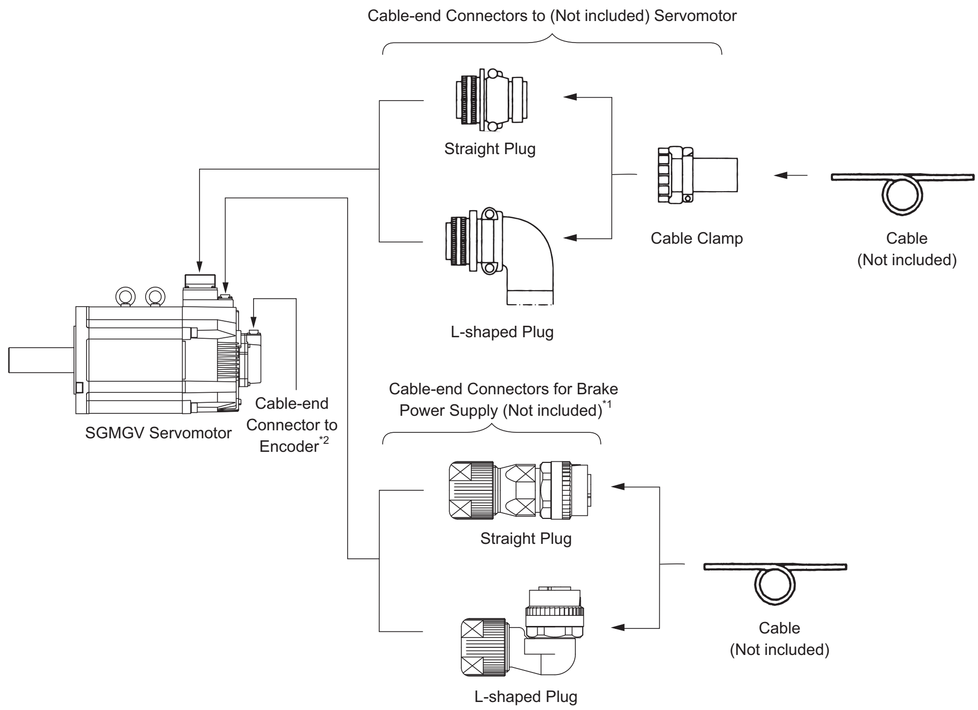
Use either of the following connectors depending on operating environment of servomotors.

- Standard connectors
- Protective structure IP67 and European safety standards compliant connector

• Standard connectors

Connector configuration

Two kinds of cable-end connectors to the servomotor are required: one connects to the main circuit and the other connects to the brake power supply. The following diagram shows relation between the connectors, cables, and devices.

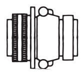



∗1. When using servomotors without holding brakes, the cable-end connector for the brake power supply is not required.
∗2. For information on cable-end connectors to encoders, refer to *2.2.2 (3) Encoder Cable*.

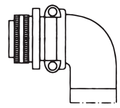
Compatible Devices

2

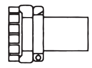
• Cable-end connectors to servomotors



Straight Plug



L-shaped Plug



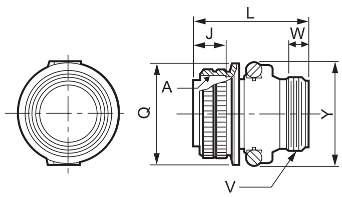
Cable Clamp

| Capacity kW | Servomotor's Receptacle for Main Circuit | Cable-end Connectors to Servomotors (Not included) | | |
|---|---|---|---|---|
| | | Straight Plug | L-shaped Plug | Cable Clamp |
| 0.85<br>1.3<br>1.8 | CE05-2A18-10PD-D (R1)<br>(MS3102A18-10P) | MS3106B18-10S | MS3108B18-10S | MS3057-10A |
| 2.9<br>4.4 | CE05-2A22-22PD-D (R1)<br>(MS3102A22-22P) | MS3106B22-22S | MS3108B22-22S | MS3057-12A |
| 5.5<br>7.5 | CE05-2A32-17PD-D (R1)<br>(MS3102A32-17P) | MS3106B32-17S | MS3108B32-17S | MS3057-20A |

Note 1. The servomotor receptacle for the main circuit is RoHS compliant. Contact the respective manufacture for information on RoHS-compliant cable-end connectors.

2. The servomotor receptacle for the main circuit is equivalent to the MS connector indicated in parentheses. Refer to these model numbers for the MS connectors when selecting cable-end connectors to servomotors.

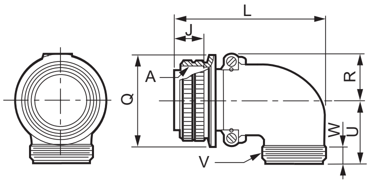
• MS3106B☐☐-☐☐S: Straight plug




Unit: mm

| Shell Size | Joint Screw A | Length of Joint Portion J±0.12 | Overall Length L max. | Outer Diameter of Joint Nut Q $^{+0}_{-0.38}$ | Cable Clamp Set Screw V | Effective Screw Length W min. | Maximum Width Y |
|---|---|---|---|---|---|---|---|
| 18 | 1-1/8-18UNEF | 18.26 | 52.37 | 34.13 | 1-20UNEF | 9.53 | 42 |
| 22 | 1-3/8-18UNEF | 18.26 | 55.57 | 40.48 | 1-3/16-18UNEF | 9.53 | 50 |
| 32 | 2-18UNS | 18.26 | 61.92 | 56.33 | 1-3/4-18UNS | 11.13 | 66 |

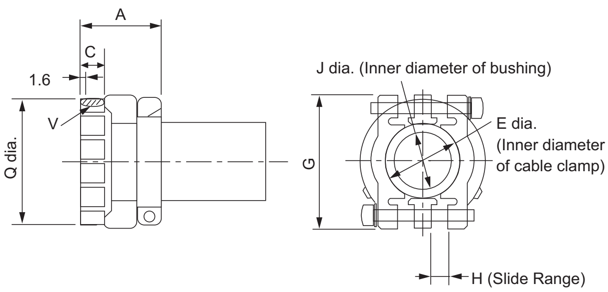
• MS3108B☐☐-☐☐S: L-shaped plug




Unit: mm

| Shell Size | Joint Screw A | Length of Joint Portion J±0.12 | Overall Length L max. | Outer Diameter of Joint Nut $Q^{+0}_{-0.38}$ | R ±0.5 | U ±0.5 | Cable Clamp Set Screw V | Effective Screw Length W min. |
|---|---|---|---|---|---|---|---|---|
| 18 | 1-1/8-18UNEF | 18.26 | 68.27 | 34.13 | 20.5 | 30.2 | 1-20UNEF | 9.53 |
| 22 | 1-3/8-18UNEF | 18.26 | 76.98 | 40.48 | 24.1 | 33.3 | 1-3/16-18UNEF | 9.53 |
| 32 | 2-18UNS | 18.26 | 95.25 | 56.33 | 32.8 | 44.4 | 1-3/4-18UNS | 11.13 |

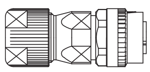
• MS3057-☐☐A: Cable clamp with rubber bushing



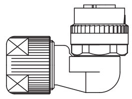

Unit: mm

| Cable Clamp Type | Applicable Connector Shell Size | Overall Length A±0.7 | Effective Screw Length C | E Diameter | G±0.7 | H | J Diameter | Set Screw V | Outer Diameter Q±0.7 Dia. | Attached Bushing |
|---|---|---|---|---|---|---|---|---|---|---|
| MS3057-10A | 18 | 23.8 | 10.3 | 15.9 | 31.7 | 3.2 | 14.3 | 1-20UNEF | 30.1 | AN3420-10 |
| MS3057-12A | 22 | 23.8 | 10.3 | 19 | 37.3 | 4 | 15.9 | 1-3/16-18UNEF | 35.0 | AN3420-12 |
| MS3057-20A | 32 | 27.8 | 11.9 | 31.7 | 51.6 | 6.3 | 23.8 | 1-3/4-18UNS | 51.6 | AN3420-20 |

• Cable-end connectors for brake power supply



Straight Plug



L-shaped Plug

| Capacity kW | Servomotor's Receptacle for Brake Power Supply | Cable-end Connectors for Brake Power Supply (Not included) | | |
|---|---|---|---|---|
| | | Straight Plug | L-shaped Plug | Manufacturer |
| 0.85 to 7.5 | CM10-R2P-D | CM10-SP2S-S-D (R1)<br>Applicable Cable:<br>4.0 mm dia. to 6.0 mm dia. | CM10-AP2S-S-D (R1)<br>Applicable Cable:<br>4.0 mm dia. to 6.0 mm dia. | DDK Ltd. |
| | | CM10-SP2S-M-D (R1)<br>Applicable Cable:<br>6.0 mm dia. to 9.0 mm dia. | CM10-AP2S-M-D (R1)<br>Applicable Cable:<br>6.0 mm dia. to 9.0 mm dia. | |
| | | CM10-SP2S-L-D (R1)<br>Applicable Cable:<br>9.0 mm dia. to 11.6 mm dia. | CM10-AP2S-L-D (R1)<br>Applicable Cable:<br>9.0 mm dia. to 11.6 mm dia. | |

Note: Use the following order number when ordering.

J Z S P - C V B 9 - S M S2 - E

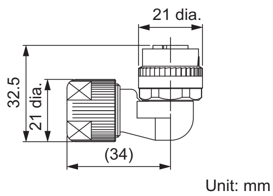
Connector Type
S: Straight plug
A: L-shaped plug

Bush Size *1(Diameter: mm)
S : Size S (4.0 to 6.0)
M: Size M (6.0 to 9.0)
L : Size L (9.0 to 11.6)

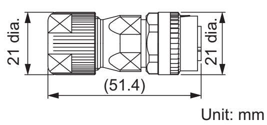
Contact Pin Type
S2: Soldered
C3: Crimped type*2

*1. The standard kit includes medium size connectors.
*2. Use the following crimping tool made by DDK Ltd.: 357J-50448T
For details, contact DDK.

• L-shaped Plug




• Straight Plug

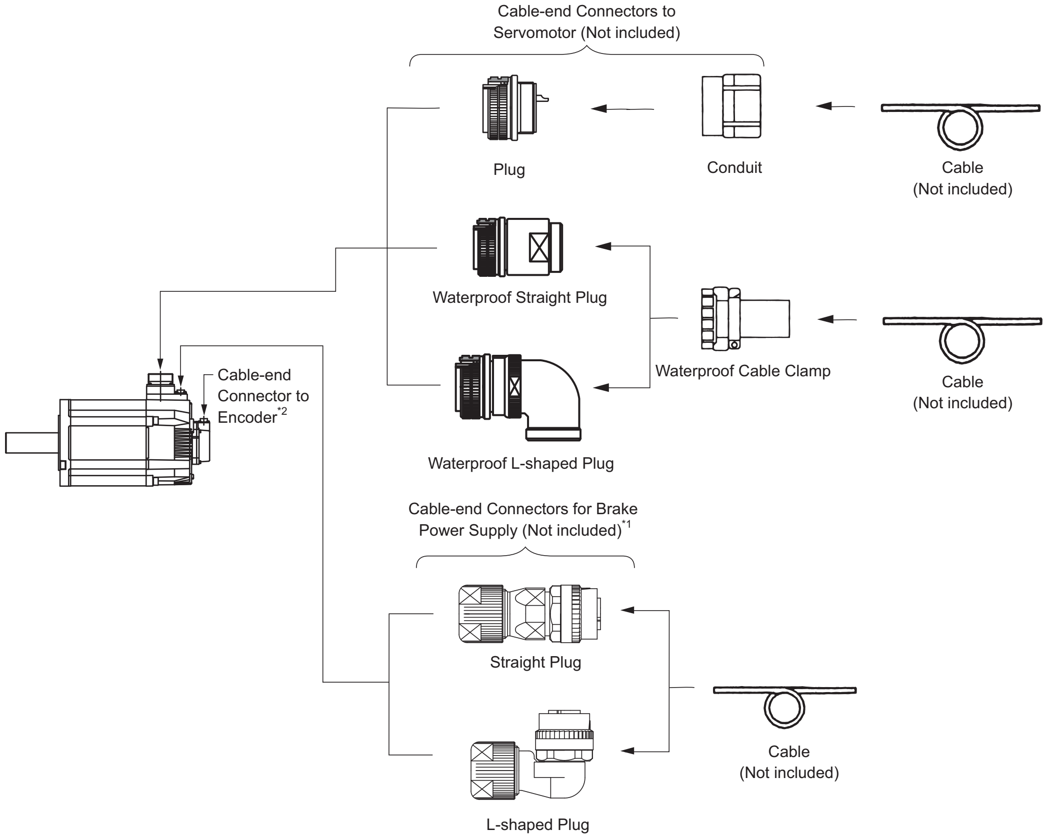



| Items | Specifications |
|---|---|
| Connector Model | CM10-□P2S-□-D (R1) (Cables are not included.) |
| Protective Structure | IP67 |
| Manufacturer | DDK Ltd. |
| Instruction Manuals | L-shaped plug (CM10-AP2S-□-D (R1)): TC-573,<br>Straight plug (CM10-SP2S-□-D (R1)): TC-583 |
| Electrical Contact Order No. | Electrical contact (100 pcs in one bag)<br>• Crimped type: CM10-#22SC(C3)-100,<br>Wire size: AWG16 to 20,<br>Outer diameter of sheath: 1.87 mm to 2.45 mm,<br>Crimping tool: 357J-50448T<br>• Soldered type: CM10-#22SC (S2)-100,<br>Wire size: AWG16 max.<br>Reel contact (4000 pcs on one reel)<br>• Crimped type: CM10-#22SC(C3)-4000,<br>Wire size: AWG 16 to 20,<br>Outer diameter of sheath: 1.87 mm to 2.45 mm,<br>Semi-automatic crimping tool:<br>AP-A50541T (product name for one set),<br>AP-A50541T-1 (product name for applicator-stripper and crimper)<br>Note: The product name of the semi-automatic tool refers to the product name of the press and applicator as a set. |

• Protective Structure IP67 and European Safety Standards Compliant Connector

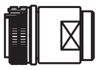
Connector Configuration

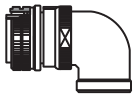
Two kinds of cable-end connectors to the servomotor are required: one connects to the main circuit and the other connects to the brake power supply. The following diagram shows relation between the connectors, cables, and devices.

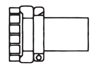



∗1. When using servomotors without holding brakes, the cable-end connector for the brake power supply is not required.
∗2. For information on cable-end connectors to encoders, refer to *2.2.2 (3) Encoder Cable*.

• Cable-end connectors to servomotors

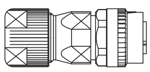

Waterproof Straight Plug

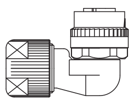

Waterproof L-shaped Plug


Waterproof Cable Clamp

| Capacity kW | Servomotor's Receptacle for Main Circuit | Cable-end Connectors to Servomotors (Not included) | | | | |
|---|---|---|---|---|---|---|
| | | Waterproof Straight Plug | Waterproof L-shaped Plug | Waterproof Cable Clamp | Applicable Cable Diameter (mm) | Manufacturer |
| 0.85<br>1.3<br>1.8 | CE05-2A18-10PD-D (R1) | CE05-6A18-10SD-D-BSS (R1) | CE05-8A18-10SD-D-BAS (R1) | CE3057-10A-1-D (R1) | 10.5 to 14.1 | DDK Ltd. |
| | | | | CE3057-10A-2-D (R1) | 8.5 to 11.0 | |
| | | | | CE3057-10A-3-D (R1) | 6.5 to 8.7 | |
| 2.9<br>4.4 | CE05-2A22-22PD-D (R1) | CE05-6A22-22SD-D-BSS (R1) | CE05-8A22-22SD-D-BAS (R1) | CE3057-12A-1-D (R1) | 12.5 to 16.0 | |
| | | | | CE3057-12A-2-D (R1) | 9.5 to 13.0 | |
| | | | | CE3057-12A-3-D (R1) | 6.8 to 10.0 | |
| | | | | CE3057-12A-7-D (R1) | 14.5 to 17.0 | |
| 5.5<br>7.5 | CE05-2A32-17PD-D (R1) | CE05-6A32-17SD-D-BSS (R1) | CE05-8A32-17SD-D-BAS (R1) | CE3057-20A-1-D (R1) | 22 to 23.8 | |
| | | | | CE3057-20A-2-D (R1) | 24 to 26.6 | |
| | | | | CE3057-20A-3-D (R1) | 22 to 22.5 | |

• Cable-end connectors for brake power supply


Straight Plug


L-shaped Plug

| Capacity kW | Servomotor's Receptacle for Brake Power Supply | Cable-end Connectors for Brake Power Supply (Not included) | | |
|---|---|---|---|---|
| | | Straight Plug | L-shaped Plug | Manufacturer |
| 0.85<br>to<br>7.5 | CM10-R2P-D | CM10-SP2S-S-D (R1)<br>Applicable Cable:<br>4.0 mm dia. to 6.0 mm dia. | CM10-AP2S-S-D (R1)<br>Applicable Cable:<br>4.0 mm dia. to 6.0 mm dia. | DDK Ltd. |
| | | CM10-SP2S-M-D (R1)<br>Applicable Cable:<br>6.0 mm dia. to 9.0 mm dia. | CM10-AP2S-M-D (R1)<br>Applicable Cable:<br>6.0 mm dia. to 9.0 mm dia. | |
| | | CM10-SP2S-L-D (R1)<br>Applicable Cable:<br>9.0 mm dia. to 11.6 mm dia. | CM10-AP2S-L-D (R1)<br>Applicable Cable:<br>9.0 mm dia. to 11.6 mm dia. | |

Note: Use the following order number when ordering.

J Z S P - C V B 9 - S M S2 - E

Connector Type
S: Straight plug
A: L-shaped plug

Bush Size *1 (Diameter: mm)
S : Size S (4.0 to 6.0)
M: Size M (6.0 to 9.0)
L : Size L (9.0 to 11.6)

Contact Pin Type
S2: Soldered
C3: Crimped type*2

*1. The standard kit includes medium size connectors.
*2. Use the following crimping tool made by DDK Ltd.: 357J-50448T
For details, contact DDK.

## ■ Specifications for cable-end connectors to SERVOPACKs

• SERVOPACK for one axis

| SERVOPACK Model | Connector Housing Model | Electrical Contact Model | Wire Size | Manufacturer |
|---|---|---|---|---|
| CACR-JU028ACA | 1-917807-2 | 1318697-6 | AWG10 | Tyco Electronics Japan G.K. |
| CACR-JU036ACA | DK-5200S-04R | DK-5RECLLP1 (D3) | AWG8 | DDK Ltd. |
| CACR-JU014DCA | 1-917807-2 | 316041-6 | AWG14 | Tyco Electronics Japan G.K. |
| CACR-JU018DCA | DK-5200S-04R | DK-5RECMLP1-100 | AWG10 | DDK Ltd. |

Note: For other SERVOPACKs, they have screw terminals. For details, refer to *7.2.1 (1) Wire Sizes and Tightening Torques*.

• SERVOPACK for two axes

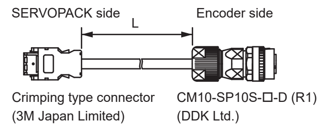
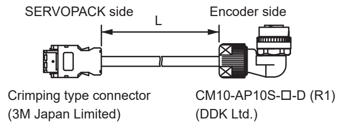
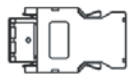
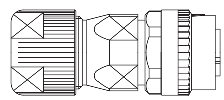
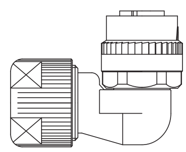
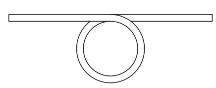
| SERVOPACK Model | Connector Model | Electrical Contact Model | Wire Size | Manufacturer |
|---|---|---|---|---|
| CACR-JUM23ACA | 1-917807-2 | 316040-6 | AWG14 | Tyco Electronics Japan G.K. |
| CACR-JUM24ACA | | 316041-6 | AWG10 | |
| CACR-JUM25ACA | | 1318697-6 | AWG8 | |
| CACR-JUM23DCA | 1-917807-2 | 316040-6 | AWG14 | |
| CACR-JUM24DCA | | | | |
| CACR-JUM25DCA | | | | |

## ■ Cables

A 600 V heat-resistant vinyl cable is recommended. Select an appropriate size of cable for the motor and the SERVOPACK used.
For details, refer to *7.1.2 (1) Main Circuit Cable Wiring* and *7.2.1 (1) Wire Sizes and Tightening Torques*.

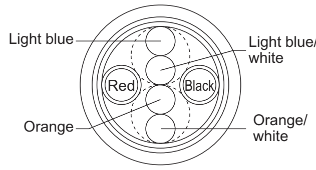
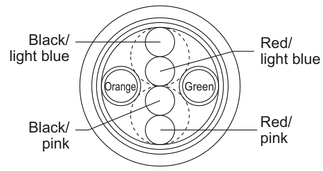
## (3) Encoder Cable

Either purchase an encoder cable with connectors on both ends or use the following specifications to select appropriate parts and make your own cable.

| Name | Length | Order No. | | External Appearance |
|---|---|---|---|---|
| | | Standard Type | Flexible Type[*1] | |
| Cables with Connectors on Both Ends | 3 m | JZSP-CVP05-03-E | – |  |
| | 5 m | JZSP-CVP05-05-E | | |
| | 10 m | JZSP-CVP05-10-E | | |
| | 15 m | JZSP-CVP05-15-E | | |
| | 20 m | JZSP-CVP05-20-E | | |
| | 3 m | JZSP-CVP08-03-E | |  |
| | 5 m | JZSP-CVP08-05-E | | |
| | 10 m | JZSP-CVP08-10-E | | |
| | 15 m | JZSP-CVP08-15-E | | |
| | 20 m | JZSP-CVP08-20-E | | |
| Kit for Cable-end Connectors to SERVOPACKs | | 36210-0100PL (Connector)<br>36310-3200-008 (Shell) | | Soldered<br><br>(3M Japan Limited) |
| Straight Plugs (IP67-rated)<br>– Used as cable-end connectors to encoder | | JZSP-CVP9-1-E[*2] | Connector Specifications<br>Plug: CM10-SP10S-M-D (R1)<br>Electrical Contact: (Crimped)[*3]<br>CM10-#22SC(C4)-100<br>Applicable Cable Diameter: 6.0 mm to 9.0 mm | <br>(DDK Ltd.) |
| | | JZSP-CVP9-3-E[*2] | Connector Specifications<br>Plug: CM10-SP10S-M-D (R1)<br>Electrical Contact: (Soldered)<br>CM10-#22SC(S1)-100<br>Applicable Cable Diameter: 6.0 mm to 9.0 mm | |
| L-shaped Plugs (IP67-rated)<br>– Used as cable-end connectors to encoder | | JZSP-CVP9-2-E[*2] | Connector Specifications<br>Plug: CM10-AP10S-M-D (R1)<br>Electrical Contact: (Crimped)[*3]<br>CM10-#22SC(C4)-100<br>Applicable Cable Diameter: 6.0 mm to 9.0 mm | <br>(DDK Ltd.) |
| | | JZSP-CVP9-4-E[*2] | Connector Specifications<br>Plug: CM10-AP10S-M-D (R1)<br>Electrical Contact: (Soldered)<br>CM10-#22SC(S1)-100<br>Applicable Cable Diameter: 6.0 mm to 9.0 mm | |
| Cables | 3 m | JZSP-CMP09-03-E | JZSP-CSP39-03-E |  |
| | 5 m | JZSP-CMP09-05-E | JZSP-CSP39-05-E | |
| | 10 m | JZSP-CMP09-10-E | JZSP-CSP39-10-E | |
| | 15 m | JZSP-CMP09-15-E | JZSP-CSP39-15-E | |
| | 20 m | JZSP-CMP09-20-E | JZSP-CSP39-20-E | |

*1. Use flexible cables for movable sections such as robot arms.
*2. For details about ordering, contact your Yaskawa representative.
*3. Use the following crimping tool made by DDK Ltd. : 357J-52667T

## ■ Cable specifications (when the cable length is 20 m or shorter)

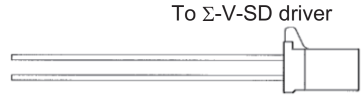
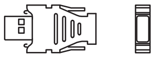
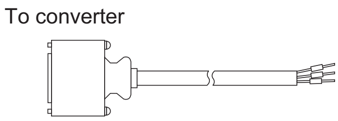
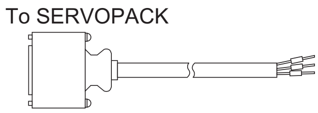
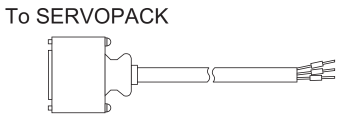
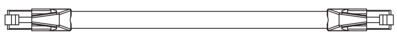
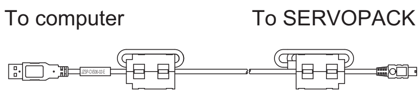
| Items | Standard Type | Flexible Type |
|---|---|---|
| Order No. * | JZSP-CMP09-☐☐-E | JZSP-CSP39-☐☐-E |
| Max Cable Length | 20 m | |
| Specifications | UL20276 (Rated temperature: 80°C)<br>AWG22×2C+AWG24×2P<br>AWG22 (0.33 $mm^2$)<br>Outer diameter of insulating sheath:<br>1.15 mm dia.<br>AWG24 (0.20 $mm^2$)<br>Outer diameter of insulating sheath:<br>1.09 mm dia. | UL20276 (Rated temperature: 80°C)<br>AWG22×2C+AWG24×2P<br>AWG22 (0.33 $mm^2$)<br>Outer diameter of insulating sheath:<br>1.35 mm dia.<br>AWG24 (0.20 $mm^2$)<br>Outer diameter of insulating sheath:<br>1.21 mm dia. |
| Finished Dimensions | 6.5 mm dia. | 6.8 mm dia. |
| Internal Configuration and Lead Color |   |   |
| Available Cable Length (Yaskawa Standards) | 3 m, 5 m, 10 m, 15 m, 20 m | |

* Specify the cable length in ☐☐ of order number.
Example: JZSP-CMP09-05-E (5 m)

## 2.2.3 Σ-V-SD Driver

### (1) Cables for Σ-V-SD Drivers

The necessary cables for wiring Σ-V-SD drivers are shown here.

| Name | Length | Order No. | External Appearance | Reference |
|---|---|---|---|---|
| Cable for 24-volt control power supply<br>• With loose leads on one end<br>• Connects one Σ-V-SD driver to 24-volt control power supply | 1 m | JZSP-CNG00-01-E |  | 2.2.3 (2) |
| | 2 m | JZSP-CNG00-02-E | | |
| | 3 m | JZSP-CNG00-03-E | | |
| Cable for 24-volt control power supply<br>• With connectors on both ends<br>• Connects two Σ-V-SD drivers | 0.2 m | JZSP-CNG01-A2-E |  | 2.2.3 (3) |
| | 0.3 m | JZSP-CNG01-A3-E | | |
| Cables for local bus communications | 0.5 m | JUPIT-W6004-A5 |  | 2.2.3 (4) |
| Terminating resister for local bus | – | JUPIT-W6024 |  | 2.2.3 (5) |
| Cable for converter I/O | 1 m | JZSP-CJI01-01-E |  | 2.2.3 (6) |
| | 2 m | JZSP-CJI01-02-E | | |
| | 3 m | JZSP-CJI01-03-E | | |
| Cable for SERVOPACK for one axis*1 | 1 m | JZSP-CSI02-1-E |  | 2.2.3 (7) |
| | 2 m | JZSP-CSI02-2-E | | |
| | 3 m | JZSP-CSI02-3-E | | |
| Cable for SERVOPACK for two axes*2 | 1 m | JZSP-CSI01-1-E |  | 2.2.3 (8) |
| | 2 m | JZSP-CSI01-2-E | | |
| | 3 m | JZSP-CSI01-3-E | | |
| Cable for EtherCAT (CoE) communications | 100 m max. | – |  | 2.2.3 (9) |
| Cable for analog monitor*3 | 1 m | JZSP-CA01-E |  | 2.2.3 (10) |
| Cable for personal computer connection*3 | 2.5 m | JZSP-CVS06-02-E |  | 2.2.3 (11) |

*1. When customers assembly the cable, refer to *2.2.3 (7) I/O Cable Specifications for SERVOPACKs for One Axis* to select appropriate parts.
*2. When customers assembly the cable, refer to *2.2.3 (8) I/O Cable Specifications for SERVOPACKs for Two Axes* to select appropriate parts.
*3. Required for maintenance work.

### (2) Cable Specifications for 24-volt Control Power Supply (With loose leads at one end and connects a Σ-V-SD driver to a 24-volt control power supply)

| Items | Specifications |
|---|---|
| Order No. * | JZSP-CNG00-□□-E |
| Cable Length | 1 m, 2 m, 3 m |
| Cable and Connector | Cable: UL1015 AWG14<br>Cable-end connector to driver: 175362-1 (PIN : 353717-2) |

* Specify the cable length in □□ of the order number.
Example: JZSP-CNG00-01-E (1 m)

### (3) Cable Specifications for 24-volt Control Power Supply (With connectors on both ends and connects two Σ-V-SD drivers)

| Items | Specifications |
|---|---|
| Order No.*1 | JZSP-CNG01-A□-E |
| Cable Length*2 | 0.2 m or 0.3 m |
| Cable and Connector | Cable: UL1015 AWG14<br>Connector: 175362-1 (PIN : 353717-2)<br>Connector manufacturer: Tyco Electronics Japan G.K. |

*1. Specify the cable length in □ of the order number.
Example: JZSP-CNG01-A2-E (0.2 m)
*2. Use a cable with a length of 0.3 m for the CACP-JU45□3B converter.

### (4) Cable Specifications for Local Bus Communications

| Items | Specifications |
|---|---|
| Order No. | JUPIT-W6004-A5 |
| Cable Length | 0.5 m |
| Cable | HRZFVV-ESB (20276) |
| Remarks | The total number of cables must equal to the total number of SERVOPACKs used. |

### (5) Cable Specifications for Terminating Resistor of the Local Bus

| Items | Specifications |
|---|---|
| Order No. | JUPIT-W6024 |
| Remarks | Connect the terminating resistor only to the SERVOPACK on the far right. |

### (6) Cable Specifications for Converter I/O Signals

| Items | Specifications |
|---|---|
| Order No. * | JZSP-CJI01-□□-E |
| Cable Length | 1 m, 2 m, 3 m |
| Cable and Connector | Cable: HP-SB/20276SR #28×6P<br>Cable-end connector for external device: 10114-6000EL (Crimping type) |
| Remarks | Used for emergency stop and the MCONs. |

* Specify the cable length in □□ of the order number.
Example: JZSP-CJI01-01-E (1 m)

## (7) I/O Cable Specifications for SERVOPACKs for One Axis

| Items | length | Specifications |
|---|---|---|
| Order No. | 1 m | JZSP-CSI02-1-E |
| | 2 m | JZSP-CSI02-2-E |
| | 3 m | JZSP-CSI02-3-E |
| Cable and connector | | Cable: SSRFPVV-SB AWG#28 × 13P, UL20276 VW-1SC<br>Shell: 10326-52A0-008 (3M Japan Limited)<br>Connector: 10126-6000EL (Crimping type, 3M Japan Limited)* |
| Remarks | | Used for input signals, such as P-OT and N-OT. |

* The soldered type is 10126-3000PE (3M Japan Limited).

## (8) I/O Cable Specifications for SERVOPACKs for Two Axes

| Items | length | Specifications |
|---|---|---|
| Order No. | 1 m | JZSP-CSI01-1-E |
| | 2 m | JZSP-CSI01-2-E |
| | 3 m | JZSP-CSI01-3-E |
| Cable and connector | | Cable: SSRFPVV-SB AWG#28 × 25P, UL20276 VW-1SC<br>Shell: 10350-52A0-008 (3M Japan Limited)<br>Connector: 10150-6000EL (Crimping type, 3M Japan Limited)* |
| Remarks | | Used for input signals, such as P-OT and N-OT. |

* The soldered type is 10150-3000PE (3M Japan Limited).

## (9) Cable Specifications for Use with EtherCAT (CoE) Communications

| Items | Specifications |
|---|---|
| Cable Length | 100 m max. |
| Cable and connector | Cable: CAT5 STP 4pairs<br>Connector: RJ-45 |
| Remarks | If you make your own cable, make sure that there is electrical continuity between the cable shield and connector shell. |
| | Recommended cable: ZB9020 (manufactured by Beckhoff Automation GmbH) |

## (10) Cable Specifications for Use with an Analog Monitor

| Items | Specifications |
|---|---|
| Order No. | JZSP-CA01-E |
| Cable length | 1 m |
| Connectors | Cable: STYLE 1007 AWM E74037, AWG24 VW-1<br>Connector: DF11-4DS-2C |
| Remarks | Used for analog output signals, such as speed reference and torque reference. |

## (11) Cable Specifications for Use with a Computer

| Items | Specifications |
|---|---|
| Order No. | JZSP-CVS06-02-E |
| Cable length | 2.5 m |
| Connectors | Cable-end connector to SERVOPACK: USB Type miniB<br>Cable-end connector to computer: USB Type A |
| Remarks | Used to connect a SERVOPACK with a personal computer in which SigmaWin for Σ-V-SD (MT) is installed. |

# 2.3 Peripheral Devices

## 2.3.1 Molded-case Circuit Breakers, Ground Fault Detectors, and Magnetic Contactors

Always install a circuit breaker to protect the main circuits. The type of circuit breaker that is required depends on what you need to detect.
Detecting only overcurrent: Use a molded-case circuit breaker.
Detecting overcurrent and leakage current: Use a ground fault detector that detects overloads and leakage current. Or, use a molded-case circuit breaker together with a ground fault detector that detects only leakage current.

**⚠ WARNING**

- Always install a molded-case circuit breaker or ground fault detector in the main circuit.
  Failure to observe this warning may result in electric shock, equipment damage, or fire.

### (1) Molded-case Circuit Breaker

A molded-case circuit breaker shuts OFF the power supply when it detects an overcurrent. Install a molded-case circuit breaker between the power supply and the main circuit power supply input terminals (R/L1, S/L2, and T/L3).
Select the molded-case circuit breaker based on the information in *(4) Converter Input Current and Inrush Current*.

### (2) Ground Fault Detector

A ground fault detector detects leakage current. Some models will also detect overcurrent in addition to leakage current. Use the type that is suitable for your application. Install a ground fault detector between the power supply and the main circuit power supply input terminals (R/L1, S/L2, and T/L3).
Recommended ground fault detector: A ground fault detector with harmonic countermeasures and a rated sensed current of 30 mA or higher for each power regeneration converter. A ground fault detector with harmonic countermeasures removes leakage current for harmonics and detects only leakage current in the frequency range that presents a hazard to humans. If you use a ground fault breaker that does not have harmonic countermeasures, the leakage current from the harmonics will increase the chance of malfunctions.

Select the ground fault detector based on the information in *(4) Converter Input Current and Inrush Current*.

### (3) Magnetic Contactors

The magnetic contactor for the control circuit power supply turns the control circuit power supply ON and OFF. The magnetic contactor for the main circuit power supply turns the main circuit power supply ON and OFF. Use a magnetic contactor (MC) to turn OFF the control power supply or main circuit power supply sequence.

Note: If the magnetic contactor on the main circuit power supply input is turned ON and OFF frequently, the Σ-V-SD servo driver may be damaged. Do not turn the power supply ON and OFF with the magnetic contactor more than one time every 30 minutes.

Select the magnetic contactor based on the information on power supply capacity, input current, and inrush current per power regeneration converter in *(4) Converter Input Current and Inrush Current*.

### (4) Converter Input Current and Inrush Current

| Voltage | Capacity (50%ED) kW | Capacity (Continuous Ratings) kW | Power Regeneration Converter Model | Power Supply Capacity per Power Regeneration Converter (kVA) | Input Current (50%ED) Arms | Input Current (Continuous Ratings) Arms | Inrush Current (Main Circuit) $A_{0\text{-}P}$ |
|---|---|---|---|---|---|---|---|
| 200 V | 15 | 11 | CACP-JU15A3☐ | 22.5 | 73 | 54 | 83 |
| | 18.5 | 15 | CACP-JU19A3☐ | 30.5 | 90 | 73 | 83 |
| | 22 | 18.5 | CACP-JU22A3☐ | 37.5 | 107 | 90 | 83 |
| | 30 | 22 | CACP-JU30A3☐ | 45.0 | 145 | 107 | 178 |
| | 37 | 30 | CACP-JU37A3B | 61.5 | 179 | 145 | 178 |
| | 45 | 37 | CACP-JU45A3B | 75.0 | 218 | 179 | 178 |
| 400 V | 15 | 11 | CACP-JU15D3☐ | 22.5 | 36 | 27 | 173 |
| | 18.5 | 15 | CACP-JU19D3☐ | 30.5 | 45 | 36 | 173 |
| | 22 | 18.5 | CACP-JU22D3☐ | 37.5 | 53 | 45 | 173 |
| | 45 | 37 | CACP-JU45D3B | 75.0 | 105 | 86 | 78 |

## 2.3.2 Surge Absorbers

A surge absorber absorbs the energy that is stored in the coil of an inductive load to suppress noise. Always use surge absorbers or diodes on all inductive loads that are connected near the Σ-V-SD servo driver. (Inductive loads include magnetic contactors, magnetic relays, magnetic valves, solenoids, and magnetic brakes.)

IMPORTANT

- Select a surge absorber with a capacity that is sufficient for the coil in the inductive load.
- Always install surge absorbers. If you do not install surge absorbers, the surge voltage from the coil that occurs when the inductive load is turned ON and OFF will affect the SERVOPACK control signal lines and could cause incorrect signals.

## 2.3.3 Absolute Encoder Battery

Use the ER6VLY+DF3 battery for absolute encoders.

**⚠ CAUTION**

- Purchase a battery for the absolute encoder separately and mount it on the power regeneration converter.
- A lithium battery is used for the absolute encoder. Confirm the most current IATA dangerous goods regulations before transporting the battery as air cargo.

## 2.3.4 AC Reactor

Make sure to install an AC reactor, which corresponds to the capacity of the individual power regeneration converter, to each power regeneration converter.
Do not connect any equipment other than the power regeneration converter to the secondary side of the AC reactor. If this caution is not observed, an overcurrent may occur in the power regeneration converter. An AC reactor is effective in improving the power factor of the power supply side.

Select an AC reactor based on the following table. For details, refer to *5.2 AC Reactor*.

<table>
<tr><th colspan="2">Power Regeneration Converter</th><th rowspan="2">AC Reactor Model</th></tr>
<tr><th>Input Voltage</th><th>Model</th></tr>
<tr><td rowspan="6">Three-phase, 200 VAC</td><td>CACP-JU15A3□</td><td>X008017</td></tr>
<tr><td>CACP-JU19A3□</td><td>X008018</td></tr>
<tr><td>CACP-JU22A3□</td><td>X008019</td></tr>
<tr><td>CACP-JU30A3□</td><td>X008020</td></tr>
<tr><td>CACP-JU37A3B</td><td>X008029</td></tr>
<tr><td>CACP-JU45A3B</td><td>X008022</td></tr>
<tr><td rowspan="5">Three-phase, 400 VAC</td><td rowspan="2">CACP-JU15D3□</td><td>X008010*</td></tr>
<tr><td>X008023</td></tr>
<tr><td>CACP-JU19D3□</td><td>X008011</td></tr>
<tr><td>CACP-JU22D3□</td><td>X008012</td></tr>
<tr><td>CACP-JU45D3B</td><td>X008024</td></tr>
</table>

* This AC reactor does not comply with UL standards.

## 2.3.5 Magnetic Contactor for Winding Selection

A magnetic contactor for winding selection is needed only if a winding selection motor is used as the spindle motor.

Select a magnetic contactor for winding selection based on the following table. For details, refer to *5.3 Magnetic Contactor for Winding Selection*.

<table>
<tr><th colspan="2">SERVOPACK</th><th colspan="2">Magnetic Contactor for Winding Selection</th></tr>
<tr><th rowspan="2">Input Voltage</th><th rowspan="2">Model</th><th>Standard</th><th>For UL Compliance</th></tr>
<tr><th>Model</th><th>Model</th></tr>
<tr><td rowspan="7">270 VDC</td><td>CACR-JU028ACA</td><td rowspan="3">HV-75AP4</td><td rowspan="3">HV-75AP4/UL</td></tr>
<tr><td>CACR-JU036ACA</td></tr>
<tr><td>CACR-JU065ACA</td></tr>
<tr><td>CACR-JU084ACA</td><td rowspan="3">HV-150AP4</td><td rowspan="3">HV-150AP4/UL</td></tr>
<tr><td>CACR-JU102ACA</td></tr>
<tr><td>CACR-JU125ACA</td></tr>
<tr><td>CACR-JU196ACA</td><td>HV-200AP4</td><td>HV-200AP4/UL</td></tr>
<tr><td rowspan="5">540 VDC</td><td>CACR-JU014DCA</td><td rowspan="3">HV-75AP4</td><td rowspan="3">HV-75AP4/UL</td></tr>
<tr><td>CACR-JU018DCA</td></tr>
<tr><td>CACR-JU033DCA</td></tr>
<tr><td>CACR-JU042DCA</td><td rowspan="2">HV-150AP4</td><td rowspan="2">HV-150AP4/UL</td></tr>
<tr><td>CACR-JU051DCA</td></tr>
</table>

## 2.3.6 Noise Filter

A noise filter installed on the power supply side eliminates noise leaking from the main circuit power line to the Σ-V-SD driver. The filter also reduces the noise leaking from the Σ-V-SD driver to the main circuit power line.
Use a noise filter designed to suppress harmonic noise. Do not use general-purpose noise filters, because their effectiveness is minimal when used with the Σ-V-SD driver.
Install a noise filter at the input side of the power regeneration converter.

Yaskawa recommends the following noise filters. For details, refer to *5.4 Noise Filter*.

| Power Regeneration Converter | | Noise Filter Model |
|---|---|---|
| Input Voltage | Model | |
| Three-phase, 200 VAC | CACP-JU15A3□ | HF3060C-SZC-47EDD |
| | CACP-JU19A3□ | HF3080C-SZC-47EDD |
| | CACP-JU22A3□ | HF3100C-SZC-47EDD |
| | CACP-JU30A3□ | HF3150C-SZC-47EDD |
| | CACP-JU37A3B | |
| | CACP-JU45A3B | HF3200C-SZC-49EDE* |
| Three-phase, 400 VAC | CACP-JU15D3□ | HF3030C-SZC-47DDD |
| | CACP-JU19D3□ | HF3040C-SZC-47EDD |
| | CACP-JU22D3□ | HF3050C-SZC-47EDD |
| | CACP-JU45D3B | HF3100C-SZC-47EDD |

* Also use the following compact AC power supply block-type capacitor (X capacitor).
Compact AC power supply block-type capacitor (X capacitor) model: LDA106M-AA (from Soshin Electric Co., Ltd.)

IMPORTANT

Some noise filters have large leakage currents. Leakage current is also greatly affected by ground conditions. If you use a ground fault detector, consider the ground conditions and the leakage current of the noise filter when you select one.
Ask the manufacturer of the noise filter for details.

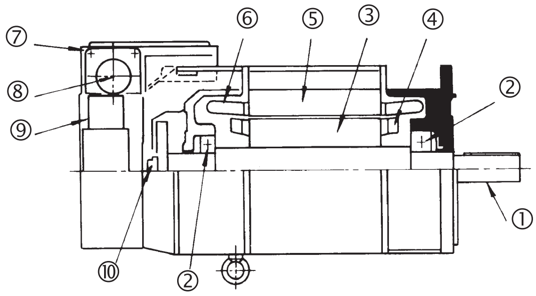
# 3

# Specifications and External Dimensions for Motors

# 3.1 Spindle Motor

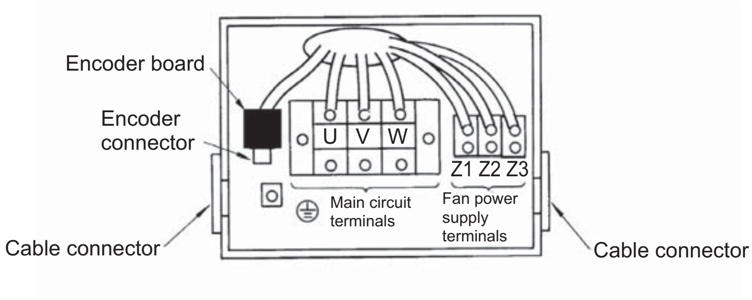
## 3.1.1 Configuration

The motor configuration is shown in the following diagram.



Motor Configuration

| Number | Name | Number | Name |
|---|---|---|---|
| ① | Output shaft | ⑥ | Stator winding |
| ② | Bearings | ⑦ | Terminal box |
| ③ | Rotor | ⑧ | Cable socket |
| ④ | Rotor short-circuit ring | ⑨ | Cooling fan |
| ⑤ | Stator | ⑩ | Encoder |




Terminal and Connector Arrangement

Encoder Connector

| Number | Terminal | Number | Terminal |
|---|---|---|---|
| 1 | DC+5 V | 7 | PC |
| 2 | 0 V | 8 | /PC |
| 3 | PA | 9 | FG (Frame Ground) |
| 4 | /PA | 10 | SS (Shield) |
| 5 | PB | 11 | TS |
| 6 | /PB | 12 | |

Model: ELR-12V
Manufacturer: J.S.T.Mfg.Co.,Ltd.
Note: A crimp tool is required.

Motor Connector

## 3.1.2 Ratings and Specifications

### (1) Single-winding Motor

| Item | | Model: UAKAJ-□□C (200 V), -□□C□□□□E (400 V) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 04 | 06 | 08 | 11 | 15 | 19 | 22 | 30[*2] | 37[*2] | 45 |
| 50% ED Rating (S3)[*1] | kW | 3.7 | 5.5 | 7.5 | 11 | 15 | 18.5 | 22 | 30 | 37 | 45 |
| Continuous Rating (S1) | kW | 2.2 | 3.7 | 5.5 | 7.5 | 11 | 15 | 18.5 | 22 | 30 | 37 |
| Continuous Rated Torque | N·m | 14 | 24 | 35 | 48 | 70 | 96 | 118 | 183 | 249 | 307 |
| Base Speed | $min^{-1}$ | 1500 | | | | | | | 1150 | | |
| Maximum Speed | $min^{-1}$ | 10000 | | | | 7000 | | | 6000 | | 5000 |
| Moment of Inertia | $\times 10^{-3}$ kg·m$^2$ | 7.1 | 14.0 | 21.0 | 25.0 | 69.0 | 69.0 | 89.0 | 231 | 266 | 398 |
| Vibration | | V5 | | | | | | | | | V10 |
| Noise | dB (A) | 75 or less | | | | | | | 80 or less | | |
| Cooling Method | | Totally enclosed, external fan cooled | | | | | | | | | |
| Protection Class | | IP44 (IEC 60034-5) | | | | | | | | | |
| Cooling Fan Motor | | Equipped with thermostat (automatic reset)<br>200 V class: Three-phase 200 V 50/60 Hz, 220 V 50/60 Hz, 230 V 60 Hz<br>400 V class: Three-phase 400 V 50/60 Hz, 440 V 50/60 Hz, 460 V 60 Hz | | | | | | | | | |
| Encoder (Magnetic) | | Pulse encoder (1024 p/r) (standard)<br>Serial encoder (17-bit) | | | | | | | | | |
| Overheating Protection | | NTC thermistor | | | | | | | | | |
| Installation | | Flange type: IM B5, IM V1 (output shaft from horizontal to vertically down)<br>Foot-mounted type: IM B3 (installed on floor) | | | | | | | | | |
| Overload Capacity | | 200% of continuous rated (S1) output for 10 s (UAKAJ-08, -37: 180% of continuous rated (S1) output for 10 s) | | | | | | | | | |
| Thermal Class | | F | | | | | | | | | |
| Withstand Voltage | | 200 V class: 1500 VAC for one minute<br>400 V class: 1800 VAC for one minute | | | | | | | | | |
| Insulation Resistance | | 500 V DC 10 MΩ min. | | | | | | | | | |
| Ambient Temperature and Ambient Humidity | | 0 to 40°C, 20% to 80% RH or less (no condensation) | | | | | | | | | |
| Altitude | | 1000 m or less | | | | | | | | | |
| Bearing Lubrication | | Grease | | | | | | | | | |
| Paint Color | | Munsell N1.5 | | | | | | | | | |
| Compliant Standards | | JIS, JEC | | | | | | | | | |
| Applicable SERVOPACK CACR-JU□□□ | Three-phase, 200 VAC | 028A | 028A | 036A | 065A | 065A | 084A | 102A | 125A | 196A | 196A |
| | Three-phase, 400 VAC | 014D | 014D | 018D | 033D | 033D | 042D | 051D | – | – | 098D |

*1. The 50% ED rating (S3) is for a 10 minute cycle consisting of 5 minutes of operation and 5 minutes stopped.
*2. Available only for three-phase, 200 VAC models.

Specifications and External Dimensions for Motors

3

## (2) Winding Selection Motor

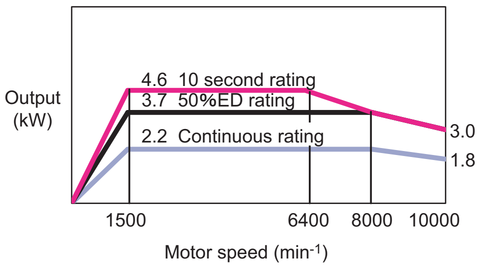
| Item | | Model: UAKBJ-□□C (200 V), -□□C□□□□E (400 V) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 06 | 08 | 11 | 15 | 19 | 22 | 30[*2] |
| 50% ED Rating (S3)[*1] | kW | 5.5 | 7.5 | 11 | 15 | 18.5 | 22 | 30 |
| Continuous Rating (S1) | kW | 3.7 | 5.5 | 7.5 | 11 | 15 | 18.5 | 20 |
| Continuous Rated Torque | N·m | 71 | 105 | 143 | 263 | 249 | 307 | 332 |
| Base Speed | $min^{-1}$ | 500 | | | 400 | 575 | | |
| Maximum Speed | $min^{-1}$ | 7000 | | | 6000 | | | 5000 |
| Moment of Inertia | $\times 10^{-3}$ kg·m$^2$ | 69.0 | 69.0 | 89.0 | 231.0 | 231.0 | 266.0 | 398.0 |
| Vibration | | V5 | | | | | | V10 |
| Noise | dB (A) | 75 or less | | | 80 or less | | | |
| Cooling Method | | Totally enclosed, external fan cooled | | | | | | |
| Protection Class | | IP44 (IEC 60034-5) | | | | | | |
| Cooling Fan Motor | | Equipped with thermostat (automatic reset)<br>200 V class: Three-phase 200 V 50/60 Hz, 220 V 50/60 Hz, 230 V 60 Hz<br>400 V class: Three-phase 400 V 50/60 Hz, 440 V 50/60 Hz, 460 V 60 Hz | | | | | | |
| Encoder (Magnetic) | | Pulse encoder (1024 p/r) (standard)<br>Serial encoder (17-bit) | | | | | | |
| Overheating Protection | | NTC thermistor | | | | | | |
| Installation | | Flange type: IM B5, IM V1 (output shaft from horizontal to vertically down)<br>Foot-mounted type: IM B3 (installed on floor) | | | | | | |
| Overload Capacity | | 200% of continuous rated (S1) output for 10 s | | | | | | |
| Thermal Class | | F | | | | | | |
| Withstand Voltage | | 200 V class: 1500 VAC for one minute<br>400 V class: 1800 VAC for one minute | | | | | | |
| Insulation Resistance | | 500 V DC 10 MΩ min. | | | | | | |
| Ambient Temperature and Ambient Humidity | | 0 to 40°C, 95% RH or less (no condensation) | | | | | | |
| Altitude | | 1000 m or less | | | | | | |
| Bearing Lubrication | | Grease | | | | | | |
| Paint Color | | Munsell N1.5 | | | | | | |
| Compliant Standards | | JIS, JEC | | | | | | |
| Applicable SERVOPACK CACR-JU□□□ | Three-phase, 200 VAC | 028A | 036A | 065A | 065A | 084A | 102A | 125A |
| | Three-phase, 400 VAC | 014D | 018D | 033D | 033D | 042D | 051D | – |

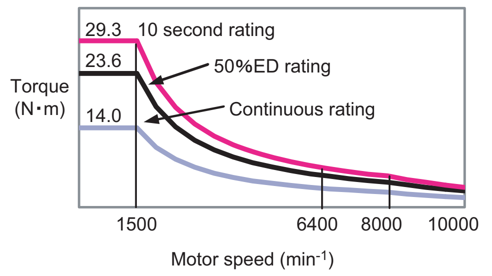
∗1. The 50% ED rating (S3) is for a 10 minute cycle consisting of 5 minutes of operation and 5 minutes stopped.
∗2. Available only for three-phase, 200 VAC models.

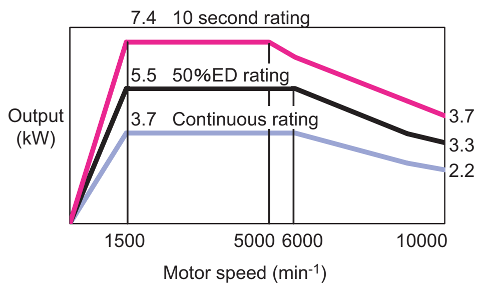
## 3.1.3 Output and Torque Characteristics

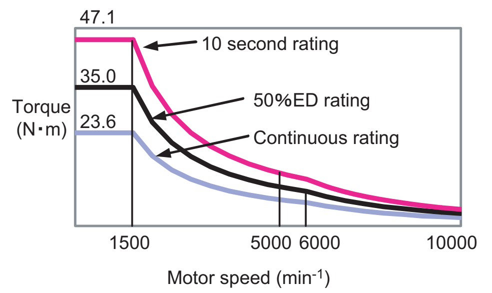
The output and torque characteristics for spindle motors are shown below.

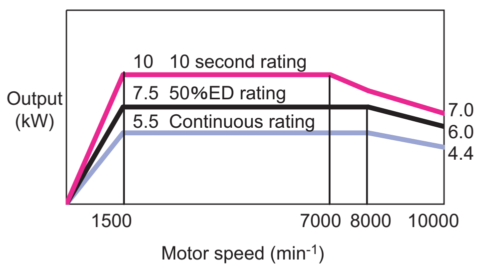
### (1) Single-winding Motors

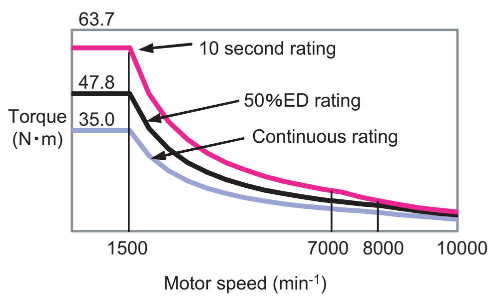
<table>
<tr><th>Model UAKAJ-</th><th>Output Characteristics</th><th>Torque Characteristics</th></tr>
<tr><td>04C</td><td>


</td><td>


</td></tr>
<tr><td>06C</td><td>


</td><td>


</td></tr>
<tr><td>08C</td><td>


</td><td>


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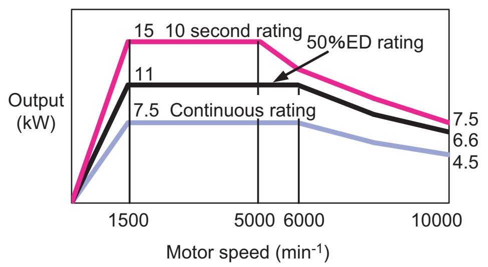

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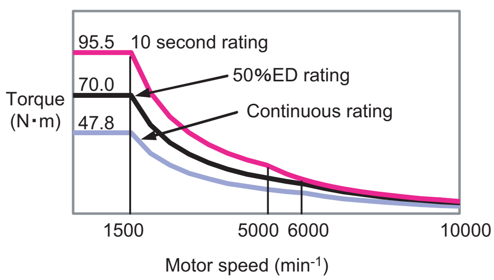

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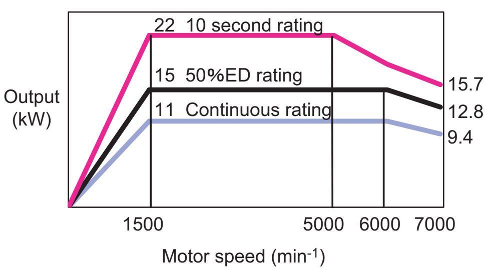

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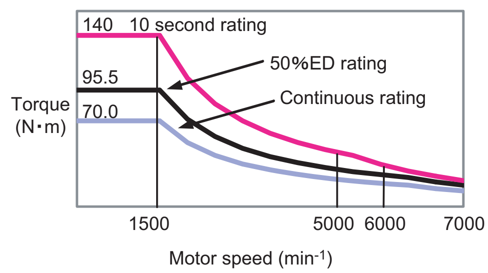

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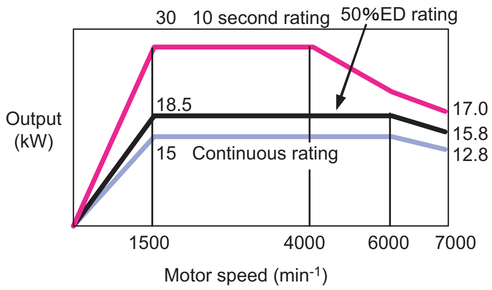
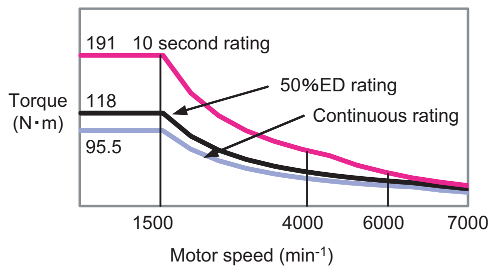
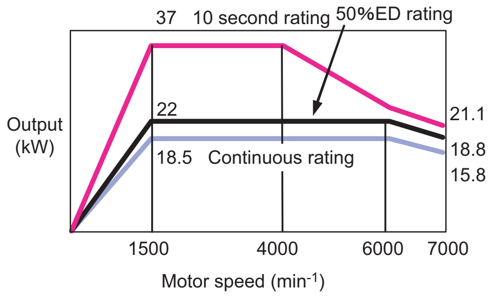
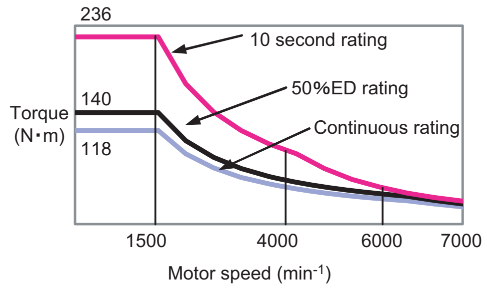
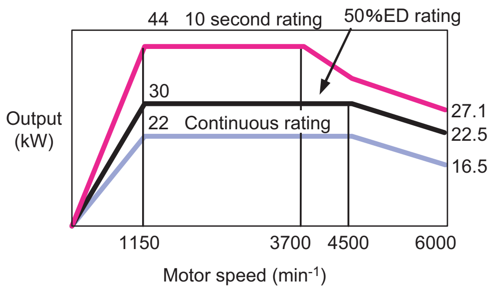
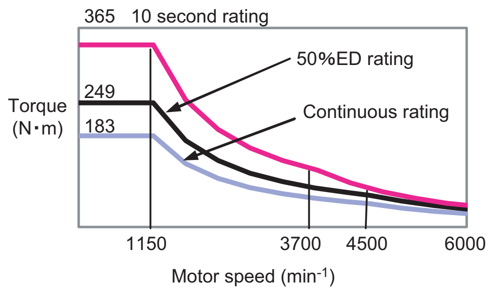
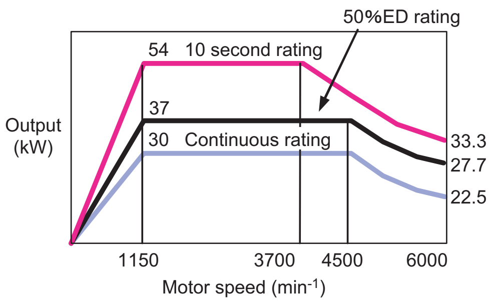
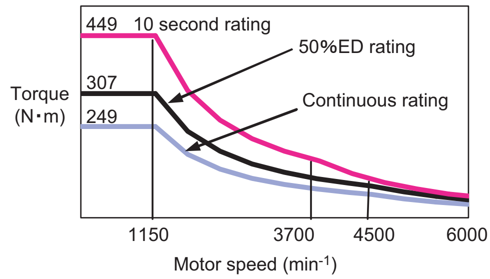
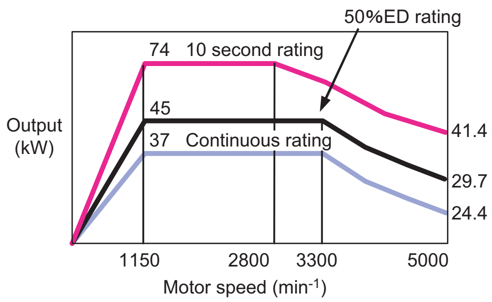
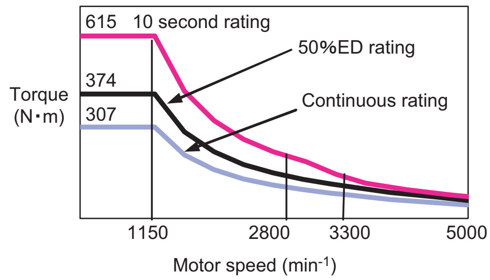
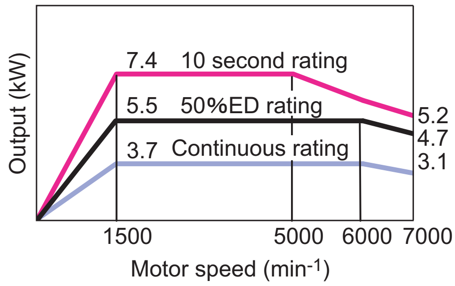
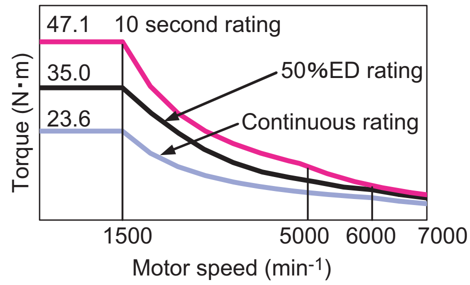
Specifications and External Dimensions for Motors

3

(cont'd)

| Model UAKAJ- | Output Characteristics | Torque Characteristics |
|---|---|---|
| 19C |  |  |
| 22C |  |  |
| 30C |  |  |
| 37C |  |  |
| 45C |  |  |

## (2) Winding Selection Motors

<table>
<tr><th>Model UAKBJ-</th><th>Output Characteristics</th><th>Torque Characteristics</th></tr>
<tr><td rowspan="2">06C</td><td>High-speed winding<br>
</td><td>High-speed winding<br>
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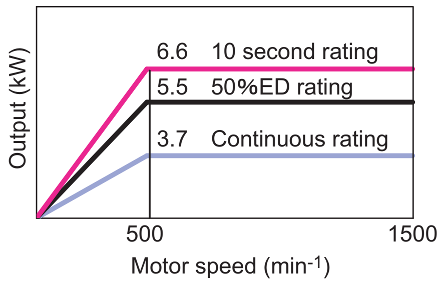
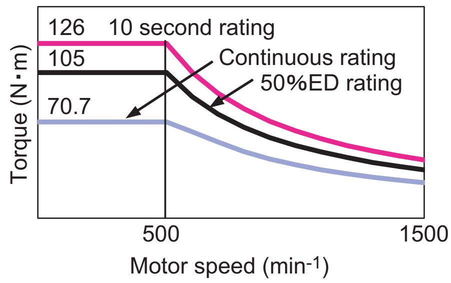
<tr><td>Low-speed winding<br>
</td><td>Low-speed winding<br>
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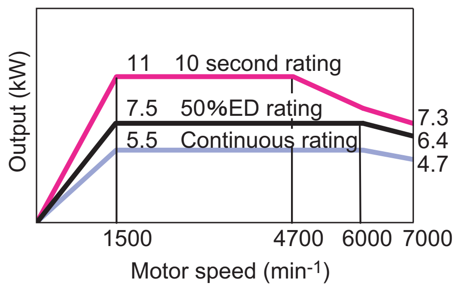
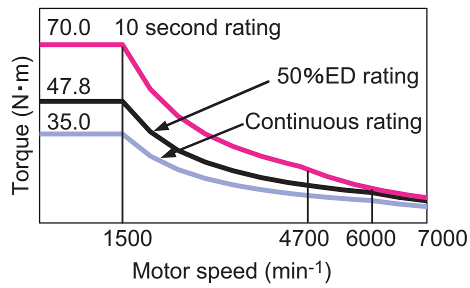
<tr><td rowspan="2">08C</td><td>High-speed winding<br>
</td><td>High-speed winding<br>
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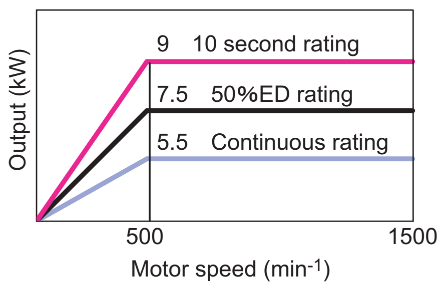
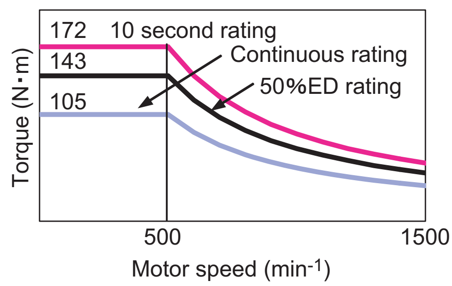
<tr><td>Low-speed winding<br>
</td><td>Low-speed winding<br>
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<table>
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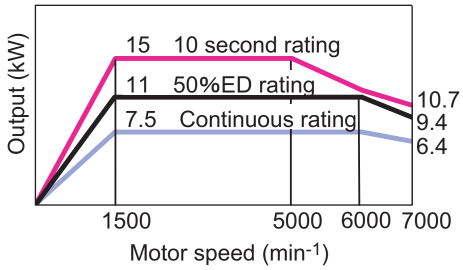
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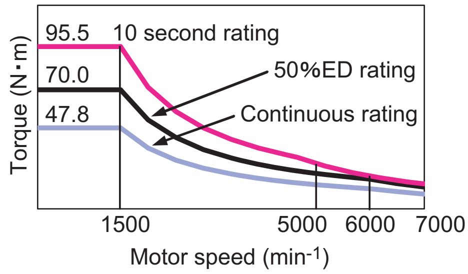
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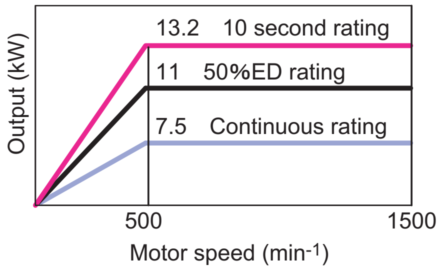
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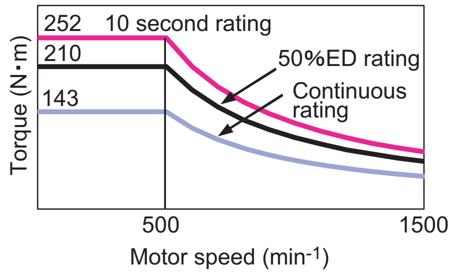
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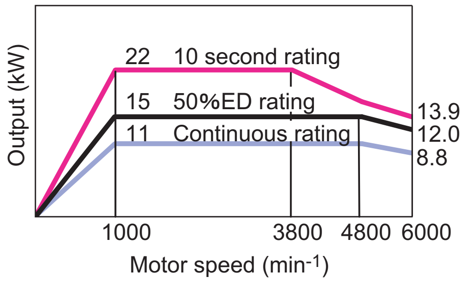
<tr><td rowspan="2">15C</td><td>High-speed winding

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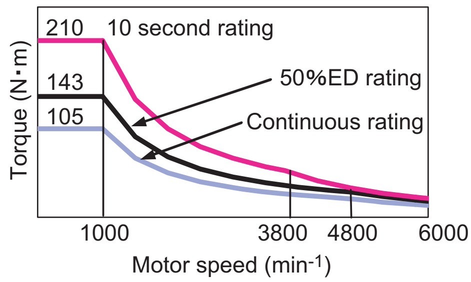
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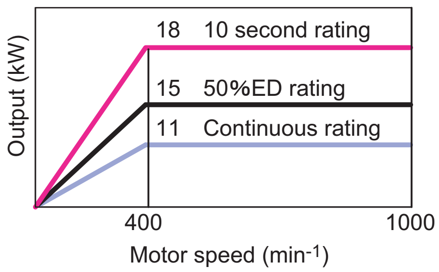
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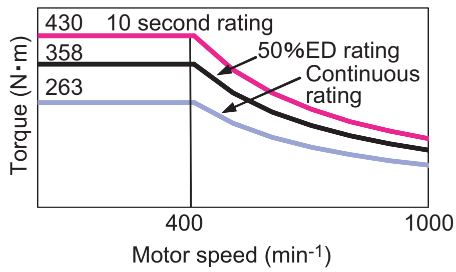
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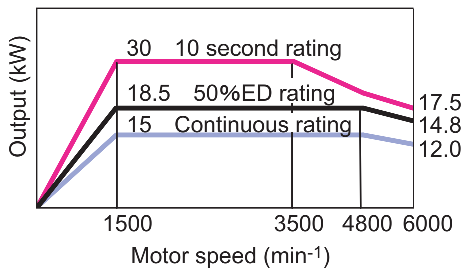
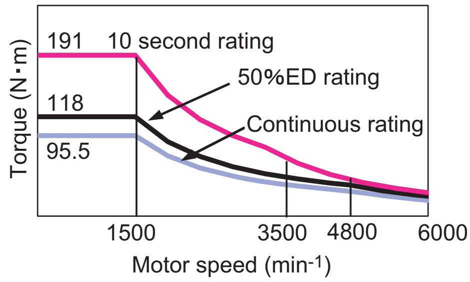
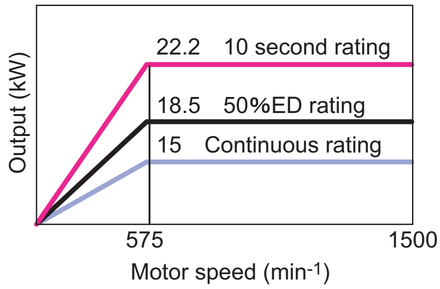
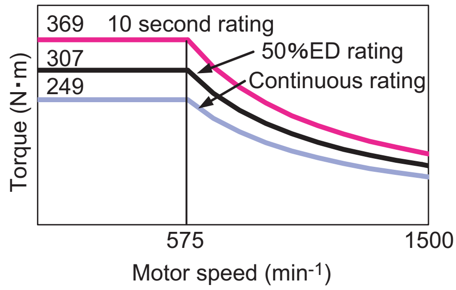
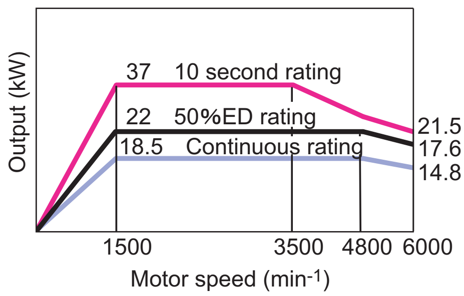
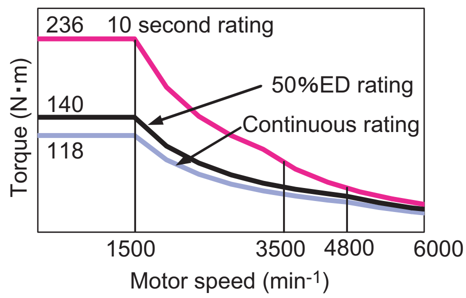
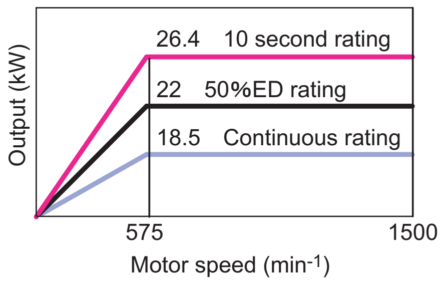
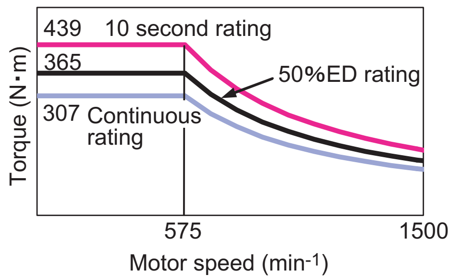
| Model UAKBJ- | Output Characteristics | Torque Characteristics |
|---|---|---|
| 19C | High-speed winding<br> | High-speed winding<br> |
| | Low-speed winding<br> | Low-speed winding<br> |
| 22C | High-speed winding<br> | High-speed winding<br> |
| | Low-speed winding<br> | Low-speed winding<br> |

Specifications and External Dimensions for Motors

3

(cont'd)

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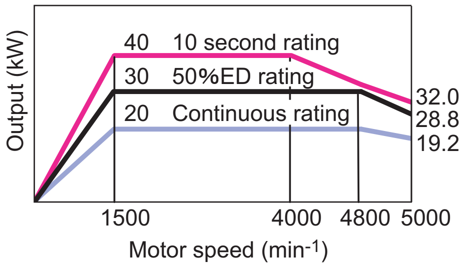
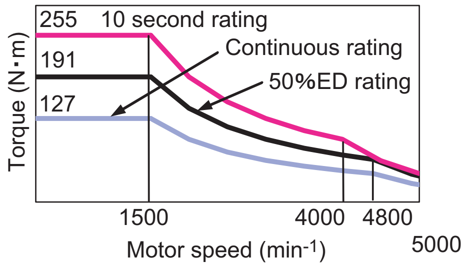
<tr><td rowspan="2">30C</td><td>High-speed winding<br>
</td><td>High-speed winding<br>
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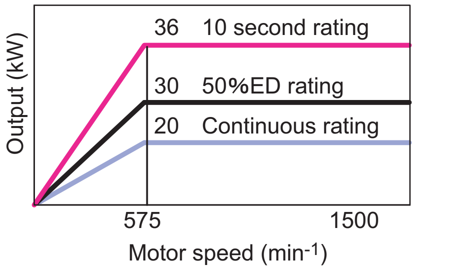
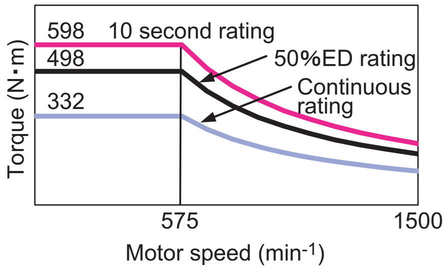
<tr><td>Low-speed winding<br>
</td><td>Low-speed winding<br>
</td></tr>
</table>

## 3.1.4 Tolerance Radial Loads

The tolerance radial loads for spindle motors are shown in the following table.

| Model: UAKAJ-, UAKBJ- | Rated Output (kW) 50%ED Rating/ Continuous Rating | Tolerance Radial Load (N) | |
|---|---|---|---|
| | | Single-winding Motor Model: UAKAJ-□□C | Winding Selection Motor Model: UAKBJ-□□C |
| 04 | 3.7/2.2 | 1180 | – |
| 06 | 5.5/3.7 | 1180 | 2940 |
| 08 | 7.5/5.5 | 1470 | 2940 |
| 11 | 11/7.5 | 1470 | 3530 |
| 15 | 15/11 | 2940 | 4410 |
| 19 | 18.5/15 | 2940 | 4410 |
| 22 | 22/18.5 | 3530 | 4900 |
| 30*1 | 30/22*2 | 4410 | 5200 |
| 37*1 | 37/30 | 4900 | – |
| 45 | 45/37 | 5200 | – |

*1. Available only for three-phase, 200 VAC models.
*2. The rated output for the winding selection motor is 30/20 kW.

## 3.1.5 Motor Total Indicator Readings

The motor TIR (Total Indicator Reading) are shown in the following tables.

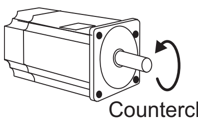
### (1) Flange Type

| Item | Model | | Accuracy |
|---|---|---|---|
| | Single-winding Motor: UAKAJ-□□ | Winding Selection Motor: UAKBJ-□□ | |
| Right Angle to the Flange Output Shaft | 04 to 22 | 06 to 11 | 0.04 mm |
| | 30, 37 | 15 | 0.06 mm |
| | 45 | 19 to 30 | 0.072 mm |
| Coaxiality of Flange External Diameter to the Output Shaft | 04 to 11 | – | 0.04 mm |
| | 15 to 22 | 06 to 11 | 0.046 mm |
| | 30, 37 | 15 | 0.048 mm |
| | 45 | 19 to 30 | 0.070 mm |
| Shaft Vibration | 04 to 08 | – | 0.02 mm |
| | 11 to 22 | 06 to 11 | 0.022 mm |
| | 30 to 45 | 15 to 30 | 0.028 mm |

### (2) Foot-mounted Type

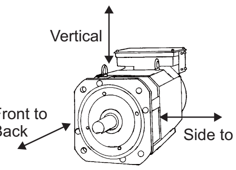
| Item | Model | | Accuracy |
|---|---|---|---|
| | Single-winding Motor: UAKAJ-□□ | Winding Selection Motor: UAKBJ-□□ | |
| Shaft Parallelism | 04 to 08 | – | 0.03 mm |
| | 11 to 22 | 06 to 11 | 0.033 mm |
| | 30 to 45 | 15 to 30 | 0.042 mm |
| Shaft Vibration | 04 to 08 | – | 0.02 mm |
| | 11 to 22 | 06 to 11 | 0.022 mm |
| | 30 to 45 | 15 to 30 | 0.028 mm |

## 3.1.6 Rotation Direction




Forward rotation of the spindle motor is counterclockwise when viewed from the load. The rotation direction can be reversed with parameter Pn000.0. For details, refer to *8.4.1 Servomotor Rotation Direction*.

## 3.1.7 Vibration Resistance



Impact Applied to the Spindle Motor

The spindle motor will withstand the following vibration acceleration in three directions: Vertical, side to side, and front to back.

| Spindle Motor | | Vibration Acceleration at Flange | Vibration Frequency | |
|---|---|---|---|---|
| Winding System | Model | | Constant Amplitude | Constant Acceleration |
| Single winding | UAKAJ-04 to -22 | 24.5 m/s$^2$ | 10 to 60 Hz | 6 to 2500 Hz |
| | UAKAJ-30, -37 | 19.6 m/s$^2$ | | |
| | UAKAJ-45 | 4.9 m/s$^2$ | | |
| Winding Selection | UAKBJ-08, -11 | 24.5 m/s$^2$ | | |
| | UAKBJ-15 to -22 | 19.6 m/s$^2$ | | |
| | UAKBJ-30 | 4.9 m/s$^2$ | | |

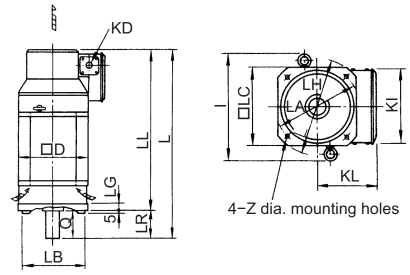
IMPORTANT

The amount of vibration the spindle motor endures will vary depending on the application. Check the vibration acceleration being applied to your motor for each application.

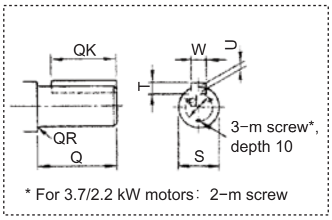
## 3.1.8 External Dimensions

### (1) Single-winding Motors

■ Flange type




Shaft Extension




Unit: mm

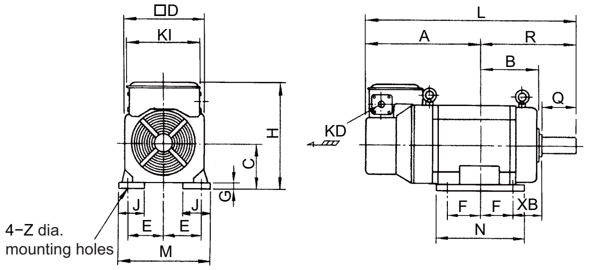
Unit: mm

| Model UAKAJ- | L | LA | LB | LC | LG | LH | LL | LR | Z | D | I | KD | KL | KI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 04 | 375 | 185 | $150^{0}_{-0.04}$ | 174 | 12 | 220 | 315 | 60 | 11 | 174 | 227 | 34 | 142 | 174 |
| 06 | 467 | 185 | $150^{0}_{-0.04}$ | 174 | 12 | 220 | 407 | 60 | 11 | 174 | 227 | 34 | 142 | 174 |
| 08 | 496 | 215 | $180^{0}_{-0.04}$ | 204 | 16 | 250 | 416 | 80 | 15 | 204 | 270 | 42.5 | 158 | 207 |
| 11 | 556 | 215 | $180^{0}_{-0.04}$ | 204 | 16 | 250 | 446 | 110 | 15 | 204 | 270 | 42.5 | 158 | 207 |
| 15 | 568 | 265 | $230^{0}_{-0.046}$ | 250 | 20 | 300 | 458 | 110 | 15 | 260 | 343 | 42.5 | 181 | 250 |
| 19 | 568 | 265 | $230^{0}_{-0.046}$ | 250 | 20 | 300 | 458 | 110 | 15 | 260 | 343 | 42.5 | 181 | 250 |
| 22 | 632 | 265 | $230^{0}_{-0.046}$ | 250 | 20 | 300 | 522 | 110 | 15 | 260 | 343 | 42.5 | 181 | 250 |
| 30 | 769 | 350 | $300^{0}_{-0.052}$ | 320 | 20 | 385 | 629 | 140 | 19 | 320 | 440 | 61 | 227 | 320 |
| 37 | 809 | 350 | $300^{0}_{-0.052}$ | 320 | 20 | 385 | 669 | 140 | 19 | 320 | 440 | 61 | 227 | 320 |
| 45 | 797 | 400 | $350^{0}_{-0.057}$ | 370 | 22 | 450 | 657 | 140 | 24 | 380 | 504 | 61 | 315 | 388 |

| Model UAKAJ- | Shaft End Dimensions | | | | | | | | | Approx. Mass kg |
|---|---|---|---|---|---|---|---|---|---|---|
| | Q | QK | QR | S | T | U | W | d | m | |
| 04 | 60 | 45 | 1 | $28^{0.009}_{-0.004}$ | 7 | 4 | 8 | 16 | M6 | 29 |
| 06 | 60 | 45 | 1 | $28^{0}_{-0.013}$ | 7 | 4 | 8 | 22 | M4 | 47 |
| 08 | 80 | 70 | 2 | $32^{0}_{-0.016}$ | 8 | 5 | 10 | 22 | M5 | 52 |
| 11 | 110 | 90 | 0.5 | $48^{0}_{-0.016}$ | 9 | 5.5 | 14 | 40 | M5 | 59 |
| 15 | 110 | 90 | 1 | $48^{0}_{-0.016}$ | 9 | 5.5 | 14 | 40 | M5 | 94 |
| 19 | 110 | 90 | 1 | $48^{0}_{-0.016}$ | 9 | 5.5 | 14 | 40 | M5 | 94 |
| 22 | 110 | 90 | 1 | $55^{0.030}_{0.011}$ | 10 | 6 | 16 | 45 | M5 | 120 |
| 30 | 140 | 110 | 2 | $60^{0.030}_{0.011}$ | 11 | 7 | 18 | 50 | M6 | 220 |
| 37 | 140 | 110 | 2 | $60^{0.030}_{0.011}$ | 11 | 7 | 18 | 50 | M6 | 250 |
| 45 | 140 | 110 | 1 | $70^{0.030}_{0.011}$ | 12 | 7.5 | 20 | 60 | M6 | 310 |

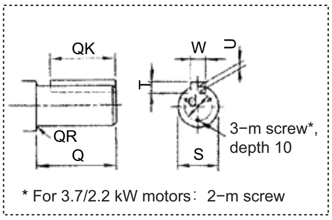
Note 1. The shaft key and the keyway are standard JIS B 1301-1996 models.
2. The figures are provided only to explain the dimensions. The actual appearance of the motor may vary.
3. The external shape of the terminal box for the serial encoder is different from the terminal box for the pulse encoder. Ask your Yaskawa representative for details.

## ■ Foot-mounted type




Shaft Extension

Unit: mm




Unit: mm

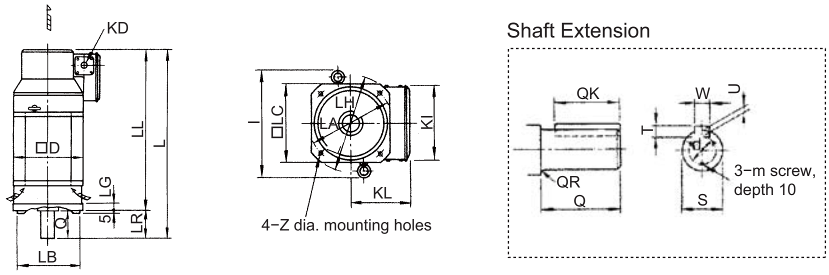
| Model UAKAJ- | A | B | C | D | E | F | G | H | J | KD | L | M | N | R |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 04 | 230 | 83 | $100^{0}_{-0.5}$ | 174 | 80 | 40 | 9 | 242 | 34 | 34 | 375 | 188 | 106 | 145 |
| 06 | 292 | 113 | $100^{0}_{-0.5}$ | 174 | 80 | 70 | 9 | 242 | 34 | 34 | 467 | 188 | 168 | 175 |
| 08 | 286 | 117 | $112^{0}_{-0.5}$ | 204 | 95 | 50 | 10 | 269 | 75 | 42.5 | 486 | 220 | 129 | 200 |
| 11 | 296 | 137 | $112^{0}_{-0.5}$ | 204 | 95 | 70 | 10 | 269 | 75 | 42.5 | 546 | 220 | 177 | 250 |
| 15 | 261 | 196 | $160^{0}_{-0.5}$ | 260 | 127 | 89 | 16 | 341 | 55 | 42.5 | 568 | 290 | 223 | 307 |
| 19 | 261 | 196 | $160^{0}_{-0.5}$ | 260 | 127 | 89 | 16 | 341 | 55 | 42.5 | 568 | 290 | 223 | 307 |
| 22 | 307 | 212 | $160^{0}_{-0.5}$ | 260 | 127 | 105 | 16 | 341 | 55 | 42.5 | 630 | 290 | 255 | 323 |
| 30 | 381 | 246 | $180^{0}_{-0.5}$ | 320 | 139.5 | 127 | 16 | 407 | 55 | 61 | 769 | 320 | 298 | 388 |
| 37 | 421 | 246 | $180^{0}_{-0.5}$ | 320 | 139.5 | 127 | 16 | 407 | 55 | 61 | 809 | 320 | 298 | 388 |
| 45 | 377 | 273 | $225^{0}_{-0.5}$ | 380 | 178 | 127 | 21 | 540 | 75 | 61 | 793 | 420 | 370 | 416 |

| Model UAKAJ- | XB | Z | KI | Shaft End Dimensions | | | | | | | | | Approx. Mass kg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Q | QK | QR | S | T | U | W | d | m | |
| 04 | 45 | 12 | 174 | 60 | 45 | 1 | $28^{0.009}_{-0.004}$ | 7 | 4 | 8 | 16 | M6 | 30 |
| 06 | 45 | 12 | 174 | 60 | 45 | 1 | $28^{0}_{-0.013}$ | 7 | 4 | 8 | 22 | M4 | 49 |
| 08 | 70 | 12 | 207 | 80 | 70 | 2 | $32^{0}_{-0.016}$ | 8 | 5 | 10 | 22 | M5 | 56 |
| 11 | 70 | 12 | 207 | 110 | 90 | 0.5 | $48^{0}_{-0.016}$ | 9 | 5.5 | 14 | 40 | M5 | 64 |
| 15 | 108 | 15 | 250 | 110 | 90 | 1 | $48^{0}_{-0.016}$ | 9 | 5.5 | 14 | 40 | M5 | 110 |
| 19 | 108 | 15 | 250 | 110 | 90 | 1 | $48^{0}_{-0.016}$ | 9 | 5.5 | 14 | 40 | M5 | 110 |
| 22 | 108 | 15 | 250 | 110 | 90 | 1 | $55^{0.030}_{0.011}$ | 10 | 6 | 16 | 45 | M5 | 130 |
| 30 | 121 | 19 | 320 | 140 | 110 | 2 | $60^{0.030}_{0.011}$ | 11 | 7 | 18 | 50 | M6 | 230 |
| 37 | 121 | 19 | 320 | 140 | 110 | 2 | $60^{0.030}_{0.011}$ | 11 | 7 | 18 | 50 | M6 | 260 |
| 45 | 149 | 24 | 388 | 140 | 110 | 1 | $70^{0.030}_{0.011}$ | 12 | 7.5 | 20 | 60 | M6 | 320 |

Note 1. The shaft key and the keyway are standard JIS B 1301-1996 models.
2. The figures are provided only to explain the dimensions. The actual appearance of the motor may vary.
3. The external shape of the terminal box for the serial encoder is different from the terminal box for the pulse encoder. Ask your Yaskawa representative for details.

## (2) Winding Selection Motors

### ■ Flange type




Unit: mm

Unit: mm

| Model UAKBJ- | L | LA | LB | LC | LG | LH | LL | LR | Z | D | I | KD | KL | KI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 06 | 568 | 265 | $230^{0}_{-0.046}$ | 250 | 20 | 300 | 458 | 110 | 15 | 260 | 343 | 42.5 | 181 | 250 |
| 08 | 568 | 265 | $230^{0}_{-0.046}$ | 250 | 20 | 300 | 458 | 110 | 15 | 260 | 343 | 42.5 | 181 | 250 |
| 11 | 632 | 265 | $230^{0}_{-0.046}$ | 250 | 20 | 300 | 522 | 110 | 15 | 260 | 343 | 42.5 | 181 | 250 |
| 15 | 769 | 350 | $300^{0}_{-0.052}$ | 320 | 20 | 385 | 629 | 140 | 19 | 320 | 440 | 61 | 227 | 320 |
| 19 | 769 | 350 | $300^{0}_{-0.052}$ | 320 | 20 | 385 | 629 | 140 | 19 | 320 | 440 | 61 | 227 | 320 |
| 22 | 809 | 350 | $300^{0}_{-0.052}$ | 320 | 20 | 385 | 669 | 140 | 19 | 320 | 440 | 61 | 227 | 320 |
| 30 | 797 | 400 | $350^{0}_{-0.057}$ | 370 | 22 | 450 | 657 | 140 | 24 | 380 | 504 | 61 | 315 | 388 |

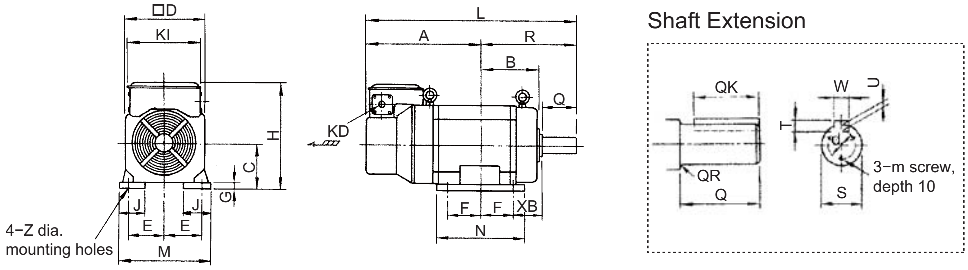
| Model UAKBJ- | Shaft End Dimensions | | | | | | | | | Approx. Mass kg |
|---|---|---|---|---|---|---|---|---|---|---|
| | Q | QK | QR | S | T | U | W | d | m | |
| 06 | 110 | 90 | 1 | $48^{0}_{-0.016}$ | 9 | 5.5 | 14 | 40 | M5 | 94 |
| 08 | 110 | 90 | 1 | $48^{0}_{-0.016}$ | 9 | 5.5 | 14 | 40 | M5 | 94 |
| 11 | 110 | 90 | 1 | $55^{0.030}_{0.011}$ | 10 | 6 | 16 | 45 | M5 | 120 |
| 15 | 140 | 110 | 2 | $60^{0.030}_{0.011}$ | 11 | 7 | 18 | 50 | M6 | 220 |
| 19 | 140 | 110 | 2 | $60^{0.030}_{0.011}$ | 11 | 7 | 18 | 50 | M6 | 220 |
| 22 | 140 | 110 | 2 | $60^{0.030}_{0.011}$ | 11 | 7 | 18 | 50 | M6 | 250 |
| 30 | 140 | 110 | 1 | $70^{0.030}_{0.011}$ | 12 | 7.5 | 20 | 60 | M6 | 310 |

Note 1. The shaft key and the keyway are standard JIS B 1301-1996 models.
2. The figures are provided only to explain the dimensions. The actual appearance of the motor may vary.
3. The external shape of the terminal box for the serial encoder is different from the terminal box for the pulse encoder. Ask your Yaskawa representative for details.

Specifications and External Dimensions for Motors

3

## ■ Foot-mounted type




Unit: mm

Unit: mm

| Model UAKBJ- | A | B | C | D | E | F | G | H | J | KD | L | M | N | R |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 06 | 261 | 196 | $160^{0}_{-0.5}$ | 260 | 127 | 89 | 16 | 341 | 55 | 42.5 | 568 | 290 | 223 | 307 |
| 08 | 261 | 196 | $160^{0}_{-0.5}$ | 260 | 127 | 89 | 16 | 341 | 55 | 42.5 | 568 | 290 | 223 | 307 |
| 11 | 307 | 212 | $160^{0}_{-0.5}$ | 260 | 127 | 105 | 16 | 341 | 55 | 42.5 | 630 | 290 | 255 | 323 |
| 15 | 381 | 246 | $180^{0}_{-0.5}$ | 320 | 139.5 | 127 | 16 | 407 | 55 | 61 | 769 | 320 | 298 | 388 |
| 19 | 381 | 246 | $180^{0}_{-0.5}$ | 320 | 139.5 | 127 | 16 | 407 | 55 | 61 | 769 | 320 | 298 | 388 |
| 22 | 421 | 246 | $180^{0}_{-0.5}$ | 320 | 139.5 | 127 | 16 | 407 | 55 | 61 | 809 | 320 | 298 | 388 |
| 30 | 376.5 | 273 | $225^{0}_{-0.5}$ | 380 | 178 | 127 | 21 | 540 | 75 | 61 | 792.5 | 420 | 370 | 416 |

| Model UAKBJ- | XB | Z | KI | Shaft End Dimensions | | | | | | | | | Approx. Mass kg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Q | QK | QR | S | T | U | W | d | m | |
| 06 | 108 | 15 | 250 | 110 | 90 | 1 | $48^{0}_{-0.016}$ | 9 | 5.5 | 14 | 40 | M5 | 110 |
| 08 | 108 | 15 | 250 | 110 | 90 | 1 | $48^{0}_{-0.016}$ | 9 | 5.5 | 14 | 40 | M5 | 110 |
| 11 | 108 | 15 | 250 | 110 | 90 | 1 | $55^{0.030}_{0.011}$ | 10 | 6 | 16 | 45 | M5 | 130 |
| 15 | 121 | 19 | 320 | 140 | 110 | 2 | $60^{0.030}_{0.011}$ | 11 | 7 | 18 | 50 | M6 | 230 |
| 19 | 121 | 19 | 320 | 140 | 110 | 2 | $60^{0.030}_{0.011}$ | 11 | 7 | 18 | 50 | M6 | 230 |
| 22 | 121 | 19 | 320 | 140 | 110 | 2 | $60^{0.030}_{0.011}$ | 11 | 7 | 18 | 50 | M6 | 260 |
| 30 | 149 | 24 | 388 | 140 | 110 | 1 | $70^{0.030}_{0.011}$ | 12 | 7.5 | 20 | 60 | M6 | 320 |

Note 1. The shaft key and the keyway are standard JIS B 1301-1996 models.
2. The figures are provided only to explain the dimensions. The actual appearance of the motor may vary.
3. The external shape of the terminal box for the serial encoder is different from the terminal box for the pulse encoder. Ask your Yaskawa representative for details.

# 3.2 Servomotors

## 3.2.1 Ratings and Specifications

Time Rating: Continuous
Vibration Class: V15
Insulation Resistance: 500 VDC, 10 MΩ min.
Ambient Temperature: 0 to 40°C
Excitation: Permanent magnet
Mounting: Flange-mounted
Thermal Class: F

Withstand Voltage: 1500 VAC for one minute (Three-phase, 200 V class)
1800 VAC for one minute (Three-phase, 400 V class)
Enclosure: Totally enclosed, self-cooled, IP67 (except for shaft opening)
Ambient Humidity: 20% to 80% (no condensation)
Drive Method: Direct drive
Rotation Direction: Counterclockwise (CCW) with forward run reference when viewed from the load side

### (1) 200 V class: Standard type

| Servomotor Model: SGMGV-□□A8A | | 05 | 09 | 13 | 20 | 30 | 44 | 55 | 75 |
|---|---|---|---|---|---|---|---|---|---|
| Rated Output* | kW | 0.45 | 0.85 | 1.3 | 1.8 | 2.9 | 4.4 | 5.5 | 7.5 |
| Rated Torque* | N·m | 2.86 | 5.39 | 8.34 | 11.5 | 18.6 | 28.4 | 35.0 | 48.0 |
| Instantaneous Peak Torque* | N·m | 8.92 | 13.8 | 23.3 | 28.7 | 45.1 | 71.1 | 87.6 | 119 |
| Rated Current* | Arms | 3.8 | 6.9 | 10.7 | 16.7 | 23.8 | 32.8 | 42.1 | 54.7 |
| Instantaneous Max. Current* | Arms | 11 | 17 | 28 | 42 | 56 | 84 | 110 | 130 |
| Rated Speed* | $min^{-1}$ | 1500 | | | | | | | |
| Max. Speed* | $min^{-1}$ | 3000 | | | | | | | |
| Torque Constant | N·m/Arms | 0.854 | 0.859 | 0.891 | 0.748 | 0.848 | 0.934 | 0.851 | 0.957 |
| Rotor Moment of Inertia | $\times 10^{-4}$ kg·m$^2$ | 3.33 (3.58) | 13.9 (16) | 19.9 (22) | 26 (28.1) | 46 (54.5) | 67.5 (76.0) | 89.0 (97.5) | 125 (134) |
| Rated Power Rate* | kW/s | 24.6 (22.8) | 20.9 (18.2) | 35.0 (31.6) | 50.9 (47.1) | 75.2 (63.5) | 119 (106) | 138 (126) | 184 (172) |
| Rated Angular Acceleration* | rad/s$^2$ | 8590 (7990) | 3880 (3370) | 4190 (3790) | 4420 (4090) | 4040 (3410) | 4210 (3740) | 3930 (3590) | 3840 (3580) |

* These items and torque-motor speed characteristics quoted in combination with a SERVOPACK are at an armature winding temperature of 20°C.

Note 1. The values in parentheses are for servomotors with holding brakes.
2. The above specifications show the values under the cooling condition when the following heat sinks are mounted on the servomotors.
SGMGV-05A : 250 mm × 250 mm × 6 mm (aluminum)
SGMGV-09A, -13A, -20A : 400 mm × 400 mm × 20 mm (iron)
SGMGV-30A, -44A, -55A, -75A : 550 mm × 550 mm × 30 mm (iron)

## (2) 200 V class: High-speed type

| Servomotor Model: SGMGV-□□A8M | | 05 | 09 | 13 | 20 | 30 | 44 | 55 | 75 |
|---|---|---|---|---|---|---|---|---|---|
| Rated Output* | kW | 0.45 | 0.85 | 1.3 | 1.8 | 2.9 | 4.4 | 5.5 | 7.5 |
| Rated Torque* | N·m | 2.86 | 5.39 | 8.34 | 11.5 | 18.6 | 28.4 | 35.0 | 48.0 |
| Instantaneous Peak Torque* | N·m | 9 | 20 | 30 | 46 | 60 | 92 | 107 | 130 |
| Rated Current* | Arms | 5.2 | 6.9 | 10.7 | 16.7 | 23.8 | 32.8 | 42.1 | 54.7 |
| Instantaneous Max. Current* | Arms | 17 | 28 | 40 | 75 | 81 | 110 | 136 | 140 |
| Rated Speed* | $min^{-1}$ | 1500 | | | | | | | |
| Max. Speed* | $min^{-1}$ | 5000 | 4000 | | | | | | |
| Torque Constant | N·m/Arms | 0.55 | 0.859 | 0.891 | 0.748 | 0.822 | 0.934 | 0.851 | 0.957 |
| Rotor Moment of Inertia | $\times 10^{-4}$ kg·m$^2$ | 3.33 (3.58) | 13.9 (16) | 19.9 (22) | 26 (28.1) | 46 (54.5) | 67.5 (76.0) | 89.0 (97.5) | 125 (134) |
| Rated Power Rate* | kW/s | 24.6 (22.8) | 20.9 (18.2) | 35.0 (31.6) | 50.9 (47.1) | 75.2 (63.5) | 119 (106) | 138 (126) | 184 (172) |
| Rated Angular Acceleration* | rad/s$^2$ | 8590 (7990) | 3880 (3370) | 4190 (3790) | 4420 (4090) | 4040 (3410) | 4210 (3740) | 3930 (3590) | 3840 (3580) |

* These items and torque-motor speed characteristics quoted in combination with a SERVOPACK are at an armature winding temperature of 20°C.

Note 1. The values in parentheses are for servomotors with holding brakes.
2. The above specifications show the values under the cooling condition when the following heat sinks are mounted on the servomotors.
SGMGV-05A : 250 mm × 250 mm × 6 mm (aluminum)
SGMGV-09A, -13A, -20A : 400 mm × 400 mm × 20 mm (iron)
SGMGV-30A, -44A, -55A, -75A : 550 mm × 550 mm × 30 mm (iron)

## (3) 400 V class: Standard type

| Servomotor Model: SGMGV-□□D8A | | 05 | 09 | 13 | 20 | 30 | 44 | 55 | 75 |
|---|---|---|---|---|---|---|---|---|---|
| Rated Output* | kW | 0.45 | 0.85 | 1.3 | 1.8 | 2.9 | 4.4 | 5.5 | 7.5 |
| Rated Torque* | N·m | 2.86 | 5.39 | 8.34 | 11.5 | 18.6 | 28.4 | 35.0 | 48.0 |
| Instantaneous Peak Torque* | N·m | 8.92 | 13.8 | 23.3 | 28.7 | 45.1 | 71.1 | 87.6 | 119 |
| Rated Current* | Arms | 1.9 | 3.5 | 5.4 | 8.4 | 11.9 | 16.5 | 20.8 | 25.7 |
| Instantaneous Max. Current* | Arms | 5.5 | 8.5 | 14 | 20 | 28 | 40.5 | 52 | 65 |
| Rated Speed* | $min^{-1}$ | 1500 | | | | | | | |
| Max. Speed* | $min^{-1}$ | 3000 | | | | | | | |
| Torque Constant | N·m/Arms | 1.71 | 1.72 | 1.78 | 1.50 | 1.70 | 1.93 | 1.80 | 1.92 |
| Rotor Moment of Inertia | $\times 10^{-4}$ kg·m$^2$ | 3.33 (3.58) | 13.9 (16) | 19.9 (22) | 26 (28.1) | 46 (54.5) | 67.5 (76.0) | 89.0 (97.5) | 125 (134) |
| Rated Power Rate* | kW/s | 24.6 (22.8) | 20.9 (18.2) | 35.0 (31.6) | 50.9 (47.1) | 75.2 (63.5) | 119 (106) | 138 (126) | 184 (172) |
| Rated Angular Acceleration* | rad/s$^2$ | 8590 (7990) | 3880 (3370) | 4190 (3790) | 4420 (4090) | 4040 (3410) | 4210 (3740) | 3930 (3590) | 3840 (3580) |

* These items and torque-motor speed characteristics quoted in combination with a SERVOPACK are at an armature winding temperature of 20°C.

