YASKAWA

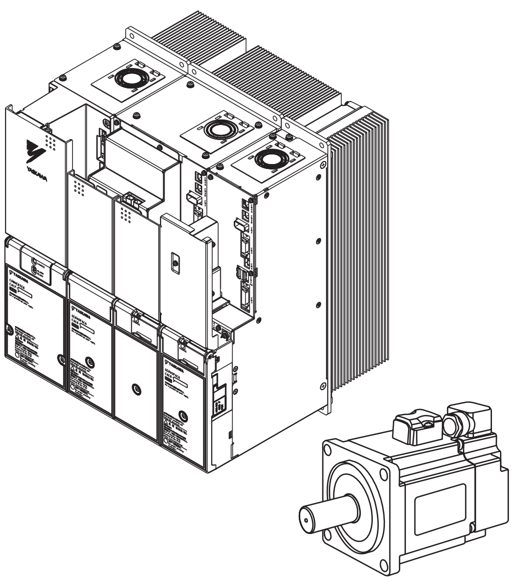
AC Servo Drives

Σ-V-SD Series

USER'S MANUAL

Rotational Motor
MECHATROLINK-III Communications Reference
Safety Option

SGMGV-□□□8□□□ Servomotor
CACP-JU□□□3□ Power regeneration converter
CACR-JU□□□□2B□20 SERVOPACK



MANUAL NO. SIEP S800001 99C

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 SERVOPACK with Built-in Safety Functions	A CACR-JU servo amplifier in the Σ-V-SD Series with built-in safety functions.
SERVOPACK for One Axis* Standard SERVOPACK*	A CACR-JU servo amplifier in the Σ-V-SD Series that can control one motor.
SERVOPACK for Two Axes*	A CACR-JU servo amplifier in the Σ-V-SD Series that can control two motors.
Σ-V-SD Driver	A power regeneration converter and a SERVOPACK
Servo Drive	The combination of a Servomotor and Σ-V-SD driver.
Servo System	A complete system that consists of a servo drive, a host controller, and peripheral devices
Safety-function-part	A generic name for the structure in a SERVOPACK that executes the safety functions specified in this manual.
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
Hardwire BaseBlock Function (HWBB)	A safety function implemented in the SERVOPACK. This function is executed by the safety-function-part upon request. This is the safety function that is equivalent to the Safe Torque Off function defined in IEC 61800-5-2.
Safe Torque Off (STO)	This is one of the safety functions defined in IEC 61800-5-2. This is the safety function that shuts OFF power supply to the motor.
Safe Stop 1 (SS1)	This is one of the safety functions defined in IEC 61800-5-2. This is the safety function that starts deceleration of the motor and executes the STO function after a specified time has passed.
Safe Stop 2 (SS2)	This is one of the safety functions defined in IEC 61800-5-2. This is the safety function that starts deceleration of the motor and prevents the motor from stopping at a distance greater than the allowable deviation from the specified position after a specified time has passed.
Safely-Limited Speed (SLS)	This is one of the safety functions defined in IEC 61800-5-2. This is the safety function that prevents the motor speed from exceeding the specified speed.
Safe BaseBlock Function (SBB function)	This is one of the safety functions implemented in the safety-function-part. This is the safety function that is equivalent to the Safe Torque Off function defined in IEC 61800-5-2.

(cont'd)

Term	Meaning
Safe BaseBlock with Delay Function (SBB-D function)	This is one of the safety functions implemented in the safety-function-part. This is the safety function that is equivalent to the Safe Stop 1 function defined in IEC 61800-5-2.
Safe Position Monitor with Delay Function (SPM-D function)	This is one of the safety functions implemented in the safety-function-part. This is the safety function that is equivalent to the Safe Stop 2 function defined in IEC 61800-5-2.
Safely Limited Speed with Delay Function (SLS-D function)	This is one of the safety functions implemented in the safety-function-part. This is the safety function that is equivalent to the Safely-Limited Speed function defined in IEC 61800-5-2.
Safe (HWBB) state	The state in which the safety-function-part has executed the HWBB function and shut OFF power to the motor.
Safe State	Safe state depends on safety functions used. SBB function: Safe (HWBB) state SBB-D function: Safe (HWBB) state SPM-D function: When monitoring positions or in a safe (HWBB) state SLS-D function: When monitoring constant-speed operation or in a safe (HWBB) state
Deceleration Monitoring	The safety-function-part is monitoring the deceleration operation of the motor.
Position Monitoring	The safety-function-part is monitoring the travel distance of the motor.
Constant-speed Monitoring	The safety-function-part is monitoring constant-speed operation of the motor.
Safety-related Parameter	A parameter related to the safety functions.
Safety-related Servo Parameter	Parameters that contain information on the safety functions of the SERVOPACK and servomotor and are managed by the safety-function-part.
System Reset	Restarting the servo system by turning the power supply OFF and ON again or by executing a software reset.
Parameter Recalculation	Calculation processing performed for a request from a MECHATROLINK-III Config command.
Proof Test	Scheduled tests defined in IEC 61508-4. This is the test that is used to detect the failure of the safety-related system.