Note 1. The values in parentheses are for servomotors with holding brakes.
2. The above specifications show the values under the cooling condition when the following heat sinks are mounted on the servomotors.
SGMGV-05D : 250 mm × 250 mm × 6 mm (aluminum)
SGMGV-09D, -13D, -20D : 400 mm × 400 mm × 20 mm (iron)
SGMGV-30D, -44D, -55D, -75D : 550 mm × 550 mm × 30 mm (iron)

## (4) 400 V class: High-speed type

| Servomotor Model: SGMGV-□□D8M | | 05 | 09 | 13 | 20 | 30 | 44 | 55 | 75 |
|---|---|---|---|---|---|---|---|---|---|
| Rated Output* | kW | 0.45 | 0.85 | 1.3 | 1.8 | 2.9 | 4.4 | 5.5 | 7.5 |
| Rated Torque* | N·m | 2.86 | 5.39 | 8.34 | 11.5 | 18.6 | 28.4 | 35.0 | 48.0 |
| Instantaneous Peak Torque* | N·m | 9 | 20 | 30 | 46 | 60 | 92 | 107 | 130 |
| Rated Current* | Arms | 2.6 | 3.5 | 5.4 | 8.4 | 11.9 | 16.5 | 20.8 | 25.7 |
| Instantaneous Max. Current* | Arms | 8.5 | 14 | 20 | 37.6 | 40.5 | 55 | 65 | 70 |
| Rated Speed* | $min^{-1}$ | 1500 | | | | | | | |
| Max. Speed* | $min^{-1}$ | 5000 | 4000 | | | | | | |
| Torque Constant | N·m/Arms | 1.13 | 1.72 | 1.78 | 1.50 | 1.64 | 1.93 | 1.80 | 1.92 |
| Rotor Moment of Inertia | $\times 10^{-4}$ kg·$m^2$ | 3.33 (3.58) | 13.9 (16) | 19.9 (22) | 26 (28.1) | 46 (54.5) | 67.5 (76.0) | 89.0 (97.5) | 125 (134) |
| Rated Power Rate* | kW/s | 24.6 (22.8) | 20.9 (18.2) | 35.0 (31.6) | 50.9 (47.1) | 75.2 (63.5) | 119 (106) | 138 (126) | 184 (172) |
| Rated Angular Acceleration* | rad/$s^2$ | 8590 (7990) | 3880 (3370) | 4190 (3790) | 4420 (4090) | 4040 (3410) | 4210 (3740) | 3930 (3590) | 3840 (3580) |

* These items and torque-motor speed characteristics quoted in combination with a SERVOPACK are at an armature winding temperature of 20°C.

Note 1. The values in parentheses are for servomotors with holding brakes.

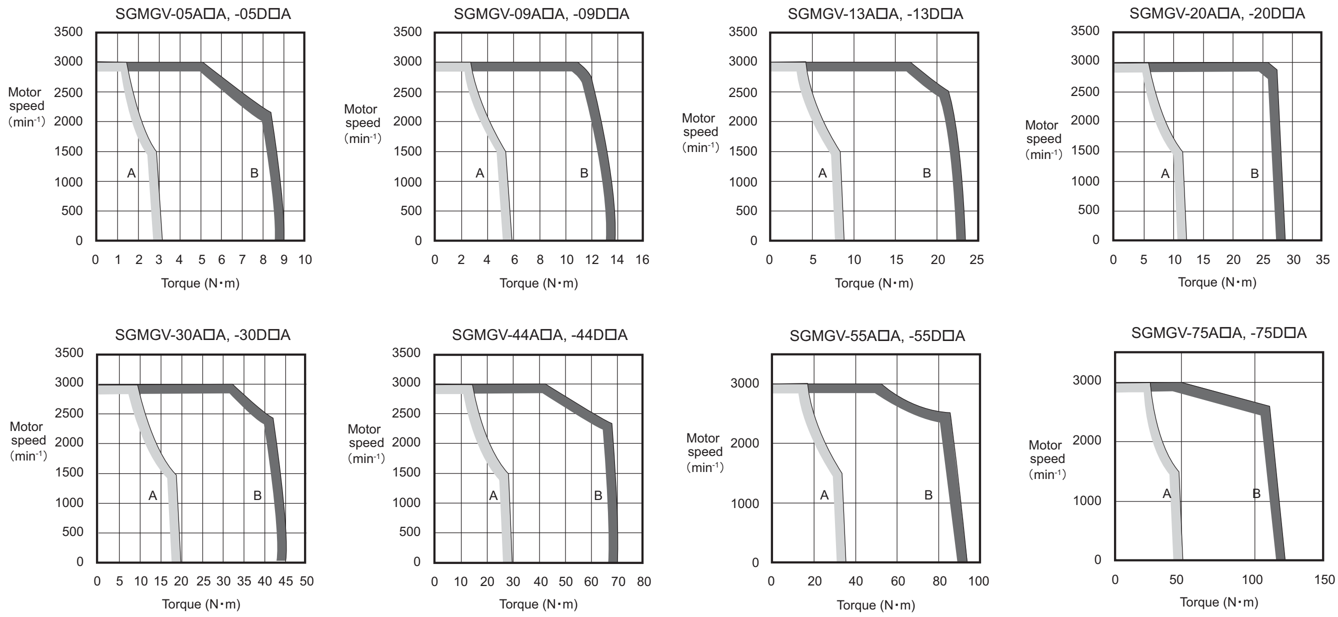
2. The above specifications show the values under the cooling condition when the following heat sinks are mounted on the servomotors.

| | |
|---|---|
| SGMGV-05D | : 250 mm × 250 mm × 6 mm (aluminum) |
| SGMGV-09D, -13D, -20D | : 400 mm × 400 mm × 20 mm (iron) |
| SGMGV-30D, -44D, -55D, -75D | : 550 mm × 550 mm × 30 mm (iron) |

## 3.2.2 Torque-Motor Speed Characteristics

### (1) 200 V, 400 V class: Standard type

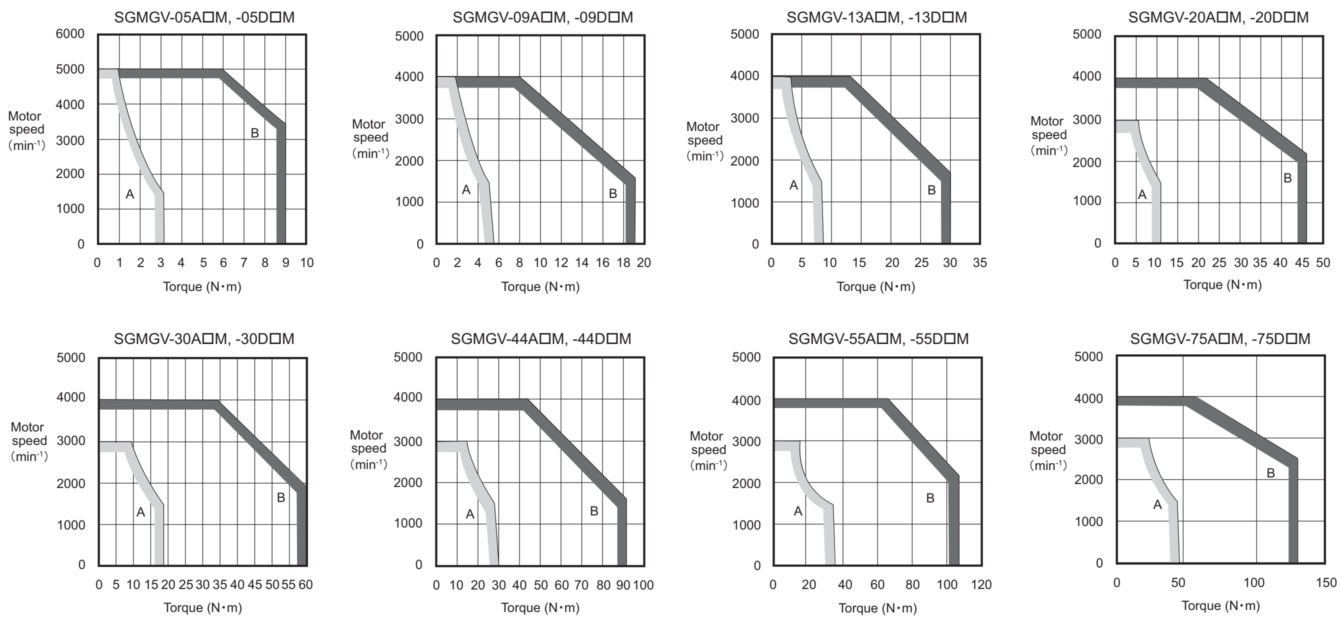
A : Continuous Duty Zone  B : Intermittent Duty Zone




Note 1. When the effective torque during intermittent duty is within the rated torque, the servomotor can be used within the intermittent duty zone.
2. When the main circuit cable length exceeds 20 m, the intermittent duty zone will shrink due to the voltage drop.
3. These torque-motor speed characteristics quoted in combination with a SERVOPACK are at an armature winding temperature of 20°C.

### (2) 200 V, 400 V class: High-speed type

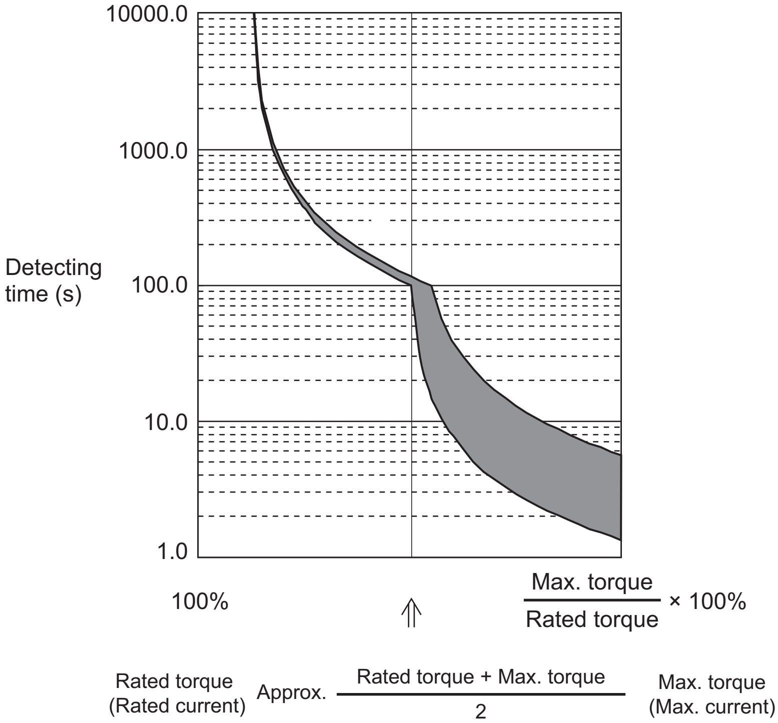
A : Continuous Duty Zone  B : Intermittent Duty Zone




Note 1. When the effective torque during intermittent duty is within the rated torque, the servomotor can be used within the intermittent duty zone.
2. When the main circuit cable length exceeds 20 m, the intermittent duty zone will shrink due to the voltage drop.
3. These torque-motor speed characteristics quoted in combination with a SERVOPACK are at an armature winding temperature of 20°C.

## 3.2.3 Overload Characteristics

The overload detection level is set under hot start* conditions at a servomotor surrounding air temperature of 40°C.




* A hot start indicates that both the SERVOPACK and the servomotor have run long enough at the rated load to be thermally saturated.

Note: Overload characteristics shown above do not guarantee continuous duty of 100% or more output. Use a servomotor with effective torque within the continuous duty zone in *3.2.2 Torque-Motor Speed Characteristics*.

## 3.2.4 Holding Brake Electrical Specifications

The holding brake electrical specifications are shown below. The holding brake is only used to hold the load and cannot be used to stop the servomotor.

| Servomotor Model | Servomotor Rated Output kW | Holding Brake Specifications | | | | |
|---|---|---|---|---|---|---|
| | | Holding Torque N·m | Rated Voltage 24 VDC | | Rated Voltage 90 VDC | |
| | | | Capacity W | Rated Current A (at 20°C) | Capacity W | Rated Current A (at 20°C) |
| SGMGV-05 | 0.45 | 4.5 | 10 | 0.42 | 10 | 0.11 |
| SGMGV-09 | 0.85 | 12.7 | 10 | 0.41 | 10 | 0.11 |
| SGMGV-13 | 1.3 | 19.6 | 10 | 0.41 | 10 | 0.11 |
| SGMGV-20 | 1.8 | 19.6 | 10 | 0.41 | 10 | 0.11 |
| SGMGV-30 | 2.9 | 43.1 | 18.5 | 0.77 | 18.5 | 0.21 |
| SGMGV-44 | 4.4 | 43.1 | 18.5 | 0.77 | 18.5 | 0.21 |
| SGMGV-55 | 5.5 | 72.6 | 25 | 1.05 | 25 | 0.28 |
| SGMGV-75 | 7.5 | 72.6 | 25 | 1.05 | 25 | 0.28 |

Note 1. For information on the holding brake power supply and connecting methods, refer to *8.4.3 (1) Wiring Example*.
2. The holding brake open time and holding brake operation time vary depending on which discharge circuit is used. Make sure holding brake open time and holding brake operation time are correct for your servomotor.

## 3.2.5 Allowable Load Moment of Inertia at the Motor Shaft

The rotor moment of inertia ratio is the value for a servomotor without a holding brake.

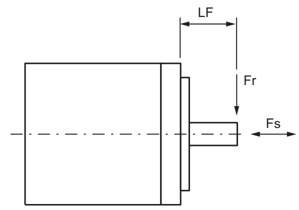
The larger the load moment of inertia, the worse the movement response of the load.
The allowable load moment of inertia ($J_L$) depends on the motor capacity, as shown below. This value is provided strictly as a guideline and results may vary depending on servomotor drive conditions.

| Servomotor Model | Servomotor Rated Output | Allowable Load Moment of Inertia (Rotor Moment of Inertia Ratio) |
|---|---|---|
| SGMGV-05 to -75 | 0.45 to 7.5 kW | 5 times |

An overvoltage alarm (A.400) is likely to occur during deceleration if the load moment of inertia exceeds the allowable load moment of inertia. Take one of the following steps if an overvoltage alarm occurs.
- Reduce the torque limit.
- Reduce the deceleration rate.
- Reduce the maximum speed.

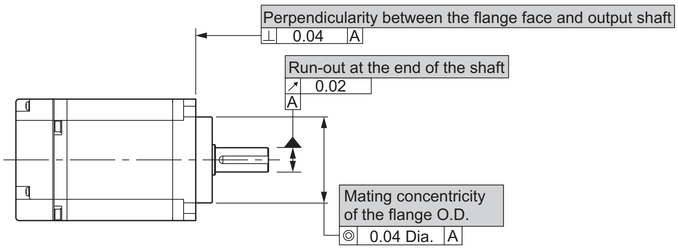
## 3.2.6 Allowable Radial and Thrust Loads

Design the mechanical system so thrust and radial loads applied to the servomotor shaft end during operation fall within the ranges shown in the table.

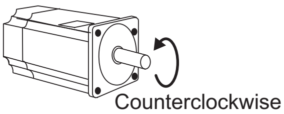
| Servomotor Model | Allowable Radial Load Fr (N) | Allowable Thrust Load Fs (N) | LF (mm) | Reference Diagram |
|---|---|---|---|---|
| SGMGV-05 | 490 | 98 | 40 |  |
| SGMGV-09 | 490 | 98 | 58 | |
| SGMGV-13 | 686 | 343 | 58 | |
| SGMGV-20 | 980 | 392 | 58 | |
| SGMGV-30 | 1470 | 490 | 79 | |
| SGMGV-44 | 1470 | 490 | 79 | |
| SGMGV-55 | 1764 | 588 | 113 | |
| SGMGV-75 | 1764 | 588 | 113 | |

### 3.2.7 Motor Total Indicator Readings

The following figure shows tolerances for the servomotor's output shaft and installation area. For more details on tolerances, refer to the external dimensions of the individual servomotor.

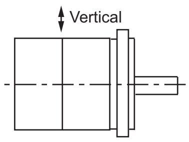



### 3.2.8 Rotation Direction




Forward rotation of the servomotor is counterclockwise when viewed from the load. The rotation direction can be reversed with parameter Pn000.0. For details, refer to *8.4.1 Servomotor Rotation Direction*.

### 3.2.9 Shock Resistance

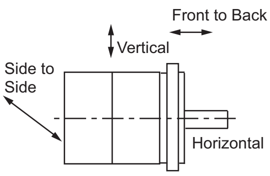


Impact Applied to the Servomotor

When the servomotor is mounted with the axis horizontal, the servomotor will withstand the following vertical impacts:

- Impact Acceleration: 490 $m/s^2$
- Impact occurrences: 2

### 3.2.10 Vibration Resistance



Impact Applied to the Servomotor

The servomotor will withstand the following vibration acceleration in three directions: Vertical, side to side, and front to back.

| Servomotor Model | Vibration Acceleration at Flange |
|---|---|
| SGMGV-05 to -44 | 49 $m/s^2$ (Front to back direction: 24.5 $m/s^2$) |
| SGMGV-55 to -75 | 24.5 $m/s^2$ |

IMPORTANT

The amount of vibration the servomotor endures will vary depending on the application. Check the vibration acceleration being applied to your servomotor for each application.

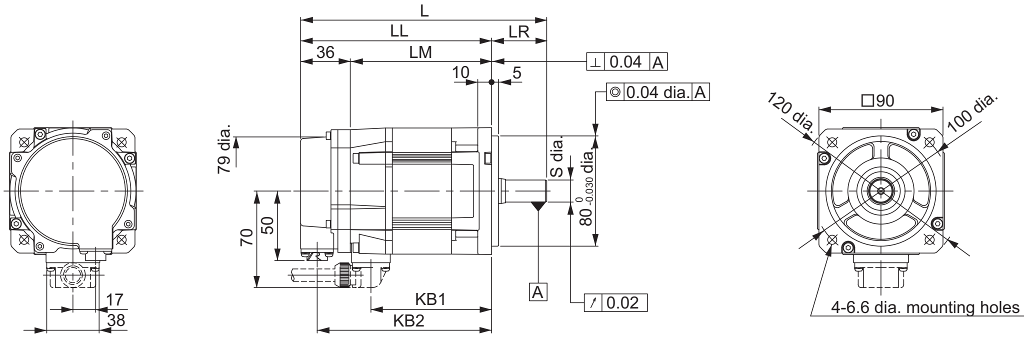
### 3.2.11 Vibration Class

The vibration class for the servomotors at rated motor speed is V15.
(A vibration class of V15 indicates a total vibration amplitude of 15 µm maximum on the servomotor during rated rotation.)

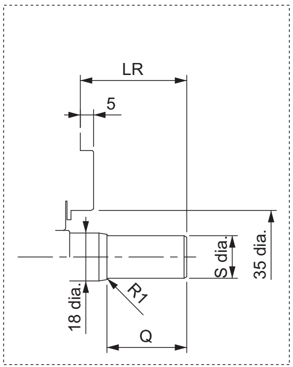
## 3.2.12 External Dimensions

### (1) Without Holding Brakes

■ 450 W




Shaft Extension




Unit: mm

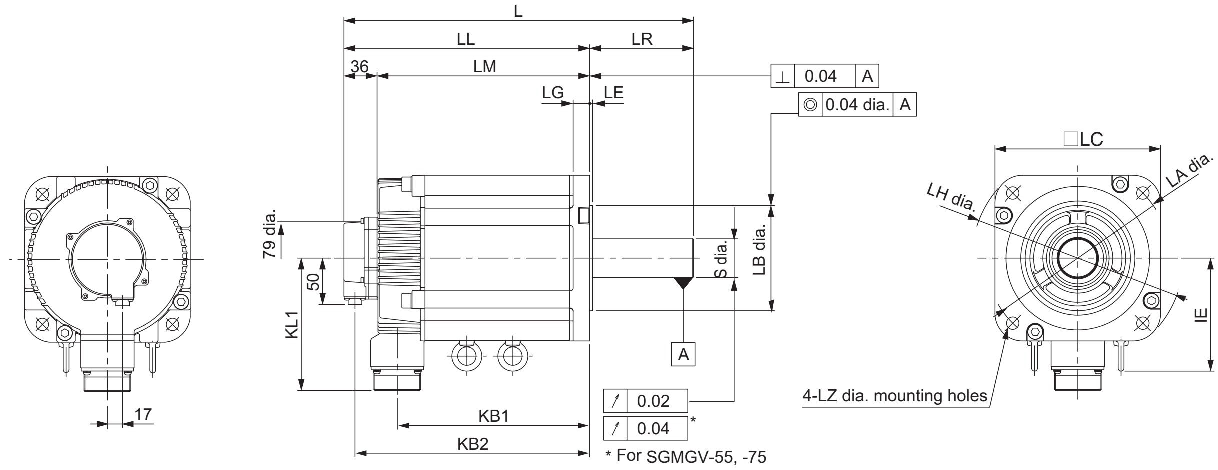
Note: For the specifications of the other shaft ends, refer to *3.2.12 (3) Shaft End Specifications*.

Unit: mm

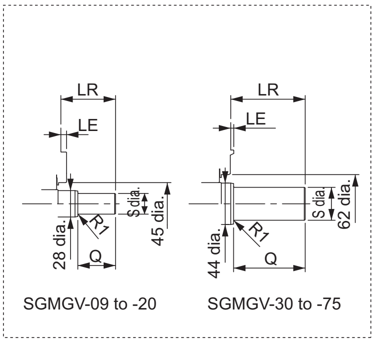
| Model SGMGV- | L | LL | LM | LR | KB1 | KB2 | Shaft End Dimensions | | Approx. Mass kg |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | S | Q | |
| 05□8□21 | 179 | 139 | 103 | 40 | 88 | 127 | $16^{\ 0}_{-0.011}$ | 30 | 3.2 |

Note: Models with oil seals are of the same configuration.

■ 850 W to 7.5 kW




Shaft Extension




Unit: mm

Note: For the specifications of the other shaft ends, refer to *3.2.12 (3) Shaft End Specifications*.

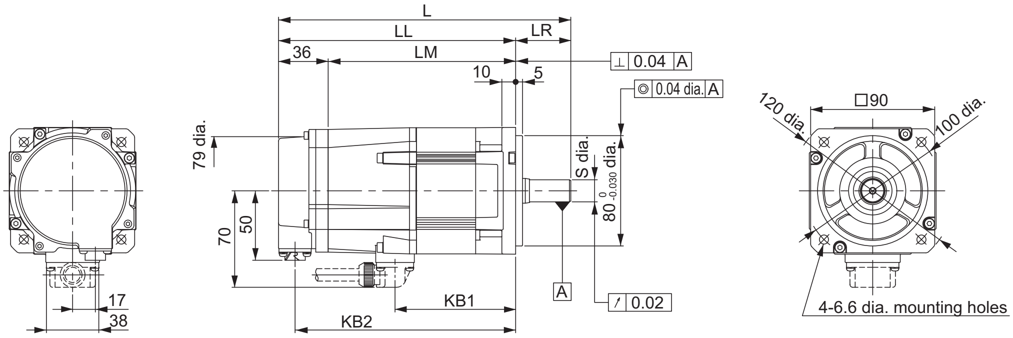
Unit: mm

| Model SGMGV- | L | LL | LM | LR | KB1 | KB2 | IE | KL1 | Flange Face Dimensions | | | | | | | Shaft End Dimensions | | Approx. Mass kg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | LA | LB | LC | LE | LG | LH | LZ | S | Q | |
| 09□8□21 | 195 | 137 | 101 | 58 | 83 | 125 | – | 104 | 145 | $110^{\ 0}_{-0.035}$ | 130 | 6 | 12 | 165 | 9 | $19^{\ 0}_{-0.013}$ | 40 | 5.5 |
| 13□8□21 | 211 | 153 | 117 | 58 | 99 | 141 | – | 104 | 145 | $110^{\ 0}_{-0.035}$ | 130 | 6 | 12 | 165 | 9 | $22^{\ 0}_{-0.013}$ | 40 | 7.1 |
| 20□8□21 | 229 | 171 | 135 | 58 | 117 | 159 | – | 104 | 145 | $110^{\ 0}_{-0.035}$ | 130 | 6 | 12 | 165 | 9 | $24^{\ 0}_{-0.013}$ | 40 | 8.6 |
| 30□8□21 | 239 | 160 | 124 | 79 | 108 | 148 | – | 134 | 200 | $114.3^{\ 0}_{-0.025}$ | 180 | 3.2 | 18 | 230 | 13.5 | $35^{+0.01}_{\ 0}$ | 76 | 13.5 |
| 44□8□21 | 263 | 184 | 148 | 79 | 132 | 172 | – | 134 | 200 | $114.3^{\ 0}_{-0.025}$ | 180 | 3.2 | 18 | 230 | 13.5 | $35^{+0.01}_{\ 0}$ | 76 | 17.5 |
| 55□8□21 | 334 | 221 | 185 | 113 | 163 | 209 | 123 | 144 | 200 | $114.3^{\ 0}_{-0.025}$ | 180 | 3.2 | 18 | 230 | 13.5 | $42^{\ 0}_{-0.016}$ | 110 | 21.5 |
| 75□8□21 | 380 | 267 | 231 | 113 | 209 | 255 | 123 | 144 | 200 | $114.3^{\ 0}_{-0.025}$ | 180 | 3.2 | 18 | 230 | 13.5 | $42^{\ 0}_{-0.016}$ | 110 | 29.5 |

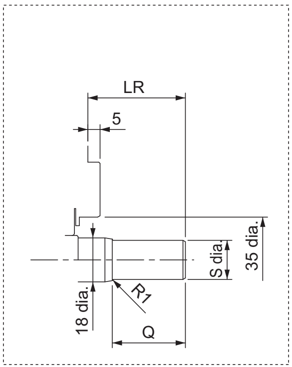
Note: Models with oil seals are of the same configuration.

## (2) With Holding Brakes

### ■ 450 W




Shaft Extension




Unit: mm

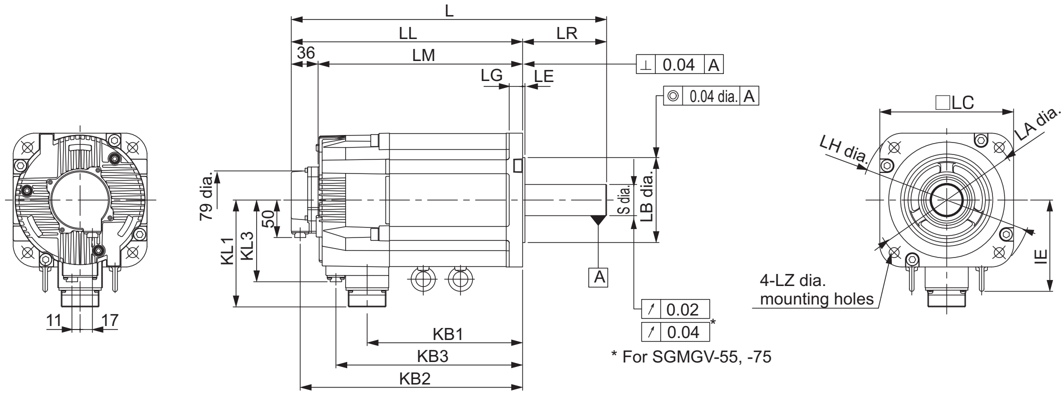
Note: For the specifications of the other shaft ends, refer to *3.2.12 (3) Shaft End Specifications*.

Unit: mm

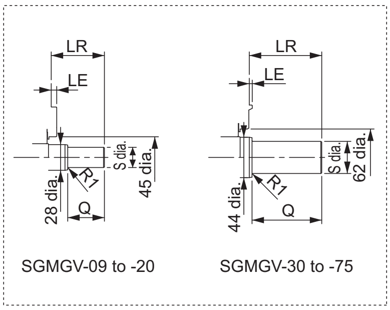
| Model SGMGV- | L | LL | LM | LR | KB1 | KB2 | Shaft End Dimensions | | Approx. Mass kg |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | S | Q | |
| 05□8□2□ | 212 | 172 | 136 | 40 | 88 | 160 | $16^{0}_{-0.011}$ | 30 | 4.2 |

Note: Models with oil seals are of the same configuration.

■ 850 W to 7.5 kW




Shaft Extension




Unit: mm

Note: For the specifications of the other shaft ends, refer to *3.2.12 (3) Shaft End Specifications*.

Unit: mm

| Model SGMGV- | L | LL | LM | LR | KB1 | KB2 | KB3 | IE | KL1 | KL3 | Flange Face Dimensions | | | | | | | Shaft End Dimensions | | Approx. Mass kg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | LA | LB | LC | LE | LG | LH | LZ | S | Q | |
| 09□8□2□ | 231 | 173 | 137 | 58 | 83 | 161 | 115 | – | 104 | 80 | 145 | $110^{\ 0}_{-0.035}$ | 130 | 6 | 12 | 165 | 9 | $19^{\ 0}_{-0.013}$ | 40 | 7.5 |
| 13□8□2□ | 247 | 189 | 153 | 58 | 99 | 177 | 131 | – | 104 | 80 | 145 | $110^{\ 0}_{-0.035}$ | 130 | 6 | 12 | 165 | 9 | $22^{\ 0}_{-0.013}$ | 40 | 9.0 |
| 20□8□2□ | 265 | 207 | 171 | 58 | 117 | 195 | 149 | – | 104 | 80 | 145 | $110^{\ 0}_{-0.035}$ | 130 | 6 | 12 | 165 | 9 | $24^{\ 0}_{-0.013}$ | 40 | 11.0 |
| 30□8□2□ | 287 | 208 | 172 | 79 | 108 | 196 | 148 | – | 134 | 110 | 200 | $114.3^{\ 0}_{-0.025}$ | 180 | 3.2 | 18 | 230 | 13.5 | $35^{+0.01}_{\ 0}$ | 76 | 19.5 |
| 44□8□2□ | 311 | 232 | 196 | 79 | 132 | 220 | 172 | – | 134 | 110 | 200 | $114.3^{\ 0}_{-0.025}$ | 180 | 3.2 | 18 | 230 | 13.5 | $35^{+0.01}_{\ 0}$ | 76 | 23.5 |
| 55□8□2□ | 378 | 265 | 229 | 113 | 163 | 253 | 205 | 123 | 144 | 110 | 200 | $114.3^{\ 0}_{-0.025}$ | 180 | 3.2 | 18 | 230 | 13.5 | $42^{\ 0}_{-0.016}$ | 110 | 27.5 |
| 75□8□2□ | 424 | 311 | 275 | 113 | 209 | 299 | 251 | 123 | 144 | 110 | 200 | $114.3^{\ 0}_{-0.025}$ | 180 | 3.2 | 18 | 230 | 13.5 | $42^{\ 0}_{-0.016}$ | 110 | 35 |

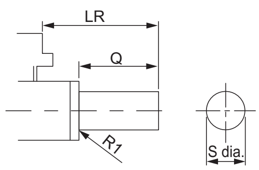
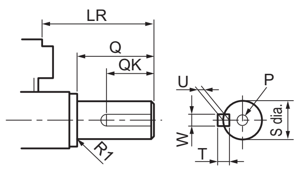
Note: Models with oil seals are of the same configuration.

## (3) Shaft End Specifications

SGMGV - □□□□□□□

| Code | Specifications | Remarks |
|---|---|---|
| 2 | Straight without key | Standard |
| 6 | Straight with key and tap for one location (Key slot is JIS B1301-1996 fastening type.) | Optional |

Unit: mm

| Shaft Extension | | Model SGMGV- | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 05□□□ | 09□□□ | 13□□□ | 20□□A | 20□□M | 30□□□, 44□□□ | 55□□□, 75□□□ |
| Code: 2 (Straight without key) | | | | | | | | |
|  | LR | 40 | 58 | 58 | 58 | 58 | 79 | 113 |
| | Q | 30 | 40 | 40 | 40 | 40 | 76 | 110 |
| | S | $16^{0}_{-0.011}$ | $19^{0}_{-0.013}$ | $22^{0}_{-0.013}$ | $24^{0}_{-0.013}$ | $24^{0}_{-0.013}$ | $35^{+0.01}_{0}$ | $42^{0}_{-0.016}$ |
| Code: 6 (Straight with key and tap) | | | | | | | | |
|  | LR | 40 | 58 | 58 | 58 | 58 | 79 | 113 |
| | Q | 30 | 40 | 40 | 40 | 40 | 76 | 110 |
| | QK | 20 | 25 | 25 | 32 | 32 | 60 | 90 |
| | S | $16^{0}_{-0.011}$ | $19^{0}_{-0.013}$ | $22^{0}_{-0.013}$ | $24^{0}_{-0.013}$ | $24^{0}_{-0.013}$ | $35^{+0.01}_{0}$ | $42^{0}_{-0.016}$ |
| | W | 5 | 5 | 6 | 8 | 8 | 10 | 12 |
| | T | 5 | 5 | 6 | 7 | 7 | 8 | 8 |
| | U | 3 | 3 | 3.5 | 4 | 4 | 5 | 5 |
| | P | M5 screw, depth 12 | | | | | M12 screw, depth 25 | M16 screw, depth 32 |

# 4

# Specifications and External Dimensions for Σ-V-SD Drivers

# 4.1 Power Regeneration Converter

## 4.1.1 Specifications

### (1) Basic Specifications

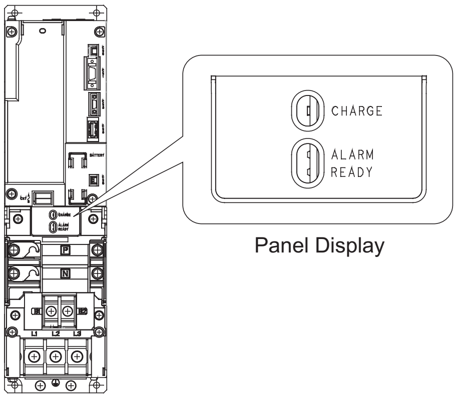
<table>
<tr><th colspan="4">Item</th><th colspan="6">Specifications</th></tr>
<tr><th colspan="4">Model: CACP-JU□□A3□,<br>CACP-JU□□D3□</th><th>15</th><th>19</th><th>22</th><th>30*</th><th>37*</th><th>45</th></tr>
<tr><td colspan="3">50% ED Rating</td><td>kW</td><td>15</td><td>18.5</td><td>22</td><td>30</td><td>37</td><td>45</td></tr>
<tr><td colspan="3">Continuous Rating</td><td>kW</td><td>11</td><td>15</td><td>18.5</td><td>22</td><td>30</td><td>37</td></tr>
<tr><td rowspan="7">Basic Specifications</td><td rowspan="2">Input Power</td><td colspan="2">Main Circuits L1, L2, and L3</td><td colspan="6">CACP-JU□□A3□: Three-phase 200 to 230 V (50/60 Hz)<br>CACP-JU□□D3□: Three-phase 380 to 480 V (50/60 Hz)<br>Allowable voltage fluctuation: +10% to -15%<br>Allowable frequency fluctuation: ±5%<br>Line voltage unbalance: 5% max.</td></tr>
<tr><td colspan="2">Control Power</td><td colspan="6">24 VDC<br>Allowable voltage fluctuation: ±15%<br>Output holding time: 100 ms min.<br><br>Current<br>CACP-JU15A3□ to CACP-JU37A3B: 1A<br>CACP-JU45A3B: 1.5 A<br>CACP-JU15D3□ to CPCP-JU45D3B: 1A</td></tr>
<tr><td rowspan="2">Output Power</td><td colspan="2">Main Circuit Power Output +/-</td><td colspan="6">CACP-JU□□A3□: 270 to 310 VDC +10 to -15%<br>CACP-JU□□D3□: 520 to 650 VDC +10 to -15%</td></tr>
<tr><td colspan="2">Control Power Output</td><td colspan="6">24 VDC ±15% (connector pass current: 10 A)</td></tr>
<tr><td rowspan="2">I/O Signals</td><td colspan="2">Sequence I/O Signals</td><td colspan="6">Input signal: Emergency stop input signal<br>Output signal: Main circuit contactor ON output signal</td></tr>
<tr><td colspan="2">Connections between Axes</td><td colspan="6">Local bus and absolute encoder battery</td></tr>
<tr><td colspan="3">Maximum Number of Connectable SERVOPACKs</td><td colspan="6">Differs in accordance with combinations of a power generation converter, SERVOPACKs and motors. Refer to 2.1.3 Power Regeneration Converter, SERVOPACK, and Motor.</td></tr>
<tr><td rowspan="5">Functions</td><td colspan="3">Indications</td><td colspan="6">CHARGE (orange), ALARM (red), and READY (green)</td></tr>
<tr><td colspan="3">Regeneration Control Method</td><td colspan="6">Power regeneration control (120-degree conduction)</td></tr>
<tr><td colspan="3">Protective Functions</td><td colspan="6">Main circuit fuse, overload, overvoltage, insufficient voltage, overcurrent, frequency error, heat sink overheating, etc.</td></tr>
<tr><td colspan="3">Battery</td><td colspan="6">The battery for the absolute encoder must be provided by the user.<br>For details, refer to 2.3.3 Absolute Encoder Battery.</td></tr>
<tr><td colspan="3">Allowable Power Loss Time</td><td colspan="6">5 ms (at 70% load)</td></tr>
</table>

* Available only for three-phase 200 VAC models.

## (2) Panel Display

The status of power regeneration converter can be checked on the panel display.

| Name | LED Color | Meaning |
|---|---|---|
| CHARGE | Orange | Lit when main circuit power is on.<br>Not lit when main circuit power is off. |
| ALARM | Red | Lit when alarm occurs.<br>Not lit when no alarm occurs. |
| READY | Green | Lit when CPU of power regeneration converter works normally.<br>Not lit when CPU of power regeneration converter not working. |



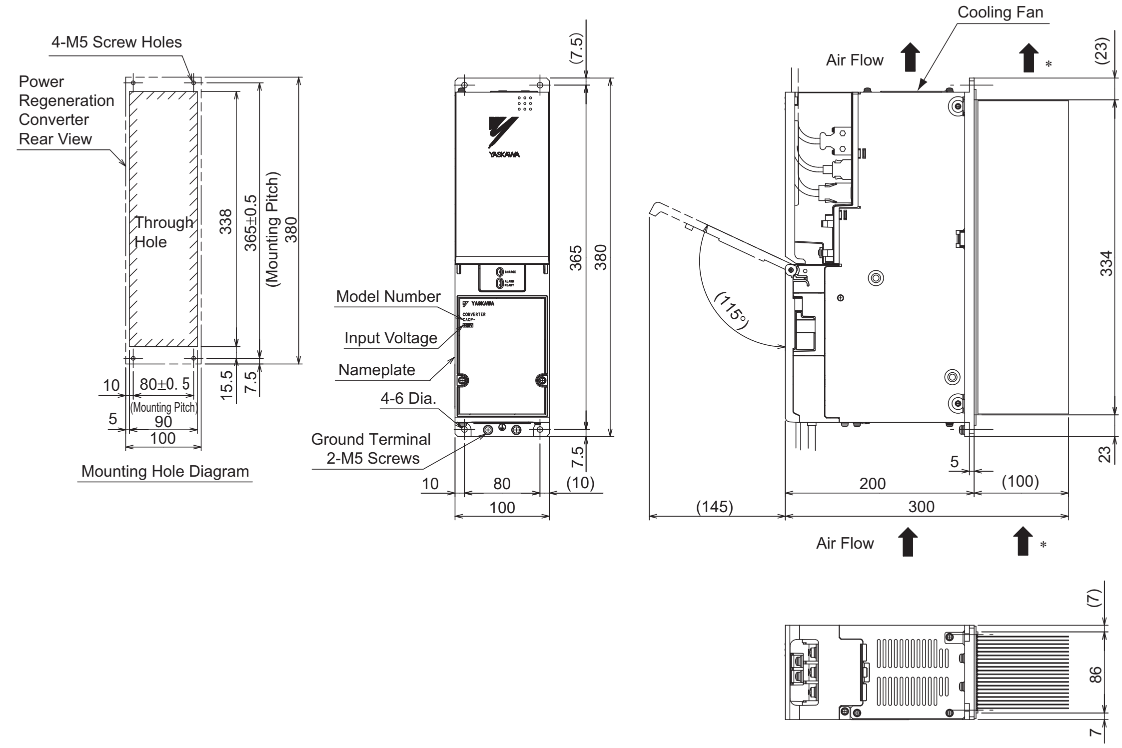

Power Regeneration Converter

## (3) I/O Current and Inrush Current

| Voltage | Capacity (50%ED) kW | Capacity (Continuous Ratings) kW | Model | Input Current (50%ED) Arms | Input Current (Continuous Ratings) Arms | Output Current (50%ED) Arms | Output Current (Continuous Ratings) Arms | Inrush Current (Main Circuit) $A_{0-P}$ |
|---|---|---|---|---|---|---|---|---|
| 200 V | 15 | 11 | CACP-JU15A3□ | 73 | 54 | 69 | 51 | 83 |
| | 18.5 | 15 | CACP-JU19A3□ | 90 | 73 | 85 | 69 | |
| | 22 | 18.5 | CACP-JU22A3□ | 107 | 90 | 102 | 85 | |
| | 30 | 22 | CACP-JU30A3□ | 145 | 107 | 138 | 102 | 178 |
| | 37 | 30 | CACP-JU37A3B | 179 | 145 | 170 | 138 | |
| | 45 | 37 | CACP-JU45A3B | 218 | 179 | 207 | 170 | |
| 400 V | 15 | 11 | CACP-JU15D3□ | 36 | 27 | 36 | 27 | 173 |
| | 18.5 | 15 | CACP-JU19D3□ | 45 | 36 | 45 | 36 | |
| | 22 | 18.5 | CACP-JU22D3□ | 53 | 45 | 53 | 45 | |
| | 45 | 37 | CACP-JU45D3B | 105 | 86 | 105 | 86 | 78 |

## 4.1.2 External Dimensions

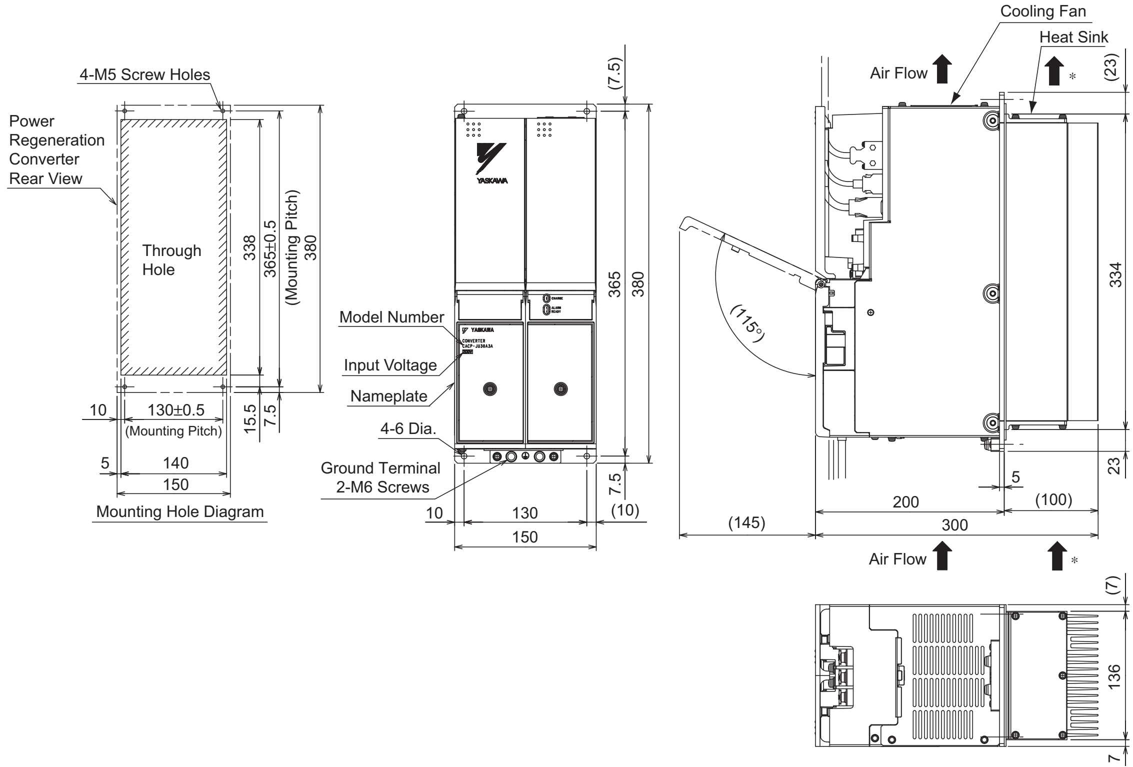
### (1) Model: CACP-JU15□3□, -JU19□3□, -JU22□3□




Unit: mm
Approx. Mass: 8.3 kg

* The cooling air speed of heat sink must be at least 2.5 m/s at the point closest to the heat sink.

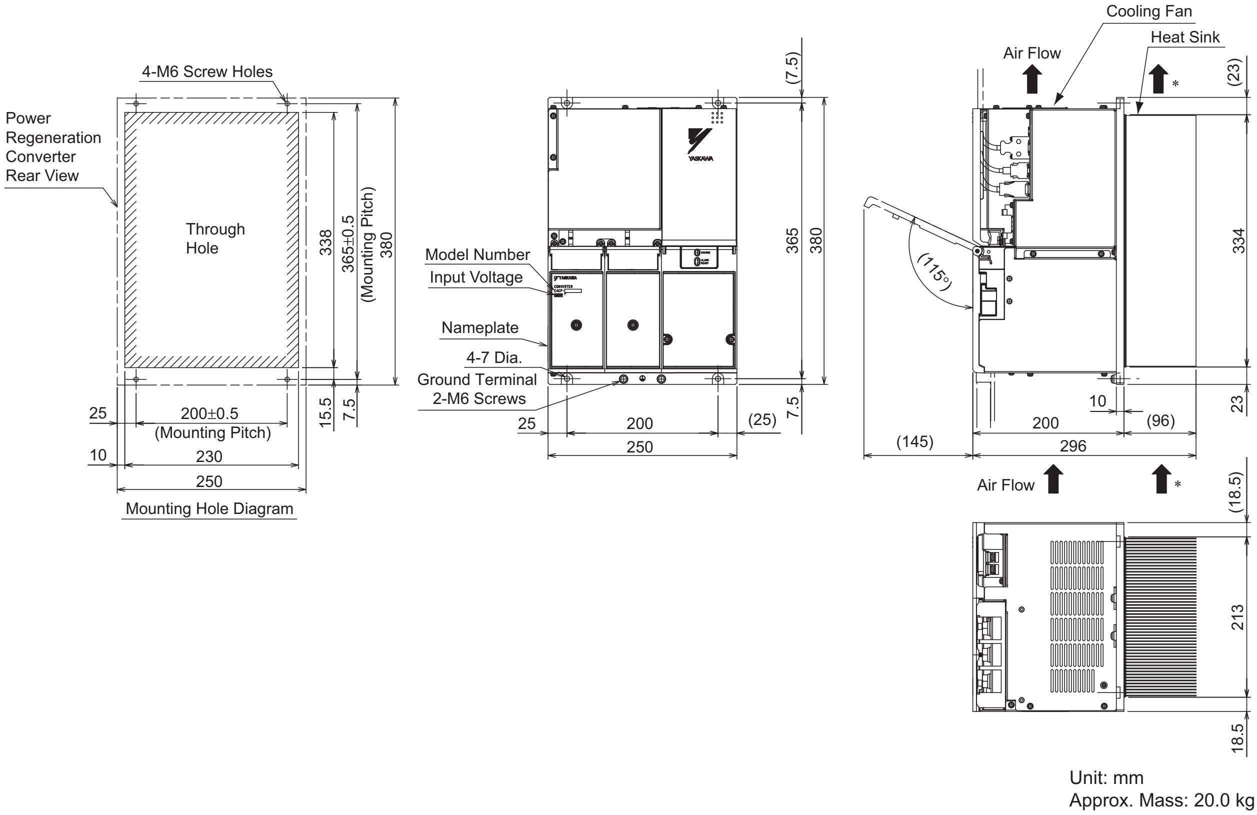
### (2) Model: CACP-JU30A3□, -JU37A3B




Unit: mm
Approx. Mass: 11.1 kg (CACP-JU30A3□)
12.0 kg (CACP-JU37A3B)

* The cooling air speed of heat sink must be at least 2.5 m/s at the point closest to the heat sink.
Note: Available only for three-phase 200 VAC models.

## (3) Model: CACP-JU45A3B, -JU45D3B




∗ The cooling air speed of heat sink must be at least 2.5 m/s at the point closest to the heat sink.

# 4.2 SERVOPACK

## 4.2.1 Specifications

### (1) Basic Specifications

| Item | | | Specifications: For Spindle Motor | Specifications: For Servomotor |
|---|---|---|---|---|
| Control Method | | | Sine-wave current drive with PWM control of IGBT | |
| Applicable Motors Model | | | UAK□J | SGMGV |
| Functions | Feedback | Motor | Pulse encoder (phases A, B, and Z), serial encoder: 17 bits | Serial encoder (absolute), Standard type: 20 bits, 4-Mbps communications |
| | | Fully-closed Loop Control | – | Serial conversion unit, 4-Mbps communications |
| | Indications | | CHARGE (orange), RDY (green), and ALM (red) | |
| | Dynamic Brake (DB) Functions | | – | Built into some models*1 or provided externally by the user. It operates when an alarm occurs, when the main circuit power supply turns OFF, when the servo turns OFF, or when the control power turns OFF. The servomotor coasts to a stop after the dynamic brake. |
| | Fuses | | Main circuit power: Not available (built into power regeneration converter)<br>Control power: Built in | |
| | Protective Functions | | Overcurrent, overload, main circuit voltage error, heat sink over-heating, overspeed, encoder error, CPU error, PG disconnection detected, parameter error, etc. | |
| | Compensation Functions | | Quadrant projection compensation and predictive control | |
| | Control | Position Loop | Proportional control | |
| | | Speed loop | Integral-proportional control and torque control | |
| | Fully-closed Loop Control | | Standard feature (A motor encoder-external encoder branch con-version unit is required.) | |
| | Analog Monitor (Built-in)*2 | Number of Channels | 2 for each axis | |
| | | Output Power Range | ±10 V (linear range: ±8 V) | |
| | | Response Frequency | 1 kHz | |
| | USB Communications | Connected Device | Personal computer (application: SigmaWin for Σ-V-SD (MT) compatible) | |
| | | Communica-tion Standard | USB 1.1 compliant, 12 Mbps (full speed support) | |
| | | Functions | Status displays, parameter setting, and adjustment function | |

∗1. Dynamic brakes are built into the following models:
- SERVOPACKs for one axis: CACR-JU028A, CACR-JU036A, CACR-JU014D, and CACR-JU018D
- SERVOPACKs for two axes: CACR-JUM23□, CACR-JUM24□, and CACR-JUM25□

If you use any other model, provide your own dynamic brake circuit.
The dynamic brake on the CACR-JU036A or CACR-JU018D does not operate when the control power supply is turned OFF.

∗2. Do not use an analog monitor signal for system control. Use an analog monitor signal only for adjusting the motor or obtaining data for maintenance purpose.

(cont'd)

<table>
<tr><th colspan="4" rowspan="2">Item</th><th colspan="2">Specifications</th></tr>
<tr><th>For Spindle Motor</th><th>For Servomotor</th></tr>
<tr><td rowspan="21">Functions (cont'd)</td><td rowspan="8">Sequence Signal</td><td rowspan="2">External Input Power</td><td>Input Power Voltage</td><td colspan="2">24 VDC ±5%</td></tr>
<tr><td>Current Required per Channel</td><td colspan="2">3 mA for normal input, 10 mA for latch input</td></tr>
<tr><td rowspan="2">Input Signals</td><td rowspan="2">Number of Channels</td><td colspan="2">Normal inputs: 2 for each axis (isolated)</td></tr>
<tr><td colspan="2">Latch inputs: 3 for SERVOPACK for 1 axis (isolated), 4 for SERVOPACK for 2 axes (isolated)</td></tr>
<tr><td rowspan="4">Output Signals (Brake)</td><td>Number of Channels</td><td colspan="2">1 for each axis (isolated)</td></tr>
<tr><td>Maximum Output Current</td><td colspan="2">50 mA</td></tr>
<tr><td>Maximum Applicable Voltage</td><td colspan="2">30 V</td></tr>
<tr><td>Delay</td><td colspan="2">Depends on brake or relay circuit.</td></tr>
<tr><td rowspan="7">HWBB Signal</td><td rowspan="2">External Input Power</td><td>Input Power Voltage</td><td colspan="2">24 VDC ±5%</td></tr>
<tr><td>Current Required per Channel</td><td colspan="2">3 mA</td></tr>
<tr><td>Input Signals</td><td>Number of Channels</td><td colspan="2">2 for each axis (isolated)</td></tr>
<tr><td rowspan="4">Output Signal</td><td>Number of Channels</td><td colspan="2">1 for each axis (isolated)</td></tr>
<tr><td>Maximum Output Current</td><td colspan="2">50 mA</td></tr>
<tr><td>Maximum Applicable Voltage</td><td colspan="2">30 V</td></tr>
<tr><td>When an HWBB signal is input</td><td colspan="2">Output ON when inputs of two channels are OFF.</td></tr>
<tr><td colspan="2" rowspan="2">Motor Winding Temperature Detection</td><td>Number of Channels</td><td>1 for each axis</td><td rowspan="2">–</td></tr>
<tr><td>Temperature Sensor</td><td>NTC thermistor</td></tr>
<tr><td colspan="2" rowspan="4">Motor Winding Selection</td><td>Number of Channels</td><td>1ch</td><td rowspan="4">–</td></tr>
<tr><td>Output Voltage</td><td>+24 V</td></tr>
<tr><td>Allowable Output Current</td><td>50 mA</td></tr>
<tr><td>Answerback Function</td><td>Supported</td></tr>
</table>

Specifications and External Dimensions for Σ-V-SD Drivers

4

(cont'd)

| Item | | | Specifications | |
|---|---|---|---|---|
| | | | For Spindle Motor | For Servomotor |
| Functions (cont'd) | Dynamic Brake (DB) External Output*3 | Number of Channels | – | 1ch |
| | | Output Voltage | | +24 V |
| | | Allowable Output Current | | 50 mA |
| | | Answerback Function | | Supported |
| | Speed Control Range | | 40 $min^{-1}$ to motor maximum speed | 1:5000 |

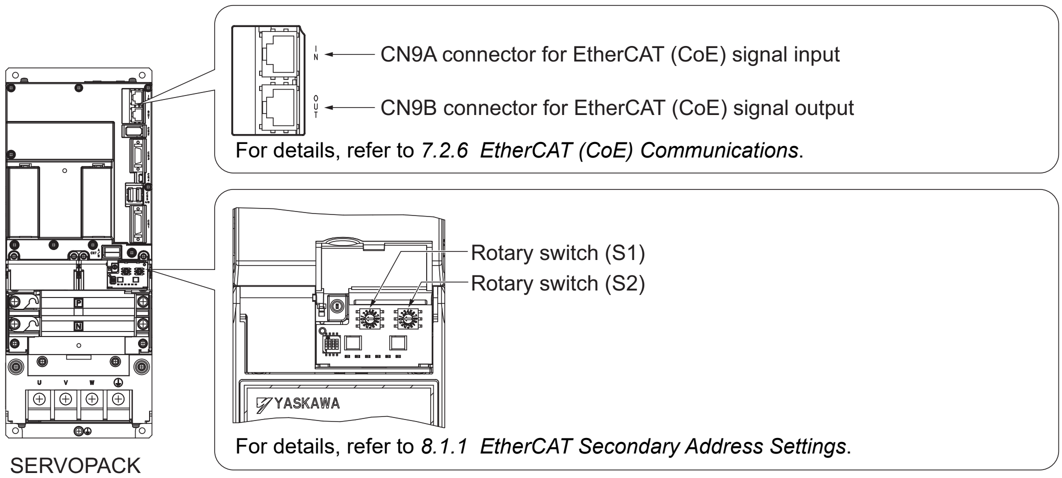
∗3. The following models have built-in dynamic brakes.
- SERVOPACKs for one axis: CACR-JU028A, 036A, 014D, 018D

If you use any other model, do not use the external output signal.

## (2) EtherCAT (CoE) Specifications

| Item | | Specifications |
|---|---|---|
| EtherCAT Communication | Applicable Communication Standards | IEC 61158 Type12, IEC 61800-7 CiA402 Drive Profile |
| | Physical Layer | 100BASE-TX (IEEE802.3) |
| | Connector | CN9A (RJ45): EtherCAT Signal IN<br>CN9B (RJ45): EtherCAT Signal OUT |
| | Cable | CAT5 STP 4 pair<br>Note: Cables are automatically recognized by the AUTO MDIX function. |
| | SyncManager | SM0: Mailbox output, SM1: Mailbox input<br>SM2: Process data outputs, SM3: Process data inputs |
| | FMMU | FMMU0: Mapped to the process data output (RxPDO) area.<br>FMMU1: Mapped to the process data input (TxPDO) area.<br>FMMU2: Mapped to the mailbox status |
| | EtherCAT Commands (Data Link Layer) | APRD, FPRD, BRD, LRD, APWR, FPWR, BWR, LWR, ARMW, FRMW<br>Note: APRW, FPRW, BRW, LRW Commands are not supported. |
| | Process Data | Configurations can be changed with PDO mapping. |
| | Mailbox (CoE) | Emergency Message, SDO Request, SDO Response, SDO information<br>Note: TxPDO/RxPDO and Remote TxPDO/RxPDO are not supported. |
| | Distributed Clocks | Free-run, DC mode (Can be selected.)<br>Supported DC cycle: 250 µs to 4 ms (every 250-µs cycle) |
| | Slave Information IF | 256 bytes (For reading only) |
| | LED Indicator | EtherCAT Link/Activity indicator (L/A) × 2<br>EtherCAT RUN indicator (RUN) × 1<br>EtherCAT ERR indicator (ERR) × 1 |
| CiA402 Drive Profile | | • Homing mode<br>• Profile position mode<br>• Interpolated position mode<br>• Profile velocity mode<br>• Profile torque mode<br>• Cyclic synchronous position mode<br>• Cyclic synchronous velocity mode<br>• Cyclic synchronous torque mode<br>• Touch probe function<br>• Torque limit function |

### ■ Connectors and Switches

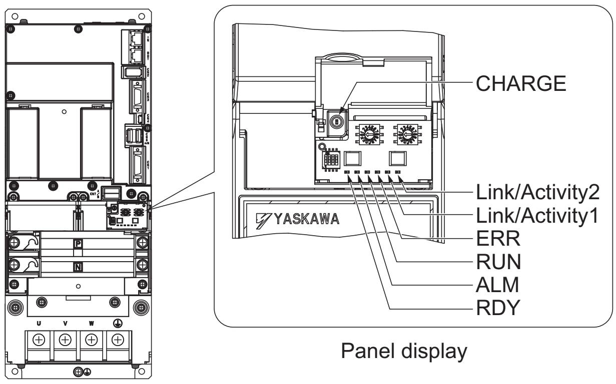



For details, refer to *7.2.6 EtherCAT (CoE) Communications*.

For details, refer to *8.1.1 EtherCAT Secondary Address Settings*.

### (3) Panel Display

The SERVOPACK status can be checked on the panel display.

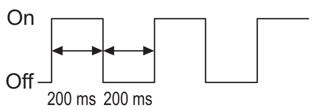
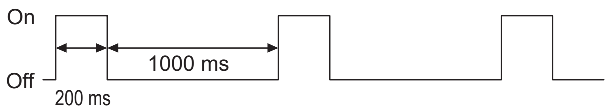
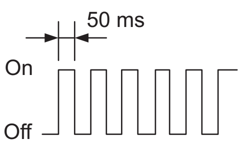



SERVOPACK    Panel display

| Name | LED Color | Meaning |
|---|---|---|
| CHARGE | Orange | Lit when main circuit power is on.<br>Not lit when main circuit power is off. |
| RDY | Green | Lit when CPU of SERVOPACK works normally.<br>Not lit when CPU of SERVOPACK not working. |
| ALM | Red | Lit when alarm occurs.<br>Not lit when no alarm occurs. |
| RUN | Green | Indicates the status of EtherCAT (CoE) communications.<br>For details, refer to ■ *RUN*. |
| ERR | Red | Indicates the status of EtherCAT (CoE) communications errors.<br>For details, refer to ■ *ERR*. |
| Link/<br>Activity1 | Green | Indicates whether a communications cable is connected to the CN9A connector and whether communications are active.<br>For details, refer to ■ *Link/Activity*. |
| Link/<br>Activity2 | | Indicates whether a communications cable is connected to the CN9B connector and whether communications are active.<br>For details, refer to ■ *Link/Activity*. |

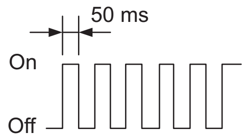
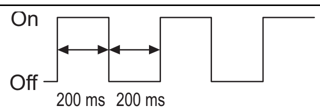
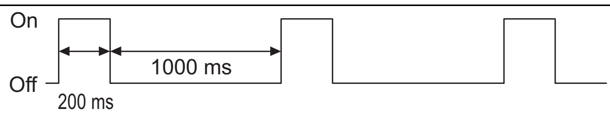
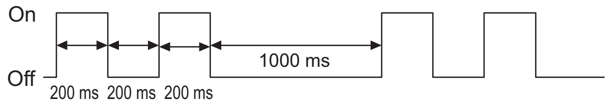
## ■ RUN

The RUN indicator shows the status of EtherCAT communication.

| LED Indicator | | Description |
|---|---|---|
| Display | Pattern | |
| Off | Continuously OFF | The EtherCAT (CoE) communication is in Init state. |
| Blinking |  | The EtherCAT (CoE) communication is in Pre-Operational state. |
| Single flash |  | The EtherCAT (CoE) communication is in Safe-Operational state. |
| On | Continuously ON | The EtherCAT (CoE) communication is in Operational state. |
| Flickering |  | The EtherCAT (CoE) communication is booting and has not yet entered the Init state. |

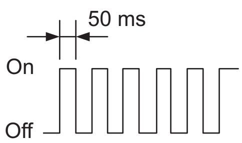
## ■ ERR

The ERR indicator shows the error status of EtherCAT communication.

| LED Indicator | | Description |
|---|---|---|
| Display | Pattern | |
| Off | Continuously OFF | The EtherCAT communication is in working condition. |
| Flickering |  | Booting Error was detected. |
| Blinking |  | State change commanded by master is impossible due to register or object settings. |
| Single flash |  | Synchronization Error, the EtherCAT (CoE) communication enters Safe-Operational state automatically. |
| Double flash |  | An application (Sync Manager) watchdog timeout has occurred. |
| On | Continuously ON | A PDI Watchdog timeout has occurred. |

## ■ Link/Activity

Indicates whether a communications cable is connected to the CN9A or CN9B connectors and whether communications are active.

| LED Indicator | | Description |
|---|---|---|
| Display | Pattern | |
| Off | Continuously OFF | A communication cable is not physically connected.<br>A EtherCAT (CoE) controller is not started up. |
| Flickering |  | Data are being exchanged. |
| On | Continuously ON | A communication cable is physically connected, but no data being exchanged. |

### (4) I/O Current

#### ■ SERVOPACK for One Axis

| Voltage | Capacity (50%ED) kW | Capacity (Continu-ous Ratings) kW | Model | Input Current (50%ED) Arms | Input Current (Continu-ous Ratings) Arms | Output Current (50%ED) Arms | Output Current (Continu-ous Ratings) Arms |
|---|---|---|---|---|---|---|---|
| 270 VDC | 5.5 | 3.7 | CACR-JU028ACA | 26 | 17 | 34 | 28 |
| | 7.5 | 5.5 | CACR-JU036ACA | 35 | 26 | 46 | 36 |
| | 15 | 11 | CACR-JU065ACA | 69 | 51 | 82 | 65 |
| | 18.5 | 15 | CACR-JU084ACA | 85 | 69 | 100 | 84 |
| | 22 | 18.5 | CACR-JU102ACA | 102 | 85 | 116 | 102 |
| | 30 | 22 | CACR-JU125ACA | 138 | 102 | 160 | 125 |
| | 45 | 37 | CACR-JU196ACA | 207 | 170 | 240 | 196 |
| 540 VDC | 5.5 | 3.7 | CACR-JU014DCA | 13 | 9 | 17 | 14 |
| | 7.5 | 5.5 | CACR-JU018DCA | 18 | 13 | 23 | 18 |
| | 15 | 11 | CACR-JU033DCA | 36 | 27 | 41 | 32.5 |
| | 18.5 | 15 | CACR-JU042DCA | 45 | 36 | 50 | 42 |
| | 22 | 18.5 | CACR-JU051DCA | 53 | 45 | 58 | 51 |
| | 45 | 37 | CACR-JU098DCA | 105 | 86 | 120 | 98 |

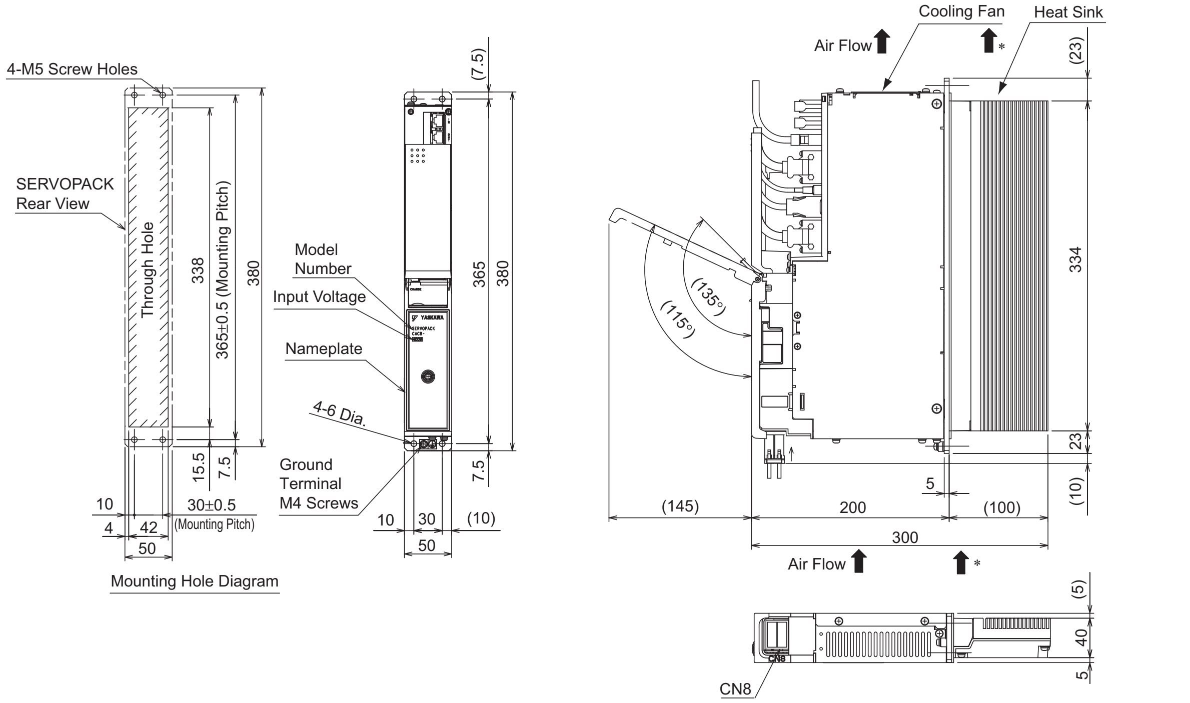
#### ■ SERVOPACK for Two Axes

| Voltage | Max. Allowable Motor Capacity | Model | Input Current (Continuous Ratings) | Output Current (Continuous Ratings/Axis) |
|---|---|---|---|---|
| 270 VDC | 1.5 | CACR-JUM23ACA | 14 | 11.6 |
| | 2.0 | CACR-JUM24ACA | 19 | 18.5 |
| | 3.0 | CACR-JUM25ACA | 28 | 24.8 |
| 540 VDC | 1.5 | CACR-JUM23DCA | 7.3 | 5.4 |
| | 2.0 | CACR-JUM24DCA | 9.7 | 8.4 |
| | 3.0 | CACR-JUM25DCA | 15 | 11.9 |

## 4.2.2 External Dimensions

### (1) SERVOPACK for One Axis

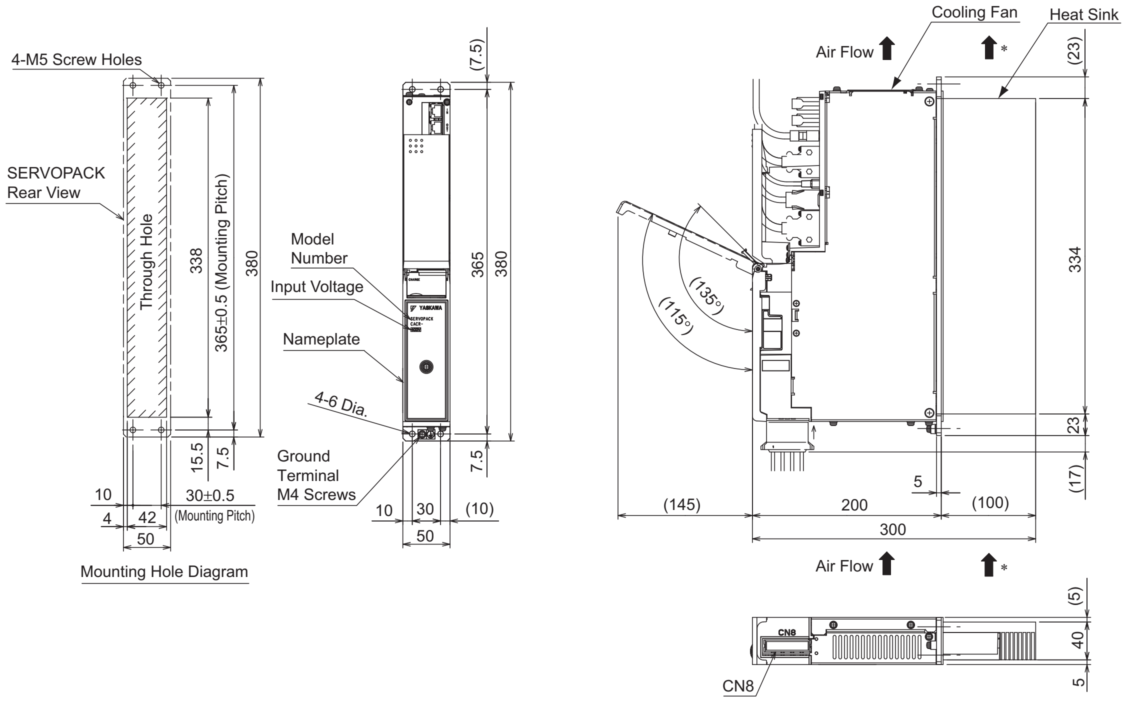
■ Model: CACR-JU028ACA, -JU014DCA




Unit: mm
Approx. Mass: 4.3 kg

* The cooling air speed of heat sink must be at least 2.5 m/s at the point closest to the heat sink.

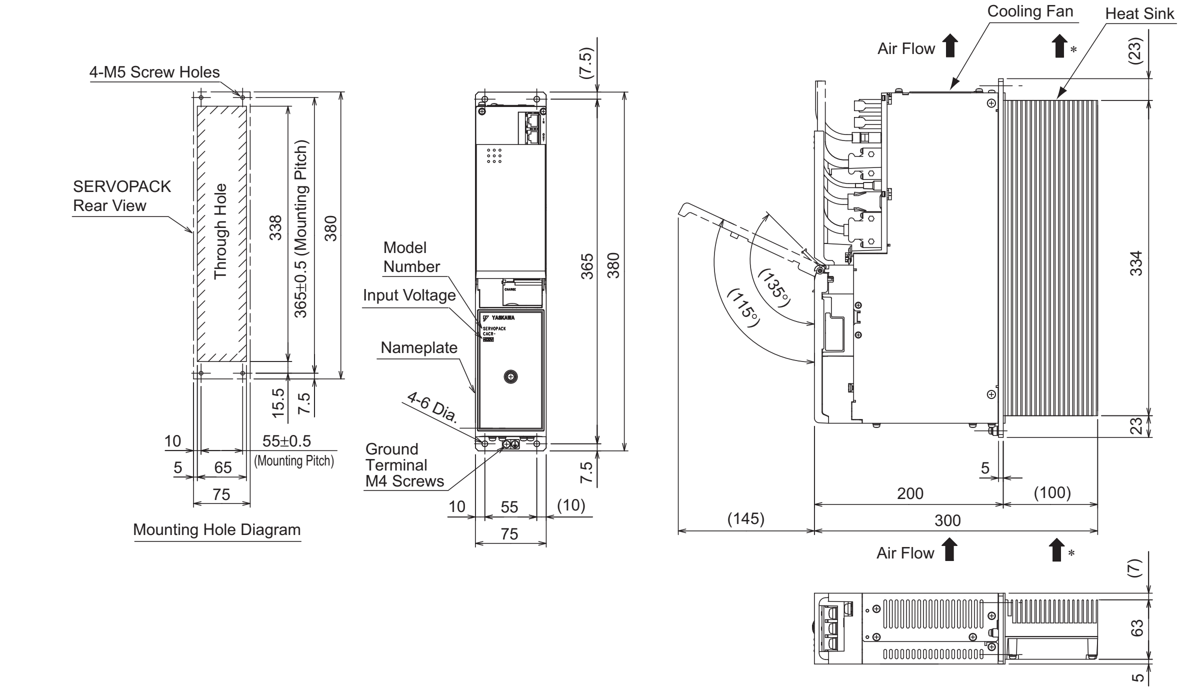
■ Model: CACR-JU036ACA, -JU018DCA




Unit: mm
Approx. Mass: 5.0 kg

* The cooling air speed of heat sink must be at least 2.5 m/s at the point closest to the heat sink.

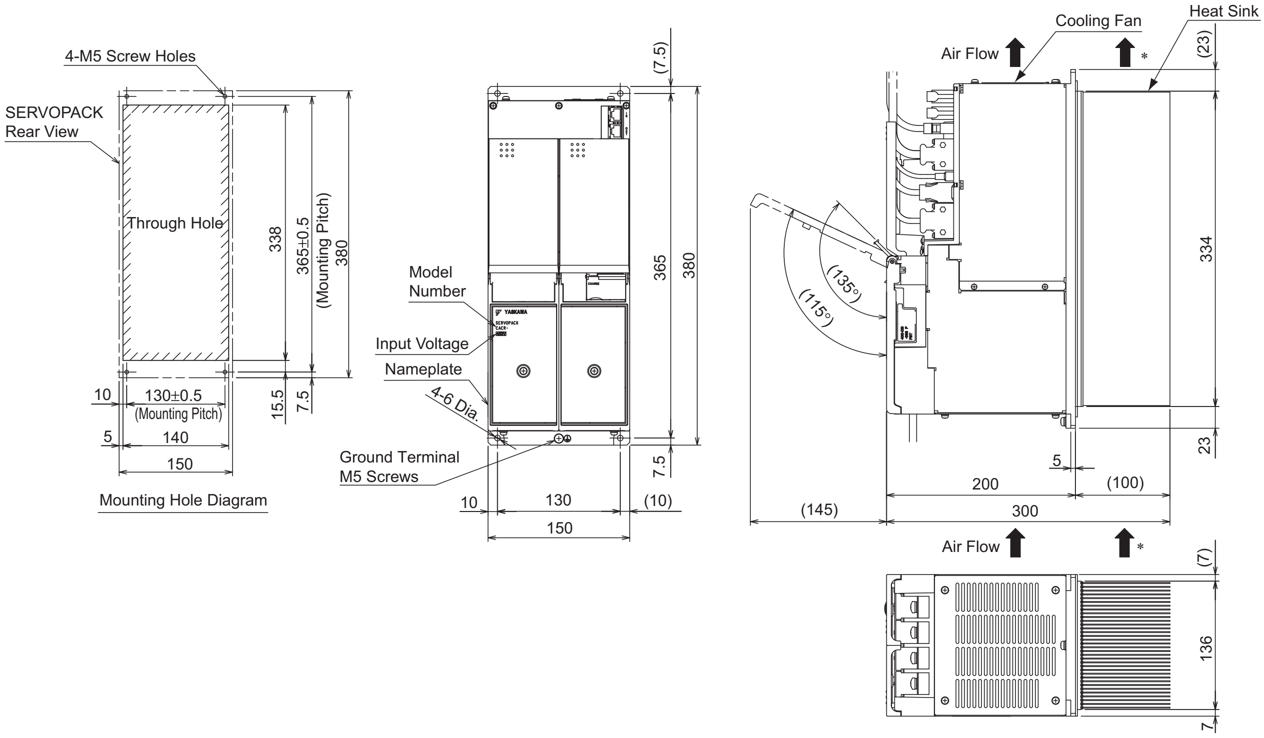
## ■ Model: CACR-JU065ACA, -JU033DCA




Unit: mm
Approx. Mass: 6.4 kg

∗ The cooling air speed of heat sink must be at least 2.5 m/s at the point closest to the heat sink.

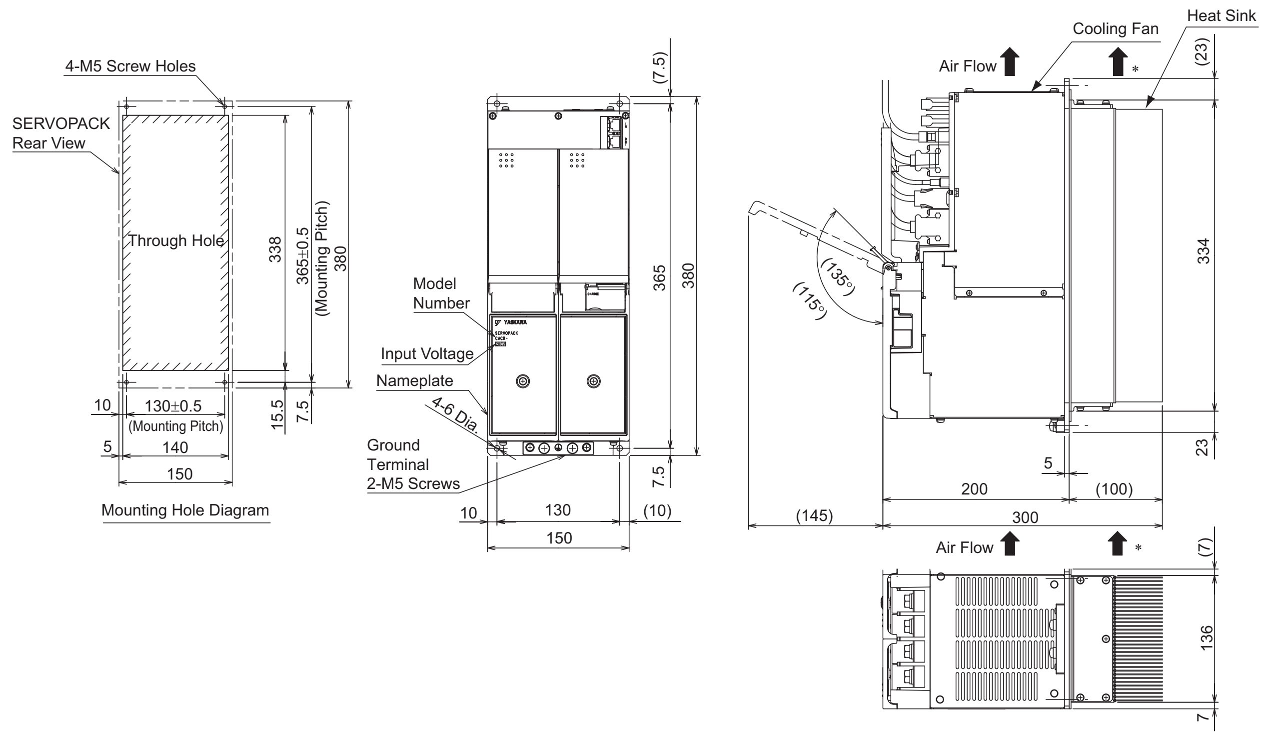
## ■ Model: CACR-JU084ACA, -JU102ACA, -JU042DCA, -JU051DCA




Unit: mm
Approx. Mass: 11.8 kg

∗ The cooling air speed of heat sink must be at least 2.5 m/s at the point closest to the heat sink.

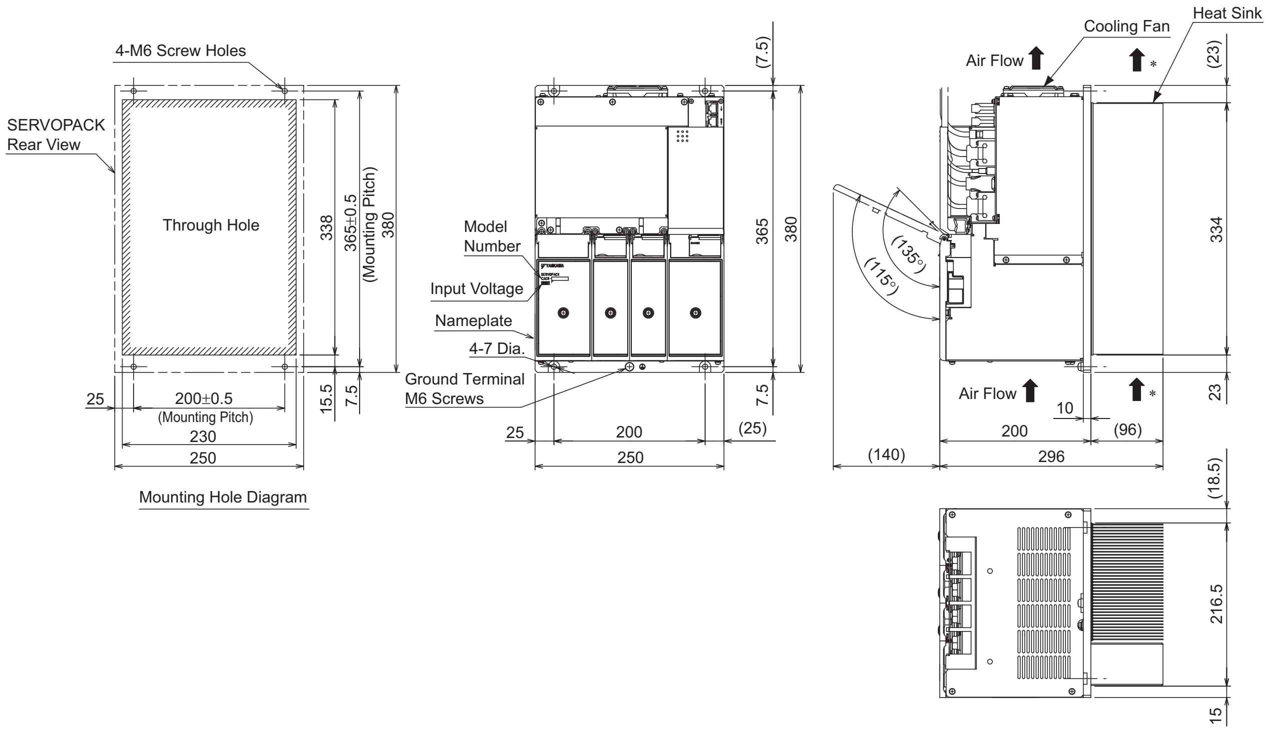
## ■ Model: CACR-JU125ACA




Unit: mm
Approx. Mass: 12.0 kg

* The cooling air speed of heat sink must be at least 2.5 m/s at the point closest to the heat sink.

## ■ Model: CACR-JU196ACA, -JU098DCA




Unit: mm
Approx. Mass: 20.0 kg

* The cooling air speed of heat sink must be at least 2.5 m/s at the point closest to the heat sink.

Specifications and External Dimensions for Σ-V-SD Drivers

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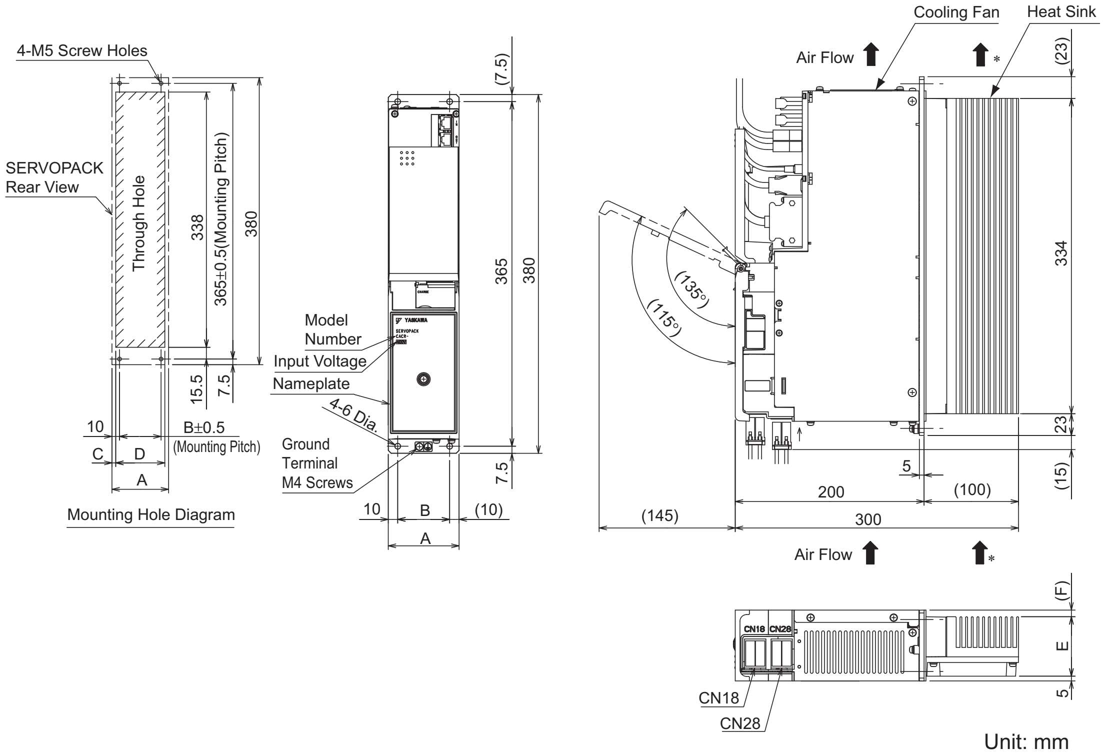
## (2) SERVOPACK for Two Axes




∗ The cooling air speed of heat sink must be at least 2.5 m/s at the point closest to the heat sink.

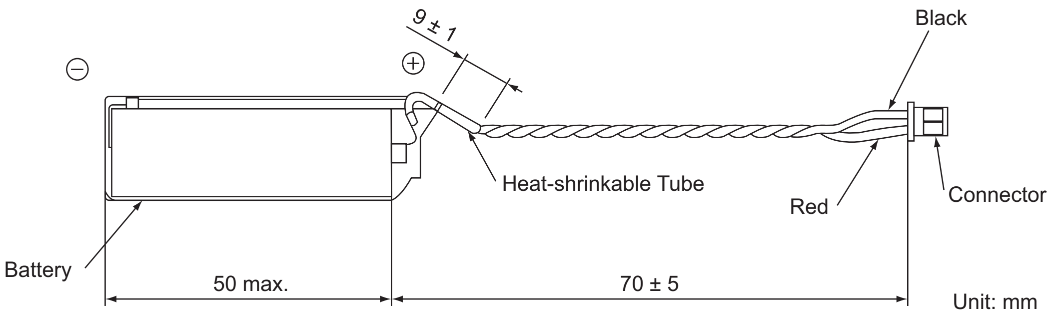
| Model | A | B | C | D | E | F | Approx. Mass (kg) |
|---|---|---|---|---|---|---|---|
| CACR-JUM23ACA | 50 | 30 | 4 | 42 | 40 | (5) | 4.5 |
| CACR-JUM24ACA | 50 | 30 | 4 | 42 | 40 | (5) | 4.5 |
| CACR-JUM25ACA | 75 | 55 | 5 | 65 | 63 | (7) | 5.7 |
| CACR-JUM23DCA | 75 | 55 | 5 | 65 | 63 | (7) | 5.2 |
| CACR-JUM24DCA | 75 | 55 | 5 | 65 | 63 | (7) | 5.2 |
| CACR-JUM25DCA | 75 | 55 | 5 | 65 | 63 | (7) | 5.7 |

# 5

# Peripheral Devices

# 5.1 Absolute Encoder Battery

## 5.1.1 Specifications




Use the following absolute encoder battery unit.

Model: ER6VLY+DF3 (a connector included)

If not using the battery unit from Yaskawa, use the following parts.

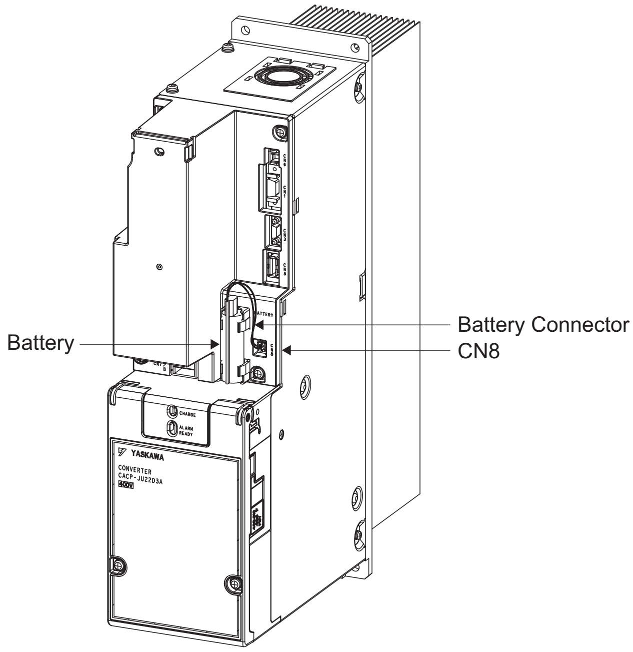
Battery model: ER6V
Connector Model: Housing DF3-2S-2C2C (Hirose Electric Co., Ltd.)
Contact DF3-2428SCFC (Hirose Electric Co., Ltd.) or DF3-2428SCC (Hirose Electric Co., Ltd.)

**⚠ CAUTION**

- Purchase a battery for the absolute encoder separately and mount it on the power regeneration converter.
- A lithium battery is used for the absolute encoder. Confirm the most current IATA dangerous goods regulations before transporting the battery as air cargo.

## 5.1.2 Setup Procedure

1. Make sure that the power supply to the Σ-V-SD driver is OFF.
2. Connect a battery (ER6VLY+DF3) to CN8 of the power regeneration converter.




For the battery replacement, refer to *8.7.3 Battery Replacement*.

Peripheral Devices
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# 5.2 AC Reactor

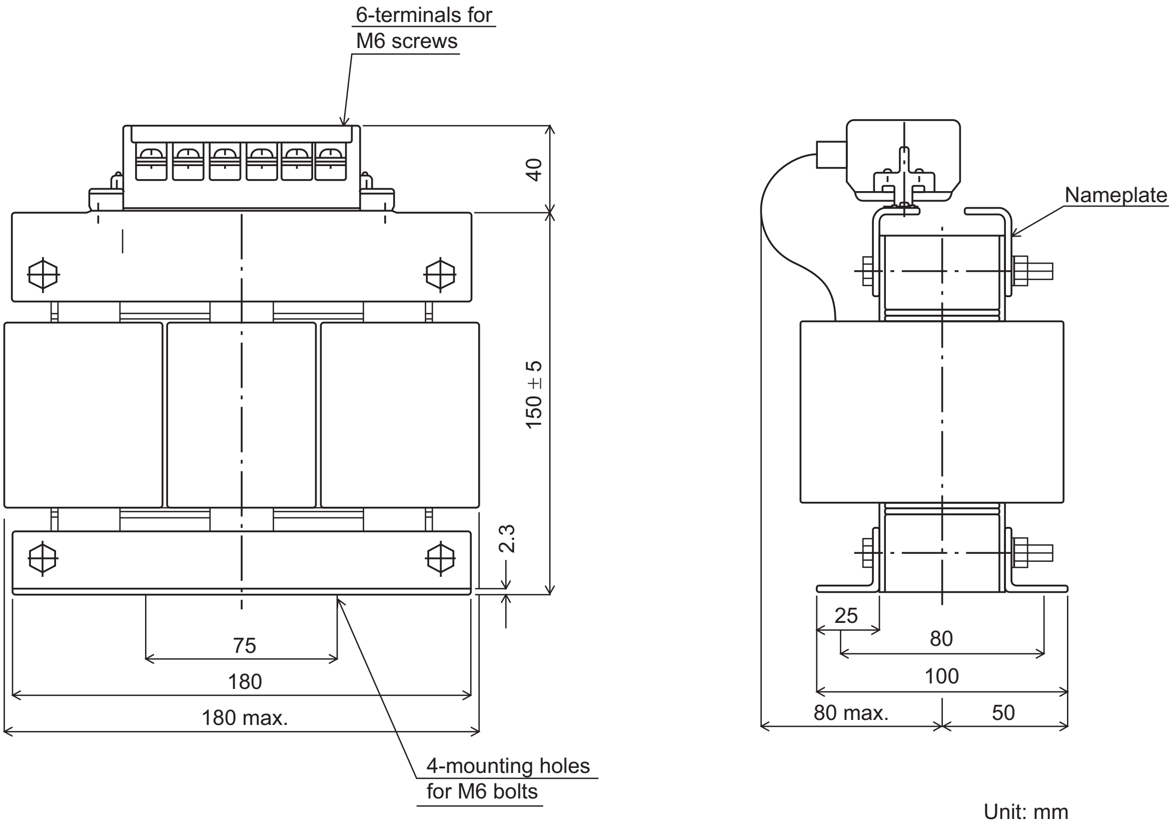
## 5.2.1 Specifications

| Power Regeneration Converter Model | AC Reactor Model | Rated Voltage (V) | Frequency (Hz) | Rated Current (A) | Inductance (mH) | Insula-tion Class (class) | Watt Data Loss (W) | Ambi-ent Tem-perature | Storage Tem-perature | Ap-prox. Mass (kg) |
|---|---|---|---|---|---|---|---|---|---|---|
| CACP-JU15A3☐ | X008017 | 230 | 50/60 | 56 | 0.21 | H | 55 | –10 to 55°C | –20 to 85°C | 8 |
| CACP-JU19A3☐ | X008018 | 230 | 50/60 | 73 | 0.17 | H | 70 | –10 to 55°C | –20 to 85°C | 8 |
| CACP-JU22A3☐ | X008019 | 230 | 50/60 | 90 | 0.14 | H | 80 | –10 to 55°C | –20 to 85°C | 12 |
| CACP-JU30A3☐ | X008020 | 230 | 50/60 | 107 | 0.1 | H | 85 | –10 to 55°C | –20 to 85°C | 12 |
| CACP-JU37A3B | X008029 | 230 | 50/60 | 145 | 0.09 | H | 93 | –10 to 55°C | –20 to 85°C | 12 |
| CACP-JU45A3B | X008022 | 230 | 50/60 | 179 | 0.07 | H | 130 | –10 to 55°C | –20 to 85°C | 25 |
| CACP-JU15D3☐ | X008010*<br>X008023 | 480 | 50/60 | 27 | 0.82 | H | 70 | –10 to 55°C | –20 to 85°C | 5 |
| CACP-JU19D3☐ | X008011 | 480 | 50/60 | 36 | 0.67 | H | 80 | –10 to 55°C | –20 to 85°C | 7.3 |
| CACP-JU22D3☐ | X008012 | 480 | 50/60 | 45 | 0.56 | H | 120 | –10 to 55°C | –20 to 85°C | 11.2 |
| CACP-JU45D3B | X008024 | 480 | 50/60 | 89 | 0.27 | H | 90 | –10 to 55°C | –20 to 85°C | 24.5 |

* This AC reactor does not comply with UL standards.

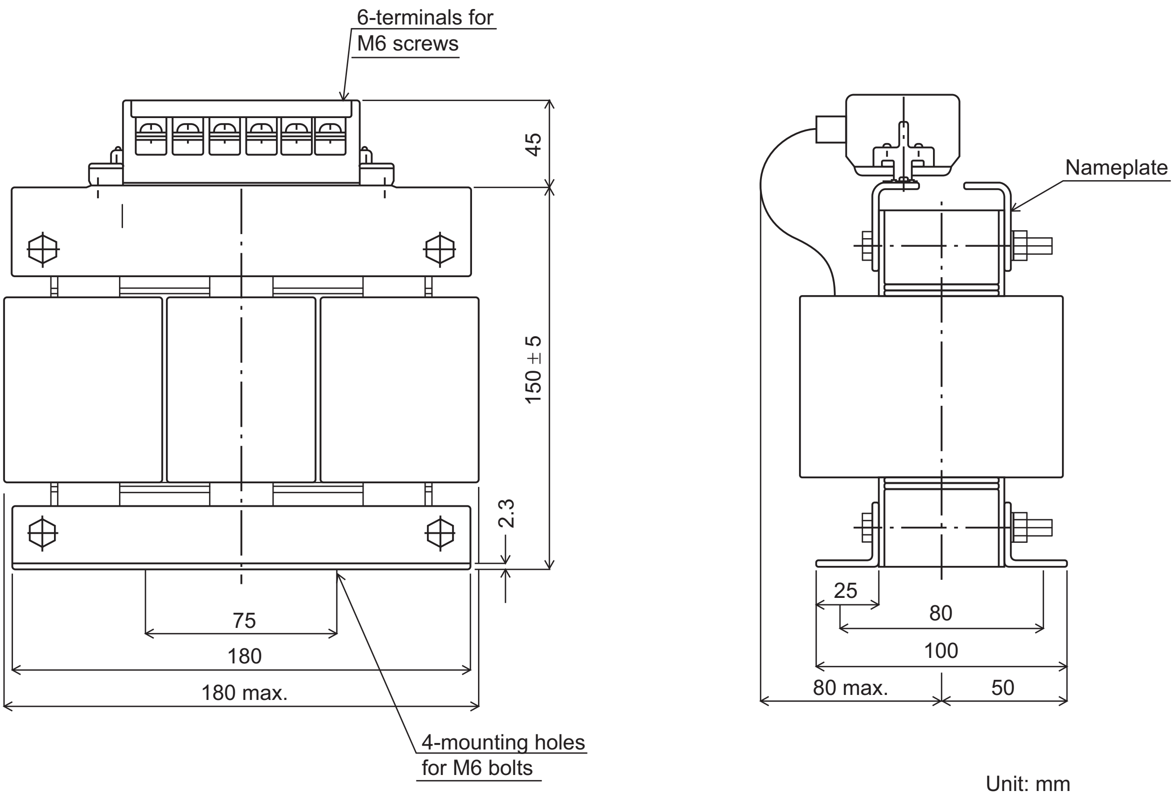
## 5.2.2 External Dimensions

### (1) Model: X008017



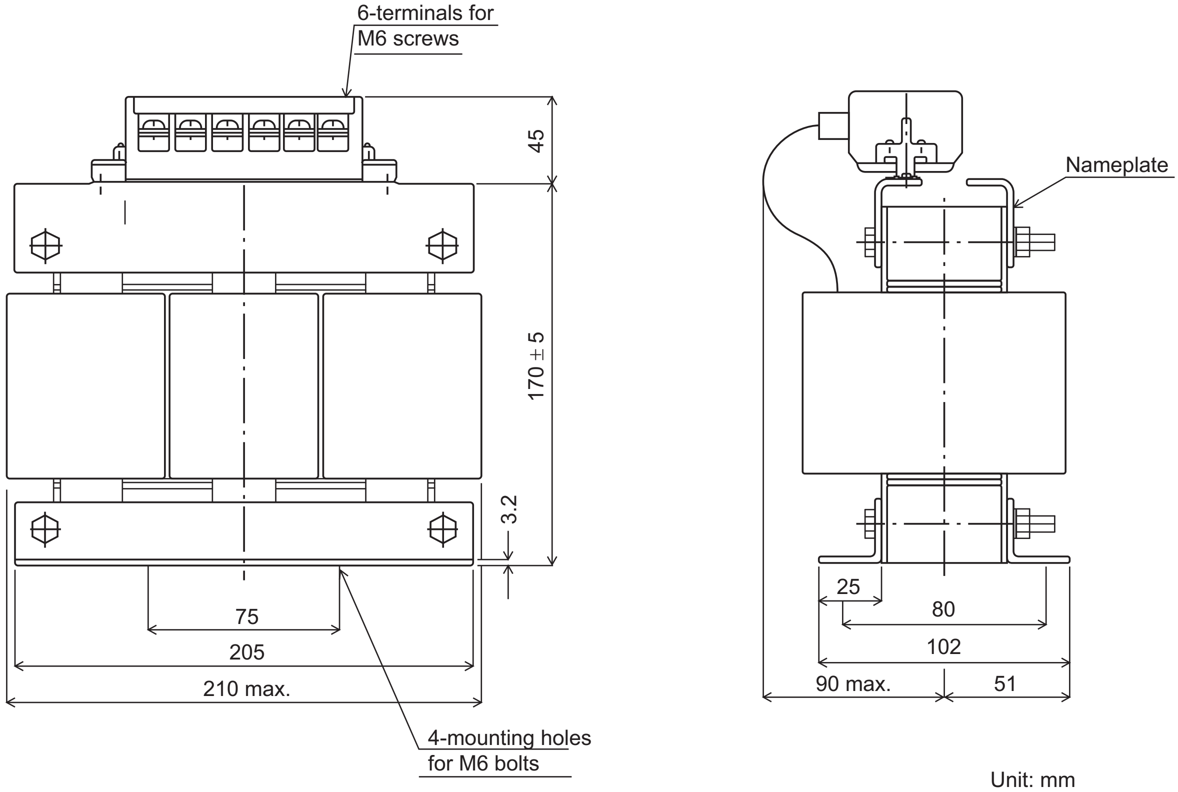

Unit: mm

### (2) Model: X008018



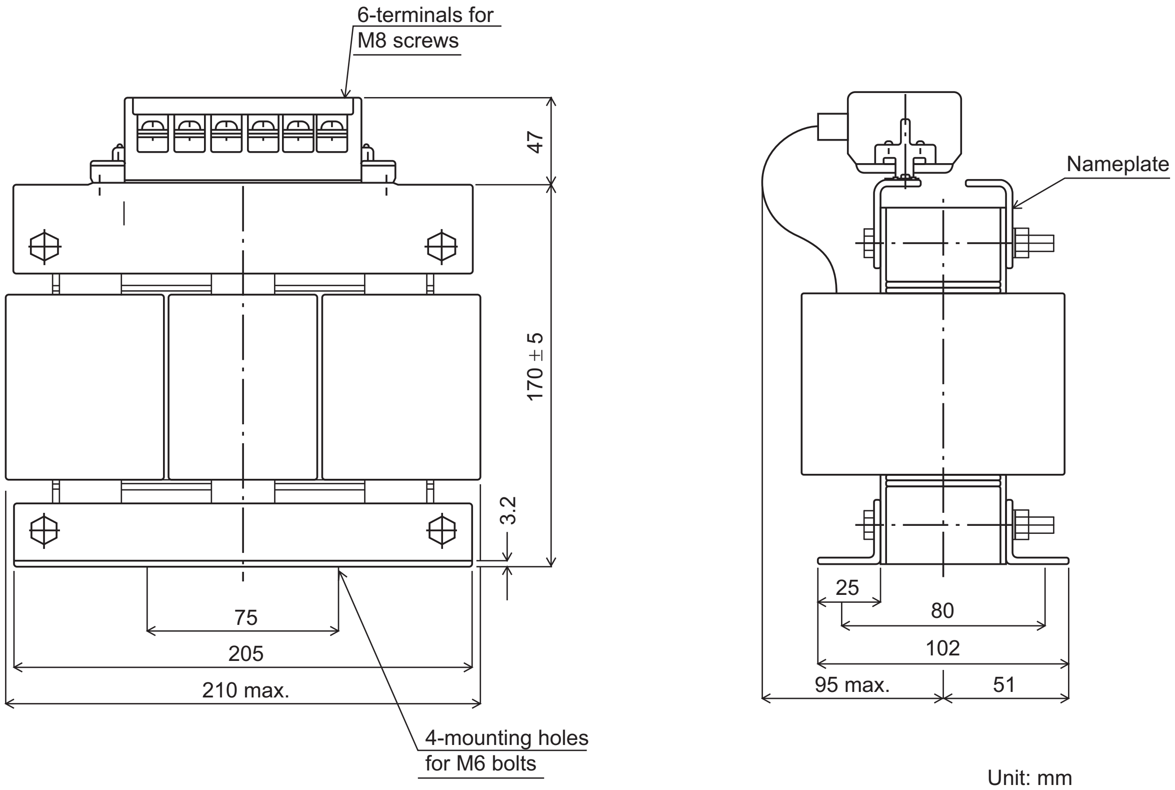

Unit: mm

## (3) Model: X008019



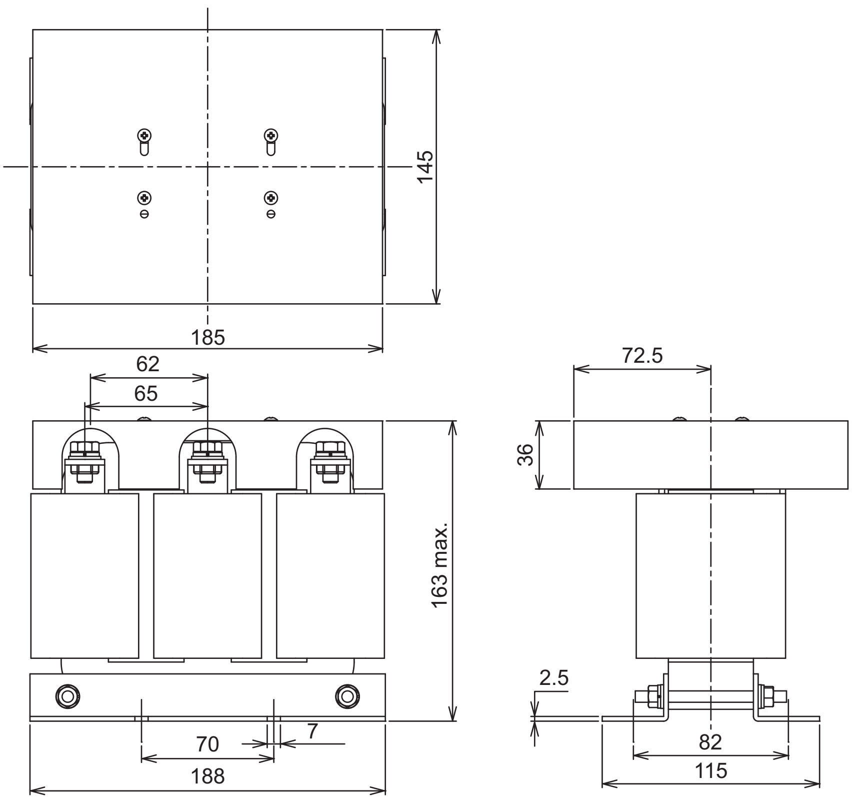

Unit: mm

## (4) Model: X008020



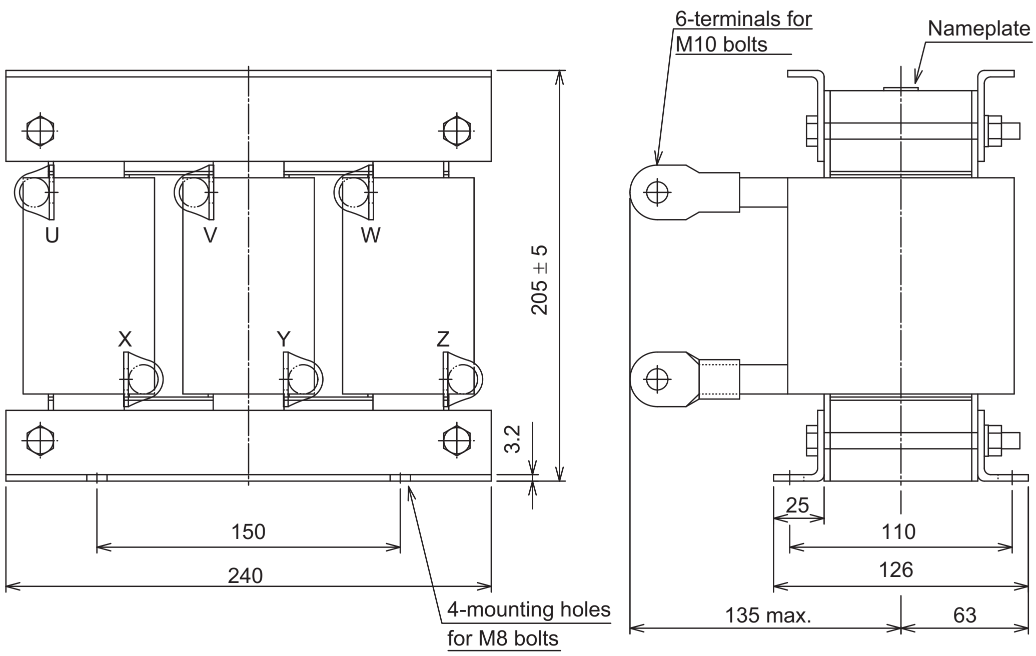

Unit: mm

(5) Model: X008029



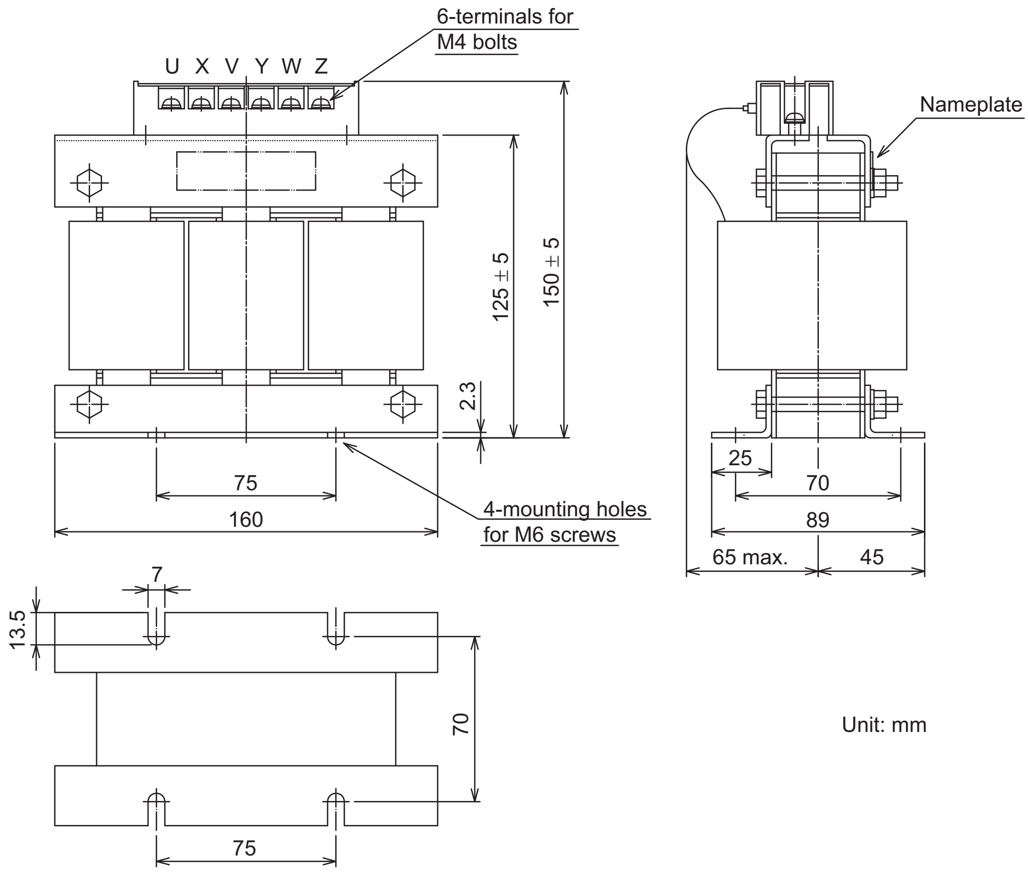

Unit: mm

(6) Model: X008022

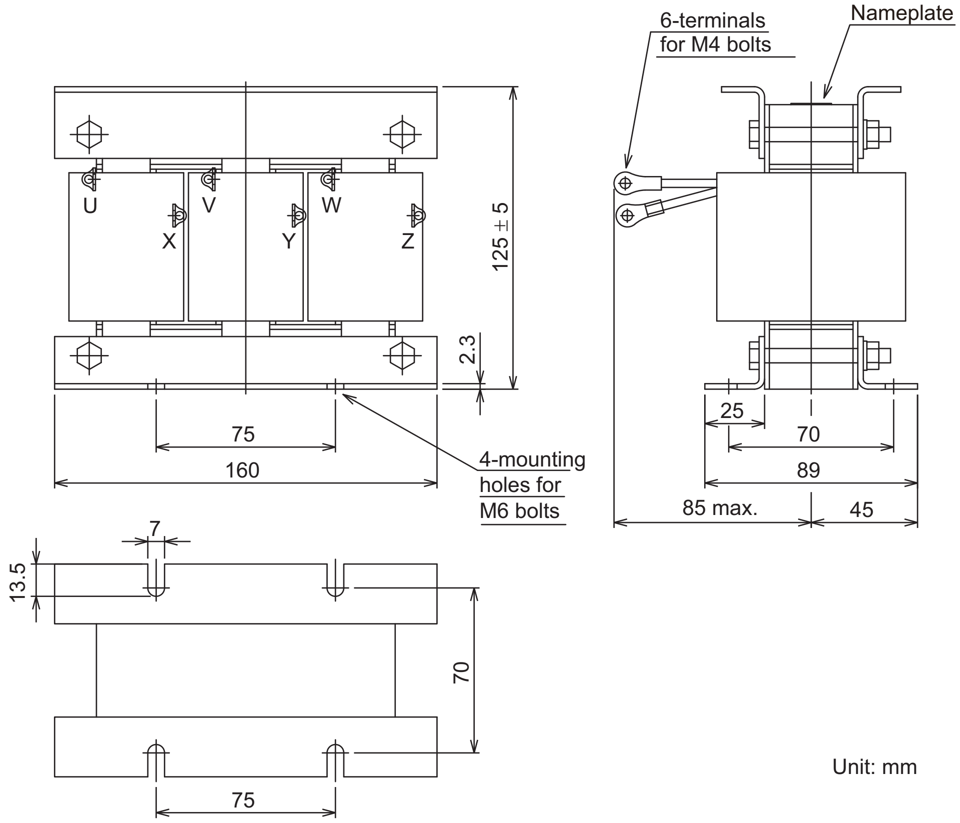



Unit: mm

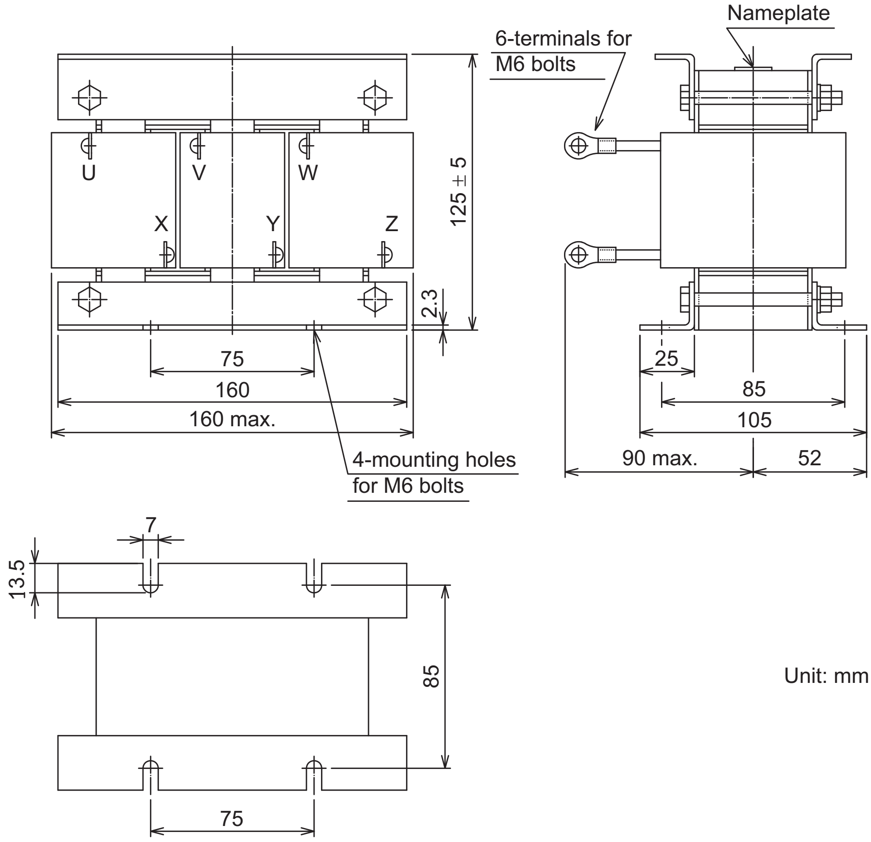
## (7) Model: X008010




## (8) Model: X008023

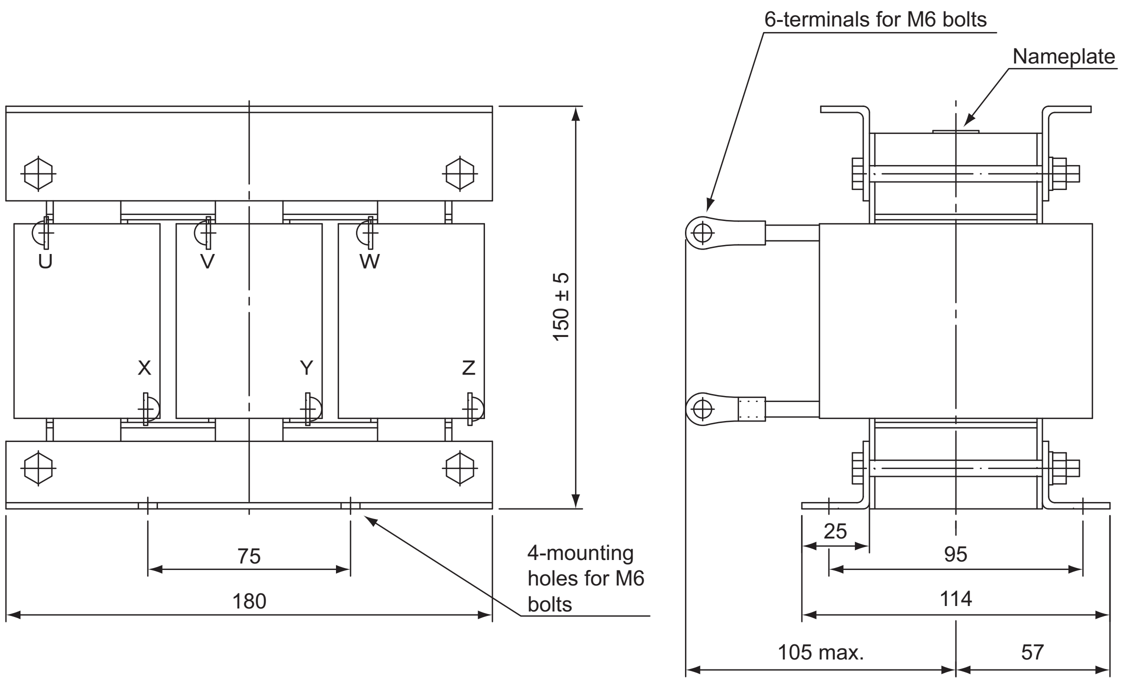


(9) Model: X008011




Unit: mm

(10) Model: X008012




Unit: mm

Peripheral Devices

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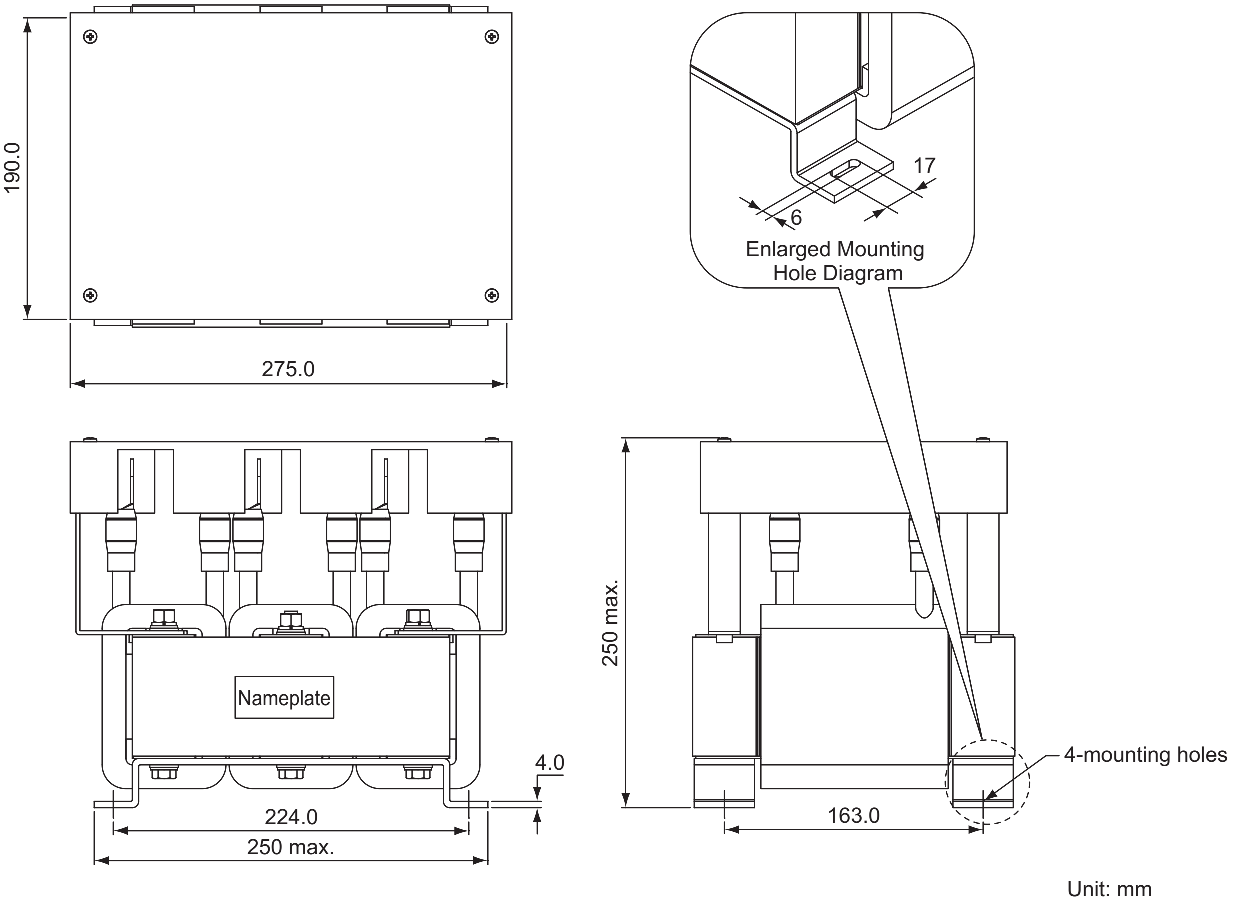
## (11) Model: X008024



# 5.3 Magnetic Contactor for Winding Selection

## 5.3.1 Specifications

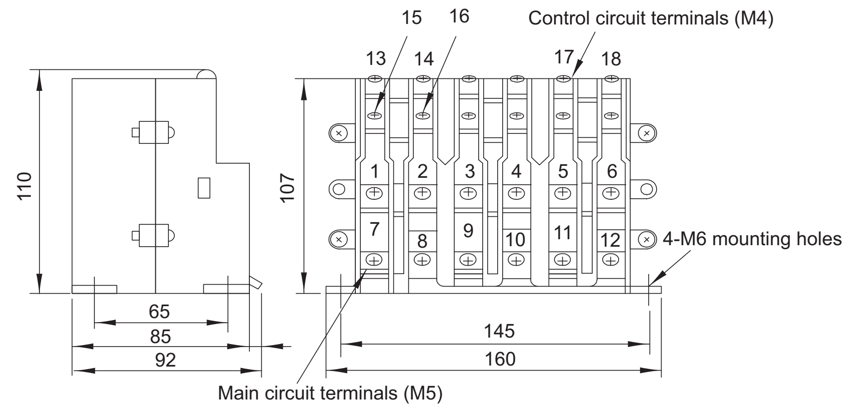
| Model | Standard*1 | HV-75AP4 | HV-150AP4 | HV-200AP4 |
|---|---|---|---|---|
| | For UL Compliance | HV-75AP4/UL | HV-150AP4/UL | HV-200AP4/UL |
| Contact | | Main contact: 3NO, 3NC, auxiliary contact: 1NC | | |
| Rated Insulation Voltage | | 600 V | | |
| Rated Applying Current | Continuous | 75 A | 150 A | 200 A |
| | 30 minutes*2 | 87 A | 175 A | 226 A |
| Breaking Current Capacity | 220 V | 200 A | 400 A | |
| | 440 V | 150 A | 300 A | |
| Open/Close Frequency | | 600 times/hour | | |
| Mechanical Duration of Life | | 5 million times | | |
| Control Magnetic Coil Rating | | 200 V 50/60 Hz, 220 V 50/60 Hz, 230 V 60 Hz | | |
| Mass | | 2.5 kg | 5.0 kg | |
| Ambient Temperature | | -10 to 55°C | | |
| Storage Temperature | | -20 to 85°C | | |
| Humidity | | 10 to 95%RH (non-condensing) | | |
| Spindle Motor Capacity (50%ED) | | 5.5 to 15 kW | 18.5 to 30 kW | 37 to 45 kw |

∗1. Safety covers are provided on the HV-☐AP4S.
∗2. A dwell time of 1 hour or more is required after applying power supply for 30 minutes.

## 5.3.2 External Dimensions

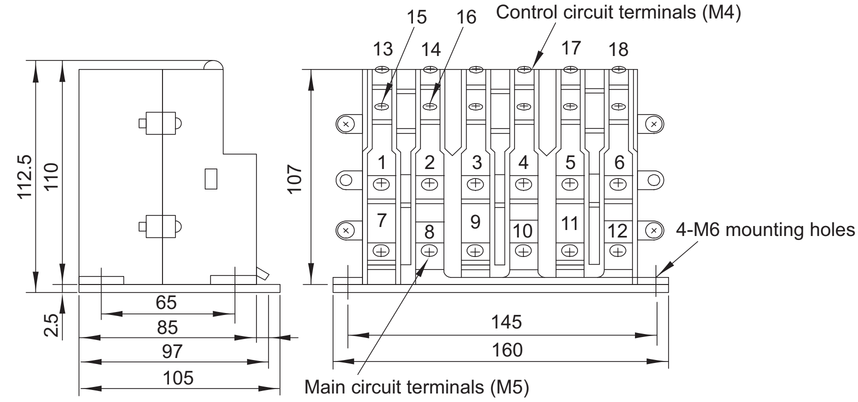
The external dimensions are shown below.

### (1) Model: HV-75AP4



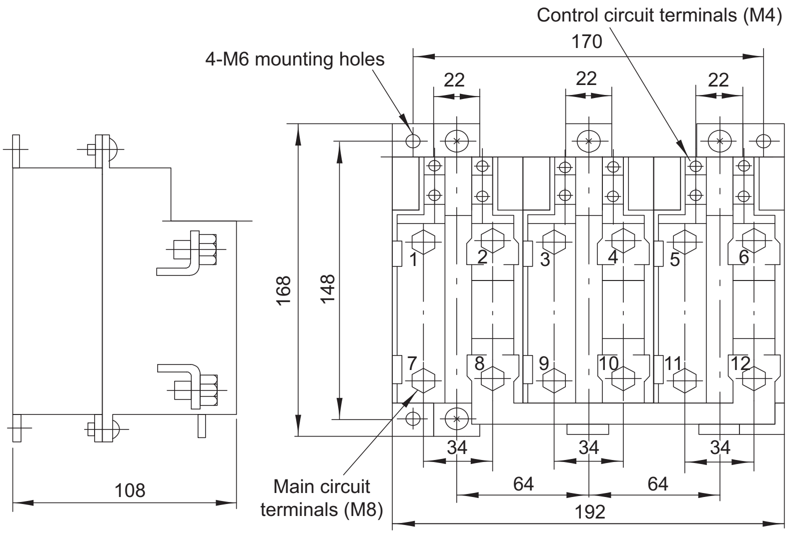

Unit: mm

(2) Model: HV-75AP4/UL




Unit: mm

(3) Model: HV-150AP4, HV-150AP4/UL, HV-200AP4, HV-200AP4/UL

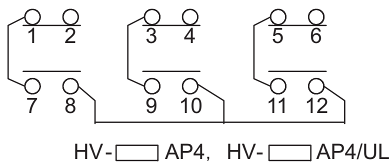



Unit: mm

## 5.3.3 Terminal Descriptions

The terminal name and operation status are shown below. For mounting direction, refer to *5.3.4 Installation Orientation*.

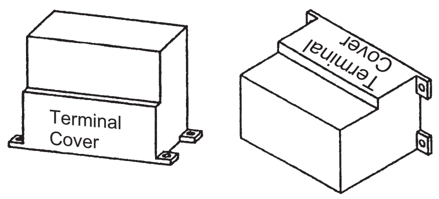
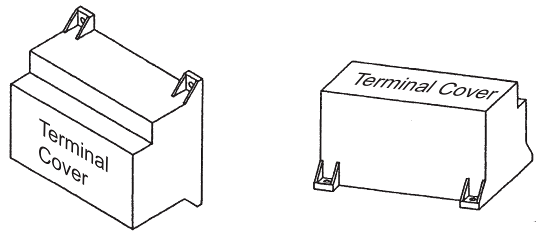
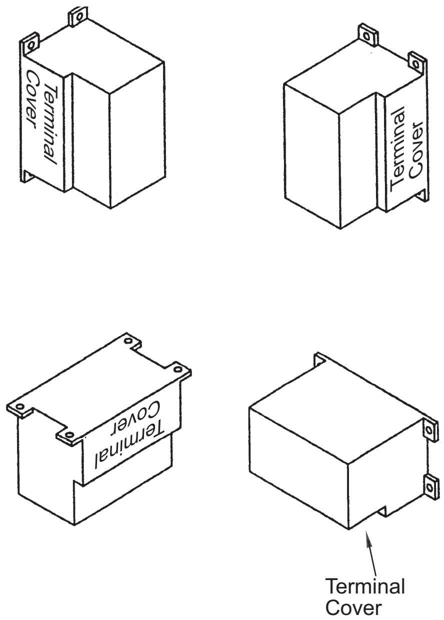
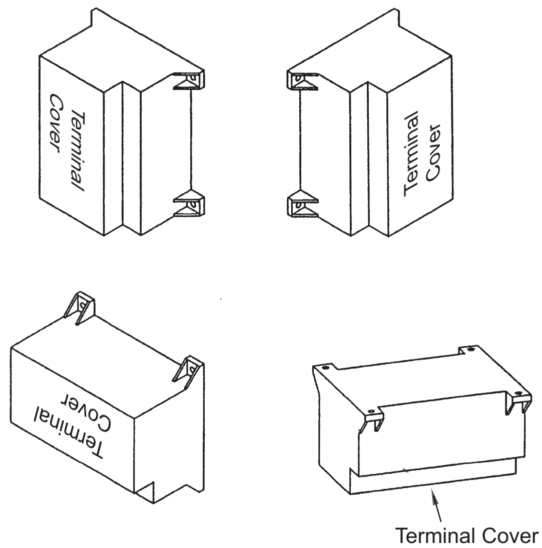
| Terminal | Name | Operation Status | |
|---|---|---|---|
| 13–14 | Selection signal | +24 V (Low-speed winding) | 0 V (High-speed winding) |
| 1–2<br>3–4<br>5–6 | Main contact: 3NC | Open | Closed |
| 7–8<br>9–10<br>11–12 | Main contact: 3NO | Closed | Open |
| 15–16 | Auxiliary contact: 1NC | Open | Closed |
| 17–18 | Single-phase<br>200 V power supply | – | – |




Note: When Using HV-75AP4□
Don't connect clamp to lower terminals (terminal No.9 and 11) for main circuit.
It may cause short circuit since there is not enough insulation distance between terminal and terminal plate.

## 5.3.4 Installation Orientation

Use the following method to install a magnetic contactor for winding selection.

| Mounting | Model: HV-75AP4, HV-75AP4/UL | Model: HV-150AP4, HV-150AP4/UL, HV-200AP4, HV-200AP4/UL |
|---|---|---|
| Possible |  |  |
| Not possible |  |  |

# 5.4 Noise Filter

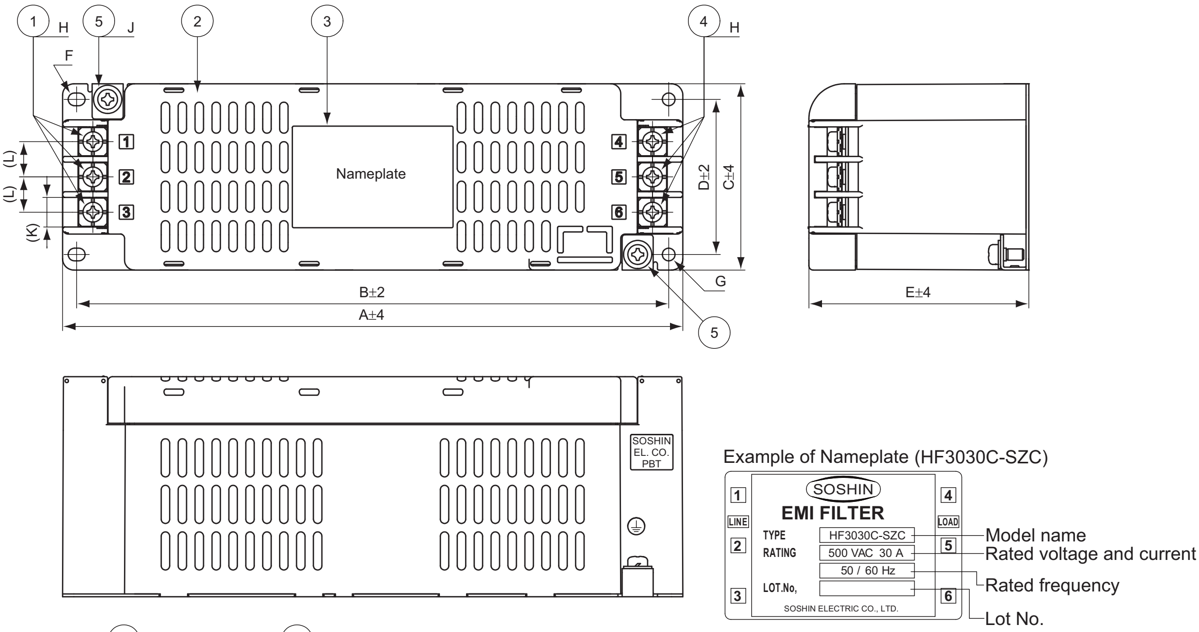
## 5.4.1 Specifications

| Power Regeneration Converter | | Noise Filter | | | | | |
|---|---|---|---|---|---|---|---|
| Input Voltage | Model | Model | Rated Current (A) | Classification | Rated Voltage | Leakage Current (mA) | Manufacturer |
| Three-phase, 200 VAC | CACP-JU15A3□ | HF3060C-SZC-47EDD | 60 | Three-phase three-wire | 480 VAC | 8 (for 200 VAC, 60 Hz) | SOSHIN ELECTRIC CO., LTD |
| | CACP-JU19A3□ | HF3080C-SZC-47EDD | 80 | | | | |
| | CACP-JU22A3□ | HF3100C-SZC-47EDD | 100 | | | | |
| | CACP-JU30A3□ | HF3150C-SZC-47EDD | 150 | | | | |
| | CACP-JU37A3B | | | | | | |
| | CACP-JU45A3B | HF3200C-SZC-49EDE* | 200 | | | 25 (for 200 VAC, 60 Hz) | |
| Three-phase, 400 VAC | CACP-JU15D3□ | HF3030C-SZC-47DDD | 30 | Three-phase three-wire | 480 VAC | 13 (for 400 VAC, 50 Hz) | SOSHIN ELECTRIC CO., LTD |
| | CACP-JU19D3□ | HF3040C-SZC-47EDD | 40 | | | | |
| | CACP-JU22D3□ | HF3050C-SZC-47EDD | 50 | | | | |
| | CACP-JU45D3B | HF3100C-SZC-47EDD | 100 | | | | |

* Also use the following compact AC power supply block-type capacitor (X capacitor).
Compact AC power supply block-type capacitor (X capacitor) model: LDA106M-AA (from Soshin Electric Co., Ltd.)
Refer to *10.4.1 EMC Installation Conditions* for the installation location of the capacitor.

## 5.4.2 External Dimensions

### (1) Model: HF3030C-SZC-47DDD, HF3040C-SZC-47EDD to HF3060C-SZC-47EDD



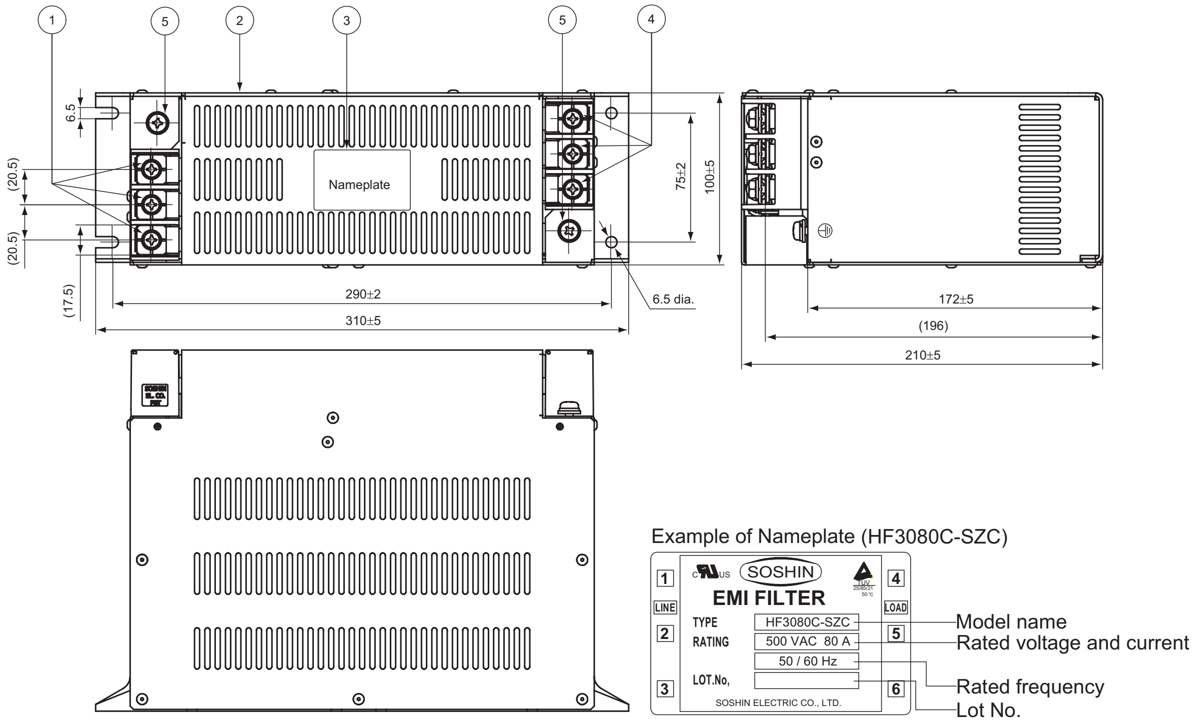

1 Input terminal
2 Case
3 Nameplate
4 Output terminal
5 Earth terminal

Unit: mm

Unit: mm

| Noise Filter Model | A | B | C | D | E | F | G | H | J | K | L |
|---|---|---|---|---|---|---|---|---|---|---|---|
| HF3030C-SZC-47DDD | 220 | 210 | 66 | 55 | 78 | R2.25 × 6 | 4.5 dia. | M4 | M4 | 10.5 | 12.5 |
| HF3040C-SZC-47EDD | 270 | 260 | 80 | 70 | 84 | R2.75 × 7 | 5.5 dia. | M5 | M4 | 13 | 16 |
| HF3050C-SZC-47EDD | | | | | | | | | | | |
| HF3060C-SZC-47EDD | | | | | | | | | | | |

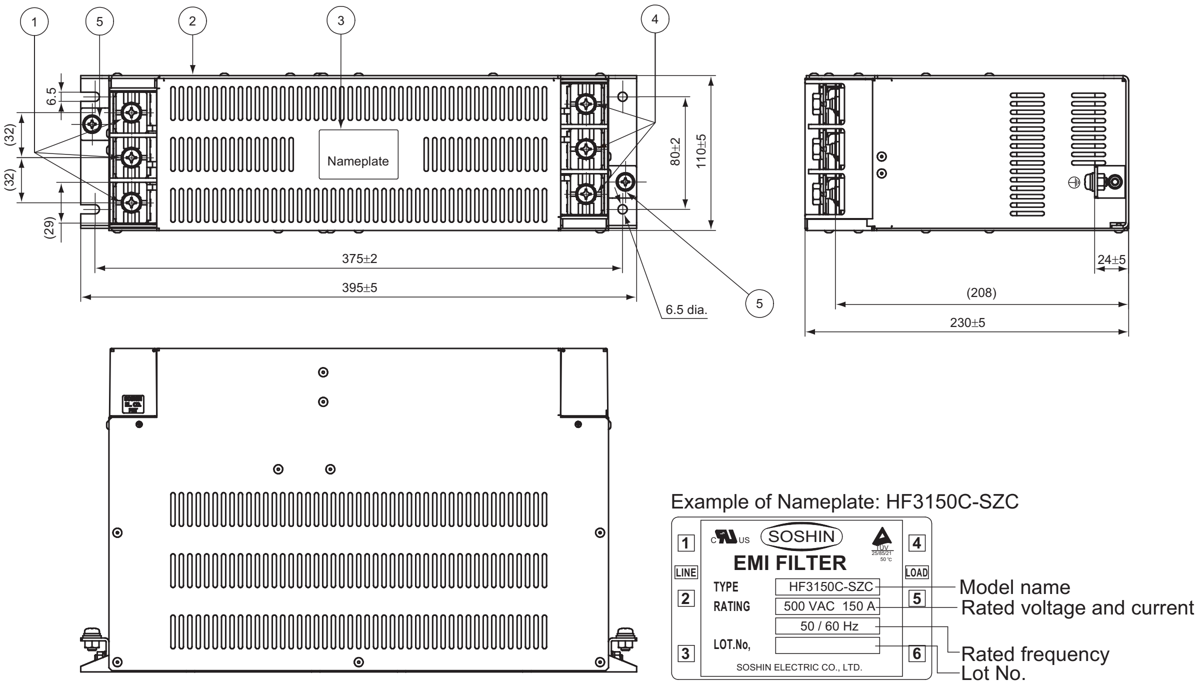
## (2) Model: HF3080C-SZC-47EDD, HF3100C-SZC-47EDD




1. Input terminal: M6
2. Case
3. Nameplate
4. Output terminal: M6
5. Earth terminal: M6

Unit: mm

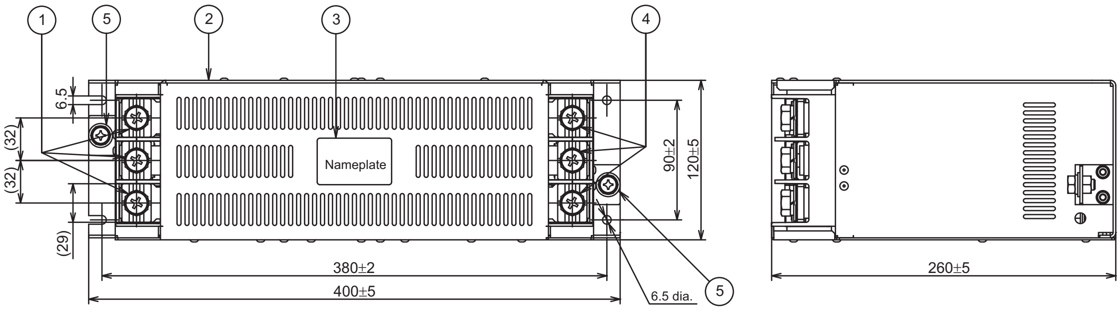
## (3) Model: HF3150C-SZC-47EDD

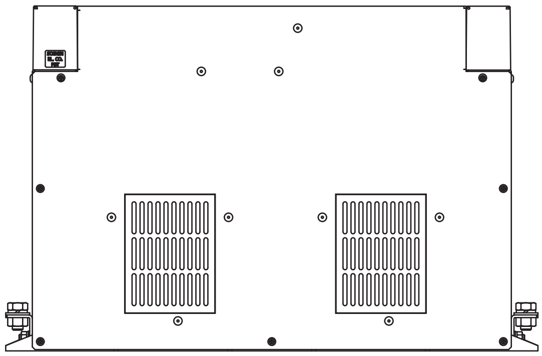



1. Input terminal: M8
2. Case
3. Nameplate
4. Output terminal: M8
5. Earth terminal: M6

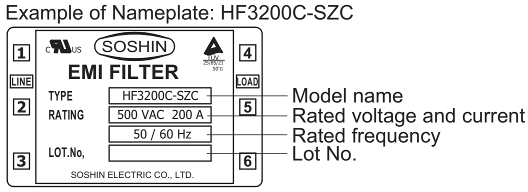
Unit: mm

## (4) Model: HF3200C-SZC-49EDE



Example of Nameplate: HF3200C-SZC

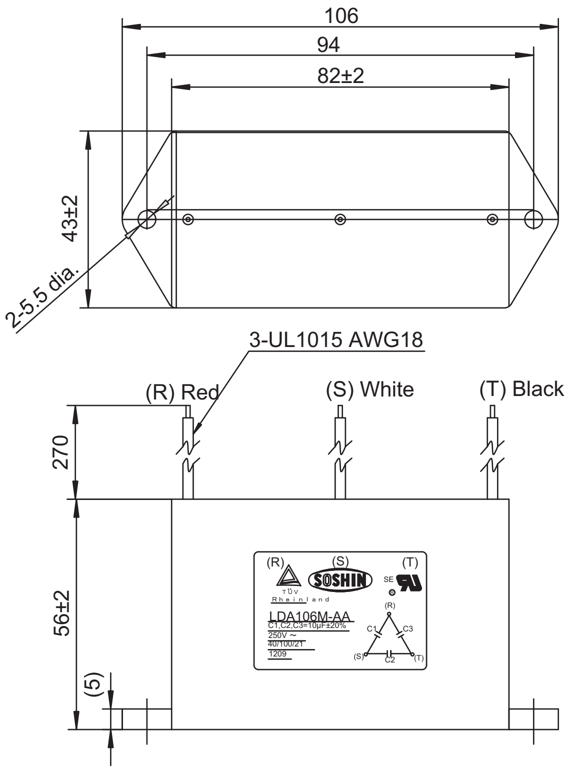



1. Input terminal: M10
2. Case
3. Nameplate
4. Output terminal: M10
5. Earth terminal: M8

Unit: mm

Note: Also use a compact AC power supply block-type capacitor (X capacitor).
Model: LDA106M-AA (Soshin Electric Co., Ltd.)

### ■ Compact AC Power Supply Block-type Capacitor (X Capacitor) Model: LDA106M-AA




Unit: mm

Peripheral Devices

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# 5.5 Base Mounting Units

When mounting servo drivers to bases, use the following base mounting units.

## 5.5.1 Specifications

| Model | Unit Width (mm) | Cooling Fan | | Terminal Block | | |
|---|---|---|---|---|---|---|
| | | Input Voltage (VDC) | Input Current (A) | Terminal Screw | Wire Sizes (AWG) | Tightening Torque (N·m) |
| JUSP-JUBM050AA | 50 | 24 | 0.42 | M3.5 | 24 to 12 | 0.8 to 1.2 N·m (7.1 to 10.6 lbf·in) |
| JUSP-JUBM075AA | 75 | | 0.94 | | | |
| JUSP-JUBM100AA | 100 | | 0.94 | | | |
| JUSP-JUBM150AA | 150 | | 1.88 | | | |
| JUSP-JUBM250AA | 250 | | 1.24 | | | |

Note: The input current that is given above is the current for one base mounting unit.

## 5.5.2 Power Regeneration Converter and SERVOPACK Combinations

### (1) Power Regeneration Converter

| Power Regeneration Converter | | Base Mounting Unit |
|---|---|---|
| Input Voltage | Model | Model |
| Three-phase 200 VAC | CACP-JU15A3□ | JUSP-JUBM100AA |
| | CACP-JU19A3□ | |
| | CACP-JU22A3□ | |
| | CACP-JU30A3□ | JUSP-JUBM150AA |
| | CACP-JU37A3B | |
| | CACP-JU45A3B | JUSP-JUBM250AA |
| Three-phase 400 VAC | CACP-JU15D3□ | JUSP-JUBM100AA |
| | CACP-JU19D3□ | |
| | CACP-JU22D3□ | |
| | CACP-JU45D3B | JUSP-JUBM250AA |

### (2) SERVOPACK

#### ■ SERVOPACK for One Axis

| SERVOPACK | | Base Mounting Unit |
|---|---|---|
| Input Voltage | Model | Model |
| 270 VDC | CACR-JU028ACA | JUSP-JUBM050AA |
| | CACR-JU036ACA | |
| | CACR-JU065ACA | JUSP-JUBM075AA |
| | CACR-JU084ACA | JUSP-JUBM150AA |
| | CACR-JU102ACA | |
| | CACR-JU125ACA | |
| | CACR-JU196ACA | JUSP-JUBM250AA |
| 540 VDC | CACR-JU014DCA | JUSP-JUBM050AA |
| | CACR-JU018DCA | |
| | CACR-JU033DCA | JUSP-JUBM075AA |
| | CACR-JU042DCA | JUSP-JUBM150AA |
| | CACR-JU051DCA | |
| | CACR-JU098DCA | JUSP-JUBM250AA |

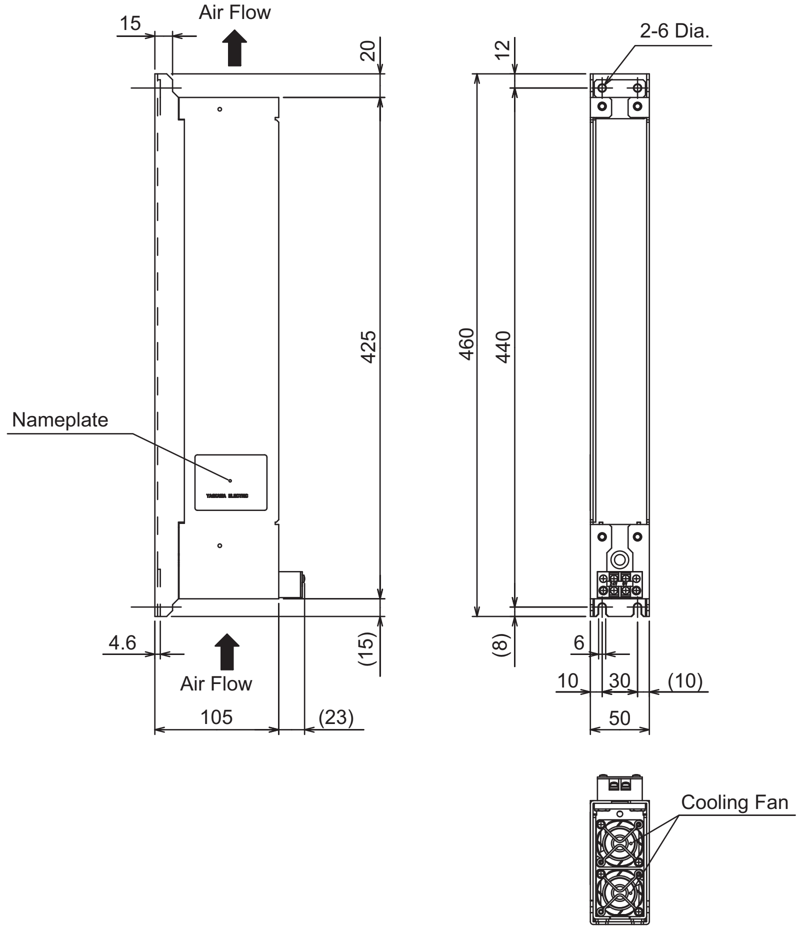
■ SERVOPACK for Two Axes

| SERVOPACK | | Base Mounting Unit |
|---|---|---|
| Input Voltage | Model | Model |
| 270 VDC | CACR-JUM23ACA | JUSP-JUBM050AA |
| | CACR-JUM24ACA | |
| | CACR-JUM25ACA | JUSP-JUBM075AA |
| 540 VDC | CACR-JUM23DCA | JUSP-JUBM075AA |
| | CACR-JUM24DCA | |
| | CACR-JUM25DCA | |

## 5.5.3 External Dimensions

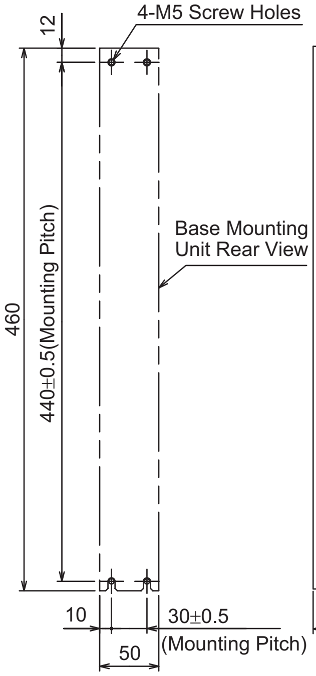
### (1) Model: JUSP-JUBM050AA

Unit: mm

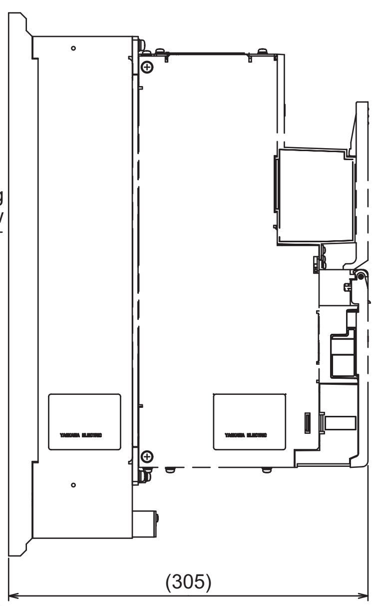



Approx. Mass: 2.7 kg

<Mounting Hole Diagram>

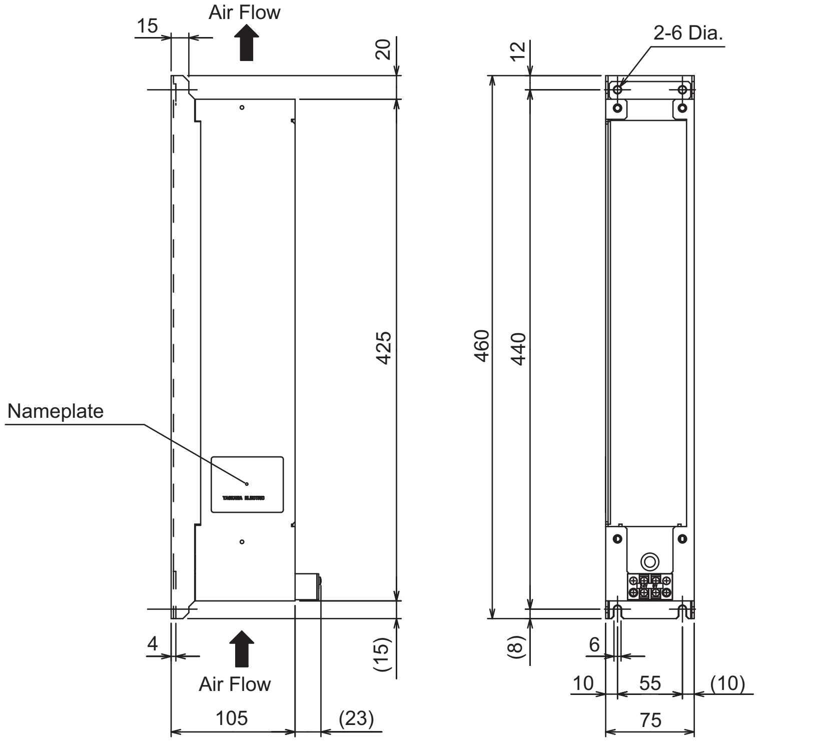


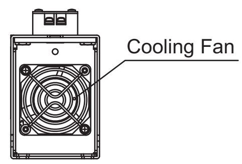

<Unit Mounted Diagram>



## (2) Model: JUSP-JUBM075AA

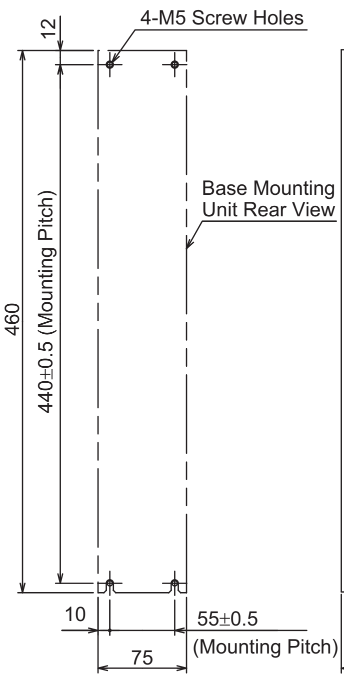
Unit: mm



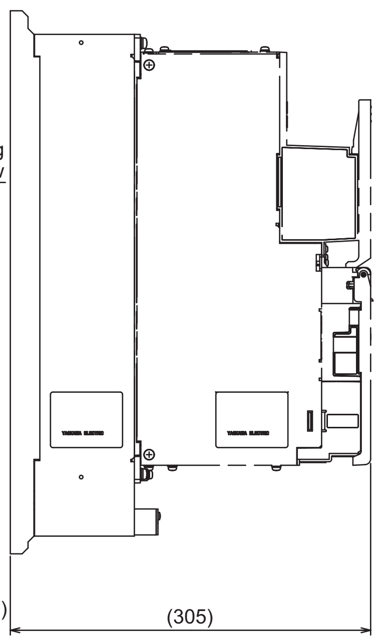




Approx. Mass: 2.7 kg

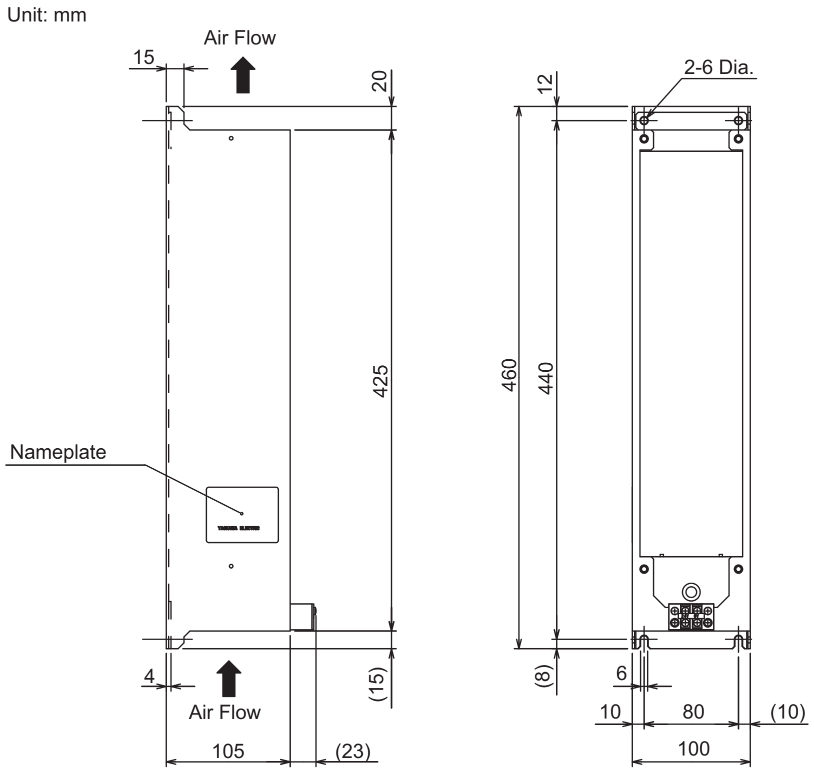
<Mounting Hole Diagram>

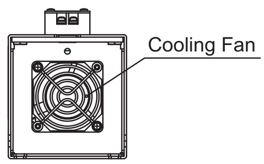



<Unit Mounted Diagram>

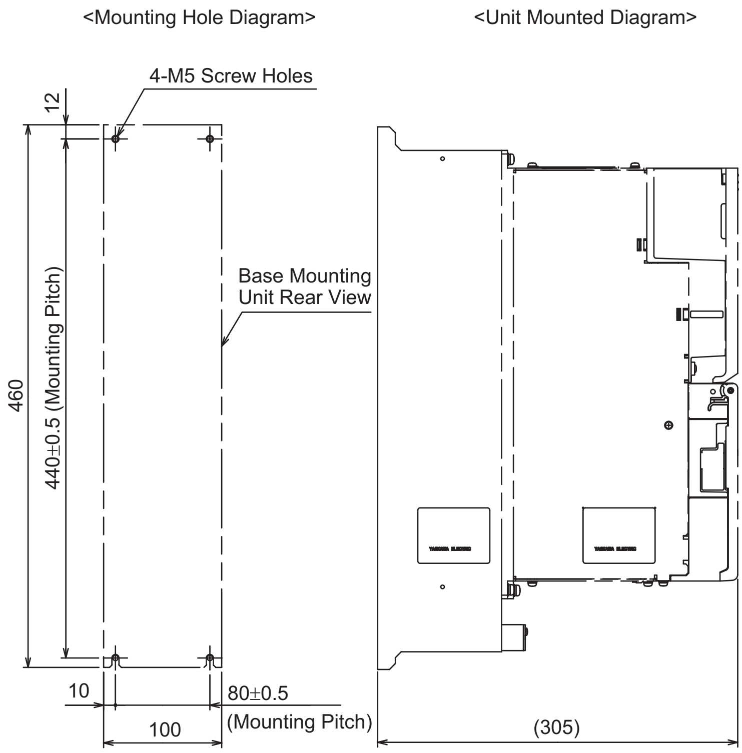


## (3) Model: JUSP-JUBM100AA

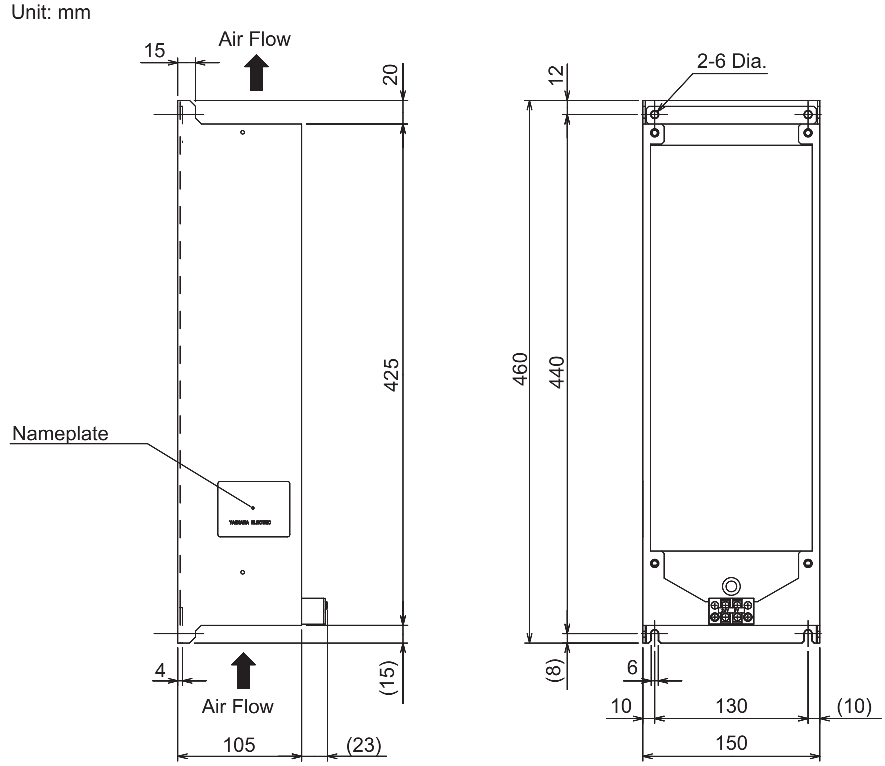


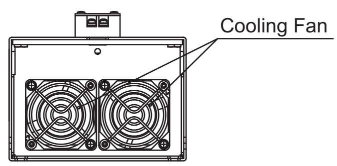




Approx. Mass: 2.8 kg



## (4) Model: JUSP-JUBM150AA

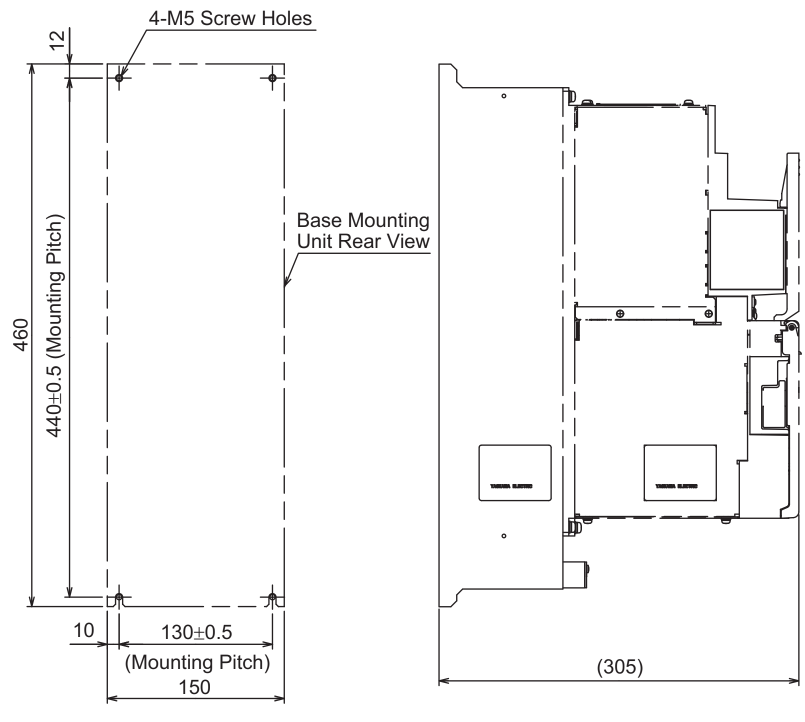



Approx. Mass: 3.5 kg

<Mounting Hole Diagram>

<Unit Mounted Diagram>




Peripheral Devices

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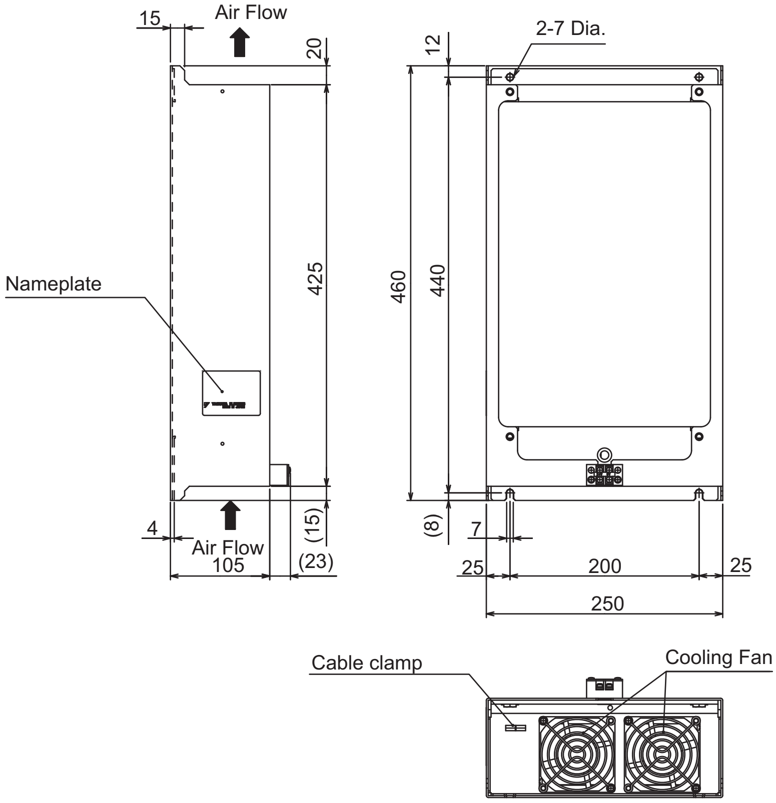
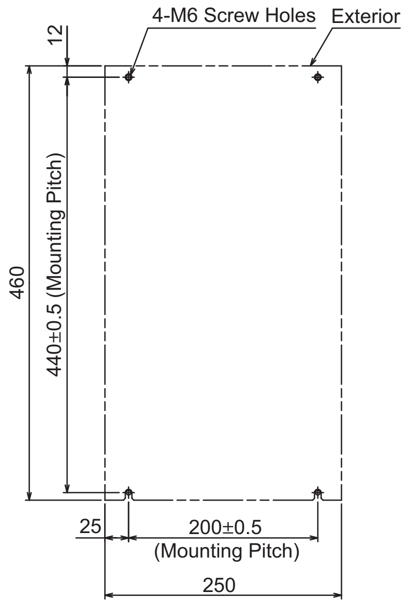
## (5) Model: JUSP-JUBM250AA

Unit: mm

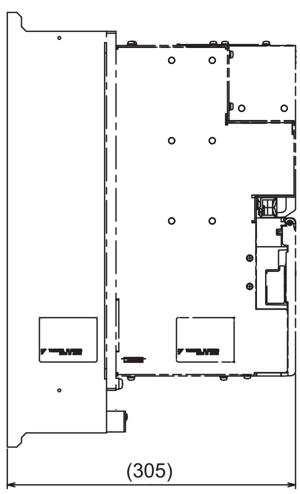



Approx. Mass: 4.9 kg

<Mounting Hole Diagram>




<Unit Mounted Diagram>

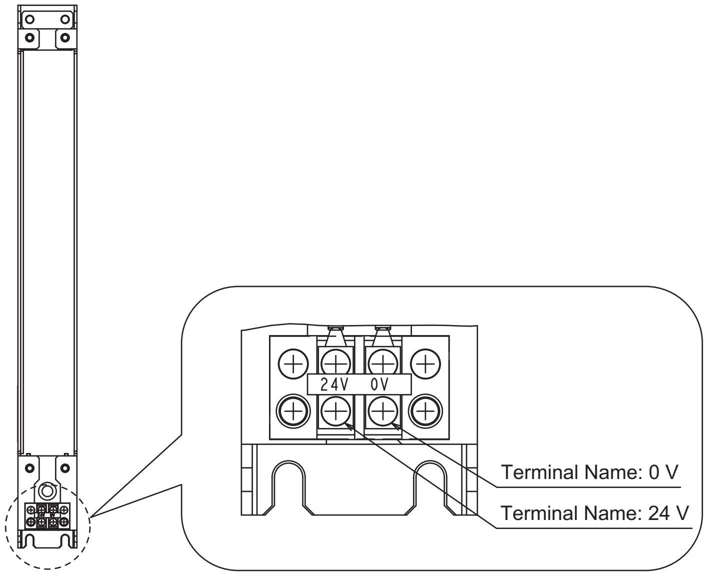


## 5.5.4 Wiring

Connect the 24-VDC and 0-VDC lines to the terminals on the base mounting unit to power the cooling fan.

Note 1. The power supply for the cooling fan on the base mounting unit is separate from the control power supply for the power regeneration converter and SERVOPACK and separate from the power supply for the sequence signals.

2. The output current that is required from the power supply when one power supply is connected to more than one base mounting unit is the total input current for all of the connected units. Use a suitable wire size for the required current and do not exceed the wire size range of the terminal block.



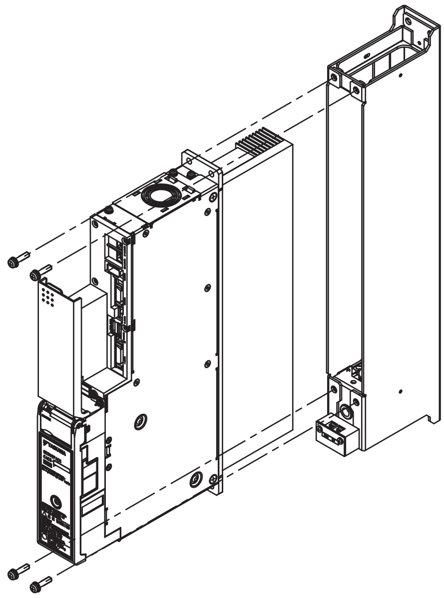
## 5.5.5 Mounting Method

Mount the power regeneration converter and SERVOPACK to the base mounting units as described in this section.

As shown in the following figure, insert the heat sink on the power regeneration converter or SERVOPACK into the base mounting unit and secure it with the enclosed screws (four).

The side of the base mounting unit with the terminal block is the bottom of the unit.

For instructions on installation in a control panel, refer to *6.2 Σ-V-SD Driver*.



| Model | Size of Enclosed Screws | Tightening Torque |
|---|---|---|
| JUSP-JUBM050AA | M5 | 2.6 to 3.2 N·m<br>(23.0 to 28.3 lbf·in) |
| JUSP-JUBM075AA | | |
| JUSP-JUBM100AA | | |
| JUSP-JUBM150AA | | |
| JUSP-JUBM250AA | M6 | 4.3 to 4.9 N·m<br>(38.1 to43.4 lbf·in) |

# 6

# Installation

# 6.1 Motors

The service life of the motor will be shortened or unexpected problems will occur if the motor is installed incorrectly or in an inappropriate location. Always observe the following installation instructions.

## 6.1.1 Installation Environment

| Item | Condition |
|---|---|
| Ambient Temperature | 0 to 40°C (no freezing) |
| Ambient Humidity | 20% to 80%RH (no condensation) |
| Installation Site | • Free of corrosive or explosive gases<br>• Well-ventilated and free of dust and moisture<br>• Facilitates inspection and cleaning.<br>• Elevation:1,000 m max.<br>• Free of high magnetic field<br>• Free of oil |
| Storage Environment | Store the motor in the following environment if it is stored with the power cable disconnected.<br>Ambient temperature during storage: -20 to +60°C (no freezing)<br>Ambient humidity during storage: 20% to 80%RH (no condensation) |

Note these additional points when using spindle motors.

**⚠ CAUTION**

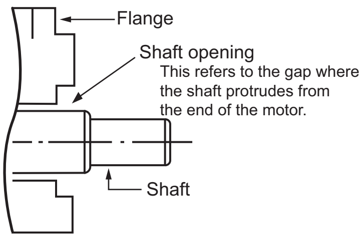
- Provide sufficient space so that cooling air will be provided to the cooling fan. Keep a space of at least 100 mm between the machine and the ventilation outlet of the motor.
  If ventilation is not proper, the motor temperature fault protective function will work regardless of whether or not the load is at the rated value or not.
- Install the motor in a clean location free from oil mist and water drops. If the motor is likely to come in contact with water or oil, protect the motor with a cover.
  The intrusion of water or dirty oil into the interior of the motor will decrease the insulation resistance, which may result in a ground fault.
- Check that the mounting bed, base, or stand of the motor is of robust construction.
  The weight of the motor as well as the dynamic load of the motor in operation will be imposed on it, possibly causing vibration.
- Use seal connectors, conduits, or similar devices to seal the cable openings of the motor terminal box.
  Failure to observe this caution may result in cuttings, mist of cutting oil, or other foreign matter entering the motor through the cable opening, possibly causing malfunction.
- If you install the motor so that the shaft faces vertically downward, do not allow the motor shaft to come into contact with the frame, ground surface, or other objects.
  Doing so would press the motor shaft into the motor, possibly damaging the bearings.

## 6.1.2 Enclosure

The motor enclosure* is described table as follows.

| | Spindle motor | Servomotor |
|---|---|---|
| Enclosure | IP44 | IP67 |

* Except shaft opening. The enclosure specification can be satisfied only when using a specified cable.




### (1) Spindle motor

If the spindle motor is used in a location that is subject to water or oil mist, contact your Yaskawa representative.

### (2) Servomotor

If the servomotor is used in a location that is subject to water or oil mist, order a servomotor with an oil seal to seal the through shaft section.

#### ■ Precautions on Using Servomotor with Oil Seal

- Put the oil surface under the oil seal lip.
- Use an oil seal in favorably lubricated condition.
- When using a servomotor with its shaft upward direction, be sure that oil will not stay in the oil seal lips.

## 6.1.3 Installation Orientation

### (1) Spindle motor

#### ■ Flange type

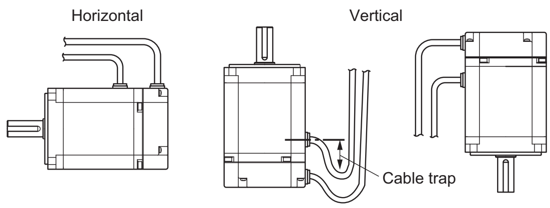
- Mount the motor with the motor shaft on the load side at any angle between horizontal and the downward vertical direction. If the motor shaft is facing up, excessive force will be imposed on the motor shaft. As a result, the service life of the motor will be adversely affected.
- Use the motor UAKAJ-45 or UAKBJ-30 (outer diameter □380) with the terminal box facing upward and the motor shaft facing horizontal. If the terminal box is in the horizontal or downward direction, dust may intrude from the ventilation mouth on the bottom of the load-side bracket. As a result, the motor may fail to operate or unexpected accidents may occur.

#### ■ Foot-mounted type

- Mount the legs on the floor. If the legs are installed upward, excessive force will be imposed on the legs. As a result, the service life of the motor will be adversely affected.

### (2) Servomotor

Mount the servomotor either horizontally or vertically. When mounting the servomotor vertically, make cable traps to keep out water. When mounting the servomotor with the shaft up, take measures with the connected machine to prevent oil from getting into the servomotor through gear boxes etc.




Installation

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## 6.1.4 Coupling Motor and Machinery

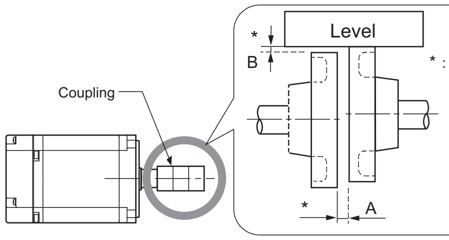
Consider the following conditions when coupling the motor with the machinery. For the servomotor, only the direct coupling is available.

### (1) Direct Coupling

Couple the motor with the machinery so that the center of the motor shaft and that of the machinery shaft are on a straight line. Insert a liner for adjustment, if necessary.

**IMPORTANT**

- Install the servomotor so that alignment accuracy falls within the following range.
  Vibration that will damage the bearings and encoders if the shafts are not properly aligned.

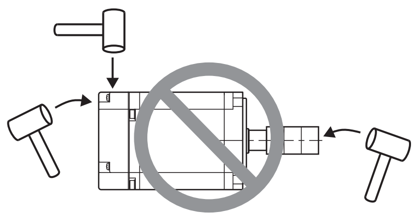



* : Alignment Accuracy

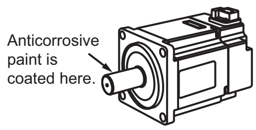
| | Spindle Motor | | Servomotor |
|---|---|---|---|
| | Standard | High-speed type | |
| Tolerance A | 0.03 mm max. | 0.01 mm max. | 0.03 mm max. |
| Surface irregularity B | 0.03 mm max. | 0.01 mm max. | 0.03 mm max. |

Note: Turn together with coupling.

- Do not allow any direct impact to the shafts when installing the couplings. Do not hit the area near encoders with a hammer etc., as impacts may damage the encoders.

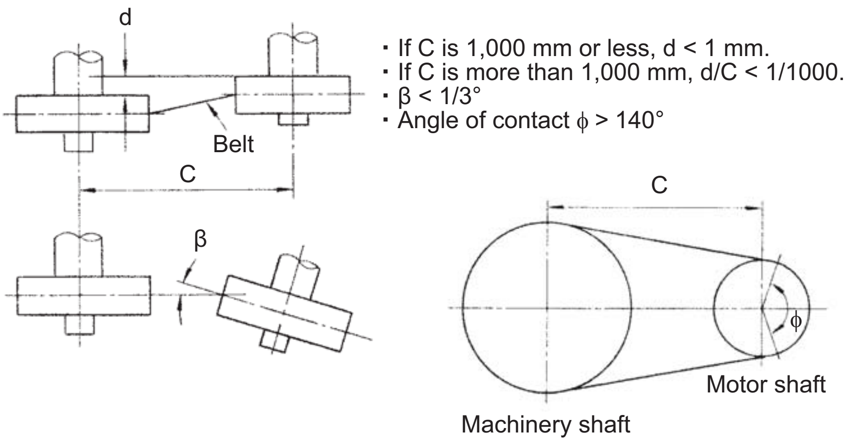


- Before installation, thoroughly remove the anticorrosive paint from the end of the motor shaft. Only after removing the paint can motors be installed on the machines.



## (2) Belt Coupling

- Check that the motor shaft is parallel to the machinery shaft and that the line connecting the centers of the pulleys and the shafts are at right angles to each other. If the angularity of the belt is improper, the belt will vibrate or slip.
- The radial load imposed on the motor shaft edge must not exceed the permissible value specified in *3.1.4 Tolerance Radial Loads.* If an excessive radial load is imposed on the motor shaft, the motor bearings will be adversely affected and the service life of the bearings will be decreased.
- Be sure that no axial load is imposed on the motor shaft.
- Check that the angle of contact of the belt and pulley will be 140° or more, or otherwise the belt may slip.




Belt Installation

## (3) Gear Coupling

Check that the motor shaft is parallel to the machinery shaft and that the centers of the gears are engaged properly. Refer to *3.1.5 Motor Total Indicator Readings* for the precision of the peripheral parts connecting to the motor shaft. The gears may grate if they do not engage properly.

Be sure that no axial load is imposed on the motor shaft.

## (4) Mounting a Pulley or Gear to the Motor Shaft

When mounting a pulley or gear to the motor shaft, consider the mounting balance of the motor. The dynamic balance of the motor is kept with a half key (for motors with a keyway), which is a half as thick as the key (T) specified in the motor shaft dimensional drawing. The motor rotates at high speed and a little imbalance in the mechanism may cause the motor to vibrate.

# 6.2 Σ-V-SD Driver

## 6.2.1 Installation Requirements

<table>
<tr><th>Item</th><th colspan="2">Specifications</th></tr>
<tr><td>Surrounding Air Temperature</td><td colspan="2">0°C to 40°C: at 100% load<br>0°C to 55°: at 70% load</td></tr>
<tr><td>Storage Temperature</td><td colspan="2">-20°C to 85°C</td></tr>
<tr><td>Ambient/<br>Storage Humidity</td><td colspan="2">90%RH or less (with no freezing or condensation)</td></tr>
<tr><td>Vibration Resistance</td><td colspan="2">4.9 m/s$^2$</td></tr>
<tr><td>Shock Resistance</td><td colspan="2">19.6 m/s$^2$</td></tr>
<tr><td>Protection Class</td><td>IP10</td><td rowspan="2">An environment that satisfies the following conditions.<br>• Free of corrosive or flammable gases<br>• Free of exposure to water, oil, or chemicals<br>• Free of dust, salts, or iron dust</td></tr>
<tr><td>Pollution Degree</td><td>2</td></tr>
<tr><td>Altitude</td><td colspan="2">1000 m or less</td></tr>
<tr><td>Others</td><td colspan="2">Free of static electricity, strong electromagnetic fields, magnetic fields or exposure to radioactivity</td></tr>
</table>

## 6.2.2 Thermal Design of Control Panel

Install the Σ-V-SD drivers, host controllers, and other units in a control panel.
Use a control panel with an enclosed structure that provides protection against corrosive gases, water, and oil. Also, design the system so that the temperature rise in the control panel does not cause the temperature to exceed the ambient operating temperature.

### (1) Calorific Value

#### ■ Power Regeneration Converter

| Model | Calorific Value at Continuous Rated Operation | | | | |
|---|---|---|---|---|---|
| | Total (W) | Loss of Control Block (W) | Loss of Power Block (W) | | |
| | | | Total | Inside | Duct |
| CACP-JU15A3□ | 116.4 | 13.1 | 103.3 | 10.3 | 93.0 |
| CACP-JU19A3□ | 154.3 | 13.1 | 141.2 | 14.1 | 127.1 |
| CACP-JU22A3□ | 183.8 | 13.1 | 170.7 | 17.1 | 153.6 |
| CACP-JU30A3□ | 247.2 | 14.7 | 232.5 | 23.2 | 209.3 |
| CACP-JU37A3B | 276.2 | 14.7 | 261.5 | 26.2 | 235.3 |
| CACP-JU45A3B | 394.7 | 14.7 | 380.0 | 38.0 | 342.0 |
| CACP-JU15D3□ | 66.8 | 13.1 | 53.7 | 5.4 | 48.4 |
| CACP-JU19D3□ | 90.5 | 13.1 | 77.4 | 7.7 | 69.7 |
| CACP-JU22D3□ | 104.8 | 13.1 | 91.7 | 9.1 | 82.6 |
| CACP-JU45D3B | 203.7 | 14.7 | 189.0 | 18.9 | 170.1 |

#### ■ SERVOPACK for One Axis

| Model | Calorific Value at Continuous Rated Operation | | | | |
|---|---|---|---|---|---|
| | Total (W) | Loss of Control Block (W) | Loss of Power Block (W) | | |
| | | | Total | Inside | Duct |
| CACR-JU028ACA | 151.4 | 16.3 | 135.1 | 27.0 | 108.1 |
| CACR-JU036ACA | 178.3 | 16.3 | 162.0 | 32.4 | 129.6 |
| CACR-JU065ACA | 321.5 | 16.2 | 305.3 | 30.5 | 274.8 |
| CACR-JU084ACA | 421.9 | 18.9 | 403.0 | 40.3 | 362.7 |
| CACR-JU102ACA | 476.1 | 18.9 | 457.2 | 45.7 | 411.5 |
| CACR-JU125ACA | 611.8 | 25.9 | 585.9 | 58.6 | 527.3 |
| CACR-JU196ACA | 1319.7 | 27.1 | 1292.6 | 129.3 | 1163.3 |
| CACR-JU014DCA | 139.4 | 16.9 | 122.5 | 24.5 | 98.0 |
| CACR-JU018DCA | 165.9 | 16.9 | 149.0 | 29.8 | 119.2 |
| CACR-JU033DCA | 305.7 | 16.3 | 289.4 | 28.9 | 260.5 |
| CACR-JU042DCA | 365.8 | 18.9 | 346.9 | 34.7 | 312.2 |
| CACR-JU051DCA | 422.2 | 18.9 | 403.3 | 40.3 | 363.0 |
| CACR-JU098DCA | 1002.9 | 25.3 | 977.6 | 97.8 | 879.8 |

### ■ SERVOPACK for Two Axes

| Model | Calorific Value at Continuous Rated Operation | | | | |
|---|---|---|---|---|---|
| | Total (W) | Loss of Control Block (W) | Loss of Power Block (W) | | |
| | | | Total | Inside | Duct |
| CACR-JUM23ACA | 134.4 | 23.4 | 111.0 | 22.2 | 88.8 |
| CACR-JUM24ACA | 199.4 | 23.4 | 176.0 | 35.2 | 140.8 |
| CACR-JUM25ACA | 248.8 | 26.8 | 222.0 | 22.2 | 199.8 |
| CACR-JUM23DCA | 113.2 | 23.4 | 89.8 | 9.0 | 80.8 |
| CACR-JUM24DCA | 145.6 | 23.4 | 122.2 | 12.2 | 110.0 |
| CACR-JUM25DCA | 215.2 | 26.8 | 188.4 | 18.8 | 169.6 |

## (2) Air Temperature Rise inside Control Panel (Average Temperature Rise)

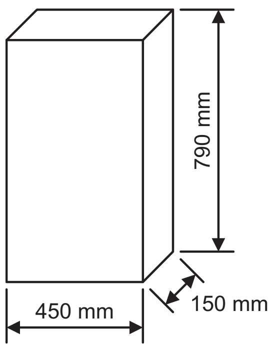
Design the control panel so that the internal air temperature will be no more than 10°C higher than the reference value. If the rise in air temperature in the control panel exceeds 10°C, a cooling system must be installed. For details, refer to *6.2.2 (3) Cooling System Installation*.

The calculation formula for internal temperature rise for a control panel made of metal sheets is as follows:

$$\Delta T = \frac{P}{qe} = \frac{P}{k \cdot A}$$

- $\Delta T$: Temperature rise in the control panel (°C)
- P: Calorific value in the control panel (W)
- qe: Heat flow through ratio of the control panel (W/°C)
- k: Heat pass through ratio of a metal plate ($W/m^2$°C)
  With a stirring fan: 6 $W/m^2$°C
  Without a stirring fan: 4 $W/m^2$°C
- A: Effective radiation area of the control panel ($m^2$)*
  * Radiation available area of the control panel surface area (Exclude the surface which contacts other object)

<Example>
Allowable Watt Data Loss for a Control Panel with a Stirring Fan




- Effective radiation area of the control panel: A=1.0155 ($m^2$)
  (Exclude the base area because control panel is type of putting on the floor.)
- Calorific value in the control panel: P=60 (W)
- Temperature rise value in the control panel: $\Delta T = \frac{P}{qe} = \frac{P}{k \cdot A} = \frac{60}{6 \times 1.0155} = 9.8$ (°C)

This example is correct design because $\Delta T$ is equal to 9.8 (°C).

## (3) Cooling System Installation

Use the following calculation formula to select a cooling system and install it in the control panel so that the air temperature in the control panel will be no more than 10°C higher than the reference value.

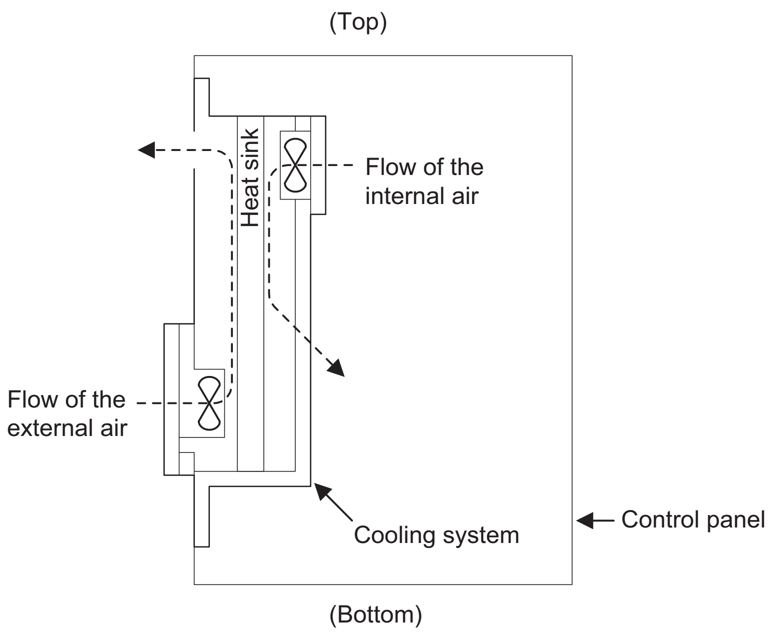
$$\Delta T = \frac{P}{qe} = \frac{P}{k \cdot (A-B)+qh}$$

- ΔT: Temperature rise in the control panel (°C)
- P: Calorific value in the control panel (W)
- qe: Heat flow through ratio of the control panel (W/°C)
- qh: Heat flow through ratio of the cooling system (W/°C)
- k: Heat pass through ratio of a metal plate ($W/m^2°C$)
  With a stirring fan: 6 $W/m^2°C$
  Without a stirring fan: 4 $W/m^2°C$
- A: Effective radiation area of the control panel ($m^2$)*
- B: Installation area of the cooling system ($m^2$)

  * Radiation available area of the control panel surface area (Exclude the surface which contacts other object)

An installation example is given below.

Install the cooling system so that internal air is taken into the control panel at the top and returned at the bottom, and so that the external air is taken in at the bottom and exhausted at the top.




Cooling System Installation

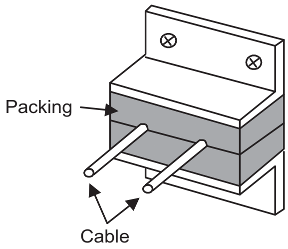
Installation

6

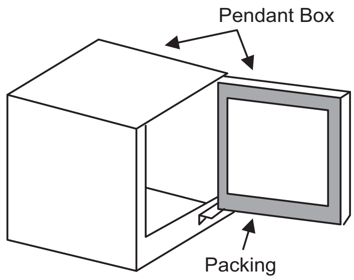
## 6.2.3 Control Panel Dust-proof Design

The host controller and other printed circuit boards mounted in the control panel may malfunction due to the effects of airborne particles (dust, cuttings, oil mist, etc.). Observe the following precautions to prevent airborne particles from entering the control panel.

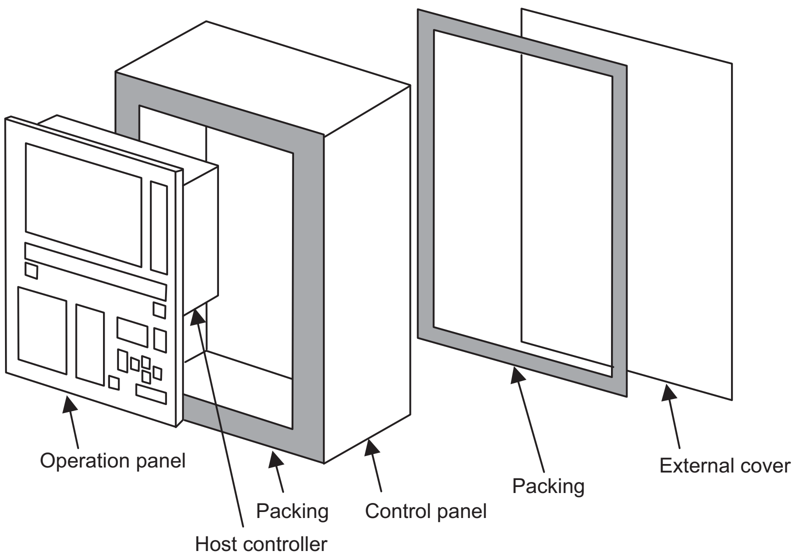
- Always use a sealed structure for the control panel.
- Block cable openings with packing. (Refer to the figure labeled Cable Openings given below.)
- Install packing on the door and external cover to seal them. (Refer to the figure labeled Door Packing given below.)
- Block all gaps.
- Oil may collect on the top surface and may enter the control panel through screw holes. Take special countermeasures, such as using oil-proof packing.




Cable Openings




Door Packing




Operation Box

## 6.2.4 Installation Precautions

Observe the following precautions when designing the control panel.

### (1) General Precautions

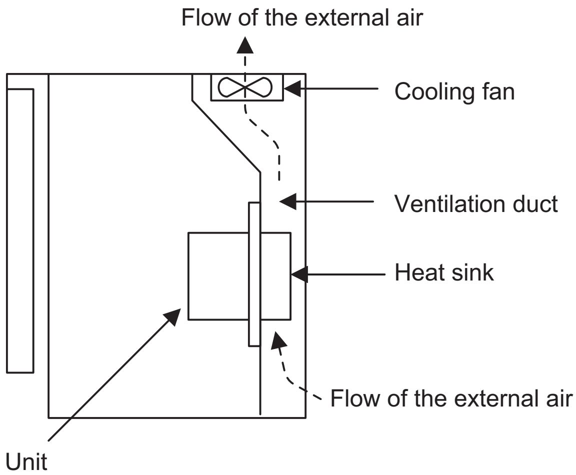
General precautions are given below.

- Always use a sealed structure for the control panel.
- Install the units so that maintenance inspections, removal, and installation can be performed easily.
- Provide about 100 mm of space between components and the control panel surfaces so that the flow of air is not blocked inside the control panel.
- Design the control panel so that the average internal air temperature will be no more than 10°C higher than the external air.
- We recommend the use of a fan to stir the air to increase cooling efficiency and prevent localized temperature increases in the sealed control panel.
- Separate the units from cables or components of 90 VDC or higher and cables or components for AC power supply by at least 10 mm to help prevent malfunction due to noise.
- Separate the primary and secondary sides of transformer and noise filters.

### (2) Installation Precautions

Precautions for installing the Σ-V-SD driver are given below.

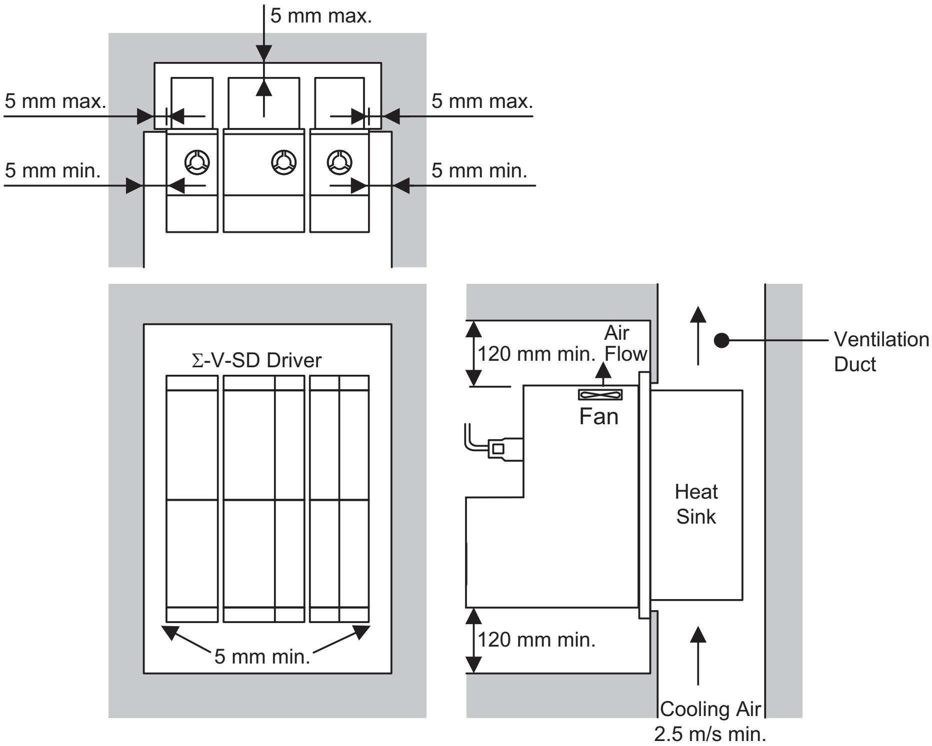
- Always secure the Σ-V-SD driver on a vertical surface using screws or bolts.
- Provide the specified space on the left, right, top, and bottom of the driver to enable maintenance and ventilation. For details, refer to *6.2.5 Installation Orientation and Space*.
- Place the heat sink of the Σ-V-SD driver outside of the ventilation ducts to allow external air flow through the heat sink. The loss from the control panel will be reduced, and the majority of the loss from the unit will be cooled directly by the external air.
- Cooling the heat sink requires an air flow of 2.5 m/s in the ventilation duct.
- Make sure that cooling air flows through the heat sink for each Σ-V-SD driver.
- We recommend a metal cooling fan. Plastic fans will deteriorate when exposed to cutting oil, which may cause Σ-V-SD driver failure or other problems.




Σ-V-SD Driver Installation

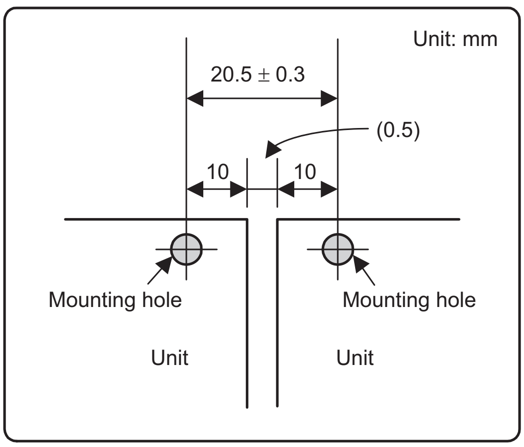
## 6.2.5 Installation Orientation and Space

Precautions for the mounting the Σ-V-SD driver, including the mounting orientation and mounting space, are given below.




Installation Orientation and Space for Σ-V-SD Driver

- Always install the power regeneration converter on the left side of the SERVOPACK.
- We recommend that you install the SERVOPACKs in order of capacity, with the SERVOPACK with the largest capacity closest to the power regeneration converter.
- All of the Σ-V-SD drivers have external heat sinks for cooling.
- Refer to the external dimension diagrams for external dimensions and mounting dimensions of the products (*4.1.2 External Dimensions* and *4.2.2 External Dimensions*).
- Make sure that the ambient air temperature of the Σ-V-SD driver is 0 to 55°C near the heat sink and inside the control panel at a 70% load, and 0 to 40°C inside the control panel at a 100% load.
- To prevent oil penetration, seal the mounting screw sections of the power regeneration converter and the SERVOPACK.
- Always install the Σ-V-SD driver with the fan at the top to ensure efficient cooling.
- When mounting the Σ-V-SD driver, allow space above and below it to prevent heat buildup.
- When stirring the air inside the control panel, do not allow the airflow to fall directly on the Σ-V-SD driver to prevent dirt from collecting on the Σ-V-SD driver.
- Provide the following spaces between the units.



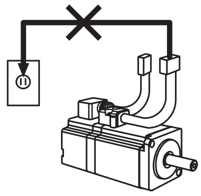
# 7

# Wiring

# 7.1 Motors

## ⚠ CAUTION

- Separate the motor main circuit cable wiring from the I/O signal cable and encoder cable at least 30 cm, and do not bundle or run them in the same duct.
  Placing these cables too close to each other may result in malfunction.
- The maximum wiring length is 3 m for I/O signal cables, 20 m for encoder cables or motor main circuit cables, and 10 m for control power supply cables (+24 V, 0 V).
- Do not connect the motor directly to a commercial power supply.
  The motor may be damaged. Connect the motor to the correct SERVOPACK.



## 7.1.1 Precautions on Wiring

### (1) Cables

#### ■ Standard Cables

Standard motor main circuit cables, encoder cables, and relay cables cannot be used in cases where high flexibility is needed, as when the cables themselves move or are twisted or turned. Use flexible cables for flexible applications.

#### ■ Flexible Cables

Even if the recommended bending radius R is followed in the mechanical design, incorrect wiring may cause the early disconnection. Observe the following precautions when wiring.

- Cable twisting
  Straighten the flexible cables wiring.
  Twisted cables cause the early disconnection. Check the indication on the cable surface to make sure that the cable is not twisted.
- Fixing method
  Do not fix the moving points of the flexible cable, or stress on the fixed points may cause early disconnection.
  Fix the cable at the minimum number of points. Do not put stress on the motor-end and SERVOPACK-end connectors.
- Cable length
  If the cable length is too long, it may result the cable sagging. If the cable length is too short, excessive tension on the fixed points will cause the early disconnection. Use a flexible cable with the optimum length.
- Interference between cables
  Avoid interference between cables.
  Interference limits the motion of flexible cable, which causes early disconnection. Keep enough distance between cables, or provide a partition when wiring.

### (2) Cable Stress

Make sure there is no bending or tension on the cables themselves, the connections, or the cable lead inlets. Be especially careful to wire encoder cables and brake cables for main circuit so that they are not subject to stress because the core wires of encoder cables and brake cables for main circuit are very thin at only 0.2 to 0.3 mm$^2$.

## (3) Connectors

Observe the following precautions:

- When the connectors are connected to the motor, be sure to connect the end of motor main circuit cables before connecting the encoder cable’s end.
  If the encoder cable’s end is connected before connecting the end of motor main circuit cables, the encoder may break because of the voltage differences between FG.
- Make sure there is no foreign matters such as dust and metal chips in the connector before connecting.
- Do not apply shock to resin connectors. Otherwise, they may be damaged.
- Make sure of the pin arrangement.
- When handling a motor with its cables connected, hold the motor or the connectors and cables will be damaged.

Observe the following precautions also when using servomotors:

- Make sure that the connector is securely fixed with screws. If the cable connector is not secure, the requirements for the protective structure’s specifications may not be met.
- Be sure not to apply stress on the connector, when using flexible cables. The connector may be damaged by stress.
- Fix the cable connector to SGMGV-05 servomotors with screws. Refer to *7.1.3 Servomotors*.