* For details, refer to the *Σ-V-SD Series User's Manual SERVOPACK with MECHATROLINK-III Communications References for Rotary Servomotor* (Manual No.: SIEP S800000 78).

■ IMPORTANT Explanations

The following icon is displayed for explanations requiring special attention.

IMPORTANT

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

■ Notation Used in this Manual

• Notation for Reverse Signals

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

Notation Example

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

• Notation for Parameters

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

• Parameters for Numeric Settings

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

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

Parameter number

Indicates the setting range for the parameter.

Indicates the minimum setting unit for the parameter.

Indicates the parameter setting before shipment.

Indicates when a change to the parameter will be effective.

Indicates the parameter classification.

• Parameters for Selecting Functions

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

Parameter number

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

This section explains the selected function.

■ 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 User’s Manual Rotational Motor/ MECHATROLINK-III Communications Reference Safety Option (this manual)	✓	✓		✓	✓	✓	✓
Σ-V-SD Series User’s Manual Rotational Motor/ MECHATROLINK-III Communications Reference (SIEP S800000 78)	✓	✓		✓	✓	✓	✓
Σ-V-SD Series User’s Manual For Application Development in Servo Systems Design (SIEP S800000 87)			✓			✓	
Σ-V-SD Series Safety Precautions (TOBP C710829 04)	✓			✓			✓
AC SERVOMOTOR Safety Precautions (TOBP C2300200 00)				✓			✓
Σ-V-SD Series Safety Precautions Base Mounting Unit (TOMP C710829 08)	✓						✓
AC SPINDLE MOTOR/ AC SERVOMOTOR INSTRUCTIONS (TOE-C235-2)	✓						✓

■ Safety Information

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

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

Safety Precautions

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

⚠ WARNING

- Never touch 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. (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

- 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 *8.2.4 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

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

■ General Precautions

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

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

The 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.