## 7.1.2 Spindle Motors

### (1) Main Circuit Cable Wiring

#### ■ Terminal Screws and Tightening Torques (200 V)

| Spindle Motor Model | | Terminal Symbols | Terminal Screw | Tightening Torque [N·m] | Wire Sizes |
|---|---|---|---|---|---|
| UAKAJ-□□CZ (Single Winding) | 04 | U, V, W, FG | M5 | 2.0 to 2.4 | AWG8 |
| | | Z1, Z2, Z3 | M4 | 1.2 to 1.8 | AWG14 |
| | 06 | U, V, W, FG | M5 | 2.0 to 2.4 | AWG8 |
| | | Z1, Z2, Z3 | M4 | 1.2 to 1.8 | AWG14 |
| | 08 | U, V, W, FG | M5 | 2.0 to 2.4 | AWG8 |
| | | Z1, Z2, Z3 | M4 | 1.2 to 1.8 | AWG14 |
| | 11 | U, V, W, FG | M5 | 2.0 to 2.4 | AWG6 |
| | | Z1, Z2, Z3 | M4 | 1.2 to 1.8 | AWG14 |
| | 15 | U, V, W, FG | M8 | 6.0 to 9.0 | AWG4 |
| | | Z1, Z2, Z3 | M4 | 1.2 to 1.8 | AWG14 |
| | 19 | U, V, W, FG | M8 | 6.0 to 9.0 | AWG2 |
| | | Z1, Z2, Z3 | M4 | 1.2 to 1.8 | AWG14 |
| | 22 | U, V, W, FG | M8 | 6.0 to 9.0 | AWG1 |
| | | Z1, Z2, Z3 | M4 | 1.2 to 1.8 | AWG14 |
| | 30 | U, V, W, FG | M10 | 10.0 to 15.0 | AWG2/0 |
| | | Z1, Z2, Z3 | M4 | 1.2 to 1.8 | AWG14 |
| | 37 | U, V, W, FG | M10 | 10.0 to 15.0 | AWG4/0 |
| | | Z1, Z2, Z3 | M4 | 1.2 to 1.8 | AWG14 |
| | 45 | U, V, W, FG | M10 | 10.0 to 15.0 | AWG4/0 |
| | | Z1, Z2, Z3 | M4 | 1.2 to 1.8 | AWG14 |
| UAKBJ-□□CZ (Winding Selection) | 06 | U1, V1, W1, U2, V2, W2, FG | M6 | 2.5 to 3.75 | AWG8 |
| | | Z1, Z2, Z3 | M4 | 1.2 to 1.8 | AWG14 |
| | 08 | U1, V1, W1, U2, V2, W2, FG | M6 | 2.5 to 3.75 | AWG8 |
| | | Z1, Z2, Z3 | M4 | 1.2 to 1.8 | AWG14 |
| | 11 | U1, V1, W1, U2, V2, W2, FG | M6 | 2.5 to 3.75 | AWG6 |
| | | Z1, Z2, Z3 | M4 | 1.2 to 1.8 | AWG14 |
| | 15 | U1, V1, W1, U2, V2, W2, FG | M8 | 6.0 to 9.0 | AWG4 |
| | | Z1, Z2, Z3 | M4 | 1.2 to 1.8 | AWG14 |
| | 19 | U1, V1, W1, U2, V2, W2, FG | M8 | 6.0 to 9.0 | AWG2 |
| | | Z1, Z2, Z3 | M4 | 1.2 to 1.8 | AWG14 |
| | 22 | U1, V1, W1, U2, V2, W2, FG | M8 | 6.0 to 9.0 | AWG1 |
| | | Z1, Z2, Z3 | M4 | 1.2 to 1.8 | AWG14 |
| | 30 | U1, V1, W1, U2, V2, W2, FG | M10 | 10.0 to 15.0 | AWG2/0 |
| | | Z1, Z2, Z3 | M4 | 1.2 to 1.8 | AWG14 |

## ■ Terminal Screws and Tightening Torques (400 V)

| Spindle Motor Model | | Terminal Symbols | Terminal Screw | Tightening Torque [N·m] | Wire Sizes |
|---|---|---|---|---|---|
| UAKAJ-□□CZ (Single Winding) | 06 | U, V, W, FG | M5 | 2.0 to 2.4 | AWG12 |
| | | Z1, Z2, Z3 | M4 | 1.2 to 1.8 | AWG14 |
| | 08 | U, V, W, FG | M5 | 2.0 to 2.4 | AWG10 |
| | | Z1, Z2, Z3 | M4 | 1.2 to 1.8 | AWG14 |
| | 11 | U, V, W, FG | M5 | 2.0 to 2.4 | AWG10 |
| | | Z1, Z2, Z3 | M4 | 1.2 to 1.8 | AWG14 |
| | 15 | U, V, W, FG | M8 | 6.0 to 9.0 | AWG8 |
| | | Z1, Z2, Z3 | M4 | 1.2 to 1.8 | AWG14 |
| | 19 | U, V, W, FG | M8 | 6.0 to 9.0 | AWG6 |
| | | Z1, Z2, Z3 | M4 | 1.2 to 1.8 | AWG14 |
| | 22 | U, V, W, FG | M8 | 6.0 to 9.0 | AWG6 |
| | | Z1, Z2, Z3 | M4 | 1.2 to 1.8 | AWG14 |
| UAKBJ-□□CZ (Winding Selection) | 06 | U1, V1, W1, U2, V2, W2, FG | M6 | 2.5 to 3.75 | AWG12 |
| | | Z1, Z2, Z3 | M4 | 1.2 to 1.8 | AWG14 |
| | 08 | U1, V1, W1, U2, V2, W2, FG | M6 | 2.5 to 3.75 | AWG10 |
| | | Z1, Z2, Z3 | M4 | 1.2 to 1.8 | AWG14 |
| | 11 | U1, V1, W1, U2, V2, W2, FG | M6 | 2.5 to 3.75 | AWG10 |
| | | Z1, Z2, Z3 | M4 | 1.2 to 1.8 | AWG14 |
| | 15 | U1, V1, W1, U2, V2, W2, FG | M8 | 6.0 to 9.0 | AWG8 |
| | | Z1, Z2, Z3 | M4 | 1.2 to 1.8 | AWG14 |
| | 19 | U1, V1, W1, U2, V2, W2, FG | M8 | 6.0 to 9.0 | AWG6 |
| | | Z1, Z2, Z3 | M4 | 1.2 to 1.8 | AWG14 |
| | 22 | U1, V1, W1, U2, V2, W2, FG | M8 | 6.0 to 9.0 | AWG6 |
| | | Z1, Z2, Z3 | M4 | 1.2 to 1.8 | AWG14 |

## ■ Wiring

- CACR-JU028ACA, -JU014DCA

| SERVOPACK End (CN8) | | Motor End |
|---|---|---|
| Pin No. | Signal Name | Terminal Name |
| A1 | U | U |
| B1 | V | V |
| B2 | W | W |
| A2 | ⏚ | ⏚ |

- CACR-JU036ACA, -JU018DCA

| SERVOPACK End (CN8) | | Motor End |
|---|---|---|
| Pin No. | Signal Name | Terminal Name |
| 1 | U | U |
| 2 | V | V |
| 3 | W | W |
| 4 | ⏚ | ⏚ |

- CACR-JU065ACA, -JU084ACA, -JU102ACA, -JU125ACA, -JU196ACA, -JU033DCA, -JU042DCA, -JU051DCA, -JU098DCA

| SERVOPACK End | Motor End |
|---|---|
| Terminal Name | Terminal Name |
| U | U |
| V | V |
| W | W |
| ⏚ | ⏚ |

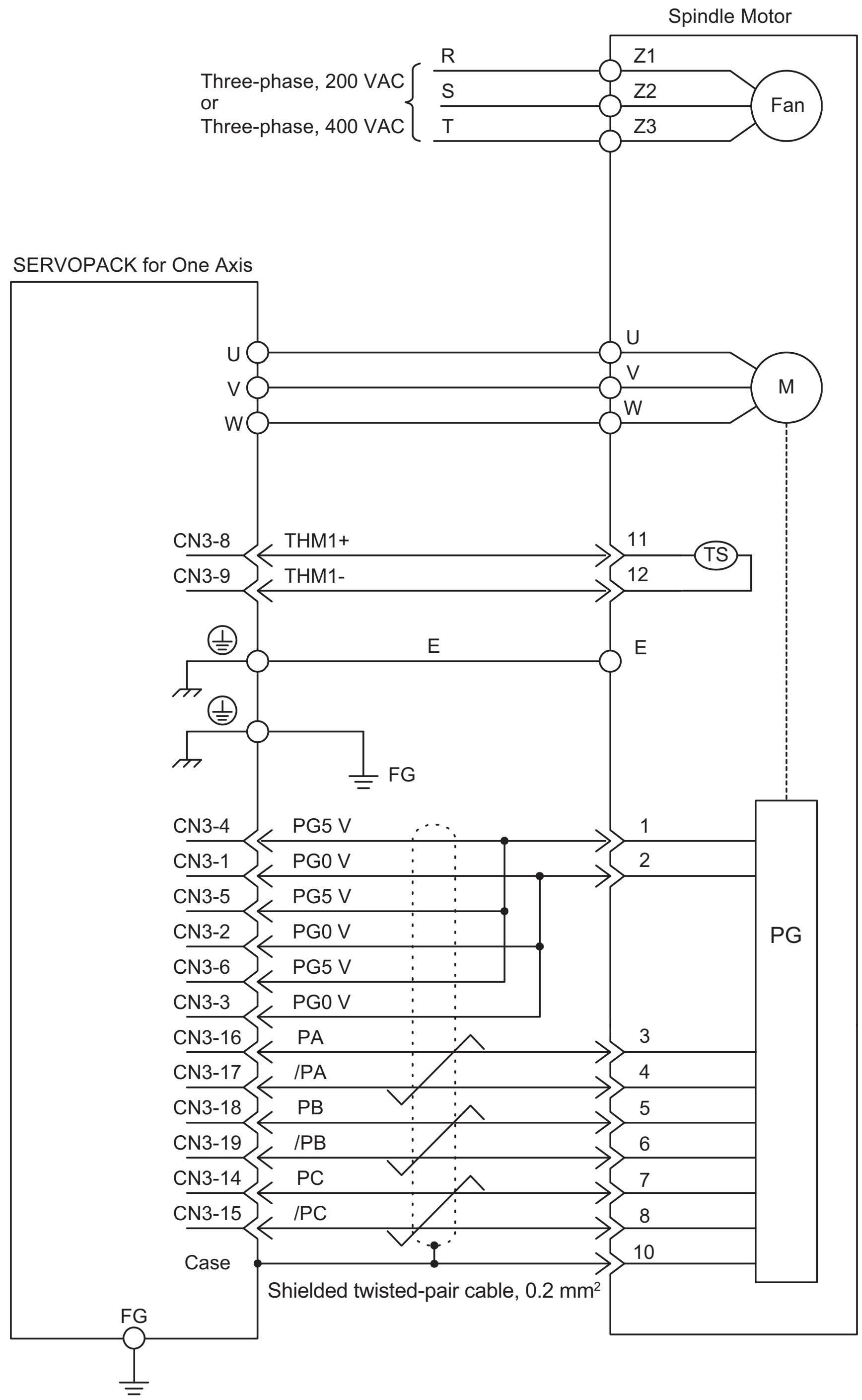
## (2) Encoder Wiring

### ■ Pulse Encoder (SERVOPACK-end connector: CN3)

• Connections

| Pin No. | Signal Name | I/O | Function | Pin No. | Signal Name | I/O | Function |
|---|---|---|---|---|---|---|---|
| 1 | PG0V | – | Power supply for encoder 0 V | 11 | CC | O | Common for magnetic contactor for winding selection |
| 2 | PG0V | – | Power supply for encoder 0 V | 12 | CA1 | I | Winding selection status signal |
| 3 | PG0V | – | Power supply for encoder 0 V | 13 | CA2 | I | |
| 4 | PG5V | O | Power supply for encoder 5 V | 14 | PC | I | Encoder phase C signal input |
| 5 | PG5V | O | Power supply for encoder 5 V | 15 | /PC | I | |
| 6 | PG5V | O | Power supply for encoder 5 V | 16 | PA | I | Encoder phase A signal input |
| 7*1 | (NC) | – | – | 17 | /PA | I | |
| 8*2 | THM1+ | I | Motor winding temperature detection | 18 | PB | I | Encoder phase B signal input |
| 9*2 | THM1– | I | | 19 | /PB | I | |
| 10 | C24V | O | +24 V DC power supply for magnetic contactor for winding selection | 20*1 | (NC) | – | – |

*1. Do not use NC signal.
*2. Use CN1 or CN3 for motor winding temperature detection.




Connecting Diagram of Pulse Encoder for Spindle Motor

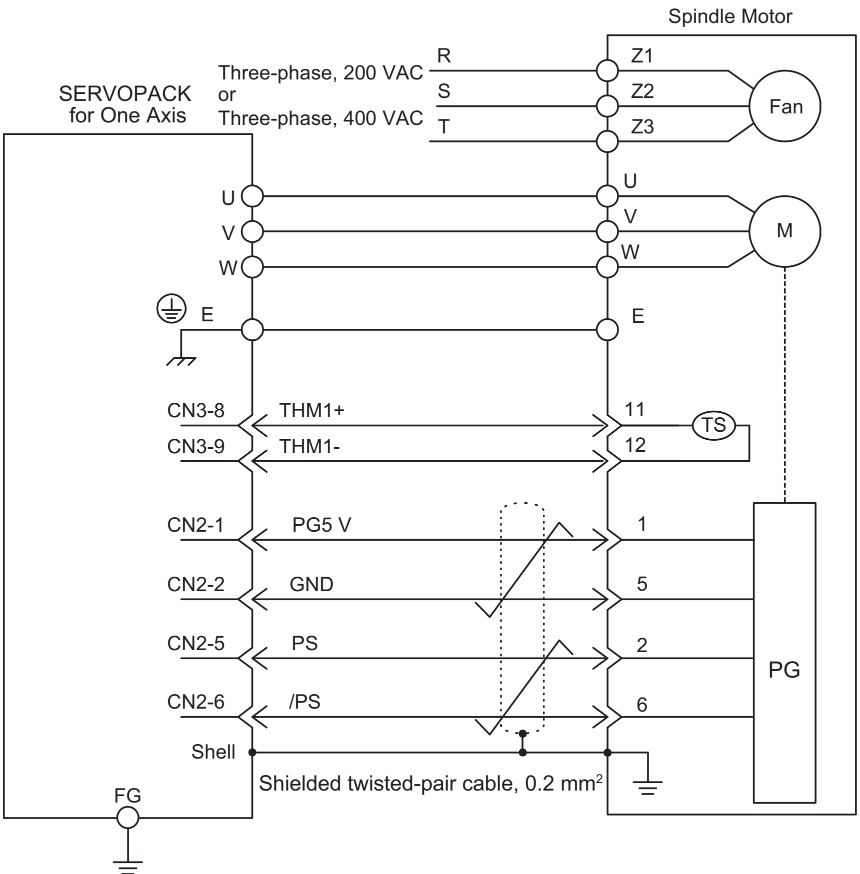
## ■ Serial Encoder (SERVOPACK-end connector: CN2)

• Connections

| Pin No. | Signal Name | I/O | Function | Pin No. | Signal Name | I/O | Function |
|---|---|---|---|---|---|---|---|
| 1 | PG5V | O | Power supply for encoder 5 V | 2 | GND | – | 0 V |
| 3 | PGBAT+ | O | Battery for encoder (+) | 4 | PGBAT- | O | Battery for encoder (–) |
| 5 | PS | I/O | Encoder serial signal (+) | 6 | /PS | I/O | Encoder serial signal (–) |
| 7* | (NC) | – | – | 8* | (NC) | – | – |
| 9* | (NC) | – | – | 10* | (NC) | – | – |

* Do not use NC signal.

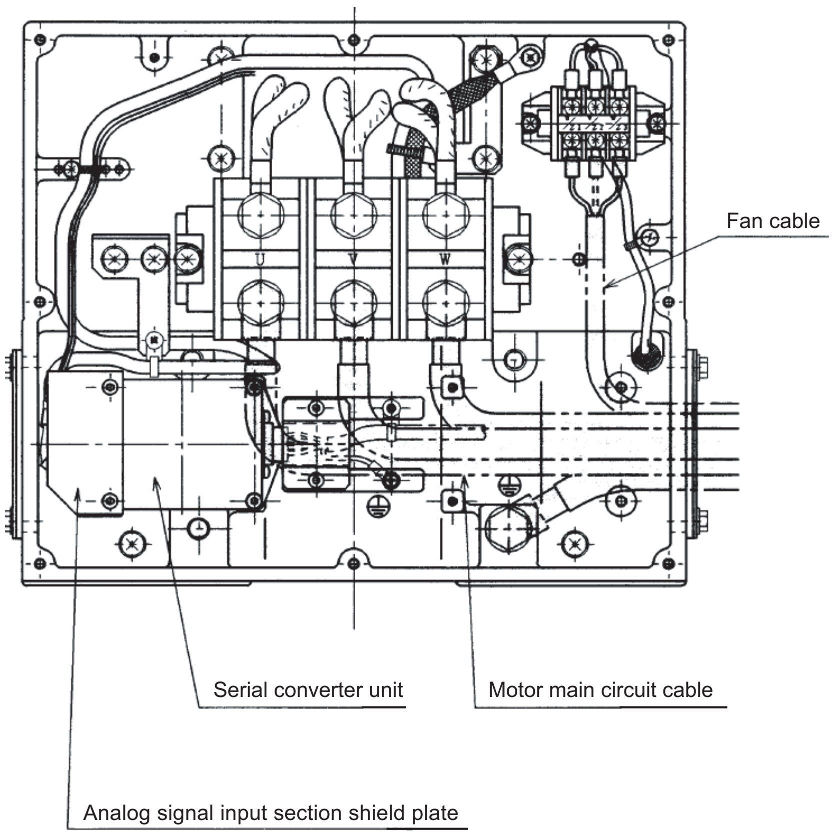
| SERVOPACK End (CN2) | | Motor End | |
|---|---|---|---|
| Pin No. | Signal Name | Pin No. | Signal Name |
| 6 | /PS | 6 | /PS |
| 5 | PS | 2 | PS |
| 4 | PGBAT– | – | PGBAT– |
| 3 | PGBAT+ | – | PGBAT+ |
| 2 | GND | 5 | GND |
| 1 | PG5V | 1 | PG5V |
| Shell | FG | Shell | FG |



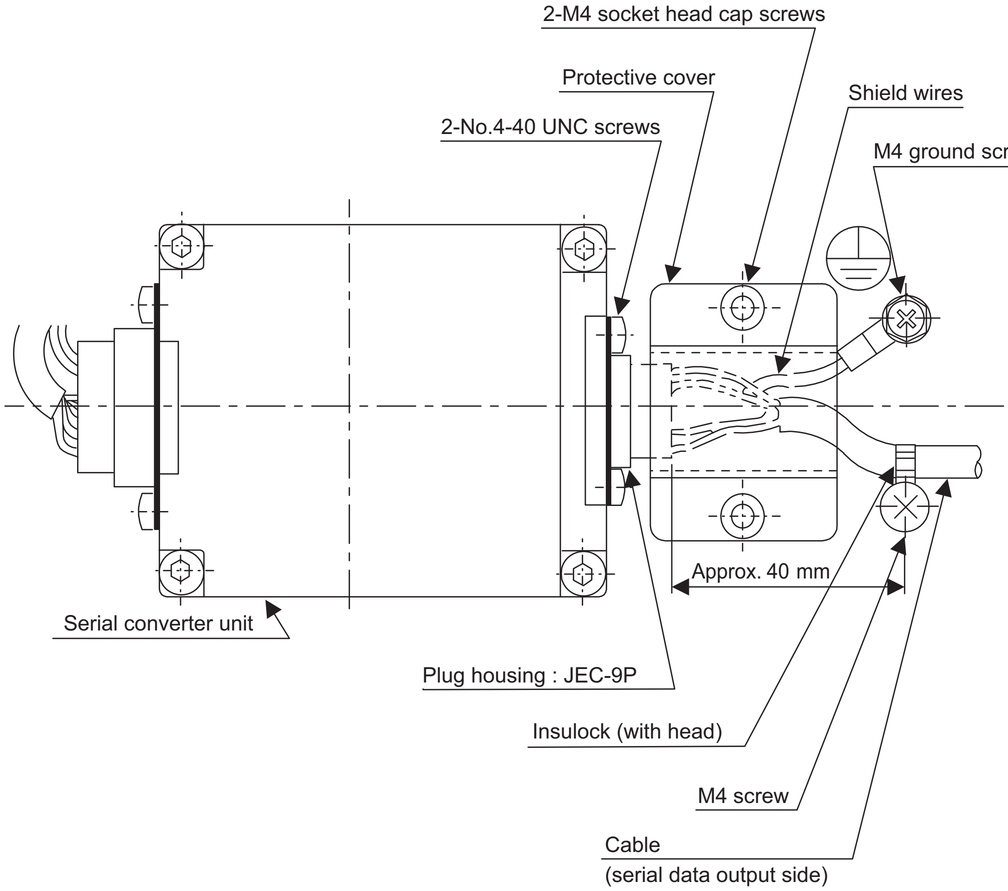

Connection Diagram of Serial Encoder for Spindle Motor

- Wiring in Terminal Box

When connecting the motor main circuit cable and fan cable inside the terminal box, connect them so that the they do not come into contact with the serial converter unit or analog signal input section shield plate. The encoder may operate incorrectly if the connections are not appropriate.
The following figure is a wiring example for a □320 spindle motor.



• Connections of Serial Encoder in Terminal Box




Note 1. When tightening No.4-40 UNC screws, the positioning hinders inserting the screwdriver. Make sure that the screws are not inserted at an angle.

2. Ensure that stress is not applied to the connection areas of the cables and plug housings when cables are secured using Insulock binders.
3. Make sure that the signal lines and shield wires do not become stuck in the protective cover.
4. The depth for M4 screws is 7 mm max.

## 7.1.3 Servomotors

**⚠ CAUTION**

- Install the I/O signal cables and encoder cable at least 30 cm away from the motor's main circuit cable. Never place them in the same duct or bundle them together.
  Placing these cables too close to each other may result in malfunction.
- When the encoder cable length exceeds 20 m, be sure to use a relay encoder cable.
- When the main circuit cable length exceeds 20 m, the intermittent duty zone will shrink due to the voltage drop.

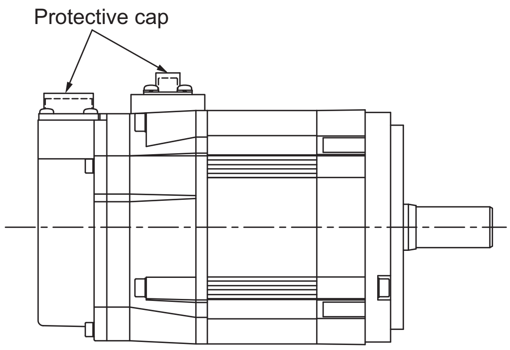
### (1) Main Circuit Cable Wiring (Model: SGMGV-05)

#### ■ Procedure

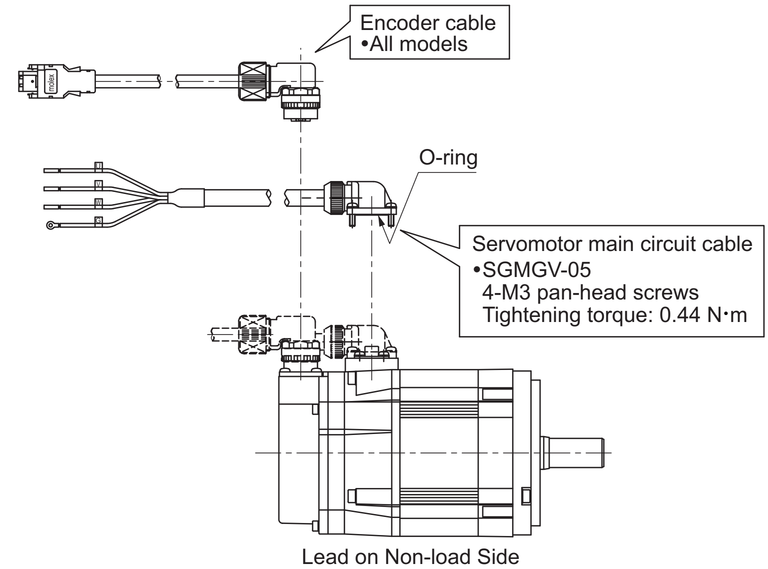
**⚠ CAUTION**

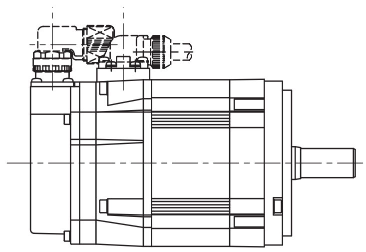
- When you connect the cables, do not touch with your bare hands the motor connector pins or the encoder connector pins that are provided with the motor.
  Particularly the encoder may be damaged by static electricity.

**1.** Remove the protective cap from the servomotor connector.



**2.** Mount the cable connector on the servomotor and fix it with screws as shown in the figure below.



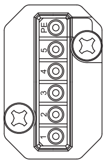




* In this case, contact your Yaskawa representative.

| IMPORTANT | • First, connect the servomotor to the servomotor main circuit cable end.<br>• Do not remove the O-ring. Mount the connector so that the O-ring is seated properly. If the O-ring is not seated properly, the requirements for the protective structure specifications may not be met. |
|---|---|

## ■ Servomotor Without Holding Brake

- Cable Specifications for Servomotor-end Connector



| | |
|---|---|
| PE | FG (Frame ground) |
| 5 | – |
| 4 | – |
| 3 | Phase U |
| 2 | Phase V |
| 1 | Phase W |

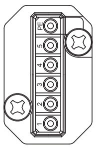
Manufacturer: Japan Aviation Electronics Industry, Ltd.

- Wiring Specifications
  - CACR-JUM23ACA, -JUM23DCA

| SERVOPACK End (CN18/CN28) | | Motor End | |
|---|---|---|---|
| Pin No. | Signal Name | Pin No. | Signal Name |
| A1 | U | 3 | U |
| B1 | V | 2 | V |
| B2 | W | 1 | W |
| A2 | FG | PE | FG |

## ■ Servomotor With Holding Brake

- Cable Specifications for Servomotor-end Connector



| | |
|---|---|
| PE | FG (Frame ground) |
| 5 | Brake terminal |
| 4 | Brake terminal |
| 3 | Phase U |
| 2 | Phase V |
| 1 | Phase W |

Manufacturer: Japan Aviation Electronics Industry, Ltd.

- Wiring Specifications
  - CACR-JUM23ACA, -JUM23DCA

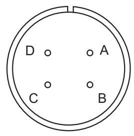
| SERVOPACK End (CN18/CN28) | | Motor End | |
|---|---|---|---|
| Pin No. | Signal Name | Pin No. | Signal Name |
| A1 | U | 3 | U |
| B1 | V | 2 | V |
| B2 | W | 1 | W |
| A2 | FG | PE | FG |
| Brake | | 4 | Brake |
| Brake | | 5 | Brake |

Note: No polarity for connection to the brake terminals.

## (2) Main Circuit Cable Wiring (Model: SGMGV-09 to -75)

### ■ Servomotor Without Holding Brake

- Cable Specifications for Servomotor-end Connector




| | |
|---|---|
| A | Phase U |
| B | Phase V |
| C | Phase W |
| D | FG (Frame ground) |

Manufacturer: DDK Ltd.

- Wiring Specifications
  - CACR-JU036ACA, -JU018DCA

| SERVOPACK End (CN8) | | Motor End | |
|---|---|---|---|
| Pin No. | Signal Name | Pin No. | Signal Name |
| 1 | U | A | U |
| 2 | V | B | V |
| 3 | W | C | W |
| 4 | ⏚ | D | ⏚ |

  - CACR-JU065ACA, -JU084ACA, -JU102ACA, -JU033DCA, -JU042DCA, -JU051DCA

| SERVOPACK End | Motor End | |
|---|---|---|
| Terminal Name | Pin No. | Signal Name |
| U | A | U |
| V | B | V |
| W | C | W |
| ⏚ | D | ⏚ |

  - CACR-JU028ACA, -JUM23□CA, -JUM24□CA, -JUM25□CA, -JU014DCA

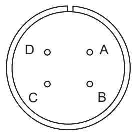
| SERVOPACK End (CN8/CN18/CN28) | | Motor End | |
|---|---|---|---|
| Pin No. | Signal Name | Pin No. | Signal Name |
| A1 | U | A | U |
| B1 | V | B | V |
| B2 | W | C | W |
| A2 | ⏚ | D | ⏚ |

Wiring

7

## ■ Servomotor With Holding Brake

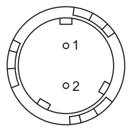
- Cable Specifications for Servomotor-end Connector




| | |
|---|---|
| A | Phase U |
| B | Phase V |
| C | Phase W |
| D | FG (Frame ground) |

Manufacturer: DDK Ltd.

- Cable Specifications for Brake-end Connector




Receptacle: CM10-R2P-D
Applicable plug (To be provided by the customer)
Plug: CM10-AP2S-□-D (L-shaped)
CM10-SP2S-□-D (Straight)
(Boxes (□) indicate a value that varies, depending on cable size.)
Manufacturer: DDK Ltd.

| | |
|---|---|
| 1 | Brake terminal |
| 2 | Brake terminal |

Note: No polarity for connection to the brake terminals.

- Wiring Specifications
  - CACR-JU036ACA, -JU018DCA

| SERVOPACK End (CN18) Pin No. | SERVOPACK End (CN18) Signal Name | | Motor End Pin No. | Motor End Signal Name |
|---|---|---|---|---|
| 1 | U | ― | A | U |
| 2 | V | ― | B | V |
| 3 | W | ― | C | W |
| 4 | ⏚ | ― | D | ⏚ |

| SERVOPACK End | | Motor End Pin No. | Motor End Signal Name |
|---|---|---|---|
| Brake | ― | 1 | Brake |
| Brake | ― | 2 | Brake |

Note: No polarity for connection to the brake terminals.

- CACR-JU065ACA, -JU084ACA, -JU102ACA, -JU033DCA, -JU042DCA, -JU051DCA

| SERVOPACK End Terminal Name | | Motor End Pin No. | Motor End Signal Name |
|---|---|---|---|
| U | ― | A | U |
| V | ― | B | V |
| W | ― | C | W |
| ⏚ | ― | D | ⏚ |

| SERVOPACK End | | Motor End Pin No. | Motor End Signal Name |
|---|---|---|---|
| Brake | ― | 1 | Brake |
| Brake | ― | 2 | Brake |

Note: No polarity for connection to the brake terminals.

• CACR-JU028ACA, -JUM23□CA, -JUM24□CA, -JUM25□CA, -JU014DCA

| SERVOPACK End (CN8/CN18/CN28) | | Motor End | |
|---|---|---|---|
| Pin No. | Signal Name | Pin No. | Signal Name |
| A1 | U | A | U |
| B1 | V | B | V |
| B2 | W | C | W |
| A2 | ⏚ | D | ⏚ |

| | Motor End | |
|---|---|---|
| | Pin No. | Signal Name |
| Brake | 1 | Brake |
| Brake | 2 | Brake |

Note: No polarity for connection to the brake terminals.

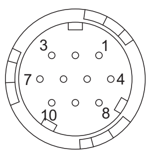
## (3) Serial Encoder Wiring (SERVOPACK-end Connector: CN21/CN22)

• Connections

| Pin No. | Signal Name | I/O | Function | Pin No. | Signal Name | I/O | Function |
|---|---|---|---|---|---|---|---|
| 1 | PG5V□* | O | Power supply for encoder 5 V | 2 | GND | – | 0 V |
| 3 | PGBAT+ | O | Encoder for battery | 4 | PGBAT– | O | Encoder for battery (–) |
| 5 | PS□* | I/O | Encoder serial signal (+) | 6 | /PS□* | I/O | Encoder serial signal (–) |
| 7 | FCPG5V□* | O | Power supply for external encoder 5 V | 8 | GND | – | Power supply for external encoder 0 V |
| 9 | FCPS□* | I/O | External encoder serial signal (+) | 10 | /FCPS□* | I/O | External encoder serial signal (–) |

* For a SERVOPACK for two axes, an axis name (1 or 2) will be displayed in □.

• Cable Specifications for Encoder-end Connector (20-bit Encoder)

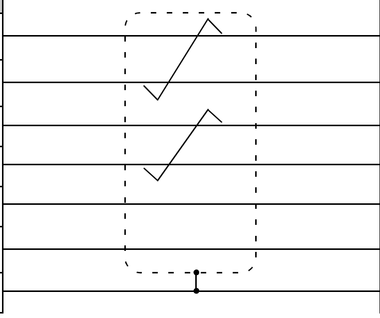



Receptacle: CM10-R10P-D
Applicable plug (To be provided by the customer)
Plug: CM10-AP10S-□-D (R1) (L-shaped)
CM10-SP10S-□-D (R1) (Straight)
(Boxes (□) indicate a value that varies, depending on cable size.)
Manufacturer: DDK Ltd.

| | | | |
|---|---|---|---|
| 1 | PS | 6 | BAT (+) |
| 2 | /PS | 7 | – |
| 3 | – | 8 | – |
| 4 | PG5V | 9 | PG0V |
| 5 | BAT (–) | 10 | FG (Frame ground) |

• Wiring Specifications

| SERVOPACK End (CN2/CN21) | | Motor End | |
|---|---|---|---|
| Signal Name | Pin No. | Pin No. | Signal Name |
| /PS□* | 6 | 2 | /PS |
| PS□* | 5 | 1 | PS |
| PGBAT– | 4 | 5 | BAT(–) |
| PGBAT+ | 3 | 6 | BAT(+) |
| GND | 2 | 9 | PG0V |
| PG5V□* | 1 | 4 | PG5V |
| FG | Shell | 10 | FG |



* For a SERVOPACK for two axes, an axis name (1 or 2) will be displayed in □.

# 7.2 Σ-V-SD Driver

## 7.2.1 Main Circuit

IMPORTANT

- Do not touch the power terminals before the main-circuit capacitor has had time to discharge because high voltage may still remain in the converter and SERVOPACK. Refer to the following table for the discharge time of main-circuit capacitor.
- When two or more SERVOPACKs are used in combination, use the longest discharge time of those SERVOPACKs for the main-circuit capacitor.

| Input Voltage | SERVOPACK Model | | Discharge Time Needed for Main-Circuit Capacitor (min) |
|---|---|---|---|
| Three-phase, 200 VAC | For one axis | CACR-JU028ACA | 15 |
| | | CACR-JU036ACA | 20 |
| | | CACR-JU065ACA | 20 |
| | | CACR-JU084ACA | 20 |
| | | CACR-JU102ACA | 25 |
| | | CACR-JU125ACA | 25 |
| | | CACR-JU196ACA | 25 |
| | For two axes | CACR-JUM23ACA | 15 |
| | | CACR-JUM24ACA | 15 |
| | | CACR-JUM25ACA | 15 |
| Three-phase, 400 VAC | For one axis | CACR-JU014DCA | 10 |
| | | CACR-JU018DCA | 15 |
| | | CACR-JU033DCA | 15 |
| | | CACR-JU042DCA | 15 |
| | | CACR-JU051DCA | 15 |
| | | CACR-JU098DCA | 20 |
| | For two axes | CACR-JUM23DCA | 15 |
| | | CACR-JUM24DCA | 15 |
| | | CACR-JUM25DCA | 15 |

- First make sure the charge indicator is turned OFF and that the DC-bus (symbol: P and N) voltage value is correct by using a tester or other device before wiring or starting an inspection.

## (1) Wire Sizes and Tightening Torques

### ■ Power Regeneration Converter

| Input Voltage | Model: CACP-JU | Terminal Symbols | Terminal Screw | Tightening Torque [N·m] | Wire Sizes |
|---|---|---|---|---|---|
| Three-phase, 200 VAC | 15A3☐ | L1, L2, L3 | M6 | 2.5 to 3.0 | AWG6 |
| | | B1, B2 | M5 | 2.0 to 2.4 | AWG14 |
| | | ⏚ | M5 | 2.0 to 2.4 | AWG6 |
| | 19A3☐ | L1, L2, L3 | M6 | 2.5 to 3.0 | AWG4 |
| | | B1, B2 | M5 | 2.0 to 2.4 | AWG14 |
| | | ⏚ | M5 | 2.0 to 2.4 | AWG4 |
| | 22A3☐ | L1, L2, L3 | M6 | 2.5 to 3.0 | AWG3 |
| | | B1, B2 | M5 | 2.0 to 2.4 | AWG14 |
| | | ⏚ | M5 | 2.0 to 2.4 | AWG4 |
| | 30A3☐ | L1, L2, L3 | M6 | 2.5 to 3.0 | AWG2 |
| | | B1, B2 | M5 | 2.0 to 2.4 | AWG14 |
| | | ⏚ | M6 | 2.5 to 3.0 | AWG4 |
| | 37A3B | L1, L2, L3 | M8 | 2.5 to 3.0 | AWG1/0 |
| | | B1, B2 | M5 | 2.0 to 2.4 | AWG14 |
| | | ⏚ | M6 | 2.5 to 3.0 | AWG2 |
| | 45A3B | L1, L2, L3 | M10 | 30 | AWG3/0 |
| | | B1, B2 | M5 | 2.0 to 2.4 | AWG14 |
| | | ⏚ | M6 | 2.5 to 3.0 | AWG1/0 |
| Three-phase, 400 VAC | 15D3☐ | L1, L2, L3 | M6 | 2.5 to 3.0 | AWG8 |
| | | B1, B2 | M5 | 2.0 to 2.4 | AWG14 |
| | | ⏚ | M5 | 2.0 to 2.4 | AWG7 |
| | 19D3☐ | L1, L2, L3 | M6 | 2.5 to 3.0 | AWG8 |
| | | B1, B2 | M5 | 2.0 to 2.4 | AWG14 |
| | | ⏚ | M5 | 2.0 to 2.4 | AWG7 |
| | 22D3☐ | L1, L2, L3 | M6 | 2.5 to 3.0 | AWG7 |
| | | B1, B2 | M5 | 2.0 to 2.4 | AWG14 |
| | | ⏚ | M5 | 2.0 to 2.4 | AWG7 |
| | 45D3B | L1, L2, L3 | M10 | 30 | AWG3 |
| | | B1, B2 | M5 | 2.0 to 2.4 | AWG14 |
| | | ⏚ | M6 | 2.5 to 3.0 | AWG4 |

## ■ SERVOPACK for One Axis

| Input Voltage | Model: CACR-JU | Terminal Symbols | Terminal Screw | Tightening Torque [N·m] | Wire Sizes | |
|---|---|---|---|---|---|---|
| | | | | | For Spindle Motor | For Servomotor |
| Three-phase, 200 VAC | 028ACA | U, V, W | (connector) | – | AWG8 | AWG10 |
| | | motor ⏚ | (connector) | – | AWG8 | AWG10 |
| | | ⏚ | M4 | 1.2 to 1.4 | AWG8 | AWG10 |
| | 036ACA | U, V, W | (connector) | – | AWG8 | AWG8 |
| | | motor ⏚ | (connector) | – | AWG8 | AWG8 |
| | | ⏚ | M4 | 1.2 to 1.4 | AWG8 | AWG8 |
| | 065ACA | U, V, W | M6 | 2.5 to 3.0 | AWG4 (AWG6)*1 | AWG6 |
| | | motor ⏚ | M6 | 2.5 to 3.0 | AWG4 (AWG6)*1 | AWG6 |
| | | ⏚ | M4 | 1.2 to 1.4 | AWG4 (AWG6)*1 | AWG6 |
| | 084ACA | U, V, W | M6 | 2.5 to 3.0 | AWG2 | AWG4 |
| | | motor ⏚ | M6 | 2.5 to 3.0 | AWG2 | AWG4 |
| | | ⏚ | M5 | 2.0 to 2.4 | AWG4 | AWG4 |
| | 102ACA | U, V, W | M6 | 2.5 to 3.0 | AWG1 | AWG4 |
| | | motor ⏚ | M6 | 2.5 to 3.0 | AWG1 | AWG4 |
| | | ⏚ | M5 | 2.0 to 2.4 | AWG4 | AWG4 |
| | 125ACA | U, V, W | M8 | 2.5 to 3.0 | AWG2/0 | – |
| | | motor ⏚ | M8 | 2.5 to 3.0 | AWG2/0 | – |
| | | ⏚ | M6 | 2.5 to 3.0 | AWG2 | – |
| | 196ACA | U, V, W | M10 | 30 | AWG4/0 | – |
| | | motor ⏚ | M10 | 30 | AWG4/0 | – |
| | | ⏚ | M6 | 2.5 to 3.0 | AWG1/0 | – |
| Three-phase, 400 VAC | 014DCA | U, V, W | (connector) | – | AWG12 | AWG14 |
| | | motor ⏚ | (connector) | – | AWG12 | AWG14 |
| | | ⏚ | M4 | 1.2 to 1.4 | AWG12 | AWG14 |
| | 018DCA | U, V, W | (connector) | – | AWG10 | AWG10 |
| | | motor ⏚ | (connector) | – | AWG10 | AWG10 |
| | | ⏚ | M4 | 1.2 to 1.4 | AWG10 | AWG10 |
| | 033DCA | U, V, W | M6 | 2.5 to 3.0 | AWG8 (AWG10)*2 | AWG10 |
| | | motor ⏚ | M6 | 2.5 to 3.0 | AWG8 (AWG10)*2 | AWG10 |
| | | ⏚ | M4 | 1.2 to 1.4 | AWG8 (AWG10)*2 | AWG10 |
| | 042DCA | U, V, W | M6 | 2.5 to 3.0 | AWG6 | AWG8 |
| | | motor ⏚ | M6 | 2.5 to 3.0 | AWG6 | AWG8 |
| | | ⏚ | M5 | 2.0 to 2.4 | AWG6 | AWG8 |
| | 051DCA | U, V, W | M6 | 2.5 to 3.0 | AWG6 | AWG8 |
| | | motor ⏚ | M6 | 2.5 to 3.0 | AWG6 | AWG8 |
| | | ⏚ | M5 | 2.0 to 2.4 | AWG6 | AWG8 |

(cont'd)

| Input Voltage | Model: CACR-JU | Terminal Symbols | Terminal Screw | Tightening Torque [N·m] | Wire Sizes | |
|---|---|---|---|---|---|---|
| | | | | | For Spindle Motor | For Servomotor |
| Three-phase, 400 VAC | 098DCA | U, V, W | M10 | 30 | AWG1 | – |
| | | motor ⏚ | M10 | 30 | AWG1 | – |
| | | ⏚ | M6 | 2.5 to 3.0 | AWG4 | – |

∗1. For motor model: UAK□J-11CZ (Input voltage: Three-phase 200 VAC)
∗2. For motor model: UAK□J-11CZ (Input voltage: Three-phase 400 VAC)

■ SERVOPACK for Two Axes

| Input Voltage | Model: CACR-JUM2 | Terminal Symbols | Terminal Screw | Tightening Torque [N·m] | Wire Sizes |
|---|---|---|---|---|---|
| Three-phase, 200 VAC | 3ACA | U, V, W | (connector) | – | AWG14 |
| | | motor ⏚ | (connector) | – | AWG14 |
| | | ⏚ | M4 | 1.2 to 1.4 | AWG14 |
| | 4ACA | U, V, W | (connector) | – | AWG10 |
| | | motor ⏚ | (connector) | – | AWG10 |
| | | ⏚ | M4 | 1.2 to 1.4 | AWG10 |
| | 5ACA | U, V, W | (connector) | – | AWG8 |
| | | motor ⏚ | (connector) | – | AWG8 |
| | | ⏚ | M4 | 1.2 to 1.4 | AWG8 |
| Three-phase, 400 VAC | 3DCA | U, V, W | (connector) | – | AWG14 |
| | | motor ⏚ | (connector) | – | AWG14 |
| | | ⏚ | M4 | 1.2 to 1.4 | AWG14 |
| | 4DCA | U, V, W | (connector) | – | AWG14 |
| | | motor ⏚ | (connector) | – | AWG14 |
| | | ⏚ | M4 | 1.2 to 1.4 | AWG14 |
| | 5DCA | U, V, W | (connector) | – | AWG14 |
| | | motor ⏚ | (connector) | – | AWG14 |
| | | ⏚ | M4 | 1.2 to 1.4 | AWG14 |

### (2) Installing a Molded-case Circuit Breaker

Install a molded-case circuit breaker (MCCB) between the power supply and the main circuit power supply input terminals (R/L1, S/L2, and T/L3). Always install a molded-case circuit breaker if you do not install a ground fault detector.

### (3) Installing a Ground Fault Detector

Install a ground fault detector between the power supply and the main circuit power supply input terminals (R/L1, S/L2, and T/L3). Always install a ground fault detector if you do not install a molded-case circuit breaker (MCCB).

### (4) Installing a Magnetic Contactor

Install a magnetic contactor (MC) if you need to turn the control power supply or main circuit power supply sequence ON and OFF.

### (5) Terminal Block Connection Sequence

You can connect the main circuit power supply terminals in any order without considering the phase order (R/L1, S/L2, T/L3).

### (6) Installing a Surge Absorber

Always install surge absorbers or diodes on all inductive loads that are connected near the Σ-V-SD servo driver. (Inductive loads include magnetic contactors, magnetic relays, magnetic valves, solenoids, and magnetic brakes.)

IMPORTANT

- Never connect a surge absorber to the output terminals (U, V, and W) from the SERVOPACK.
- Always install surge absorbers. If you do not install surge absorbers, the surge voltage from the coil that occurs when the inductive load is turned ON and OFF will affect the SERVOPACK control signal lines and could cause incorrect signals.

### (7) Prohibition of Installation of Phase Advancing Capacitor

Do not connect a phase advancing capacitor or surge absorber to main circuit power supply input (R/L1, S/L2, or T/L3) of a power regeneration converter. The phase advancing capacitor or surge absorber may become overheated and damaged by the harmonic components of the Σ-V-SD driver. Also, the Σ-V-SD driver may malfunction because of overcurrent.

### (8) Designing the Power ON Sequence

Take the following points into consideration when designing the power ON sequence.

- The main circuit power supply must turn ON only after it has been confirmed that no servo alarm has occurred.
- The main circuit power supply must turn OFF when a servo alarm occurs during operation. The state of the motor must be considered when the main circuit power supply is turned OFF during operation. For details, refer to *7.2.1 (9) Typical Main Circuit Wiring Example*.

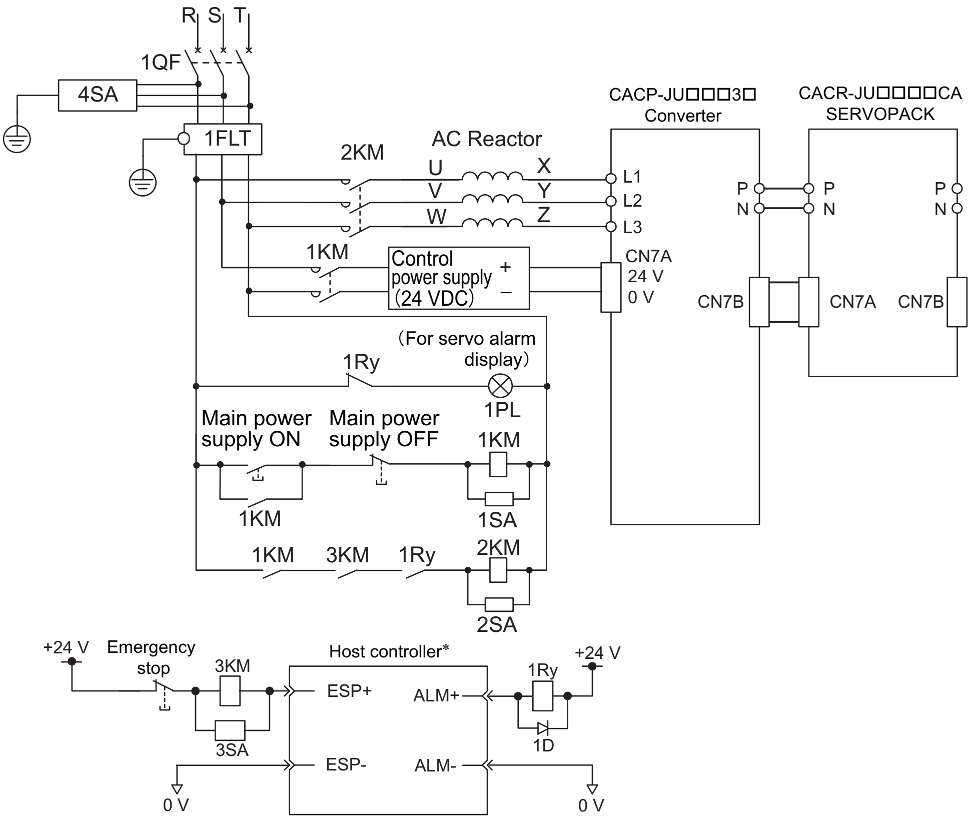
## (9) Typical Main Circuit Wiring Example

The typical main circuit wiring examples is shown below.

**⚠ WARNING**

- Do not touch the power terminals before the main-circuit capacitor has had time to discharge because high voltage may still remain in the converter and SERVOPACK. Refer to this section for the details of discharge time of main-circuit capacitor.

  After the charge indicator goes out, check the voltage on the DC bus line (i.e., between the P and N terminals) with a voltage tester or other device and confirm safety before you perform wiring or inspection work.



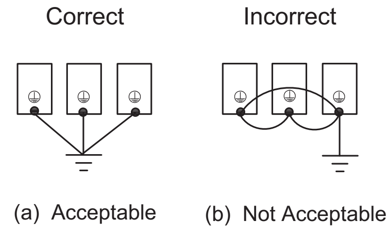

1QF: Molded-case circuit breaker
1FIL: Noise filter
1KM: Magnetic contactor (for control power supply)
2KM: Magnetic contactor (for main circuit power supply)
3KM: Magnetic contactor (for emergency stop)
1Ry: Relay
1PL: Indicator lamp
1SA: Surge absorber
2SA: Surge absorber
3SA: Surge absorber
4SA: Surge absorber
1D: Flywheel diode

* A host controller is not provided by Yaskawa.

## (10) Grounding

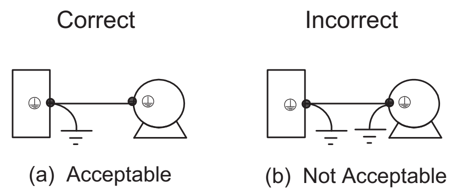
Use the following information to ensure that the ground is sufficient.

- Make sure to ground the ground terminal (⏚).
  200 V class: Ground to 100 Ω or less
  400 V class: Ground to 10 Ω or less
- Never ground the Σ-V-SD driver in common with welding machines, motors, or other large current electrical equipment. Wiring for grounding cable must be separated from the large-current electrical equipment.
- Always use a ground wire that complies with technical standards on electrical equipment. Minimize the length of the ground wire. Leakage current flows through the Σ-V-SD driver. Therefore, if the distance between the ground terminal and the ground terminal is too long, the potential on the ground terminal of the Σ-V-SD driver will become unstable.
- Always ground Σ-V-SD driver and motors using a ground terminal even when equipment is grounded through sill channel or steel plate.
- Ground each Σ-V-SD driver directly to the ground as shown in the following figure (a). Do not make a loop as shown in (b).




Grounding

- Ground the Σ-V-SD driver and motor as shown in the following figure (a). Do not ground both the Σ-V-SD driver and motor as shown in (b).




Grounding of Motor and Σ-V-SD Driver

## 7.2.2 Control Circuit Power Supply

### (1) Specifications

#### ■ Voltage

24 VDC ± 15%

#### ■ Current

• Power Regeneration Converter

| Input Voltage | Model | Specification |
|---|---|---|
| Three-phase, 200 VAC | CACP-JU15A3☐ | 1 A |
| | CACP-JU19A3☐ | |
| | CACP-JU22A3☐ | |
| | CACP-JU30A3☐ | |
| | CACP-JU37A3B | |
| | CACP-JU45A3B | 1.5 A |
| Three-phase, 400 VAC | CACP-JU15D3☐ | 1 A |
| | CACP-JU19D3☐ | |
| | CACP-JU22D3☐ | |
| | CACP-JU45D3B | |

• SERVOPACK for One Axis

| Input Voltage | Model | Specification |
|---|---|---|
| 270 VDC | CACR-JU028ACA | 1.5 A |
| | CACR-JU036ACA | |
| | CACR-JU065ACA | |
| | CACR-JU084ACA | |
| | CACR-JU102ACA | |
| | CACR-JU125ACA | |
| | CACR-JU196ACA | 2 A |
| 540 VDC | CACR-JU014DCA | 1.5 A |
| | CACR-JU018DCA | |
| | CACR-JU033DCA | |
| | CACR-JU042DCA | |
| | CACR-JU051DCA | |
| | CACR-JU098DCA | 2.5 A |

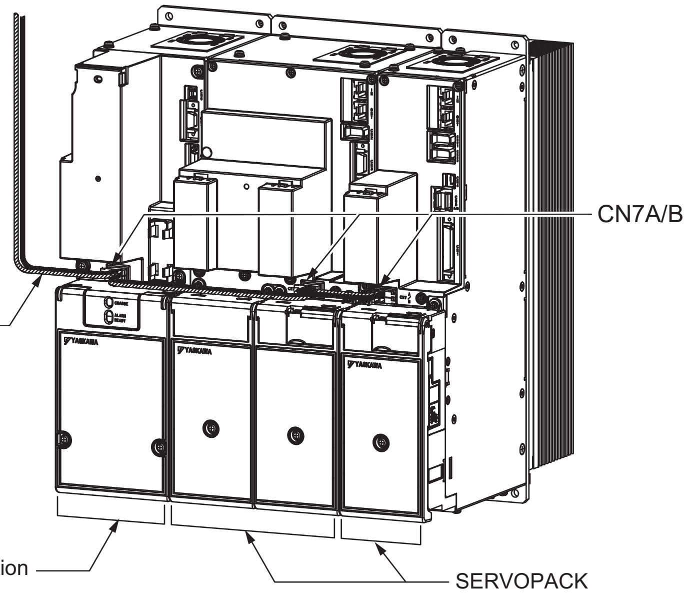
• SERVOPACK for Two Axes

| Input Voltage | Model | Specification |
|---|---|---|
| 270 VDC | CACR-JUM23ACA | 1.5 A |
| | CACR-JUM24ACA | |
| | CACR-JUM25ACA | |
| 540 VDC | CACR-JUM23DCA | |
| | CACR-JUM24DCA | |
| | CACR-JUM25DCA | |

**IMPORTANT**

- The allowable current for the control power supply is 10 A. Perform wiring so that the total current when combined with the Σ-V-SD driver is 10 A or less.
- Refer to *2.1.3 Power Regeneration Converter, SERVOPACK, and Motor* for the maximum number of connected drives.

## (2) Connections




Control Power Supply Cable Wiring

| Pin No. | Signal Name | I/O | Function | Pin No. | Signal Name | I/O | Function |
|---|---|---|---|---|---|---|---|
| A | 24 VDC | I/O | +24 VDC | B | 0 V | I/O | 0 V |

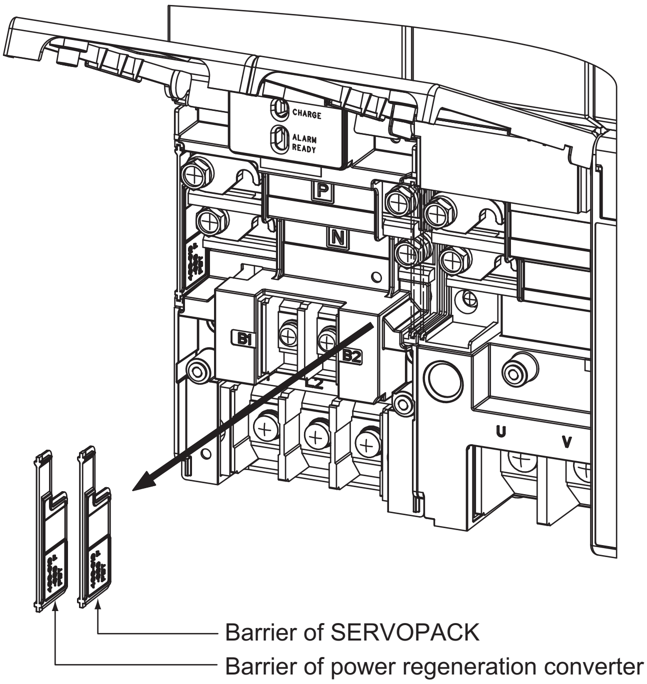
| CN7A/B | | | CN7A/B | |
|---|---|---|---|---|
| Pin No. | Signal Name | | Pin No. | Signal Name |
| A | 24 VDC | — | A | 24 VDC |
| B | 0 V | — | B | 0 V |

## 7.2.3 DC-bus

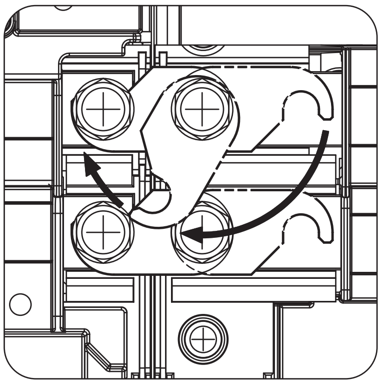
A bus bar built into the Σ-V-SD driver connects the power regeneration converter and a SERVOPACK or two SERVOPACKs.

The bus bar connection procedure is given below.

**1.** Remove the barriers between the devices to connect.

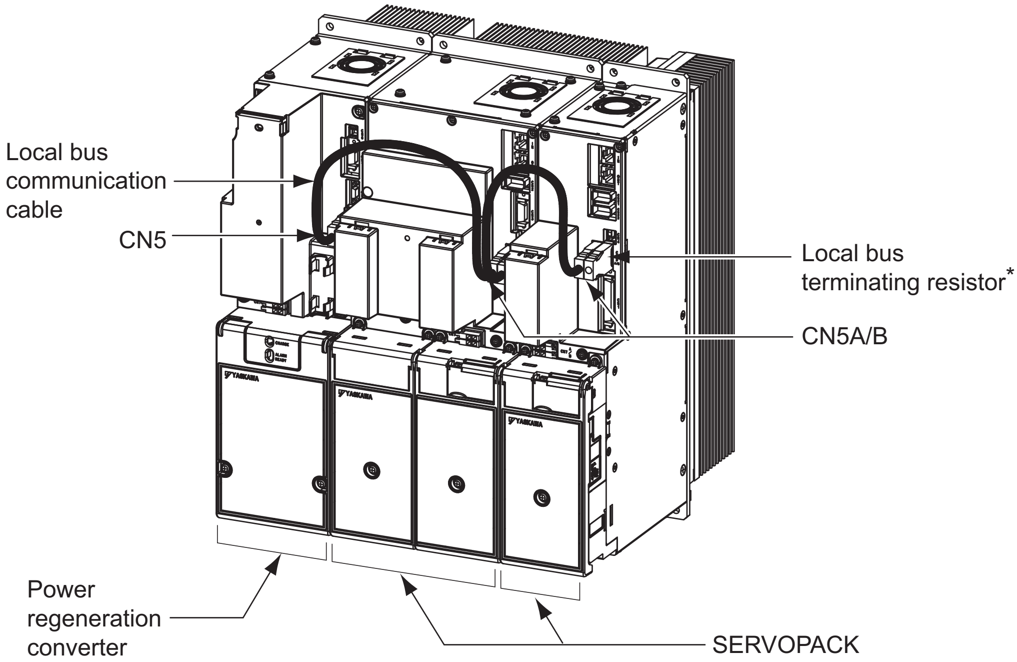



**2.** Rotate the bus bar of the device on the right 180° clockwise, and then hook it on the terminals of the device on the left.



## 7.2.4 Local Bus

A local bus communication cable connects the power regeneration converter (CN5) and SERVOPACK (CN5A and CN5B).




* Connect only one resistor on the SERVOPACK on the right.

| IMPORTANT | If you connect two or more SERVOPACKs to one power regeneration converter, do not set the same value for the rightmost digit of the SERVOPACK address in Pn010 (5C00h).<br>For details, refer to *8.4.8 Setting Local Bus Addresses*. |
|---|---|

## 7.2.5 I/O Signals

**IMPORTANT**

Do not use CN1 on the SERVOPACK as the I/O signal for an emergency stop.
Use CN1 on the power regeneration converter.

### (1) Connections

Connector Pin Arrangement (CN1) for I/O Signals of the Power Regeneration Converter

| Pin No. | Signal Name | I/O | Function | Pin No. | Signal Name | I/O | Function |
|---|---|---|---|---|---|---|---|
| 1 | /MCON+ | O | Main circuit connector ON output | 8* | (NC) | – | – |
| 2 | /MCON– | O | Main circuit connector ON output | 9* | (NC) | – | – |
| 3* | (NC) | – | – | 10* | (NC) | – | – |
| 4* | (NC) | – | – | 11 | /ESP+ | I | Emergency stop input |
| 5* | (NC) | – | – | 12 | /ESP– | I | Emergency stop input |
| 6* | (NC) | – | – | 13* | (NC) | – | – |
| 7* | (NC) | – | – | 14* | (NC) | – | – |

* Do not use NC signal.
Note: Connect the shielded wires to the CN1 connector shell.

Connector Pin Arrangement (CN1) for I/O Signals of the SERVOPACK for One Axis

| Pin No. | Signal Name | I/O | Function | Pin No. | Signal Name | I/O | Function |
|---|---|---|---|---|---|---|---|
| 1 | COM24V | I | +24V external power supply input | 14*1 | (NC) | – | – |
| 2 | /Probe1 | I | Probe 1 latch signal input | 15*3 | (NC) | – | – |
| 3 | /Probe2 | I | Probe 2 latch signal input | 16*3 | (NC) | – | – |
| 4 | /Home | I | Home switch input | 17 | /HWBB1– | I | Baseblock input 1 |
| 5*1 | (NC) | – | – | 18 | /HWBB1+ | I | Baseblock input 1 |
| 6 | P-OT1 | I | Forward overtravel | 19 | /HWBB2– | I | Baseblock input 2 |
| 7 | N-OT1 | I | Reverse overtravel | 20 | /HWBB2+ | I | Baseblock input 2 |
| 8*1 | (NC) | – | – | 21 | EDM1– | O | Baseblock monitoring signal |
| 9 | /BK1+ | O | Brake | 22 | EDM1+ | O | Baseblock monitoring signal |
| 10 | /BK1– | O | Brake | 23 | DBA1 | I | External dynamic brake answer signal |
| 11*2 | THM1+ | I | Motor winding temperature detection | 24 | DBA2 | I | External dynamic brake answer signal |
| 12*2 | THM1– | I | Motor winding temperature detection | 25 | DBON | O | External dynamic brake |
| 13*1 | (NC) | – | – | 26 | DB24V | O | External dynamic brake |

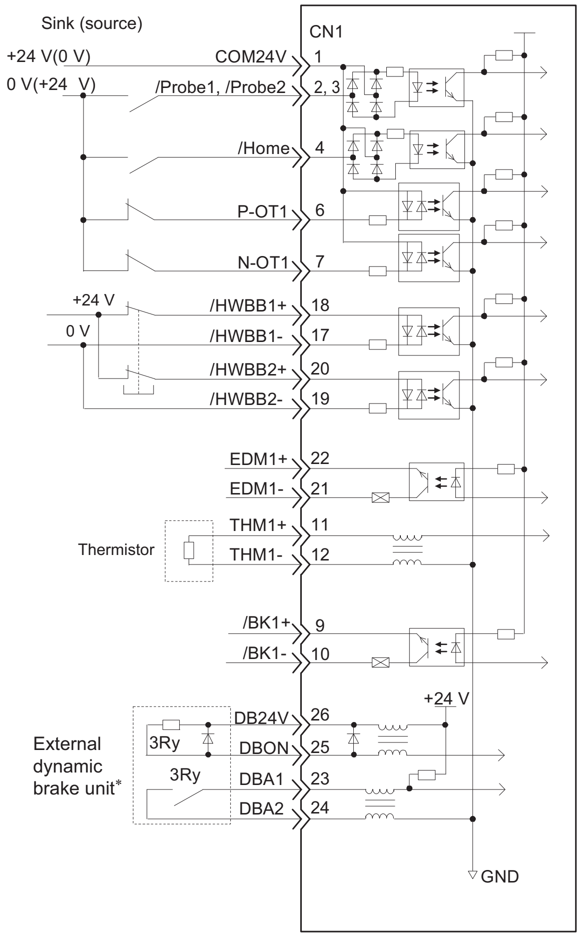
*1. Do not use NC signal.
*2. Use CN1 or CN3 for motor winding temperature detection.
*3. Do not normally connect these terminals. However, you can connect CN1-15 and CN1-16 when you do not use the HWBB. For details, refer to *7.2.5 (2) Connection Diagrams*.
Note: Connect the shielded wires to the CN1 connector shell.

Connector Pin Arrangement (CN1) for I/O Signals of the SERVOPACK for Two Axes

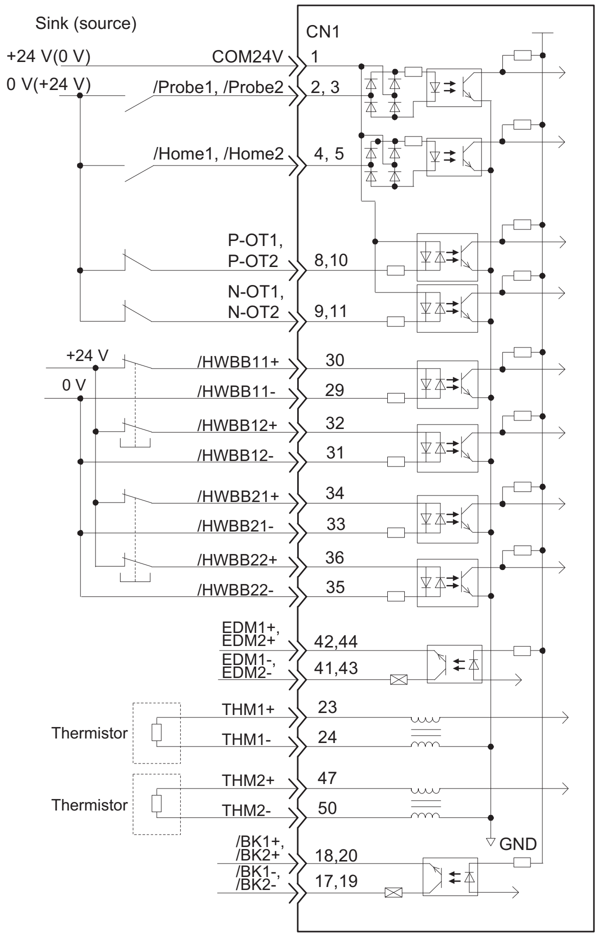
| Pin No. | Signal Name | I/O | Function | Pin No. | Signal Name | I/O | Function |
|---|---|---|---|---|---|---|---|
| 1 | COM24V | I | +24 V external power supply input | 26*1 | (NC) | – | – |
| 2 | /Probe1 | I | Probe 1 latch signal input | 27*2 | (NC) | – | – |
| 3 | /Probe2 | I | Probe 2 latch signal input | 28*2 | (NC) | – | – |
| 4 | /Home1 | I | Home switch input for axis 1 | 29 | /HWBB11– | I | Baseblock input 1 for 1st axis |
| 5 | /Home2 | I | Home switch input for axis 2 | 30 | /HWBB11+ | I | Baseblock input 1 for 1st axis |
| 6*1 | (NC) | – | – | 31 | /HWBB12– | I | Baseblock input 2 for 1st axis |
| 7*1 | (NC) | – | – | 32 | /HWBB12+ | I | Baseblock input 2 for 1st axis |
| 8 | P-OT1 | I | Forward overtravel for 1st axis | 33 | /HWBB21– | I | Baseblock input 1 for 2nd axis |
| 9 | N-OT1 | I | Reverse overtravel for 1st axis | 34 | /HWBB21+ | I | Baseblock input 1 for 2nd axis |
| 10 | P-OT2 | I | Forward overtravel for 2nd axis | 35 | /HWBB22– | I | Baseblock input 2 for 2nd axis |
| 11 | N-OT2 | I | Reverse overtravel for 2nd axis | 36 | /HWBB22+ | I | Baseblock input 2 for 2nd axis |
| 12*1 | (NC) | – | – | 37*1 | (NC) | – | – |
| 13*1 | (NC) | – | – | 38*1 | (NC) | – | – |
| 14*1 | (NC) | – | – | 39*1 | (NC) | – | – |
| 15*1 | (NC) | – | – | 40*1 | (NC) | – | – |
| 16*1 | (NC) | – | – | 41 | EDM1– | O | Baseblock monitoring signal for 1st axis |
| 17 | /BK1– | O | Brake for 1st axis | 42 | EDM1+ | O | Baseblock monitoring signal for 1st axis |
| 18 | /BK1+ | O | Brake for 1st axis | 43 | EDM2– | O | Baseblock monitoring signal for 2nd axis |
| 19 | /BK2– | O | Brake for 2nd axis | 44 | EDM2+ | O | Baseblock monitoring signal for 2nd axis |
| 20 | /BK2+ | O | Brake for 2nd axis | 45*1 | (NC) | – | – |
| 21*1 | (NC) | – | – | 46*1 | (NC) | – | – |
| 22*1 | (NC) | – | – | 47 | THM2+ | I | Motor winding temperature detection for 2nd axis |
| 23 | THM1+ | I | Motor winding temperature detection for 1st axis | 48*1 | (NC) | – | – |
| 24 | THM1– | I | Motor winding temperature detection for 1st axis | 49*1 | (NC) | – | – |
| 25*1 | (NC) | – | – | 50 | THM2– | I | Motor winding temperature detection for 2nd axis |

*1. Do not use the NC terminals.
*2. Do not normally connect these terminals. However, you can connect CN1-27 and CN1-28 when you do not use the HWBB. For details, refer to *7.2.5 (2) Connection Diagrams*.

## (2) Connection Diagrams



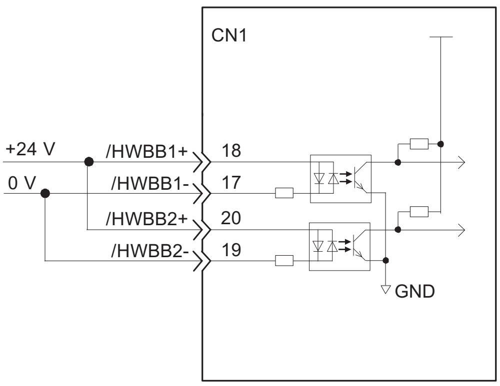

I/O Connections for SERVOPACKs for One Axis



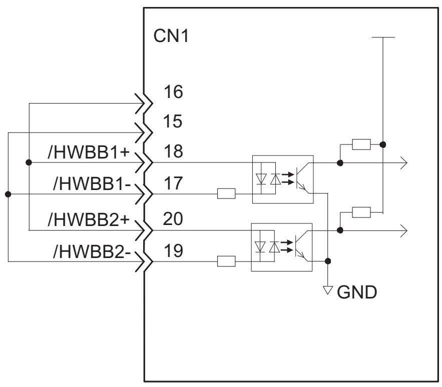

I/O Connections for SERVOPACKs for Two Axes

* Not provided by Yaskawa. For details, contact your Yaskawa representative.

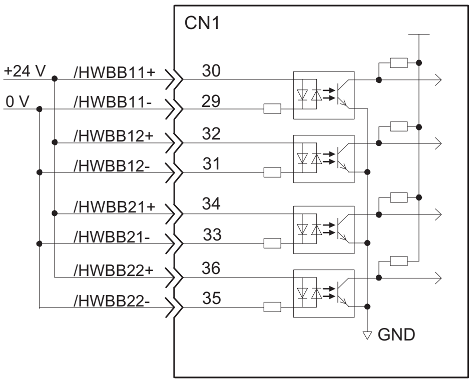
Note: If you do not use the HWBB, uses the connections shown in one of the following diagrams.



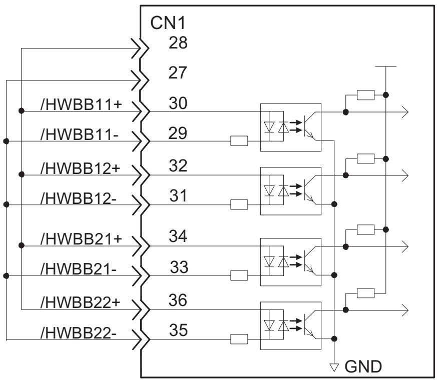

Connection Example 1
When Not Using a One-axis HWBB




Connection Example 2
When Not Using a One-axis HWBB




Connection Example 1
When Not Using a Two-axis HWBB

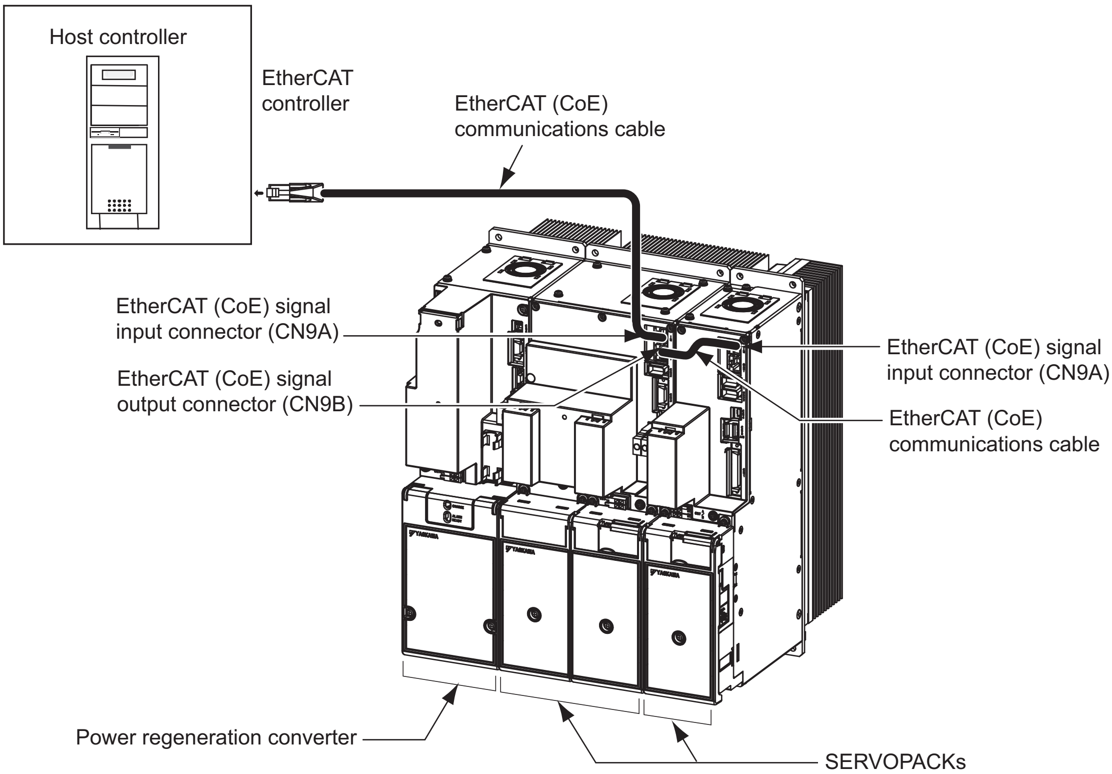



Connection Example 2
When Not Using a Two-axis HWBB

## 7.2.6 EtherCAT (CoE) Communications

Connect the host controller and connectors CN9A and CN9B on the SERVOPACK with the EtherCAT (CoE) communications cable.

Connect CN9A to the master and CN9B to the slave. If reversed, communication will not be successfully performed.




Note: Do not allow any one EtherCAT (CoE) communications cable to exceed 100 m.

- Connector Specifications

| Connector | Description |
|---|---|
| CN9A | EtherCAT (CoE) signal input |
| CN9B | EtherCAT (CoE) signal output |

- Connector Pin Arrangement

| Pin No. | Signal Name | Remarks |
|---|---|---|
| 1 | TD+ | Send data |
| 2 | TD- | |
| 3 | RD+ | Receive data |
| 4 | – | N.C.* |
| 5 | – | N.C.* |
| 6 | RD- | Receive data |
| 7 | – | N.C.* |
| 8 | – | N.C.* |

* Pins denoted as N.C. do not connect to any signal.

# 7.3 Winding Selection

Winding selection for an AC spindle motor is an effective way to extend the constant output control range of a servo (spindle) drive.

Contact your Yaskawa representative for details on changing the winding from the SERVOPACK.

# 8

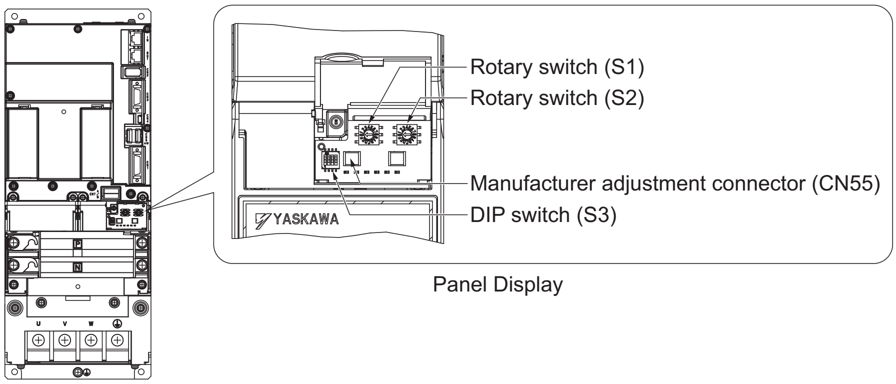
# Operation

# 8.1 EtherCAT (CoE) Communications Settings

This section describes the switch settings necessary for EtherCAT (CoE) communications.

## 8.1.1 EtherCAT Secondary Address Settings

The EtherCAT secondary address (Station Alias) can be used for identification or for addressing of a device. The station address is set using the rotary switches S1 and S2.




### (1) Settings

The combination of the settings of rotary switches S1 and S2 determine the station alias number.

Station alias number = (Setting of S1) × 16 + (Setting of S2)

<Notes>
When you turn the power supply to the SERVOPACK OFF and back ON, the station alias number is set in the Configured Station Alias Register of the EtherCAT slave controller (ESC).

**IMPORTANT**

- Always keep the DIP switch pins (S3) set to OFF.
- Do not use connector CN55 (manufacturer adjustment connector).

### (2) General Identification Process during Start Up

During start up the master detects the slaves by using the Auto Increment Addressing. The Identity object will be read from the slave and compared with the values from the master's configuration (which was provided by the EtherCAT configuration tool before). So the order of the slaves in the network has to be the same as in the master's configuration. To allow a different network topology a Station Alias is defined.

### (3) Example Scenario

With a machining center there might be two identical drives to work in X and Y direction. It might happen that the cabling order is mixed up after a device replacement. To avoid that the drives receive wrong process data, an explicit address of the device is used with a Station Alias.

### (4) Identification of Devices with Station Alias

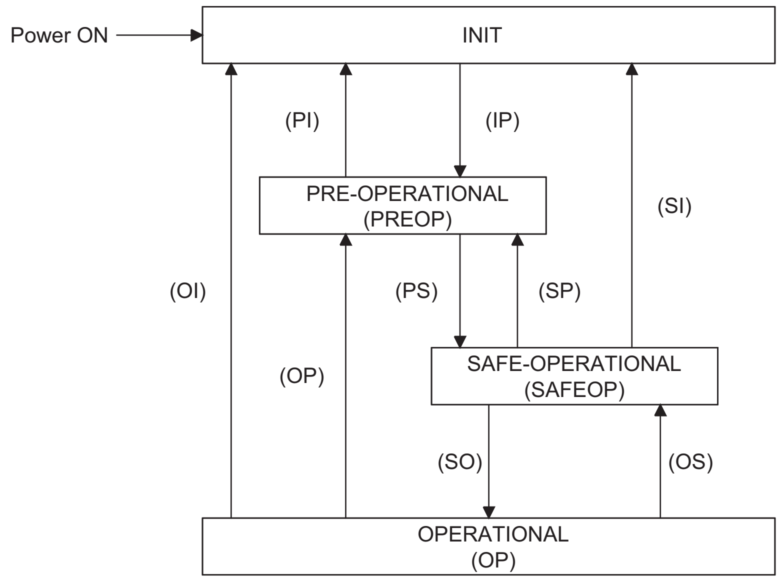
The master reads the Station Alias by using the Auto Increment Addressing. The detected Station Alias will be compared with the values from the master's configuration to get the relation of the network topology and the configured topology.

## 8.1.2 EtherCAT (CoE) Commands

For information on the EtherCAT (CoE) commands, refer to *Σ-V-SD series User's Manual For Command Profile EtherCAT (CoE) Communications Reference* (manual no.: SIEP S800000 95).

# 8.2 EtherCAT State Machine

The EtherCAT State Machine (ESM) is responsible for the coordination of master and slave applications at start up and during operation. State changes are typically initiated by requests of the master.
The states of the EtherCAT State Machine are as follows.



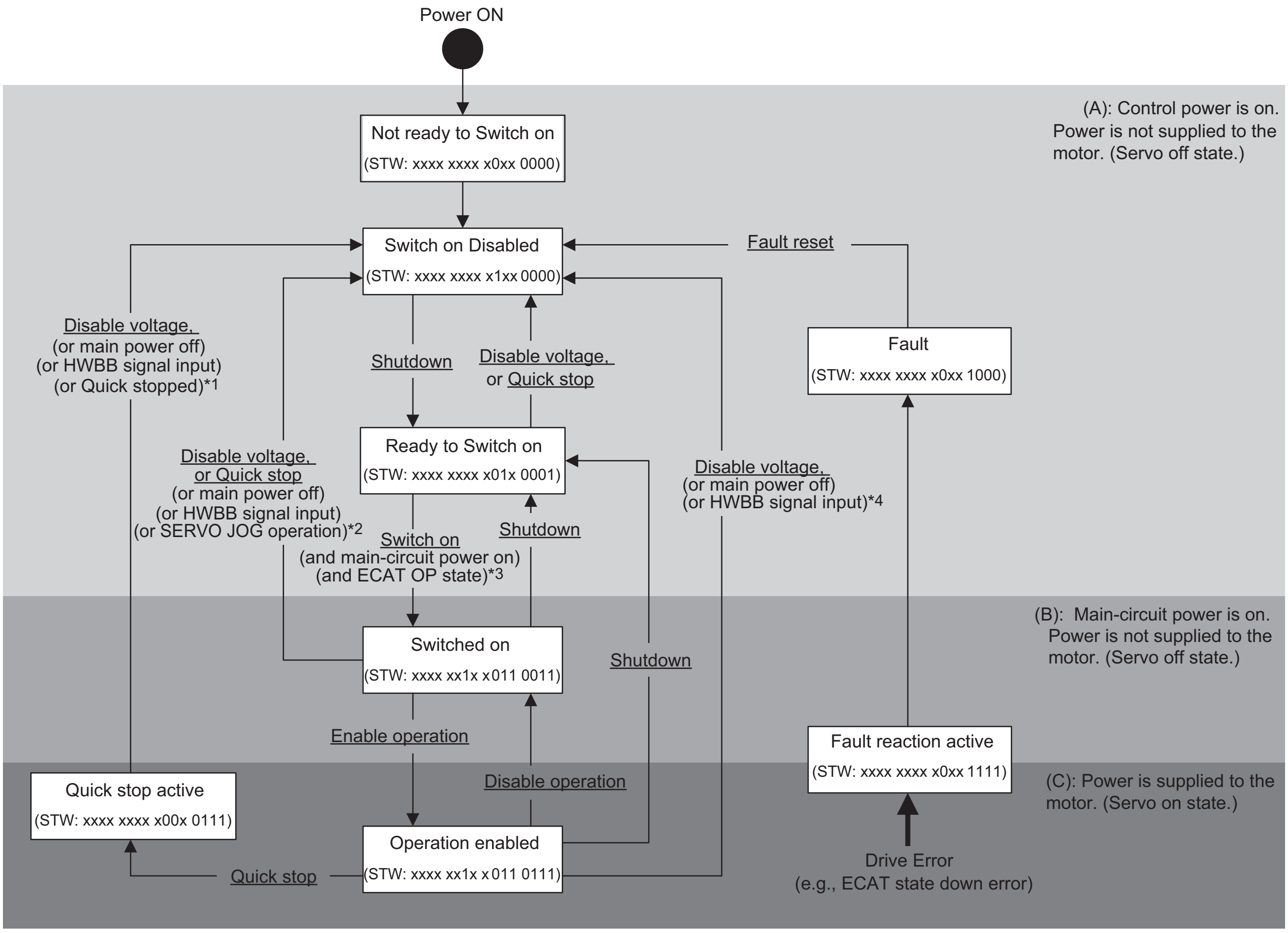

| State | Description |
|---|---|
| INIT | • No mailbox communication is possible.<br>• No process data communication is possible. |
| INIT => PREOP | • Master configures DL Address and SyncManager channels for Mailbox communication.<br>• Master initializes DC clock synchronization.<br>• Master requests ‘Pre-Operational’ state.<br>• Master sets AL Control register.<br>• Slave checks whether the mailbox was initialized correctly. |
| PREOP | • Mailbox communication is possible.<br>• No process data communication is possible. |
| PREOP => SAFEOP | • Master configures SyncManager channels and FMMU channels for process data.<br>• Master configures PDO mapping and the sync manager PDO assignment parameters via SDO.<br>• Master requests ‘Safe-Operational’ state.<br>• Slave checks whether the sync manager channels for process data communication and, if required, the distributed clocks settings are correct. |
| SAFEOP | • Mailbox communication is possible.<br>• Process Data communication is possible, but only Inputs are evaluated – Outputs remain in ‘Safe’ state. |
| SAFEOP => OP | • Master sends valid Outputs.<br>• Master requests ‘Operational’ state. |
| OP | • Mailbox communication is possible.<br>• Process data communication is possible. |

Operation

8

# 8.3 Device Control

The device control for the servo drive is carried out in the order shown in the following flowchart. Controlword (Object 6040h) controls the operating status of the servo drive, and Statusword (Object 6041h) is used to monitor this status.




∗1. In Quick stop Active state, the SERVOPACK automatically transits to the Switch on Disabled state at the following cases:
-The main power supply was turned off.
-HWBB signal was inputted.
-The motor was stopped.

∗2. In Switched on state, the SERVOPACK automatically transits to the Switch on Disabled state at the following cases:
-The main power supply was turned off.
-HWBB signal was inputted.
-Motor operation was already enabled by the engineering tool (SigmaWin for Σ-V-SD (MT)).

∗3. In Ready to Switch on state, the SERVOPACK transits to the next state in the following cases:
-The main power supply was turned on.
-EtherCAT State Machine (ESM) is in Operational state.
-The servomotor is not run by SigmaWin for Σ-V-SD (MT).

∗4. In Operation Enabled state, the SERVOPACK automatically transits to the Switch on Disabled state at the following cases:
-The main power supply was turned off.
-HWBB signal was inputted.

Note 1. ☐ shows state.
2. STW means the Statusword of Object 6041h.
3. ______ (underline) means the control command of Controlword (Object 6040h).

## (1) State Machine Controlling Command

| Command | Bits of the Controlword (6040h) | | | | |
|---|---|---|---|---|---|
| | Bit7 | Bit3 | Bit2 | Bit1 | Bit0 |
| Shutdown | 0 | – | 1 | 1 | 0 |
| Switch on | 0 | 0 | 1 | 1 | 1 |
| Switch on<br>+ Enable operation | 0 | 1 | 1 | 1 | 1 |
| Disable voltage | 0 | – | – | 0 | – |
| Quick stop | 0 | – | 0 | 1 | – |
| Disable operation | 0 | 0 | 1 | 1 | 1 |
| Enable operation | 0 | 1 | 1 | 1 | 1 |
| Fault reset | 0 → 1 | – | – | – | – |

## (2) Bits of Statusword (6041h)

| Bit No | Data Description | Note |
|---|---|---|
| 0 | Ready to switch on | For details, refer to *Σ-V-SD series User's Manual For Command Profile EtherCAT (CoE) Communications Reference* (manual no.: SIEP S800000 95) |
| 1 | Switched on | |
| 2 | Operation enabled | |
| 3 | Fault | |
| 4 | Voltage enabled | |
| 5 | Quick stop | |
| 6 | Switch on disabled | |
| 7 | Warning | |
| 8 | Reserved | |
| 9 | Remote | |
| 10 | Target reached | |
| 11 | Internal limit active | |
| 12 | Operation mode specific | |
| 13 | | |
| 14 | Torque limit active | |
| 15 | HWBB active | |

## (3) Related Objects

| Index | Sub | Name | Access | PDO Mapping | Units | Type |
|---|---|---|---|---|---|---|
| 6040h | – | Controlword | RW | Yes | – | UINT |
| 6041h | – | Statusword | RO | Yes | – | UINT |
| 605Ah | – | Quick Stop Option Code | RW | No | – | INT |
| 605Bh | – | Shutdown Option Code | RW | No | – | INT |
| 605Ch | – | Disable Operation Option Code | RW | No | – | INT |
| 605Dh | – | Halt Option Code | RW | No | – | INT |
| 605Eh | – | Fault Reaction Option Code | RW | No | – | INT |

## 8.4 Settings for Common Basic Functions

The following table lists basic parameters to be set up for motor operation.

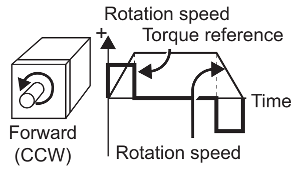
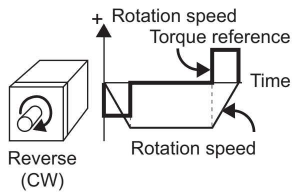
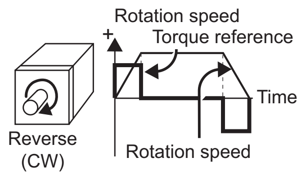
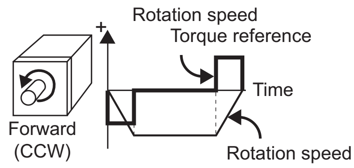
| Step | Items | | Reference | Parameters (Index Numbers) |
|---|---|---|---|---|
| 1 | Servomotor Rotation Direction | | *8.4.1 Servomotor Rotation Direction* | Pn000 (2000h) |
| 2 | Overtravel | | *8.4.2 Overtravel* | Pn50A (2110h:1)<br>Pn50B (2110h:2)<br>Pn001 (2001h)<br>Pn406 (20A2h)<br>Pn430 (20AAh:1)<br>Pn431 (20AAh:2) |
| 3 | Unit Settings | Position | *Σ-V-SD series User's Manual For Command Profile EtherCAT (CoE) Communications Reference* (manual no.: SIEP S800000 95) | PnB02 (2301h:1)<br>PnB04 (2301h:2) |
| | | Velocity | | PnB06 (2302h:1)<br>PnB08 (2302h:2) |
| | | Accelera-tion | | PnB0A (2303h:1)<br>PnB0C (2303h:2) |
| 4 | Holding Brakes | | *8.4.3 Holding Brakes* | Pn506 (2112h:1)<br>Pn507 (2112h:2)<br>Pn508 (2112h:4) |
| 5 | Stopping Servomotor after Servo OFF Command or Alarm Occurrence | | *8.4.4 Stopping Servomotor after SV_OFF Command or Alarm Occurrence* | Pn001 (2001h)<br>Pn00B (200Bh) |
| 6 | Instantaneous Power Interruption Settings | | *8.4.5 Instantaneous Power Interruption Settings* | – |
| 7 | Setting Motor Overload Detection Level | | *8.4.6 Setting Motor Overload Detection Level* | Pn52B (2104h:1)<br>Pn52C (2104h:2) |
| 8 | Spindle Motor Specification | | *8.4.7 Spindle Motor Settings* | Pn01E (2030h:3)<br>Pn01F (2030h:4) |
| 9 | Local Bus Addresses | | *8.4.8 Setting Local Bus Addresses* | Pn010 (5C00h) |

Note: After you change any of the above settings for basic functions, use one of the following methods to enable the changes.

- Turn the power supply to the Σ-V-SD Driver OFF and back ON.
- Write 1 to object 2300h in the Switch on Disabled state.

## 8.4.1 Servomotor Rotation Direction

The servomotor rotation direction can be reversed with parameter Pn000.0 without changing the polarity of the speed/position reference. The standard setting for forward rotation is counterclockwise (CCW) as viewed from the load end of the servomotor.

| Parameter (Index Number) | | Forward/Reverse Reference | Direction of Motor Rotation | Applicable Overtravel (OT) |
|---|---|---|---|---|
| **Pn000 (2000h)** | n.□□□0<br>The encoder counts up by a forward reference.<br>[Factory setting] | Forward Reference |  | P-OT |
| | | Reverse Reference |  | N-OT |
| | n.□□□1<br>The encoder counts up by a reverse reference. | Forward Reference |  | P-OT |
| | | Reverse Reference |  | N-OT |

Note: SigmaWin for Σ-V-SD (MT) trace waveforms are shown in the above table.

## 8.4.2 Overtravel

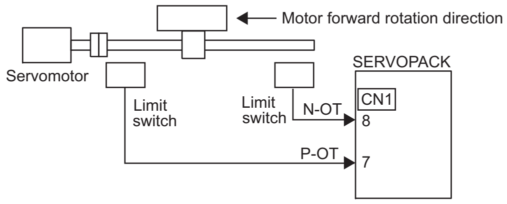
If movable machine parts overtravel and exceed the allowable range of motion, the overtravel limit function forces the parts to stop by activating the limit switch.

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

The overtravel function is not affected by the set value of Pn01E.0 (Motor Type/Application Selection Setting).

**⚠ CAUTION**

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




Note: For pin numbers of CN1, refer to *7.2.5 I/O Signals*.

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

### (1) Signal Setting

| Type | Name | Connector Pin Number | Setting | Meaning |
|---|---|---|---|---|
| Input | P-OT | Note: For pin numbers of CN1, refer to *7.2.5 I/O Signals*. | ON | Forward run allowed. Normal operation status. |
| | | | OFF | Forward run prohibited. Forward overtravel. |
| | N-OT | | 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 Function Setting

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

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

| Parameter (Index Number) | | Meaning | When Enabled | Classification |
|---|---|---|---|---|
| **Pn50A (2110h:1)** | n.1□□□ [Factory setting] | Inputs the Forward Run Prohibited (P-OT) signal from CN1-6*1. | After restart | Setup |
| | n.8□□□ | Disables the Forward Run Prohibited (P-OT) signal. Allows constant forward rotation. | | |
| **Pn50B (2110h:2)** | n.□□□2 [Factory setting] | Inputs the Reverse Run Prohibited (N-OT) signal from CN1-7*2. | | |
| | n.□□□8 | Disables the Reverse Run Prohibited (N-OT) signal. Allows constant reverse rotation. | | |

*1. For a SERVOPACK for two axes: CN1-8 (P-OT1), CN1-10 (P-OT2)
*2. For a SERVOPACK for two axes: CN1-9 (P-OT1), CN1-11 (P-OT2)

## (3) Servomotor Stopping Method When Overtravel Occurs

There are three servomotor stopping methods when overtravel occurs.

- Dynamic brake
  By short-circuiting the electric circuits, the servomotor comes to a quick stop.
  For the spindle motor, it coasts to a stop.
- Decelerate to a stop
  Stops by using emergency stop torque.
- Coast to a stop
  Stops naturally, with no control, by using the friction resistance of the motor in operation.

After servomotor 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 servomotor stopping method can be set in parameter Pn001. The factory setting of Pn001 differs depending on the model. For details, refer to *12.1 SERVOPACK Parameters*.

<table>
<tr><th colspan="2">Parameter<br>(Index Number)</th><th>Stop Method</th><th>Mode After Stopping</th><th>When Enabled</th><th>Classification</th></tr>
<tr><td rowspan="5">Pn001<br>(2001h)</td><td>n.□□00</td><td rowspan="2">DB</td><td rowspan="3">Coast</td><td rowspan="5">After restart</td><td rowspan="5">Setup</td></tr>
<tr><td>n.□□01</td></tr>
<tr><td>n.□□02</td><td>Coast</td></tr>
<tr><td>n.□□1□</td><td rowspan="2">Deceleration to a stop</td><td>Zero clamp</td></tr>
<tr><td>n.□□2□</td><td>Coast</td></tr>
</table>

- 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 servomotor stopping methods after the SV_OFF command is received or an alarm occurs, refer to *8.4.4 Stopping Servomotor after SV_OFF Command or Alarm Occurrence*.

Note: A coasting to a stop is always performed regardless of the set values of Pn001 if a spindle motor is used.

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

Emergency stop torque can be set with Pn406.

<table>
<tr><td rowspan="3">Pn406*<br>(20A2h)</td><td colspan="4">Emergency Stop Torque    Speed   Position</td><td rowspan="2">Classification</td></tr>
<tr><td>Setting Range</td><td>Setting Unit</td><td>Factory Setting</td><td>When Enabled</td></tr>
<tr><td>0 to 800</td><td>1%</td><td>800</td><td>Immediately</td><td>Setup</td></tr>
</table>

* If a spindle motor is used, a stop will be performed using the torque values that are set for Pn430 and Pn431.

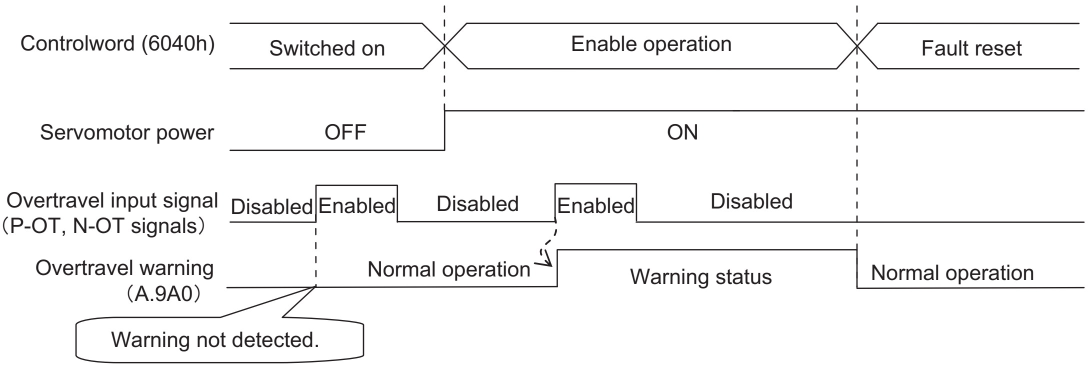
- The setting unit is a percentage of the rated torque.
- The factory setting is 800% so that the setting is large enough a value to operate the servomotor at maximum torque. The maximum value of emergency stop torque that is actually available, however, is limited to the maximum torque of the servomotor.

### (4) Overtravel Warning Function

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

To use the overtravel warning function, set digit 4 of Pn00D to 1 (detects overtravel warning).

#### ■ Warning Output Timing




<Notes>

- Warnings are detected for overtravel in the same direction as the reference.
- Warnings are not detected for overtravel in the reverse direction from the reference.
  Example: A warning will not be output for a forward reference even if the N-OT signal (reverse run prohibited) turns ON.
- A warning can be detected in either the forward or reverse direction, when there is no reference.
- A warning will not be detected when the servomotor power is OFF even if overtravel occurs.
- A warning will not be detected when the servomotor power changes from OFF to ON even if overtravel status exists.
- Use the Fault Reset command to clear the warning, and not the servo ON/OFF or the overtravel signal.
- If the warning is cleared during overtravel status with the Fault Reset command, a warning will not be detected again until the overtravel status has been cleared.
- The overtravel warning will be detected when the software limit is in effect.

**⚠ CAUTION**

- The overtravel warning function only detects warnings. It has no affect on stopping for overtravel or motion operations at the host controller. The next step (e.g., the next motion or other command) can be executed even if an overtravel warning exists. However, depending on the processing specifications and programming for warnings in the host controller, operation may be affected when an overtravel warning occurs (e.g., motion may stop or not stop). Confirm the specifications and programming in the host controller.
- When an overtravel occurs, the SERVOPACK will perform stop processing for overtravel. Therefore, when an overtravel warning occurs, the servomotor may not reach the target position specified by the host controller. Check the feedback position to make sure that the axis is stopped at a safe position.

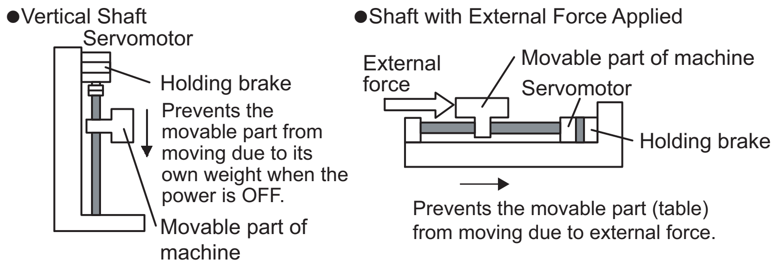
#### ■ Related Parameter

| Parameter (Index Number) | | Meaning | When Enabled | Classification |
|---|---|---|---|---|
| **Pn00D (200Dh)** | n.0□□□ [Factory setting] | Does not detect overtravel warning. | Immediately | Setup |
| | n.1□□□ | Detects overtravel warning. | | |

## 8.4.3 Holding Brakes

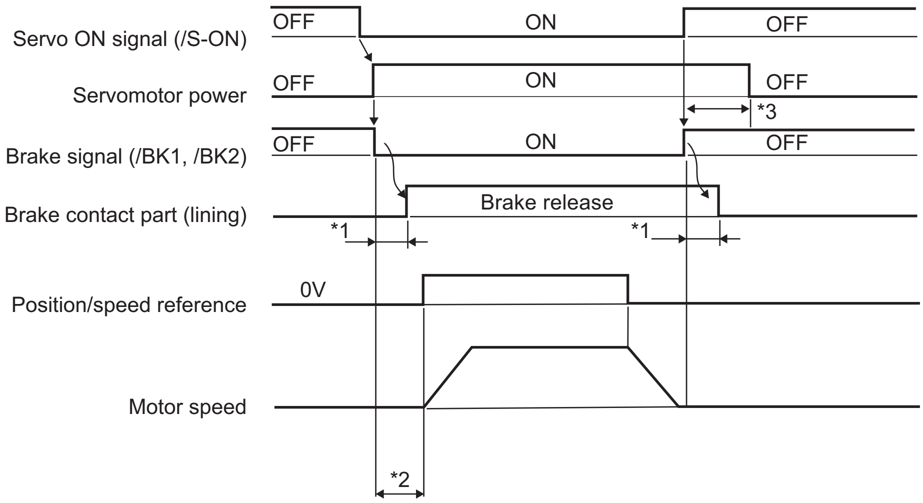
A holding brake is a brake used to hold the position of the movable part of the machine when the SERVOPACK is turned OFF so that movable part does not move due to gravity or external forces. Holding brakes are built into servomotors with brakes.

The holding brake is used in the following cases.




> **IMPORTANT**
> - The brake built into the servomotor with brakes is a de-energization brake, which is used only to hold and cannot be used for braking. Use the holding brake only to hold a stopped motor.
> - The servomotor power should not continue to be ON when activating the brake.

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




∗1. The operation delay time of the brake depends on the model. For details, refer to *Brake Operation Delay Time* shown in the following page.
∗2. Allow a period of 50 ms or more after the brake signal (/BK) is turned ON until the speed reference is input.
∗3. Use Pn506, Pn507, and Pn508 to set the timing of when the brake will be activated and when the servomotor power will be turned OFF.

Brake Operation Delay Time

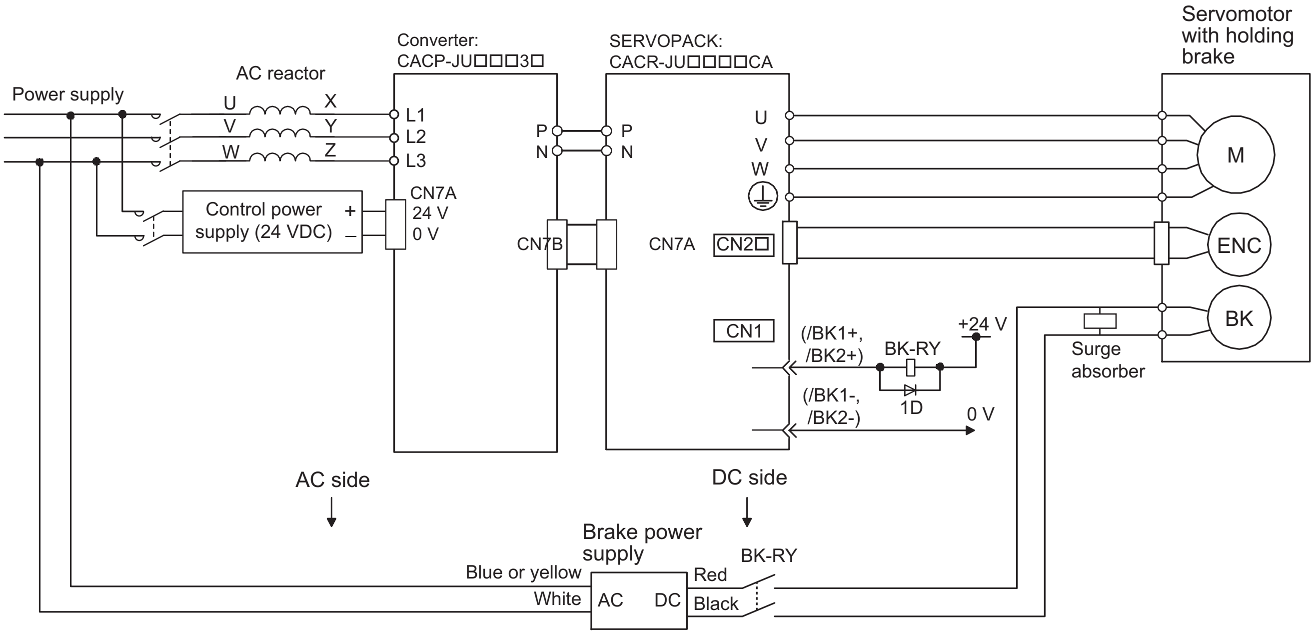
| Model | Voltage | Brake Release Time (ms) | Brake Applied Time (ms) |
|---|---|---|---|
| SGMGV-05 to 20 | 24 VDC, 90 VDC | 100 | 80 |
| SGMGV-30, -44 | | 170 | 100 (24 VDC), 80 (90 VDC) |
| SGMGV-55, -75 | | 170 | 80 |

Note: The above operation delay time is an example when the power supply is turned ON and OFF on the DC side.
The holding brake release time and holding brake operating time depend on the discharge circuit that is used.
Always confirm the operation delay time on the actual equipment before actual operation.

## (1) Wiring Example

Use the brake signals (/BK1, /BK2) 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 signals (/BK1, /BK2).




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. The user is responsible for providing the power supply.

IMPORTANT

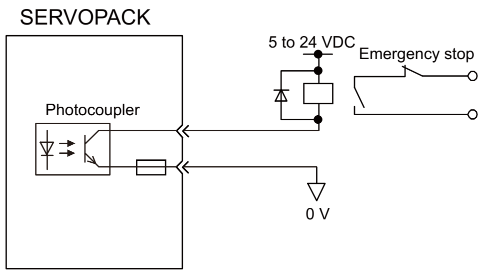
- Select the optimum surge absorber in accordance with the applied brake current and brake power supply.

  When using the LPSE-2H01-E power supply: Z10D471 (Made by SEMITEC Corporation)

  When using the LPDE-1H01-E power supply: Z10D271 (Made by SEMITEC Corporation)

  When using the 24-V power supply: Z15D121 (Made by SEMITEC Corporation)
- After the surge absorber is connected, check the total time the brake is applied for the system. Depending on the surge absorber, the total time the brake is applied can be changed.
- Configure the relay circuit to apply the holding brake by the emergency stop.

Relay Circuit Example




- The holding break stops operating if the signal line is disconnected when positive logic is the reverse of the polarity of the break signals (/BK1 and /BK2). If it is necessary to use this type of setting, be sure to check operation and confirm that there are no safety problems.
- A short-circuit fault may occur in the output circuit due to a wiring error or the application of an incorrect voltage. If such a fault occurs, the holding break will not operate, which may result in damage to machinery or an accident causing injury. Always implement safety measures to ensure safety in case such a fault should occur.

## (2) Brake Signal (/BK) Setting

This output signal controls the brake.

The /BK signals turn OFF (applies the brake) when an alarm is detected or the servomotor power is OFF. The brake OFF timing can be adjusted with Pn506.

| Type | Name | Connector Pin Number | Setting | Meaning |
|---|---|---|---|---|
| Output | /BK1, /BK2 | For pin numbers of CN1, refer to *7.2.5 I/O Signals*. | ON (close) | Releases the brake. |
| | | | OFF (open) | Applies the brake. |

IMPORTANT

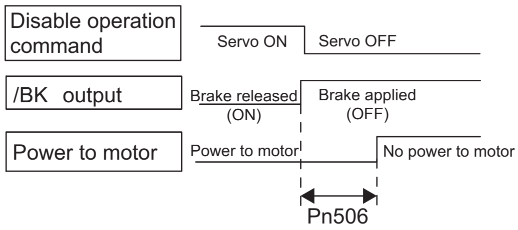
The /BK signals remain ON during overtravel. The brake is released.

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

When the servomotor stops, the /BK signals turn OFF at the same time as the Disable operation command is received. Use Pn506 to change the timing to turn OFF the servomotor power after the Disable operation command has been received.

| Pn506 (2112h:1) | Brake Reference-Servo OFF Delay Time | | Speed Position Torque | | Classification |
|---|---|---|---|---|---|
| | Setting Range | Setting Unit | Factory Setting | When Enabled | |
| | 0 to 50 | 10 ms | 0 | Immediately | Setup |

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




**IMPORTANT**

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

### (4) Brake (/BK) Signal Output Timing during Servomotor Rotating

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

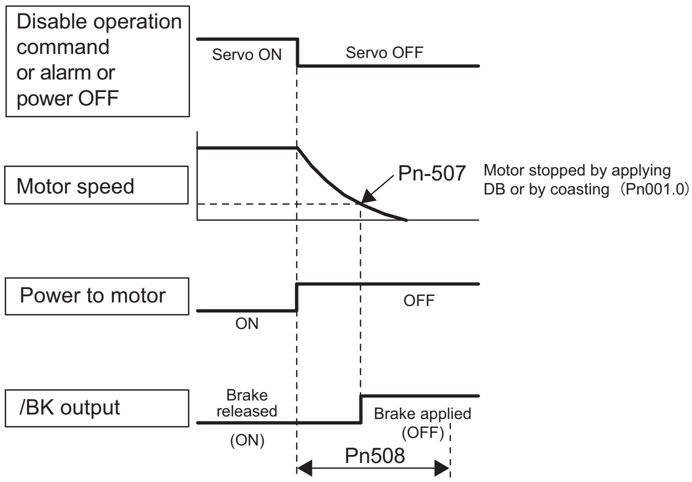
Note: If the servomotor is set so that it comes to a zero-speed stop for an alarm, follow the information in *(3) Brake ON Timing after the Servomotor Stops* after the servomotor comes to a stop for a zero position reference.

| | | | | | |
|---|---|---|---|---|---|
| **Pn507 (2112h:2)** | Brake Reference Output Speed Level | | Speed Position Torque | | Classification |
| | Setting Range | Setting Unit | Factory Setting | When Enabled | |
| | 0 to 10000 | 1 $min^{-1}$ | 100 | Immediately | Setup |
| **Pn508 (2112h:4)** | Waiting Time for Brake Signal When Motor Running | | Speed Position Torque | | Classification |
| | Setting Range | Setting Unit | Factory Setting | When Enabled | |
| | 10 to 100 | 10 ms | 50 | Immediately | Setup |

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

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

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




> **IMPORTANT**
>
> The servomotor will be limited to its maximum speed even if the value set in Pn507 is higher than the maximum speed.

## 8.4.4 Stopping Servomotor after SV_OFF Command or Alarm Occurrence

The stopping method can be selected after the SV_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 or the SV_ON command and SV_OFF command are received with a reference input applied to start and stop the servomotor, 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.
- Dynamic braking is an auxiliary function for an emergency stop. It is not intended to stop the motor. The motor may coast to a stop due to a fault. For protection, install stopping equipment to ensure safety at the machinery if an error occurs.
- Do not use the servo drive with a load moment of inertia that exceeds the allowable value. Doing so may result in damage or failure of the resistors or power elements in the SERVOPACK.
- Parameters cannot be used to set the stopping method for the servomotor if the main circuit power supply (L1, L2, L3) or the control power supply (24 V or 0 V) is turned OFF during operation without turning OFF the servo. The stopping method depends on the conditions, as given below.
  - Turning OFF the main circuit power supply without turning OFF the servo: The alarm stopping method is used. For details, refer to *11.2.1 List of Servo Drive Alarms*.
  - Turning OFF the control power supply without turning OFF the servo: Refer to the following table.

| SERVOPACK Model: CACR- | Condition | Stopping Method |
|---|---|---|
| JU036ACA, JU018DCA | – | Coast |
| JUM2□□CA, JU028ACA, JU014DCA | – | DB |
| JU065ACA, JU084ACA, JU102ACA, JU125ACA, JU196ACA, JU033DCA, JU042DCA, JU051DCA, JU098DCA | External DB circuit is not connected to a SERVOPACK. | Coast |
| | External DB circuit is connected to a SERVOPACK. | DB |

- If the servomotor must be stopped by coasting rather than by dynamic braking when the main circuit power supply or the control power supply is turned OFF but the SV_OFF command has not been received, arrange the sequence externally so the current will be cut off for servomotor wires U, V, and W.
- To minimize the coasting distance of the servomotor to come to a stop when an alarm occurs, the zero-speed stopping method is factory-set for alarms to which the zero-speed stop method is applicable. The DB stopping method may be more suitable than the zero-speed stopping method, however, depending on the application.
  For example, for multiple axes coupling operation (a twin-drive operation), machinery damage may result if a zero-speed stop alarm occurs for one of the coupled shafts and the other shaft stops by dynamic brake. In such cases, change the method to the DB stopping method.
- If an induction motor is used (Pn01E.0 = 1, 3, or 5), a coasting to a stop is performed without dynamic braking even if a combination with a DB circuit is specified. If an induction motor is used, always set Pn001.0 to 2.

## (1) Stopping Method for Servomotor after SV_OFF Command is Received

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

The factory setting of Pn001.0 depends on the model. For details, refer to *12.1 SERVOPACK Parameters*. If a spindle motor is used, a coasting to a stop is performed for the motor stopping method when the servo is turned OFF, regardless of the setting of Pn001.0.

| Parameter (Index Number) | | Stop Mode | Mode After Stopping | When Enabled | Classification |
|---|---|---|---|---|---|
| **Pn001 (2001h)** | n.□□□0 | DB | DB | After restart | Setup |
| | n.□□□1 | | Coast | | |
| | n.□□□2 | Coast | Coast | | |

Note: Similar to the Coast Mode, the setting (Pn001.0 = 1) (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 types of alarms: Gr.1 and Gr.2.

Gr.1: The alarm stopping method depends on the setting of Pn01E.0.
If Pn01E.0 = 0 and a SERVOPACK with a capacity of 5 kW max. is used: The stopping method set in Pn001.0 is used. Stopping is performed with dynamic braking (DB) in the factory setting.
If Pn01E.0 = 0 and a SERVOPACK with a capacity that exceeds 5 kW max. is used: A coasting to a stop is performed.
If Pn01E.0 = 1 to 8: A coasting to a stop is performed.

Gr.2: The motor is stopped according to the setting in Pn00B.1 if an alarm occurs. Pn00B.1 is factory-set to stop the motor by setting the speed reference to "0." The motor under torque control will always use the Gr.1 method to stop. By setting Pn00B.1 to 1, the motor stops using the same method as Gr.1. When coordinating a number of motors, use this alarm stop method to prevent machine damage that may result due to differences in the stop method.

Refer to *11.2.1 List of Servo Drive Alarms* to determine if the alarm that occurred is Gr.1 or Gr.2.

### ■ 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 in *(1) Stopping Method for Servomotor after SV_OFF Command is Received*.

| Parameter (Index Number) | | Stop Mode | Mode After Stopping | When Enabled | Classification |
|---|---|---|---|---|---|
| **Pn001 (2001h)** | n.□□□0 | DB* | DB* | After restart | Setup |
| | n.□□□1 | | Coast | | |
| | n.□□□2 | Coast | Coast | | |

* If a spindle motor is used, a coasting to a stop is performed.

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

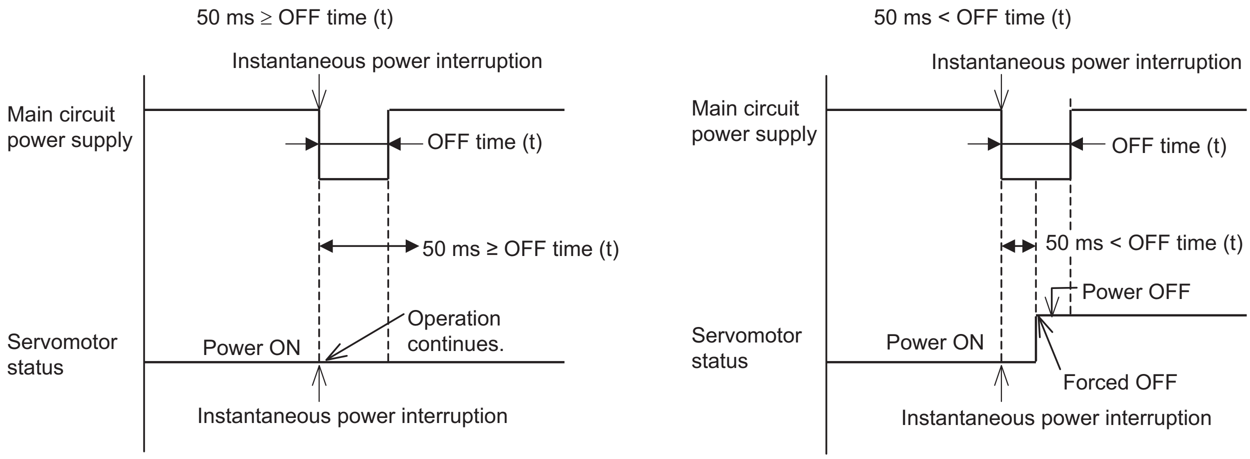
| Parameter (Index Number) | | Stop Mode | Mode After Stopping | When Enabled | Classification |
|---|---|---|---|---|---|
| Pn00B (200Bh) | Pn001 (2001h) | | | | |
| n.□□0□ [Factory setting] | n.□□□0 | Zero-speed stopping*1 | DB*2 | After restart | Setup |
| | n.□□□1 | | Coast | | |
| | n.□□□2 | | | | |
| n.□□1□ | n.□□□0 | DB*2 | DB*2 | | |
| | n.□□□1 | | Coast | | |
| | n.□□□2 | Coast | | | |

*1. Zero-speed stopping: The speed reference is set to 0 to stop quickly.
*2. If a spindle motor is used, a coasting to a stop is performed.
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.

## 8.4.5 Instantaneous Power Interruption Settings

If the power interruption time is shorter than 50 ms, the servomotor will continue operation. If it is longer than 50 ms, a power failure during converter drive operation alarm (A.41C) will occur and the servomotor's power will be turned OFF.

Note: The time that is treated as an instantaneous power interruption is 50 ms for a Σ-V-SD driver with EtherCAT (CoE) communications reference. You cannot change this time.




**IMPORTANT**

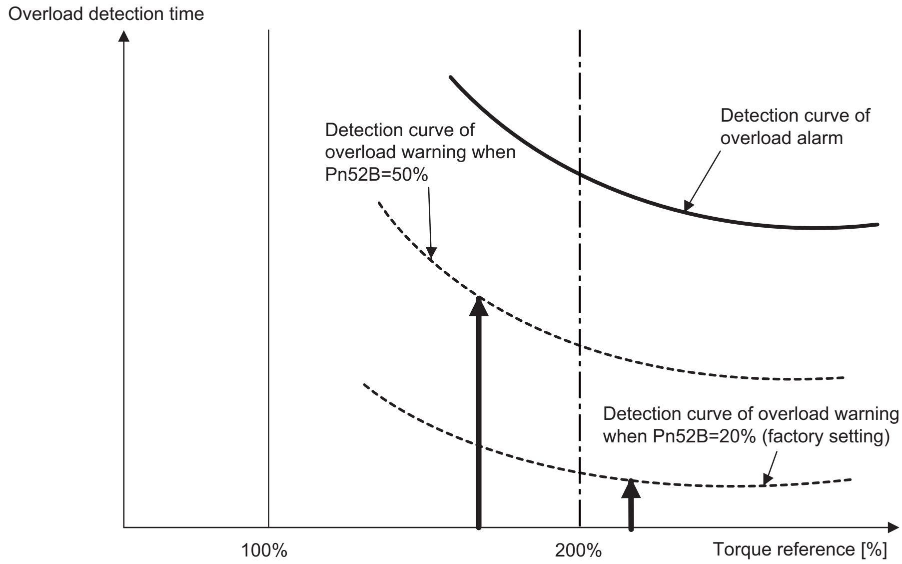
- The holding time of the control power supply (24 VDC) depends on the capability of the power supply (provision of power supply: user's responsibility). Check the power supply before using the application.
- If the load on the servomotor during the power interruption is large, an undervoltage alarm (A.410) or a converter DC undervoltage alarm (A.41A) may occur.

## 8.4.6 Setting Motor Overload Detection Level

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

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

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




| Pn52B (2104h:1) | Overload Warning Level | | Speed Position | | Classification |
|---|---|---|---|---|---|
| | Setting Range | Setting Unit | Factory Setting | When Enabled | |
| | 1 to 100 | 1% | 20 | Immediately | Setup |

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

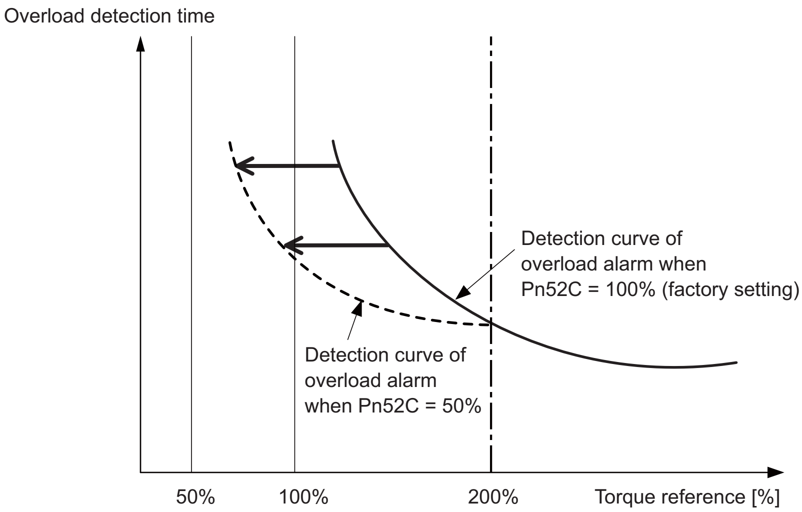
An overload (low load) alarm (A.720) can be detected earlier to protect the servomotor from overloading. The time required to detect an overload alarm can be shortened by using the derated motor base current obtained with the following equation. The detection level of the overload (high load) alarm (A.710) cannot be changed.

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

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

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

As a guideline of motor heating conditions, the relationship between the heat sink sizes and deratings of base current is shown in a graph in:
*Servomotor Heating Conditions* in *Rotary Servomotors General Instruction* in *Σ-V Series Product Catalog* (KAEP S800000 42).
Set Pn52C to a value in accordance with the heat sink size and derating shown in the graph, so that an overload alarm can be detected at the best timing to protect the servomotor from overloading.




| Pn52C (2104h:2) | Derating of Base Current at Detecting Overload of Motor Speed Position | | | | Classification |
|---|---|---|---|---|---|
| | Setting Range | Setting Unit | Factory Setting | When Enabled | |
| | 10 to 100 | 1% | 100 | After restart | Setup |

## 8.4.7 Spindle Motor Settings

If a spindle motor is used, set the parameters as given below by using SigmaWin for Σ-V-SD (MT).

> **IMPORTANT**
> Make the correct settings for the items described in this section.
> An incorrect setting may result in spindle motor operation failure or incorrect operation.

### (1) Spindle Motor Constant Settings

Write the motor constants of the spindle motor to use to the SERVOPACK. Ask your Yaskawa representative for information on motor constants.

### (2) Settings for the Motor Type, Application Selection, and Winding Selection

Set the motor type, application setting, and winding selection in Pn01E.0 and Pn01E.1 to match the specifications of the spindle motor.

| Parameter | | | Meaning |
|---|---|---|---|
| No. (Index Number) | Name | Setting | |
| Pn01E.0 (2030h:3) | Motor Type | n.□□□0 [Factory setting] | Servomotor |
| | | n.□□□1 | SPM type spindle motor* |
| | | n.□□□2 | Induction type servomotor* |
| | | n.□□□3 | Spindle motor |
| | | n.□□□4 | IPM type servomotor* |
| | | n.□□□5 | IPM type spindle motor |
| | | n.□□□6 | IPM built-in spindle motor |
| Pn01E.1 (2030h:3) | Winding Selection | n.□□0□ [Factory setting] | None |
| | | n.□□1□ | Mechanical winding selection |

* Under development

<Setting Example for the UAKBJ-22CZ100E>

This motor is used as the spindle axis, so Pn01E.0 is set to 3. Also, a winding selection motor is used, so Pn01E.1 is set to 1.

### (3) Encoder Type Setting

Set the encoder type using Pn01F.0 according to the spindle motor specifications.
After making the setting, turn the power supply OFF and then ON again, check to be sure that the system monitor in SigmaWin for Σ-V-SD (MT) shows Power OFF (BB), and then confirm operation by jogging. When doing so, pay careful attention to safety if the machinery is connected.

| Parameter | | | Meaning |
|---|---|---|---|
| No. (Index Number) | Name | Setting | |
| Pn01F.0 (2030h:4) | Encoder Type | n.□□□0 [Factory setting] | Serial encoder (servomotor) |
| | | n.□□□1 | Pulse encoder (spindle motor) |
| | | n.□□□2 | Serial encoder (spindle motor) |

### (4) Motor Rotation Direction Setting

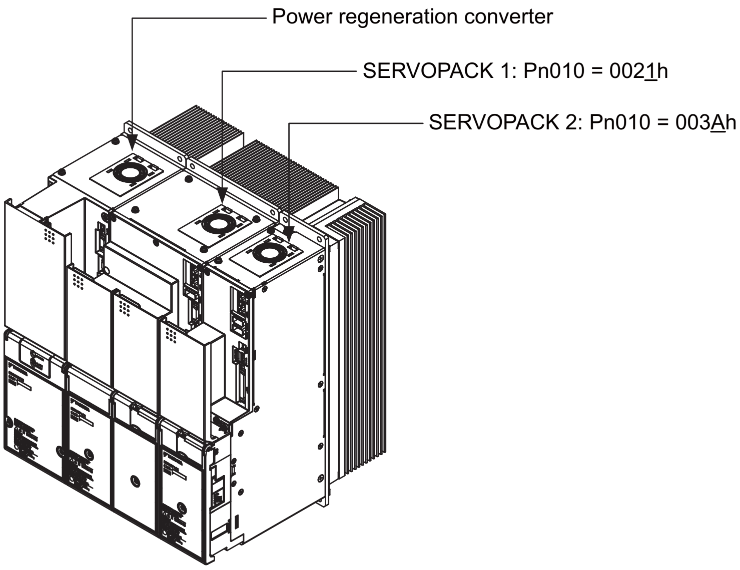
Set the motor rotation direction using Pn000.0.
For setting details, refer to *8.4.1 Servomotor Rotation Direction*.

## 8.4.8 Setting Local Bus Addresses

If you connect two or more SERVOPACKs to one power regeneration converter, set the SERVOPACK address in Pn010 (5C00h). The setting range is 0000h to 007Fh. Set the rightmost digit to a unique value for each SERVOPACK.
If the same value is set for more than one SERVOPACK, an alarm will occur.
The settings are valid after the power supply is turned OFF and ON again.

The following setting example is for two SERVOPACKs.

• Correct Settings




• Incorrect Settings

SERVOPACK 1: Pn010 = 002Ah
SERVOPACK 2: Pn010 = 003Ah

# 8.5 Trial Operation

This section describes a trial operation using EtherCAT (CoE) communications.

## 8.5.1 Inspection and Checking before Trial Operation

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

### (1) Servomotors

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

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

Note: When performing trial operation on a servomotor that has been stored for a long period of time, perform the inspection according to the procedures described in *11.1 Inspection and Maintenance*.

### (2) SERVOPACKs

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

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

## 8.5.2 Trial Operation via EtherCAT (CoE) Communication

An example procedure for EtherCAT (CoE) communications using Profile Position Mode for trial operation is provided in the following table.
For details, refer to *Σ-V-SD series User's Manual For Command Profile EtherCAT (CoE) Communications Reference* (manual no.: SIEP S800000 95).

| Step | Operation |
|---|---|
| 1 | Make sure that the wires are connected correctly and then connect the I/O connector (CN1) and the EtherCAT (CoE) communications connectors (CN9A and CN9B). |
| 2 | Turn ON the power supply to the Σ-V-SD Driver.<br>When the control power is supplied, the SERVOPACK RDY indicator will light.<br>When the main circuit power is supplied normally, the SERVOPACK charge indicator (CHARGE) will light.<br>When a master or slave that has its power supply turned ON is connected, the LINK1 and LINK2 indicators for the CN9A and CN9B connectors to which the EtherCAT (CoE) communications cables are connected will light. |
| 3 | Change the EtherCAT communication state to Operational. |
| 4 | Set the Modes of operation to Profile Position mode. |
| 5 | Change the drive state to "Operation enabled" by command of the Controlword.<br>When the power is supplied to the motor, the Statusword indicates "Operation enabled" state. |
| 6 | Set the Target position, Profile velocity, Profile acceleration, and Profile deceleration, and then set Controlword to start positioning.* |
| 7 | Check the following points while performing in step 6.<br>• Check whether the motor is moving to the reference direction.<br>If motor is moving to reverse direction to the reference, then change the setting of servomotor direction rotation.<br>• Check to make sure that there is no abnormal vibration, noise, or heating. If any abnormality is found, clear the problem.<br><br>Note: Because the running-in of the load machine is not sufficient at the time of the trial operation, the servomotor may become overloaded. |

* Use PDO for objects that are PDO mapped.
The values will not be changed even if SDO is changed.

# 8.6 Limiting Torque

The SERVOPACK provides the following four methods for limiting output torque to protect the machine. Each method uses the set minimum torque to limit the output.

For details, refer to *Σ-V-SD series User's Manual For Command Profile EtherCAT (CoE) Communications Reference* (manual no.: SIEP S800000 95).

| Limiting Method | Parameters (Index Numbers) |
|---|---|
| Torque limited by parameter setting only. | Pn402 (20A0h:1)<br>Pn403 (20A0h:2) |
| Torque limit set by parameter enabled by command from controller. | PnB11 (6040h)<br>Pn404 (20A3h:1)<br>Pn405 (20A3h:2) |
| Torque limit controlled from controller. | PnB38 (6072h)<br>PnB80 (60E0h)<br>PnB82 (60E1h) |

## ■ Internal Torque Limit

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

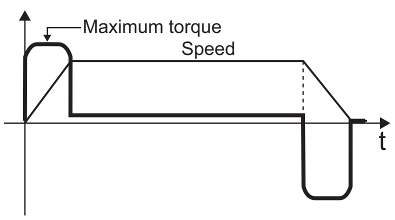
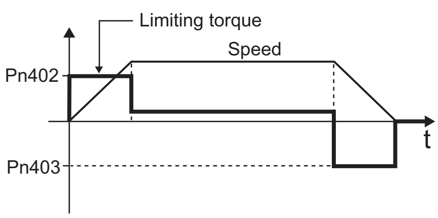
- Servomotor (Pn01E.0 = 0, 2, 4)

| | | | | | |
|---|---|---|---|---|---|
| **Pn402 (20A0h:1)** | Forward Torque Limit | | Speed Position | | Classification |
| | Setting Range | Setting Unit | Factory Setting | When Enabled | |
| | 0 to 800 | 1% | 800 | Immediately | Setup |
| **Pn403 (20A0h:2)** | Reverse Torque Limit | | Speed Position | | Classification |
| | Setting Range | Setting Unit | Factory Setting | When Enabled | |
| | 0 to 800 | 1% | 800 | Immediately | Setup |

The setting unit is a percentage of the rated torque.

Note 1. If the settings of Pn402 and Pn403 are too low, the torque may be insufficient for acceleration or deceleration of the servomotor.
2. The maximum torque of the servomotor is used whenever the value exceeds the maximum torque.

Trace Waveform

| No Internal Torque Limit (Maximum Torque Can Be Output) | Internal Torque Limit |
|---|---|
|  |  |

- Spindle motor (Pn01E.0 = 1, 3, 5)

  Set the torque limit for motor acceleration in Pn430. Set the torque limit for motor deceleration in Pn431. The direction of motor rotation is not affected.

| Pn430 (20AAh:1) | Torque Limit (Powering) Speed Position | | | | Classification |
|---|---|---|---|---|---|
| | Setting Range | Setting Unit | Factory Setting | When Enabled | |
| | 0 to 800 | 1% | 150 | Immediately | Setup |

| Pn431 (20AAh:2) | Torque Limit (Regeneration) Speed Position | | | | Classification |
|---|---|---|---|---|---|
| | Setting Range | Setting Unit | Factory Setting | When Enabled | |
| | 0 to 800 | 1% | 150 | Immediately | Setup |

The setting unit is a percentage of the rated torque.

Note 1. If the setting is too low, the torque may be insufficient for acceleration or deceleration of the motor.
2. The maximum torque of the motor is used whenever the value exceeds the maximum torque.

# 8.7 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.

## 8.7.1 Encoder Resolution

The encoder resolution is shown below.

| Servomotor Model | Encoder Resolution |
|---|---|
| SGMGV | 20 bit |

The absolute encoder can be used as an incremental encoder by setting the Pn002.

| Parameter (Index Number) | | Meaning | When Enabled | Classification |
|---|---|---|---|---|
| **Pn002 (2002h)** | n.□0□□ [Factory setting] | Uses the absolute encoder as an absolute encoder. | After restart | Setup |
| | n.□1□□ | Uses the absolute encoder as an incremental encoder. | | |

A battery is not required when using the absolute encoder as an incremental encoder.

## 8.7.2 Backup of the Settings

A battery is required to save position data in the absolute encoder.
Install a battery to the power regeneration converter.
For the battery, refer to *2.3.3 Absolute Encoder Battery*.

## 8.7.3 Battery Replacement

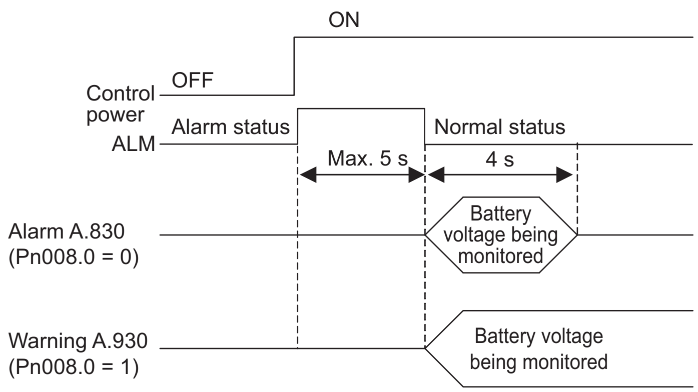
If the battery voltage drops to approximately 2.7 V or less, an absolute encoder battery error alarm (A.830) or an absolute encoder battery error warning (A.930) will be displayed.

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

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

| Parameter (Index Number) | | Meaning | When Enabled | Classification |
|---|---|---|---|---|
| **Pn008 (2008h)** | n.□□□0 [Factory setting] | Outputs the alarm A.830 when the battery voltage drops. | After restart | Setup |
| | n.□□□1 | Outputs the warning A.930 when the battery voltage drops. | | |

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

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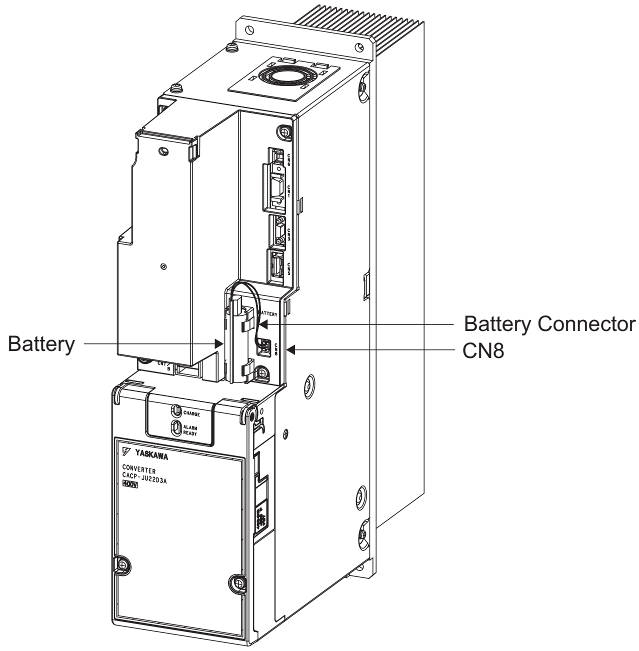
### ■ Battery Replacement Procedure

1. Turn ON the control power supply of the Σ-V-SD driver only.
2. Remove the old battery from the CN8 of the power regeneration converter and mount the new battery (model: ER6VLY+DF3).
3. Turn OFF the control power supply to clear the absolute encoder battery error alarm (A.830).
4. Turn ON the control power supply again.
5. Check that the alarm display has been cleared and that the Σ-V-SD driver operates normally.




| | |
|---|---|
| IMPORTANT | Before removing the battery or the encoder cable, turn ON the control power supply of the Σ-V-SD driver. If the power is not turned ON first, the data in the absolute encoder will be lost. |

## 8.7.4 Absolute Encoder Setup

**⚠ CAUTION**

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

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

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

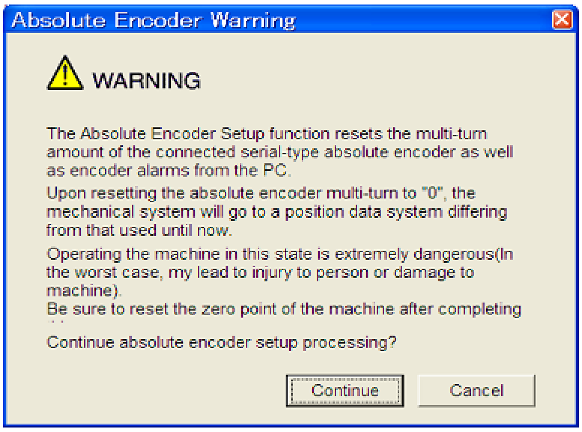
Set up the absolute encoder using SigmaWin for Σ-V-SD (MT).

Setup (Initialization) can be performed using EtherCAT (CoE) command (Object 2310h:1).
For EtherCAT (CoE) command, refer to *Σ-V-SD series User's Manual For Command Profile EtherCAT (CoE) Communications Reference* (manual no.: SIEP S800000 95).

## ■ Procedure for Setup

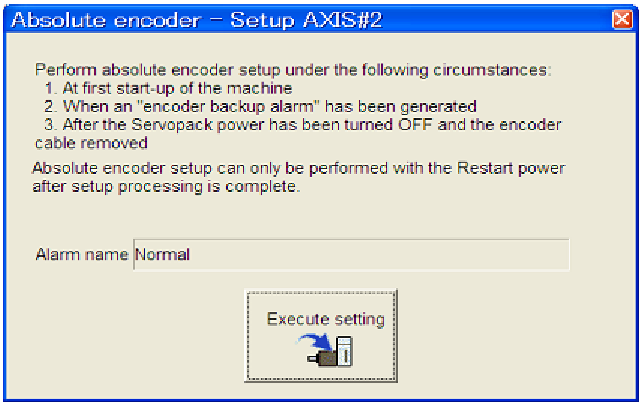
Follow the steps below to setup the absolute encoder.

1. Make sure that the motor power is OFF.
2. In the SigmaWin for Σ-V-SD (MT) component main window, click **Setup**, point to **Set Absolute Encoder** and click **Reset Absolute Encoder**. A warning message appears confirming if you want to continue the processing.



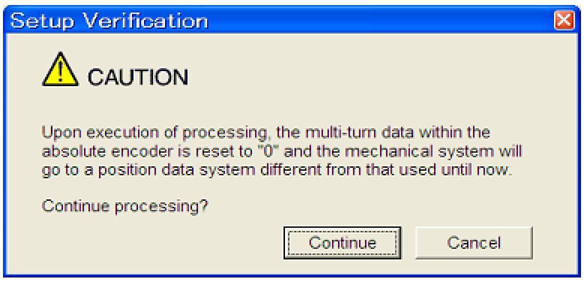

Click **Cancel** to return to the main window without resetting the absolute encoder.

3. Click **Continue**, and the Absolute encoder Setup box appears.




The Alarm Name box displays the code and name of the alarm that is occurring now.

4. Click **Execute setting**, and a verification message appears confirming if you want to continue although the coordinate system will change.

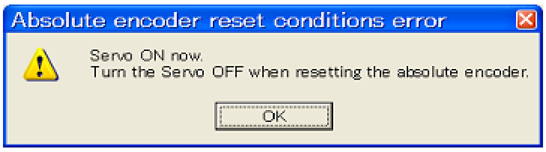



Click **Cancel** to return to the previous window without resetting the absolute encoder.

**5.** Click **Continue** to set up the encoder.

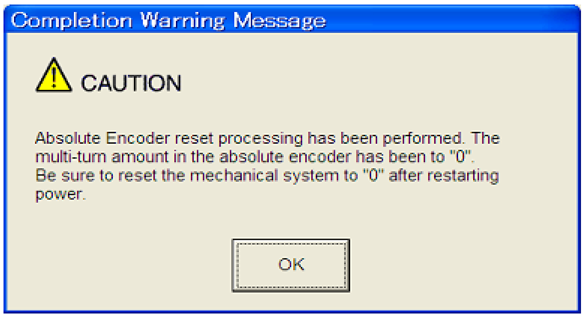
< If Setup is Unsuccessful >

If setting up is attempted with the servo ON, a reset conditions error occurs, and the processing is aborted.




Click **OK** to return to the main window.

< If Setup Completes Normally >



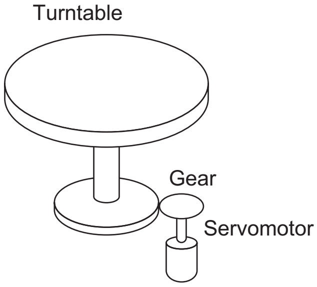

If the encoder is set up successfully, a warning message will appear reminding you that the coordinate system has changed and must also be reset.

**6.** Click **OK** to return to the main window.

**7.** Restart the servo, and perform an origin search.

## 8.7.5 Multiturn Limit Setting

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




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

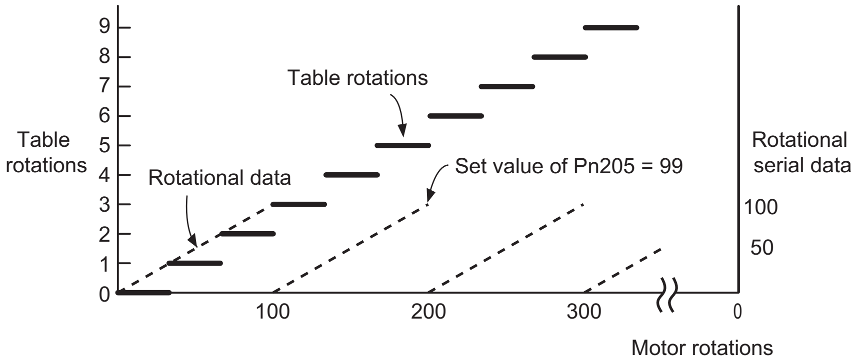
For a machine with a gear ratio of n:m, as shown above, the value of m minus 1 will be the setting for the multiturn limit setting (Pn205).

Multiturn limit setting (Pn205) = m-1

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

Pn205 is set to 99.

Pn205 = 100 – 1 = 99




| Pn205 (20C0h) | Multiturn Limit Setting | | Speed Position | | Classification |
|---|---|---|---|---|---|
| | Setting Range | Setting Unit | Factory Setting | When Enabled | |
| | 0 to 65535 | 1 Rev | 65535 | After restart | Setup |

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

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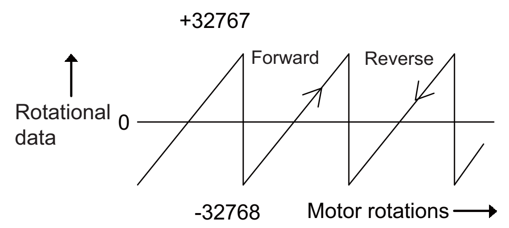
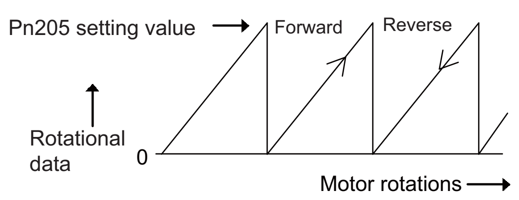
The range of the data will vary when this parameter is set to anything other than the factory setting.

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

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

## 8.7.6 Multiturn Limit Disagreement Alarm (A.CC0)

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

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

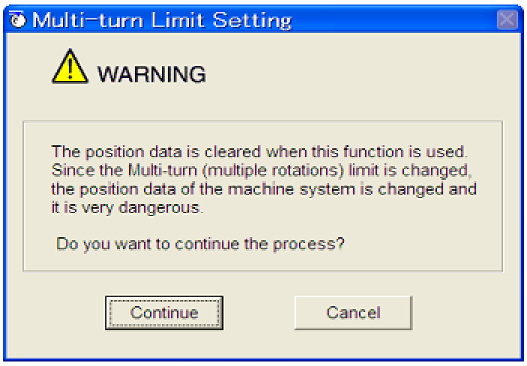
If this alarm is displayed, perform the operation described below and change the multiturn limit value in the encoder to the value set in Pn205.

Use SigmaWin for Σ-V-SD (MT) to change the multiturn limit.

Setup (Initialization) can be performed using EtherCAT (CoE) command (Object 2310h:1).
For EtherCAT (CoE) command, refer to *Σ-V-SD series User's Manual For Command Profile EtherCAT (CoE) Communications Reference* (manual no.: SIEP S800000 95).

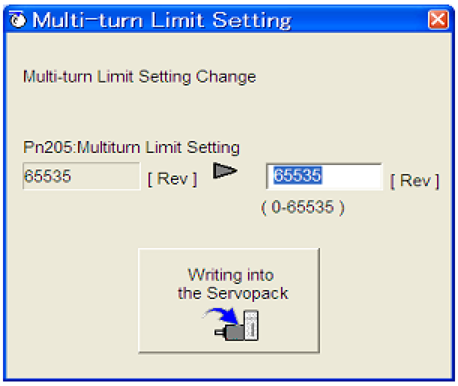
Follow the steps below to set the multiturn limit to the Σ-V-SD driver and the servomotor.

**1.** In the SigmaWin for Σ-V-SD (MT) component main window, click **Setup**, print to **Set Absolute Encoder** and click **Multi-Turn Limit Setting.** A verification message appears confirming if you want to continue although the position data will change.

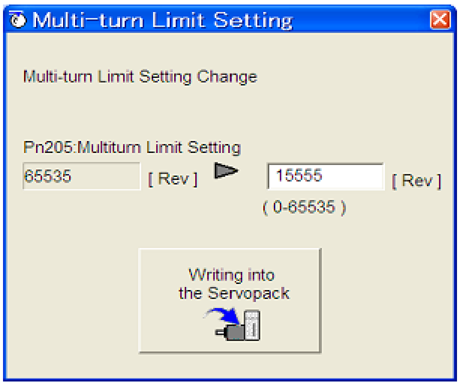



Click **Cancel** to return to the main window without setting the multiturn limit.

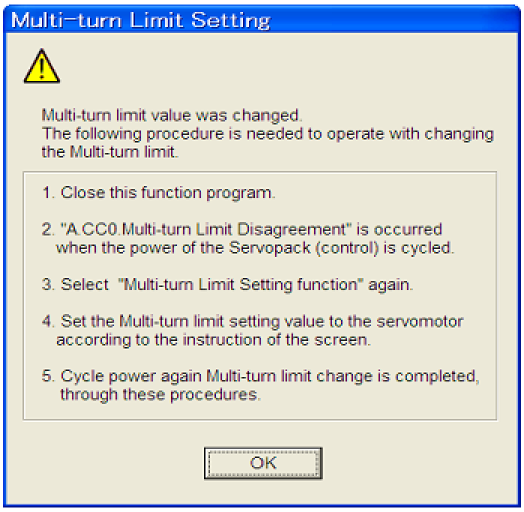
**2.** Click **Continue**, and the Multi-Turn Limit Setting box appears.




**3.** Change the setting to the desired number of revolutions.



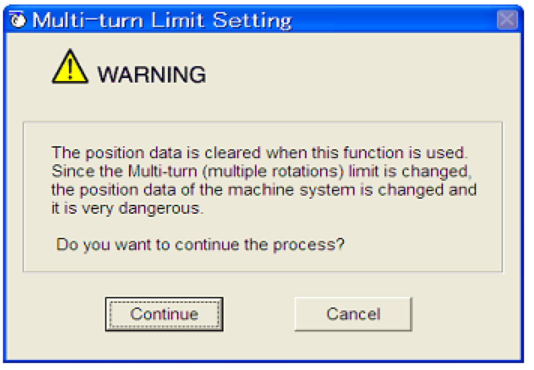

**4.** To save the settings, click **Writing into the Servopack**, and a warning message appears.



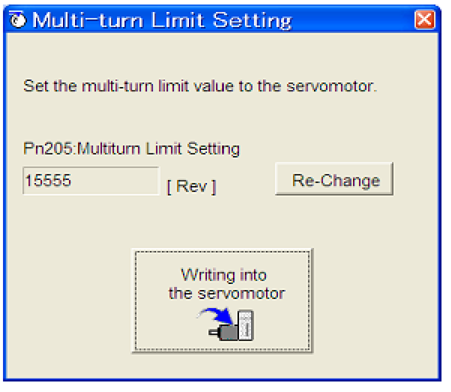

**5.** Click **OK** and the settings are changed to the new ones.

**6.** After turning off the power, restart the Σ-V-SD driver. Because only the settings for the Σ-V-SD driver were made, the settings for the motor are still incomplete and Multiturn Limit Disagreement alarm (A.CC0) occurs.

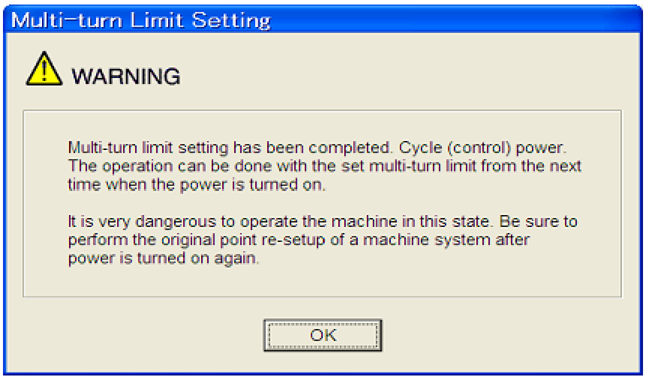
**7.** Return to the SigmaWin for Σ-V-SD (MT) component main window. To make the settings for the motor, click **Setup** and then click **Multi-Turn Limit Setting** again. A verification message appears confirming if you want to continue although the position data will change.




**8.** Click **Continue**, and the Multi-Turn Limit Setting box appears. To change the settings, click **Re-Change**.




**9.** To save the settings, click **Writing into the Motor**, and a warning message appears.



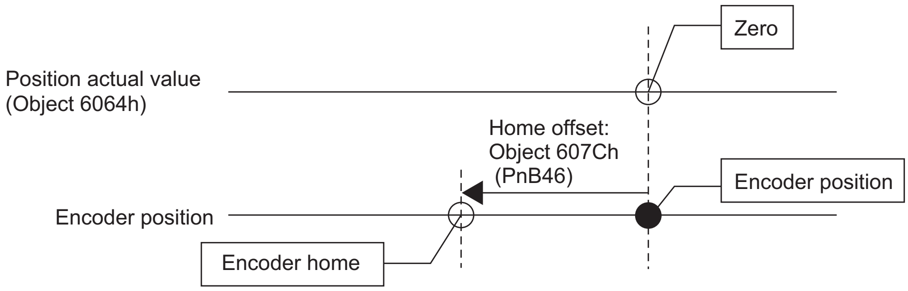

**10.** Click **OK**.

## 8.7.7 Absolute Encoder Home Offset

If you use an absolute encoder, you can set an offset between the encoder position and the machine position. The setting is not made with a parameter. A Σ-V-SD EtherCAT (CoE) command is used as shown below.
If you use an absolute encoder, the offset between the encoder position and the machine position (Position Actual Value: index 6064h) is set in reference units. When the power supply is turned OFF and ON again or when parameters are enabled with index 2300h, the offset is added to the Position Actual Value at 6064h.

For details, refer to *Σ-V-SD series User's Manual For Command Profile EtherCAT (CoE) Communications Reference* (manual no.: SIEP S800000 95).

| Index | Sub Index | Name | Data Type | Access | Setting Range | Default Value | EEPROM |
|---|---|---|---|---|---|---|---|
| 607Ch | 0 | Home offset | DINT | RW | -536870912 to 536870911 | 0 | Yes |



# 8.8 Safety Function

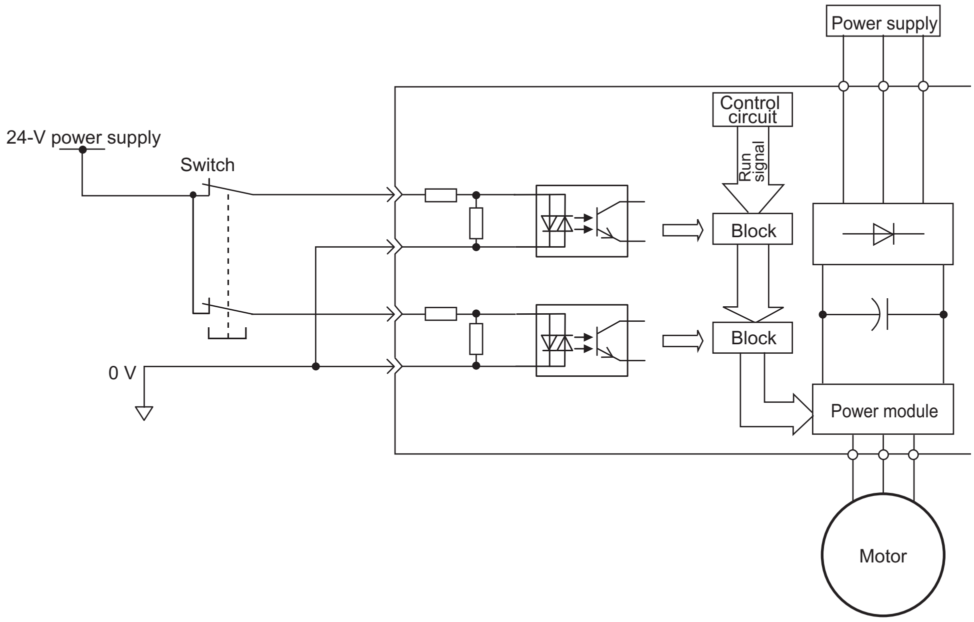
The safety function is incorporated in the SERVOPACK to reduce the risk associated with the machine by protecting workers from injury and by securing safe machine operation. Especially when working in hazardous areas inside the safeguard, as for machine maintenance, it can be used to avoid adverse machine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

## 8.8.1 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.<br>Incorrect use of the machine may cause injury.<br>• The servomotor 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.<br>Incorrect use of the machine may cause injury.<br>• 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.<br>Incorrect use of the machine may cause injury.<br>• The dynamic brake and the brake signal are not safety-related parts of a control system. Be sure to design the system that these failures will not cause a dangerous condition when the HWBB function operates.<br>Incorrect use of the machine may cause injury.<br>• Connect devices meeting safety standards for the signals for safety functions.<br>Incorrect use of the machine may cause injury.<br>• If the HWBB function is used for an emergency stop, turn OFF the power supply to the servomotor with independent electric or mechanical parts.<br>Incorrect use of the machine may cause injury.<br>• 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.<br>Failure to observe this warning may cause an electric shock. |

## 8.8.2 Hard Wire Base Block (HWBB) Function

The Hard Wire Base Block function (hereinafter referred to as HWBB function) is a function designed to baseblock the motor (shut off the motor current) by using the hardwired circuits.
This section describes the HWBB signals (/HWBB1 and /HWBB2) for a single axis of the servomotor.
Each circuit for two channel input signals blocks the run signal to turn off the power module that controls the motor current, and the motor current is shut off. (Refer to the diagram below.)




Note: For HWBB function signal connections, the input signal is the 0 V 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 HWBB function 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

When using the HWBB function, be sure to perform a risk assessment of the servo system in advance.
Make sure that the safety level of the standards is met. For details about the standards, refer to *10.1 Compliance with UL Standards, EU Directives, UK Regulations and Other Safety Standards* at the front of this manual.

Note: To meet the performance level d (PLd) in EN ISO 13849-1, the EDM signal must be monitored by a host controller. If the EDM signal is not monitored by a host controller, the system only qualifies for the performance level c (PLc).

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

- The servomotor will move in an application where external force is applied to the servomotor (for example, gravity on the vertical axis). Take measures to secure the servomotor, such as installing a mechanical brake.
- The servomotor may move within the electric angle of 180 degrees in case of the power module failure, etc. If a spindle motor is used, a coasting to a stop is performed. Make sure that safety is ensured even in that situation. The rotation angle depends on the motor type.
  The maximum rotation angle is given below.
  Rotational motor: 1/6 rotation max. (rotation angle at the motor shaft)
- 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.

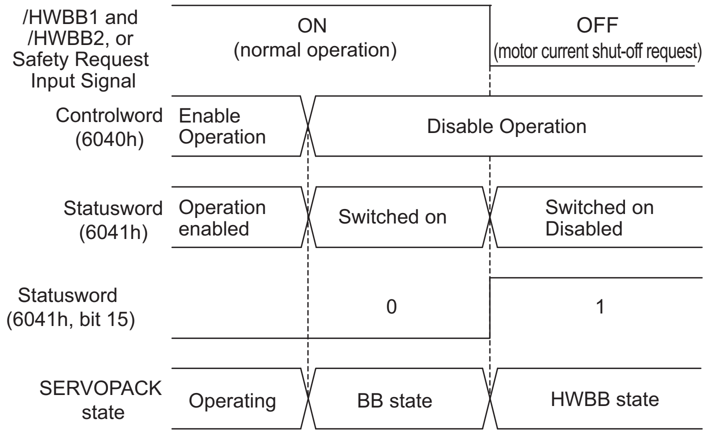
Operation

8

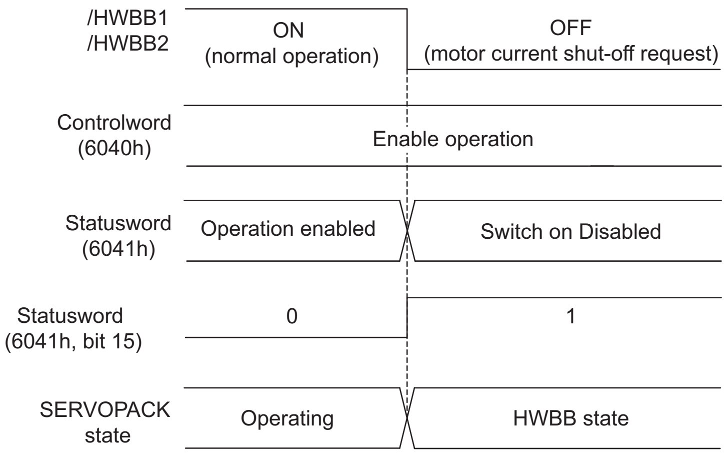
## (2) Hard Wire Base Block (HWBB) State

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

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




The HWBB function operates while the motor power is ON.




## (3) HWBB Status Monitor

The status of HWBB function execution can be monitored using the following objects.

### ■ Statusword (6041h)

| Bit | State | Display Contents |
|---|---|---|
| 15 | HWBB active | 0: – |
| | | 1: The HWBB function is operating. |

## (4) Restoring Operation from a HWBB State

Restoring operation from a HWBB state are as follows.

### ■ Conditions for Restoring Operation

Satisfy all of the following conditions to return to normal operation.

- The input states of all HWBB signals must be ON.
- The servo ON command must be OFF.
- If the SigmaWin for Σ-V-SD (MT) is connected, the Servo ON command from the SigmaWin for Σ-V-SD (MT) must not be active.

### ■ Procedure to Return to Normal Operation

1. Specify a Shutdown command in the Controlword (Object 6040h bits 0 to 3) to reset the drive state.
2. Specify a Switch on + Enable operation command in the Controlword (Object 6040h bits 0 to 3).

Power will be supplied to the motor.

## (5) Error Detection in HWBB Signal

If either the /HWBB1 or /HWBB2 signal is input and the other signal is not input within 10 s, an A.EB1 alarm (Safety function signal input timing error) will occur. This makes it possible to detect failures, such as disconnection of the HWBB signals.

**⚠ CAUTION**

- The safety function signal input timing error alarm (A.EB1) is not a safety-related part of a control system. Keep this in mind in the system design.

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

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

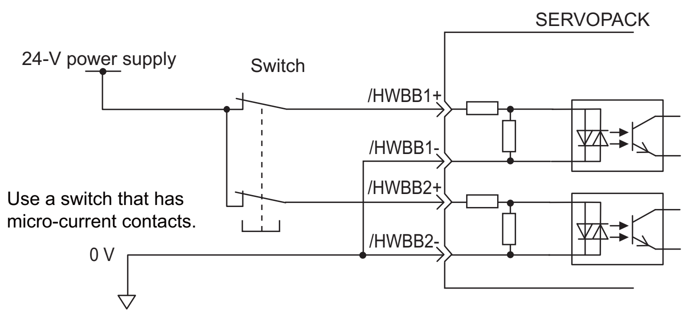
**IMPORTANT**

For HWBB function signal connections, the input signal is the 0 V 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 HWBB function 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



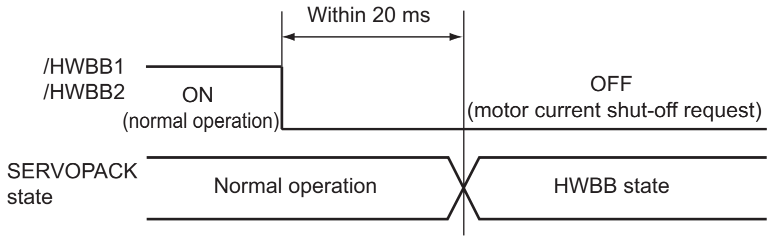
## ■ Specifications

| Type | SERVOPACK | | Signal Name | Pin Number | State | Meaning |
|---|---|---|---|---|---|---|
| Input | For one axis | | /HWBB1 | CN1-18, CN1-17 | ON | Does not use the HWBB function. (normal operation) |
| | | | | | OFF | Uses the HWBB function. (motor current shut-off request) |
| | | | /HWBB2 | CN1-20, CN1-19 | ON | Does not use the HWBB function. (normal operation) |
| | | | | | OFF | Uses the HWBB function. (motor current shut-off request) |
| | For two axes | 1st axis | /HWBB11 | CN1-30, CN1-29 | ON | Does not use the HWBB function. (normal operation) |
| | | | | | OFF | Uses the HWBB function. (motor current shut-off request) |
| | | | /HWBB12 | CN1-32, CN1-31 | ON | Does not use the HWBB function. (normal operation) |
| | | | | | OFF | Uses the HWBB function. (motor current shut-off request) |
| | | 2nd axis | /HWBB21 | CN1-34, CN1-33 | ON | Does not use the HWBB function. (normal operation) |
| | | | | | OFF | Uses the HWBB function. (motor current shut-off request) |
| | | | /HWBB22 | CN1-36, CN1-35 | ON | Does not use the HWBB function. (normal operation) |
| | | | | | OFF | Uses the HWBB function. (motor current shut-off request) |

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

| Items | Characteristics | Remarks |
|---|---|---|
| Internal Impedance | 8.2 kΩ | – |
| Operation Movable Voltage Range | +24 V±5% | – |
| Maximum Delay Time | 20 ms | Time from the HWBB 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, the power supply to the motor will be turned OFF within 20 ms (see below).




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

### (7) Operation with SigmaWin for Σ-V-SD (MT)

The HWBB function works while the SERVOPACK operates with SigmaWin for Σ-V-SD (MT).

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
- Origin search
- Program JOG operation
- Advanced autotuning
- EasyFFT
- Automatic offset-adjustment of motor current detection signal

### (8) Brake Signal (/BK1, /BK2)

When the /HWBB1 or /HWBB2 signal is OFF and the HWBB function operates, the brake signal (/BK1, /BK2) will turn OFF. At that time, Pn506 (brake reference - servo OFF delay time) will be disabled. Therefore, the motor may be moved by external force until the actual brake becomes effective after the brake signal (/BK1, /BK2) turns OFF.

**⚠ CAUTION**

- The brake signal output is not related to the 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 motor with a brake is used, keep in mind that the brake for the motor is used only to prevent the movable part from being moved by gravity or an external force and it cannot be used to brake the motor.

### (9) Dynamic Brake

If the dynamic brake is enabled in Pn001.0 (stopping method after SV_OFF command), the motor 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.

**⚠ CAUTION**

- Design the system so that the system will not be put into danger if the motor coasts in the HWBB state. We recommend that you normally use a command to stop the motor first and then change to the HWBB state.
- If the application frequently uses the HWBB function, do not use the dynamic brake to stop the motor. Otherwise element deterioration in the SERVOPACK may result. To prevent internal elements from deteriorating, use a sequence in which the HWBB state occurs after the motor has come to a stop.

## 8.8.3 External Device Monitor (EDM☐)

The external device monitor (EDM☐) functions to monitor failures in the HWBB function. Connect the monitor to feedback signals to the safety function device.

Note: To meet the performance level d (PLd) in EN ISO 13849-1, the EDM signal must be monitored by a host controller. If the EDM signal is not monitored by a host controller, the system only qualifies for the performance level c (PLc).

### ■ Failure Detection Signal for EDM Signal

The relation of the EDM, /HWBB1, and /HWBB2 signals is shown below.

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

- SERVOPACKs for One Axis

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

- SERVOPACKs for Two Axes

| Signal Name | Logic | | | |
|---|---|---|---|---|
| /HWBB11 | ON | ON | OFF | OFF |
| /HWBB12 | ON | OFF | ON | OFF |
| EDM1 | OFF | OFF | OFF | ON |
| /HWBB21 | ON | ON | OFF | OFF |
| /HWBB22 | ON | OFF | ON | OFF |
| EDM2 | OFF | OFF | OFF | ON |

**⚠ WARNING**

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

## ■ Connection Example

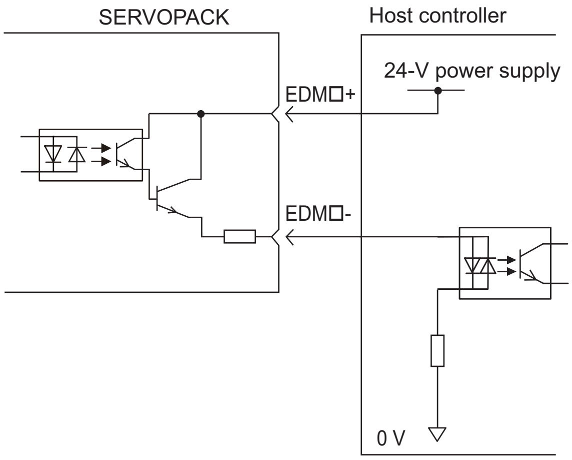
IMPORTANT

For HWBB function signal connections, the input signal is the 0 V 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 HWBB function 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.

The connection example of EDM signal is shown below.




## ■ Specifications

| Type | SERVOPACK | | Signal Name | Pin Number | State | Meaning |
|---|---|---|---|---|---|---|
| Output | For one axis | | EDM1 | CN1-22, CN1-21 | ON | Both the /HWBB1 and the /HWBB2 signals are working normally. |
| | | | EDM1 | | OFF | The /HWBB1 signal, the /HWBB2 signal or both are not working normally. |
| | For two axes | 1st axis | EDM1 | CN1-42, CN1-41 | ON | Both the /HWBB11 and the /HWBB12 signals are working normally. |
| | | | EDM1 | | OFF | The /HWBB11 signal, the /HWBB12 signal or both are not working normally. |
| | | 2nd axis | EDM2 | CN1-44, CN1-43 | ON | Both the /HWBB21 and the /HWBB22 signals are working normally. |
| | | | EDM2 | | OFF | The /HWBB21 signal, the /HWBB22 signal or both are not working normally. |

Electrical characteristics of EDM signal are as follows.

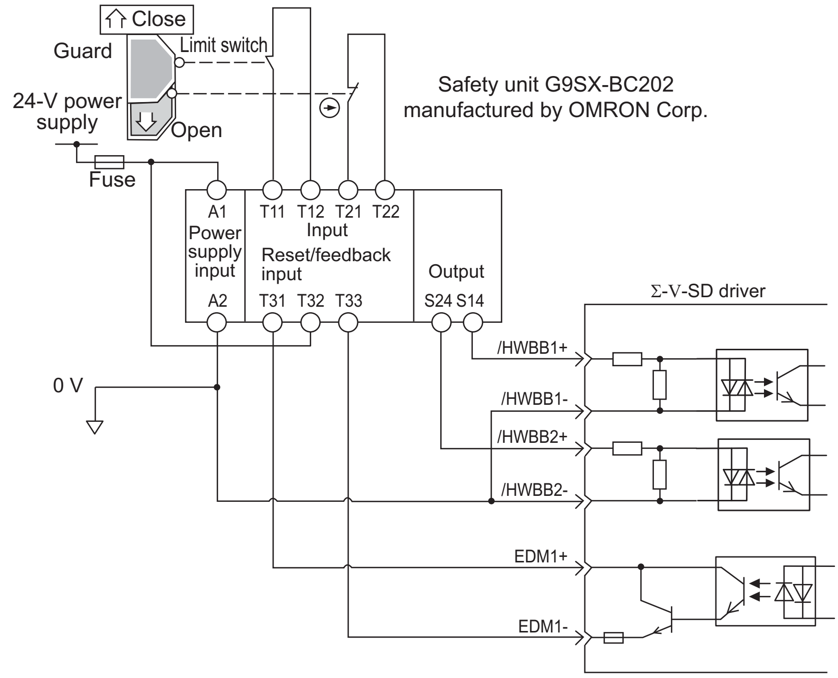
| Items | Characteristics | Remarks |
|---|---|---|
| Maximum Allowable Voltage | 30 VDC | – |
| Maximum Current | 50 mADC | – |
| Maximum Voltage Drop at ON | 1.0 V | Voltage between EDM1+ and EDM1- or EDM2 + and EDM2- when current is 50 mA |
| Maximum Delay Time | 20 ms | Time from the change in HWBB signal until the change in EDM☐ |

Note: The EDM signal is used as a sourcing output. Connect the EDM☐ so that the current flows from EDM1+ to EDM1- or EDM2+ to EDM2-. For details, refer to *(1) Connection Example* in *8.8.4 Safety Function Application Example*.

## 8.8.4 Safety Function Application Example

This section provides a safety function application example for a SERVOPACK for one axis.

### (1) Connection Example




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 device is reset, and the /HWBB1 and the /HWBB2 signals turn ON, and the operation becomes possible.

### (2) Failure Detection Method

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

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

### (3) Usage Example

| | |
|---|---|
| 1 | Request to open the guard. |
| 2 | When the motor is operating, the host controller stops the motor and sends servo OFF command (SV_OFF). |
| 3 | Open the guard and enter. |
| 4 | The /HWBB1 and /HWBB2 signals are OFF and HWBB function operates. (The operation in the guard is available.) |
| 5 | After completing the operation, leave and close the guard. |
| 6 | The host controller sends servo ON command (SV_ON). |

### 8.8.5 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 HWBB signals turn OFF, check that the system monitor of the SigmaWin for Σ-V-SD (MT) displays “Hbb” and that the servomotor does not operate.
- Check the ON/OFF states of the HWBB signals with the input signal field ESTP (HWBB).
  → If the ON/OFF states of the signals do not coincide with the ESTP (HWBB), 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 EDM signal is OFF while in normal operation.

# 9

# Adjustments

# 9.1 Type of Adjustments and Basic Adjustment Procedure

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

## 9.1.1 Adjustments

Adjustments (tuning) are performed to optimize the responsiveness of the SERVOPACK.

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

The servo gain is set using a combination of parameters, such as speed loop gain, position loop gain, filters, moment of inertia ratio. These parameters influence each other. Therefore, the servo gain must be set considering the balance between the set values.

Generally, the responsiveness of a machine with high rigidity can be improved by increasing the servo gain. If the servo gain of a machine with low rigidity is increased, however, the machine will vibrate and the responsiveness may not be improved. In such case, it is possible to suppress the vibration with a variety of vibration suppression functions in the SERVOPACK.

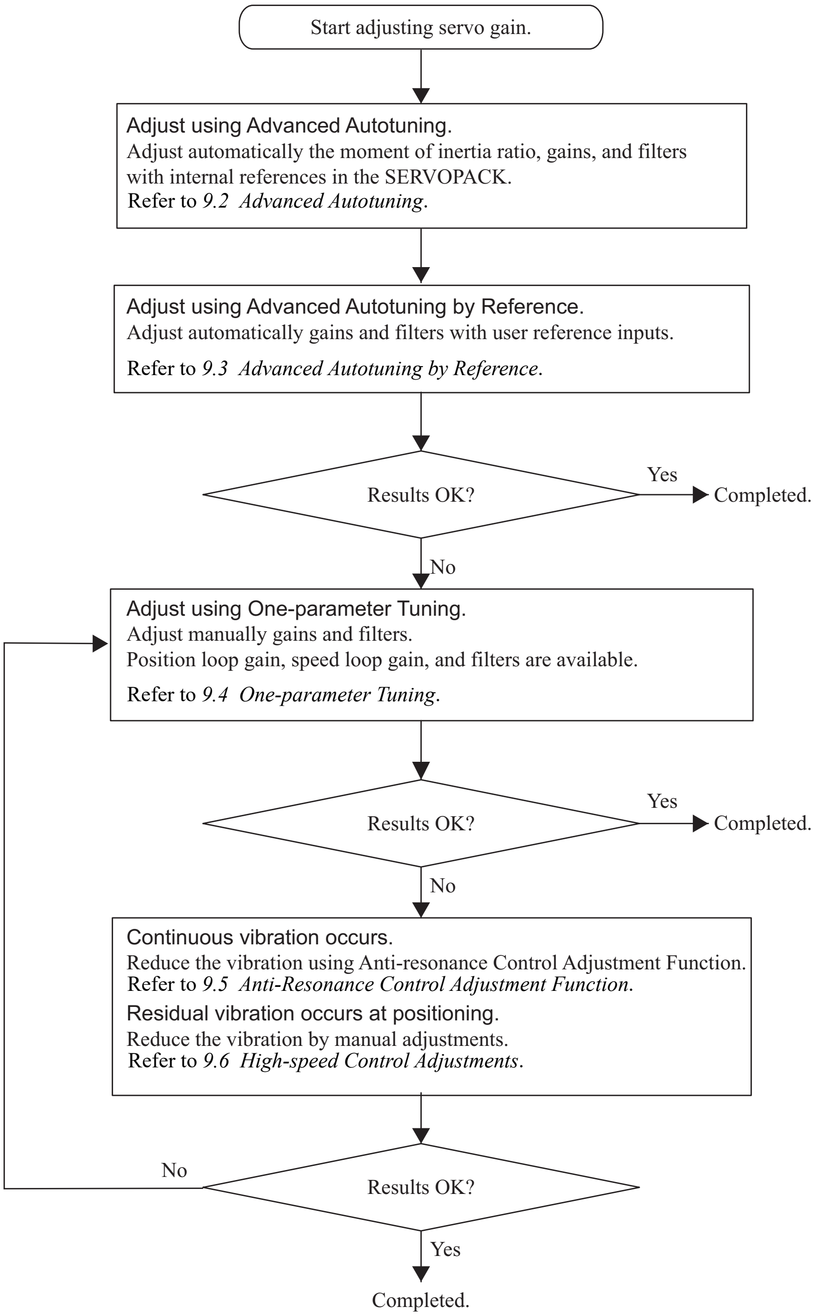
The servo gains are factory-set to stable values. The following utility function can be used to adjust the servo gain to increase the responsiveness of the machine in accordance with the actual conditions. With this function, parameters related to adjustment above will be adjusted automatically and the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

This section describes the following utility adjustment functions. These functions are adjusted with SigmaWin for Σ-V-SD (MT).

| Utility Function for Adjustment | Outline | Applicable Control Method |
|---|---|---|
| Advanced Autotuning | The following parameters are automatically adjusted using internal references in the SERVOPACK during automatic operation.<br>• Moment of inertia ratio<br>• Gains (position loop gain, speed loop gain, etc.)<br>• Filters (torque reference filter, notch filter)<br>• Anti-resonance control adjustment function | Speed and Position |
| Advanced Autotuning by Reference | The following parameters are automatically adjusted with the position reference input from the host controller while the machine is in operation.<br>• Gains (position loop gain, speed loop gain, etc.)<br>• Filters (torque reference filter, notch filter)<br>• Anti-resonance control adjustment function | Position |
| One-parameter Tuning | The following parameters are manually adjusted with the position or speed reference input from the host controller while the machine is in operation.<br>• Gains (position loop gain, speed loop gain, etc.)<br>• Filters (torque reference filter, notch filter)<br>• Anti-resonance control adjustment function | Speed and Position |
| Anti-Resonance Control Adjustment Function | This function effectively suppresses continuous vibration. | Speed and Position |

## 9.1.2 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.



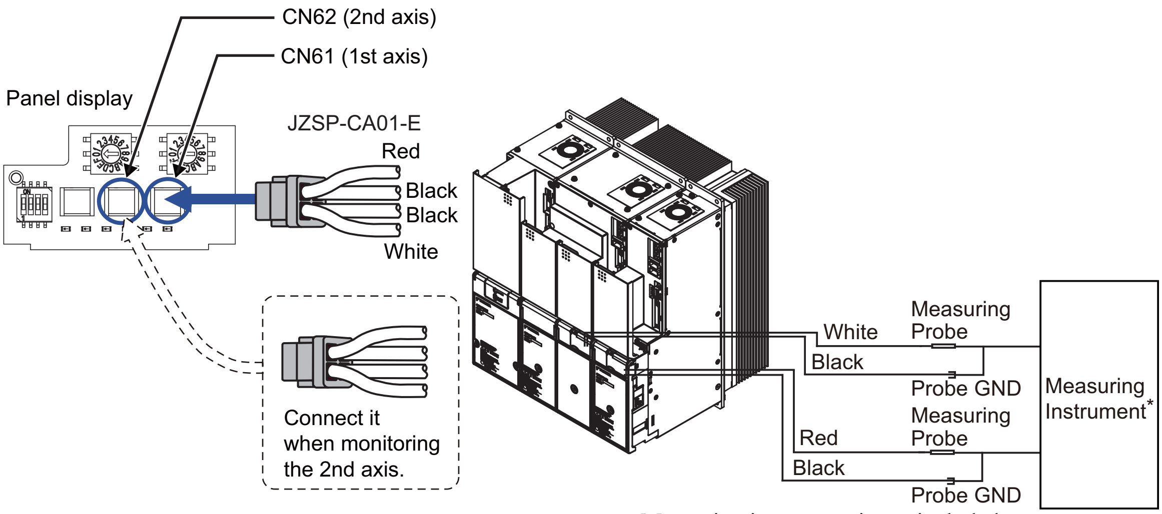
### 9.1.3 Monitoring Analog Signals

Check the operating status of the machine and signal waveform when adjusting the servo gain. Connect a measuring instrument, such as a memory recorder, to connectors CN61 and CN62 analog monitor connector on the SERVOPACK to monitor analog signal waveform.

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

#### (1) Connectors CN61 and CN62 for Analog Monitor

To monitor analog signals, connect a measuring instrument with cable (model: JZSP-CA01-E) to the connectors CN61 and CN62.

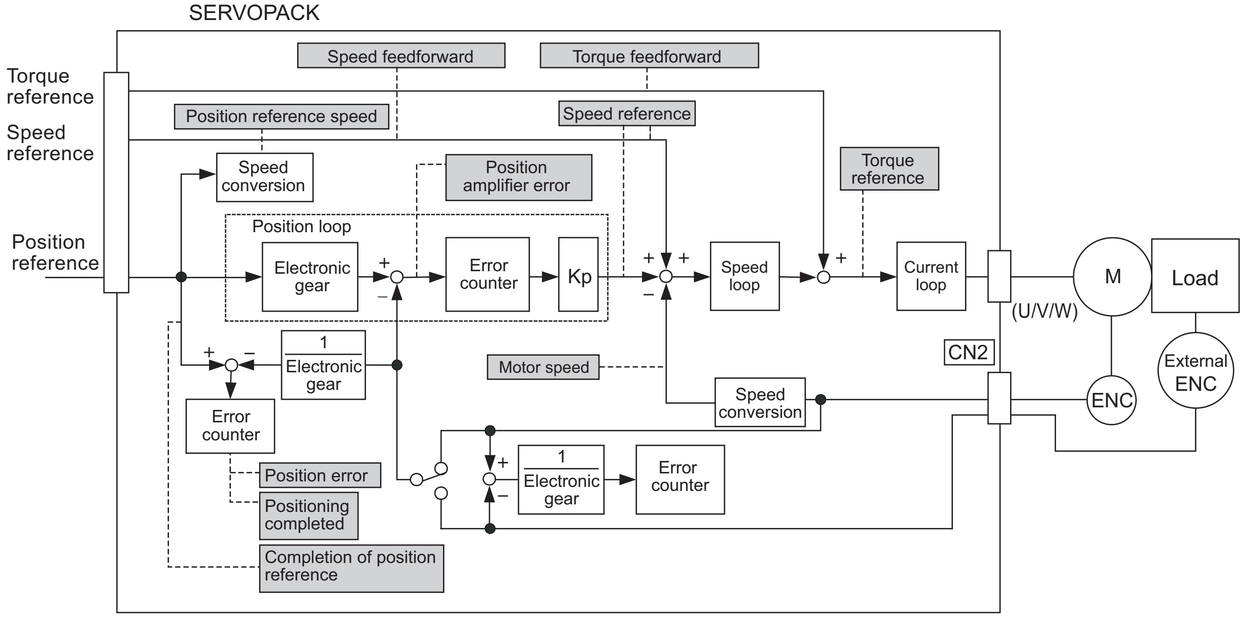


*Measuring instrument is not included.
The user is responsible for providing it.

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

## (2) Monitor Signal

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




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

| Parameter (Index Number) | | Description | | |
|---|---|---|---|---|
| | | Monitor Signal | Unit | Remarks |
| Pn006 (2006h) Pn007 (2007h) | n.□□00 [Pn007 Factory Setting] | Motor speed | 1 V/1000 min$^{-1}$ | – |
| | n.□□01 | Speed reference | 1 V/1000 min$^{-1}$ | – |
| | n.□□02 [Pn006 Factory Setting] | Torque reference | Servomotor:<br>1 V/100% rated torque<br>Spindle motor:<br>1.2 V/max. torque | – |
| | n.□□03 | Position error | 0.05 V/1 reference unit | 0 V at speed/torque control |
| | n.□□04 | Position amplifier error | 0.05 V/1 encoder pulse unit | – |
| | n.□□05 | Position reference speed | 1 V/1000 min$^{-1}$ | – |
| | n.□□06 | Reserved | – | – |
| | n.□□07 | Motor-external encoder position error | 0.01 V/1 reference unit | – |
| | n.□□08 | Positioning completed | Completed: 5 V<br>Not completed: 0 V | Completion indicated by output voltage. |
| | n.□□09 | Speed feedforward | 1 V/1000 min$^{-1}$ | – |
| | n.□□0A | Torque feedforward | 1 V/100% rated torque | – |
| | n.□□0B | Reserved | – | – |
| | n.□□0C | Completion of position reference | Completed: 5 V<br>Not completed: 0 V | Completion indicated by output voltage. |
| | n.□□0D | External encoder speed | 1 V/1000 min$^{-1}$ | Value at motor shaft |
| | n.□□46 | Load meter | 6 V/100% | Output reference of the load meter is set in Pn01C. |
| | n.□□47 | Quadrant Error Compensation | 1 V/100% | – |

## (3) Setting Monitor Factor

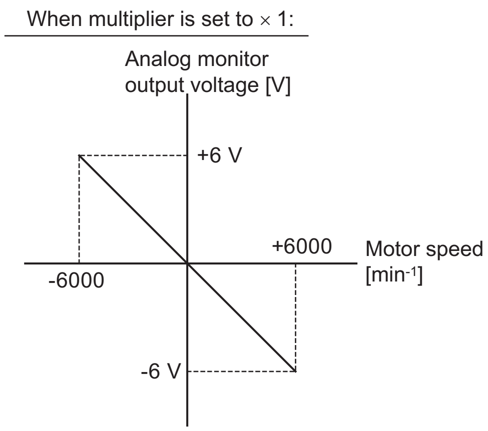
The output voltages on analog monitors 1 and 2 are calculated by the following equations.

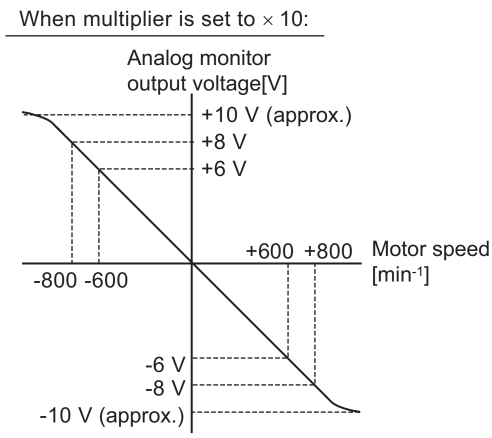
$$\text{Analog monitor 1 output voltage} = (-1) \times \left( \underset{(\text{Pn006=n.00}\square\square)}{\text{Signal selection}} \times \underset{(\text{Pn552})}{\text{Multiplier}} + \underset{(\text{Pn550})}{\text{Offset voltage [V]}} \right)$$

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

<Example>

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




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

## (4) Related Parameters

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

| | | | | | |
|---|---|---|---|---|---|
| **Pn550 (2116h:1)** | Analog Monitor 1 Offset Voltage | | Speed | Position | Classification |
| | Setting Range | Setting Unit | Factory Setting | When Enabled | |
| | -10000 to 10000 | 0.1 V | 0 | Immediately | Setup |
| **Pn551 (2116h:2)** | Analog Monitor 2 Offset Voltage | | Speed | Position | Classification |
| | Setting Range | Setting Unit | Factory Setting | When Enabled | |
| | -10000 to 10000 | 0.1 V | 0 | Immediately | Setup |
| **Pn552 (2116h:3)** | Analog Monitor Magnification (× 1) | | Speed | Position | Classification |
| | Setting Range | Setting Unit | Factory Setting | When Enabled | |
| | -10000 to 10000 | × 0.01 | 100 | Immediately | Setup |
| **Pn553 (2116h:4)** | Analog Monitor Magnification (× 2) | | Speed | Position | Classification |
| | Setting Range | Setting Unit | Factory Setting | When Enabled | |
| | -10000 to 10000 | × 0.01 | 100 | Immediately | Setup |

## 9.1.4 Safety Precautions on Adjustment of Servo Gains

**⚠ CAUTION**

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

Failure to observe this caution may result in injury or damage to the product.

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

### (1) Overtravel Function

Set the overtravel function. For details on how to set the overtravel function, refer to *8.4.2 Overtravel*.

### (2) Torque Limit

The torque limit calculates the torque required to operate the machine and sets the torque limits so that the output torque will not be greater than required. Setting torque limits can reduce the amount of shock applied to the machine when troubles occur, such as collisions or interference. If a torque limit is set lower than the value that is needed for operation, overshooting or vibration may occur.
For details, refer to *8.6 Limiting Torque*.

### (3) Excessive Position Error Alarm Level

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

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

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

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

$$\text{Pn520} > \frac{\text{Max. Motor Speed [min}^{-1}\text{]}}{60} \times \frac{\text{Encoder Resolution}^{*1}}{\text{Pn102 (1/s)}^{*2}} \times (1.2 \text{ to } 2)^{*3}$$

*1. The 10th digit of the model number of the servomotor provides information about the encoder resolution.

SGMGV-□□□□□□□

| Symbol | Specifications | Encoder resolution |
|---|---|---|
| 8 | 20-bit absolute | 1048576 |

*2. To check the Pn102 setting, change the parameter display setting to display all parameters (Pn00B.0 = 1).
*3. This coefficient is used to add a margin that prevents a position error overflow alarm (A.d00) from occurring in actual operation of the servomotor.
Set the level to a value that satisfies these equations, and no position error overflow alarm (A.d00) will be generated during normal operation. The servomotor will be stopped, however, if it does not operate according to the reference and the SERVOPACK detects an excessive position error.
If the servomotor's maximum number of rotations is 6000 min$^{-1}$ and Pn102 is set to 40 with an encoder resolution of 20-bit (1048576), the setting of Pn520 is calculated as shown with the following equation.

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

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 increase the excessive position error alarm level (Pn520).

■ Related Parameter

| Pn520 (2102h:2) | Excessive Position Error Alarm Level (Position) | | | | Classification |
|---|---|---|---|---|---|
| | Setting Range | Setting Unit | Factory Setting | When Enabled | |
| | 1 to 1073741823 | 1 reference unit | 5242880 | Immediately | Setup |

■ Related Alarm

| Alarm Display | Alarm Name | Meaning |
|---|---|---|
| A.d00 | Position Error Overflow | Position errors exceeded parameter Pn520. |

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

If the SV_ON command is received when position errors remain in the error counter, the servomotor will move to return to the home position and change the value of position errors to zero. To prevent the servomotor from moving suddenly, select the appropriate level for the excessive position error alarm level at servo ON (Pn526) to restrict operation of the servomotor.

■ Related Parameters

| Pn526 (2103h:1) | Excessive Position Error Alarm Level at Servo ON (Position) | | | | Classification |
|---|---|---|---|---|---|
| | Setting Range | Setting Unit | Factory Setting | When Enabled | |
| | 1 to 1073741823 | 1 reference unit | 5242880 | Immediately | Setup |

| Pn528 (2103h:2) | Excessive Position Error Warning Level at Servo ON (Position) | | | | Classification |
|---|---|---|---|---|---|
| | Setting Range | Setting Unit | Factory Setting | When Enabled | |
| | 10 to 100 | 1% | 100 | Immediately | Setup |

| Pn529 (2103h:3) | Speed Limit Level at Servo ON (Position) | | | | Classification |
|---|---|---|---|---|---|
| | Setting Range | Setting Unit | Factory Setting | When Enabled | |
| | 0 to 10000 | 1 $min^{-1}$ | 10000 | Immediately | Setup |

■ Related Alarms

| Alarm Display | Alarm Name | Meaning |
|---|---|---|
| A.d01 | Position Error Overflow Alarm at Servo ON | The position error is greater than the set value of Pn526. |
| A.d02 | Position Error Overflow Alarm by Speed Limit at Servo ON | When the position error remain in the error counter, Pn529 limits the speed if the SV_ON command is received. If Pn529 limits the speed in such a state, this alarm occurs when position references are input and the number of position errors exceeds the value set for the excessive position error alarm level (Pn520). |

When an alarm occurs, refer to *Chapter 11 Inspection, Maintenance, and Troubleshooting* and take the corrective actions.

# 9.2 Advanced Autotuning

This section describes the adjustment using advanced autotuning.

IMPORTANT

- Advanced autotuning starts adjustments based on the set speed loop gain (Pn100). Therefore, precise adjustments cannot be made if there is vibration when starting adjustments. In this case, make adjustments after lowering the speed loop gain (Pn100) until vibration is eliminated.
- If the operating conditions, such as the machine-load or drive system, are changed after advanced autotuning, then change the following related parameters to disable any values that were adjusted before performing advanced autotuning once again with the setting to calculate the moment of inertia (Jcalc = ON). If advanced autotuning is performed without changing the parameters, machine vibration may occur, resulting in damage to the machine.

  Pn160.0=0 (Does not use anti-resonance control.)

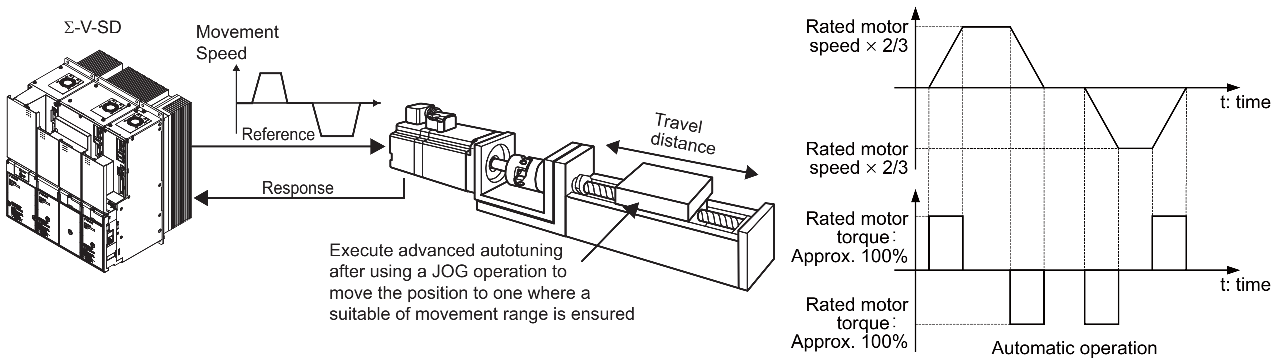
  Pn408=n.00□0 (Does not use friction compensation, 1st notch filter, or 2nd notch filter.)

## 9.2.1 Advanced Autotuning

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

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

- Maximum speed: Rated motor speed × 2/3
- Acceleration torque: Approximately 100% of rated motor torque force
  The acceleration torque varies with the influence of the moment of inertia ratio (Pn103), machine friction, and external disturbance.
- Travel distance: The travel distance can be set freely. The distance is factory-set to a value equivalent to 3 motor rotations.




Advanced autotuning performs the following adjustments.

- Moment of inertia ratio
- Gains (e.g., position loop gain and speed loop gain)
- Filters (torque reference filter and notch filter)
- Anti-resonance control

Refer to *9.2.2 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) Preparation

Check the following settings before performing advanced autotuning.

- The main circuit power supply must be ON.
- There must be no overtravel.
- The servomotor power must be OFF.
- The control method must not be set to torque control.
- Gain setting 1 must be selected.
- All alarms and warning must be cleared.
- The hardwire baseblock (HWBB) must be disabled.
- The write prohibited setting must not be set to write-protect parameters.

## (2) When Advanced Autotuning Cannot Be Performed

Advanced autotuning cannot be performed normally under the following conditions. Refer to *9.3 Advanced Autotuning by Reference* and *9.4 One-parameter Tuning* for details.

- The machine system can work only in a single direction.
- The operating range is within 0.5 rotation.

## (3) When Advanced Autotuning Cannot Be Performed Successfully

Advanced autotuning cannot be performed successfully under the following conditions. Refer to *9.3 Advanced Autotuning by Reference* and *9.4 One-parameter Tuning* for details.

- The operating range is not applicable.
- The moment of inertia changes within the set operating range.
- The machine has high dynamic 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 used.

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

Change only the overshoot detection level (Pn561) to finely adjust the amount of overshooting without changing the positioning completed width (Pn522). Because Pn561 is set by default to 50%, the allowable amount of overshooting is the half as that for the positioning completed width.
When Pn561 is set to 0%, the amount of overshooting can be adjusted to prevent overshooting the positioning completed width. If the setting of Pn561 is changed, however, the positioning time may be extended.

| **Pn561 (2148h)** | Overshoot Detection Level | | Speed Position Torque | | Classification |
|---|---|---|---|---|---|
| | Setting Range | Setting Unit | Factory Setting | When Enabled | |
| | 0 to 100 | 1% | 50 | Immediately | Setup |

## (4) Advanced Autotuning Procedure

The following procedure is used for advanced autotuning.
Advanced autotuning is performed from the SigmaWin for Σ-V-SD (MT).

### ⚠ WARNING

Autotuning without reference input involves motor operation, and it is therefore hazardous.
Refer to the SigmaWin for Σ-V-SD (MT) Operation Manual before performing autotuning without reference input.
Be particularly careful of the following point.

- Ensure safety near all moving parts.
  Vibration may occur during autotuning without a host frequency. Provide an emergency stop means to shut OFF the power supply during implementation. The motor will move in both directions within the movement range. Check the movement range and direction, and provide overtravel prevention means and other safety measures as required.

### ⚠ CAUTION

Two methods are available to stop autotuning without reference input while the motor is running, and the motor will stop according to the method selected. Make sure to select the best method for the situation.

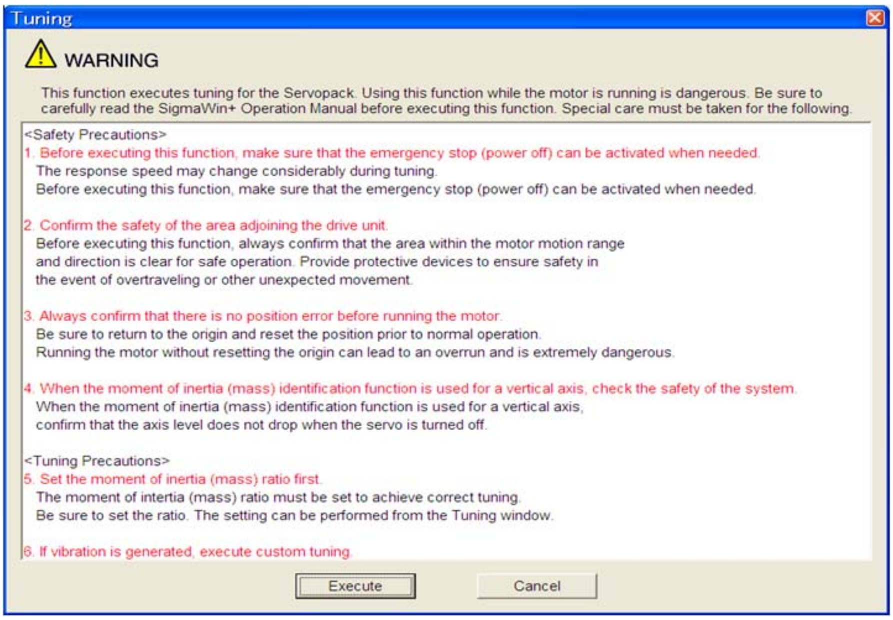
- If the SERVO OFF button is used, the motor will stop according to the stopping method after servo off specified by the parameters.
- If the CANCEL button is used, the motor will decelerate to a stop and then enter a zero clamp state.
  Note: The CANCEL button may be invalid in some SERVOPACKs.

The operating procedure from the SigmaWin for Σ-V-SD (MT) is described here.

### ⚠ CAUTION

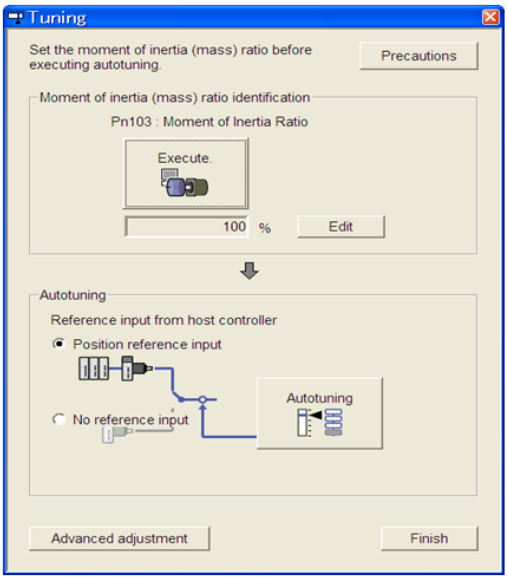
- When using the SERVOPACK with Jcalc = OFF (load moment of inertia is not calculated), be sure to set a suitable value for the moment of inertia ratio (Pn103). If the setting greatly differs from the actual moment of inertia ratio, normal control of the SERVOPACK may not be possible, and vibration may result.

**1.** In the SigmaWin Σ-V-SD (MT) component main window, click **Tuning** and then click **Tuning**.

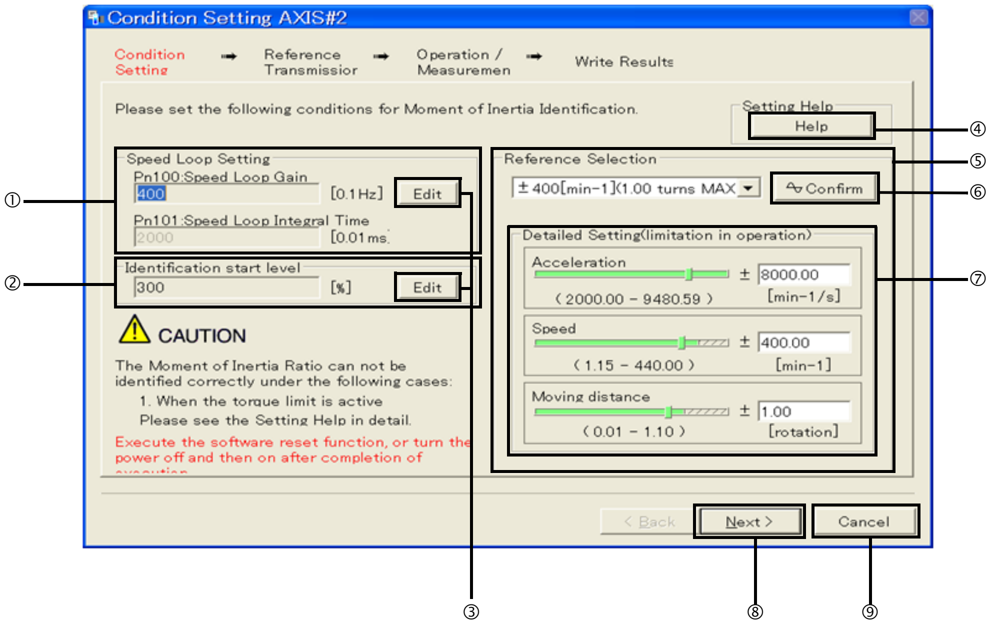



Click **Cancel** to return to the SigmaWin Σ-V-SD (MT) component main window without executing tuning.

**2.** Click **Execute**. The following window appears.




**3.** Click **Execute**. The following window appears.




①Speed Loop Setting

Set the speed loop gain and integral time constant.

If the response of the speed loop is poor, the moment of inertia (mass) ratio cannot be measured accurately.

The speed loop setting to get the required response for the moment of inertia (mass) setting is already set to the default setting. Normally, this setting does not have to be changed.

If this speed loop gain is too high, and is causing excitation in the machine, lower the setting.

②Identification Start Level

Set the moment of inertia (mass) identification start level.

With a heavy load or low-rigidity machine, torque limit may be applied and the moment of inertia identification may fail.

In this case, double the identification start level and execute identification again.

③Edit

Click **Edit** to view the Speed Loop-Related Setting Change box or the Identification Start Level Setting Change box.

④Help

Click **Help** to open the window for guidelines on the reference condition settings.

⑤Reference Selection

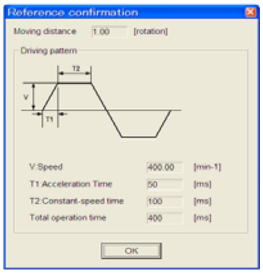
Select a reference pattern from the Reference Selection box or create the reference pattern by directly entering the values.

As the setting for maximum acceleration increases, the accuracy of the inertia identification tends to improve.

Consider the pulley diameter or the speed reduction ratio such as the ball screw pitches, and set the maximum acceleration within the operable range.

⑥Confirm

Click **Confirm** to view the driving pattern.




⑦Detailed Setting

Create the reference pattern for setting the moment of inertia (mass) by changing the values with the slider or by directly entering the values.

⑧Next>

Click **Next** to view the Reference Transmission box.

⑨Cancel

Click **Cancel** to return to the main window without changing the conditions.

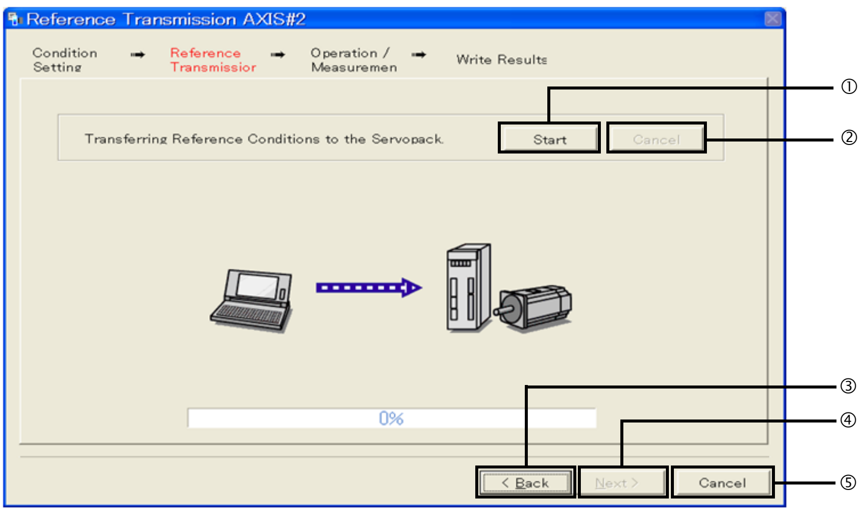
## ⚠ CAUTION

- The amount of movement is the value for each operation (a forward run or a reverse run). After several operations, the operation starting position may have moved in either direction. Confirm the operable range before each measurement and operation.
- Certain settings for the parameters or inertia size of the machine may result in overshooting or undershooting, and cause the speed to temporarily exceed the maximum speed. Allow a margin when making the settings.

### <If the moment of inertia (mass) ratio cannot be measured accurately>

If the torque (force) is limited, the moment of inertia (mass) ratio identification cannot be made correctly. Adjust the setting of the limit or decrease the acceleration in Reference Selection so that the torque (force) will not be limited

**4.** Click **Next**. The following window appears.

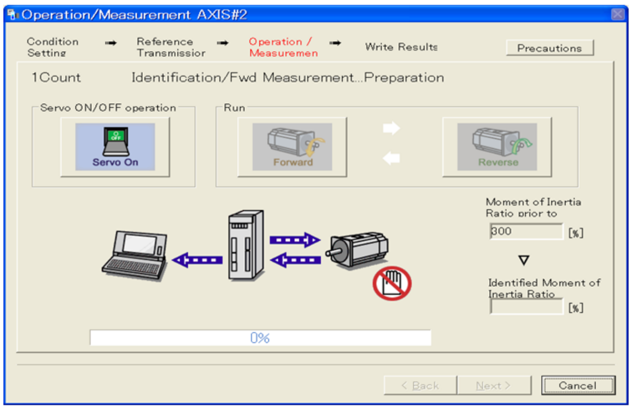



①Start

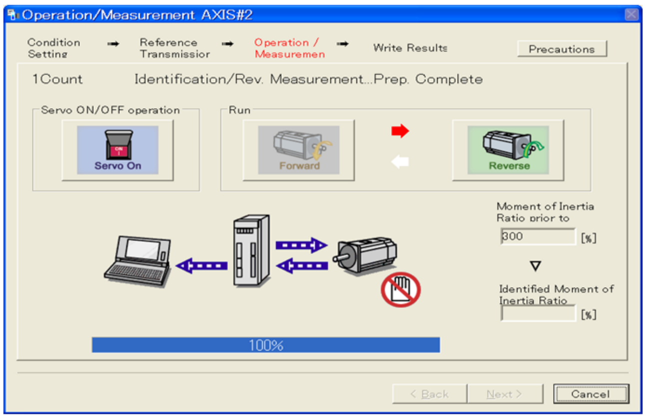
Click to **Start** to transfer the reference conditions to the SERVOPACK. A progress bar displays the progress status of the transfer.

②Cancel
The **Cancel** button is available only during the transfer to the SERVOPACK. After the transmission is finished, it is unavailable and cannot be selected.
③<Back
Click **Back** to return to the Condition Setting box. The **Back** button is unavailable during a data transfer.
④Next>
The **Next** button is available if the data is transferred successfully. If an error occurs or if the transmission is interrupted, it is unavailable and cannot be selected.
Click **Next** to view the Operation/Measurement box.
⑤Cancel
Click **Cancel** to stop processing and return to the main window.

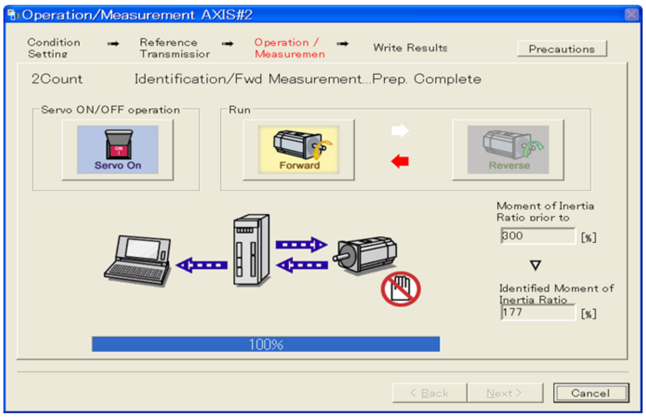
5. Click **Start** to transfer the reference conditions to the SERVOPACK.
6. Click **Next**. The following window appears.




7. Click **Servo On**.
8. Click **Forward** to take measurements by turning (moving) the motor forward. After the measurements and the data transmission are finished, the following window appears.



**9.** Click **Reverse** to take measurements by turning (moving) the motor in reverse. After the measurements and the data transmission are finished, the following window appears.

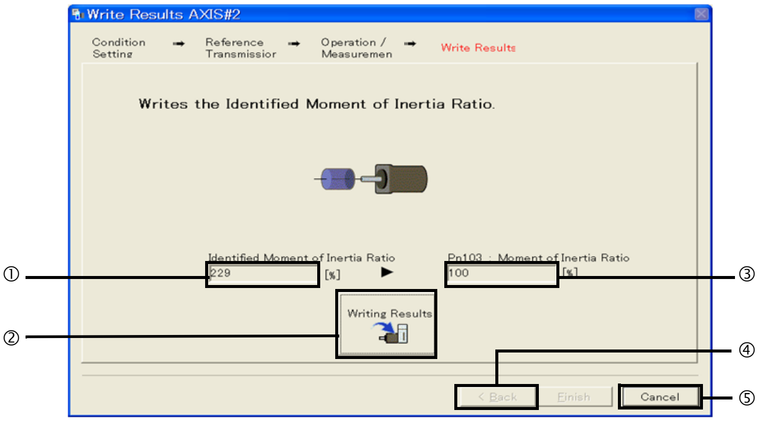



**10.** Repeat steps 7 through 9 until all the measurements have been taken.

Measurements will be made from two to seven times and then verification will be performed. The actual number of times the measurements have been taken is displayed in the upper left part on the screen. The progress bar displays the percentage of data that has been transferred.

**11.** After the measurement has been successfully completed, click **Servo ON** to turn to the servo OFF status.

**12.** Click **Next**. The following window appears.




①Identified Moment of Inertia (Mass) Ratio

Displays the moment of inertia (mass) ratio calculated in the operation/measurement.

②Writing Results

Click **Writing Results** to assign the value displayed in the identified moment of inertia (mass) ratio to SERVOPACK parameter Pn103.

③Pn103: Moment of Inertia (Mass) Ratio

Displays the value assigned to the parameter.

Click **Writing Results**, and the new ratio calculated from the operation/measurement will be displayed.

④<Back

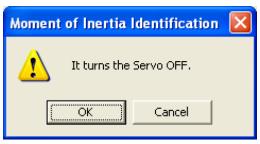
The **Back** button is unavailable.

⑤Cancel

Click **Cancel** to return to the main window.