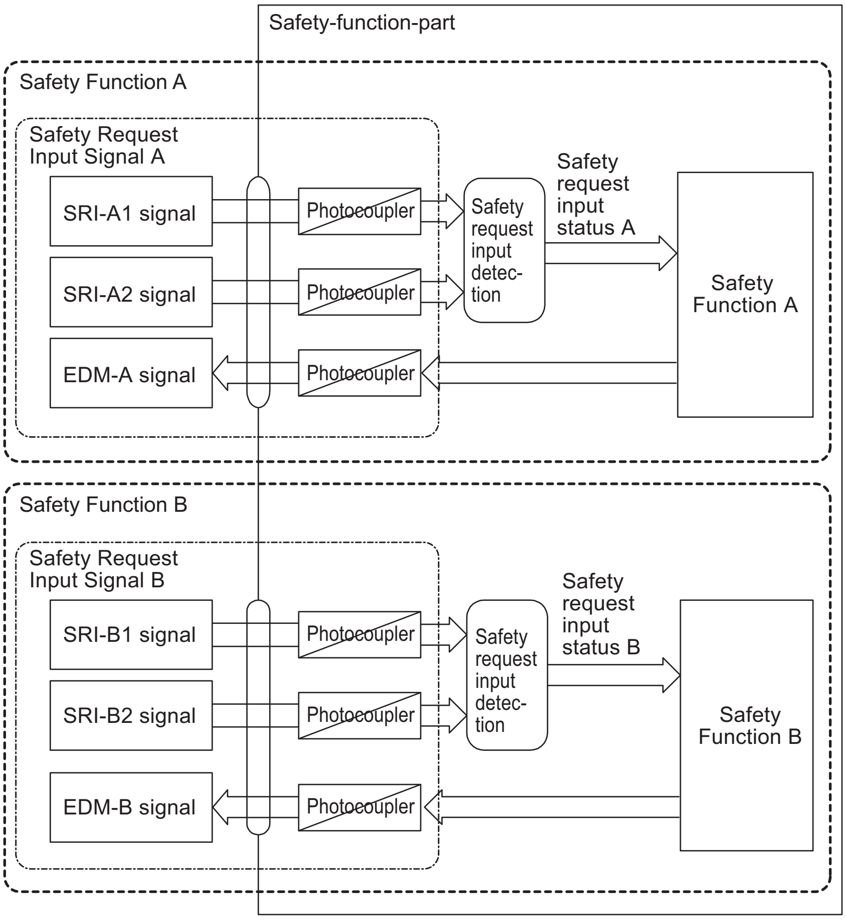
1.2 Overview

The Σ-V-SD Series SERVOPACKs with safety functions are equipped with the following four safety functions to provide machine safety. These functions reduce risks during usage of the machine by protecting people from hazardous operations of movable machine parts. The stopping function that is defined in functional safety standards can be achieved with these four functions.

Function	Description	Remarks	Reference
Safe BaseBlock Function (SBB function)	This function shuts OFF the power supply to the motor by executing the HWBB function according to the states of the input signals.	This safety function is equivalent to the Safe Torque Off function that is defined in IEC 61800-5-2.	9.6
Safe BaseBlock with Delay Function (SBB-D function)	1. This function monitors the deceleration of the motor until the specified time according to the state of the input signal. 2. It shuts OFF the power supply to the motor by executing the HWBB function.	This safety function is equivalent to the Safe Stop 1 function that is defined in IEC 61800-5-2.	9.7
Safe Position Monitor with Delay Function (SPM-D function)	1. This function monitors the deceleration of the motor until the specified time according to the state of the input signal. 2. It monitors the position after the motor has stopped.	This safety function is equivalent to the Safe Stop 2 function that is defined in IEC 61800-5-2.	9.8
Safely Limit Speed with Delay Function (SLS-D function)	1. This function monitors the deceleration of the motor until the specified time according to the state of the input signal. 2. It monitors the motor speed to make sure that it is within the allowable range.	This safety function is equivalent to the Safely-Limited Speed function that is defined in IEC 61800-5-2.	9.9

The safety-function-part has two safety functions with the same features and these functions can be allocated separately. Each of these functions has a two input channels and one output channel. The safety functions that are specified beforehand are executed according to the states of the input signals.

A schematic diagram of the functions is shown below.



1.3 Restrictions

1.3.1 Applicable Servomotors

The following servomotors can be used.

Servomotor Model	
SGMGV (medium inertia, medium capacity) 1500 min^{-1}	SGMGV-09A
	SGMGV-13A
	SGMGV-20A
	SGMGV-30A
	SGMGV-44A
	SGMGV-55A
	SGMGV-75A
	SGMGV-09D
	SGMGV-13D
	SGMGV-20D
	SGMGV-30D
	SGMGV-44D
	SGMGV-55D
	SGMGV-75D

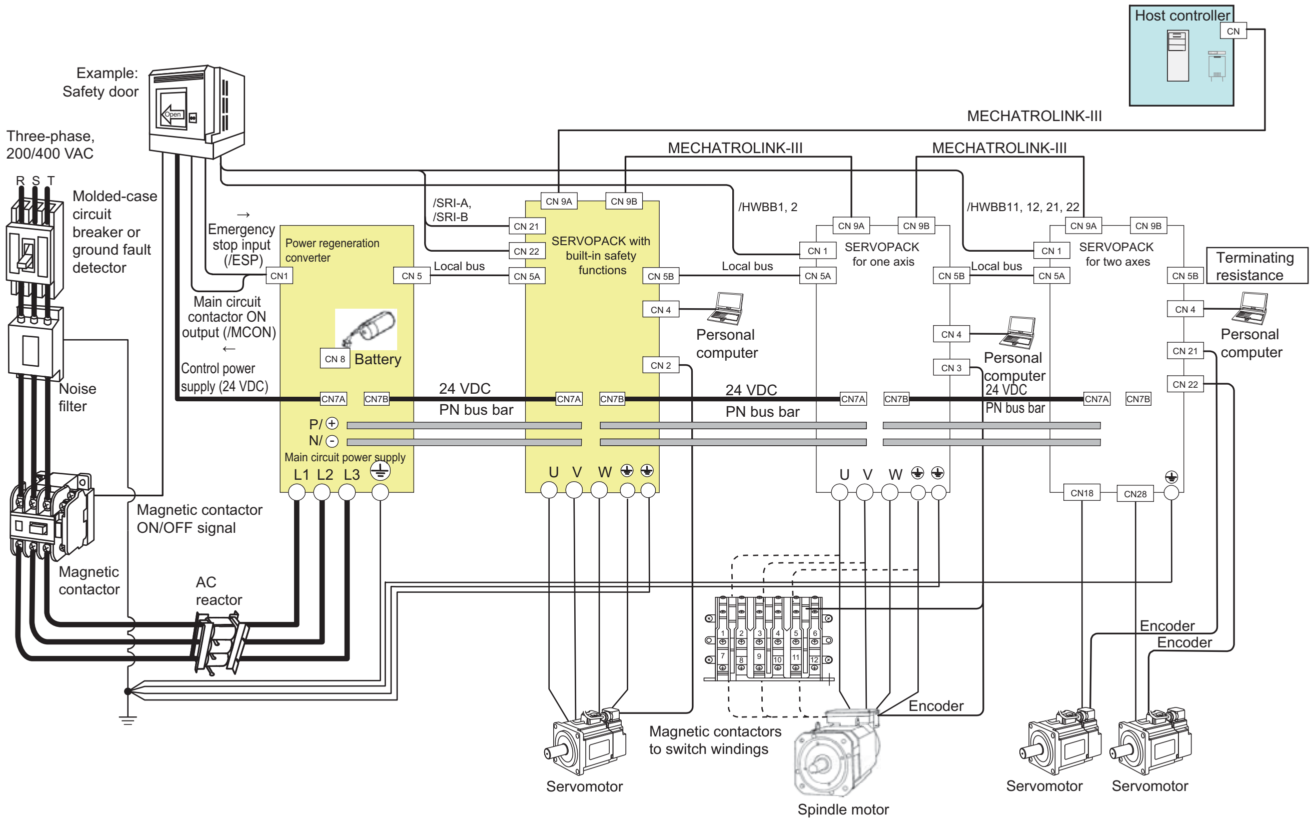
For details on combinations of SERVOPACKs and servomotors, refer to *2.1 Combinations*.

1.3.2 Differences from Standard SERVOPACKs

The following restrictions apply to the SERVOPACKs described in this manual in comparison with the standard SERVOPACKs.

- A spindle motor cannot be used.
  To use a spindle motor, use a standard SERVOPACK.
- An external encoder cannot be used.
  To use an external encoder, use a standard SERVOPACK.
- There is a lower limit to the setting of the number of encoder output pulses (Pn212). For details, refer to *9.5.5 Setting Encoder Output Pulse*
- You cannot use the HWBB input signals (CN1 pins 17 to 20) and EDM1 signal (CN1 pins 21 and 22) of the standard SERVOPACKs (CACR-JU□□□□2A and CACR-JU□□□□2B). Make the HWBB inputs inactive. For details, refer to *7.2.5 (2) Connection Diagrams*.
- The SERVOPACKs described in this manual provide an SBB (safety base block, equivalent to STO defined in IEC 61800-5-2), which is functionally equivalent to the HWBB provided by standard SERVOPACKs. Refer to ■ *Safe Performance* in *12.1 Harmonized Standards* for the safety performance of the SBB.

1.4 System Configurations



Note: Refer to the *Σ-V-SD Series User's Manual Rotational Motor/MECHATROLINK-III Communications References* (Manual No.: SIEP S800000 78) for details on spindle motors, SERVOPACKs for one axis, and SERVOPACKs for two axes.

Outline

1

1.5 Model Designation

1.5.1 Servomotor

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

SGMGV - 3 0 D 8 A 2 1

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

Specifications
Σ-V Series Servomotor SGMGV (medium inertia)

7th + 8th digits: Rated Output

Code	Specifications (kW)
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

1.5.2 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*3	Base-mounted

14th to 19th digits: Custom-made*4

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 *12.2 Models in Compliance by Standard*.
∗3. Applicable only for CACP-JU□□A3BB using three-phase, 200 VAC input voltage.
∗4. For details about custom-made converters, contact your Yaskawa representative.