<Supplement>

When **Next** is clicked without turning to the servo OFF status, the following message appears. Click **OK** to turn to the servo OFF status.




Adjustments

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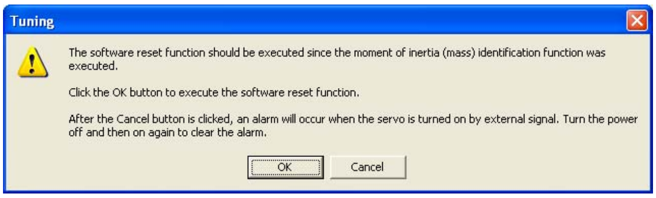
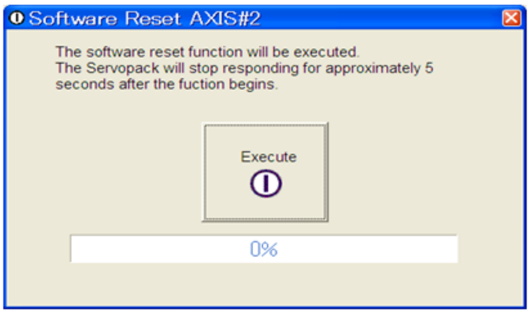
**13.** Click **Writing Results** to set the moment of inertia (mass) ratio calculated in the operation/measurement to the parameters.

**14.** After confirming that the value displayed in the identified moment of inertia (mass) ratio and the value displayed in the Pn103: Moment of Inertia Ratio are the same, click **Finish**. The following window appears.

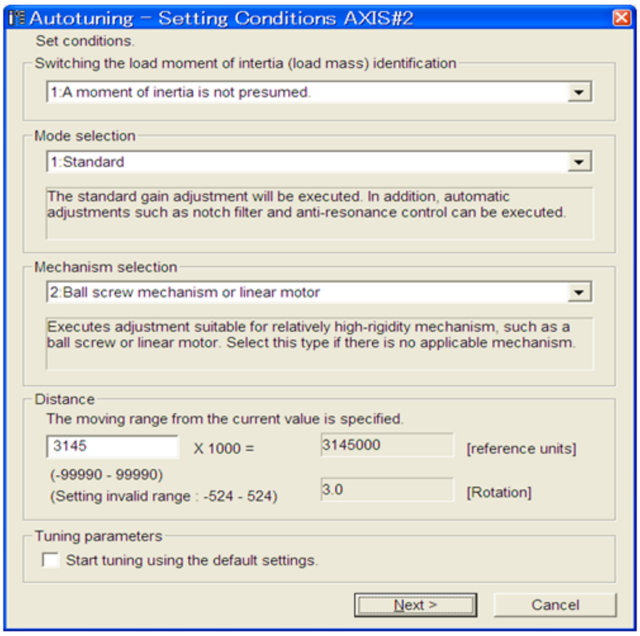



**15.** Click **OK**. The following window appears.



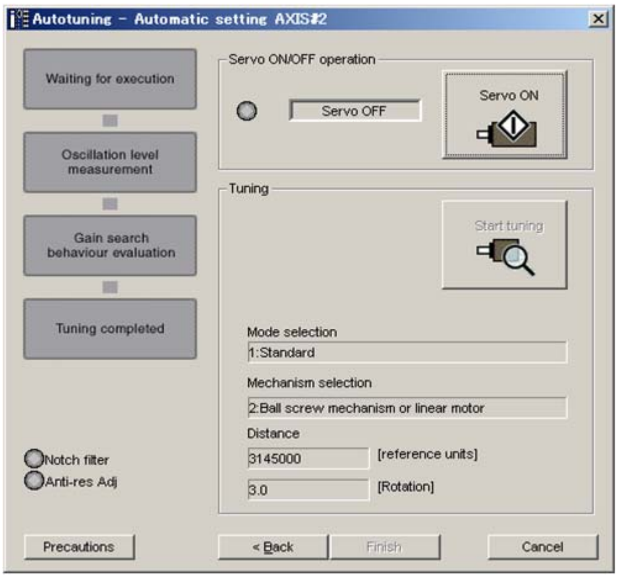

**16.** Click **Execute** to save the change of Pn103 (Moment of Inertia (Mass) Ratio) to SERVOPACK. After the saving is finished, the tuning main window appears.

**17.** Select the **No reference input** option under **Reference input from host controller** in the Tuning main window, and then click **Autotuning**. The following window appears.

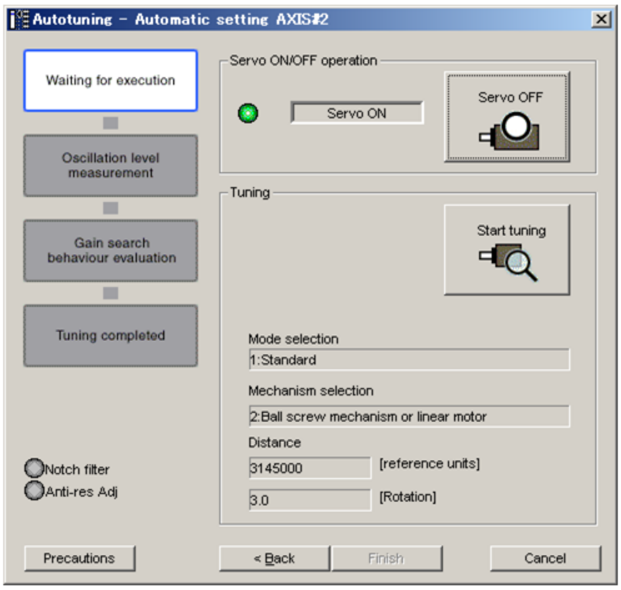


**18.** Select whether or not to use the load moment of inertia (load mass) identification from the **Switching the load moment of inertia (load mass) identification** box, the mode from the **Mode selection** box, the mechanism from the **Mechanism selection** box, and enter the moving distance. Then, click **Next**.

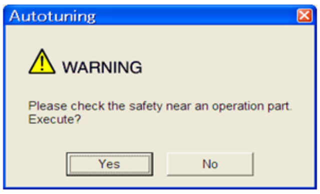
When the **Start tuning using the default settings**. check box is selected in the Autotuning-Setting Conditions box, tuning will be executed using the tuning parameters set to the default values.




**19.** Click **Servo ON**. The following window appears.




**20.** Click **Start tuning**. The following box appears.




Adjustments

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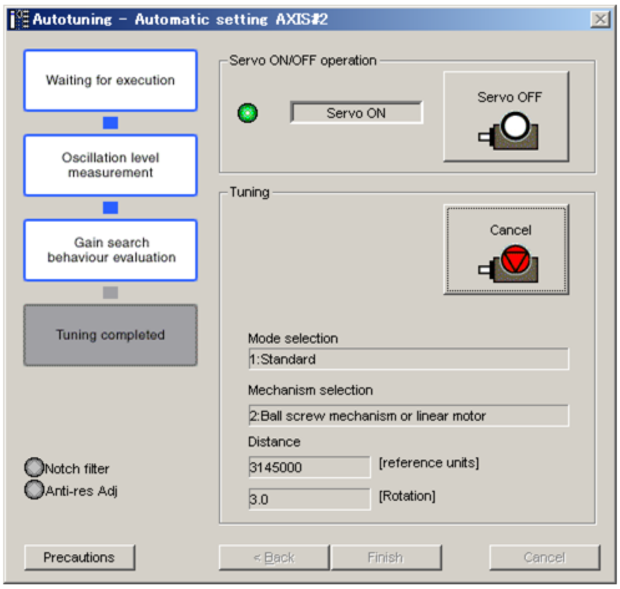
**21.** After confirming the safety of the area adjoining the drive unit, click **Yes**. The motor will start rotating and tuning will start.




Vibration generated during tuning is automatically detected, and the optimum setting for the detected vibration will be made. When the setting is complete, the LED indicator lamps (bottom left of the box) of the functions used for the setting will light up.

**22.** When tuning is completed, click **Finish** to return to the main window. The results of tuning will be written in the parameters.

## 9.2.2 Related Parameters

The following table lists parameters related to this function and their possibility of being changed while executing this function or of being changed automatically after executing this function.

- Parameters related to this function
  These are parameters that are used or referenced when executing this function.

- Allowed changes during execution of this function
  Yes : Parameters can be changed using SigmaWin for Σ-V-SD (MT) while this function is being executed.
  No : Parameters cannot be changed using SigmaWin for Σ-V-SD (MT) while this function is being executed.

- Automatic changes after execution of this function
  Yes : Parameter set values are automatically set or adjusted after execution of this function.
  No : Parameter set values are not automatically set or adjusted after execution of this function.

| Parameter | Name | Mid-execution Changes | Automatic Changes |
|---|---|---|---|
| **Pn100** | Speed Loop Gain | No | Yes |
| **Pn101** | Speed Loop Integral Time Constant | No | Yes |
| **Pn102** | Position Loop Gain | No | Yes |
| **Pn103** | Moment of Inertia Ratio | No | No |
| **Pn104** | 2nd Speed Loop Gain | No | Yes |
| **Pn105** | 2nd Speed Loop Integral Time Constant | No | Yes |
| **Pn106** | 2nd Position Loop Gain | No | Yes |
| **Pn12B** | 3rd Speed Loop Gain | No | Yes |
| **Pn12C** | 3rd Speed Loop Integral Time Constant | No | Yes |
| **Pn12D** | 3rd Position Loop Gain | No | Yes |
| **Pn12E** | 4th Speed Loop Gain | No | Yes |
| **Pn12F** | 4th Speed Loop Integral Time Constant | No | Yes |
| **Pn130** | 4th Position Loop Gain | No | Yes |
| **Pn160** | Anti-Resonance Control Related Switch | Yes | Yes |
| **Pn161** | Anti-Resonance Frequency | No | Yes |
| **Pn163** | Anti-Resonance Damping Gain | No | Yes |
| **Pn401** | 1st Step 1st Torque Reference Filter Time Constant | No | Yes |
| **Pn408** | Torque Related Function Switch | Yes | Yes |
| **Pn409** | 1st Notch Filter Frequency | No | Yes |
| **Pn40A** | 1st Notch Filter Q Value | No | Yes |
| **Pn40C** | 2nd Notch Filter Frequency | No | Yes |
| **Pn40D** | 2nd Notch Filter Q Value | No | Yes |
| **Pn412** | 1st Step 2nd Torque Reference Filter Time Constant | No | Yes |
| **Pn413** | 1st Step 3rd Torque Reference Filter Time Constant | No | Yes |
| **Pn414** | 1st Step 4th Torque Reference Filter Time Constant | No | Yes |
| **Pn531** | Program JOG Movement Distance | No | No |
| **Pn533** | Program JOG Movement Speed | No | No |
| **Pn534** | Program JOG Acceleration/Deceleration Time | No | No |
| **Pn535** | Program JOG Waiting Time | No | No |
| **Pn536** | Number of Times of Program JOG Movement | No | No |

# 9.3 Advanced Autotuning by Reference

Adjustments with advanced autotuning by reference are described below.

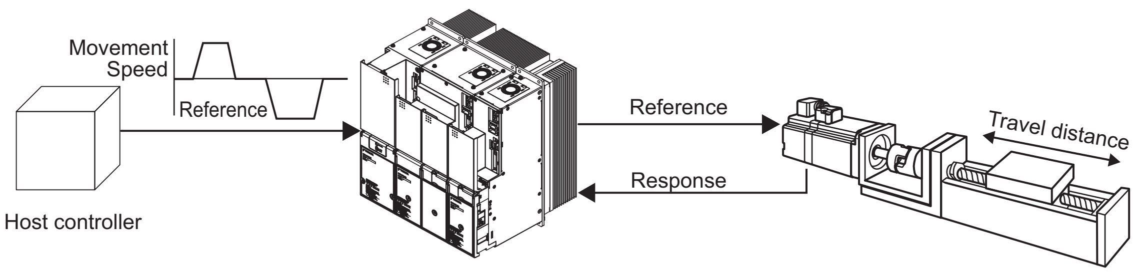
| IMPORTANT | Advanced autotuning by reference starts adjustments based on the set speed loop gain (Pn100). Therefore, precise adjustments cannot be made if there is vibration when starting adjustments. In this case, make adjustments after lowering the speed loop gain (Pn100) until vibration is eliminated. |
|---|---|

## 9.3.1 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 moment of inertia ratio is correctly set to Pn103, advanced autotuning by reference can be performed without performing advanced autotuning.




Advanced autotuning by reference performs the following adjustments.

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

Refer to *9.3.2 Related Parameters* for parameters used for adjustments.

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

## (1) Preparation

Check the following settings before performing advanced autotuning by reference. The message “NO-OP” indicating that the settings are not appropriate will be displayed, if all of the following conditions are not met.

- The SERVOPACK must be in Servo Ready status.
- There must be no overtravel.
- The servomotor power must be OFF.
- The position control must be selected when the servomotor power is ON.
- Gain setting 1 must be selected.
- All alarms and warnings must be cleared.
- The hardwire baseblock (HWBB) must be disabled.
- The write prohibited setting must not be set to write-protect parameters.

## (2) When Advanced Autotuning by Reference Cannot Be Performed Successfully

Advanced autotuning by reference cannot be performed successfully under the following conditions. If the result of autotuning is not satisfactory, perform one-parameter tuning. Refer to *9.4 One-parameter Tuning* for details.

- The travel distance in response to references from the host controller is smaller than the set positioning completed width (Pn522).
- The motor speed in response to references from the host controller is smaller than the set rotation detection level (Pn502).
- The stopped time is 10 ms or less. (The stop time is the time that bit 10 (target reached) of the Statusword (6041h) is 1.)
- 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 to small.

Change only the overshoot detection level (Pn561) to finely adjust the amount of overshooting without changing the positioning completed width (Pn522). Because Pn561 is set by default to 50%, the allowable amount of overshooting is the half 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 (2148h)** | Overshoot Detection Level Speed Position | | | | Classification |
|---|---|---|---|---|---|
| | Setting Range | Setting Unit | Factory Setting | When Enabled | |
| | 0 to 100 | 1% | 50 | Immediately | Setup |

Adjustments

9

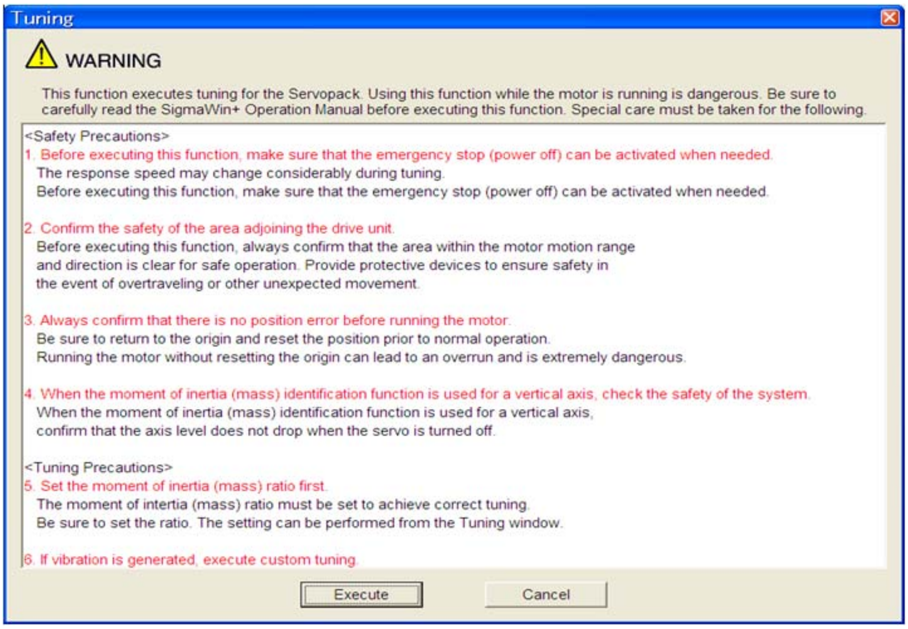
### (3) Advanced Autotuning by Reference Procedure

The following procedure is used for advanced autotuning by reference.

Advanced autotuning by reference is performed from the SigmaWin for Σ-V-SD (MT).

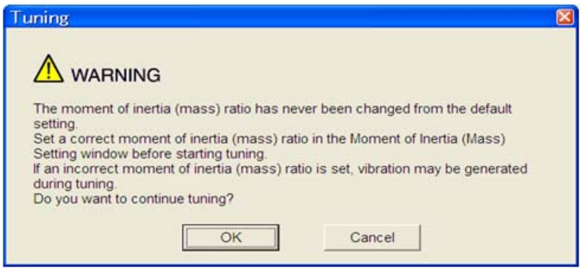
The operating procedure from the SigmaWin for Σ-V-SD (MT) is described here.

1. Confirm that the correct moment of inertia ratio in Pn103 is set by using the advanced autotuning.
2. In the SigmaWin Σ-V-SD (MT) component main window, click **Tuning** and then click **Tuning**.

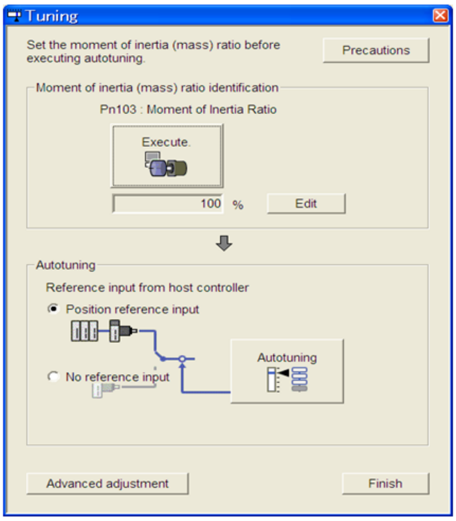



Click **Cancel** to return to the SigmaWin Σ-V-SD (MT) component main window without executing tuning.

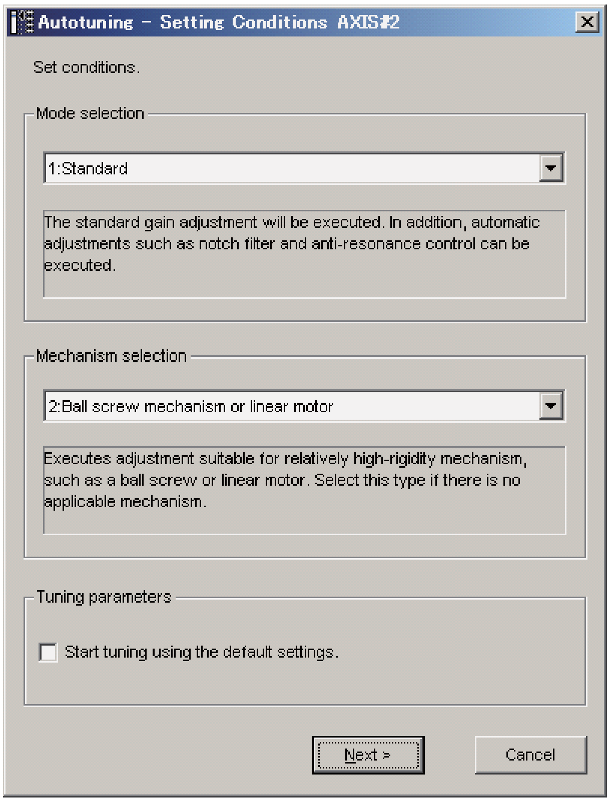
3. Click **Execute**. The following window appears.



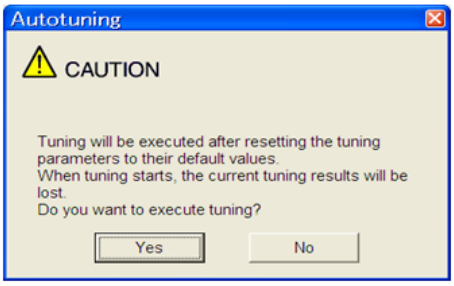
**4.** After confirming that there is no problem, click **OK**. The following window appears.



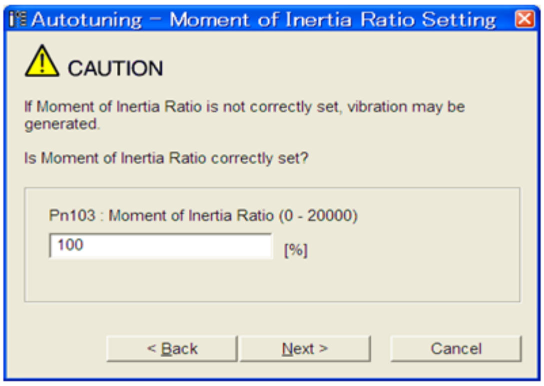

**5.** Select the **Position reference input** option under **Reference input from host controller** in the Tuning main window, and then click **Autotuning**. The following window appears.



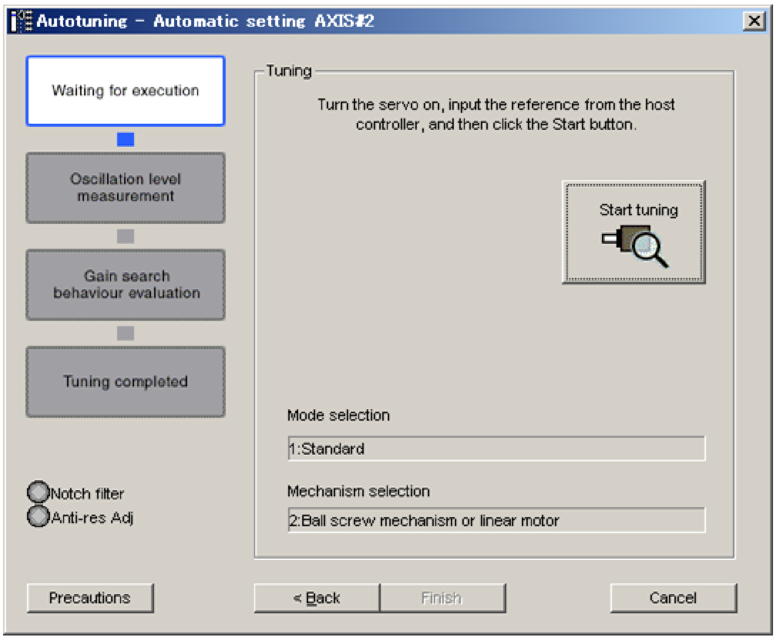
**6.** Select the mode from the **Mode selection** combo box and the mechanism from **Mechanism selection** combo box, and then click **Next**. When the **Start tuning using the default settings**. check box is selected in the Autotuning-Setting Conditions box, tuning will be executed using tuning parameters set to the default value.



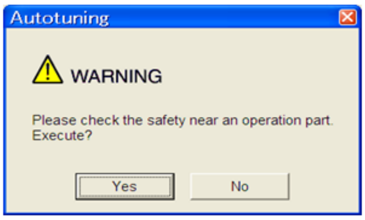

**7.** Click **Yes**. The following box appears.



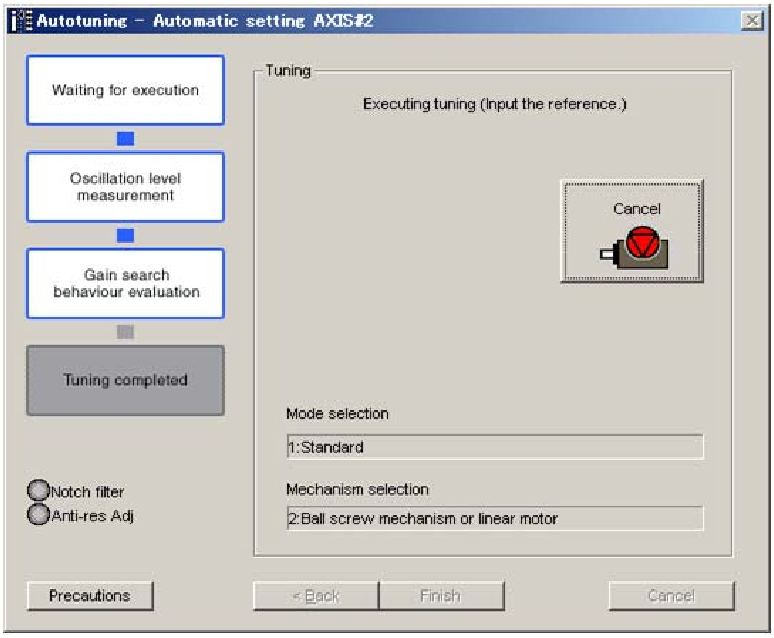

**8.** Enter the correct moment of inertia ratio and then click **Next**. The following window appears.



**9.** After confirming the safety of the area adjoining the drive unit, turn the servo on and then input the reference from the host controller. Click **Start tuning**.




**10.** Click **Yes** to start tuning.




Vibration generated during tuning is automatically detected, and the optimum setting for the detected vibration will be made. When the setting is complete, the LED indicator lamps (bottom left of the box) of the functions used for the setting will light up.

**11.** When tuning is completed, click **Finish** to return to the main window. The results of tuning will be written in the parameters.

## 9.3.2 Related Parameters

The following table lists parameters related to this function and their possibility of being changed while executing this function or of being changed automatically after executing this function.

• Parameters related to this function
These are parameters that are used or referenced when executing this function.

• Allowed changes during execution of this function
Yes : Parameters can be changed using SigmaWin for Σ-V-SD (MT) while this function is being executed.
No : Parameters cannot be changed using SigmaWin for Σ-V-SD (MT) while this function is being executed.

• Automatic changes after execution of this function
Yes : Parameter set values are automatically set or adjusted after execution of this function.
No : Parameter set values are not automatically set or adjusted after execution of this function.

| Parameter | Name | Mid-execution Changes | Automatic Changes |
|---|---|---|---|
| **Pn100** | Speed Loop Gain | No | Yes |
| **Pn101** | Speed Loop Integral Time Constant | No | Yes |
| **Pn102** | Position Loop Gain | No | Yes |
| **Pn103** | Moment of Inertia Ratio | No | No |
| **Pn104** | 2nd Speed Loop Gain | No | Yes |
| **Pn105** | 2nd Speed Loop Integral Time Constant | No | Yes |
| **Pn106** | 2nd Position Loop Gain | No | Yes |
| **Pn12B** | 3rd Speed Loop Gain | No | Yes |
| **Pn12C** | 3rd Speed Loop Integral Time Constant | No | Yes |
| **Pn12D** | 3rd Position Loop Gain | No | Yes |
| **Pn12E** | 4th Speed Loop Gain | No | Yes |
| **Pn12F** | 4th Speed Loop Integral Time Constant | No | Yes |
| **Pn130** | 4th Position Loop Gain | No | Yes |
| **Pn160** | Anti-Resonance Control Related Switch | Yes | Yes |
| **Pn161** | Anti-Resonance Frequency | No | Yes |
| **Pn163** | Anti-Resonance Damping Gain | No | Yes |
| **Pn401** | 1st Step 1st Torque Reference Filter Time Constant | No | Yes |
| **Pn408** | Torque Related Function Switch | Yes | Yes |
| **Pn409** | 1st Notch Filter Frequency | No | Yes |
| **Pn40A** | 1st Notch Filter Q Value | No | Yes |
| **Pn40C** | 2nd Notch Filter Frequency | No | Yes |
| **Pn40D** | 2nd Notch Filter Q Value | No | Yes |
| **Pn412** | 1st Step 2nd Torque Reference Filter Time Constant | No | Yes |
| **Pn413** | 1st Step 3rd Torque Reference Filter Time Constant | No | Yes |
| **Pn414** | 1st Step 4th Torque Reference Filter Time Constant | No | Yes |

# 9.4 One-parameter Tuning

Adjustments with one-parameter tuning are described below.

## 9.4.1 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 tuning level.

One-parameter tuning performs the following adjustments.

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

Refer to *9.4.2 Related Parameters* for parameters used for adjustments.

Perform one-parameter tuning if satisfactory responsiveness is not obtained with advanced autotuning or advanced autotuning by reference.

To fine-tune each servo gain after one-parameter tuning, refer to *9.6 High-speed Control Adjustments*.

**⚠ 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.
  Failure to observe this caution may result in injury or damage to the product.
- Be sure to set a suitable value for the moment of inertia ratio (Pn103) before executing the one-parameter tuning.
  If the setting greatly differs from the actual moment of inertia ratio, normal control of the machine may not be possible, and vibration may result.

### (1) Preparation

Check the following settings before performing one-parameter tuning.
The message “NO-OP” indicating that the settings are not appropriate will be displayed, if the following condition is not met.

- The write prohibited setting must not be set to write-protect parameters.

### (2) Tuning Mode

There are two one-parameter tuning modes.

- Tuning Mode 0: Emphasizes stability.
- Tuning Mode 1: Emphasizes response.

Adjustments are made for applications other than positioning.
Operations in one tuning level can be performed to change more than one servo gain during stable control. When vibration is detected, the notch filter, the anti-resonance control settings, and other parameters are set automatically. The anti-resonance control can be also made manually.

Also, automatic adjustment is supported to achieve gain balance.

### (3) One-parameter Tuning Procedure

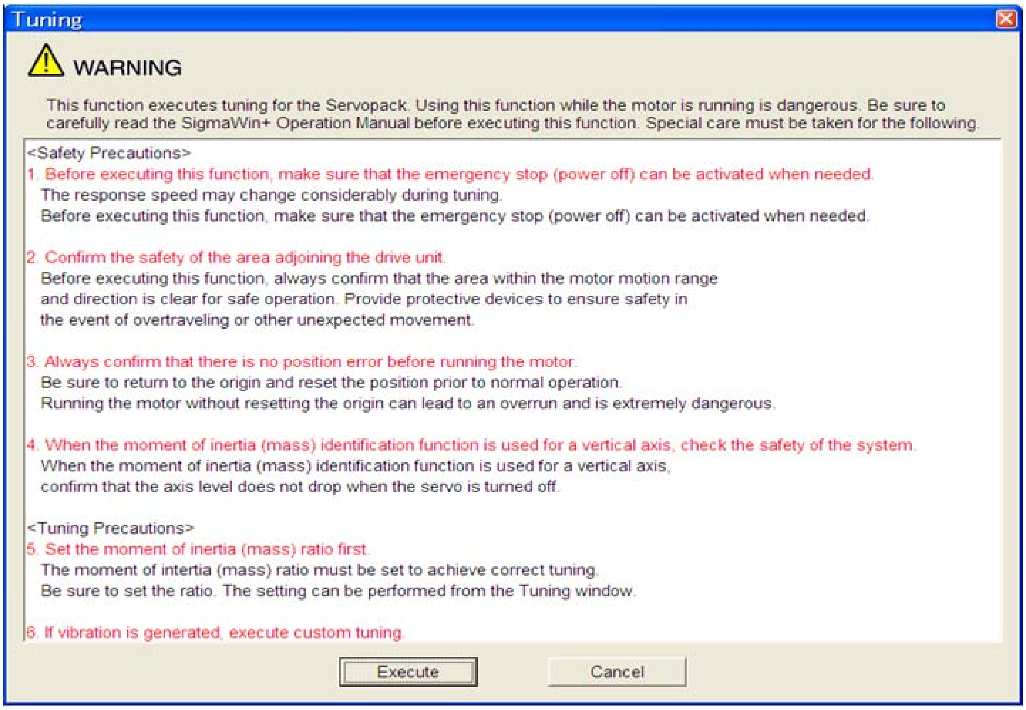
One-parameter tuning is performed from the SigmaWin for Σ-V-SD (MT).

The operating procedure from the SigmaWin for Σ-V-SD (MT) is described here.

> **⚠ WARNING**
>
> Be sure to carefully read the SigmaWin for Σ-V-SD (MT) Operation Manual before executing this function.
> Special care must be taken for the following.
>
> - Before executing this function, make sure that the emergency stop (power off) can be activated when needed.
>
>   When tuning is initiated by this function, some parameters will be overwritten with the recommended values. As a result, the response speeds may change considerably. Before executing this function, make sure that the emergency stop (power off) can be activated when needed.
> - Set a correct moment of inertia (mass) ratio to execute this function.
>
>   If not correctly set, vibration may be generated.
> - When the feedforward level is changed, the new value is applied after the positioning completed signal is output (after bit 10 (target reached) of the Statusword (6041h) is changed to 1).

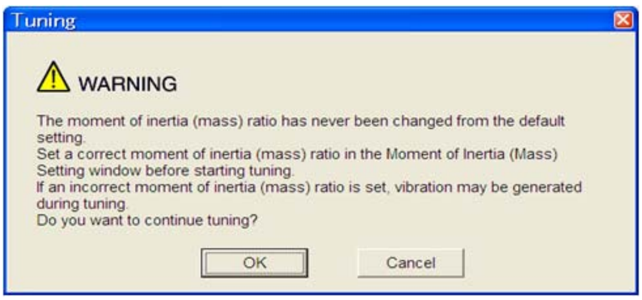
**1.** Confirm that the correct moment of inertia ratio in Pn103 is set.

**2.** In the SigmaWin Σ-V-SD (MT) component main window, click **Tuning** and then click **Tuning**.

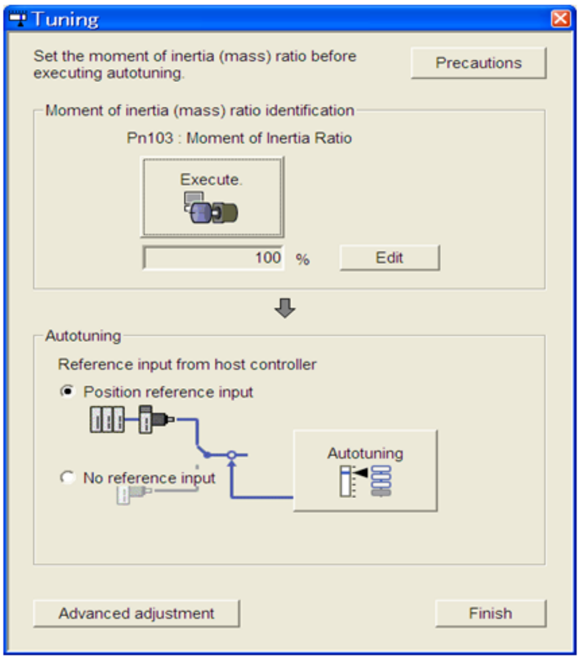



Click **Cancel** to return to the SigmaWin Σ-V-SD (MT) component main window without executing tuning.

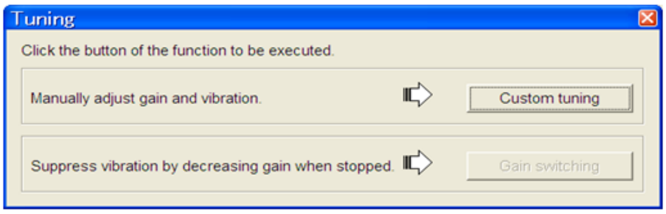
**3.** Click **Execute**. The following window appears.



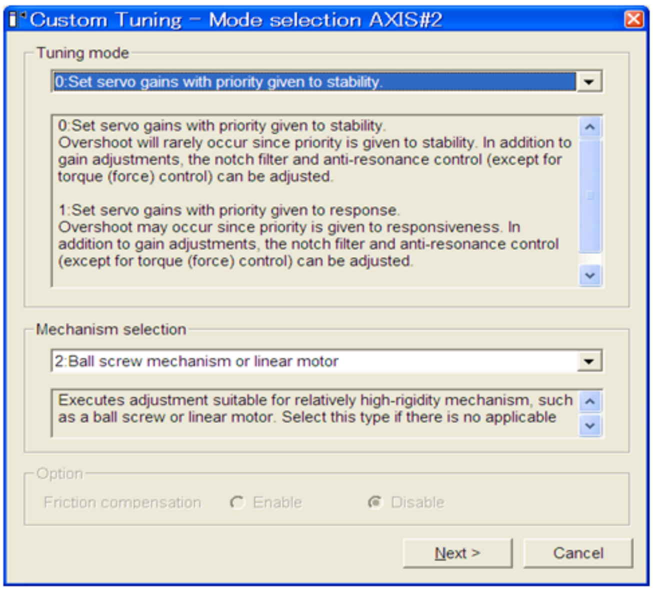
**4.** Click **OK**. The following window appears.




**5.** Click **Advanced adjustment**. The following box appears.



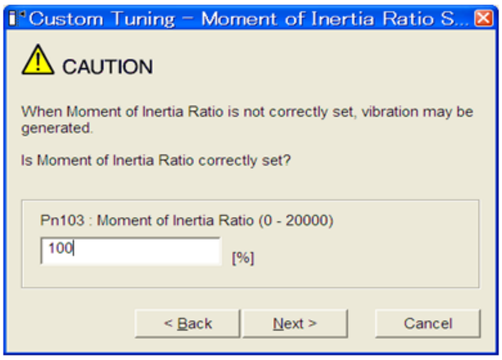

**6.** Click **Custom tuning**. The following box appears.



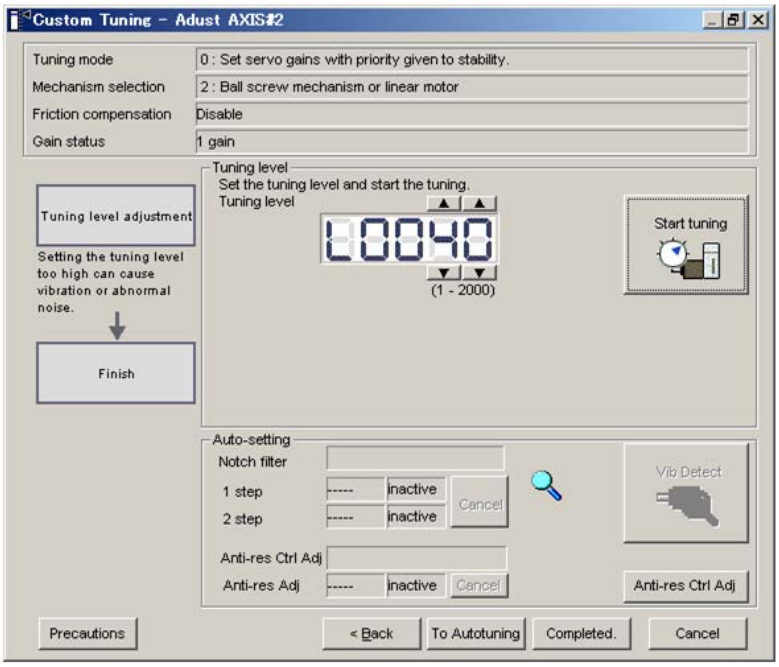

**7.** Select the tuning mode and the mechanism.

The tuning modes that can be selected will vary according to the SERVOPACK setting.

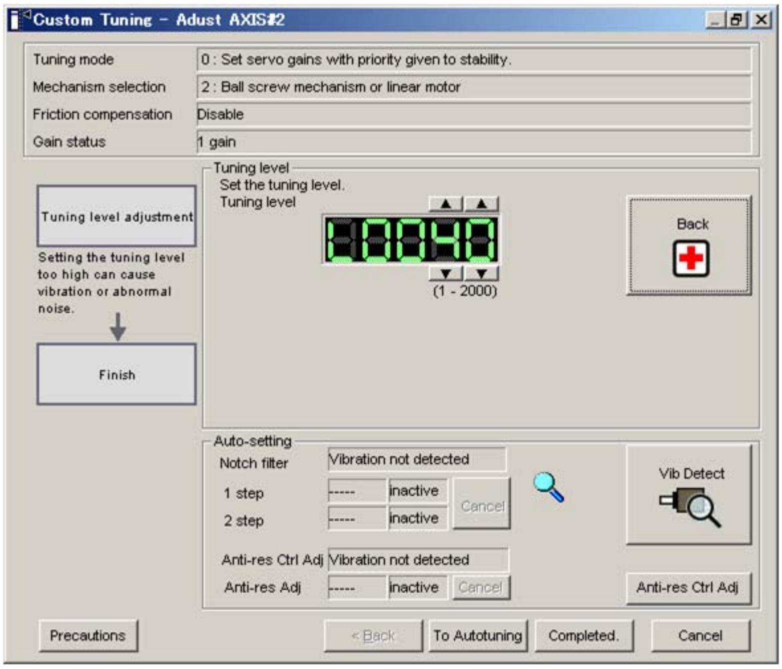
**8.** Click **Next**. The following box appears.




**9.** Enter the correct moment of inertia ratio and then click **Next**. The following window appears.



**10.** Turn the servo on and then input the reference from the host controller. Click **Start tuning**.

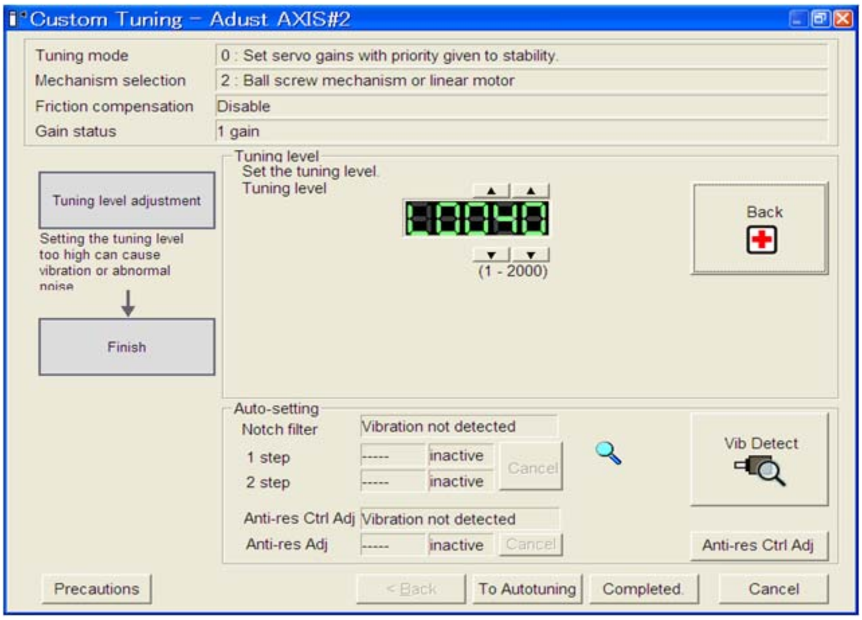



**11.** Change the tuning level by clicking the setting arrows. Continue to raise the level until an overshoot occurs.

Note: The new tuning level is applied after the positioning completion signal is output (after bit 10 (target reached) of the Statusword (6041h) is changed to 1).

The notch filter/anti-resonance control auto setting function, the anti-resonance control adjustment function, or autotuning with reference input can be used as required.
For details, refer to ■ *Functions To Suppress Vibration*.

To reset to the original settings and status, click **Back**.




**12.** When tuning is complete, click **Completed** to return to the main window. The settings will be written in the SERVOPACK.

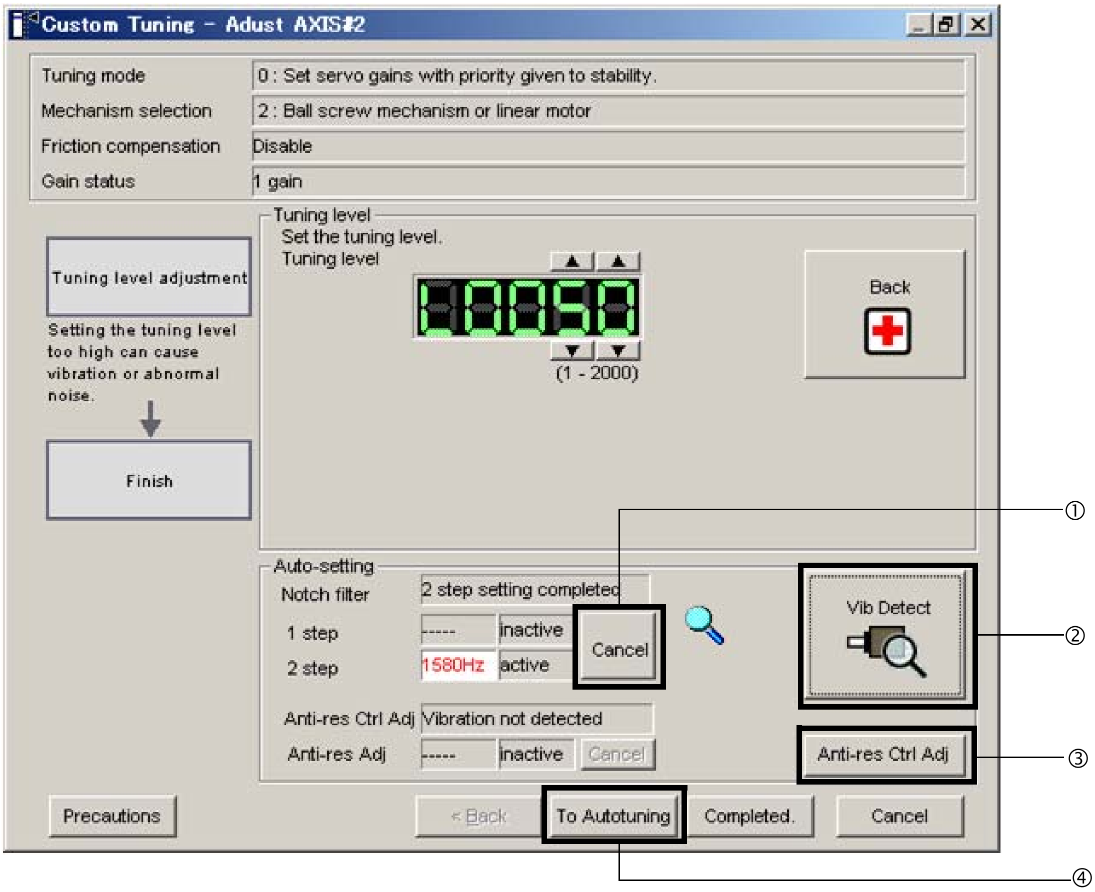
## ■ Functions To Suppress Vibration

For vibration frequencies above 1,000 Hz when servo gains are increased, the notch filter auto setting function provides effective suppression. For vibration frequencies between 100 and 1,000 Hz, the anti-resonance control adjustment auto setting function is effective.

### • Auto Setting

To use auto settings, enable automatically setting the notch filter and anti-resonance control in the parameter settings.
Notch filter frequencies that are suitable for the vibration that was detected during tuning will be set for **1 step** and **2 step**. If automatic setting is enabled for anti-resonance control, the anti-resonance control frequency will be set automatically.

The window that is used to automatically set the notch filters is shown below.




Window with Notch Filter Automatically Set

① **Cancel**
If the automatically set notch filter frequency (or anti-resonance control frequency) does not effectively suppress vibration, click **Cancel** to reset to the preceding frequency.
When the frequency is reset, vibration detection will restart.

② **Vib Detect** (vibration detection)
When automatically setting the notch filters and anti-resonance control is enabled, vibration detection is performed manually. Click **Vib Detect** (vibration detection). The SERVOPACK will detect the current vibration and set **1 step** and **2 step** to values that are suitable for the detected vibration. If you automatically set anti-resonance control, the anti-resonance control frequency will be set. Even if the SERVOPACK does not detect vibration during one-parameter tuning, you can execute vibration detection manually.

③ **Anti-res Ctrl Adj** (anti-resonance control)
Click **Anti-res Ctrl Adj** (anti-resonance control) to execute the anti-resonance control function if further adjustment is required. See *9.5 Anti-Resonance Control Adjustment Function* for details.

④ **To Autotuning**

Click **To Autotuning** to execute autotuning using reference inputs from the host controller. See *9.3.1 Advanced Autotuning by Reference* for details.

## (4) Related Functions on One-parameter Tuning

This section describes functions related to one-parameter tuning.

### ■ Notch Filter

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

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

| Parameter (Index Number) | | Function | When Enabled | Classification |
|---|---|---|---|---|
| **Pn460 (20A9h:7)** | n.□□□0 | Does not set the 1st notch filter automatically with the utility function. | Immediately | Tuning |
| | n.□□□1 [Factory setting] | Sets the 1st notch filter automatically with the utility function. | | |
| | n.□0□□ | Does not set the 2nd notch filter automatically with the utility function. | | |
| | n.□1□□ [Factory setting] | Sets the 2nd notch filter automatically with the utility function. | | |

### ■ Anti-Resonance Control Adjustment

This function reduces low vibration frequency, which the notch filter does not detect.

Usually, set this function to Auto Setting. (The anti-resonance control is factory-set to Auto Setting.)
When this function is set to Auto Setting, vibration will be automatically detected during one-parameter tuning and anti-resonance control will be automatically adjusted and set.

| Parameter (Index Number) | | Function | When Enabled | Classification |
|---|---|---|---|---|
| **Pn160 (206Bh:1)** | n.□□0□ | Does not use the anti-resonance control automatically with the utility function. | Immediately | Tuning |
| | n.□□1□ [Factory setting] | Uses the anti-resonance control automatically with the utility function. | | |

## 9.4.2 Related Parameters

The following table lists parameters related to this function and their possibility of being changed while executing this function or of being changed automatically after executing this function.

• Parameters related to this function
These are parameters that are used or referenced when executing this function.

• Allowed changes during execution of this function
Yes : Parameters can be changed using SigmaWin for Σ-V-SD (MT) while this function is being executed.
No : Parameters cannot be changed using SigmaWin for Σ-V-SD (MT) while this function is being executed.

• Automatic changes after execution of this function
Yes : Parameter set values are automatically set or adjusted after execution of this function.
No : Parameter set values are not automatically set or adjusted after execution of this function.

| Parameter | Name | Mid-execution Changes | Automatic Changes |
|---|---|---|---|
| **Pn100** | Speed Loop Gain | No | Yes |
| **Pn101** | Speed Loop Integral Time Constant | No | Yes |
| **Pn102** | Position Loop Gain | No | Yes |
| **Pn103** | Moment of Inertia Ratio | No | No |
| **Pn104** | 2nd Speed Loop Gain | No | Yes |
| **Pn105** | 2nd Speed Loop Integral Time Constant | No | Yes |
| **Pn106** | 2nd Position Loop Gain | No | Yes |
| **Pn12B** | 3rd Speed Loop Gain | No | Yes |
| **Pn12C** | 3rd Speed Loop Integral Time Constant | No | Yes |
| **Pn12D** | 3rd Position Loop Gain | No | Yes |
| **Pn12E** | 4th Speed Loop Gain | No | Yes |
| **Pn12F** | 4th Speed Loop Integral Time Constant | No | Yes |
| **Pn130** | 4th Position Loop Gain | No | Yes |
| **Pn160** | Anti-Resonance Control Related Switch | Yes | Yes |
| **Pn161** | Anti-Resonance Frequency | No | Yes |
| **Pn163** | Anti-Resonance Damping Gain | No | Yes |
| **Pn401** | 1st Step 1st Torque Reference Filter Time Constant | No | Yes |
| **Pn408** | Torque Related Function Switch | Yes | Yes |
| **Pn409** | 1st Notch Filter Frequency | No | Yes |
| **Pn40A** | 1st Notch Filter Q Value | No | Yes |
| **Pn40C** | 2nd Notch Filter Frequency | No | Yes |
| **Pn40D** | 2nd Notch Filter Q Value | No | Yes |
| **Pn412** | 1st Step 2nd Torque Reference Filter Time Constant | No | Yes |
| **Pn413** | 1st Step 3rd Torque Reference Filter Time Constant | No | Yes |
| **Pn414** | 1st Step 4th Torque Reference Filter Time Constant | No | Yes |

# 9.5 Anti-Resonance Control Adjustment Function

This section describes the anti-resonance control adjustment function.

## 9.5.1 Anti-Resonance Control Adjustment Function

The anti-resonance control adjustment function increases the effectiveness of the vibration suppression after one-parameter tuning. This function is effective in supporting anti-resonance control adjustment if the vibration frequencies are from 100 to 1,000 Hz.

This function rarely needs to be used because it is automatically set by the advanced autotuning or advanced autotuning by reference input. Use this function only if fine-tuning is required, or vibration detection is failed and readjustment is required.

Perform one-parameter tuning or use another method to increase the responsiveness after performing this function. If the anti-resonance gain is increased with one-parameter tuning performed, vibration may result. If that occurs, perform this function again to fine-tune the settings.

**⚠ CAUTION**

- If this function is executed, related parameters will be set automatically. Therefore, there will be a large response change after this function is executed. Enable the function in a state where the machine can come to an emergency stop at any time to ensure the safety operation of the machine.
- Be sure to set a suitable value for the moment of inertia ratio (Pn103) before executing the anti-resonance control adjustment function. If the setting greatly differs from the actual moment of inertia ratio, normal control of the machine may not be possible, and vibration may result.

**IMPORTANT**

- This function detects vibration between 100 and 1,000 Hz. Vibration will not be detected for frequencies outside of this range, and instead, “F----” will be displayed.
- Vibration can be reduced more effectively by increasing the anti-resonance damping gain (Pn163). The amplitude of vibration may become larger if the damping gain is excessively high. Increase the damping gain from about 0% to 200% in 10% increments while checking the effect of vibration reduction. If the effect of vibration reduction is still insufficient at a gain of 200%, cancel the setting, and lower the control gain using a different method, such as one-parameter tuning.

### (1) Preparation

Check the following settings before performing anti-resonance control adjustment function.
The message “NO-OP” indicating that the settings are not appropriate will be displayed, if the following condition is not met.

- The write prohibited setting must not be set to write-protect parameters.

### (2) Anti-Resonance Control Adjustment Function Operating Procedure

With this function, an operation reference is sent, and the function is executed while vibration is occurring.

Anti-resonance control adjustment function is performed from the SigmaWin for Σ-V-SD (MT).
The following methods can be used for the anti-resonance control adjustment function.

- With Undetermined Vibration Frequency
- With Determined Vibration Frequency

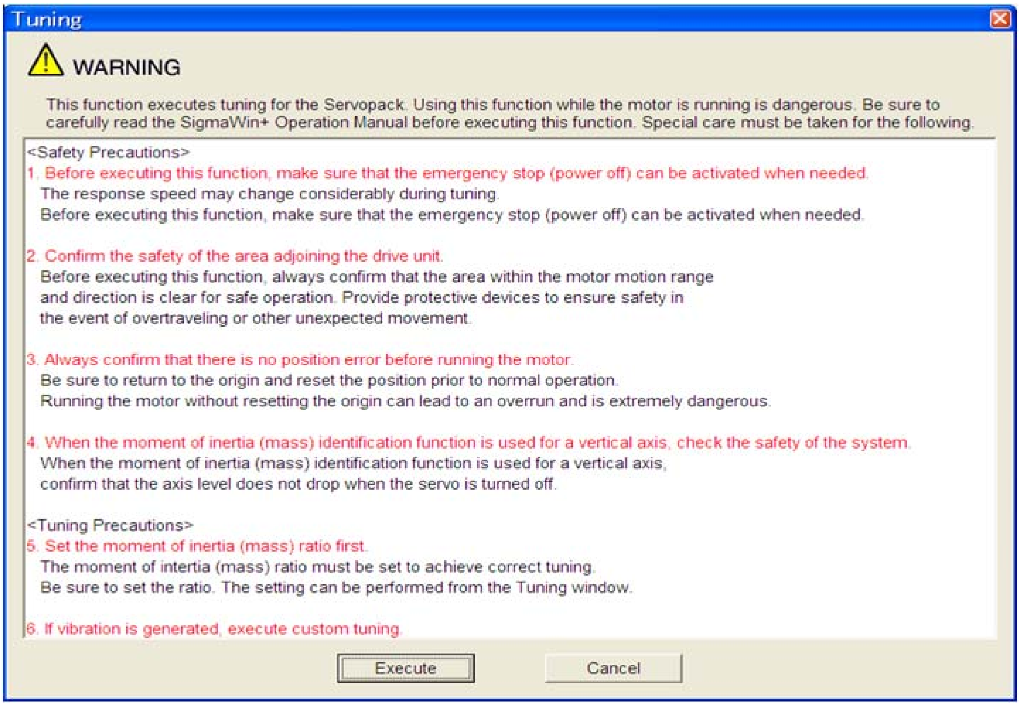
The operating procedure from the SigmaWin for Σ-V-SD (MT) is described here.

> ⚠ **CAUTION**
>
> Be sure to carefully read the SigmaWin for Σ-V-SD (MT) Operation Manual before executing this function.
> Special care must be taken for the following.
>
> - **Before executing this function, make sure that the emergency stop (power off) can be activated when needed.**
>   This function will automatically set parameters when used. As a result, the response speeds may change considerably after execution. Before executing this function, make sure that the emergency stop (power off) can be activated when needed.
> - **The moment of inertia (mass) must be correctly set to execute this function.**
>   If it is not correctly set, satisfactory anti-resonance control cannot be achieved.
> - **This function is generally only used to adjust the servo gain, as you should avoid considerable change in the frequency.**
>   If the frequency is changed while the anti-resonance control adjustment function is being used, the current anti-resonance control effect will be lost. Care must be taken when automatic frequency detection is executed in Auto Detect mode.
> - **If vibration cannot be suppressed by executing this function, cancel execution and reduce the servo gain by other methods such as custom tuning.**
> - **Use an adjustment method such as custom tuning to improve response characteristics after executing this function.**
>   **When the servo gain is increased during an adjustment such as custom tuning, vibration may be generated. In this case, execute the anti-resonance control adjustment function again for fine adjustment.**

The anti-resonance control adjustment function supports the adjustment of anti-resonance control effective for vibration frequencies from 100 to 1,000 Hz when servo gain is increased. Vibration can be suppressed by setting vibration frequency by auto detection or by manual setting to adjust damping gain. Input a reference and execute this function when there is vibration.

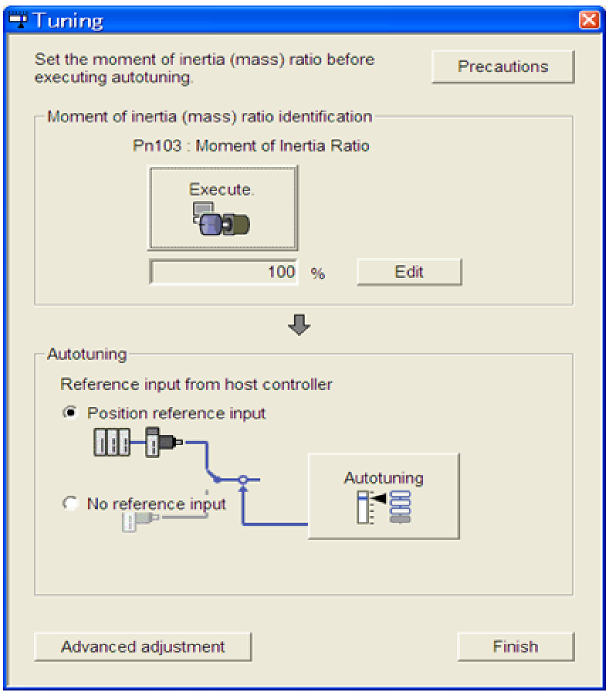
## ■ With Undetermined Vibration Frequency

**1.** In the SigmaWin Σ-V-SD (MT) component main window, click **Tuning** and then click **Tuning**.

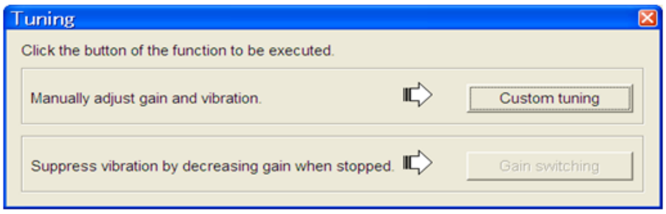



Click **Cancel** to return to the SigmaWin Σ-V-SD (MT) component main window without executing tuning.

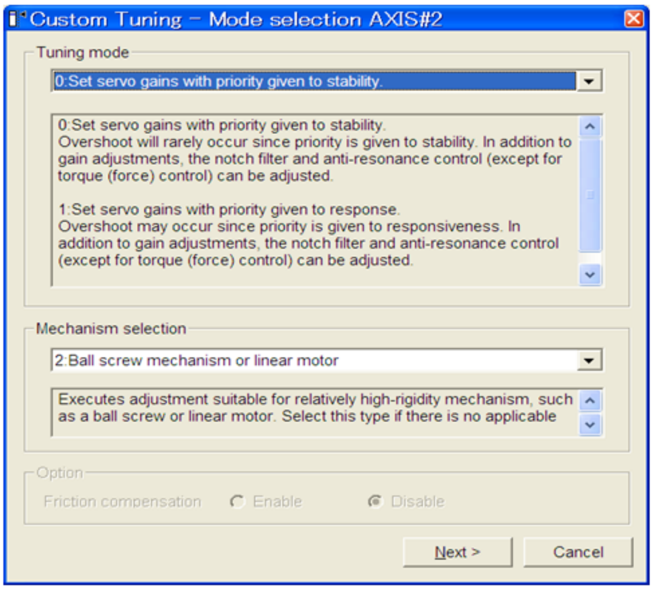
**2.** Click **Execute**. The following window appears.



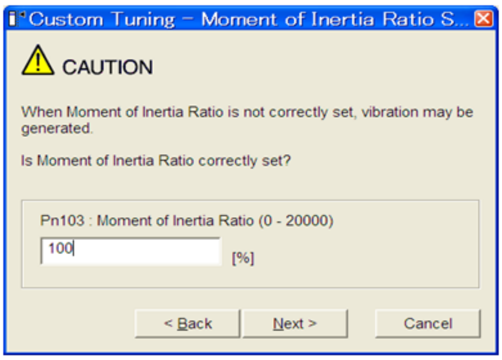
**3.** Click **Advanced adjustment**. The following box appears.



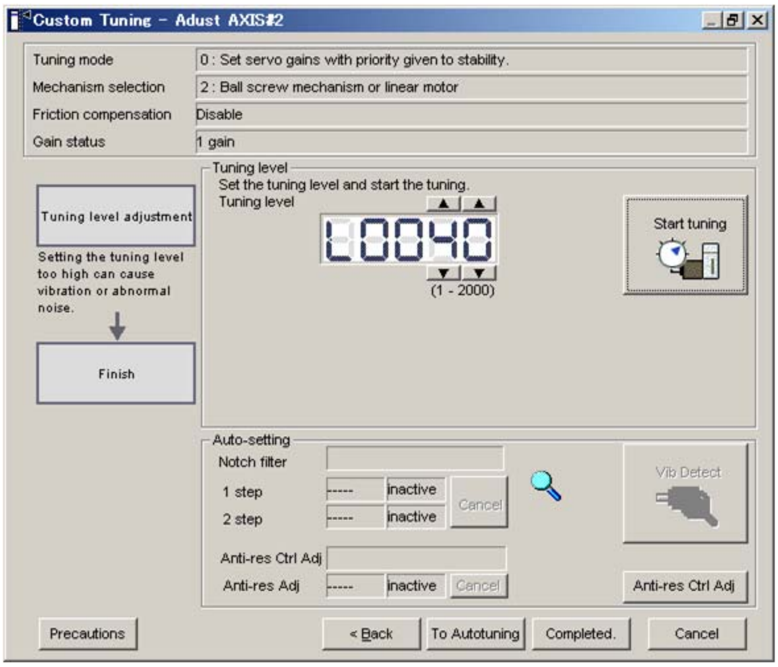

**4.** Click **Custom tuning**. The following box appears.



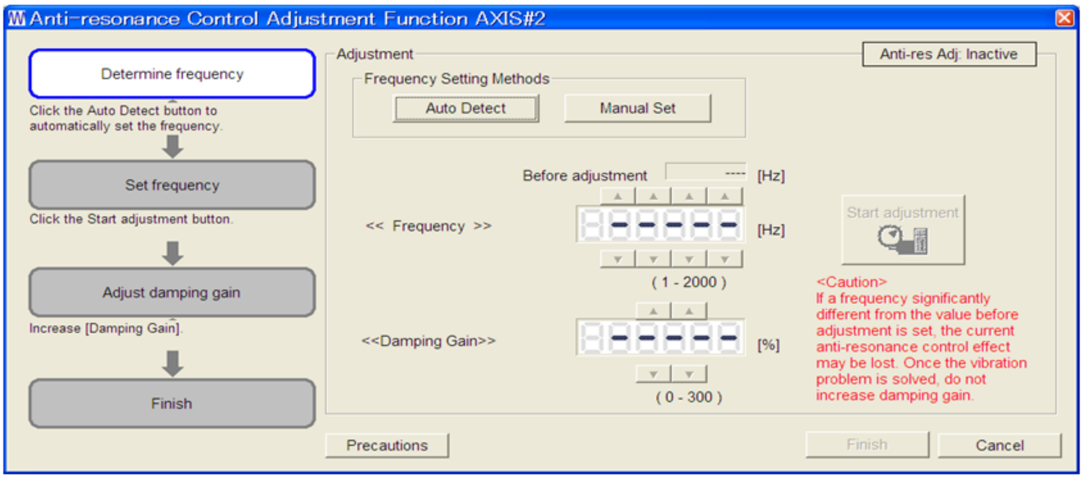

**5.** Select the tuning mode and the mechanism, and then click **Next**. The following box appears.



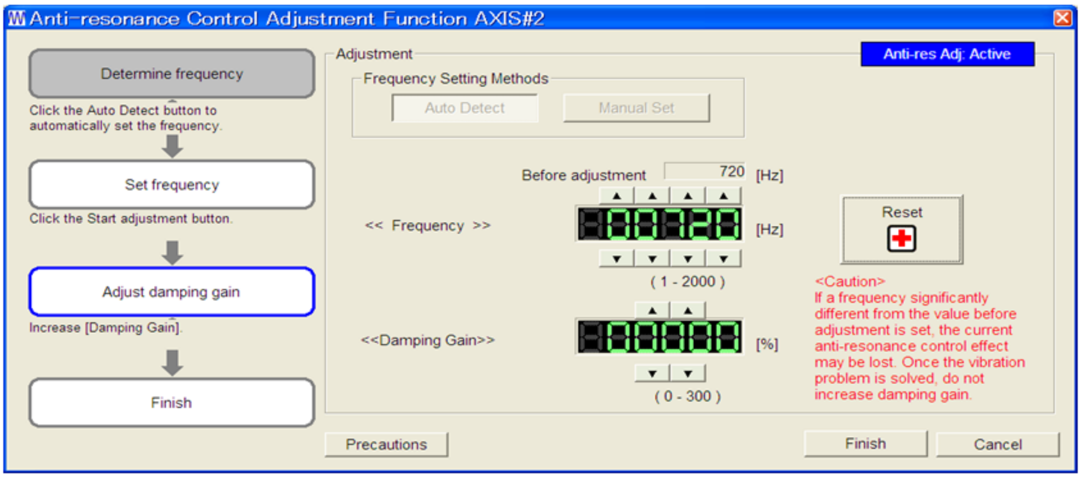
**6.** Enter the correct moment of inertia ratio and then click **Next**. The following window appears.



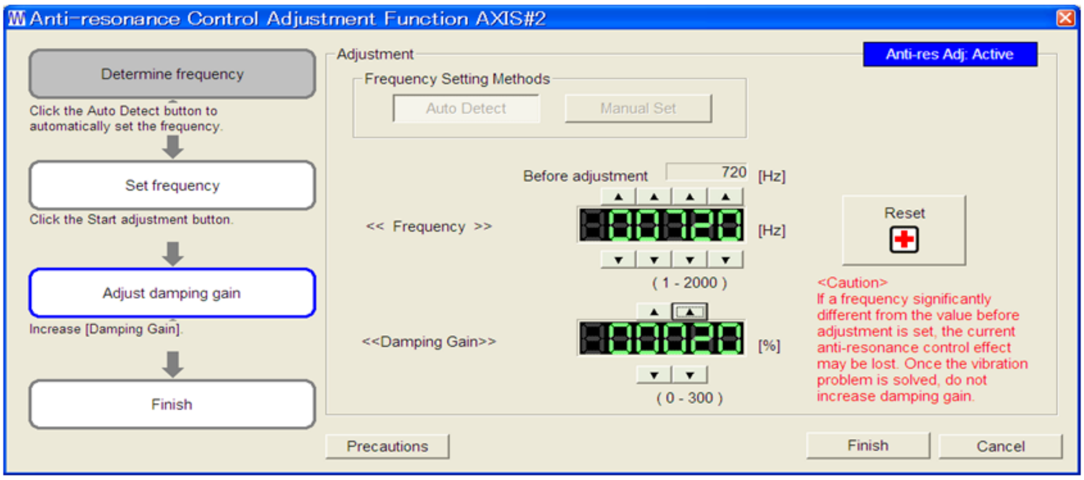

**7.** Click **Anti-res Ctrl Adj**. The following window appears.



**8.** Click **Auto Detect** to set the frequency and click **Start adjustment**. The following window appears.




**9.** Adjust the damping gain by clicking the setting arrows.

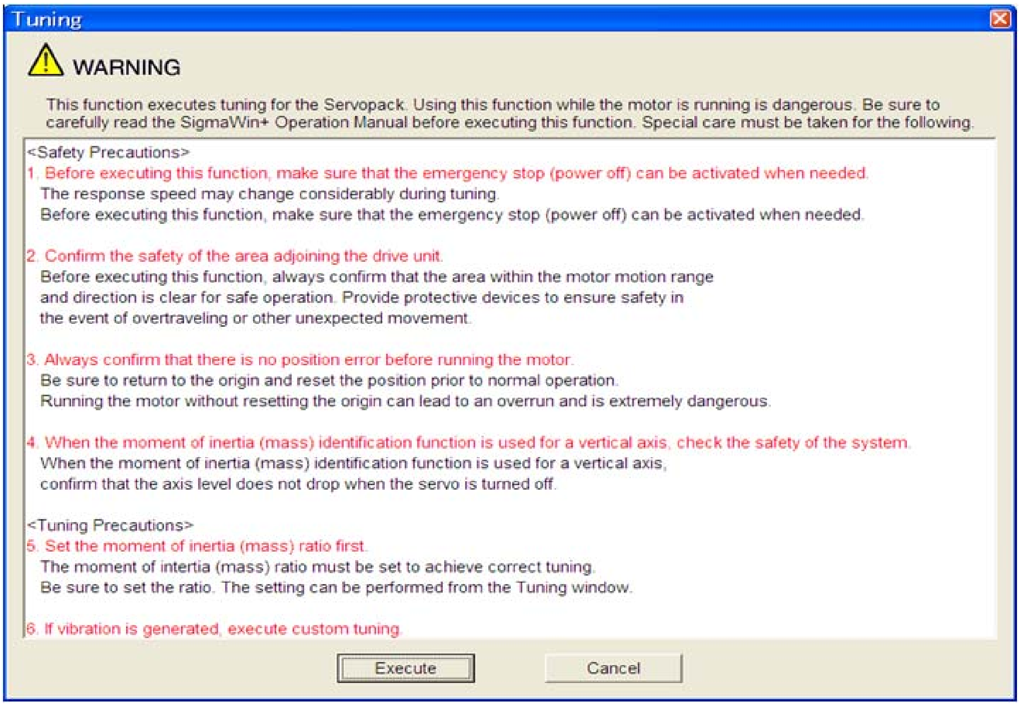



Click **Reset** to reset the settings to their original values during adjustment.

**10.** When the adjustment is complete, click **Finish** to return to the main window. The set values will be written in the SERVOPACK.

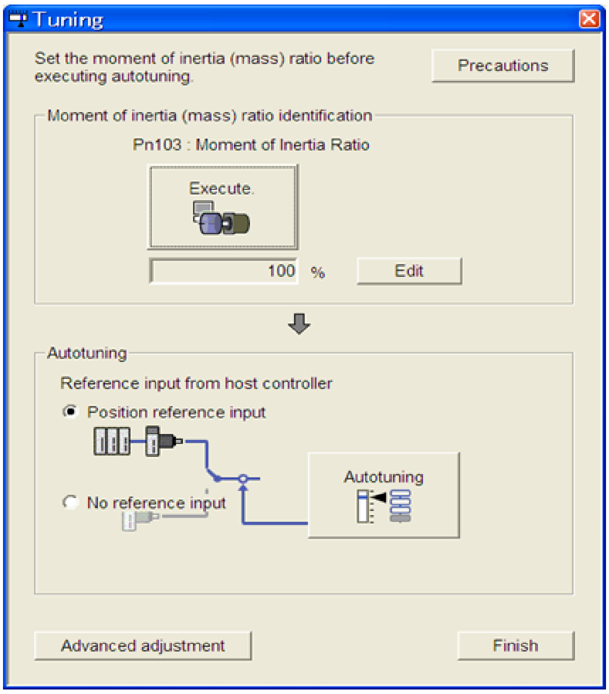
## ■ With Determined Vibration Frequency

**1.** In the SigmaWin Σ-V-SD (MT) component main window, click **Tuning** and then click **Tuning**.

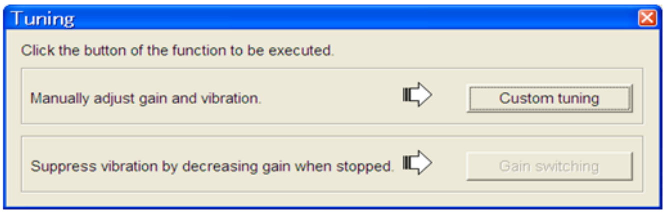



Click **Cancel** to return to the SigmaWin Σ-V-SD (MT) component main window without executing tuning.

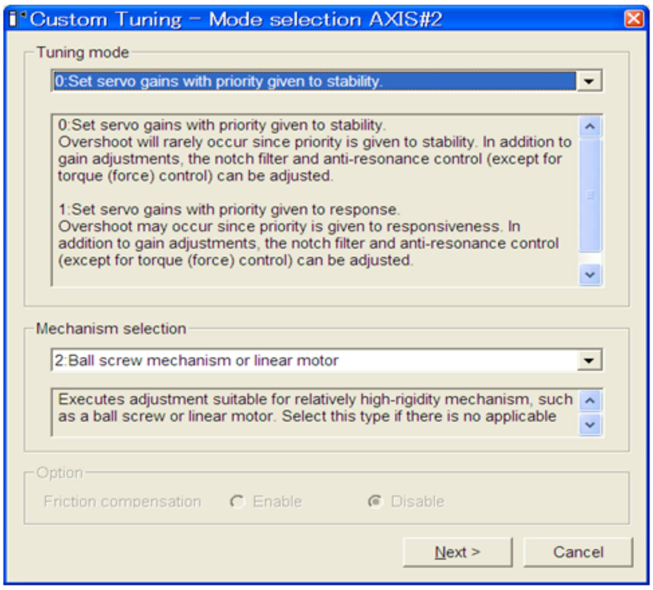
**2.** Click **Execute**. The following window appears.



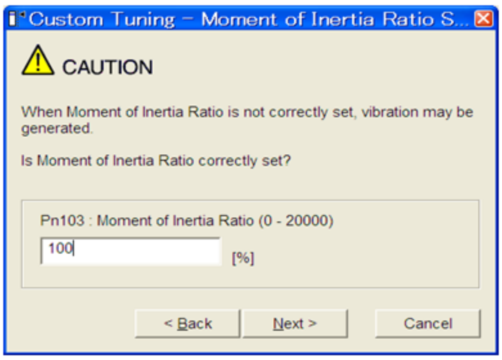
**3.** Click **Advanced adjustment**. The following box appears.



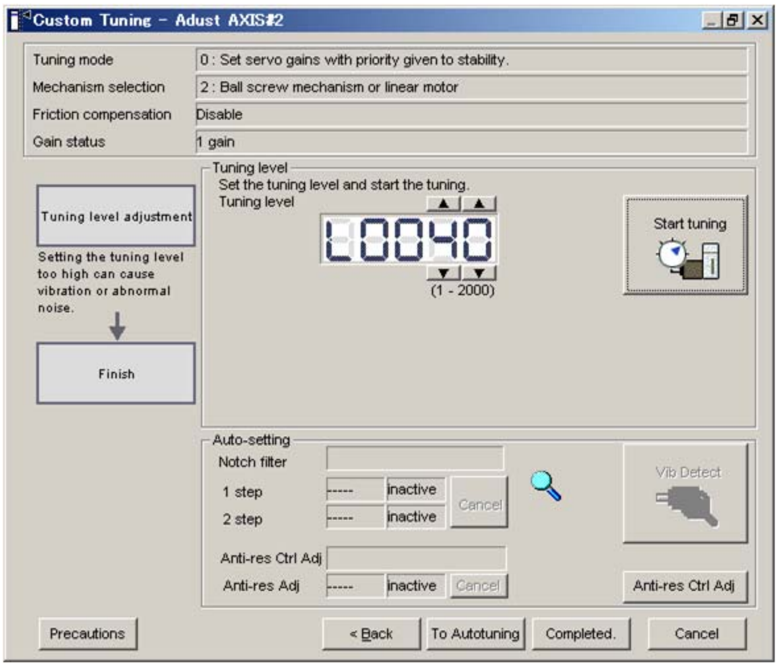

**4.** Click **Custom tuning**. The following box appears.



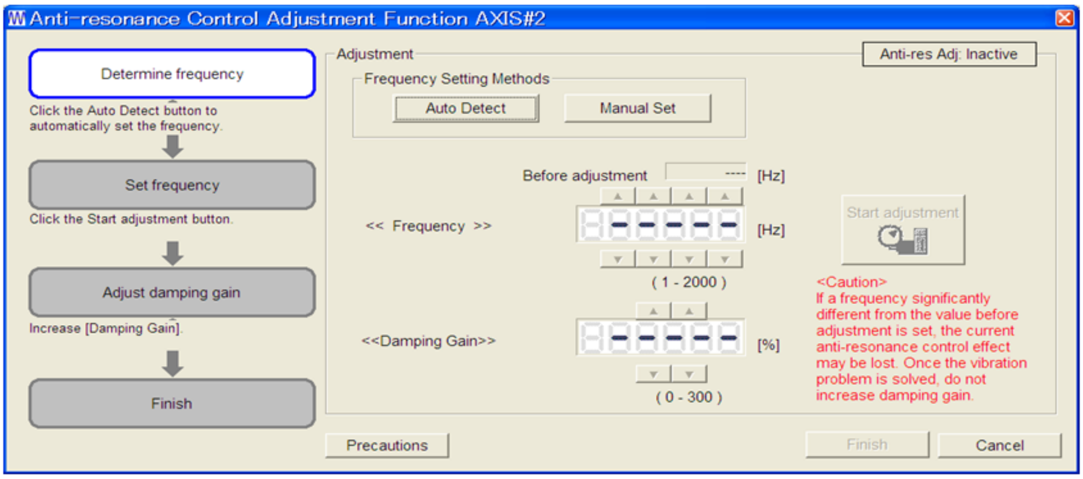

**5.** Select the tuning mode and the mechanism, and then click **Next**. The following box appears.



6. Enter the correct moment of inertia ratio and then click **Next**. The following window appears.



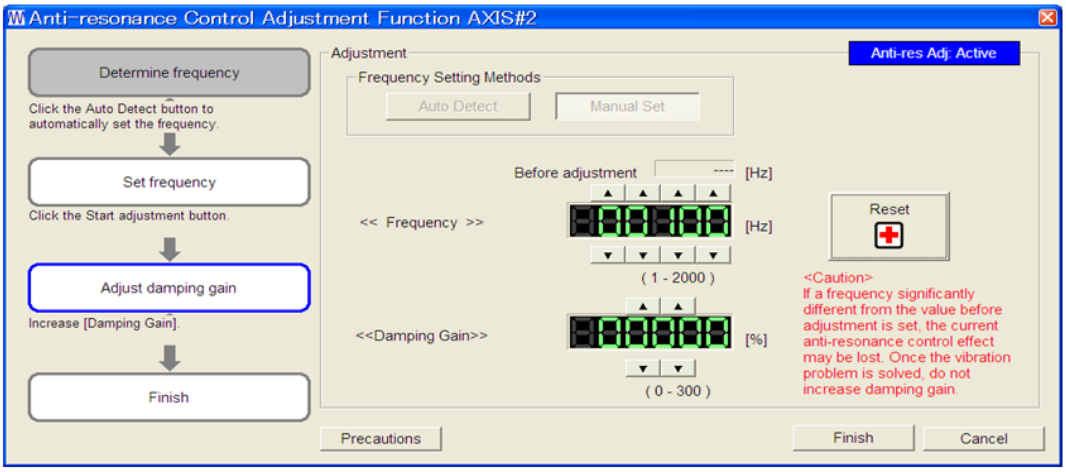

7. Click **Anti-res Ctrl Adj**. The following window appears.



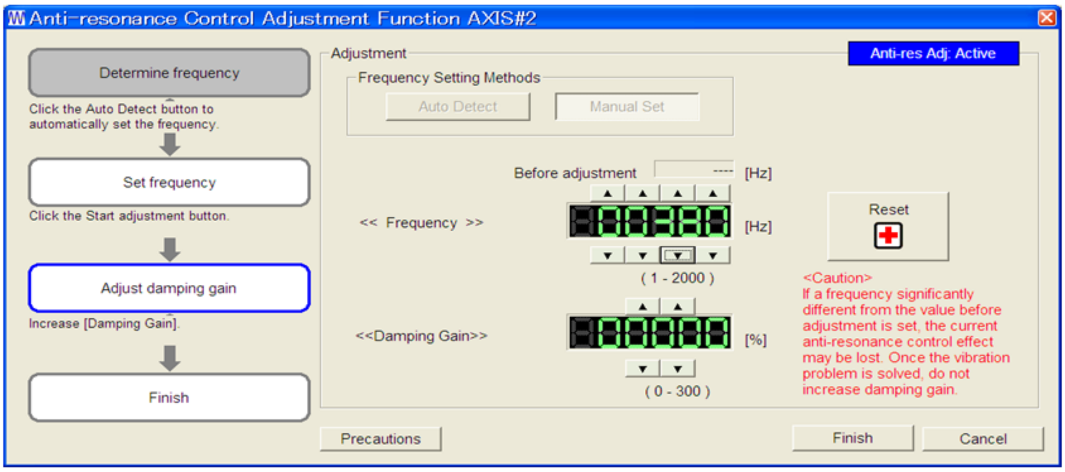

Adjustments

9

**8.** Click **Manual Set** to set the frequency and click **Start adjustment**. The following window appears.

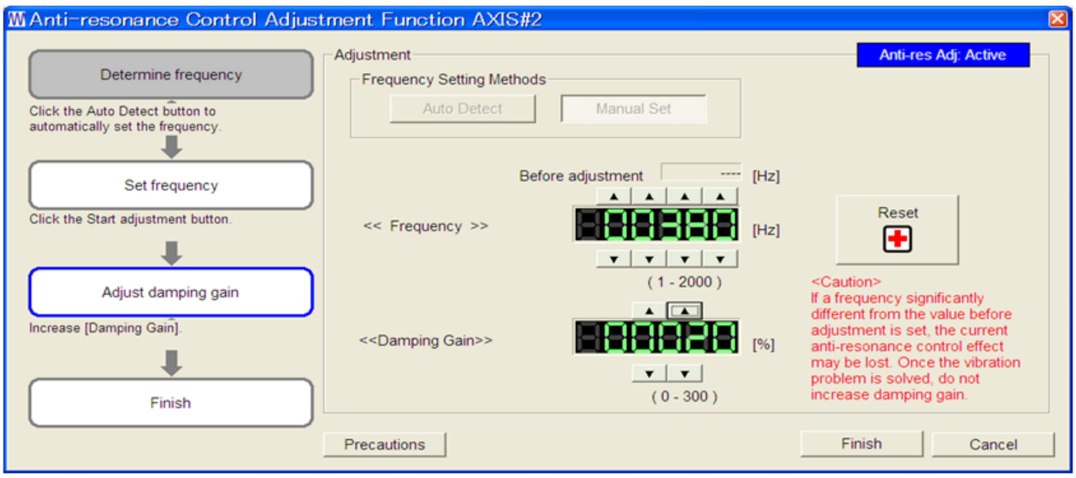



**9.** Adjust the frequency by clicking the setting arrows.




Click **Reset** to reset the settings to their original values during adjustment.

**10.** Adjust the damping gain by clicking the setting arrows.




Click **Reset** to reset the settings to their original values during adjustment.

**11.** When the adjustment is complete, click **Finish** to return to step 6. The set values will be written in the SERVOPACK.

## 9.5.2 Related Parameters

The following table lists parameters related to this function and their possibility of being changed while executing this function or of being changed automatically after executing this function.

- Parameters related to this function
  These are parameters that are used or referenced when executing this function.

- Allowed changes during execution of this function
  Yes : Parameters can be changed using SigmaWin for Σ-V-SD (MT) while this function is being executed.
  No : Parameters cannot be changed using SigmaWin for Σ-V-SD (MT) while this function is being executed.

- Automatic changes after execution of this function
  Yes : Parameter set values are automatically set or adjusted after execution of this function.
  No : Parameter set values are not automatically set or adjusted after execution of this function.

| Parameter | Name | Mid-execution Changes | Automatic Changes |
|---|---|---|---|
| **Pn160** | Anti-Resonance Control Related Switch | Yes | Yes |
| **Pn161** | Anti-Resonance Frequency | No | Yes |
| **Pn162** | Anti-Resonance Gain Compensation | Yes | No |
| **Pn163** | Anti-Resonance Damping Gain | No | Yes |
| **Pn164** | Anti-Resonance Filter Time Constant 1 Compensation | Yes | No |
| **Pn165** | Anti-Resonance Filter Time Constant 2 Compensation | Yes | No |

# 9.6 High-speed Control Adjustments

After performing advanced autotuning or one-parameter tuning, servo tuning can be performed according to machine operation to enable high-speed, high-precision machine operation.

The procedure is described here.

**1.** Select the control functions according to the machine operation.

Select the control functions to use based on the following table.

| Operation Mode | Required Operations | Control Functions That Are Used |
|---|---|---|
| Cutting operation | High-precision cutting | Predictive control and quadrant projection compensation |
| High-speed feeding operation | Machine vibration suppression | Internal speed feedforward control and model following control |
| Spindle axis operation | Changing the gain | Gain selection |

**2.** Set Machine tool function (23C8h:1)* and the related parameters.

Refer to the following table to make the required settings for Machine tool function and the parameters.

* For details, refer to *Σ-V-SD series User's Manual For Command Profile EtherCAT (CoE) Communications Reference* (manual no. SIEP S800000 95).

| Operation Mode | Machine Tool Function | | | | Control Function | | | Remark |
|---|---|---|---|---|---|---|---|---|
| | Bit5 | Bit4 | Bit1 | Bit0 | Pn070.0 | Pn070.1 | Pn071.0 | |
| | Operation Mode | | Gain Selection | | Predictive Control | Quadrant Projection Compensation | Internal speed feedforward control and model following control | |
| Cutting operation | 0 | | Gain bank 0 (Fixed) | | 0 | 0 | – | Cannot use internal speed feedforward control function. |
| | | | | | 0 | 1 or 2 | – | |
| | | | | | 1 | 0 | – | |
| | | | | | 1 | 1 or 2 | – | |
| High-speed feeding operation | 1 | | Gain bank 1 (Fixed) | | – | – | 0 or 1 or 2 | – |
| Spindle axis operation | 2 | | Select gain bank from 0 to 3. | | – | – | – | Cannot use internal speed feedforward control function. |

• Related Parameters

| Parameter (Index Number) | | Function | When Enabled | Classification |
|---|---|---|---|---|
| Pn070 (2030h:5) | n.□□□0 [Factory setting] | Disables predictive function. | After restart | Setup |
| | n.□□□1 | Enables predictive function. | | |
| | n.□□0□ [Factory setting] | Disables quadrant projection compensation function. | | |
| | n.□□1□ | Enables quadrant projection compensation function 1. | | |
| | n.□□2□ | Enables quadrant projection compensation function 2. | | |
| Pn071.0 (2030h:6) | n.□□□0 [Factory setting] | No function | After restart | Setup |
| | n.□□□1 | Uses internal speed FF function. | | |
| | n.□□□2 | Uses model following control function. | | |

• Parameters for Gain Bank 0 to 3

| Parameter | Gain Bank | | | |
|---|---|---|---|---|
| | 0 | 1 | 2 | 3 |
| Speed Loop Gain | Pn100 | Pn104 | Pn12B | Pn12E |
| Speed Loop Integral Time Constant | Pn101 | Pn105 | Pn12C | Pn12F |
| Position Loop Gain | Pn102 | Pn106 | Pn12D | Pn130 |
| Torque Reference Filter Time Constant | Pn401 | Pn412 | Pn413 | Pn414 |

# 10

# Standards Compliance

# 10.1 Compliance with UL Standards, EU Directives, UK Regulations and Other Safety Standards

Certification marks for the standards for which the product has been certified by certification bodies are shown on nameplate. Products that do not have the marks are not certified for the standards.

## (1) North American Safety Standards (UL)

| Products and Models | North American Safety Standards (UL File No.) |
|---|---|
| Power regeneration converter (CACP-JU□□□3□),<br>SERVOPACK (CACR-JU□□□□C□) | UL508C (E147823) |
| Servomotor (SGMGV-□□□8□□□) | UL1004-1<br>UL1004-6<br>(E165827)<br>CSA C22.2 No.100 |

## (2) EU Directives

| Products and Models | EU Directives | Harmonized Standards |
|---|---|---|
| Power regeneration converter (CACP-JU□□□3□),<br>SERVOPACK (CACR-JU□□□□C□) | Machinery Directive<br>2006/42/EC | EN ISO 13849-1: 2015* |
| | EMC Directive<br>2014/30/EU | EN 55011 Group 1, Class A<br>EN 61000-6-2<br>EN 61000-6-4<br>EN 61800-3<br>(Category C2, Second environment) |
| | Low Voltage Directive<br>2014/35/EU | EN 61800-5-1 |
| | RoHS Directive<br>2011/65/EU<br>(EU)2015/863 | EN IEC 63000 |
| Spindle motor (UAKAJ, UAKBJ) | EMC Directive<br>2014/30/EU | EN 55011 Group 1, Class A<br>EN 61000-6-2<br>EN 61000-6-4<br>EN 61800-3<br>(Category C2, Second environment) |
| | Low Voltage Directive<br>2014/35/EU | EN 60034-1<br>EN 60034-5 |
| | RoHS Directive<br>2011/65/EU<br>(EU)2015/863 | EN IEC 63000 |
| Servomotor (SGMGV-□□□8□□□) | EMC Directive<br>2014/30/EU | EN 55011 Group 1, Class A<br>EN 61000-6-2<br>EN 61800-3<br>(Category C2, Second environment) |
| | Low Voltage Directive<br>2014/35/EU | EN 60034-1<br>EN 60034-5 |
| | RoHS Directive<br>2011/65/EU<br>(EU)2015/863 | EN IEC 63000 |

* For details, refer to *(4) Safety Standards*.

Standards Compliance

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## (3) UK Conformity Assessed (UKCA)

UK
CA

| Products and Models | UK Regulations | Designated Standards |
|---|---|---|
| Power regeneration converter (CACP-JU□□□3□), SERVOPACK (CACR-JU□□□□C□) | Supply of Machinery (Safety) Regulations<br>S.I. 2008/1597 | EN ISO 13849-1: 2015* |
| | Electromagnetic Compatibility Regulations<br>S.I. 2016/1091 | EN 55011 Group 1, Class A<br>EN 61000-6-2<br>EN 61000-6-4<br>EN 61800-3<br>(Category C2, Second environment) |
| | Electrical Equipment (Safety) Regulations<br>S.I. 2016/1101 | EN 61800-5-1 |
| | Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations<br>S.I. 2012/3032 | EN IEC 63000 |
| Spindle motor (UAKAJ, UAKBJ) | Electromagnetic Compatibility-Regulations<br>S.I. 2016/1091 | EN 55011 Group 1, Class A<br>EN 61000-6-2<br>EN 61000-6-4<br>EN 61800-3<br>(Category C2, Second environment) |
| | Electrical Equipment (Safety) Regulations<br>S.I. 2016/1101 | EN 60034-1<br>EN 60034-5 |
| | Restriction of the Use of Certain-Hazardous Substances in Electricaland Electronic Equipment Regulations<br>S.I. 2012/3032 | EN IEC 63000 |
| Servomotor (SGMGV-□□□8□□□) | Electromagnetic Compatibility-Regulations<br>S.I. 2016/1091 | EN 55011 Group 1, Class A<br>EN 61000-6-2<br>EN 61800-3<br>(Category C2, Second environment) |
| | Electrical Equipment (Safety) Regulations<br>S.I. 2016/1101 | EN 60034-1<br>EN 60034-5 |
| | Restriction of the Use of Certain-Hazardous Substances in Electricaland Electronic Equipment Regulations<br>S.I. 2012/3032 | EN IEC 63000 |

Note: We declared the UKCA marking based on the designated standards in the above table.

* For details, refer to *(4) Safety Standards*.

### (4) Safety Standards

| Products and Models | Safety Standards | Standards |
|---|---|---|
| SERVOPACK (CACR-JU□□□□C□) | Safety of Machinery | EN ISO 13849-1: 2015<br>EN 60204-1, Stop Category 0 |
| | Functional Safety | EN 61508 series<br>EN 61800-5-2 |
| | Functional Safety EMC | EN 61326-3-1 |

■ Safety Performance

| Items | Standards | Performance Level |
|---|---|---|
| Safety Integrity Level | EN 61508 | SIL2 |
| Probability of Dangerous Failure per Hour | EN 61508 | PFH = $3.95 \times 10^{-9}$ [1/h] |
| Performance Level | EN ISO 13849-1 | PLd (Category 3) |
| Mean Time to Dangerous Failure of Each Channel | EN ISO 13849-1 | MTTFd: High |
| Average Diagnostic Coverage | EN ISO 13849-1 | DCavg: Low |
| Stop Category | EN 60204-1 | Stop category 0 |
| Safety Function | EN 61800-5-2 | STO |
| Proof Test Interval | EN 61508 | 10 years |

# 10.2 Models in Compliance with Standards

The following table shows the models that are in compliance with standards.

Note: Contact your Yaskawa representative for details on models scheduled for certification.

■ Power Regeneration Converter

| Model | North American Safety Standards (UL) | EU Directives | UKCA |
|---|---|---|---|
| CACP-JU15A3A | Not available | Complied | Complied |
| CACP-JU19A3A | | | |
| CACP-JU22A3A | | | |
| CACP-JU30A3A | | | |
| CACP-JU15D3A | | | |
| CACP-JU19D3A | | | |
| CACP-JU22D3A | | | |
| CACP-JU15A3B | Certified | | |
| CACP-JU19A3B | | | |
| CACP-JU22A3B | | | |
| CACP-JU30A3B | | | |
| CACP-JU37A3B | | | |
| CACP-JU45A3B | | | |
| CACP-JU15D3B | | | |
| CACP-JU19D3B | | | |
| CACP-JU22D3B | | | |
| CACP-JU45D3B | | | |

■ SERVOPACK for One Axis

| Model | North American Safety Standards (UL) | EU Directives | UKCA | Safety Standards and Safety Performance |
|---|---|---|---|---|
| CACR-JU028ACA | Certified | Complied | Complied | Certified |
| CACR-JU036ACA | | | | |
| CACR-JU065ACA | | | | |
| CACR-JU084ACA | | | | |
| CACR-JU102ACA | | | | |
| CACR-JU125ACA | | | | |
| CACR-JU196ACA | | | | |
| CACR-JU014DCA | | | | |
| CACR-JU018DCA | | | | |
| CACR-JU033DCA | | | | |
| CACR-JU042DCA | | | | |
| CACR-JU051DCA | | | | |
| CACR-JU098DCA | | | | Pending |

■ SERVOPACK for Two Axes

| Model | North American Safety Standards (UL) | EU Directives | UKCA | Safety Standards and Safety Performance |
|---|---|---|---|---|
| CACR-JUM23ACA | Certified | Complied | Complied | Certified |
| CACR-JUM24ACA | | | | |
| CACR-JUM25ACA | | | | |
| CACR-JUM23DCA | Pending | | | |
| CACR-JUM24DCA | | | | |
| CACR-JUM25DCA | | | | |

# 10.3 Precautions for Complying with UL Standards

This drive has been tested according to UL standard UL508C, and it fully complies with the UL requirements.

To comply with the UL standard, be sure to meet the following conditions when combining this drive with other devices.

## (1) Installation Location

Install the servo drive in a location with a pollution degree of 2 or lower according to UL specifications. Install at an altitude of 1000 m max.

## (2) Wiring the Main Circuit Terminals

Wire the main circuit terminals with the maximum tightening toque that is given in *7.2.1 (1) Wire Sizes and Tightening Torques*.

## (3) Short-circuit Rating

This servo drive has undergone UL short-circuit testing using a power supply with a current of 31,000 A maximum and a voltage of 480 V maximum.

## (4) 24-VDC Control Power Supply

Use a 24-VDC control power supply with double insulation or reinforced insulation.

## (5) AC Reactor

Use an AC reactor for UL compliance according to *5.2.1 Specifications*.

## (6) Magnetic Contactor for Winding Selection

Use a magnetic contactor for winding selection for UL compliance according to *5.3.1 Specifications*.

## (7) Heat Sink Cooling

Provide an airflow of 2.5 m/s or higher in the ventilation duct to cool the heat sink. Or, use a Yaskawa base mounting unit.

Refer to *5.5 Base Mounting Units* for information on the base mounting unit.

## (8) Grounding

Ground the neutral point of a 400-V power supply.

The leakage current may exceed 3.5 mA. Therefore, use a 10-mm$^2$ or thicker copper grounding wire.

# 10.4 Precautions for Complying with European Standards

## 10.4.1 EMC Installation Conditions

This section describes the recommended installation conditions that satisfy EMC guidelines for the Σ-V-SD driver.

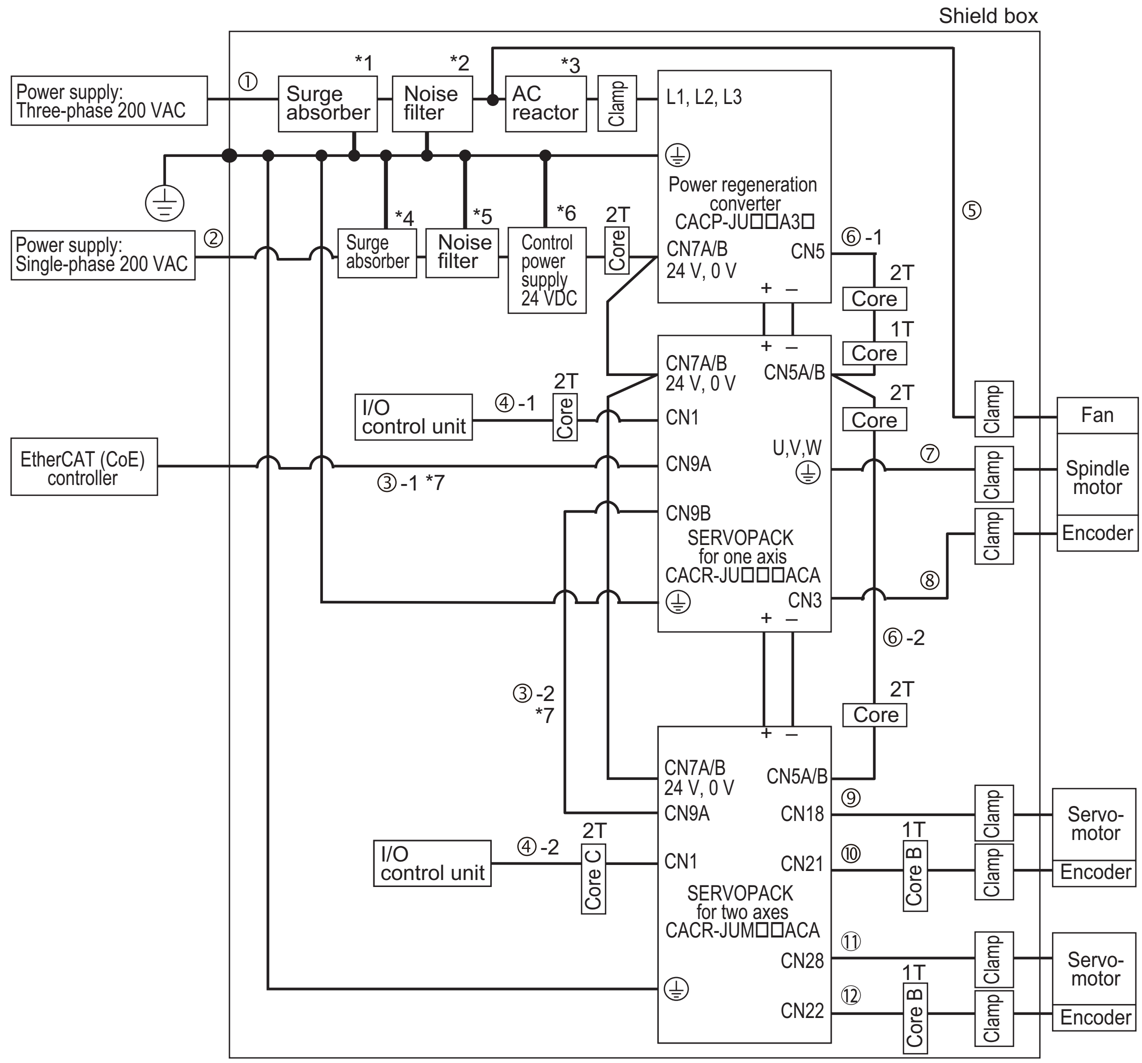
This section describes the EMC installation conditions satisfied in test conditions prepared by Yaskawa. The actual EMC level may differ depending on the actual system's configuration, wiring, and other conditions. However, because this product is built-in, check that the following conditions are still met after being installed in the user's product.

The harmonized standards are EN 55011 Group 1, Class A, EN 61000-6-2, EN 61000-6-4, and EN 61800-3 (Category C2, Second environment).

| ⚠ WARNING |
| --- |
| • In a domestic environment, this product may cause radio interference in which case supplementary mitigation measures may be required. |

| ⚠ CAUTION |
| --- |
| • This equipment is not intended for use in residential environments and may not provide adequate protection to radio reception in such environments. |

The circuit examples are shown below.




| Symbol | Cable Name | Specification |
|---|---|---|
| ① | Main circuit cable | Shield cable |
| ② | Control power cable | Non-shield cable |
| ③-1, ③-2 | EtherCAT (CoE) communication cable | Shield cable |
| ④-1, ④-2 | Input/output signal cable | Shield cable |
| ⑤ | Spindle motor fan cable | Shield cable |
| ⑥-1, ⑥-2 | Local bus cable | Shield cable |
| ⑦ | Spindle motor main circuit cable | Shield cable |
| ⑧ | Spindle motor encoder cable | Shield cable |
| ⑨ | Servomotor main circuit cable for 1st axis | Shield cable |
| ⑩ | Servomotor encoder cable for 1st axis | Shield cable |
| ⑪ | Servomotor main circuit cable for 2nd axis | Shield cable |
| ⑫ | Servomotor encoder cable for 2nd axis | Shield cable |

∗1. Recommended surge absorber model: LT-C32G801WS (Soshin Electric Co., Ltd.)
∗2. For more information on this noise filter, refer to *5.4 Noise Filter*.
∗3. For more information on this AC reactor, refer to *5.2 AC Reactor*.
∗4. Install the following surge absorber on the power line between the single-phase 200 V power supply and the 24 VDC power supply.
Surge absorber model: LT-C12G801WS (Soshin Electric Co., Ltd.)

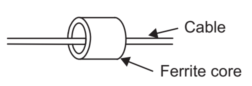
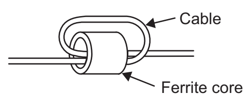
∗5. Install the following noise filter on the power line between the single-phase 200 V power supply and the 24 VDC power supply.
Noise filter model: HF2005A-UP (Soshin Electric Co., Ltd.)

∗6. Use a 24-VDC control power supply with double insulation against primary or reinforced insulation.

∗7. For the EtherCAT (CoE) communication cable, refer to *2.2.3 (9) Cable Specifications for Use with EtherCAT (CoE) Communications*.

## 10.4.2 Precautions

### (1) Attachment Methods of Ferrite Cores

| One turn | Two turn |
|---|---|
|   |   |

### (2) Recommended Ferrite Core

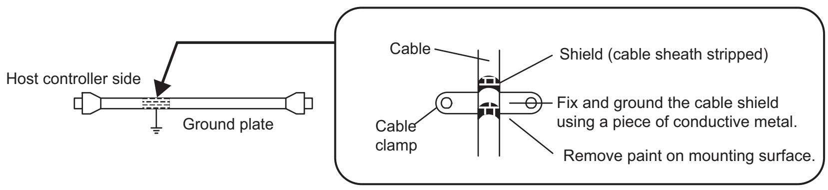
| Core Name (Used in diagrams)* | Model | Manufacturer |
|---|---|---|
| Core | SFT-72SN | TAKEUCHI INDUSTRY Co., Ltd. |
| Core B | TFT-152613N | |
| Core C | TFT-274015S | |

∗ For details, refer to diagrams in *10.4.1 EMC Installation Conditions*.