(2) SERVOPACK

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

CACR-JU 102 A 2 □ □ □□□□□□

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
2	MECHATROLINK-III

13th digit: Design Revision Order

B

14th digit: Mounting

Code	Specifications
Blank	Duct-ventilated
B*1	Base-mounted

15th to 20th digits*2: Custom-made*3

Code	Specifications
Blank	Standard
20	Built-in safety functions

∗1. Applicable only for CACR-JU□□□A2□B using three-phase, 200 VAC input voltage.
∗2. If you select a duct-ventilated model (mounting specification: blank), the 14th to 19th digits are used.
∗3. For details about custom-made SERVOPACKs, contact your Yaskawa representative.

2

Compatible Devices

2.1 Combinations

2.1.1 SERVOPACKs and Motors

SERVOPACK Model	Input Voltage	Servomotor SGMGV- Standard	Servomotor SGMGV- High Speed	Max. Allowable Motor Capacity (kW)
CACR-JU028A	270 VDC	09A*, 13A, 20A, 30A	09A*, 13A	3.0
CACR-JU036A		30A, 44A	20A, 30A	5.0
CACR-JU065A		55A	44A	6.0
CACR-JU084A		75A	–	7.5
CACR-JU102A		–	55A, 75A	–
CACR-JU125A		–	–	–
CACR-JU196A		–	–	–
CACR-JU014D	540 VDC	09D*, 13D, 20D, 30D	09D*, 13D	3.0
CACR-JU018D		30D, 44D	20D, 30D	5.0
CACR-JU033D		55D	44D	6.0
CACR-JU042D		75D	55D	7.5
CACR-JU051D		–	75D	–
CACR-JU098D		–	–	–

* Contact your Yaskawa representative to use this motor.

2.1.2 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-JU15A	11	7.7	37.5	132
CACP-JU19A	15	10.5	46.3	147
CACP-JU22A	18.5	12.95	55	162
CACP-JU30A	22	15.4	75	192
CACP-JU37A	30	23.1	92.5	390
CACP-JU45A	37	25.9	112.5	390
CACP-JU15D	11	7.7	37.5	33
CACP-JU19D	15	10.5	46.3	37
CACP-JU22D	18.5	12.95	55	41
CACP-JU45D	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.

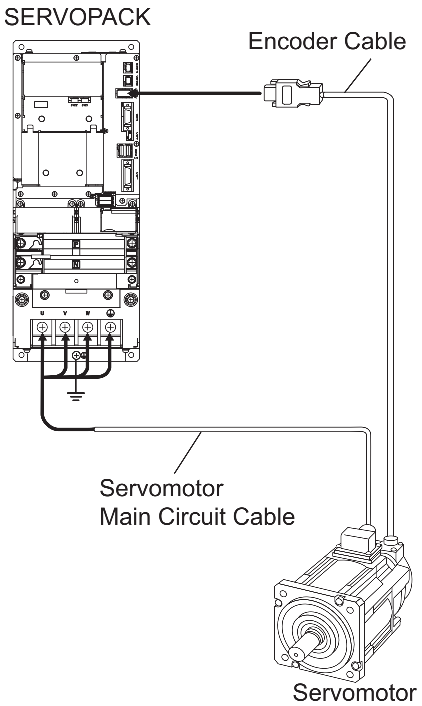
SERVOPACK Model	Continuous Rated Capacity (kW)	Charge Constant
CACR-JU028A	3.7	16
CACR-JU036A	5.5	24
CACR-JU065A	11	40
CACR-JU084A	15	52
CACR-JU102A	18.5	64
CACR-JU125A	22	64
CACR-JU196A	37	102
CACR-JU014D	3.7	4
CACR-JU018D	5.5	6
CACR-JU033D	11	10
CACR-JU042D	15	13
CACR-JU051D	18.5	16
CACR-JU098D	37	26