### (3) Fixing the Cable

Fix and ground the cable shield using a piece of conductive metal.

• Example of Cable Clamp




### (4) Shield Box

A shield box, which is a closed metallic enclosure, is effective as reinforced shielding against electromagnetic interference (EMI) from SERVOPACKs. The structure of the box should allow the main body, door, and cooling unit to be attached to the ground. The box opening should be as small as possible.

Note: Do not connect the analog monitor cable to the SERVOPACK during operations.
Connect them only when the machinery is stopped during maintenance.

Standards Compliance

10

### 10.4.3 Compliance with Low Voltage Directive

This drive has been tested according to European standard IEC61800-5-1, and it fully complies with the Low Voltage Directive.

To comply with the Low Voltage Directive, be sure to meet the following conditions when combining this drive with other devices.

#### (1) Installation Location

Install the servo drive in a location with an overvoltage category of 3 and a pollution degree of 2 or lower according to IEC 664 specifications. Install at an altitude of 1000 m max.

#### (2) Protection against Foreign Matter

The degree of protection of the servo drives is IP10.

#### (3) Grounding

Ground the neutral point of the 400-V power supply. The leakage current may exceed 3.5 mA. Therefore, use a 10-mm$^2$ or thicker copper grounding wire.

#### (4) 24-VDC Control Power Supply

Use a 24-VDC control power supply with double insulation or reinforced insulation against primary.

# 10.5 Precautions for Complying with United Kingdom Conformity Assessed (UKCA)

The products conform with the related technical requirements under UK legislation.

The UK legislation requirements for this product are identical to the requirements for CE. To comply with the UK legislation requirements for the equipment or machine in which you used the products, refer to *10.4 Precautions for Complying with European Standards*

# 11

# Inspection, Maintenance, and Troubleshooting

# 11.1 Inspection and Maintenance

## 11.1.1 Motor

### (1) Inspection

The following table provides explanations about the inspections required for the spindle motor and the servomotor. The inspection and maintenance frequencies in the table are only guidelines. Increase or decrease the frequency to suit the operating conditions and environment.

| Item | Frequency | Procedure | Comments |
|---|---|---|---|
| Vibration and Noise | Daily | Touch and listen.<br>There is no problem as long as vibration and the sound level do not increase over normal levels. | – |
| Exterior | According to degree of contamination | Clean with cloth or compressed air. | – |
| Insulation Resistance Measurement | At least once a year | Disconnect the SERVOPACK and test the insulation resistance with a 500-V resistance meter between each of the phases U, V, and W in the motor's main circuit cable and FG. Must exceed 10 MΩ. | Contact your Yaskawa representative if the insulation resistance is below 10 MΩ . |
| Overhaul | Spindle motor:<br>At least once every 12,000 hours or 2 years.<br>Servomotor:<br>At least once every 20,000 hours or 5 years. | Contact your Yaskawa representative. | – |

**IMPORTANT**

During inspection and maintenance, do not disassemble the motor.

### (2) Replacement Schedule

The parts of the motor have a limited service life due to mechanical wear. Perform periodic inspections for preventive maintenance. The part replacement period varies with the usage condition and usage environment. A part must be replaced if there is any problem, even if it is not yet time to replace it. Contact your Yaskawa representative if a part needs to be replaced or if the standard replacement period has elapsed.

| Motor | Part | Standard Replacement Period | Remarks |
|---|---|---|---|
| Spindle motor | Cooling fan | 12,000 hours or 2 years | A part must be replaced if there is any problem, even if the standard replacement period has not yet elapsed. |
| | Bearing | 12,000 hours or 2 years | |
| Servomotor | Oil seal | 5,000 hours | |
| | Bearing | 20,000 hours or 5 years | |

## 11.1.2 Σ-V-SD Driver

### (1) Inspection

For inspections and maintenance of the Σ-V-SD Driver, follow the inspection procedures in the table below at least once every year.

| Item | Frequency | Procedure | Remedy |
|---|---|---|---|
| Exterior | At least once a year | Check for dust, dirt, and oil on surfaces. | Clean with compressed air or cloth. |
| Loose screws | | Check for loose terminal block and connector screws. | Tighten any loose screws. |

### (2) Replacement Schedule

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

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

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

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

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

# 11.2 Alarm Displays

If the SERVOPACK detects an alarm, it stops the motor with the motor stop method for alarms that is described below and displays the alarm status.

## ■ Status Indications

| | |
|---|---|
| Statusword (object 6041h) | Bit 3 (Fault) in the Statusword changes to 1.<br>(Bit 3 is 0 when operation is normal.) |
| Error code (object 603Fh) | The current alarm code is stored in object 603Fh. |
| Emergency message* | The controller is notified of the alarm that occurred.<br>(Notification may not be possible if EtherCAT communications are unsta-ble.) |

* For details, refer to *11.4 Monitoring Communications Data When Alarms or Warnings Occur*.

## ■ Motor Stop Method for Alarms

Gr.1: The alarm stopping method depends on the setting of Pn01E.0.
If Pn01E.0 = 0 and a SERVOPACK with a capacity of 5 kW max. is used:
The stopping method set in Pn001.0 is used. Stopping is performed with dynamic braking (DB) in the factory setting.
If Pn01E.0 = 0 and a SERVOPACK with a capacity that exceeds 5 kW max. is used:
A coasting to a stop is performed.
If Pn01E.0 = 1 to 8:
A coasting to a stop is performed.

Gr.2: The motor is stopped according to the setting in Pn00B.1 if an alarm occurs. Pn00B.1 is factory-set to stop the motor by setting the speed reference to "0." The motor under torque control will always use the Gr.1 method to stop. By setting Pn00B.1 to 1, the motor stops using the same method as Gr.1. When coordinating a number of motors, use this alarm stop method to prevent machine damage that may result due to differences in the stop method.

## ■ Resetting Alarms

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.

The alarm name, alarm meaning, motor stop method for alarms, and alarm reset capability are listed in order of the alarm numbers in *11.2.1 List of Servo Drive Alarms* and *11.2.2 List of Alarms for EtherCAT (CoE) Communications*.

The probable causes of alarms and corrective actions are provided in *11.2.3 Troubleshooting of the Servo Drive Alarms* and *11.2.4 Troubleshooting of the EtherCAT (CoE) Communications*.

## 11.2.1 List of Servo Drive Alarms

The following table shows the list of alarm name, meaning, motor stop method and alarm reset in alarm number order.

| Alarm Display | Alarm Name | Meaning | Motor 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.029** | Motor Parameter Checksum Error | The motor parameter data in the SERVOPACK is incorrect. | Gr.1 | N/A |
| **A.02C** | Converter Parameter Checksum Error | The data of the parameter in the power regeneration converter is incorrect. | Gr.1 | N/A |
| **A.02D** | Converter Parameter Format Error | The format of the parameter in the power regeneration converter is incorrect. | Gr.1 | N/A |
| **A.02E** | Converter System Checksum Error | The data of the parameter in the power regeneration converter is incorrect. | Gr.1 | N/A |
| **A.030** | Main Circuit Detector Error | Detection data for main circuit is incorrect. | Gr.1 | Available |
| **A.040** | Parameter Setting Error | The parameter setting in the SERVOPACK is outside the allowable setting range. | Gr.1 | N/A |
| **A.042** | Parameter Combination Error | Combination of some parameters exceeds the setting range. | Gr.1 | N/A |
| **A.04B** | Converter Parameter Setting Error | The parameter setting in the power regeneration converter is outside the allowable setting range. | Gr.1 | N/A |
| **A.050** | Combination Error | The SERVOPACK and the motor capacities do not match each other. | Gr.1 | Available |
| **A.051** | Unsupported Device Alarm | The device unit unsupported was connected. | Gr.1 | N/A |
| **A.052** | Motor Type Setting Mismatch | The motor type/Application selection setting (Pn01E.0) does not match the motor parameter written inside the SERVOPACK. | Gr.1 | N/A |
| **A.053** | Winding Selection Setting Mismatch | The Winding Change Setting (Pn01E.1) does not match the motor parameter written inside the SERVOPACK. | Gr.1 | N/A |
| **A.054** | Unsupported Winding Selection Alarm | The combination of the SERVOPACK and motor does not support winding selection. | Gr.1 | N/A |
| **A.05A** | Induction Motor Combination Error | The capacity of the spindle motor is outside of the range that can be combined. | Gr.1 | Available |
| **A.05B** | Converter Combination Error | The converter and SERVOPACK are not combined correctly. | Gr.1 | N/A |
| **A.0B0** | Cancelled Servo ON Command Alarm | The host controller reference was sent to turn the Servo ON (Enable operation) after the Servo ON function was used with the utility function. | Gr.1 | Available |
| **A.100** | Overcurrent | An overcurrent flowed through the IGBT.<br>Heat sink of the SERVOPACK was overheated. | Gr.1 | N/A |
| **A.10A** | Converter Overcurrent | An overcurrent flowed through the power transistor inside the power regeneration converter. | Gr.1 | N/A |
| **A.11A** | Converter Ground Fault | A ground fault occurred inside the power regeneration converter. | Gr.1 | N/A |
| **A.22A** | Converter Fuse Blowout | The fuse of the main power supply inside the power regeneration converter is blown out. | Gr.1 | N/A |
| **A.400** | Overvoltage | The DC-bus voltage inside the SERVOPACK is excessively high. | Gr.1 | Available |
| **A.40A** | Converter Overvoltage | The DC-bus voltage inside the power regeneration converter is abnormally high. | Gr.1 | Available |
| **A.40B** | Converter AC Overvoltage | The AC power supply voltage inside the power regeneration converter is abnormally high. | Gr.1 | Available |
| **A.40C** | Abnormal Voltage in Converter Main Circuit | An error occurred in the main circuit of the power regeneration converter. | Gr.1 | Available |

(cont'd)

| Alarm Display | Alarm Name | Meaning | Motor Stop Method | Alarm Reset |
|---|---|---|---|---|
| **A.410** | Undervoltage | The DC-bus voltage is excessively low. | Gr.2 | Available |
| **A.41A** | Converter DC Undervoltage | The DC-bus voltage inside the power regeneration converter is abnormally low. | Gr.2 | Available |
| **A.41B** | Converter AC Undervoltage | The AC voltage inside the power regeneration converter is abnormally low. | Gr.1 | Available |
| **A.41C** | Power Failure While Motor Running | The AC power supply was cut off while the motor was running. | Gr.1 | Available |
| **A.42C** | Converter Initial Charging Error | The charging of the main circuit capacitor did not finish within the specified period of time. | Gr.1 | Available |
| **A.450** | Main Circuit Capacitor Overvoltage | The capacitor of the main circuit has deteriorated or is faulty. | Gr.1 | N/A |
| **A.510** | Overspeed | The motor speed is excessively high. | Gr.1 | Available |
| **A.521** | Autotuning Alarm | Vibration was detected during autotuning. | Gr.1 | Available |
| **A.531** | Excessive Speed Deviation | The deviation between the speed reference and the actual motor speed is abnormal. | Gr.1 | Available |
| **A.540** | Overspeed (During Low-speed Winding) | The low-speed winding maximum rotation speed was exceeded during low-speed winding. | Gr.1 | Available |
| **A.690** | Winding Selection Operation Fault | • During the winding selection operation check that is performed when the power is turned ON, the electromagnetic contactor for winding selection did not change according to the internal command.<br>• Winding selection was not completed within two seconds of receiving the winding selection command.<br>• Chattering occurred in the electromagnetic contactor for winding selection when the winding selection command was not received. | Gr.1 | N/A |
| **A.6B0** | Emergency Stop Failure | The motor did not stop within 10 s after the emergency stop signal input. | 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.72A** | Converter Electric Operation Overload | Continuous electrical operation was performed that exceeded the rated output of the power supply regenerative converter. | Gr.2 | Available |
| **A.72B** | Converter Power Supply Regenerative Overload | Continuous regenerative operation was performed that exceeded the ratings of the power regenerative converter. | 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.74A** | Converter Inrush Resistance Overload | The main circuit power supply turned ON and OFF frequently. | Gr.1 | Available |
| **A.790** | Motor Overheated | The motor temperature exceeded the upper limit. | Gr.1 | Available |
| **A.791** | Motor Temperature Detection Error | The motor thermistor is either disconnected or is damaged. | Gr.1 | N/A |
| **A.7A0** | Heat Sink in SERVOPACK Overheated | The temperature of the heat sink in the SERVOPACK exceeded 100°C, or the thermistor in the SERVOPACK was disconnected or damaged. | Gr.2 | Available |
| **A.7AB** | Built-in Fan in SERVOPACK Stopped*1 | The fan inside the SERVOPACK stopped. | Gr.1 | Available |
| **A.7AC** | Built-in Fan in Converter Stopped*1 | The fan inside the power regeneration converter stopped. | Gr.1 | Available |

*1. If the fan stops, an alarm or a warning will issued in accordance with the setting of SERVOPACK parameter Pn00D.2.

(cont'd)

| Alarm Display | Alarm Name | Meaning | Motor Stop Method | Alarm Reset |
|---|---|---|---|---|
| **A.7BA** | Converter Heat Sink Overheated | The heat sink inside the power regeneration converter exceeded 100°C, or the thermistor in the converter was disconnected or damaged. | Gr.2 | 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 was 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***2 | External Encoder Error of Scale | The external encoder is faulty. | Gr.1 | Available |
| **A.8A1***2 | External Encoder Error of Module | The serial converter unit is faulty. | Gr.1 | Available |
| **A.8A2***2 | External Encoder Error of Sensor (Incremental) | The external encoder is faulty. | Gr.1 | Available |
| **A.8A3***2 | External Encoder Error of Position (Absolute) | The position of external encoder is faulty. | Gr.1 | Available |
| **A.8A5***2 | External Encoder Overspeed | The overspeed from the external encoder occurred. | Gr.1 | Available |
| **A.8A6***2 | External 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.B4A** | Converter Gate Drive Output Error | An error occurred in the gate drive signal of power transistor of the power regeneration converter. | Gr.1 | N/A |
| **A.BDA** | Converter CPU: AD Conversion Circuit Error | An error occurred in the A/D conversion circuit inside the power regeneration converter. | Gr.1 | Available |
| **A.BDB** | Converter Reference Voltage Error 1 | An error occurred in the reference voltage output inside the power regeneration converter. | Gr.1 | Available |
| **A.BDC** | Converter Reference Voltage Error 2 | An error occurred in the reference voltage output inside the power regeneration converter. | Gr.1 | Available |
| **A.BDD** | Converter System Error 0 | Internal program error 0 occurred inside the power regeneration converter. | Gr.1 | N/A |
| **A.BE0** | Firmware Error | An internal program error occurred in the SERVOPACK. | Gr.1 | N/A |
| **A.BEA** | Converter System Error 1 | Internal program error 1 occurred inside the power regeneration converter. | Gr.1 | N/A |
| **A.BEB** | Converter System Error 2 | Internal program error 2 occurred inside the power regeneration converter. | 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 |
| **A.C2A** | Pulse Encoder Phase C Error/ Pulse Error | The number of pulses per revolution exceeded the setting range. | Gr.1 | N/A |

*2. The alarm that may occur when using external encoders.

(cont'd)

| Alarm Display | Alarm Name | Meaning | Motor Stop Method | Alarm Reset |
|---|---|---|---|---|
| **A.C3A** | Pulse Encoder Phase A Disconnection | The signal line for phase A of the pulse encoder is disconnected. | Gr.1 | N/A |
| **A.C3B** | Pulse Encoder Phase B Disconnection | The signal line for phase B of the pulse encoder is disconnected. | Gr.1 | N/A |
| **A.C3C** | Pulse Encoder Phase C Disconnection | The signal line for phase C of the pulse encoder is disconnected. | Gr.1 | N/A |
| **A.C50** | Phase C Not Detected | Phase C was not detected during the first two rotations after the power supply was turned ON. | Gr.1 | N/A |
| | Magnetic Pole Incorrect Detection | The magnetic pole could not be detected. | | |
| **A.C51** | Overtravel Detection at Polarity Detection | An overtravel signal was detected during magnetic pole detection. | Gr.1 | Available |
| **A.C52** | Polarity Detection Uncompleted | An attempt was made to detect the magnetic pole for the high-speed winding or when changing the winding (for motors with a winding selection). | Gr.1 | Available |
| **A.C53** | Out of Range for Polarity Detection | Movement during magnetic pole detection reached or exceeded the set value of Pn494. | Gr.1 | N/A |
| **A.C54** | Polarity Detection Error 2 | The magnetic pole could not be detected. | Gr.1 | N/A |
| **A.C80** | Absolute Encoder Clear Error and Multiturn Limit Setting Error | The multiturn for the absolute encoder was not properly cleared or set. | Gr.1 | N/A |
| **A.C90** | Encoder Communications Error | Communications between the SERVOPACK and the encoder is not possible. | Gr.1 | N/A |
| **A.C91** | Encoder Communications Position Data Error | An encoder position data calculation error occurred. | Gr.1 | N/A |
| **A.C92** | Encoder Communications Timer Error | An error occurs in the communications timer between the encoder and the SERVOPACK. | Gr.1 | N/A |
| **A.CA0** | Encoder Parameter Error | Encoder parameters are faulty. | Gr.1 | N/A |
| **A.CB0** | Encoder Echoback Error | Contents of communications with encoder is incorrect. | Gr.1 | N/A |
| **A.CC0** | Multiturn Limit Disagreement | Different multiturn limits have been set in the encoder and the SERVOPACK. | Gr.1 | N/A |
| **A.CF1**[*2] | Serial Converter Unit Communications Error (Reception error) | Reception from the serial converter unit. | Gr.1 | N/A |
| **A.CF2**[*2] | Serial Converter Unit Communications Error (Timer stop) | Timer for communications with the serial converter unit is faulty. | Gr.1 | N/A |
| **A.D00** | Position Error Pulse Overflow | The setting of Pn520 (Position Deviation Overflow Alarm Level) was exceeded by the position deviation. | Gr.1 | Available |
| **A.D01** | Position Error Pulse Overflow Alarm at Servo ON | Position error pulses accumulated too much. | Gr.1 | Available |
| **A.D02** | Position Error Pulse Overflow Alarm by Speed Limit at Servo ON | After a position error pulse has been input, Pn529 limits the speed if the SV_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 |
| **A.D10** | Motor-load Position Error Overflow | The position error between motor and load is excessive. | Gr.2 | Available |
| **A.E00** | System Alarm 5 | Internal program error 5 occurred in the SERVOPACK. | Gr.1 | Available |
| **A.E02** | System Alarm 6 | Internal program error 6 occurred in the SERVOPACK. | Gr.1 | N/A |
| **A.E03** | System Alarm 7 | Internal program error 7 occurred in the SERVOPACK. | Gr.1 | N/A |
| **A.E61** | System Alarm 8 | Internal program error 8 occurred in the SERVOPACK. | Gr.1 | N/A |

*2. The alarm that may occur when using external encoders.

(cont'd)

| Alarm Display | Alarm Name | Meaning | Motor Stop Method | Alarm Reset |
|---|---|---|---|---|
| **A.EB1** | Safety Function Signal Input Timing Error | The safety function signal input timing is faulty. | Gr.1 | N/A |
| **A.EEA** | Converter Local Bus WD Error | A power regeneration converter local bus WD alarm occurred. | Gr.1 | N/A |
| **A.EEB** | Converter Local Bus Communications Error | A communications error occurred during the power regeneration converter local bus communications. | Gr.1 | Available |
| **A.EF0** | Local Bus Connection Error | The local bus is not connected. | Gr.1 | Available |
| **A.EF2** | Local Bus Drive WD Error | A local bus watchdog alarm occurred in the SERVOPACK. | Gr.2 | N/A |
| **A.EF4** | Local Bus Communications Error | An error occurred during local bus communications. | Gr.2 | Available |
| **A.F1A** | Converter AC Power Supply Open Phase | The voltage was low for one second in phase L1, L2, or L3 when the main power supply was turned ON. | Gr.1 | Available |
| **A.F2A** | Converter AC Power Supply Frequency Error | The power supply frequency is faulty. | Gr.1 | Available |
| **A.F2B** | Converter AC Power Supply Frequency Detection Time Exceeded | The detection of the AC power supply input frequency was not completed within the set time. | Gr.1 | Available |
| **A.F30** | External DB Error | There is an error in the connection to the external dynamic brake. | Gr.1 | N/A |
| **A.F3B** | Converter AC Power Supply Phase Sequence Error | An error occurred in the AC power supply phase sequence. | Gr.1 | Available |

## 11.2.2 List of Alarms for EtherCAT (CoE) Communications

This table lists the alarms of the EtherCAT (CoE) communications.

| Alarm Code | Alarm Name | Meaning | Motor Stop Method | Alarm Reset |
|---|---|---|---|---|
| **0EA0h** | System Alarm 9 | Internal program error 9 occurred in the SERVOPACK. | Gr.1 | N/A |
| **0EA1h** | System Alarm 10 | Internal program error 10 occurred in the SERVOPACK. | Gr.1 | N/A |
| **0EA2h** | System Alarm 11 | Internal program error 11 occurred in the SERVOPACK. | Gr.1 | N/A |
| **0EA3h** | System Alarm 12 | Internal program error 12 occurred in the SERVOPACK. | Gr.1 | N/A |
| **0A10h** | EtherCAT DC Synchronization Error * | The Sync0 event and the SERVOPACK cannot be synchronized. | Gr.1 | Available |
| **0A11h** | EtherCAT State Error | The EtherCAT AL state became not “Operational” while the DS402 drive state is in “Operation enabled.” | Gr.1 | Available |
| **0A12h** | EtherCAT Outputs Data Synchronization Error * | The events, receive process data and sync0, do not synchronize. (Failed to receive the process data.) | Gr.1 | Available |
| **0A20h** | Parameter Setting Error | The parameter setting is out of range. | Gr.1 | N/A |
| **0A40h** | System Alarm 13 | Internal program error 13 occurred in the SERVOPACK. | Gr.1 | N/A |
| **0A41h** | System Alarm 14 | Internal program error 14 occurred in the SERVOPACK. | Gr.1 | N/A |
| **0A47h** | Loading Servo Information Error | The loading of SERVOPACK information was failed. | Gr.1 | N/A |
| **0A48h** | EEPROM Parameter Data Error | The checksum in EEPROM is broken. | Gr.1 | N/A |

* If an error is detected, the status of EtherCAT communication changes to SAFEOP.

### 11.2.3 Troubleshooting of the Servo Drive Alarms

When an error occurs in the servo drives, LEDs on the panel operator will light up. Refer to the following table to identify the cause of an alarm and the action to be taken.

Contact your Yaskawa representative if the problem cannot be solved by the described corrective action.

| Alarm: Alarm Name | Cause | Investigative Actions | Corrective Actions |
|---|---|---|---|
| A.020: Parameter Checksum Error (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. |
| | The power supply went OFF while changing a parameter setting. | Note the circumstances when the power supply went OFF. | Initialize the parameter and then set the parameter again. |
| | The number of times that parameters were written exceeded the limit. | Check to see if the parameters were frequently changed through the host controller. | The SERVOPACK may be faulty. 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. |
| | SERVOPACK failure | 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: Parameter Format Error (The data format of the parameter in the SERVOPACK is incorrect.) | The software version of SERVOPACK that caused the alarm is older than that of the written parameter. | Check SigmaWin for the Σ-V-SD (MT) 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. |
| | SERVOPACK failure | – | The SERVOPACK may be faulty. Replace the SERVOPACK. |
| A.022: System Checksum Error (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. |
| | SERVOPACK failure | 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. |

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| Alarm: Alarm Name | Cause | Investigative Actions | Corrective Actions |
|---|---|---|---|
| A.029: Motor Parameter Checksum Error (The motor parameter data in the SERVOPACK is corrupted.) | Writing the motor parameters failed. | Check to see if write processing ended before the write was completed. | Write the motor parameters again. |
| | Motor Parameter Error | Check to see if suitable motor parameters were written. | Write suitable motor parameters. |
| | The power supply voltage suddenly dropped. | Measure the power supply voltage. | Set the power supply voltage within the specified range. |
| | The power supply went OFF while changing a motor parameter setting. | Note the circumstances when the power supply went OFF. | Write the motor parameters again. |
| | The number of times that motor parameters were written exceeded the limit. | Check to see if the parameters were frequently changed. | The SERVOPACK may be faulty. Repair or replace the SERVOPACK. |
| | 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. |
| | SERVOPACK failure | 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.02C: Converter Parameter Checksum Error (The parameter data in the power regeneration converter is incorrect.) | Power regeneration converter failure | – | The power regeneration converter may be faulty. Replace the power regeneration converter. |
| A.02D: Converter Parameter Format Error (The parameter format in the power regeneration converter is incorrect.) | Power regeneration converter failure | – | The power regeneration converter may be faulty. Replace the power regeneration converter. |
| A.02E: Converter System Checksum Error (The parameter data in the power regeneration converter is incorrect.) | Power regeneration converter failure | – | The power regeneration converter may be faulty. Replace the power regeneration converter. |
| A.030: Main Circuit Detector Error | SERVOPACK failure | – | The SERVOPACK may be faulty. Replace the SERVOPACK. |
| A.040: Parameter Setting Error (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. |
| | SERVOPACK failure | – | 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. |
| A.042: Parameter Combination Error | The speed of program JOG operation is lower than the setting range after having changed the setting of Pn533 "Program JOG Movement Speed." | Check that the detection conditions* is satisfied. | Increase the setting for Pn533 "Program JOG Movement Speed." |

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| Alarm: Alarm Name | Cause | Investigative Actions | Corrective Actions |
|---|---|---|---|
| A.04B: Converter Parameter Setting Error (The parameter data in the power regeneration converter is incorrect.) | Power regeneration converter failure | – | The power regeneration converter may be faulty. Replace the power regeneration converter. |
| A.050: Combination Error (The SERVOPACK and servomotor capacities do not correspond.) | The SERVOPACK and servomotor capacities do not match each other. | Check the capacities to see if they satisfy the following condition: (Servomotor capacity)/(SERVOPACK capacity) ≥ 1/4, and (Servomotor capacity)/(SERVOPACK capacity) ≤ 4. | Select the proper combination of SERVOPACK and servomotor capacities. |
| | Encoder failure | Replace the servomotor and see if the alarm occurs again. | Replace the servomotor (encoder). |
| | SERVOPACK failure | – | The SERVOPACK may be faulty. Replace the SERVOPACK. |
| A.051: Unsupported Device Alarm | An unsupported serial converter unit, serial encoder, or external encoder is connected to the SERVOPACK. | Check the product specifications, and select the correct model. | Select the correct combination of units. |
| A.052: Motor Type Setting Mismatch (The Motor Type/Application Selection Setting (Pn01E.0) does not match the motor parameter written inside the SERVOPACK.) | The Motor Type Setting (Pn01E.0) is wrong. | Check the parameter setting (Pn01E.0) and the servomotor that is used in combination with the SERVOPACK. | Correct the Motor Type Setting (Pn01E.0) according to the combined servomotor. |
| | A mistake occurred in writing the motor parameter file. | Check the model of the combined servomotor from the product information monitor in SigmaWin for the Σ-V-SD (MT). | Write the motor parameter file in the SERVOPACK according to the combined servomotor. |
| A.053: Winding Selection Setting Mismatch (The Winding Change Setting (Pn01E.1) does not match the motor parameter written inside the SERVOPACK.) | The Motor Type Setting (Pn01E.0) is wrong. | Check the parameter setting (Pn01E.0) and the servomotor that is used in combination with the SERVOPACK. | Correct the Motor Type Setting (Pn01E.0) according to the combined servomotor. |
| | The Winding Change Setting (Pn01E.1) is wrong. | Check the parameter setting (Pn01E.1) and the motor that is used in combination with the SERVOPACK. | Correct the Winding Change Setting (Pn01E.1) according to the combined motor. |
| | A mistake occurred in writing the motor parameter file. | Check the model of the combined servomotor from the product information monitor in SigmaWin for the Σ-V-SD (MT). | Write the motor parameter file in the SERVOPACK according to the combined servomotor. |
| A.054: Unsupported Winding Selection Alarm (The combination of the SERVOPACK and servomotor does not support winding selection) | The combination of the SERVOPACK and motor does not allow winding selection. | – | Change the combination of the SERVOPACK and servomotor. |

* Detection Condition Formulas
An alarm is detected if either of the following two conditions is met.

- $$\frac{\text{Pn585 [mm/s]}}{\text{Linear scale pitch [}\mu\text{m]}} \times \frac{\text{Division number of serial converter unit}}{10} \leq 1$$
- $$\frac{\text{Pn385 [100 mm/s]}}{\text{Linear scale pitch [}\mu\text{m]}} \times \frac{\text{Division number of serial converter unit}}{\text{approx. } 6.10 \times 10^5} \geq 1$$

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| Alarm: Alarm Name | Cause | Investigative Actions | Corrective Actions |
|---|---|---|---|
| A.05A: Induction Motor Combination Error (The capacity of the spindle motor is outside of the range that can be combined.) | The SERVOPACK capacity and spindle motor capacity are not compatible. | Check the combination of the SERVOPACK capacity and servomotor capacity. | Align the SERVOPACK capacity and spindle motor capacity. |
| A.05B: Converter Combination Error (The converter and SERVOPACK are not combined correctly.) | A converter that does not support an emergency stop was used with Pn01B.0 set to 1. | – | Replace the converter. |
| A.0B0: Cancelled Servo ON Command Alarm | After executing the utility function to turn ON the power to the motor, the Servo ON command was sent from the host controller. | – | Turn the SERVOPACK power supply OFF and then ON again. |
| A.100: Overcurrent (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. | Correct the wiring. |
| | Short-circuit or ground fault of main circuit cable or motor main circuit cable. | Check for short-circuits across the cable phase-U, -V, and -W, or between the grounding and terminal U, V, or W. | Some cables may be damaged. Replace damaged cables. |
| | Short-circuit or ground fault inside the motor. | Check for short-circuits across the motor terminal phase-U, -V, and -W, or between the grounding and motor terminal U, V, or W. | The motor may be faulty. Replace the motor. |
| | 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. | The SERVOPACK may be faulty. Replace the SERVOPACK. |
| | 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 in SigmaWin for the Σ-V-SD (MT) to see how many times the DB has been used. Or, check the alarm history 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. |
| | A heavy load was applied while the motor was stopped or running at a low-speed. | Check to see if the operating conditions are outside servo drive specifications. | Reduce the load applied to the motor 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. |
| | SERVOPACK failure | – | Turn the power supply OFF and then ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK. |

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| Alarm: Alarm Name | Cause | Investigative Actions | Corrective Actions |
|---|---|---|---|
| A.10A: Converter Overcurrent (An overcurrent flowed through the power transistor inside the power regeneration converter.) | A mistake occurred when selecting the power regeneration converter capacity. | Check the power regeneration converter capacity and the total output capacity of the SERVOPACK. | Change the power regeneration converter capacity. |
| | An unmatched AC reactor is used. | – | Use the specified AC reactor. |
| | The main circuit cable is either incorrectly wired or has a contact fault. | Make sure the wiring is correct. | Correct the wiring. |
| | A short-circuit or ground fault occurred in the main circuit cable. | Check for short-circuits across phase R, S, and T of the cable, or between the ground and phase R, S, or T. | The cable may have short-circuited. Replace the cable. |
| | A short-circuit or ground fault occurred in the power regeneration converter. | Check for short-circuits across phase R, S, and T of the main circuit power supply connection terminal of the power regeneration converter, or between the ground and phase R, S, or T. | The power regeneration converter may be faulty. Replace the power regeneration converter. |
| | Malfunction caused by noise. | Improve the noise environment, including the wiring and installation, and check to see if the alarm occurs again. | Take measures against noise, such as wiring the FG correctly. Match the FG wire size with the SERVOPACK main circuit wire size. |
| | A short-circuit or ground fault occurred in the AC reactor. | – | The AC reactor may be faulty. Replace the AC reactor. |
| | Power regeneration converter failure | – | Turn the power supply OFF and then ON again. If the alarm still occurs, the power regeneration converter may be faulty. Replace the power regeneration converter. |
| A.11A: Converter Ground Fault (A ground fault occurred.) | Ground fault of motor cable | Check for short-circuits between the cable phase-U, -V, and -W and the grounding. | The cable may be faulty. Replace the cable. |
| | Ground fault inside the motor | Check for short-circuits between the motor terminals U, V, and W and the grounding. | The motor may be faulty. Replace the motor |
| | Ground fault of main circuit in the SERVOPACK | Check for short-circuits between the motor connection terminals U, V, and W on the SERVOPACK and the grounding, or between terminals P and N and the grounding. | The SERVOPACK may be faulty. Replace the SERVOPACK. |
| | Ground fault of main circuit in the power regeneration converter | Check for short-circuits between the power connection terminals L1, L2, and L3 on the power regeneration converter and the grounding, or between terminals P and N and the grounding. | The power regeneration converter may be faulty. Replace the power regeneration converter. |
| | Power regeneration converter failure | Turn the control power ON and check if an alarm occurs. | If an alarm occurs after turning the control power ON, the power regeneration converter may be faulty. Replace the power regeneration converter. |
| A.22A: Converter Fuse Blowout (The fuse of the main power supply inside the power regeneration converter is blown out.) | The fuse of the main power supply inside the power regeneration converter is blown out. | – | Replace the power regeneration converter. |

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| Alarm: Alarm Name | Cause | Investigative Actions | Corrective Actions |
|---|---|---|---|
| A.400: Overvoltage (The DC-bus voltage inside the SERVOPACK is abnormally high.) | • For 200-VAC SERVOPACKs with DC-bus power supply input: The power supply voltage exceeded 410 V.<br>• For 400-VAC SERVOPACKs with DC-bus power supply input: The power supply voltage exceeded 820 V. | 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, and turn the power supply ON again after installing a surge absorber. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK. |
| | Acceleration/deceleration was executed under the following conditions.<br>• The AC power supply voltage of 200-VAC SERVOPACK was in the range between 230 V and 270 V.<br>• The AC power supply voltage of 400-VAC SERVOPACK was in the range between 480 V and 560 V. | Check the power supply voltage and the speed and torque during operation. | Set AC power supply voltage within the specified range. |
| | 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. |
| | SERVOPACK failure | – | 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. |

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| Alarm: Alarm Name | Cause | Investigative Actions | Corrective Actions |
|---|---|---|---|
| A.40A: Converter Overvoltage (The DC-bus voltage inside the converter is abnormally high.) | • For 200-V power regeneration converter with DC-bus power supply input: The power voltage exceeded 410 V.<br>• For 400-V power regeneration converter with DC-bus power supply input: The power voltage exceeded 820 V. | Measure the power supply voltage. | Set the AC/DC power supply voltage within the specified range. |
| | The power supply is unstable, or was influenced by a lightening surge. | Measure the power supply voltage. | Improve the power supply conditions, and turn ON the power supply again after installing a surge absorber. If the alarm still occurs, the power regeneration converter may be faulty. Replace the power regeneration converter. |
| | Acceleration/deceleration was executed under the following conditions.<br>• The AC power supply voltage of 200-VAC SERVOPACK was in the range between 230 V and 270 V.<br>• The AC power supply voltage of 400-VAC SERVOPACK was in the range is between 480 V and 560 V. | Check the power supply voltage and the speed and torque during operation. | Set the AC power supply voltage within the specified range. |
| | The moment of inertia exceeded the allowable value in the SERVOPACK connected to the power regeneration converter. | Make sure the moment of inertia ratio is within the allowable range. | Increase the deceleration time, or reduce the load. |
| | Power regeneration converter failure | – | Turn OFF the control power and then turn it ON again while the main circuit power supply is OFF. If the alarm still occurs, the power regeneration converter may be faulty. Replace the power regeneration converter. |
| A.40B: Converter AC Overvoltage (The AC power supply voltage inside the converter is abnormally high.) | The main circuit cable is either incorrectly wired or has a contact fault. | Make sure the wiring is correct. | Correct the wiring. |
| | The main circuit power supply voltage is higher than the specified range. | Measure the AC power supply voltage. | Set the voltage to an appropriate value. |
| | An error occurred in the AC voltage detection circuit inside the power regeneration converter. | – | Turn the power supply OFF and then ON again. If the alarm still occurs, the power regeneration converter may be faulty. Replace the power regeneration converter. |

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| Alarm: Alarm Name | Cause | Investigative Actions | Corrective Actions |
|---|---|---|---|
| A.40C: Abnormal Voltage in Converter Main Circuit (An error occurred in the main circuit of the power regeneration converter.) | The AC voltage is unstable. | Measure the AC power supply voltage. | Improve the power supply conditions. |
| | The DC bus voltage is unstable, or an error occurred in the main circuit in the SERVOPACK. | Measure the DC bus power supply voltage. | The SERVOPACK may be faulty. Replace the SERVOPACK. |
| | The DC bus voltage is unstable, or an error occurred in the main circuit in the power regeneration converter. | Measure the DC bus power supply voltage. | The power regeneration converter may be faulty. Replace the power regeneration converter. |
| | An error occurred in the AC/DC voltage detection circuit in the power regeneration converter. | – | The power regeneration converter may be faulty. Replace the power regeneration converter. |
| A.410: Undervoltage (The DC-bus voltage inside the SERVOPACK is low.) | • For 200-VAC SERVOPACKs: The power supply voltage was in the range between 125 V and 170 V.<br>• For 400-VAC SERVOPACKs: The power supply voltage was in the range between 250 V and 323 V. | 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. | Improve the power supply conditions. |
| | SERVOPACK failure | – | The SERVOPACK may be faulty. Replace the SERVOPACK. |
| A.41A: Converter DC Undervoltage (The DC-bus voltage inside the power regeneration converter is low.) | • For 200-VAC power regeneration converter: The power supply voltage was in the range between 125 V and 170 V.<br>• For 400-VAC power regeneration converter: The power supply voltage was in the range between 250 V and 323 V. | Measure the power supply voltage. | Set the power supply voltage within the specified range. |
| | The wiring of the main circuit DC bus is incorrect. | Check the wiring. | Correct the wiring of the main circuit DC bus. |
| | An error occurred in the main circuit of the SERVOPACK connected to the converter. | Separate the main circuit DC bus of the SERVOPACK. | Separate the SERVOPACK and then turn ON the power supply again. If an alarm does not occur, the SERVOPACK may be faulty. Replace the SERVOPACK. |
| | Power regeneration converter failure | – | Turn the power supply OFF and then ON again. If the alarm still occurs, the power regeneration converter may be faulty. Replace the power regeneration converter. |

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| Alarm: Alarm Name | Cause | Investigative Actions | Corrective Actions |
|---|---|---|---|
| A.41B: Converter AC Undervoltage (The AC voltage inside the power regeneration converter is low.) | • For 200-VAC power regeneration converter: The power supply was in the range between 50 V to 125 V.<br>• For 400-VAC power regeneration converter: The power supply was in the range between 100 V to 250 V. | Measure the power supply voltage. | Set AC power supply voltage within the specified range. |
| | Power regeneration converter failure | – | If an alarm occurs after turning the correct power ON, the power regeneration converter may be faulty. Replace the power regeneration converter. |
| A.41C: Power Failure While Motor Running (The AC power supply was cut off while the motor was running.) | A power failure occurred. | – | Turn the power supply OFF and then ON again. |
| | The AC power supply was disconnected by the main circuit contactor. | Check the main circuit contactor and NFB. | Turn OFF the AC power supply and then turn it ON again. |
| | The AC voltage is unstable during the operation.<br>• For 200-VAC power regeneration converter: The power supply was 50 V or less.<br>• For 400-VAC power regeneration converter: The power supply was 100 V or less. | Measure the power supply voltage. | Set AC power supply voltage within the specified range. |
| | Power regeneration converter failure | – | If an alarm occurs after turning the correct power ON, the power regeneration converter may be faulty. Replace the power regeneration converter. |
| A.42C: Converter Initial Charging Error (Charging of the main circuit capacitor did not finish within the specified period of time.) | The main circuit cable is either incorrectly wired or has a contact fault. | Make sure the wiring is correct. | Correct the wiring. |
| | The wiring of the main circuit DC bus is incorrect. | Check the wiring. | Correct the wiring of the main circuit DC bus. |
| | An error occurred in the main circuit of the SERVOPACK connected to the converter. | Separate the main circuit DC bus of the SERVOPACK. | Separate the SERVOPACK and then turn ON the power supply again. If an alarm does not occur, the SERVOPACK may be faulty. Replace the SERVOPACK. |
| | Converter rapid discharge circuit failure | – | Turn the power supply OFF and then ON again. If the alarm still occurs, the power regeneration converter may be faulty. Replace the power regeneration converter. |
| | The AC-DC conversion circuit inside the power regeneration converter has failed. | – | Turn the power supply OFF and then ON again. If the alarm still occurs, the power regeneration converter may be faulty. Replace the power regeneration converter. |
| A.450: Main Circuit Capacitor Overvoltage (The capacitor of the main circuit has deteriorated or is faulty.) | Main circuit capacitor failure | – | Turn the power supply OFF and then ON again. If the alarm still occurs, the power regeneration converter may be faulty. Replace the power regeneration converter. |
| | An error occurred in the main circuit detection circuit. | | |

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| Alarm: Alarm Name | Cause | Investigative Actions | Corrective Actions |
|---|---|---|---|
| A.510: Overspeed (The servomotor speed exceeds the maximum.) | The order of phases U, V, and W in the servomotor wiring is incorrect. | Check the 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. | Adjust the servo gain, or reconsider the operation conditions. |
| | SERVOPACK failure | – | The SERVOPACK may be faulty. Replace the SERVOPACK. |
| A.521: Autotuning Alarm (Vibration was detected during one-parameter tuning or Easy-FFT.) | Excessive vibration was detected in the motor during one-parameter tuning. | Check the speed waveform of the motor. | Perform the corrective action for the operating procedure for the function. |
| A.531: Excessive Speed Deviation (The deviation between the speed reference and actual motor speed is abnormal.) | The motor main circuit cable is either incorrectly wired or has a contact fault. | Make sure the wiring is correct. | Correct the wiring. |
| | A short-circuit or ground fault occurred in the motor main circuit cable. | Check for short-circuits across phase U, V, and W of the cable, or between the ground and phase U, V, or W. | The cable may have short-circuited. Replace the cable. |
| | The load is heavy (for example, the cutting resistance may be high). | Check to see if the load friction is high and the moment of inertia of the load is too high. | Remove the load. |
| A.540: Overspeed (During Low-speed Winding) (The low-speed winding maximum speed was exceeded during low-speed winding.) | The sequence of phase U, V, and W motor lines is incorrect. | Check the wiring of the motor and of the electromagnetic contactor for winding selection. | Correct the motor wiring. |
| | The reference input value exceeds the maximum speed of the low-speed winding. | Check the input reference. | Reduce the reference value, or adjust the gain. |
| | The low-speed winding maximum rotation speed was exceeded during low-speed winding. | Check the motor speed from the motor speed monitor in SigmaWin for the Σ-V-SD (MT). | Adjust the gain, or revise the operating conditions. |
| | SERVOPACK failure | – | The SERVOPACK may be faulty. Replace the SERVOPACK. |
| A.690: Winding Selection Operation Fault | During the winding selection check that is performed when the power is turned ON, the electromagnetic contactor for winding selection did not change according to the internal command. | Check the wiring of the SERVOPACK and of the electromagnetic contactor for winding selection. | Correct the wiring of the winding selection signal. |
| | Winding selection was not completed within two seconds of receiving the winding selection command. | Check the wiring of the electromagnetic contactor for winding selection. | Correct the wiring of the electromagnetic contactor for winding selection. |
| | Chattering occurred in the electromagnetic contactor for winding selection when the winding selection command was not received. | Check the wiring of the electromagnetic contactor for winding selection. | Correct the wiring of the electromagnetic contactor for winding selection, or replace the electromagnetic contactor for winding selection. |
| A.6B0: Emergency Stop Failure (The motor did not stop within 10 s after the emergency stop signal input.) | The set value of the emergency stop torque in Pn406 is too small. | – | Correct the emergency stop torque setting in Pn406. |

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| Alarm: 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 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 command and servomotor speed. | Remove the mechanical problems. |
| | SERVOPACK failure | – | The SERVOPACK may be faulty. Replace the SERVOPACK. |
| A.72A:<br>Converter Electric Operation Overload<br>(A continuous operation drew power at a rate that exceeded the rated output of the power regeneration converter.) | The sequence of phase U, V, and W motor lines is incorrect. | Check the wiring of the motor's main circuit cable. | Correct the motor wiring. |
| | The motor main circuit cable is either incorrectly wired or has a contact fault. | Make sure the wiring is correct. | Correct the wiring. |
| | A mistake occurred when selecting the power regeneration converter capacity. | Check the power regeneration converter capacity and the total output capacity of the SERVOPACK. | Change the power regeneration converter capacity. |
| | Converter current detection circuit failure | – | Turn the power supply OFF and then ON again. If the alarm still occurs, the power regeneration converter may be faulty. Replace the power regeneration converter. |
| | The AC power supply voltage is low. | Measure the power supply voltage. | Set AC power supply voltage within the specified range. |
| A.72B:<br>Converter Power Supply Regenerative Overload<br>(Continuous power regeneration exceeded the ratings of the power regeneration converter.) | A mistake occurred when selecting the power regeneration converter capacity. | Check the power regeneration converter capacity and the total output capacity of the SERVOPACK. | Change the power regeneration converter capacity. |
| | The AC power supply voltage is low. | Measure the power supply voltage. | Set AC power supply voltage within the specified range. |
| | Power regeneration converter failure | – | Turn the power supply OFF and then ON again. If the alarm still occurs, the power regeneration converter may be faulty. Replace the power regeneration converter. |
| 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 in SigmaWin for the Σ-V-SD (MT) to see how many times the DB has been used. | • Reduce the servomotor reference speed.<br>• Reduce the moment of inertia ratio.<br>• Reduce the number of times of the DB stop operation. |
| | SERVOPACK failure | – | The SERVOPACK may be faulty. Replace the SERVOPACK. |
| A.74A:<br>Converter Inrush Resistance Overload<br>(The main circuit power supply turned ON and OFF frequently.) | The main circuit power supply turned ON and OFF frequently. | Check the ON/OFF sequence of the main circuit power supply. | Change the sequence and operation pattern such that the main circuit power supply does not turn ON and OFF frequently. |
| | Inrush limit circuit failure | – | Turn the power supply OFF and then ON again after cooling the power regeneration converter to the ambient temperature. If the alarm still occurs, the power regeneration converter may be faulty. Replace the power regeneration converter. |

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| Alarm: Alarm Name | Cause | Investigative Actions | Corrective Actions |
|---|---|---|---|
| A.790: Motor Overheated (The motor temperature has exceeded the upper limit.) | The ambient temperature around the motor is high. | Check the ambient temperature around the motor. | Make sure the ambient temperature around the motor does not increase. |
| | Acceleration and deceleration were repeated frequently. | – | Make the acceleration/deceleration of the motor smoother, or change the operation pattern. |
| A.791: Motor Temperature Detection Error (The motor thermistor is either disconnected or is damaged.) | The cable between the SERVOPACK and spindle motor is either disconnected or has a contact fault. | Make sure the wiring is not disconnected and no contact fault exists. | Correct the wiring. |
| | The thermistor wiring in the spindle motor is disconnected. | – | The spindle motor may be faulty. Replace the spindle motor. |
| | The thermistor has failed. | – | The spindle motor may be faulty. Replace the spindle motor. |
| A.7A0: Heat Sink in SERVOPACK Overheated (The temperature of the heat sink in the SERVOPACK exceeded 100°C, or the thermistor in the SERVOPACK was disconnected or damaged.) | The operating ambient temperature is too high. | Check the ambient temperature using a thermometer. | Improve the installation conditions of the SERVOPACK and reduce the operating ambient temperature. |
| | The overload alarm has been reset by turning OFF the power too many times. | Check the alarm history to see if the overload alarm of the SERVOPACK was reported. | Change the method for resetting the alarm. |
| | The installation orientation of the SERVOPACK is incorrect or the distance from other equipment is insufficient. | Check the installation conditions of the SERVOPACK. | Install the SERVOPACK correctly as specified. |
| | SERVOPACK failure | – | The SERVOPACK may be faulty. Replace the SERVOPACK. |
| | The heat sink cooling fan in the ventilation duct stopped or the fan in the base mounting unit stopped. | Make sure that there is no foreign matter in the fans. | Remove the foreign matter. Or replace the fan. |
| A.7AB: Built-in Fan in SERVOPACK Stopped | The fan inside the SERVOPACK stopped. | Check for foreign matter or debris inside the SERVOPACK. | Remove the foreign matter. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK. |
| A.7AC: Built-in Fan in Converter Stopped (The fan inside the power regeneration converter stopped.) | The fan inside the power regeneration converter stopped. | Check for foreign matter or debris inside the power regeneration converter. | Remove the foreign matter. If the alarm still occurs, the power regeneration converter may be faulty. Replace the power regeneration converter. |

(cont'd)

| Alarm: Alarm Name | Cause | Investigative Actions | Corrective Actions |
|---|---|---|---|
| A.7BA: Converter Heat Sink Overheated (The temperature of the heat sink inside the power regeneration converter exceeded 100°C, or the thermistor in the converter was disconnected or damaged.) | The operating ambient temperature is high. | Check the operating ambient temperature using a thermometer. | Improve the installation conditions of the power regeneration converter and reduce the operating ambient temperature. |
| | The overload alarm has been reset by turning OFF the power too many times. | – | Remove the cause of the overload alarm. |
| | Either the load is in excess or operation is performed beyond the power regeneration processing capacity. | – | Review the load and operation conditions. |
| | The installation orientation of the power regeneration converter is incorrect or the distance from other equipment is insufficient. | Check the installation conditions of the power regeneration converter. | Install the power regeneration converter correctly as specified. |
| | Power regeneration converter failure | – | The power regeneration converter may be faulty. Replace the power regeneration converter. |
| | The heat sink cooling fan in the ventilation duct stopped or the fan in the base mounting unit stopped. | Make sure that there is no foreign matter in the fans. | Remove the foreign matter. Or replace the fan. |
| A.810: Encoder Backup Error (Detected on the encoder.) (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. |
| | The encoder cable disconnected, and connected again. | Check to see if the power was turned ON initially. | Confirm the connection and set up the encoder. |
| | 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. |
| | Absolute encoder failure | – | If the alarm cannot be reset by setting up the encoder again, replace the servomotor. |
| | SERVOPACK failure | – | The SERVOPACK may be faulty. Replace the SERVOPACK. |
| A.820: Encoder Checksum Error (Detected on the encoder.) | Encoder failure | – | Set up the encoder again. If the alarm still occurs, the servomotor may be faulty. Replace the servomotor. |
| | SERVOPACK failure | – | The SERVOPACK may be faulty. Replace the SERVOPACK. |
| A.830: Absolute Encoder Battery Error (The absolute encoder battery voltage is lower than the specified value.) | The battery connection is incorrect. | Check the battery connection. | Reconnect the battery. |
| | The battery voltage is lower than the specified value 2.7 V. | Measure the battery voltage. | Replace the battery. |
| | SERVOPACK failure | – | The SERVOPACK may be faulty. Replace the SERVOPACK. |
| | Encoder failure | – | Turn the power supply OFF and then ON again. If the alarm still occurs, the servomotor may be faulty. Replace the servomotor. |

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| Alarm: Alarm Name | Cause | Investigative Actions | Corrective Actions |
|---|---|---|---|
| A.840: Encoder Data Error (Detected on the encoder.) | Encoder failure | – | 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: Encoder Overspeed (Detected when the control power supply was turned ON.) (Detected on the encoder.) | The servomotor was running at 200 $min^{-1}$ or higher when the control power supply was turned ON. | Check the speed monitor in SigmaWin for the Σ-V-SD (MT) to see the servomotor speed when the power is turned ON. | Reduce the servomotor speed to a value less than 200 $min^{-1}$, and turn ON the control power supply. |
| | Encoder failure | – | Turn the power supply OFF and then ON again. If the alarm still occurs, the servomotor may be faulty. Replace the servomotor. |
| | SERVOPACK failure | – | Turn the power supply OFF and then ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK. |
| A.860: Encoder Overheated (Only when an absolute encoder is connected.) (Detected on the encoder.) | The ambient temperature around the servomotor is too high. | Measure the ambient temperature around the servomotor. | The ambient temperature must be 40°C or less. |
| | The servomotor load is greater than the rated load. | Check the accumulated load ratio monitor in SigmaWin for the Σ-V-SD (MT) to see the load. | Set the servomotor load within the specified range. |
| | Encoder failure | – | Turn the power supply OFF and then ON again. If the alarm still occurs, the servomotor may be faulty. Replace the servomotor. |
| | SERVOPACK failure | – | Turn the power supply OFF and then ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK. |
| A.8A0: External Encoder Error of Scale | Setting of the zero point position of absolute external scale failed because the servomotor rotated. | Before setting the zero point position, use the fully-closed feedback counter monitor in SigmaWin for the Σ-V-SD (MT) to confirm that the servomotor is not rotating. | Make the settings so that the servomotor will be stopped while setting the zero point position. |
| | External encoder failure | – | Replace the external encoder. |
| A.8A1: External Encoder Error of Module | External encoder failure | – | Replace the external encoder. |
| | Serial converter unit failure | – | Replace the serial converter unit. |
| A.8A2: External Encoder Error of Sensor (Incremental) | External encoder failure | – | Replace the external encoder. |
| A.8A3: External Encoder Error of Position (Absolute) | Absolute external encoder failure | – | The absolute external encoder may be faulty. Refer to the encoder manufacture's instruction manual for corrective actions. |
| A.8A5: External Encoder Overspeed | The overspeed from the external encoder occurred. | – | Repair or replace the external encoder. |
| A.8A6: External Encoder Overheated | The overheat from the external encoder occurred. | – | Repair or replace the external encoder. |

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| Alarm: Alarm Name | Cause | Investigative Actions | Corrective Actions |
|---|---|---|---|
| A.B31: Current Detection Error 1 (Phase-U) | The current detection circuit for phase U is faulty. | – | Turn the power supply OFF and then ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK. |
| A.B32: Current Detection Error 2 (Phase-V) | The current detection circuit for phase V is faulty. | – | Turn the power supply OFF and then ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK. |
| A.B33: Current Detection Error 3 (Current detector) | The detection circuit for the current is faulty. | – | Turn the power supply OFF and then ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK. |
| | The servomotor main circuit cable is disconnected. | Check for disconnection of the motor main circuit cable. | Correct the servomotor wiring. |
| A.B4A: Converter Gate Drive Output Error | The gate drive signal output circuit of power transistor of the power regeneration converter has failed. | – | The power regeneration converter may be faulty. Replace the power regeneration converter. |
| A.BDA: Converter CPU: AD Conversion Circuit Error (An error occurred in the A/D conversion circuit inside the power regeneration converter.) | Power regeneration converter failure | – | The power regeneration converter may be faulty. Replace the power regeneration converter. |
| A.BDB: Converter Reference Voltage Error 1 (An error occurred in the reference voltage output inside the power regeneration converter.) | Power regeneration converter failure | – | The power regeneration converter may be faulty. Replace the power regeneration converter. |
| A.BDC: Converter Reference Voltage Error 2 (An error occurred in the reference voltage output inside the power regeneration converter.) | Power regeneration converter failure | – | The power regeneration converter may be faulty. Replace the power regeneration converter. |
| A.BDD: Converter System Error 0 | Power regeneration converter failure | – | The power regeneration converter may be faulty. Replace the power regeneration converter. |
| A.BE0: Firmware Error | SERVOPACK failure | – | Turn the power supply OFF and then ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK. |
| A.BEA: Converter System Error 1 | Power regeneration converter failure | – | The power regeneration converter may be faulty. Replace the power regeneration converter. |
| A.BEB: Converter System Error 2 | Power regeneration converter failure | – | The power regeneration converter may be faulty. Replace the power regeneration converter. |
| A.BF0: System Alarm 0 | SERVOPACK failure | – | Turn the power supply OFF and then ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK. |

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| Alarm: Alarm Name | Cause | Investigative Actions | Corrective Actions |
|---|---|---|---|
| A.BF1: System Alarm 1 | SERVOPACK failure | – | Turn the power supply OFF and then ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK. |
| A.BF2: System Alarm 2 | SERVOPACK failure | – | Turn the power supply OFF and then ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK. |
| A.BF3: System Alarm 3 | SERVOPACK failure | – | Turn the power supply OFF and then ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK. |
| A.BF4: System Alarm 4 | SERVOPACK failure | – | Turn the power supply OFF and then ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK. |
| A.C10: Servo Overrun Detected (Detected when the servomotor power is ON.) | The order of phases U, V, and W in the servomotor wiring is incorrect. | Check the servomotor wiring. | Confirm that the servomotor is correctly wired. |
| | Encoder failure | – | 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. |
| | SERVOPACK failure | – | Turn the power supply OFF and then ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK. |
| A.C2A: Pulse Encoder Phase C Error/Pulse Error | An error occurred in the feedback pulse count of the pulse encoder. | Check the signal wiring of the pulse encoder. | Correct the wiring of the pulse encoder. |
| | Malfunction caused by noise. | Improve the noise environment, including the wiring and installation, and check to see if the alarm occurs again. | Install the pulse encoder cable away from the peripheral equipment, or add a ferrite core. |
| A.C3A: Pulse Encoder Phase A Disconnection | The signal line for phase A of the pulse encoder is disconnected. | Check the signal wiring of the pulse encoder. | Correct the wiring of the pulse encoder. |
| A.C3B: Pulse Encoder Phase B Disconnection | The signal line for phase B of the pulse encoder is disconnected. | Check the signal wiring of the pulse encoder. | Correct the wiring of the pulse encoder. |
| A.C3C: Pulse Encoder Phase C Disconnection | The signal line for phase C of the pulse encoder is disconnected. | Check the signal wiring of the pulse encoder. | Correct the wiring of the pulse encoder. |

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| Alarm: Alarm Name | Cause | Investigative Actions | Corrective Actions |
|---|---|---|---|
| A.C50: Phase C Not Detected | The phase C signal of the pulse encoder is not wired correctly. | Check the signal wiring of the pulse encoder. | Correct the wiring of the pulse encoder. |
| | Pulse encoder error | Check the phase C signal of the pulse encoder. | The pulse encoder may have failed. Replace the motor. |
| A.C50: Magnetic Pole Incorrect Detection | The parameters are not set correctly. | Check the encoder specifications and the feedback signal status. | Set the power torque limit in Pn430 and the regeneration torque limit in Pn431 correctly. |
| | Noise is entering on the encoder signal. | Check to see if the FG on the servomotor is connected to the FG on the SERVOPACK and that the FG on the SERVOPACK is connected to the FG on the power supply. Also, make sure that the encoder cable is shielded properly. Check to see if the detection command is being given repeatedly in the same direction. | Correct the shield on the encoder cable.<br>Correct the FG wiring. |
| | An external force was applied to the motor's rotor. | – | Reduce the external force to about 10% or less of the motor's rated torque. |
| | The resolution of the encoder is too low. | – | Increase the magnetic pole detection command speed in Pn493. |
| A.C51: Overtravel Detection at Polarity Detection | An overtravel signal was detected during magnetic pole detection. | Check the overtravel position. | Move the motor's stator to a position where overtravel will not be detected. |
| A.C52: Polarity Detection Uncompleted | An attempt was made to detect the magnetic pole for the high-speed winding (for motors with a winding selection). | – | Perform magnetic pole detection for the low-speed winding. |
| | An attempt was made to detect the magnetic pole when changing the winding (for motors with a winding selection). | | |
| A.C53: Out of Range for Polarity Detection | The travel distance during magnetic pole detection exceeded the magnetic pole detection travel range in Pn494. | – | Increase the magnetic pole detection travel range in Pn494.<br>Increase the magnetic pole detection speed loop gain in Pn481. |
| A.C54: Polarity Detection Error 2 | The motor's electrical angle during magnetic pole detection confirmation exceeded the magnetic pole detection allowable deviation range in Pn498. | – | Increase the magnetic pole detection confirmation torque in Pn495.<br>Increase the magnetic pole detection allowable deviation range in Pn498 (however, a motor overheating alarm or overload alarm may occur).<br>Reduce the external force on the motor's stator to about 10% or less of the motor's rated torque. |
| A.C80: Absolute Encoder Clear Error (Multiturn Limit Setting Error) | Encoder failure | – | Turn the power supply OFF and then ON again. If the alarm still occurs, the servomotor may be faulty. Replace the servomotor. |
| | SERVOPACK failure | – | Turn the power supply OFF and then ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK. |

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| Alarm: Alarm Name | Cause | Investigative Actions | Corrective Actions |
|---|---|---|---|
| A.C90: Encoder Communications Error | Contact fault of encoder connector or incorrect encoder wiring. | Check the encoder connector contact status. | Re-insert the encoder connector and confirm that the encoder is correctly wired. |
| | Encoder cable disconnection or short-circuit.<br>Or, incorrect cable impedance. | Check the encoder cable. | Use the encoder cable with the specified rating. |
| | Corrosion caused by improper temperature, humidity, or gas<br>Short-circuit caused by intrusion of water drops or cutting oil<br>Connector contact fault caused by vibration. | Check the operating environment. | Improve the operating environmental conditions, and replace the cable. If the alarm still occurs, replace the SERVOPACK. |
| | Malfunction caused by noise interference. | – | Correct the wiring around the encoder to avoid noise interference (Separate the encoder cable from the servomotor main circuit cable, improve grounding, etc.) |
| | SERVOPACK failure | – | Connect the servomotor or spindle motor to another SERVOPACK, and turn ON the control power. If no alarm occurs, the SERVOPACK may be faulty. Replace the SERVOPACK. |
| | Encoder failure | – | Connect the servomotor or spindle motor to another SERVOPACK, and turn ON the control power supply. If the alarm occurs, the servomotor or spindle motor may be faulty. Replace the servomotor or spindle motor. |
| A.C91: Encoder Communications Position Data Error | The noise interference occurred on the input/output signal line because the encoder cable is bent and the sheath is damaged. | Check the encoder cable and connector. | Confirm that there is no problem with the encoder cable layout. |
| | The encoder cable is bundled with a high-current line or near a high-current line. | Check the encoder cable layout. | Confirm that there is no surge voltage on the encoder cable. |
| | The FG potential varies because of influence from machines on the servomotor side, such as the welder. | Check the encoder cable layout. | Properly ground the device to separate from the encoder FG. |
| A.C92: Encoder Communications Timer Error | Noise interference occurred on the input/output signal line from the encoder. | – | Take countermeasures against noise. |
| | Excessive vibration and shocks were applied to the encoder. | Check the operating environment. | Reduce the machine vibration, or correctly install the servomotor. |
| | Encoder failure | – | Turn the power supply OFF and then ON again. If the alarm still occurs, the servomotor may be faulty. Replace the servomotor. |
| | SERVOPACK failure | – | Turn the power supply OFF and then ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK. |

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| Alarm: Alarm Name | Cause | Investigative Actions | Corrective Actions |
|---|---|---|---|
| A.CA0: Encoder Parameter Error | Encoder failure | – | Turn the power supply OFF and then ON again. If the alarm still occurs, the servomotor may be faulty. Replace the servomotor. |
| | SERVOPACK failure | – | Turn the power supply OFF and then ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK. |
| A.CB0: Encoder Echoback Error | The encoder wiring and contact are incorrect. | Check the encoder wiring. | Correct the encoder wiring. |
| | Noise interference occurred due to incorrect encoder cable specifications. | – | Use tinned annealed copper twisted-pair or shielded twisted-pair cable with a core of at least 0.12 $mm^2$. |
| | Noise interference occurred because the wiring distance for the encoder cable is too long. | – | The wiring distance must be 20 m max. |
| | The FG potential varies because of influence from machines on the servomotor side, such as the welder. | Check the encoder cable and connector. | Make the grounding for the machine separately from encoder side FG. |
| | Excessive vibration and shocks were applied to the encoder. | Check the operating environment. | Reduce the machine vibration or correctly install the servomotor. |
| | Encoder failure | – | Turn the power supply OFF and then ON again. If the alarm still occurs, the servomotor may be faulty. Replace the servomotor. |
| | SERVOPACK failure | – | Turn the power supply OFF and then ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK. |
| A.CC0: Multiturn Limit Disagreement | The multiturn limit value of the encoder is different from that of the SERVOPACK. Or, the multiturn limit value of the SERVOPACK has been changed. | Check the value of the Pn205 of the SERVOPACK. | Change the settings at the occurrence of alarm. |
| | SERVOPACK failure | – | Turn the power supply OFF and then ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK. |
| A.CF1: Serial Converter Unit Communications Error (Reception error) | Wiring of cable between serial converter unit and SERVOPACK is incorrect or contact is faulty. | Check the external encoder wiring. | Correct the cable wiring. |
| | The specified cable is not used between serial converter unit and SERVOPACK. | Confirm the external encoder wiring specifications. | Use the specified cable. |
| | Cable between serial converter unit and SERVOPACK is too long. | Measure the external encoder cable length. | Use 20 m cable max. |
| | Sheath of cable between serial converter unit and SERVOPACK is broken. | Check the external encoder cable. | Replace the cable. |
| A.CF2: Serial Converter Unit Communications Error (Timer stop) | Noise interferes with the cable between serial converter unit and SERVOPACK. | – | Correct the wiring around serial converter unit, e.g., separating input/output signal line from main circuit cable or grounding. |
| | Serial converter unit failure | – | Replace the serial converter unit. |
| | SERVOPACK failure | – | Replace the SERVOPACK. |

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| Alarm: Alarm Name | Cause | Investigative Actions | Corrective Actions |
|---|---|---|---|
| A.D00: Position Error Pulse Overflow (The setting of Pn520 (Position Deviation Overflow Alarm Level) was exceeded by the position deviation.) | 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 position reference speed is too high. | Reduce the reference speed, and operate the SERVOPACK. | Reduce the position reference speed or acceleration of position reference. |
| | The acceleration of the position reference is too high. | Reduce the reference acceleration, and operate the SERVOPACK. | Reduce the reference acceleration of the position reference. |
| | 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. |
| | SERVOPACK failure | – | Turn the power supply OFF and then ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK. |
| A.D01: Position Error Pulse Overflow Alarm at Servo ON | The SV_ON command (Enable operation) is received when the number of position error pulses is greater than the set value of Pn526 while the servomotor power is OFF. | Check the error counter monitor in SigmaWin for the Σ-V-SD (MT) while the servomotor power is OFF. | Correct the excessive position error alarm level at servo ON (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 SV_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). | – | Correct the excessive position error alarm level (Pn520).<br>Or, adjust the speed limit level at servo turns ON (Pn529). |
| A.D10: Motor-load Position Error 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 change the setting of the external encoder usage method (Pn002.3) to reverse the direction. |
| | 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: System Alarm 5 | SERVOPACK failure | – | The SERVOPACK may be faulty. Replace the SERVOPACK. |
| | A setting on the DIP switch (S3) was changed. | Check the DIP switch settings. | Turn OFF all pins on the DIP switch (S3). |
| A.E02: System Alarm 6 | SERVOPACK failure | – | The SERVOPACK may be faulty. Replace the SERVOPACK. |
| A.E03: System Alarm 7 | | | |
| A.E61: System Alarm 8 | | | |

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| Alarm: Alarm Name | Cause | Investigative Actions | Corrective Actions |
|---|---|---|---|
| A.EB1: Safety Function Signal Input Timing Error | <SERVOPACK for One Axis> The lag between activations of the two 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 output signal circuits or devices for HWBB or the SERVOPACK input signal circuits may be faulty. Alternatively, the input signal cables may be disconnected. Repair or replace them. |
| | <SERVOPACK for Two Axes> The lag between activations of the two input signals /HWBB11 and /HWBB12 or the two input signals /HWBB21 and /HWBB22 for the HWBB function is 10 seconds or more. | | |
| A.EEA: Converter Local Bus WD Error (A power regeneration converter local bus WD alarm occurred.) | The local bus cable of the power regeneration converter is either disconnected or a has a contact fault. | Check the local bus cable. | Either re-install the local bus cable or replace it. |
| | Malfunction caused by noise | Improve the noise environment, including the wiring and installation, and check to see if the alarm occurs again. | Install the local bus cable away from the peripheral equipment, or replace it with a cable that has a ferrite core. |
| | The terminator circuit inside the power regeneration converter has failed. | – | Turn the power supply OFF and then ON again. If the alarm still occurs, the power regeneration converter may be faulty. Replace the power regeneration converter. |
| A.EEB: Converter Local Bus Communications Error (A communications error occurred in the power regeneration converter local bus.) | The same local bus address is set twice. | Check to see if the same value is set for the rightmost digit of Pn010 (5C00h) for more than one SERVOPACK. | Set the rightmost digit of Pn010 (5C00h) to a unique value for each SERVOPACK. |
| | The local bus cable of the power regeneration converter is either disconnected or a has a contact fault. | Check the local bus cable. | Either re-install the local bus cable or replace it. |
| | Malfunction caused by noise | Improve the noise environment, including the wiring and installation, and check to see if the alarm occurs again. | Install the local bus cable away from the peripheral equipment, or replace it with a cable that has a ferrite core. |
| | The terminator circuit inside the power regeneration converter has failed. | – | Turn the power supply OFF and then ON again. If the alarm still occurs, the power regeneration converter may be faulty. Replace the power regeneration converter. |
| A.EF0: Local Bus Connection Error (An error occurred in the local bus connection.) | The local bus cable is either disconnected or has a contact fault. | Check the local bus cable. | Either re-install the local bus cable or replace it. |
| | Malfunction caused by noise | Improve the noise environment, including the wiring and installation, and check to see if the alarm occurs again. | Install the local bus cable away from the peripheral equipment, or replace it with a cable that has a ferrite core. |
| | The local bus terminator is not installed. | Make sure the local bus terminator is installed at the terminal SERVOPACK. | Install the terminator. |
| | Terminator circuit failure | – | Turn the power supply OFF and then ON again. If the alarm still occurs, the power regeneration converter or the terminator may be faulty. Replace the power regeneration converter or the terminator. |

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| Alarm: Alarm Name | Cause | Investigative Actions | Corrective Actions |
|---|---|---|---|
| A.EF2: Local Bus Drive WD Error (A local bus watchdog alarm occurred in the SERVOPACK.) | Malfunction caused by noise | Improve the noise environment, including the wiring and installation, and check to see if the alarm occurs again. | Install the local bus cable away from the peripheral equipment, or replace it with a cable that has a ferrite core. |
| | The local bus terminator is not installed. | Make sure the local bus terminator is installed at the terminal SERVOPACK. | Install the terminator. |
| | Terminator circuit failure | – | Turn the power supply OFF and then ON again. If the alarm still occurs, the power regeneration converter or the terminator may be faulty. Replace the power regeneration converter or the terminator. |
| A.EF4: Local Bus Communications Error (An error occurred during the local bus communications.) | An error occurred during local bus communications. | Check the insertion of connector of the local bus cable and the cable wiring. | The local bus cable may be faulty. Replace the local bus cable. |
| | | | The SERVOPACK may be faulty. Replace the SERVOPACK. |
| A.F1A: Converter AC Power Supply Open Phase (The voltage was low for one second on phase L1, L2, or L3 when the main power supply was turned ON.) | The three-phase power supply wiring is faulty. | Check the power supply wiring. | Make sure the power supply wiring is correct. |
| | The three-phase power supply is unbalanced. | Measure the voltage for each phase of the three-phase power supply. | Balance the power supply by changing phases. |
| | Power regeneration converter failure | – | Turn the power supply OFF and then ON again. If the alarm still occurs, the power regeneration converter may be faulty. Replace the power regeneration converter. |
| A.F2A: Converter AC Power Supply Frequency Error (The deviation in the power supply frequency is large.) | The three-phase power supply wiring is faulty. | Check the power supply wiring. | Make sure the power supply wiring is correct. |
| | The three-phase power supply is unbalanced. | Measure the voltage for each phase of the three-phase power supply. | Balance the power supply by changing phases. |
| | An error occurred in the frequency of the three-phase power supply. | Measure the frequency of the three-phase power supply. | Make sure the power supply wiring is correct. |
| | Power regeneration converter failure | – | Turn the power supply OFF and then ON again. If the alarm still occurs, the power regeneration converter may be faulty. Replace the power regeneration converter. |
| A.F2B: Converter AC Power Supply Frequency Detection Time Exceeded (The detection of the AC power supply input frequency was not completed within the set time.) | The three-phase power supply wiring is faulty. | Check the power supply wiring. | Make sure the power supply wiring is correct. |
| | The three-phase power supply is unbalanced. | Measure the voltage for each phase of the three-phase power supply. | Balance the power supply by changing phases. |
| | An error occurred in the frequency of the three-phase power supply. | Measure the frequency of the three-phase power supply. | Make sure the power supply wiring is correct. |
| | Power regeneration converter failure | – | Turn the power supply OFF and then ON again. If the alarm still occurs, the power regeneration converter may be faulty. Replace the power regeneration converter. |

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| Alarm: Alarm Name | Cause | Investigative Actions | Corrective Actions |
|---|---|---|---|
| A.F30: External Dialog Box Error (There is an error in the connection to the external dynamic brake.) | There is an error in the connection to the external dynamic brake. | Make sure that the external dynamic brake is connected correctly. | Connect the external dynamic brake correctly. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK. |
| | The external DB circuit failed. | – | Replace the external dynamic brake circuit. |
| | A parameter is not set correctly. | Check the settings of Pn001.0 and Pn601. | Correct the settings of Pn001.0 and Pn601. |
| A.F3B: Converter AC Power Supply Phase Sequence Error (An error occurred in the AC power supply phase sequence.) | The three-phase power supply wiring is faulty. | Check the power supply wiring. | Make sure the power supply wiring is correct. |
| | The phases of the three-phase power supply was different before and after an instantaneous power interruption. | – | Modify the power supply so that the phases remain fixed. |
| | Power regeneration converter failure | – | Turn the power supply OFF and then ON again. If the alarm still occurs, the power regeneration converter may be faulty. Replace the power regeneration converter. |

## 11.2.4 Troubleshooting of the EtherCAT (CoE) Communications

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 Code | Alarm Name | Cause | Investigative Action | Corrective Action |
|---|---|---|---|---|
| **0EA0h** | System Alarm 9 | Fault occurred in the SERVOPACK. | – | Repair or replace the SERVOPACK. |
| **0EA1h** | System Alarm 10 | Fault occurred in the SERVOPACK. | – | Repair or replace the SERVOPACK. |
| **0EA2h** | System Alarm 11 | Fault occurred in the SERVOPACK. | – | Repair or replace the SERVOPACK. |
| **0EA3h** | System Alarm 12 | Fault occurred in the SERVOPACK. | – | Repair or replace the SERVOPACK. |
| **0A10h** | EtherCAT DC Synchronization Error | Synchronous timing (Sync0) fluctuated for EtherCAT communication. | – | Turn the power supply OFF and ON again and then reestablish communication. |
| **0A11h** | EtherCAT State Error | EtherCAT communication was not in Operational state while the servomotor was operating. | – | Reset the alarm and then reestablish communication. |
| **0A12h** | EtherCAT Outputs Data Synchronization Error | An EtherCAT communication error occurred due to noise. | – | Correct the EtherCAT wiring and apply countermeasures for noise. |
| | | The controller did not update process data in the regular cycle interval. | Check the process data that the controller is outputting. | Correct the controller so that it updates the process data in the regular cycle interval. |
| | | There is a fault in the EtherCAT cable or connector wiring. | Check the EtherCAT cable and connector wiring. | Correct the wiring. |
| **0A20h** | Parameter Setting Error | The position unit is set out of range. | Check whether the setting is within the following range.<br>1/4096 < Object 2301:01/Object 2301:02 < 4096 | Correct the setting of object 2301h. |
| | | The velocity unit is set out of range. | Check whether the setting is within the following range.<br>1/128 ≤ Object 2302:01/Object 2302:02 ≤ 524288 | Correct the setting of object 2302h. |
| | | The acceleration unit is set out of range. | Check whether the setting is within the following range.<br>1/128 ≤ Object 2303:01/Object 2303:02 ≤ 16384 | Correct the setting of object 2303h. |
| **0A40h** | System Alarm 13 | Fault occurred in the SERVOPACK. | – | Repair or replace the SERVOPACK. |
| **0A41h** | System Alarm 14 | | | |

(cont'd)

| Alarm Code | Alarm Name | Cause | Investigative Action | Corrective Action |
|---|---|---|---|---|
| 0A47h | Loading Servo Information Error | Object 2300h was executed while an utility function was being executed using the SigmaWin for Σ-V-SD (MT). | – | Turn the power supply OFF and ON again. |
| | | The power supply was turned ON or object 2300h was executed while the encoder was not connected. | Check the wiring of the encoder. | Reconnect the encoder, and then turn ON the power supply again. |
| | | The power supply was turned ON or object 2300h was executed while alarm 040h (Parameter Setting Error 1) occurred. | Check the setting of the parameter. | Reset the parameter, and then turn ON the power supply again. |
| | | Fault occurred in the SERVOPACK. | – | Repair or replace the SERVOPACK. |
| 0A48h | EEPROM Parameter Data Error | The power supply was interrupted during parameter writing. | Check the timing of the power interruption. | Initialize the parameter set value (object 1011h), and then input the parameter again. |
| | | The number of parameters written exceeded the maximum value. | – | Repair or replace the SERVOPACK.<br>Correct the parameter writing method. |
| | | The power supply voltage momentarily dropped. | Measure the power supply voltage. | Set the power supply voltage within the specifications, and initialize the parameter set value (object 1011h). |
| | | Fault occurred in the SERVOPACK. | – | Repair or replace the SERVOPACK. |

# 11.3 Warning Displays

The following sections describe troubleshooting in response to warning displays.

The warning name and warning meaning are listed in order of the warning numbers in *11.3.1 List of Warnings*.

The causes of warnings and troubleshooting methods are provided in *11.3.2 Troubleshooting of Warnings*.

## 11.3.1 List of Warnings

This section provides list of warnings.

| Warning Number | Warning Name | Meaning | Reset | Setting Parameter |
|---|---|---|---|---|
| **A.900** | Position Error Overflow | Position error exceeded the parameter setting (Pn520×Pn51E/100). | Required | Pn008.2 |
| **A.901** | Position Error Overflow Alarm at Servo ON | When the servomotor power turns ON, the position error exceeded the parameter setting (Pn526×Pn528/100). | Required | Pn008.2 |
| **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. | Required | Pn008.2 |
| **A.911** | Vibration | Abnormal vibration at the motor speed was detected. | Required | Pn008.2 |
| **A.91A** | Converter Electric Operation Overload | This warning occurs before the converter electric operation overload alarm (A.72A) occurs. If the warning is ignored and operation continues, a converter electric operation overload alarm may occur. | Required | – |
| **A.91B** | Converter Power Supply Regenerative Overload | This warning occurs before the converter power supply regenerative overload alarm (A.72B) occurs. If the warning is ignored and operation continues, a converter power supply regenerative overload alarm may occur. | Required | – |
| **A.921** | Dynamic Brake Overload | This warning occurs before dynamic brake overload alarm (A.730 or A.731) occurs. If the warning is ignored and operation continues, a dynamic brake overload alarm may occur. | Required | Pn008.2 |
| **A.923** | Built-in Fan in SERVOPACK Stopped | The fan inside the SERVOPACK stopped. | Required | Pn00D.2 |
| **A.92B** | Built-in Fan in Converter Stopped | The fan inside the power regeneration converter stopped. | Required | Pn00D.2* |
| **A.930** | Absolute Encoder Battery Error | This warning occurs when the voltage of absolute encoder's battery is lowered. | Required | Pn008.2 |
| **A.971** | Undervoltage | This warning occurs before undervoltage alarm (A.410) occurs. If the warning is ignored and operation continues, an undervoltage alarm may occur. | Required | Pn008.1 |
| **A.97D** | Converter Heat Sink Overheated | This warning occurs before the converter heat sink overheated alarm (A.7BA) occurs. If the warning is ignored and operation continues, a converter heat sink overheated alarm may occur. | Required | – |
| **A.980** | Motor Overheated | This warning occurs before the motor overheated alarm (A.790) occurs. If the warning is ignored and operation continues, a motor overheated alarm may occur. | Required | – |
| **A.9A0** | Overtravel | Overtravel is detected while the servomotor power is ON. | Required | Pn00D.3 |

* If Pn00D.2 is set to 1 in any of the SERVOPACKs, this warning is detected for all axes when the servos are turned ON.

Note: If Pn008.2 is set to 1 to prevent detection of warnings, only the following warnings will be detected:
A.91A, A.91B, and A.92B

## 11.3.2 Troubleshooting of Warnings

Refer to the following table to identity the cause of a warning and the action to be taken. Contact your Yaskawa representative if the problem cannot be solved by the described corrective action.

| Warning Number: Warning Name (Warning Description) | Cause | Investigative Actions | Corrective Actions |
|---|---|---|---|
| A.900: Position Error Overflow | The servomotor U, V, and W wirings is faulty. | Check the servomotor main circuit cable connection. | Confirm that there is no contact fault in the motor wiring or encoder wiring. |
| | The SERVOPACK gain is too low. | Check the SERVOPACK gain. | Increase the servo gain by using the function such as advanced autotuning. |
| | The position reference acceleration is too fast. | Reduce the reference acceleration, and operate the SERVOPACK. | Reduce the reference acceleration. |
| | Setting of the excessive position error alarm level (Pn520) is low against the operating condition. | Check the alarm level (Pn520) to see if it is set to an appropriate value. | Set the Pn520 to proper value. |
| | SERVOPACK failure | – | Turn the power supply OFF and then ON again. If the warning still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK. |
| A.901: Position Error Overflow Alarm at Servo ON | When the servomotor power turns ON, the position error exceeded the parameter setting (Pn526×Pn528/100). | – | Correct the excessive position error warning level at servo ON (Pn528). |
| A.910: Overload (Warning before alarm A.710 or A.720 occurs) | Incorrect wiring or contact fault of servomotor and encoder. | Check the wiring. | Confirm that the servomotor and encoder are correctly wired. |
| | Operation beyond the overload protection characteristics. | Check the servomotor overload characteristics and executed run command. | Reconsider the load conditions and operating 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 operation reference and servomotor speed. | Remove the mechanical problems. |
| | SERVOPACK failure | – | The SERVOPACK may be faulty. Replace the SERVOPACK. |
| A.911: Vibration | Abnormal vibration was detected while the servomotor is rotating. | Check for abnormal noise from the servomotor, and check the speed and torque waveforms during operation. | Reduce the servomotor speed or reduce the servo gain by using the function such as one-parameter tuning. |
| | The moment of inertia ratio (Pn103) value is greater than the actual value or is greatly changed. | Check the moment of inertia ratio. | Set the moment of inertia ratio (Pn103) to an appropriate value. |

(cont'd)

| Warning Number: Warning Name (Warning Description) | Cause | Investigative Actions | Corrective Actions |
|---|---|---|---|
| A.91A: Converter Electric Operation Overload | The sequence of phase U, V, and W motor lines is incorrect. | Check the wiring of the motor's main circuit cable. | Correct the motor wiring. |
| | The motor main circuit cable is either incorrectly wired or has a contact fault. | Make sure the wiring is correct. | Correct the wiring. |
| | A mistake occurred when selecting the power regeneration converter capacity. | Check the power regeneration converter capacity and the total output capacity of the SERVOPACK. | Change the power regeneration converter capacity. |
| | Converter current detection circuit failure | – | Turn the power supply OFF and then ON again. If the warning still occurs, the power regeneration converter may be faulty. Replace the power regeneration converter. |
| | The AC power supply voltage is low. | Measure the power supply voltage. | Set AC power supply voltage within the specified range. |
| A.91B: Converter Power Supply Regenerative Overload | A mistake occurred when selecting the power regeneration converter capacity. | Check the power regeneration converter capacity and the total output capacity of the SERVOPACK. | Change the power regeneration converter capacity. |
| | The AC power supply voltage is low. | Measure the power supply voltage. | Set AC power supply voltage within the specified range. |
| | Power regeneration converter failure | – | Turn the power supply OFF and then ON again. If the warning still occurs, the power regeneration converter may be faulty. Replace the power regeneration converter. |
| A.921: Dynamic Brake Overload (Warning before the alarm A.731 occurs) | 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 power consumed by DB resistance monitor in SigmaWin for Σ-V-SD (MT) to see how many times the DB has been used. | Reconsider the following:<br>• Reduce the servomotor reference speed.<br>• Reduce the moment of inertia ratio.<br>• Reduce the number of times of the DB stop operation. |
| | SERVOPACK failure | – | The SERVOPACK may be faulty. Replace the SERVOPACK. |
| A.923: Built-in Fan in SERVOPACK Stopped | The fan inside the SERVOPACK stopped. | Check for foreign matter or debris inside the SERVOPACK. | Remove foreign matter. If the warning still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK. |
| A.92B: Built-in Fan in Converter Stopped | The fan inside the power regeneration converter stopped. | Check for foreign matter or debris inside the power regeneration converter. | Remove the foreign matter. If the warning still occurs, the power regeneration converter may be faulty. Replace the power regeneration converter. |

(cont'd)

| Warning Number: Warning Name (Warning Description) | Cause | Investigative Actions | Corrective Actions |
|---|---|---|---|
| A.930: Absolute Encoder Battery Error (The absolute encoder battery voltage is lower than the specified value.) * Only when an absolute encoder is connected. | The battery connection is incorrect. | Check the battery connection. | Reconnect the battery. |
| | The battery voltage is lower than the specified value 2.7 V. | Measure the battery voltage. | Replace the battery. |
| | SERVOPACK failure | – | The SERVOPACK may be faulty. Replace the SERVOPACK. |
| A.971: Undervoltage | • For 200-VAC SERVOPACKs: The AC power supply voltage was in the range between 125 V and 170 V.<br>• For 400-VAC SERVOPACKs: The AC power supply voltage was in the range between 250 V and 323 V. | 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. | Improve the power supply conditions. |
| | SERVOPACK failure | – | The SERVOPACK may be faulty. Replace the SERVOPACK. |
| A.97D: Converter Heat Sink Overheated | The operating ambient temperature is high. | Check the operating ambient temperature using a thermometer. | Improve the installation conditions of the power regeneration converter and reduce the operating ambient temperature. |
| | The overload alarm has been reset by turning OFF the power too many times. | – | Remove the cause of the overload alarm. |
| | Either the load is in excess or operation is performed beyond the power regeneration processing capacity. | – | Review the load and operation conditions. |
| | The installation orientation of the power regeneration converter is incorrect or the distance from other equipment is insufficient. | Check the installation conditions of the power regeneration converter. | Install the power regeneration converter correctly as specified. |
| | Power regeneration converter failure | – | The power regeneration converter may be faulty. Replace the power regeneration converter. |

(cont'd)

| Warning Number: Warning Name (Warning Description) | Cause | Investigative Actions | Corrective Actions |
|---|---|---|---|
| A.980: Motor Overheated | The ambient temperature around the motor is high. | Check the ambient temperature around the motor. | Make sure the ambient temperature around the motor does not increase. |
| | Acceleration and deceleration were repeated frequently. | – | Make the acceleration/deceleration of the motor smoother, or change the operation pattern. |
| A.9A0: Overtravel (Overtravel status is detected.) | When the servomotor power is ON, overtravel status is detected. | Check the status of the overtravel signals using the host controller. | Refer to *11.5 Troubleshooting Malfunction Based on Operation and Conditions of the Motor*. Even if overtravel signals were not shown, momentary overtravel may have been detected. Do the following.<br>• Do not specify movements that would cause overtravel from the host controller.<br>• Check the wiring of the overtravel signals.<br>• Take countermeasures for noise. |

# 11.4 Monitoring Communications Data When Alarms or Warnings Occur

From the host controller, you can monitor the alarm and warning codes that are detected in the SERVOPACK by using emergency messages.

The Emergency Telegram consists of eight bytes with the data as shown in table below:

| Byte | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|
| Content | Emergency Error Code (FF00h)[*1] | | Error Register (Object 1001h) | Reserved | Manufacturer Specific Error Field | | | |
| | | | | | SERVOPACK's Alarm/Warning Code[*2] | | Reserved | Axis No. |

*1. Manufacturer-specific error code FF00h is always used.
*2. For details on alarms and warnings of the SERVOPACK, refer to *11.2 Alarm Displays* and *11.3 Warning Displays*.

# 11.5 Troubleshooting Malfunction Based on Operation and Conditions of the Motor

Troubleshooting for the malfunctions based on the operation and conditions of the motor is provided in this section.

| Problem | Probable Cause | Investigative Actions | Corrective Actions |
|---|---|---|---|
| Motor Does Not Start | The control power supply is not ON. | Check voltage between control power terminals. | Turn OFF the servo system.<br>Correct the wiring. |
| | The main circuit power supply is not ON. | Check the voltage between main circuit power terminals. | Turn OFF the servo system.<br>Correct the wiring. |
| | Wiring of I/O signal connector CN1 faulty or disconnected. | Turn OFF the servo system.<br>Check if the connector CN1 is properly inserted and connected. | Correct the connector CN1 connection. |
| | Motor or encoder wiring disconnected. | Check the wiring. | Turn OFF the servo system.<br>Correct the wiring. |
| | Overloaded | Run under no load and check the load status. | Turn OFF the servo system.<br>Reduce load or replace with larger capacity motor. |
| | Settings for the input signal selections (Pn50A and Pn50B) is incorrect. | Check the settings for parameters Pn50A and Pn50B. | Correct the settings for parameter Pn50A and Pn50B. |
| | Motor type differs from parameter setting (Pn01E.0). | Check the settings for parameter Pn01E.0. | Set parameter Pn01E.0 to the motor type being used. |
| | Encoder type differs from parameter setting (Pn01F.0). | Check the settings for parameter Pn01F.0. | Set parameter Pn01F.0 to the encoder type being used. |
| | SV_ON command (Enable operation) is not sent. | Check the command sent from the host controller. | Send the SV_ON command (Enable operation). |
| | 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 and /HWBB2 input signal. | Set the /HWBB1 and /HWBB2 input signal to ON. |
| | SERVOPACK failure | – | Turn OFF the servo system.<br>Replace the SERVOPACK. |
| Motor Moves Instantaneously, and then Stops | Servomotor wiring is incorrect. | Turn OFF the servo system.<br>Check the motor wiring. | Correct the wiring. |
| | Encoder wiring is incorrect. | Turn OFF the servo system.<br>Check the encoder wiring. | Correct the wiring. |
| Motor Speed Unstable | Wiring connection to motor is defective. | Turn OFF the servo system.<br>Check connections of power line (phases U, V, and W) and encoder connectors. | Tighten any loose terminals or connectors and correct the wiring. |
| Motor Rotates Without Reference Input | SERVOPACK failure | – | Turn OFF the servo system.<br>Replace the SERVOPACK. |

(cont'd)

| Problem | Probable Cause | Investigative Actions | Corrective Actions |
|---|---|---|---|
| Dynamic Brake Does Not Operate | Improper Pn001.0 setting | Check the setting for parameter Pn001.0. | Correct the setting for parameter Pn001.0. |
| | Improper Pn01E.1 setting | Check the setting for parameter Pn01E.1. | Correct the setting for parameter Pn01E.1. |
| | Improper Pn601 setting | Check the setting for parameter Pn601. | Correct the setting for parameter Pn601. |
| | External DB circuit fault | Check the wiring and components for external DB circuit. | Turn OFF the servo system.<br>Correct the wiring for external DB circuit, or replace the components. |
| | DB resistor disconnected | Check if excessive moment of inertia, motor overspeed, or DB frequently activated occurred. | Turn OFF the servo system.<br>Replace the SERVOPACK, and reduce the load. |
| | DB drive circuit fault | – | Turn OFF the servo system.<br>There is a defective component in the DB circuit. Replace the SERVOPACK. |
| Abnormal Noise from Servomotor | Mounting is not secured. | Turn OFF the servo system.<br>Check if there are any loose mounting screws. | Tighten the mounting screws. |
| | | Turn OFF the servo system.<br>Check if there is misalignment of couplings. | Align the couplings. |
| | | Turn OFF the servo system.<br>Check if there are unbalanced couplings. | Balance the couplings. |
| | Bearings are defective. | Turn OFF the servo system.<br>Check for noise and vibration around the bearings. | Replace the motor. |
| | Vibration source at the driven machine | Turn OFF the servo system.<br>Check for any foreign matter, damage, or deformations on the machinery's movable parts. | Contact the machine manufacturer. |
| | Noise interference due to incorrect I/O signal cable specifications | Turn OFF the servo system.<br>The I/O signal cable must be tinned annealed copper shielded twisted-pair or screened unshielded twisted-pair cable with a core of 0.12 $mm^2$ min. | Use the specified I/O signal cable. |
| | Noise interference due to length of I/O signal cable | Turn OFF the servo system.<br>Check the length of the I/O signal cable. | The I/O signal cable length must be no more than 3 m. |
| | Noise interference due to incorrect encoder cable specifications | Turn OFF the servo system.<br>The encoder cable must be tinned annealed copper shielded twisted-pair or screened unshielded twisted-pair cable with a core of 0.12 $mm^2$ min. | Use the specified encoder cable. |
| | Noise interference due to length of encoder cable | Turn OFF the servo system.<br>Check the length of the encoder cable. | The encoder cable must be no more than 20 m. |
| | Noise interference due to damaged encoder cable | Turn OFF the servo system.<br>Check if the encoder cable is bent and the sheath is damaged. | Replace the encoder cable and modify the encoder cable layout. |
| | Excessive noise to the encoder cable | Turn OFF the servo system.<br>Check if the encoder cable is bundled with a high-current line or near a high-current line. | Correct the encoder cable layout so that no surge is applied. |

(cont'd)

| Problem | Probable Cause | Investigative Actions | Corrective Actions |
|---|---|---|---|
| Abnormal Noise from Servomotor (cont'd) | The FG potential varies because of influence from machines on the servomotor side, such as the welder. | Turn OFF the servo system.<br>Check if the machines are correctly grounded. | Properly ground the machines to separate from the encoder FG. |
| | SERVOPACK pulse counting error due to noise interference | Check if there is noise interference on the I/O signal line from the encoder. | Turn OFF the servo system.<br>Take measures against noise in the encoder wiring. |
| | Excessive vibration and shock to the encoder | Turn OFF the servo system.<br>Check if vibration from the machine occurred or motor installation is incorrect (mounting surface accuracy, fixing, alignment, etc.). | Reduce vibration from the machine, or secure the motor installation. |
| | Encoder failure | – | Turn OFF the servo system.<br>Replace the motor. |
| Motor Vibrates at Frequency of Approx. 200 to 400 Hz. | Unbalanced servo gains | Check to see if the servo gains have been correctly adjusted. | Execute the advanced autotuning. |
| | Speed loop gain value (Pn100) too high | Check the speed loop gain (Pn100).<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 (Pn102).<br>Factory setting: Kp = 40.0/s | Reduce the position loop gain (Pn102). |
| | Incorrect speed loop integral time constant (Pn101) | Check the speed loop integral time constant (Pn101).<br>Factory setting: Ti = 20.0 ms | Correct the speed loop integral time constant (Pn101). |
| | Incorrect moment of inertia ratio (Pn103) | Check the moment of inertia ratio (Pn103). | Correct the moment of inertia ratio (Pn103). |
| High Motor Speed Overshoot on Starting and Stopping | Unbalanced servo gains | Check to see if the servo gains have been correctly adjusted. | Execute the advanced autotuning. |
| | Speed loop gain value (Pn100) too high | Check the speed loop gain (Pn100).<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 (Pn102).<br>Factory setting: Kp = 40.0/s | Reduce the position loop gain (Pn102). |
| | Incorrect speed loop integral time constant (Pn101) | Check the speed loop integral time constant (Pn101).<br>Factory setting: Ti = 20.0 ms | Correct the speed loop integral time constant (Pn101). |
| | Incorrect moment of inertia ratio data (Pn103) | Check the moment of inertia ratio (Pn103). | Correct the moment of inertia ratio (Pn103). |
| Absolute Encoder Position Difference Error (The position saved in the host controller when the power was turned OFF is different from the position when the power was next turned ON.) | Noise interference due to improper encoder cable specifications | Turn OFF the servo system.<br>The encoder cable must be tinned annealed copper shielded twisted-pair or screened unshielded twisted-pair cable with a core of 0.12 $mm^2$ min. | Use the specified encoder cable. |
| | Noise interference due to length of encoder cable | Turn OFF the servo system.<br>Check the encoder cable length. | The encoder cable length must be no more than 20 m. |
| | Noise interference due to damaged encoder cable | Turn OFF the servo system.<br>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 | Turn OFF the servo system.<br>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. | Turn OFF the servo system.<br>Check if the machines are correctly grounded. | Ground machines correctly, and prevent diversion to the FG on the encoder side. |
| | SERVOPACK pulse counting error due to noise interference | Check if there is noise interference on the I/O signal line from the encoder. | Turn OFF the servo system.<br>Take measures against noise in the encoder wiring. |

(cont'd)

| Problem | Probable Cause | Investigative Actions | Corrective Actions |
|---|---|---|---|
| Absolute Encoder Position Difference Error (The position saved in the host controller when the power was turned OFF is different from the position when the power was next turned ON.) (cont'd) | Excessive vibration and shock to the encoder | Turn OFF the servo system.<br>Check if vibration from the machine occurred or motor installation is incorrect (mounting surface accuracy, fixing, alignment, etc.). | Reduce vibration from the machine, or secure the motor installation. |
| | Encoder failure | – | Turn OFF the servo system.<br>Replace the motor. |
| | SERVOPACK failure<br>(The pulse count does not change.) | – | Turn OFF the servo system.<br>Replace the SERVOPACK. |
| | Host controller multiturn data reading error | Check the error detection section of the host controller. | Correct the error detection section of the host controller. |
| | | Check if the host controller is executing data parity checks. | Execute a multiturn data parity check. |
| | | Check noise in the cable between the SERVOPACK and the host controller. | Take measures against noise, and again execute a multiturn data parity check. |
| 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. |
| | Forward or reverse run prohibited signal malfunctioning. | Check the fluctuation of the external power supply (+24 V) voltage for the input signal. | Stabilize the external power supply (+24 V) voltage. |
| | | Check if the overtravel limit switch operates correctly. | Correct the overtravel limit switch. |
| | | Check if the overtravel limit switch wiring is correct. (check for damaged cables or loose screws.) | Correct the overtravel limit switch wiring. |
| | Incorrect forward or reverse run prohibited signal (P-OT/N-OT) allocation (parameters Pn50A.3, Pn50B.0) | Check if the P-OT signal is allocated in Pn50A.3. | If another signal is allocated in Pn50A.3, allocate P-OT. |
| | | Check if the N-OT signal is allocated in Pn50B.0. | If another signal is allocated in Pn50B.0, allocate N-OT. |
| | Incorrect motor stop method selection | Check the settings for parameters Pn001.0 and Pn001.1 when the servomotor power is OFF. | Select a servomotor stop method other than "coast to stop." |
| | | Check the settings for parameters Pn001.0 and Pn001.1 when in torque control. | Select a servomotor stop method other than "coast to stop." |
| Improper Stop Position by Overtravel (OT) Signal | Improper limit switch position and dog length | – | Install the limit switch at the appropriate position. |
| | The overtravel limit switch position is too short for the coasting distance. | – | Install the overtravel limit switch at the appropriate position. |
| Position Error (Without Alarm) | Noise interference due to incorrect encoder cable specifications | Turn OFF the servo system.<br>The encoder cable must be tinned annealed copper shielded twisted-pair or screened unshielded twisted-pair cable with a core of 0.12 $mm^2$ min. | Use the specified encoder cable. |
| | Noise interference due to length of encoder cable | Turn OFF the servo system.<br>Check the length of the encoder cable. | The encoder cable must be no more than 20 m. |
| | Noise influence due to damaged encoder cable | Turn OFF the servo system.<br>Check if the encoder cable is bent and its sheath is damaged. | Replace the encoder cable and modify the encoder cable layout. |

(cont'd)

| Problem | Probable Cause | Investigative Actions | Corrective Actions |
|---|---|---|---|
| Position Error (Without Alarm) (cont'd) | Excessive noise to encoder cable | Turn OFF the servo system.<br>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. |
| | The FG potential varies because of influence from machines on the servomotor side such as the welder. | Turn OFF the servo system.<br>Check if the machines are correctly grounded. | Properly ground the machines encoder FG. |
| | SERVOPACK pulse count error due to noise | Turn OFF the servo system.<br>Check if the I/O signal line from the encoder is influenced by noise. | Take measures against noise in the encoder wiring. |
| | Excessive vibration and shock to the encoder | Turn OFF the servo system.<br>Check if vibration from the machine occurred or motor installation is incorrect (mounting surface accuracy, fixing, alignment, etc.). | Reduce the machine vibration or mount the motor securely. |
| | Unsecured coupling between machine and motor | Turn OFF the servo system.<br>Check if a position error occurs at the coupling between machine and motor. | Secure the coupling between the machine and motor. |
| | Noise interference due to improper I/O signal cable specifications | Turn OFF the servo system.<br>The I/O signal cable must be tinned annealed copper shielded twisted-pair or screened unshielded twisted-pair cable with a core of 0.12 $mm^2$ min. | Use input signal cable with the specified specifications. |
| | Noise interference due to length of I/O signal cable | Turn OFF the servo system.<br>Check the I/O signal cable length. | The I/O signal cable length must be no more than 3 m. |
| | Encoder failure (The pulse count does not change.) | – | Turn OFF the servo system.<br>Replace the motor. |
| | SERVOPACK failure | – | Turn OFF the servo system.<br>Replace the SERVOPACK. |
| Motor Overheated | Ambient operating temperature too high | Measure the motor ambient operating temperature. | Reduce the ambient operating temperature to 40°C or less. |
| | Motor surface dirty | Turn OFF the servo system.<br>Visually check the surface. | Clean dust and oil from the surface. |
| | Motor overloaded | Check the load status with monitor. | If overloaded, reduce load or replace with larger capacity SERVOPACK and motor. |

# 12

# Appendix

# 12.1 SERVOPACK Parameters

This section contains a tables of parameters.

Note: Do not change the following parameters from the factory settings.
- Reserved parameters
- Parameters not described in this manual

### Supplemental Information

The index numbers for a SERVOPACK for one axis and axis 1 of a SERVOPACK for two axes are given for the index numbers of the servo parameters. The index numbers for axis 2 of a SERVOPACK for two axes can be calculated by adding 400h to the index numbers for axis 1.

### Example:

Parameter number: Pn100
= Index number for axis 1: 2040h
↓ Add 400h to calculate the index number for axis 2.
= Index number for axis 2: 2440h

| Parameter No. (Index No.) | Size | Name | Setting Range | Units | Factory Setting | When Enabled | Classification | Motor Type | Reference Section |
|---|---|---|---|---|---|---|---|---|---|
| **Pn000 (2000h)** | 2 | Basic Function Select Switch 0 | 0000h to 00B3h | – | 0000h | After restart | Setup | spindle motor, servo-motor | – |

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

1st digit:

| Direction Selection | | Reference Section |
|---|---|---|
| 0 | Forward reference for forward rotation. | 8.4.1 |
| 1 | Forward reference for reverse rotation. | |
| 2, 3 | Reserved (Do not use.) | |

2nd digit: Reserved (Do not change.)

3rd digit: Reserved (Do not change.)

4th digit: Reserved (Do not change.)

(cont'd)

| Parameter No. (Index No.) | Size | Name | Setting Range | Units | Factory Setting | When Enabled | Classification | Motor Type | Reference Section |
|---|---|---|---|---|---|---|---|---|---|
| **Pn001 (2001h)** | 2 | Application Function Select Switch 1 | 0100h to 1222h | – | * | After restart | Setup | spindle motor, servo-motor | – |

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

1st digit:

| Servomotor power OFF or Alarm Gr.1 Stop Mode | | Reference Section |
|---|---|---|
| 0 | Stops the motor by applying DB (dynamic brake). | 8.4.4 |
| 1 | Stops the motor by applying DB and then releases DB. | |
| 2 | Makes the motor coast to a stop state without using the DB. | |

2nd digit:

| Overtravel (OT) Stop Mode | | Reference Section |
|---|---|---|
| 0 | Same setting as Pn001.0 (Stops the motor by applying DB or by coasting). | 8.4.2 |
| 1 | Sets the torque of Pn406 to the maximum value, decelerates the motor to a stop, and then sets it to servolock state. | |
| 2 | Sets the torque of Pn406 to the maximum value, decelerates the motor to a stop, and then sets it to coasting state. | |

3rd digit: Reserved (Do not change.)

4th digit: Reserved (Do not change.)

| Parameter No. (Index No.) | Size | Name | Setting Range | Units | Factory Setting | When Enabled | Classification | Motor Type | Reference Section |
|---|---|---|---|---|---|---|---|---|---|
| **Pn002 (2002h)** | 2 | Application Function Select Switch 2 | 0000h to 4113h | – | 0001h | After restart | Setup | spindle motor, servo-motor | – |

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

1st digit: Reserved (Do not change.)

2nd digit: Reserved (Do not change.)

3rd digit:

| Absolute Encoder Usage | | Reference Section |
|---|---|---|
| 0 | Uses absolute encoder as an absolute encoder. | 8.7.1 |
| 1 | Uses absolute encoder as an incremental encoder. | |

4th digit:

| External Encoder Usage | |
|---|---|
| 0 | Does not use external encoder. |
| 1 | Uses in forward rotation with forward reference. |
| 2 | Reserved (Do not use.) |
| 3 | Uses in reversed rotation with forward reference. |
| 4 | Reserved (Do not use.) |

* Varies in accordance with the SERVOPACK used.
SERVOPACK CACR-JU028ACA, -JU036ACA, -JU014DCA, -JU018DCA, -JUM2□ACA, -JUM2□DCA: 0200h
Other models: 0202h

(cont'd)

| Parameter No. (Index No.) | Size | Name | Setting Range | Units | Factory Setting | When Enabled | Classification | Motor Type | Reference Section |
|---|---|---|---|---|---|---|---|---|---|
| **Pn006 (2006h)** | 2 | Application Function Select Switch 6 | 0000h to 005Fh | – | 0002h | Immedi-ately | Setup | spindle motor, servo-motor | 9.1.3 |

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

2nd and 1st digits: Analog Monitor 1 Signal Selection

| | |
|---|---|
| 00 | Motor speed (1 V/1000 min$^{-1}$) |
| 01 | Speed reference (1 V/1000 min$^{-1}$) |
| 02 | Torque reference (1 V/100% for servomotor, 1.2 V/max. torque for spindle motor) |
| 03 | Position error (0.05 V/1 reference unit) |
| 04 | Position amplifier error (0.05 V/1 encoder pulse unit) |
| 05 | Position reference speed (1 V/1000 min$^{-1}$) |
| 06 | Reserved (Do not use.) |
| 07 | Motor-external encoder 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$^{-1}$) |
| 0A | Torque feedforward (1 V/100%) |
| 0B | Reserved (Do not use.) |
| 0C | Completion of position reference (completed: 5 V, not completed: 0 V) |
| 0D | External encoder speed (1 V/1000 min$^{-1}$) |
| 46 | Load meter (6 V/100%) |
| 47 | Quadrant error compensation (1 V/100%) |

3rd digit: Reserved (Do not change.)

4th digit: Reserved (Do not change.)

(cont'd)

| Parameter No. (Index No.) | Size | Name | Setting Range | Units | Factory Setting | When Enabled | Classification | Motor Type | Reference Section |
|---|---|---|---|---|---|---|---|---|---|
| **Pn007 (2007h)** | 2 | Application Function Select Switch 7 | 0000h to 005Fh | – | 0000h | Immediately | Setup | spindle motor, servomotor | 9.1.3 |

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

1st and 2nd digits: Analog Monitor 2 Signal Selection

| | |
|---|---|
| 00 | Motor speed (1 V/1000 min$^{-1}$) |
| 01 | Speed reference (1 V/1000 min$^{-1}$) |
| 02 | Torque reference (1 V/100% for servomotor, 1.2 V/max. torque for spindle motor) |
| 03 | Position error (0.05 V/1 reference unit) |
| 04 | Position amplifier error (0.05 V/1 encoder pulse unit) |
| 05 | Position reference speed (1 V/1000 min$^{-1}$) |
| 06 | Reserved (Do not use.) |
| 07 | Motor-external encoder 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$^{-1}$) |
| 0A | Torque feedforward (1 V/100%) |
| 0B | Reserved (Do not use.) |
| 0C | Completion of position reference (completed: 5 V not completed: 0 V) |
| 0D | External encoder speed (1 V/1000 min$^{-1}$) |
| 46 | Load meter (6 V/100%) |
| 47 | Quadrant error compensation (1 V/100%) |

3rd digit: Reserved (Do not change.)

4th digit: Reserved (Do not change.)

| Parameter No. (Index No.) | Size | Name | Setting Range | Units | Factory Setting | When Enabled | Classification | Motor Type | Reference Section |
|---|---|---|---|---|---|---|---|---|---|
| **Pn008 (2008h)** | 2 | Application Function Select Switch 8 | 0000h to 7121h | – | 4000h | After restart | Setup | spindle motor, servomotor | – |

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

1st digit: Lowered Battery Voltage Alarm/Warning Selection

| | | Reference Section |
|---|---|---|
| 0 | Outputs alarm (A.830) for lowered battery voltage. | 8.7.3 |
| 1 | Outputs warning (A.930) for lowered battery voltage. | |

2nd digit: Function Selection for UnderVoltage

| | |
|---|---|
| 0 | Does not detect warning for undervoltage. |
| 1 | Detects warning for undervoltage. |
| 2 | Reserved (Do not use.) |

3rd digit: Warning Detection Selection

| | |
|---|---|
| 0 | Detects warning. |
| 1 | Does not detect warning. |

4th digit: Reserved (Do not change.)

(cont'd)

| Parameter No. (Index No.) | Size | Name | Setting Range | Units | Factory Setting | When Enabled | Classification | Motor Type | Reference Section |
|---|---|---|---|---|---|---|---|---|---|
| **Pn00B (200Bh)** | 2 | Application Function Select Switch B | 0000h to 1111h | – | 0001h | After restart | Setup | spindle motor, servo-motor | – |

**Pn00B (200Bh)**

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

1st digit: Reserved (Do not change.)

2nd digit:

| Alarm Gr.2 Stop Method Selection | | Reference Section |
|---|---|---|
| 0 | Stops the motor by setting the speed reference to "0." | 8.4.4 |
| 1 | Same setting as Pn001.0 (Stops the motor by applying DB or by coasting). | |

3rd digit: Reserved (Do not change.)

4th digit: Reserved (Do not change.)

| Parameter No. (Index No.) | Size | Name | Setting Range | Units | Factory Setting | When Enabled | Classification | Motor Type | Reference Section |
|---|---|---|---|---|---|---|---|---|---|
| **Pn00D (200Dh)** | 2 | Application Function Select Switch D | 0000h to 1101h | – | 0000h | – | Setup | spindle motor, servo-motor | – |

**Pn00D (200Dh)**

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

1st digit: Reserved (Do not change.)

2nd digit: Reserved (Do not change.)

3rd digit:

| Fan Stop Error Detection Selection | | When Enabled |
|---|---|---|
| 0 | Issues an alarm after the fan stops. | After restart |
| 1 | Issues a warning for a specified time and then an alarm after the fan stops. | |

4th digit:

| Overtravel Warning Detection Selection | | When Enabled |
|---|---|---|
| 0 | Does not detect overtravel warning. | Immediately |
| 1 | Detects overtravel warning. | |

| Parameter No. (Index No.) | Size | Name | Setting Range | Units | Factory Setting | When Enabled | Classification | Motor Type | Reference Section |
|---|---|---|---|---|---|---|---|---|---|
| **Pn010 (5C00h)** | 2 | SERVOPACK Address (for USB/Local bus communication) | 0000h to 007Fh | – | 0001h | After restart | Setup | spindle motor, servo-motor | – |

(cont'd)

| Parameter No. (Index No.) | Size | Name | Setting Range | Units | Factory Setting | When Enabled | Classification | Motor Type | Reference Section |
|---|---|---|---|---|---|---|---|---|---|
| **Pn01B (2030h:1)** | 2 | Application Function Select Switch 1B | 0000h to 0011h | – | 0000h | After restart | Setup | spindle motor, servo-motor | – |

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

1st digit: Emergency Stop Signal Selection

| | |
|---|---|
| 0 | Disables the emergency stop signal. |
| 1 | Enables the emergency stop signal. |

2nd digit: Contactor Control Function Selection

| | |
|---|---|
| 0 | Disables MCON signal. |
| 1 | Enables MCON signal. |

3rd digit: Reserved (Do not change.)

4th digit: Reserved (Do not change.)

| Parameter No. (Index No.) | Size | Name | Setting Range | Units | Factory Setting | When Enabled | Classification | Motor Type | Reference Section |
|---|---|---|---|---|---|---|---|---|---|
| **Pn01C (2030h:2)** | 2 | Application Function Select Switch 1C | 0000h to 1003h | – | 0000h | After restart | Setup | spindle motor | – |

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

1st digit: Load Ratio Output Level Selection

| | |
|---|---|
| 0 | Outputs a load ratio of 120% for the 10-s rated output of the motor. |
| 1 | Outputs a load ratio of 100% for the 10-s rated output of the motor. |
| 2 | Outputs a load ratio of 100% for the 50% ED rated output of the motor. |
| 3 | Outputs a load ratio of 100% for the continuous rated output of the motor. |

2nd digit: Reserved (Do not change.)

3rd digit: Reserved (Do not change.)

4th digit: Reserved (Do not change.)

(cont'd)

| Parameter No. (Index No.) | Size | Name | Setting Range | Units | Factory Setting | When Enabled | Classification | Motor Type | Reference Section |
|---|---|---|---|---|---|---|---|---|---|
| **Pn01E (2030h:3)** | 2 | Application Function Select Switch 1E | 0000h to 0016h | – | 0000h | After restart | Setup | spindle motor, servo-motor | – |

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

1st digit:

| Motor Type | |
|---|---|
| 0 | Servomotor |
| 1 | SPM type spindle motor (under development) |
| 2 | Induction type servomotor (under development) |
| 3 | Spindle motor |
| 4 | IPM type servomotor (under development) |
| 5 | IPM type spindle motor |
| 6 | IPM built-in spindle motor |

2nd digit:

| Winding Selection | |
|---|---|
| 0 | None |
| 1 | Mechanical winding selection |
| 2 | Reserved (Do not use.) |
| 3 | Uses external DB by CN3. |

3rd digit: Reserved (Do not change.)

4th digit: Reserved (Do not change.)

| Parameter No. (Index No.) | Size | Name | Setting Range | Units | Factory Setting | When Enabled | Classification | Motor Type | Reference Section |
|---|---|---|---|---|---|---|---|---|---|
| **Pn01F (2030h:4)** | 2 | Application Function Select Switch 1F | 0000h to 0002h | – | 0000h | After restart | Setup | spindle motor, servo-motor | – |

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

1st digit:

| Encoder Type | |
|---|---|
| 0 | Serial encoder (servomotor) |
| 1 | Pulse encoder (spindle motor) |
| 2 | Serial encoder (spindle motor) |

2nd digit: Reserved (Do not change.)

3rd digit: Reserved (Do not change.)

4th digit: Reserved (Do not change.)

| Parameter No. (Index No.) | Size | Name | Setting Range | Units | Factory Setting | When Enabled | Classification | Motor Type | Reference Section |
|---|---|---|---|---|---|---|---|---|---|
| **Pn030 (–)** | 2 | Reserved (Do not change.) | – | – | 0000 | – | Setup | spindle motor, servo-motor | – |

(cont'd)

| Parameter No. (Index No.) | Size | Name | Setting Range | Units | Factory Setting | When Enabled | Classification | Motor Type | Reference Section |
|---|---|---|---|---|---|---|---|---|---|
| **Pn070 (2030h:5)** | 2 | Function at Cutting Feed | 0000h to 0021h | – | 0000h | After restart | Setup | spindle motor, servo-motor | – |

4th digit 3rd digit 2nd digit 1st digit

n.□□□□

1st digit:

| Predictive Function (at cutting) | |
|---|---|
| 0 | Disables predictive function. |
| 1 | Enables predictive function. |

2nd digit:

| Quadrant Projection Compensation at Cutting | |
|---|---|
| 0 | Disables quadrant projection compensation function. |
| 1 | Enables quadrant projection compensation function 1. |
| 2 | Enables quadrant projection compensation function 2. |

3rd digit: Reserved (Do not change.)

4th digit: Reserved (Do not change.)

| Parameter No. (Index No.) | Size | Name | Setting Range | Units | Factory Setting | When Enabled | Classification | Motor Type | Reference Section |
|---|---|---|---|---|---|---|---|---|---|
| **Pn071 (2030h:6)** | 2 | Function at Fast-forward | 0000h to 0022h | – | 0000h | After restart | Setup | spindle motor, servo-motor | – |

4th digit 3rd digit 2nd digit 1st digit

n.□□□□

1st digit:

| Control Method | |
|---|---|
| 0 | No function |
| 1 | Uses internal speed FF. |
| 2 | Uses model following control. |

2nd digit: Reserved (Do not change.)

3rd digit: Reserved (Do not change.)

4th digit: Reserved (Do not change.)

(cont'd)

| Parameter No. (Index No.) | Size | Name | Setting Range | Units | Factory Setting | When Enabled | Classification | Motor Type | Reference Section |
|---|---|---|---|---|---|---|---|---|---|
| **Pn07F (2030h:7)** | 2 | Application Function Select Switch 7F | 0000h to 0002h | – | 0000h | After restart | Setup | spindle motor, servo-motor | – |

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

1st digit: Invalid Axis Setting

| | |
|---|---|
| 0 | No invalid axis |
| 1 | Sets 2nd axis as a invalid axis for a SERVOPACK for two axes. |
| 2 | Reserved (Do not use.) |

2nd digit: Reserved (Do not change.)

3rd digit: Reserved (Do not change.)

4th digit: Reserved (Do not change.)

| Parameter No. (Index No.) | Size | Name | Setting Range | Units | Factory Setting | When Enabled | Classification | Motor Type | Reference Section |
|---|---|---|---|---|---|---|---|---|---|
| **Pn100 (2040h:1)** | 2 | Speed Loop Gain | 10 to 20000 | 0.1 Hz | 400 | Immedi-ately | Tuning | spindle motor, servo-motor | – |
| **Pn101 (2040h:2)** | 2 | Speed Loop Integral Time Constant | 15 to 51200 | 0.01 ms | 2000 | Immedi-ately | Tuning | spindle motor, servo-motor | – |
| **Pn102 (2040h:3)** | 2 | Position Loop Gain | 10 to 20000 | 0.1/s | 400 | Immedi-ately | Tuning | spindle motor, servo-motor | – |
| **Pn103 (2060h)** | 2 | Moment of Inertia Ratio | 0 to 20000 | 1% | 100 | Immedi-ately | Tuning | spindle motor, servo-motor | – |
| **Pn104 (2041h:1)** | 2 | 2nd Speed Loop Gain | 10 to 20000 | 0.1 Hz | 400 | Immedi-ately | Tuning | spindle motor, servo-motor | – |
| **Pn105 (2041h:2)** | 2 | 2nd Speed Loop Integral Time Constant | 15 to 51200 | 0.01 ms | 2000 | Immedi-ately | Tuning | spindle motor, servo-motor | – |
| **Pn106 (2041h:3)** | 2 | 2nd Position Loop Gain | 10 to 20000 | 0.1/s | 400 | Immedi-ately | Tuning | spindle motor, servo-motor | – |
| **Pn109 (2061h)** | 2 | Feedforward Gain | 0 to 100 | 1% | 0 | Immedi-ately | Tuning | spindle motor, servo-motor | – |
| **Pn10A (2062h)** | 2 | Feedforward Filter Time Constant | 0 to 6400 | 0.01 ms | 0 | Immedi-ately | Tuning | spindle motor, servo-motor | – |

(cont'd)

| Parameter No. (Index No.) | Size | Name | Setting Range | Units | Factory Setting | When Enabled | Classification | Motor Type | Reference Section |
|---|---|---|---|---|---|---|---|---|---|
| **Pn10B (2065h)** | 2 | Application Function for Gain Select Switch | 0000h to 5334h | – | 0000h | – | Setup | spindle motor, servo-motor | – |
| | 4th digit 3rd digit 2nd digit 1st digit<br>n.□□□□<br>1st digit: Reserved (Do not change.)<br>2nd digit: Speed Loop Control Method (When Enabled: After restart)<br>0: PI control<br>1: I-P control<br>2, 3: Reserved (Do not use.)<br>3rd digit: Reserved (Do not change.)<br>4th digit: Reserved (Do not change.) | | | | | | | | |
| **Pn121 (2067h:1)** | 2 | Friction Compensation Gain | 10 to 1000 | 1% | 100 | Immedi-ately | Tuning | spindle motor, servo-motor | – |
| **Pn123 (2067h:3)** | 2 | Friction Compensation Coefficient | 0 to 100 | 1% | 0 | Immedi-ately | Tuning | spindle motor, servo-motor | – |
| **Pn124 (2067h:4)** | 2 | Friction Compensation Frequency Correction | -10000 to 10000 | 0.1 Hz | 0 | Immedi-ately | Tuning | spindle motor, servo-motor | – |
| **Pn125 (2067h:5)** | 2 | Friction Compensation Gain Correction | 1 to 1000 | 1% | 100 | Immedi-ately | Tuning | spindle motor, servo-motor | – |
| **Pn12B (2042:1)** | 2 | 3rd Speed Loop Gain | 10 to 20000 | 0.1 Hz | 400 | Immedi-ately | Tuning | spindle motor, servo-motor | – |
| **Pn12C (2042h:2)** | 2 | 3rd Speed Loop Integral Time Constant | 15 to 51200 | 0.01 ms | 2000 | Immedi-ately | Tuning | spindle motor, servo-motor | – |
| **Pn12D (2042h:3)** | 2 | 3rd Position Loop Gain | 10 to 20000 | 0.1/s | 400 | Immedi-ately | Tuning | spindle motor, servo-motor | – |
| **Pn12E (2043h:1)** | 2 | 4th Speed Loop Gain | 10 to 20000 | 0.1 Hz | 400 | Immedi-ately | Tuning | spindle motor, servo-motor | – |
| **Pn12F (2043h:2)** | 2 | 4th Speed Loop Integral Time Constant | 15 to 51200 | 0.01 ms | 2000 | Immedi-ately | Tuning | spindle motor, servo-motor | – |

(cont'd)

<table>
<tr><th>Parameter No. (Index No.)</th><th>Size</th><th>Name</th><th>Setting Range</th><th>Units</th><th>Factory Setting</th><th>When Enabled</th><th>Classification</th><th>Motor Type</th><th>Reference Section</th></tr>
<tr><td>Pn130 (2043h:3)</td><td>2</td><td>4th Position Loop Gain</td><td>10 to 20000</td><td>0.1/s</td><td>400</td><td>Immedi-ately</td><td>Tuning</td><td>spindle motor, servo-motor</td><td>–</td></tr>
<tr><td rowspan="2">Pn140 (206Ah:1)</td><td>2</td><td>Model Following Control Related Switch</td><td>0000h to 1121h</td><td>–</td><td>0100h</td><td>Immedi-ately</td><td>Tuning</td><td>spindle motor, servo-motor</td><td>–</td></tr>
<tr><td colspan="9">4th digit 3rd digit 2nd digit 1st digit<br>n.□□□□<br>1st digit: Reserved (Do not change.)<br>2nd digit: Reserved (Do not change.)<br>3rd digit: Reserved (Do not change.)<br>4th digit: Selection of Speed Feedforward (VFF) / Torque Feedforward (TFF)<br>0: Does not use model following control and speed/torque feedforward together.<br>1: Uses model following control and speed/torque feedforward together.</td></tr>
<tr><td>Pn141 (206Ah:2)</td><td>2</td><td>Model Following Control Gain</td><td>10 to 20000</td><td>0.1/s</td><td>500</td><td>Immedi-ately</td><td>Tuning</td><td>spindle motor, servo-motor</td><td>–</td></tr>
<tr><td>Pn142 (206Ah:3)</td><td>2</td><td>Model Following Control Gain Compensation</td><td>500 to 2000</td><td>0.1%</td><td>1000</td><td>Immedi-ately</td><td>Tuning</td><td>spindle motor, servo-motor</td><td>–</td></tr>
<tr><td>Pn143 (206Ah:4)</td><td>2</td><td>Model Following Control Bias (Forward Direction)</td><td>0 to 10000</td><td>0.1%</td><td>1000</td><td>Immedi-ately</td><td>Tuning</td><td>spindle motor, servo-motor</td><td>–</td></tr>
<tr><td>Pn144 (206Ah:5)</td><td>2</td><td>Model Following Control Bias (Reverse Direction)</td><td>0 to 10000</td><td>0.1%</td><td>1000</td><td>Immedi-ately</td><td>Tuning</td><td>spindle motor, servo-motor</td><td>–</td></tr>
<tr><td>Pn147 (206Ah:8)</td><td>2</td><td>Model Following Control Speed Feedforward Compensation</td><td>0 to 10000</td><td>0.1%</td><td>1000</td><td>Immedi-ately</td><td>Tuning</td><td>spindle motor, servo-motor</td><td>–</td></tr>
</table>

(cont'd)

| Parameter No. (Index No.) | Size | Name | Setting Range | Units | Factory Setting | When Enabled | Classification | Motor Type | Reference Section |
|---|---|---|---|---|---|---|---|---|---|
| **Pn150 (208Ah:1)** | 2 | Predictive Control Function Select Switch | 0000h to 0014h | – | 0012h | After restart | Setup | spindle motor, servo-motor | – |

Pn150 (208Ah:1): n.□□□□ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit: Response Time Constant for Predictive Control Model

| | |
|---|---|
| 0 | Reserved (Do not use.) |
| 1 | Reserved (Do not use.) |
| 2 | Tp = 0.001 |
| 3 | Tp = 0.002 |
| 4 | Reserved (Do not use.) |

2nd digit: Predictive Control

| | |
|---|---|
| 0 | Reserved (Do not use.) |
| 1 | Kp linkage predictive parameter setting |

3rd digit: Reserved (Do not change.)

4th digit: Reserved (Do not change.)

| Parameter No. (Index No.) | Size | Name | Setting Range | Units | Factory Setting | When Enabled | Classification | Motor Type | Reference Section |
|---|---|---|---|---|---|---|---|---|---|
| **Pn151 (208Ah:2)** | 2 | Predictive Control Acceleration/Deceleration Gain | 0 to 300 | 1% | 100 | Immediately | Tuning | spindle motor, servo-motor | – |
| **Pn152 (208Ah:3)** | 2 | Predictive Control Ratio of Weight | 0 to 300 | 1% | 100 | Immediately | Tuning | spindle motor, servo-motor | – |
| **Pn153 (208Ah:4)** | 2 | Predictive Control Equivalent Kp Ratio | 10 to 300 | 1% | 100 | Immediately | Tuning | spindle motor, servo-motor | – |
| **Pn154 (208Ah:5)** | 2 | Predictive Control Speed FF Gain | 0 to 5000 | 0.1% | 0 | Immediately | Tuning | spindle motor, servo-motor | – |
| **Pn155 (208Ah:6)** | 2 | Predictive Control Torque FF Gain | 0 to 5000 | 0.1% | 0 | Immediately | Tuning | spindle motor, servo-motor | – |
| **Pn156 (208Ah:7)** | 2 | Predictive Control Torque FF Filter Time Constant | 0 to 65535 | 0.01 ms | 0 | Immediately | Tuning | spindle motor, servo-motor | – |
| **Pn157 (208Ah:8)** | 2 | Predictive Control Parameter Kph(C) | 0 to 100 | 0.1 | 80 | Immediately | Tuning | spindle motor, servo-motor | – |
| **Pn158 (208Ah:9)** | 2 | Predictive Control Parameter Cd | 0 to 5000 | 0.1 | 0 | Immediately | Tuning | spindle motor, servo-motor | – |

(cont'd)

| Parameter No. (Index No.) | Size | Name | Setting Range | Units | Factory Setting | When Enabled | Classification | Motor Type | Reference Section |
|---|---|---|---|---|---|---|---|---|---|
| **Pn159 (208Ah:10)** | 2 | Predictive Control Parameter α | -90 to 1000 | 0.01 | 0 | Immediately | Tuning | spindle motor, servomotor | – |
| **Pn15A (208Ah:11)** | 2 | Predictive Control Equivalent Kp Fine Adjustment Amount | -10000 to 32767 | 0.1/s | 0 | Immediately | Tuning | spindle motor, servomotor | – |
| **Pn160 (206Bh:1)** | 2 | Anti-Resonance Control Related Switch | 0000h to 0011h | – | 0010h | Immediately | Tuning | spindle motor, servomotor | 9.5 |

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

1st digit: Anti-Resonance Control Selection

| | |
|---|---|
| 0 | Does not use anti-resonance control. |
| 1 | Uses anti-resonance control. |

2nd digit: Anti-Resonance Control Adjustment Selection

| | |
|---|---|
| 0 | Does not adjust anti-resonance control automatically using utility function. |
| 1 | Adjusts anti-resonance control automatically using utility function. |

3rd digit: Reserved (Do not change.)

4th digit: Reserved (Do not change.)

| Parameter No. (Index No.) | Size | Name | Setting Range | Units | Factory Setting | When Enabled | Classification | Motor Type | Reference Section |
|---|---|---|---|---|---|---|---|---|---|
| **Pn161 (206Bh:2)** | 2 | Anti-Resonance Frequency | 10 to 20000 | 0.1 Hz | 1000 | Immediately | Tuning | spindle motor, servomotor | – |
| **Pn162 (206Bh:3)** | 2 | Anti-Resonance Gain Compensation | 1 to 1000 | 1% | 100 | Immediately | Tuning | spindle motor, servomotor | – |
| **Pn163 (206Bh:4)** | 2 | Anti-Resonance Damping Gain | 0 to 300 | 1% | 0 | Immediately | Tuning | spindle motor, servomotor | – |
| **Pn164 (206Bh:5)** | 2 | Anti-Resonance Filter Time Constant 1 Compensation | -1000 to 1000 | 0.01 ms | 0 | Immediately | Tuning | spindle motor, servomotor | – |
| **Pn165 (206Bh:6)** | 2 | Anti-Resonance Filter Time Constant 2 Compensation | -1000 to 1000 | 0.01 ms | 0 | Immediately | Tuning | spindle motor, servomotor | – |
| **Pn205 (20C0h)** | 2 | Multiturn Limit Setting | 0 to 65535 | 1 Rev | 65535 | After restart | Setup | servomotor | 8.7.5 |
| **Pn20A (20C1h)** | 4 | Number of External Scale Pitch | 4 to 1048576 | 1 pitch/rev | 32768 | After restart | Setup | spindle motor, servomotor | – |
| **Pn20E (–)** | 4 | Reserved (Do not change.) | – | – | 16 | – | – | spindle motor, servomotor | – |

(cont'd)

| Parameter No. (Index No.) | Size | Name | Setting Range | Units | Factory Setting | When Enabled | Classification | Motor Type | Reference Section |
|---|---|---|---|---|---|---|---|---|---|
| **Pn210 (–)** | 4 | Reserved (Do not change.) | – | – | 1 | – | – | spindle motor, servo-motor | – |
| **Pn22A (2083h)** | 2 | Fully-closed Control Selection Switch | 0000h to 1003h | – | 0000h | After restart | Setup | spindle motor, servo-motor | – |
| | n.□□□□ (4th digit, 3rd digit, 2nd digit, 1st digit)<br>1st digit: Reserved (Do not change.)<br>2nd digit: Reserved (Do not change.)<br>3rd digit: Reserved (Do not change.)<br>4th digit: Speed Feedback Selection at Fully-closed Control<br>0: Uses motor encoder speed.<br>1: Uses external encoder speed. | | | | | | | | |
| **Pn230 (20D0h:1)** | 4 | Number of Encoder Pulse | 100 to 1048576 | Pitch/Rev | 1024 | After restart | Setup | spindle motor | – |
| **Pn232 (20D0h:2)** | 2 | C-Phase Compensation Width | -200 to 200 | pulse | 0 | After restart | Setup | spindle motor | – |
| **Pn233 (20D0h:3)** | 2 | Magnetic Pole Origin Corrected Value | -18000 to 18000 | 0.01 deg | 0 | After restart | Setup | spindle motor | – |
| **Pn234 (20D0h:4)** | 2 | Pulse Encoder Stop Vibration Suppression | 0000h to 0001h | – | 0000h | Immedi-ately | Setup | spindle motor | – |
| | n.□□□□ (4th digit, 3rd digit, 2nd digit, 1st digit)<br>1st digit: Pulse Encoder Stop Vibration Suppression<br>0: Do not use stop vibration suppression.<br>1: Use stop vibration suppression.<br>2nd digit: Reserved (Do not change.)<br>3rd digit: Reserved (Do not change.)<br>4th digit: Reserved (Do not change.) | | | | | | | | |
| **Pn304 (2140h)** | 2 | JOG Speed | 0 to 10000 | 1 $min^{-1}$ | 500 | Immedi-ately | Setup | spindle motor, servo-motor | – |
| **Pn305 (2090h)** | 2 | Soft Start Acceleration Time | 0 to 10000 | 1 ms | 0 | Immedi-ately | Setup | spindle motor, servo-motor | – |
| **Pn306 (2091h)** | 2 | Soft Start Deceleration Time | 0 to 10000 | 1 ms | 0 | Immedi-ately | Setup | spindle motor, servo-motor | – |

(cont'd)

| Parameter No. (Index No.) | Size | Name | Setting Range | Units | Factory Setting | When Enabled | Classification | Motor Type | Reference Section |
|---|---|---|---|---|---|---|---|---|---|
| **Pn311 (2094h:2)** | 2 | Vibration Detection Sensibility | 50 to 500 | 1% | 100 | Immedi-ately | Tuning | spindle motor, servo-motor | – |
| **Pn324 (2143h)** | 2 | Moment of Inertia Calculating Start Level | 0 to 20000 | 1% | 300 | Immedi-ately | Setup | spindle motor, servo-motor | 9.2 |
| **Pn401 (2040h:4)** | 2 | 1st Step 1st Torque Reference Filter Time Constant | 0 to 65535 | 0.01 ms | 100 | Immedi-ately | Tuning | spindle motor, servo-motor | – |
| **Pn402 (20A0h:1)** | 2 | Forward Torque Limit | 0 to 800 | 1% | 800 | Immedi-ately | Setup | servo-motor | – |
| **Pn403 (20A0h:2)** | 2 | Reverse Torque Limit | 0 to 800 | 1% | 800 | Immedi-ately | Setup | servo-motor | – |
| **Pn404 (20A3h:1)** | 2 | Forward External Torque Limit | 0 to 800 | 1% | 100 | Immedi-ately | Setup | servo-motor | – |
| **Pn405 (20A3h:2)** | 2 | Reserve External Torque Limit | 0 to 800 | 1% | 100 | Immedi-ately | Setup | servo-motor | – |
| **Pn406 (20A2h)** | 2 | Emergency Stop Torque | 0 to 800 | 1% | 800 | Immedi-ately | Setup | spindle motor, servo-motor | 8.4.2 |
| **Pn407 (20A5h)** | 2 | Speed Limit during Torque Control | 0 to 10000 | 1 $min^{-1}$ | 10000 | Immedi-ately | Setup | spindle motor, servo-motor | – |
| **Pn408 (20A7h)** | 2 | Torque Related Function Switch | 0000h to 1111h | – | 0000h | – | Setup | spindle motor, servo-motor | – |

Pn408 (20A7h):

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

| 1st Step Notch Filter Selection | | When Enabled |
|---|---|---|
| 0 | N/A | Immediately |
| 1 | Uses 1st step notch filter for torque reference. | |

| Speed Limit Selection | | When Enabled |
|---|---|---|
| 0 | Uses the smaller of the maximum motor rotational speed and the value of Pn407 as the speed limit value. | After restart |
| 1 | Uses the smaller of the overspeed detection speed and the value of Pn407 as the speed limit value. | |

| 2nd Step Notch Filter Selection | | When Enabled |
|---|---|---|
| 0 | N/A | Immediately |
| 1 | Uses 2nd step notch filter for torque reference. | |

Reserved (Do not change.)

(cont'd)

| Parameter No. (Index No.) | Size | Name | Setting Range | Units | Factory Setting | When Enabled | Classification | Motor Type | Reference Section |
|---|---|---|---|---|---|---|---|---|---|
| **Pn409 (20A9h:1)** | 2 | 1st Notch Filter Frequency | 50 to 2000 | 1 Hz | 2000 | Immedi-ately | Tuning | spindle motor, servo-motor | – |
| **Pn40A (20A9h:2)** | 2 | 1st Notch Filter Q Value | 50 to 1000 | 0.01 | 70 | Immedi-ately | Tuning | spindle motor, servo-motor | – |
| **Pn40B (20A9h:3)** | 2 | 1st Notch Filter Depth | 0 to 1000 | 0.001 | 0 | Immedi-ately | Tuning | spindle motor, servo-motor | – |
| **Pn40C (20A9h:4)** | 2 | 2nd Notch Filter Frequency | 50 to 2000 | 1 Hz | 2000 | Immedi-ately | Tuning | spindle motor, servo-motor | – |
| **Pn40D (20A9h:5)** | 2 | 2nd Notch Filter Q Value | 50 to 1000 | 0.01 | 70 | Immedi-ately | Tuning | spindle motor, servo-motor | – |
| **Pn40E (20A9h:6)** | 2 | 2nd Notch Filter Depth | 0 to 1000 | 0.001 | 0 | Immedi-ately | Tuning | spindle motor, servo-motor | – |
| **Pn412 (2041h:4)** | 2 | 1st Step 2nd Torque Reference Filter Time Constant | 0 to 65535 | 0.01 ms | 100 | Immedi-ately | Tuning | spindle motor, servo-motor | – |
| **Pn413 (2042h:4)** | 2 | 1st Step 3rd Torque Reference Filter Time Constant | 0 to 65535 | 0.01 ms | 100 | Immedi-ately | Tuning | spindle motor, servo-motor | – |
| **Pn414 (2043h:4)** | 2 | 1st Step 4th Torque Reference Filter Time Constant | 0 to 65535 | 0.01 ms | 100 | Immedi-ately | Tuning | spindle motor, servo-motor | – |
| **Pn416 (20A9h:14)** | 2 | Torque Related Function Switch 2 | 0000h to 0011h | – | 0000h | Immedi-ately | Setup | spindle motor, servo-motor | – |

**Pn416 (20A9h:14)**

4th digit 3rd digit 2nd digit 1st digit

n.□□□□

1st digit: 3rd Step Notch Filter Selection

| 3rd Step Notch Filter Selection | |
|---|---|
| 0 | N/A |
| 1 | Uses 3rd step notch filter for torque reference. |

2nd digit: 4th Step Notch Filter Selection

| 4th Step Notch Filter Selection | |
|---|---|
| 0 | N/A |
| 1 | Uses 4th step notch filter for torque reference. |

3rd digit: Reserved (Do not change.)

4th digit: Reserved (Do not change.)

(cont'd)

| Parameter No. (Index No.) | Size | Name | Setting Range | Units | Factory Setting | When Enabled | Classification | Motor Type | Reference Section |
|---|---|---|---|---|---|---|---|---|---|
| **Pn417 (20A9h:8)** | 2 | 3rd Notch Filter Frequency | 50 to 2000 | 1 Hz | 2000 | Immedi-ately | Tuning | spindle motor, servo-motor | – |
| **Pn418 (20A9h:9)** | 2 | 3rd Notch Filter Q Value | 50 to 1000 | 0.01 | 70 | Immedi-ately | Tuning | spindle motor, servo-motor | – |
| **Pn419 (20A9h:10)** | 2 | 3rd Notch Filter Depth | 0 to 1000 | 0.001 | 0 | Immedi-ately | Tuning | spindle motor, servo-motor | – |
| **Pn41A (20A9h:11)** | 2 | 4th Notch Filter Frequency | 50 to 2000 | 1 Hz | 2000 | Immedi-ately | Tuning | spindle motor, servo-motor | – |
| **Pn41B (20A9h:12)** | 2 | 4th Notch Filter Q Value | 50 to 1000 | 0.01 | 70 | Immedi-ately | Tuning | spindle motor, servo-motor | – |
| **Pn41C (20A9h:13)** | 2 | 4th Notch Filter Depth | 0 to 1000 | 0.001 | 0 | Immedi-ately | Tuning | spindle motor, servo-motor | – |
| **Pn430 (20AAh:1)** | 2 | Torque Limit (Powering) | 0 to 800 | 1% | 150 | Immedi-ately | Setup | spindle motor | – |
| **Pn431 (20AAh:2)** | 2 | Torque Limit (Regeneration) | 0 to 800 | 1% | 150 | Immedi-ately | Setup | spindle motor | – |
| **Pn432 (20ABh:1)** | 2 | Motor Flux Lower Level | 10 to 100 | 1% | 15 | Immedi-ately | Setup | spindle motor | – |
| **Pn433 (20ABh:2)** | 2 | Servo Mode Flux Level (for High-speed Winding) | 30 to 100 | 1% | 100 | Immedi-ately | Setup | spindle motor | – |
| **Pn434 (20ABh:3)** | 2 | Servo Mode Base Speed Ratio (for High-speed Winding) | 100 to 500 | 1% | 100 | Immedi-ately | Setup | spindle motor | – |
| **Pn435 (20ABh:4)** | 2 | Servo Mode Flux Level (for Low-speed Winding) | 30 to 100 | 1% | 100 | Immedi-ately | Setup | spindle motor | – |
| **Pn436 (20ABh:5)** | 2 | Servo Mode Base Speed Ratio (for Low-speed Winding) | 100 to 500 | 1% | 100 | Immedi-ately | Setup | spindle motor | – |
| **Pn43F (20ACh:1)** | 2 | Load Ratio Meter Filter Time Constant | 0 to 5000 | 1 ms | 100 | Immedi-ately | Tuning | spindle motor | – |
| **Pn456 (2146h:4)** | 2 | Sweep Torque Reference Amplitude | 1 to 800 | 1% | 15 | Immedi-ately | Tuning | spindle motor, servo-motor | – |

(cont'd)

| Parameter No. (Index No.) | Size | Name | Setting Range | Units | Factory Setting | When Enabled | Classification | Motor Type | Reference Section |
|---|---|---|---|---|---|---|---|---|---|
| **Pn460 (20A9h:7)** | 2 | Notch Filter Adjustment Switch | 0000h to 0101h | – | 0101h | Immediately | Tuning | spindle motor, servomotor | 9.2 |

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

1st digit: Notch Filter Adjustment Selection 1

| | |
|---|---|
| 0 | Does not adjust 1st step notch filter automatically using utility function. |
| 1 | Adjust 1st step notch filter automatically using utility function. |

2nd digit: Reserved (Do not change.)

3rd digit: Notch Filter Adjustment Selection 2

| | |
|---|---|
| 0 | Does not adjust 2nd step notch filter automatically using utility function. |
| 1 | Adjust 2nd step notch filter automatically using utility function. |

4th digit: Reserved (Do not change.)

| Parameter No. (Index No.) | Size | Name | Setting Range | Units | Factory Setting | When Enabled | Classification | Motor Type | Reference Section |
|---|---|---|---|---|---|---|---|---|---|
| **Pn481 (20C8h:1)** | 2 | Magnetic Pole Detection Speed Loop Gain | 10 to 20000 | 0.1 Hz | 400 | Immediately | Tuning | spindle motor, servomotor | – |
| **Pn482 (20C8h:2)** | 2 | Magnetic Pole Detection Speed Integral Time | 15 to 51200 | 0.01 ms | 3000 | Immediately | Tuning | spindle motor, servomotor | – |
| **Pn486 (20C8h:4)** | 2 | Magnetic Pole Detection Command Acceleration/ Deceleration Time | 0 to 100 | 1 ms | 25 | Immediately | Tuning | spindle motor, servomotor | – |
| **Pn487 (20C8h:5)** | 2 | Magnetic Pole Detection Command Constant Speed Time | 0 to 300 | 1 ms | 0 | Immediately | Tuning | spindle motor, servomotor | – |
| **Pn488 (20C8h:6)** | 2 | Magnetic Pole Detection Command Waiting Time | 50 to 500 | 1 ms | 100 | Immediately | Tuning | spindle motor, servomotor | – |
| **Pn490 (20C8h:9)** | 2 | Magnetic Pole Detection Load Level | 0 to 20000 | 1% | 100 | Immediately | Tuning | spindle motor, servomotor | – |
| **Pn493 (20C8h:12)** | 2 | Magnetic Pole Detection Command Speed | 0 to 1000 | 1 $\text{min}^{-1}$ | 50 | Immediately | Tuning | spindle motor, servomotor | – |
| **Pn494 (20C8h:13)** | 2 | Magnetic Pole Detection Variable Range | 1 to 65535 | 0.001 rev | 250 | Immediately | Tuning | spindle motor, servomotor | – |
| **Pn495 (20C8h:14)** | 2 | Magnetic Pole Detection Confirmation Torque Reference | 0 to 200 | 1% | 100 | Immediately | Tuning | spindle motor, servomotor | – |

(cont'd)

| Parameter No. (Index No.) | Size | Name | Setting Range | Units | Factory Setting | When Enabled | Classification | Motor Type | Reference Section |
|---|---|---|---|---|---|---|---|---|---|
| **Pn498 (20C8h:17)** | 2 | Polarity Detection Allowable Error Range | 0 to 30 | 1 deg | 10 | Immediately | Tuning | spindle motor, servomotor | – |
| **Pn499 (20C8h:18)** | 2 | Reserved (Do not change.) | – | – | 15 | – | Tuning | spindle motor, servomotor | – |
| **Pn49A (20C8h:19)** | 2 | Reserved (Do not change.) | – | – | 50 | – | Tuning | spindle motor, servomotor | – |
| **Pn4B0 (20AEh:1)** | 2 | Acceleration Rate Correction Switch | 0000h to 0001h | – | 0000h | After restart | Setup | servomotor | – |

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

1st digit: Acceleration Rate Correction Switch

| | |
|---|---|
| 0 | Disables acceleration rate correction. |
| 1 | Enables acceleration rate correction. |

2nd digit: Reserved (Do not change.)

3rd digit: Reserved (Do not change.)

4th digit: Reserved (Do not change.)

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Pn4B1 (20AEh:2)** | 2 | Forward Compensation Number of Steps | 1 to 65535 | – | 1 | Immediately | Tuning | servomotor | – |
| **Pn4B2 (20AEh:3)** | 2 | Forward Compensation Torque | 0 to 30000 | 0.01% | 0 | Immediately | Tuning | servomotor | – |
| **Pn4B3 (20AEh:4)** | 2 | Forward Offset Position Ratio | 0 to 100 | % | 0 | Immediately | Tuning | servomotor | – |
| **Pn4B4 (20AEh:5)** | 2 | Forward Offset Compensation Torque | 0 to 30000 | 0.01% | 0 | Immediately | Tuning | servomotor | – |
| **Pn4B5 (20AEh:6)** | 2 | 2nd Step Forward Compensation Position Ratio | 0 to 600 | % | 0 | Immediately | Tuning | servomotor | – |
| **Pn4B6 (20AEh:7)** | 2 | 2nd Step Forward Compensation Torque | 0 to 30000 | 0.01% | 0 | Immediately | Tuning | servomotor | – |
| **Pn4B7 (20AEh:8)** | 2 | Reverse Compensation Number of Steps | 1 to 65535 | – | 1 | Immediately | Tuning | servomotor | – |
| **Pn4B8 (20AEh:9)** | 2 | Reverse Compensation Torque | 0 to 30000 | 0.01% | 0 | Immediately | Tuning | servomotor | – |
| **Pn4B9 (20AEh:10)** | 2 | Reverse Offset Position Ratio | 0 to 100 | % | 0 | Immediately | Tuning | servomotor | – |
| **Pn4BA (20AEh:11)** | 2 | Reverse Offset Compensation Torque | 0 to 30000 | 0.01% | 0 | Immediately | Tuning | servomotor | – |
| **Pn4BB (20AEh:12)** | 2 | 2nd Step Reverse Compensation Position Ratio | 0 to 600 | % | 0 | Immediately | Tuning | servomotor | – |
| **Pn4BC (20AEh:13)** | 2 | 2nd Step Reverse Compensation Torque | 0 to 30000 | 0.01% | 0 | Immediately | Tuning | servomotor | – |

(cont'd)

| Parameter No. (Index No.) | Size | Name | Setting Range | Units | Factory Setting | When Enabled | Classification | Motor Type | Reference Section |
|---|---|---|---|---|---|---|---|---|---|
| **Pn4BD (20AEh:14)** | 2 | Forward Compensation Step Correction Function Coefficient a | 0 to 65535 | – | 0 | Immediately | Tuning | servomotor | – |
| **Pn4BE (20AEh:15)** | 2 | Forward Compensation Step Correction Function Coefficient b | 0 to 65535 | – | 0 | Immediately | Tuning | servomotor | – |
| **Pn4BF (20AEh:16)** | 2 | Forward Compensation Torque Correction Function Coefficient a | 0 to 10000 | 0.01 | 0 | Immediately | Tuning | servomotor | – |
| **Pn4C0 (20AEh:17)** | 2 | Forward Compensation Torque Correction Function Coefficient b | 0 to 10000 | 0.01 | 0 | Immediately | Tuning | servomotor | – |
| **Pn4C1 (20AEh:18)** | 2 | Reverse Compensation Step Correction Function Coefficient a | 0 to 65535 | – | 0 | Immediately | Tuning | servomotor | – |
| **Pn4C2 (20AEh:19)** | 2 | Reverse Compensation Step Correction Function Coefficient b | 0 to 65535 | – | 0 | Immediately | Tuning | servomotor | – |
| **Pn4C3 (20AEh:20)** | 2 | Reverse Compensation Torque Correction Function Coefficient a | 0 to 10000 | 0.01 | 0 | Immediately | Tuning | servomotor | – |
| **Pn4C4 (20AEh:21)** | 2 | Reverse Compensation Torque Correction Function Coefficient b | 0 to 10000 | 0.01 | 0 | Immediately | Tuning | servomotor | – |
| **Pn4C5 (20AEh:22)** | 2 | Forward Acceleration Rate Correction Projection Compensation Limit Clamp Value | 0 to 30000 | 0.01% | 0 | Immediately | Tuning | servomotor | – |
| **Pn4C6 (20AEh:23)** | 2 | Reverse Acceleration Rate Correction Projection Compensation Limit Clamp Value | 0 to 30000 | 0.01% | 0 | Immediately | Tuning | servomotor | – |
| **Pn4F0 (20ADh:1)** | 2 | 1st Positive Projection Compensation Gain | 0 to 65535 | 100000 $/s^3$ | 10000 | Immediately | Setup | servomotor | – |
| **Pn4F1 (20ADh:2)** | 2 | 1st Positive Projection Compensation Limit Offset | 0 to 30000 | 0.01% | 0 | Immediately | Setup | servomotor | – |
| **Pn4F2 (20ADh:3)** | 2 | 2nd Positive Projection Compensation Gain | 0 to 65535 | 100000 $/s^3$ | 1000 | Immediately | Setup | servomotor | – |
| **Pn4F3 (20ADh:4)** | 2 | 2nd Positive Projection Compensation Limit Offset | 0 to 30000 | 0.01% | 0 | Immediately | Setup | servomotor | – |
| **Pn4F4 (20ADh:5)** | 2 | Positive Projection Compensation Limit Change Value | -30000 to 30000 | 0.01 %/ms | 0 | Immediately | Setup | servomotor | – |
| **Pn4F5 (20ADh:6)** | 2 | Positive Projection Compensation Limit Clamp Value | 0 to 30000 | 0.01% | 0 | Immediately | Setup | servomotor | – |
| **Pn4F6 (20ADh:7)** | 2 | 1st Negative Projection Compensation Gain | 0 to 65535 | 100000 $/s^3$ | 10000 | Immediately | Setup | servomotor | – |
| **Pn4F7 (20ADh:8)** | 2 | 1st Negative Projection Compensation Limit Offset | 0 to 30000 | 0.01% | 0 | Immediately | Setup | servomotor | – |
| **Pn4F8 (20ADh:9)** | 2 | 2nd Negative Projection Compensation Gain | 0 to 65535 | 100000 $/s^3$ | 1000 | Immediately | Setup | servomotor | – |

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| Parameter No. (Index No.) | Size | Name | Setting Range | Units | Factory Setting | When Enabled | Classification | Motor Type | Reference Section |
|---|---|---|---|---|---|---|---|---|---|
| **Pn4F9 (20ADh:10)** | 2 | 2nd Negative Projection Compensation Limit Offset | 0 to 30000 | 0.01% | 0 | Immedi-ately | Setup | servomo-tor | – |
| **Pn4FA (20ADh:11)** | 2 | Negative Projection Compensation Limit Change Value | -30000 to 30000 | 0.01%/ ms | 0 | Immedi-ately | Setup | servomo-tor | – |
| **Pn4FB (20ADh:12)** | 2 | Negative Projection Compensation Limit Clamp Value | 0 to 30000 | 0.01% | 0 | Immedi-ately | Setup | servomo-tor | – |
| **Pn4FC (20ADh:13)** | 2 | Projection Compensa-tion Timing Constant | -350 to 32767 | 0.1/s | 0 | Immedi-ately | Setup | servomo-tor | – |
| **Pn501 (2100h:1)** | 2 | Zero Clamp Level | 0 to 10000 | 1 $min^{-1}$ | 10 | Immedi-ately | Setup | spindle motor, servo-motor | – |
| **Pn502 (2100h:2)** | 2 | Rotation Detection Level | 1 to 10000 | 1 $min^{-1}$ | 20 | Immedi-ately | Setup | servo-motor | – |
| **Pn503 (2100h:3)** | 2 | Speed Coincidence Signal Output Width | 0 to 100 | 1 $min^{-1}$ | 10 | Immedi-ately | Setup | servo-motor | – |
| **Pn506 (2112h:1)** | 2 | Brake Reference - Servo OFF Delay Time | 0 to 50 | 10 ms | 0 | Immedi-ately | Setup | spindle motor, servo-motor | 8.4.3 |
| **Pn507 (2112h:2)** | 2 | Brake Reference Output Speed Level | 0 to 10000 | 1 $min^{-1}$ | 100 | Immedi-ately | Setup | spindle motor, servo-motor | |
| **Pn508 (2112h:4)** | 2 | Waiting Time for Brake Signal When Motor Running | 10 to 100 | 10 ms | 50 | Immedi-ately | Setup | spindle motor, servo-motor | |
| **Pn50A (2110h:1)** | 2 | Input Signal Selection 1 | 0000h to FFF1h | – | 1881h | After restart | Setup | spindle motor, servo-motor | – |

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

1st digit: Reserved (Do not change.)

2nd digit: Reserved (Do not change.)

3rd digit: Reserved (Do not change.)

4th digit:

| P-OT Signal Mapping | | Reference Section |
|---|---|---|
| 0 to 7 | Forward run allowed when P-OT input signal is ON (L-level) | 7.2.5 |
| 8 | Forward run allowed | |
| 9 to F | Forward run allowed when P-OT input signal is OFF (H-level) | |

(cont'd)

| Parameter No. (Index No.) | Size | Name | Setting Range | Units | Factory Setting | When Enabled | Classification | Motor Type | Reference Section |
|---|---|---|---|---|---|---|---|---|---|
| **Pn50B (2110h:2)** | 2 | Input Signal Selection 2 | 0000h to FFFFh | – | 8882h | After restart | Setup | spindle motor, servo-motor | – |

Pn50B: n.□□□□ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit:

| N-OT Signal Mapping | | Reference Section |
|---|---|---|
| 0 to 7 | Reverse run allowed when N-OT input signal is ON (L-level). | 7.2.5 |
| 8 | Reverse run allowed. | |
| 9 to F | Reverse run allowed when N-OT input signal is OFF (H-level). | |

2nd digit: Reserved (Do not change.)

3rd digit: Reserved (Do not change.)

4th digit: Reserved (Do not change.)

| Parameter No. (Index No.) | Size | Name | Setting Range | Units | Factory Setting | When Enabled | Classification | Motor Type | Reference Section |
|---|---|---|---|---|---|---|---|---|---|
| **Pn511 (2110h:3)** | 2 | Probe1, Probe2, HOME Input Signal setting | 0000h to FFFFh | – | 6543h | After restart | Setup | spindle motor, servo-motor | – |

Pn511: n.□□□□ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit: Reserved (Do not change.)

2nd digit:

| /Probe1 Input Signal Allocation | |
|---|---|
| 0 to 7 | Input /Probe1 signal from input terminal. |
| 8 to F | Input reversed /Probe1 signal from input terminal. |

3rd digit:

| /Probe2 Input Signal Allocation | |
|---|---|
| 0 to F | Same as /Probe1 Input Signal Allocation. |

4th digit:

| /Home Input Signal Allocation | |
|---|---|
| 0 to F | Same as /Probe1 Input Signal Allocation. |

(cont'd)

| Parameter No. (Index No.) | Size | Name | Setting Range | Units | Factory Setting | When Enabled | Classification | Motor Type | Reference Section |
|---|---|---|---|---|---|---|---|---|---|
| **Pn517 (2110h:4)** | 2 | OT Function | 0000h to 0003h | – | 0000h | Immedi-ately | Setup | spindle motor, servo-motor | – |
| | n.□□□□ (4th digit, 3rd digit, 2nd digit, 1st digit)<br>1st digit: Hardware OT Function<br>0: Enables OT function.<br>1: Disables OT function for forward run.<br>2: Disables OT function for reverse run.<br>3: Disables OT function.<br>2nd digit: Reserved (Do not change.)<br>3rd digit: Reserved (Do not change.)<br>4th digit: Reserved (Do not change.) | | | | | | | | |
| **Pn51B (2102h:5)** | 4 | Excessive Error Level between Servomotor and Load Positions | 0 to 1073741824 | 1 refer-ence unit | 1000 | Immedi-ately | Setup | spindle motor, servo-motor | – |
| **Pn51E (2102h:1)** | 2 | Excessive Position Error Warning Level | 10 to 100 | 1% | 100 | Immedi-ately | Setup | spindle motor, servo-motor | 11.3.1 |
| **Pn520 (2102h:2)** | 4 | Excessive Position Error Alarm Level | 1 to 1073741823 | 1 refer-ence unit | 5242880 | Immedi-ately | Setup | spindle motor, servo-motor | 9.1.4<br>11.2.1 |
| **Pn522 (2102h:3)** | 4 | Positioning Completed Width | 0 to 1073741824 | 1 refer-ence unit | 7 | Immedi-ately | Setup | spindle motor, servo-motor | – |
| **Pn524 (2102h:4)** | 4 | NEAR Signal Width | 1 to 1073741824 | 1 refer-ence unit | 1073741824 | Immedi-ately | Setup | spindle motor, servo-motor | – |
| **Pn526 (2103h:1)** | 4 | Excessive Position Error Alarm Level at Servo ON | 1 to 1073741823 | 1 refer-ence unit | 5242880 | Immedi-ately | Setup | spindle motor, servo-motor | 11.2.1 |
| **Pn528 (2103h:2)** | 2 | Excessive Position Error Warning Level at Servo ON | 10 to 100 | 1% | 100 | Immedi-ately | Setup | spindle motor, servo-motor | 11.3.1 |
| **Pn529 (2103h:3)** | 2 | Speed Limit Level at Servo ON | 0 to 10000 | 1 $min^{-1}$ | 10000 | Immedi-ately | Setup | spindle motor, servo-motor | 11.2.1 |
| **Pn52A (2102h:6)** | 2 | Multiplier per One Fully-closed Rotation | 0 to 100 | 1% | 20 | Immedi-ately | Tuning | spindle motor, servo-motor | – |

(cont'd)

<table>
<tr><th>Parameter No. (Index No.)</th><th>Size</th><th>Name</th><th>Setting Range</th><th>Units</th><th>Factory Setting</th><th>When Enabled</th><th>Classification</th><th>Motor Type</th><th>Reference Section</th></tr>
<tr><td>Pn52B (2104h:1)</td><td>2</td><td>Overload Warning Level</td><td>1 to 100</td><td>1%</td><td>20</td><td>Immedi-ately</td><td>Setup</td><td>spindle motor, servo-motor</td><td>8.4.6</td></tr>
<tr><td>Pn52C (2104h:2)</td><td>2</td><td>Derating of Base Current at Detecting Overload of Motor</td><td>10 to 100</td><td>1%</td><td>100</td><td>After restart</td><td>Setup</td><td>spindle motor, servo-motor</td><td>8.4.6</td></tr>
<tr><td rowspan="2">Pn530 (2142h:1)</td><td>2</td><td>Program JOG Operation Related Switch</td><td>0000h to 0005h</td><td>–</td><td>0000h</td><td>Immedi-ately</td><td>Setup</td><td>spindle motor, servo-motor</td><td>–</td></tr>
<tr><td colspan="9">n.□□□□ (4th digit, 3rd digit, 2nd digit, 1st digit)<br><br>1st digit: Program JOG Operation Switch<br>0: (Waiting time Pn535 → Forward movement Pn531) × Number of movements Pn536<br>1: (Waiting time Pn535 → Reverse movement Pn531) × Number of movements Pn536<br>2: (Waiting time Pn535 → Forward movement Pn531) × Number of movements Pn536<br>(Waiting time Pn535 → Reverse movement Pn531) × Number of movements Pn536<br>3: (Waiting time Pn535 → Reverse movement Pn531) × Number of movements Pn536<br>(Waiting time Pn535 → Forward movement Pn531) × Number of movements Pn536<br>4: (Waiting time Pn535 → Forward movement Pn531 → Waiting time Pn535 → Reverse movement Pn531) × Number of movements Pn536<br>5: (Waiting time Pn535 → Reverse movement Pn531 → Waiting time Pn535 → Forward movement Pn531) × Number of movements Pn536<br><br>2nd digit: Reserved (Do not change.)<br>3rd digit: Reserved (Do not change.)<br>4th digit: Reserved (Do not change.)</td></tr>
<tr><td>Pn531 (2142h:2)</td><td>4</td><td>Program JOG Movement Distance</td><td>1 to 1073741824</td><td>1 refer-ence unit</td><td>32768</td><td>Immedi-ately</td><td>Setup</td><td>spindle motor, servo-motor</td><td>–</td></tr>
<tr><td>Pn533 (2142h:3)</td><td>2</td><td>Program JOG Movement Speed</td><td>1 to 10000</td><td>1 min$^{-1}$</td><td>500</td><td>Immedi-ately</td><td>Setup</td><td>spindle motor, servo-motor</td><td>–</td></tr>
<tr><td>Pn534 (2142h:4)</td><td>2</td><td>Program JOG Accelera-tion/Deceleration Time</td><td>2 to 10000</td><td>1 ms</td><td>100</td><td>Immedi-ately</td><td>Setup</td><td>spindle motor, servo-motor</td><td>–</td></tr>
<tr><td>Pn535 (2142h:5)</td><td>2</td><td>Program JOG Waiting Time</td><td>0 to 10000</td><td>1 ms</td><td>100</td><td>Immedi-ately</td><td>Setup</td><td>spindle motor, servo-motor</td><td>–</td></tr>
<tr><td>Pn536 (2142h:6)</td><td>2</td><td>Number of Times of Program JOG Movement</td><td>0 to 1000</td><td>1 time</td><td>1</td><td>Immedi-ately</td><td>Setup</td><td>spindle motor, servo-motor</td><td>–</td></tr>
<tr><td>Pn541 (2098h:1)</td><td>2</td><td>Rated Speed Setting</td><td>100 to 65535</td><td>1 min$^{-1}$</td><td>65535</td><td>After restart</td><td>Setup</td><td>spindle motor</td><td>–</td></tr>
<tr><td>Pn542 (2098h:2)</td><td>2</td><td>Speed Coincidence Detection Width</td><td>10 to 50</td><td>1%</td><td>15</td><td>Immedi-ately</td><td>Setup</td><td>spindle motor</td><td>–</td></tr>
</table>

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| Parameter No. (Index No.) | Size | Name | Setting Range | Units | Factory Setting | When Enabled | Classification | Motor Type | Reference Section |
|---|---|---|---|---|---|---|---|---|---|
| **Pn543 (2098h:3)** | 2 | Speed Detection Level | 0 to 10000 | 0.01% | 1000 | Immedi-ately | Setup | spindle motor | – |
| **Pn544 (2098h:4)** | 2 | Speed Detection Hysteresis | 0 to 10000 | 0.01% | 100 | Immedi-ately | Setup | spindle motor | – |
| **Pn545 (2098h:5)** | 2 | Speed Error Excessive Protection Select Switch | 0000h to 0031h | – | 0000h | Immedi-ately | Setup | spindle motor | – |
| | n.□□□□ (4th digit, 3rd digit, 2nd digit, 1st digit)<br>1st digit: Detection Range of Speed Error Excessive Protection<br>0: 1/2 or less of speed reference<br>1: 1/4 or less of speed reference<br>2nd digit: Delay Time of Speed Error Excessive Protection<br>0: 0 ms<br>1: 300 ms<br>2: 400 ms<br>3: 500 ms<br>3rd digit: Reserved (Do not change.)<br>4th digit: Reserved (Do not change.) | | | | | | | | |
| **Pn550 (2116h:1)** | 2 | Analog Monitor 1 Offset Voltage | -10000 to 10000 | 0.1 V | 0 | Immedi-ately | Setup | spindle motor, servo-motor | 9.1.3 |
| **Pn551 (2116h:2)** | 2 | Analog Monitor 2 Offset Voltage | -10000 to 10000 | 0.1 V | 0 | Immedi-ately | Setup | spindle motor, servo-motor | |
| **Pn552 (2116h:3)** | 2 | Analog Monitor Magnification (× 1) | -10000 to 10000 | × 0.01 | 100 | Immedi-ately | Setup | spindle motor, servo-motor | |
| **Pn553 (2116h:4)** | 2 | Analog Monitor Magnification (× 2) | -10000 to 10000 | × 0.01 | 100 | Immedi-ately | Setup | spindle motor, servo-motor | |
| **Pn561 (2148h)** | 2 | Overshoot Detection Level | 0 to 100 | 1% | 50 | Immedi-ately | Setup | spindle motor, servo-motor | 9.2.1<br>9.3.1 |
| **Pn601 (2114h)** | 2 | DB Resistor Capacity | 0 to 65535 | 10 W | 0 | After restart | Setup | spindle motor, servo-motor | – |
| **Pn630 (2118h:1)** | 2 | Emergency Stop Execution Delay Time | 0 to 10000 | 1 ms | 0 | Immedi-ately | Setup | spindle motor, servo-motor | – |
| **Pn631 (2118h:2)** | 2 | External Magnetic Contactor OFF Delay Time | 0 to 10000 | 1 ms | 0 | After restart | Setup | spindle motor, servo-motor | – |

# 12.2 Parameter Recording Table

Use the following table for recording parameters.

| Parameter | Index Number | Factory Setting | | | | | | Name | When Enabled |
|---|---|---|---|---|---|---|---|---|---|
| **Pn000** | **2000h** | 0000h | | | | | | Basic Function Select Switch 0 | After restart |
| **Pn001** | **2001h** | *1 | | | | | | Application Function Select Switch 1 | After restart |
| **Pn002** | **2002h** | 0001h | | | | | | Application Function Select Switch 2 | After restart |
| **Pn006** | **2006h** | 0002h | | | | | | Application Function Select Switch 6 | Immediately |
| **Pn007** | **2007h** | 0000h | | | | | | Application Function Select Switch 7 | Immediately |
| **Pn008** | **2008h** | 4000h | | | | | | Application Function Select Switch 8 | After restart |
| **Pn00B** | **200Bh** | 0001h | | | | | | Application Function Select Switch B | After restart |
| **Pn00D** | **200Dh** | 0000h | | | | | | Application Function Select Switch D | *2 |
| **Pn010** | **5C00h** | 0001h | | | | | | SERVOPACK Address (for USB/Local bus communication) | After restart |
| **Pn01B** | **2030h:1** | 0000h | | | | | | Application Function Select Switch 1B | After restart |
| **Pn01C** | **2030h:2** | 0000h | | | | | | Application Function Select Switch 1C | After restart |
| **Pn01E** | **2030h:3** | 0000h | | | | | | Application Function Select Switch 1E | After restart |
| **Pn01F** | **2030h:4** | 0000h | | | | | | Application Function Select Switch 1F | After restart |
| **Pn030** | **–** | 0000 | | | | | | Reserved (Do not change.) | – |
| **Pn070** | **2030h:5** | 0000h | | | | | | Function at Cutting Feed | After restart |
| **Pn071** | **2030h:6** | 0000h | | | | | | Function at Fast-forward | After restart |
| **Pn07F** | **2030h:7** | 0000h | | | | | | Application Function Select Switch 7F | After restart |
| **Pn100** | **2040h:1** | 400 | | | | | | Speed Loop Gain | Immediately |
| **Pn101** | **2040h:2** | 2000 | | | | | | Speed Loop Integral Time Constant | Immediately |
| **Pn102** | **2040h:3** | 400 | | | | | | Position Loop Gain | Immediately |
| **Pn103** | **2060h** | 100 | | | | | | Moment of Inertia Ratio | Immediately |
| **Pn104** | **2041h:1** | 400 | | | | | | 2nd Speed Loop Gain | Immediately |
| **Pn105** | **2041h:2** | 2000 | | | | | | 2nd Speed Loop Integral Time Constant | Immediately |
| **Pn106** | **2041h:3** | 400 | | | | | | 2nd Position Loop Gain | Immediately |
| **Pn109** | **2061h** | 0 | | | | | | Feedforward Gain | Immediately |
| **Pn10A** | **2062h** | 0 | | | | | | Feedforward Filter Time Constant | Immediately |
| **Pn10B** | **2065h** | 0000h | | | | | | Application Function for Gain Select Switch | – |
| **Pn121** | **2067h:1** | 100 | | | | | | Friction Compensation Gain | Immediately |

*1. Varies in accordance with the SERVOPACK used.
SERVOPACK CACR-JU028ACA, -JU036ACA, -JU014DCA, -JU018DCA, -JUM2□ACA, -JUM2□DCA: 0200h
Other models: 0202h

*2. The timing varies in accordance with the digit changed in a parameter (1st digit, 2nd digit, and so on). For details, refer to 12.1 Parameters.

(cont'd)

| Parameter | Index Number | Factory Setting | | | | | | Name | When Enabled |
|---|---|---|---|---|---|---|---|---|---|
| **Pn123** | **2067h:3** | 0 | | | | | | Friction Compensation Coefficient | Immediately |
| **Pn124** | **2067h:4** | 0 | | | | | | Friction Compensation Frequency Correction | Immediately |
| **Pn125** | **2067h:5** | 100 | | | | | | Friction Compensation Gain Correction | Immediately |
| **Pn12B** | **2042h:1** | 400 | | | | | | 3rd Speed Loop Gain | Immediately |
| **Pn12C** | **2042h:2** | 2000 | | | | | | 3rd Speed Loop Integral Time Constant | Immediately |
| **Pn12D** | **2042h:3** | 400 | | | | | | 3rd Position Loop Gain | Immediately |
| **Pn12E** | **2043h:1** | 400 | | | | | | 4th Speed Loop Gain | Immediately |
| **Pn12F** | **2043h:2** | 2000 | | | | | | 4th Speed Loop Integral Time Constant | Immediately |
| **Pn130** | **2043h:3** | 400 | | | | | | 4th Position Loop Gain | Immediately |
| **Pn140** | **206Ah:1** | 0000h | | | | | | Model Following Control Related Switch | Immediately |
| **Pn141** | **206Ah:2** | 500 | | | | | | Model Following Control Gain | Immediately |
| **Pn142** | **206Ah:3** | 1000 | | | | | | Model Following Control Gain Compensation | Immediately |
| **Pn143** | **206Ah:4** | 1000 | | | | | | Model Following Control Bias (Forward Direction) | Immediately |
| **Pn144** | **206Ah:5** | 1000 | | | | | | Model Following Control Bias (Reverse Direction) | Immediately |
| **Pn147** | **206Ah:8** | 1000 | | | | | | Model Following Control Speed Feedforward Compensation | Immediately |
| **Pn150** | **208Ah:1** | 0012h | | | | | | Predictive Control Function Select Switch | After restart |
| **Pn151** | **208Ah:2** | 100 | | | | | | Predictive Control Acceleration/Deceleration Gain | Immediately |
| **Pn152** | **208Ah:3** | 100 | | | | | | Predictive Control Ratio of Weight | Immediately |
| **Pn153** | **208Ah:4** | 100 | | | | | | Predictive Control Equivalent Kp Ratio | Immediately |
| **Pn154** | **208Ah:5** | 0 | | | | | | Predictive Control Speed FF Gain | Immediately |
| **Pn155** | **208Ah:6** | 0 | | | | | | Predictive Control Torque FF Gain | Immediately |
| **Pn156** | **208Ah:7** | 0 | | | | | | Predictive Control Torque FF Filter Time Constant | Immediately |
| **Pn157** | **208Ah:8** | 80 | | | | | | Predictive Control Parameter Kph(C) | Immediately |
| **Pn158** | **208Ah:9** | 0 | | | | | | Predictive Control Parameter Cd | Immediately |
| **Pn159** | **208Ah:10** | 0 | | | | | | Predictive Control Parameter $\alpha$ | Immediately |
| **Pn15A** | **208Ah:11** | 0 | | | | | | Predictive Control Equivalent Kp Fine Adjustment Amount | Immediately |
| **Pn160** | **206Bh:1** | 0010h | | | | | | Anti-Resonance Control Related Switch | Immediately |
| **Pn161** | **206Bh:2** | 1000 | | | | | | Anti-Resonance Frequency | Immediately |
| **Pn162** | **206Bh:3** | 100 | | | | | | Anti-Resonance Gain Compensation | Immediately |

(cont'd)

| Parameter | Index Number | Factory Setting | | | | | | Name | When Enabled |
|---|---|---|---|---|---|---|---|---|---|
| **Pn163** | **206Bh:4** | 0 | | | | | | Anti-Resonance Damping Gain | Immediately |
| **Pn164** | **206Bh:5** | 0 | | | | | | Anti-Resonance Filter Time Constant 1 Compensation | Immediately |
| **Pn165** | **206Bh:6** | 0 | | | | | | Anti-Resonance Filter Time Constant 2 Compensation | Immediately |
| **Pn205** | **20C0h** | 65535 | | | | | | Multiturn Limit Setting | After restart |
| **Pn20A** | **20C1h** | 32768 | | | | | | Number of External Scale Pitch | After restart |
| **Pn20E** | **–** | 16 | | | | | | Reserved (Do not change.) | – |
| **Pn210** | **–** | 1 | | | | | | Reserved (Do not change.) | – |
| **Pn22A** | **2083h** | 0000h | | | | | | Fully-closed Control Selection Switch | After restart |
| **Pn230** | **20D0h:1** | 1024 | | | | | | Number of Encoder Pulse | After restart |
| **Pn232** | **20D0h:2** | 0 | | | | | | C-Phase Compensation Width | After restart |
| **Pn233** | **20D0h:3** | 0 | | | | | | Magnetic Pole Origin Corrected Value | After restart |
| **Pn234** | **20D0h:4** | 0000h | | | | | | Pulse Encoder Stop Vibration Suppression | Immediately |
| **Pn304** | **2140h** | 500 | | | | | | JOG Speed | Immediately |
| **Pn305** | **2090h** | 0 | | | | | | Soft Start Acceleration Time | Immediately |
| **Pn306** | **2091h** | 0 | | | | | | Soft Start Deceleration Time | Immediately |
| **Pn311** | **2094h:2** | 100 | | | | | | Vibration Detection Sensibility | Immediately |
| **Pn324** | **2143h** | 300 | | | | | | Moment of Inertia Calculating Start Level | Immediately |
| **Pn401** | **2040h:4** | 100 | | | | | | 1st Step 1st Torque Reference Filter Time Constant | Immediately |
| **Pn402** | **20A0h:1** | 800 | | | | | | Forward Torque Limit | Immediately |
| **Pn403** | **20A0h:2** | 800 | | | | | | Reverse Torque Limit | Immediately |
| **Pn404** | **20A3h:1** | 100 | | | | | | Forward External Torque Limit | Immediately |
| **Pn405** | **20A3h:2** | 100 | | | | | | Reverse External Torque Limit | Immediately |
| **Pn406** | **20A2h** | 800 | | | | | | Emergency Stop Torque | Immediately |
| **Pn407** | **20A5h** | 10000 | | | | | | Speed Limit during Torque Control | Immediately |
| **Pn408** | **20A7h** | 0000h | | | | | | Torque Related Function Switch | – |
| **Pn409** | **20A9h:1** | 2000 | | | | | | 1st Notch Filter Frequency | Immediately |
| **Pn40A** | **20A9h:2** | 70 | | | | | | 1st Notch Filter Q Value | Immediately |
| **Pn40B** | **20A9h:3** | 0 | | | | | | 1st Notch Filter Depth | Immediately |
| **Pn40C** | **20A9h:4** | 2000 | | | | | | 2nd Notch Filter Frequency | Immediately |
| **Pn40D** | **20A9h:5** | 70 | | | | | | 2nd Notch Filter Q Value | Immediately |
| **Pn40E** | **20A9h:6** | 0 | | | | | | 2nd Notch Filter Depth | Immediately |
| **Pn412** | **2041h:4** | 100 | | | | | | 1st Step 2nd Torque Reference Filter Time Constant | Immediately |
| **Pn413** | **2042h:4** | 100 | | | | | | 1st Step 3rd Torque Reference Filter Time Constant | Immediately |
| **Pn414** | **2043h:4** | 100 | | | | | | 1st Step 4th Torque Reference Filter Time Constant | Immediately |

(cont'd)

| Parameter | Index Number | Factory Setting | | | | | | Name | When Enabled |
|---|---|---|---|---|---|---|---|---|---|
| **Pn416** | **20A9h:14** | 0000h | | | | | | Torque Related Function Switch 2 | Immediately |
| **Pn417** | **20A9h:8** | 2000 | | | | | | 3rd Notch Filter Frequency | Immediately |
| **Pn418** | **20A9h:9** | 70 | | | | | | 3rd Notch Filter Q Value | Immediately |
| **Pn419** | **20A9h:10** | 0 | | | | | | 3rd Notch Filter Depth | Immediately |
| **Pn41A** | **20A9h:11** | 2000 | | | | | | 4th Notch Filter Frequency | Immediately |
| **Pn41B** | **20A9h:12** | 70 | | | | | | 4th Notch Filter Q Value | Immediately |
| **Pn41C** | **20A9h:13** | 0 | | | | | | 4th Notch Filter Depth | Immediately |
| **Pn430** | **20AAh:1** | 150 | | | | | | Torque Limit (Powering) | Immediately |
| **Pn431** | **20AAh:2** | 150 | | | | | | Torque Limit (Regeneration) | Immediately |
| **Pn432** | **20ABh:1** | 15 | | | | | | Motor Flux Lower Level | Immediately |
| **Pn433** | **20ABh:2** | 100 | | | | | | Servo Mode Flux Level (for High-speed Winding) | Immediately |
| **Pn434** | **20ABh:3** | 100 | | | | | | Servo Mode Base Speed Ratio (for High-speed Winding) | Immediately |
| **Pn435** | **20ABh:4** | 100 | | | | | | Servo Mode Flux Level (for Low-speed Winding) | Immediately |
| **Pn436** | **20ABh:5** | 100 | | | | | | Servo Mode Base Speed Ratio (for Low-speed Winding) | Immediately |
| **Pn43F** | **20ACh:1** | 100 | | | | | | Load Ratio Meter Filter Time Constant | Immediately |
| **Pn456** | **2146h:4** | 15 | | | | | | Sweep Torque Reference Amplitude | Immediately |
| **Pn460** | **20A9h:7** | 0101h | | | | | | Notch Filter Adjustment Switch | Immediately |
| **Pn481** | **20C8h:1** | 40 | | | | | | Magnetic Pole Detection Speed Loop Gain | Immediately |
| **Pn482** | **20C8h:2** | 30 | | | | | | Magnetic Pole Detection Speed Integral Time | Immediately |
| **Pn486** | **20C8h:4** | 25 | | | | | | Magnetic Pole Detection Command Acceleration/ Deceleration Time | Immediately |
| **Pn487** | **20C8h:5** | 0 | | | | | | Magnetic Pole Detection Command Constant Speed Time | Immediately |
| **Pn488** | **20C8h:6** | 100 | | | | | | Magnetic Pole Detection Command Waiting Time | Immediately |
| **Pn490** | **20C8h:9** | 100 | | | | | | Magnetic Pole Detection Load Level | Immediately |
| **Pn493** | **20C8h:12** | 50 | | | | | | Magnetic Pole Detection Command Speed | Immediately |
| **Pn494** | **20C8h:13** | 0.25 | | | | | | Magnetic Pole Detection Variable Range | Immediately |
| **Pn495** | **20C8h:14** | 100 | | | | | | Magnetic Pole Detection Confirmation Torque Reference | Immediately |
| **Pn498** | **20C8h:17** | 10 | | | | | | Polarity Detection Allowable Error Range | Immediately |
| **Pn499** | **20C8h:18** | 15 | | | | | | Reserved (Do not change.) | – |
| **Pn49A** | **20C8h:19** | 50 | | | | | | Reserved (Do not change.) | – |
| **Pn4B0** | **20AEh:1** | 0000h | | | | | | Acceleration Rate Correction Switch | After restart |

(cont'd)

| Parameter | Index Number | Factory Setting | | | | | | Name | When Enabled |
|---|---|---|---|---|---|---|---|---|---|
| **Pn4B1** | **20AEh:2** | 1 | | | | | | Forward Compensation Number of Steps | Immediately |
| **Pn4B2** | **20AEh:3** | 0 | | | | | | Forward Compensation Torque | Immediately |
| **Pn4B3** | **20AEh:4** | 0 | | | | | | Forward Offset Position Ratio | Immediately |
| **Pn4B4** | **20AEh:5** | 0 | | | | | | Forward Offset Compensation Torque | Immediately |
| **Pn4B5** | **20AEh:6** | 0 | | | | | | 2nd Step Forward Compensation Position Ratio | Immediately |
| **Pn4B6** | **20AEh:7** | 0 | | | | | | 2nd Step Forward Compensation Torque | Immediately |
| **Pn4B7** | **20AEh:8** | 1 | | | | | | Reverse Compensation Number of Steps | Immediately |
| **Pn4B8** | **20AEh:9** | 0 | | | | | | Reverse Compensation Torque | Immediately |
| **Pn4B9** | **20AEh:10** | 0 | | | | | | Reverse Offset Position Ratio | Immediately |
| **Pn4BA** | **20AEh:11** | 0 | | | | | | Reverse Offset Compensation Torque | Immediately |
| **Pn4BB** | **20AEh:12** | 0 | | | | | | 2nd Step Reverse Compensation Position Ratio | Immediately |
| **Pn4BC** | **20AEh:13** | 0 | | | | | | 2nd Step Reverse Compensation Torque | Immediately |
| **Pn4BD** | **20AEh:14** | 0 | | | | | | Forward Compensation Step Correction Function Coefficient a | Immediately |
| **Pn4BE** | **20AEh:15** | 0 | | | | | | Forward Compensation Step Correction Function Coefficient b | Immediately |
| **Pn4BF** | **20AEh:16** | 0 | | | | | | Forward Compensation Torque Correction Function Coefficient a | Immediately |
| **Pn4C0** | **20AEh:17** | 0 | | | | | | Forward Compensation Torque Correction Function Coefficient b | Immediately |
| **Pn4C1** | **20AEh:18** | 0 | | | | | | Reverse Compensation Step Correction Function Coefficient a | Immediately |
| **Pn4C2** | **20AEh:19** | 0 | | | | | | Reverse Compensation Step Correction Function Coefficient b | Immediately |
| **Pn4C3** | **20AEh:20** | 0 | | | | | | Reverse Compensation Torque Correction Function Coefficient a | Immediately |
| **Pn4C4** | **20AEh:21** | 0 | | | | | | Reverse Compensation Torque Correction Function Coefficient b | Immediately |
| **Pn4C5** | **20AEh:22** | 0 | | | | | | Forward Acceleration Rate Correction Projection Compensation Limit Clamp Value | Immediately |
| **Pn4C6** | **20AEh:23** | 0 | | | | | | Reverse Acceleration Rate Correction Projection Compensation Limit Clamp Value | Immediately |
| **Pn4F0** | **20ADh:1** | 10000 | | | | | | 1st Positive Projection Compensation Gain | Immediately |
| **Pn4F1** | **20ADh:2** | 0 | | | | | | 1st Positive Projection Compensation Limit Offset | Immediately |

(cont'd)

| Parameter | Index Number | Factory Setting | | | | | | Name | When Enabled |
|---|---|---|---|---|---|---|---|---|---|
| **Pn4F2** | **20ADh:3** | 1000 | | | | | | 2nd Positive Projection Compensation Gain | Immediately |
| **Pn4F3** | **20ADh:4** | 0 | | | | | | 2nd Positive Projection Compensation Limit Offset | Immediately |
| **Pn4F4** | **20ADh:5** | 0 | | | | | | Positive Projection Compensa-tion Limit Change Value | Immediately |
| **Pn4F5** | **20ADh:6** | 0 | | | | | | Positive Projection Compensa-tion Limit Clamp Value | Immediately |
| **Pn4F6** | **20ADh:7** | 10000 | | | | | | 1st Negative Projection Compensation Gain | Immediately |
| **Pn4F7** | **20ADh:8** | 0 | | | | | | 1st Negative Projection Compensation Limit Offset | Immediately |
| **Pn4F8** | **20ADh:9** | 1000 | | | | | | 2nd Negative Projection Compensation Gain | Immediately |
| **Pn4F9** | **20ADh:10** | 0 | | | | | | 2nd Negative Projection Compensation Limit Offset | Immediately |
| **Pn4FA** | **20ADh:11** | 0 | | | | | | Negative Projection Compensation Limit Change Value | Immediately |
| **Pn4FB** | **20ADh:12** | 0 | | | | | | Negative Projection Compensation Limit Clamp Value | Immediately |
| **Pn4FC** | **20ADh:13** | 0 | | | | | | Projection Compensation Tim-ing Constant | Immediately |
| **Pn501** | **2100h:1** | 10 | | | | | | Zero Clamp Level | Immediately |
| **Pn502** | **2100h:2** | 20 | | | | | | Rotation Detection Level | Immediately |
| **Pn503** | **2100h:3** | 10 | | | | | | Speed Coincidence Signal Output Width | Immediately |
| **Pn506** | **2112h:1** | 0 | | | | | | Brake Reference - Servo OFF Delay Time | Immediately |
| **Pn507** | **2112h:2** | 100 | | | | | | Brake Reference Output Speed Level | Immediately |
| **Pn508** | **2112h:4** | 50 | | | | | | Waiting Time for Brake Signal When Motor Running | Immediately |
| **Pn50A** | **2110h:1** | 1881h | | | | | | Input Signal Selection 1 | After restart |
| **Pn50B** | **2110h:2** | 8882h | | | | | | Input Signal Selection 2 | After restart |
| **Pn511** | **2110h:3** | 6543h | | | | | | Probe1, Probe2, HOME Input Signal setting | After restart |
| **Pn517** | **2110h:4** | 0000h | | | | | | OT Function | Immediately |
| **Pn51B** | **2102h:5** | 1000 | | | | | | Excessive Error Level between Servomotor and Load Posi-tions | Immediately |
| **Pn51E** | **2102h:1** | 100 | | | | | | Excessive Position Error Warning Level | Immediately |
| **Pn520** | **2102h:2** | 5242880 | | | | | | Excessive Position Error Alarm Level | Immediately |
| **Pn522** | **2102h:3** | 7 | | | | | | Positioning Completed Width | Immediately |
| **Pn524** | **2102h:4** | 1073741824 | | | | | | NEAR Signal Width | Immediately |
| **Pn526** | **2103h:1** | 5242880 | | | | | | Excessive Position Error Alarm Level at Servo ON | Immediately |
| **Pn528** | **2103h:2** | 100 | | | | | | Excessive Position Error Warning Level at Servo ON | Immediately |

(cont'd)

| Parameter | Index Number | Factory Setting | | | | | | Name | When Enabled |
|---|---|---|---|---|---|---|---|---|---|
| **Pn529** | **2103h:3** | 10000 | | | | | | Speed Limit Level at Servo ON | Immediately |
| **Pn52A** | **2102h:6** | 20 | | | | | | Multiplier per One Fully-closed Rotation | Immediately |
| **Pn52B** | **2104h:1** | 20 | | | | | | Overload Warning Level | Immediately |
| **Pn52C** | **2104h:2** | 100 | | | | | | Derating of Base Current at Detecting Overload of Motor | After restart |
| **Pn530** | **2142h:1** | 0000h | | | | | | Program JOG Operation Related Switch | Immediately |
| **Pn531** | **2142h:2** | 32768 | | | | | | Program JOG Movement Distance | Immediately |
| **Pn533** | **2142h:3** | 500 | | | | | | Program JOG Movement Speed | Immediately |
| **Pn534** | **2142h:4** | 100 | | | | | | Program JOG Acceleration/ Deceleration Time | Immediately |
| **Pn535** | **2142h:5** | 100 | | | | | | Program JOG Waiting Time | Immediately |
| **Pn536** | **2142h:6** | 1 | | | | | | Number of Times of Program JOG Movement | Immediately |
| **Pn541** | **2098h:1** | 65535 | | | | | | Rated Speed Setting | After restart |
| **Pn542** | **2098h:2** | 15 | | | | | | Speed Coincidence Detection Width | Immediately |
| **Pn543** | **2098h:3** | 1000 | | | | | | Speed Detection Level | Immediately |
| **Pn544** | **2098h:4** | 100 | | | | | | Speed Detection Hysteresis | Immediately |
| **Pn545** | **2098h:5** | 0000h | | | | | | Speed Error Excessive Protection Select Switch | Immediately |
| **Pn550** | **2116h:1** | 0 | | | | | | Analog Monitor 1 Offset Voltage | Immediately |
| **Pn551** | **2116h:2** | 0 | | | | | | Analog Monitor 2 Offset Voltage | Immediately |
| **Pn552** | **2116h:3** | 100 | | | | | | Analog Monitor Magnification (× 1) | Immediately |
| **Pn553** | **2116h:4** | 100 | | | | | | Analog Monitor Magnification (× 2) | Immediately |
| **Pn561** | **2148h** | 50 | | | | | | Overshoot Detection Level | Immediately |
| **Pn601** | **2114h** | 0 | | | | | | DB Resistor Capacity | After restart |
| **Pn630** | **2118h:1** | 0 | | | | | | Emergency Stop Execution Delay Time | Immediately |
| **Pn631** | **2118h:2** | 0 | | | | | | External Magnetic Contactor OFF Delay Time | After restart |

# 12.3 Index Numbers and Corresponding Parameter Numbers

Use the following table to find the parameter numbers that correspond to the index numbers of the EtherCAT (CoE) commands of the Σ-V-SD Driver.

### Supplemental Information

The index numbers for a SERVOPACK for one axis and axis 1 of a SERVOPACK for two axes are given for the index numbers of the servo parameters. The index numbers for axis 2 of a SERVOPACK for two axes can be calculated by adding 400h to the index numbers for axis 1.

### Example:

Parameter number: Pn100
= Index number for axis 1: 2040h
↓ Add 400h to calculate the index number for axis 2.
= Index number for axis 2: 2440h

| Index Number | Parameter | Name |
|---|---|---|
| **2000h** | **Pn000** | Basic Function Select Switch 0 |
| **2001h** | **Pn001** | Application Function Select Switch 1 |
| **2002h** | **Pn002** | Application Function Select Switch 2 |
| **2006h** | **Pn006** | Application Function Select Switch 6 |
| **2007h** | **Pn007** | Application Function Select Switch 7 |
| **2008h** | **Pn008** | Application Function Select Switch 8 |
| **200Bh** | **Pn00B** | Application Function Select Switch B |
| **200Dh** | **Pn00D** | Application Function Select Switch D |
| **2030h:1** | **Pn01B** | Application Function Select Switch 1B |
| **2030h:2** | **Pn01C** | Application Function Select Switch 1C |
| **2030h:3** | **Pn01E** | Application Function Select Switch 1E |
| **2030h:4** | **Pn01F** | Application Function Select Switch 1F |
| **2030h:5** | **Pn070** | Function at Cutting Feed |
| **2030h:6** | **Pn071** | Function at Fast-forward |
| **2030h:7** | **Pn07F** | Application Function Select Switch 7F |
| **2040h:1** | **Pn100** | Speed Loop Gain |
| **2040h:2** | **Pn101** | Speed Loop Integral Time Constant |
| **2040h:3** | **Pn102** | Position Loop Gain |
| **2040h:4** | **Pn401** | 1st Step 1st Torque Reference Filter Time Constant |
| **2041h:1** | **Pn104** | 2nd Speed Loop Gain |
| **2041h:2** | **Pn105** | 2nd Speed Loop Integral Time Constant |
| **2041h:3** | **Pn106** | 2nd Position Loop Gain |
| **2041h:4** | **Pn412** | 1st Step 2nd Torque Reference Filter Time Constant |
| **2042h:1** | **Pn12B** | 3rd Speed Loop Gain |
| **2042h:2** | **Pn12C** | 3rd Speed Loop Integral Time Constant |
| **2042h:3** | **Pn12D** | 3rd Position Loop Gain |
| **2042h:4** | **Pn413** | 1st Step 3rd Torque Reference Filter Time Constant |
| **2043h:1** | **Pn12E** | 4th Speed Loop Gain |
| **2043h:2** | **Pn12F** | 4th Speed Loop Integral Time Constant |
| **2043h:3** | **Pn130** | 4th Position Loop Gain |
| **2043h:4** | **Pn414** | 1st Step 4th Torque Reference Filter Time Constant |
| **2060h** | **Pn103** | Moment of Inertia Ratio |
| **2061h** | **Pn109** | Feedforward Gain |
| **2062h** | **Pn10A** | Feedforward Filter Time Constant |

(cont'd)

| Index Number | Parameter | Name |
|---|---|---|
| **2065h** | **Pn10B** | Application Function for Gain Select Switch |
| **2067h:1** | **Pn121** | Friction Compensation Gain |
| **2067h:3** | **Pn123** | Friction Compensation Coefficient |
| **2067h:4** | **Pn124** | Friction Compensation Frequency Correction |
| **2067h:5** | **Pn125** | Friction Compensation Gain Correction |
| **206Ah:1** | **Pn140** | Model Following Control Related Switch |
| **206Ah:2** | **Pn141** | Model Following Control Gain |
| **206Ah:3** | **Pn142** | Model Following Control Gain Compensation |
| **206Ah:4** | **Pn143** | Model Following Control Bias (Forward Direction) |
| **206Ah:5** | **Pn144** | Model Following Control Bias (Reverse Direction) |
| **206Ah:8** | **Pn147** | Model Following Control Speed Feedforward Compensation |
| **206Bh:1** | **Pn160** | Anti-Resonance Control Related Switch |
| **206Bh:2** | **Pn161** | Anti-Resonance Frequency |
| **206Bh:3** | **Pn162** | Anti-Resonance Gain Compensation |
| **206Bh:4** | **Pn163** | Anti-Resonance Damping Gain |
| **206Bh:5** | **Pn164** | Anti-Resonance Filter Time Constant 1 Compensation |
| **206Bh:6** | **Pn165** | Anti-Resonance Filter Time Constant 2 Compensation |
| **2083h** | **Pn22A** | Fully-closed Control Selection Switch |
| **208Ah:1** | **Pn150** | Predictive Control Function Select Switch |
| **208Ah:2** | **Pn151** | Predictive Control Acceleration/Deceleration Gain |
| **208Ah:3** | **Pn152** | Predictive Control Ratio of Weight |
| **208Ah:4** | **Pn153** | Predictive Control Equivalent Kp Ratio |
| **208Ah:5** | **Pn154** | Predictive Control Speed FF Gain |
| **208Ah:6** | **Pn155** | Predictive Control Torque FF Gain |
| **208Ah:7** | **Pn156** | Predictive Control Torque FF Filter Time Constant |
| **208Ah:8** | **Pn157** | Predictive Control Parameter Kph (C) |
| **208Ah:9** | **Pn158** | Predictive Control Parameter Cd |
| **208Ah:10** | **Pn159** | Predictive Control Parameter α |
| **208Ah:11** | **Pn15A** | Predictive Control Equivalent Kp Fine Adjustment Amount |
| **2090h** | **Pn305** | Soft Start Acceleration Time |
| **2091h** | **Pn306** | Soft Start Deceleration Time |
| **2094h:2** | **Pn311** | Vibration Detection Sensibility |
| **2098h:1** | **Pn541** | Rated Speed Setting |
| **2098h:2** | **Pn542** | Speed Coincidence Detection Width |
| **2098h:3** | **Pn543** | Speed Detection Level |
| **2098h:4** | **Pn544** | Speed Detection Hysteresis |
| **2098h:5** | **Pn545** | Speed Error Excessive Protection Select Switch |
| **20A0h:1** | **Pn402** | Forward Torque Limit |
| **20A0h:2** | **Pn403** | Reverse Torque Limit |
| **20A2h** | **Pn406** | Emergency Stop Torque |
| **20A3h:1** | **Pn404** | Forward External Torque Limit |
| **20A3h:2** | **Pn405** | Reverse External Torque Limit |
| **20A5h** | **Pn407** | Speed Limit during Torque Control |
| **20A7h** | **Pn408** | Torque Related Function Switch |
| **20A9h:1** | **Pn409** | 1st Notch Filter Frequency |

(cont'd)

| Index Number | Parameter | Name |
|---|---|---|
| **20A9h:2** | **Pn40A** | 1st Notch Filter Q Value |
| **20A9h:3** | **Pn40B** | 1st Notch Filter Depth |
| **20A9h:4** | **Pn40C** | 2nd Notch Filter Frequency |
| **20A9h:5** | **Pn40D** | 2nd Notch Filter Q Value |
| **20A9h:6** | **Pn40E** | 2nd Notch Filter Depth |
| **20A9h:7** | **Pn460** | Notch Filter Adjustment Switch |
| **20A9h:8** | **Pn417** | 3rd Notch Filter Frequency |
| **20A9h:9** | **Pn418** | 3rd Notch Filter Q Value |
| **20A9h:10** | **Pn419** | 3rd Notch Filter Depth |
| **20A9h:11** | **Pn41A** | 4th Notch Filter Frequency |
| **20A9h:12** | **Pn41B** | 4th Notch Filter Q Value |
| **20A9h:13** | **Pn41C** | 4th Notch Filter Depth |
| **20A9h:14** | **Pn416** | Torque Related Function Switch 2 |
| **20AAh:1** | **Pn430** | Torque Limit (Powering) |
| **20AAh:2** | **Pn431** | Torque Limit (Regeneration) |
| **20ABh:1** | **Pn432** | Motor Flux Lower Level |
| **20ABh:2** | **Pn433** | Servo Mode Flux Level (for High-speed Winding) |
| **20ABh:3** | **Pn434** | Servo Mode Base Speed Ratio (for High-speed Winding) |
| **20ABh:4** | **Pn435** | Servo Mode Flux Level (for Low-speed Winding) |
| **20ABh:5** | **Pn436** | Servo Mode Base Speed Ratio (for Low-speed Winding) |
| **20ACh:1** | **Pn43F** | Load Ratio Meter Filter Time Constant |
| **20ADh:1** | **Pn4F0** | 1st Positive Projection Compensation Gain |
| **20ADh:2** | **Pn4F1** | 1st Positive Projection Compensation Limit Offset |
| **20ADh:3** | **Pn4F2** | 2nd Positive Projection Compensation Gain |
| **20ADh:4** | **Pn4F3** | 2nd Positive Projection Compensation Limit Offset |
| **20ADh:5** | **Pn4F4** | Positive Projection Compensation Limit Change Value |
| **20ADh:6** | **Pn4F5** | Positive Projection Compensation Limit Clamp Value |
| **20ADh:7** | **Pn4F6** | 1st Negative Projection Compensation Gain |
| **20ADh:8** | **Pn4F7** | 1st Negative Projection Compensation Limit Offset |
| **20ADh:9** | **Pn4F8** | 2nd Negative Projection Compensation Gain |
| **20ADh:10** | **Pn4F9** | 2nd Negative Projection Compensation Limit Offset |
| **20ADh:11** | **Pn4FA** | Negative Projection Compensation Limit Change Value |
| **20ADh:12** | **Pn4FB** | Negative Projection Compensation Limit Clamp Value |
| **20ADh:13** | **Pn4FC** | Projection Compensation Timing Constant |
| **20AEh:1** | **Pn4B0** | Acceleration Rate Correction Switch |
| **20AEh:2** | **Pn4B1** | Forward Compensation Number of Steps |
| **20AEh:3** | **Pn4B2** | Forward Compensation Torque |
| **20AEh:4** | **Pn4B3** | Forward Offset Position Ratio |
| **20AEh:5** | **Pn4B4** | Forward Offset Compensation Torque |
| **20AEh:6** | **Pn4B5** | 2nd Step Forward Compensation Position Ratio |
| **20AEh:7** | **Pn4B6** | 2nd Step Forward Compensation Torque |
| **20AEh:8** | **Pn4B7** | Reverse Compensation Number of Steps |
| **20AEh:9** | **Pn4B8** | Reverse Compensation Torque |
| **20AEh:10** | **Pn4B9** | Reverse Offset Position Ratio |
| **20AEh:11** | **Pn4BA** | Reverse Offset Compensation Torque |

(cont'd)

| Index Number | Parameter | Name |
|---|---|---|
| **20AEh:12** | **Pn4BB** | 2nd Step Reverse Compensation Position Ratio |
| **20AEh:13** | **Pn4BC** | 2nd Step Reverse Compensation Torque |
| **20AEh:14** | **Pn4BD** | Forward Compensation Step Correction Function Coefficient a |
| **20AEh:15** | **Pn4BE** | Forward Compensation Step Correction Function Coefficient b |
| **20AEh:16** | **Pn4BF** | Forward Compensation Torque Correction Function Coefficient a |
| **20AEh:17** | **Pn4C0** | Forward Compensation Torque Correction Function Coefficient b |
| **20AEh:18** | **Pn4C1** | Reverse Compensation Step Correction Function Coefficient a |
| **20AEh:19** | **Pn4C2** | Reverse Compensation Step Correction Function Coefficient b |
| **20AEh:20** | **Pn4C3** | Reverse Compensation Torque Correction Function Coefficient a |
| **20AEh:21** | **Pn4C4** | Reverse Compensation Torque Correction Function Coefficient b |
| **20AEh:22** | **Pn4C5** | Forward Acceleration Rate Correction Projection Compensation Limit Clamp Value |
| **20AEh:23** | **Pn4C6** | Reverse Acceleration Rate Correction Projection Compensation Limit Clamp Value |
| **20C0h** | **Pn205** | Multiturn Limit Setting |
| **20C1h** | **Pn20A** | Number of External Scale Pitch |
| **20C8h:1** | **Pn481** | Magnetic Pole Detection Speed Loop Gain |
| **20C8h:2** | **Pn482** | Magnetic Pole Detection Speed Integral Time |
| **20C8h:4** | **Pn486** | Magnetic Pole Detection Command Acceleration/Deceleration Time |
| **20C8h:5** | **Pn487** | Magnetic Pole Detection Command Constant Speed Time |
| **20C8h:6** | **Pn488** | Magnetic Pole Detection Command Waiting Time |
| **20C8h:9** | **Pn490** | Magnetic Pole Detection Load Level |
| **20C8h:12** | **Pn493** | Magnetic Pole Detection Command Speed |
| **20C8h:13** | **Pn494** | Magnetic Pole Detection Variable Range |
| **20C8h:14** | **Pn495** | Magnetic Pole Detection Confirmation Torque Reference |
| **20C8h:17** | **Pn498** | Polarity Detection Allowable Error Range |
| **20C8h:18** | **Pn499** | Reserved (Do not change.) |
| **20C8h:19** | **Pn49A** | Reserved (Do not change.) |
| **20D0h:1** | **Pn230** | Number of Encoder Pulse |
| **20D0h:2** | **Pn232** | C-Phase Compensation Width |
| **20D0h:3** | **Pn233** | Magnetic Pole Origin Corrected Value |
| **20D0h:4** | **Pn234** | Pulse Encoder Stop Vibration Suppression |
| **2100h:1** | **Pn501** | Zero Clamp Level |
| **2100h:2** | **Pn502** | Rotation Detection Level |
| **2100h:3** | **Pn503** | Speed Coincidence Signal Output Width |
| **2102h:1** | **Pn51E** | Excessive Position Error Warning Level |
| **2102h:2** | **Pn520** | Excessive Position Error Alarm Level |
| **2102h:3** | **Pn522** | Positioning Completed Width |
| **2102h:4** | **Pn524** | NEAR Signal Width |
| **2102h:5** | **Pn51B** | Excessive Error Level between Servomotor and Load Positions |
| **2102h:6** | **Pn52A** | Multiplier per One Fully-closed Rotation |
| **2103h:1** | **Pn526** | Excessive Position Error Alarm Level at Servo ON |
| **2103h:2** | **Pn528** | Excessive Position Error Warning Level at Servo ON |
| **2103h:3** | **Pn529** | Speed Limit Level at Servo ON |
| **2104h:1** | **Pn52B** | Overload Warning Level |
| **2104h:2** | **Pn52C** | Derating of Base Current at Detecting Overload of Motor |

(cont'd)

| Index Number | Parameter | Name |
|---|---|---|
| **2110h:1** | **Pn50A** | Input Signal Selection 1 |
| **2110h:2** | **Pn50B** | Input Signal Selection 2 |
| **2110h:3** | **Pn511** | Probe1, Probe2, HOME Input Signal setting |
| **2110h:4** | **Pn517** | OT Function |
| **2112h:1** | **Pn506** | Brake Reference - Servo OFF Delay Time |
| **2112h:2** | **Pn507** | Brake Reference Output Speed Level |
| **2112h:4** | **Pn508** | Waiting Time for Brake Signal When Motor Running |
| **2114h** | **Pn601** | DB Resistor Capacity |
| **2116h:1** | **Pn550** | Analog Monitor 1 Offset Voltage |
| **2116h:2** | **Pn551** | Analog Monitor 2 Offset Voltage |
| **2116h:3** | **Pn552** | Analog Monitor Magnification (×1) |
| **2116h:4** | **Pn553** | Analog Monitor Magnification (×2) |
| **2118h:1** | **Pn630** | Emergency Stop Execution Delay Time |
| **2118h:2** | **Pn631** | External Magnetic Contactor OFF Delay Time |
| **2140h** | **Pn304** | JOG Speed |
| **2142h:1** | **Pn530** | Program JOG Operation Related Switch |
| **2142h:2** | **Pn531** | Program JOG Movement Distance |
| **2142h:3** | **Pn533** | Program JOG Movement Speed |
| **2142h:4** | **Pn534** | Program JOG Acceleration/Deceleration Time |
| **2142h:5** | **Pn535** | Program JOG Waiting Time |
| **2142h:6** | **Pn536** | Number of Times of Program JOG Movement |
| **2143h** | **Pn324** | Moment of Inertia Calculating Start Level |
| **2146h:4** | **Pn456** | Sweep Torque Reference Amplitude |
| **2148h** | **Pn561** | Overshoot Detection Level |
| **5C00h** | **Pn010** | SERVOPACK Address (for USB/Local bus communication) |

# Index

## R



## S



## U



## W



## Z

## Revision History

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

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WEB revision number

Revision number

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Date of publication

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| April 2023 | <7> | 0 | Chapters 10, 11.2 | Partially revised |
| | | | Back cover | Revision: Address |
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| | | | Back cover | Revision: Address |
| January 2018 | <3> | 0 | All chapters | Partly revised |
| | | | Back cover | Revision: Address |
| March 2017 | <2> | – | 1.3.3 (1) | Addition: Power regeneration converter in mounting specifications (base-mounted) |
| | | | 1.3.3 (2) | Addition: SERVOPACK for one axis in mounting specifications (base-mounted) |
| | | | 2.3.4, 5.2 | Addition: X008023 AC reactor |
| | | | 5.2.1 | Revision: Approx. mass of X008010 AC reactor |
| | | | 10.2 | Revision: Information on certification for international standards |
| | | | Back cover | Revision: Address |
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| | | | Back cover | Revision: Address and format |
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AC Servo Drives

# Σ-V-SD Series

# USER'S MANUAL
# Design and Maintenance

## Rotational Motor
## EtherCAT (CoE) Communications Reference


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In the event that the end user of this product is to be the military and said product is to be employed in any weapons systems or the manufacture thereof, the export will fall under the relevant regulations as stipulated in the Foreign Exchange and Foreign Trade Regulations. Therefore, be sure to follow all procedures and submit all relevant documentation according to any and all rules, regulations and laws that may apply.

Specifications are subject to change without notice for ongoing product modifications and improvements.




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