Compatible Devices

2

2.2 Selecting Cables

2.2.1 Servomotor



(1) Main Circuit Cable

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

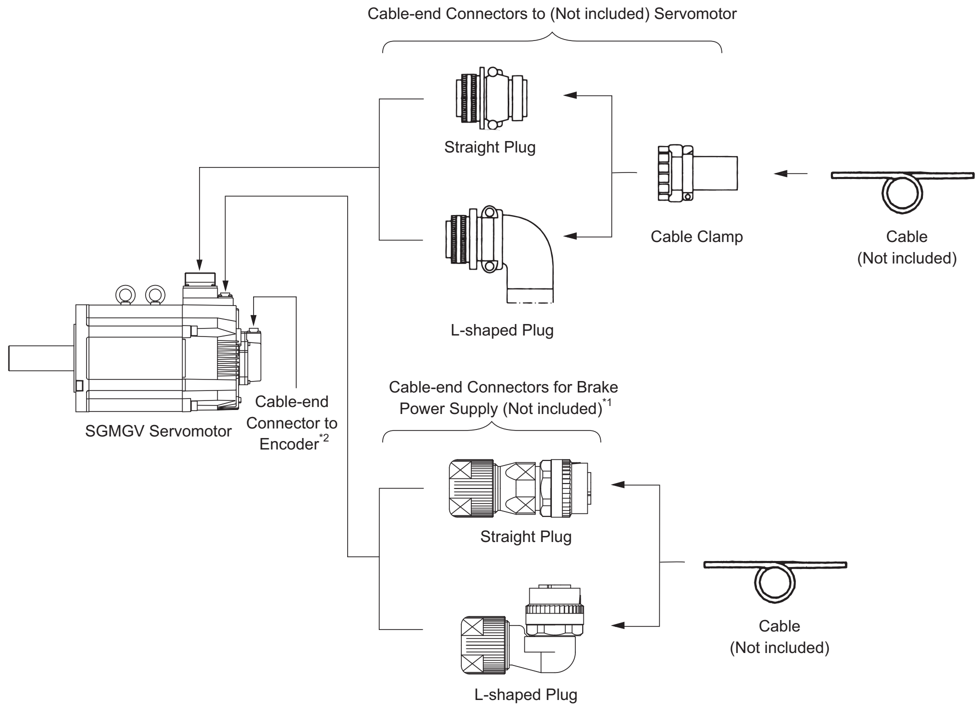
Use either of the following connectors depending on operating environment of servomotors.

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

- Standard connectors

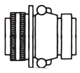
Connector configuration

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.

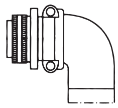


∗1. When using servomotors without holding brakes, the cable-end connector for the brake power supply is not required.
∗2. For information on cable-end connectors to encoders, refer to *2.2.1 (2) Encoder Cable*.

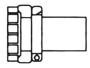
• Cable-end connectors to servomotors



Straight Plug



L-shaped Plug

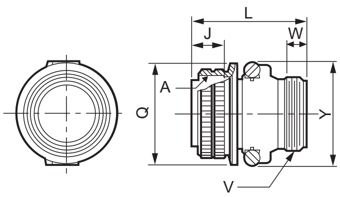


Cable Clamp

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

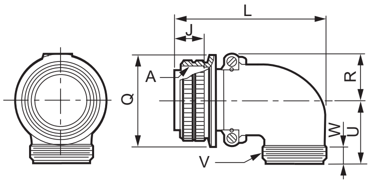
• MS3106B□□-□□S: Straight plug



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

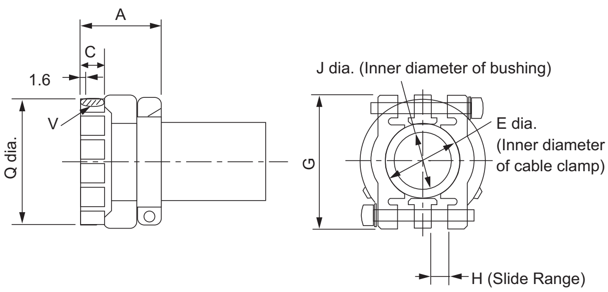
• MS3108B□□-□□S: L-shaped plug



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

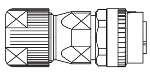
• MS3057-□□A: Cable clamp with rubber bushing



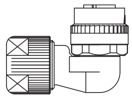
Unit: mm

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 Applicable Cable: 4.0 mm dia. to 6.0 mm dia.	CM10-AP2S-S-D Applicable Cable: 4.0 mm dia. to 6.0 mm dia.	DDK Ltd.
		CM10-SP2S-M-D Applicable Cable: 6.0 mm dia. to 9.0 mm dia.	CM10-AP2S-M-D Applicable Cable: 6.0 mm dia. to 9.0 mm dia.	
		CM10-SP2S-L-D Applicable Cable: 9.0 mm dia. to 11.6 mm dia.	CM10-AP2S-L-D Applicable Cable: 9.0 mm dia. to 11.6 mm dia.	

Note: For the brake power cable, the cable-end connectors are available from Yaskawa Control Co., Ltd. Use the following order number when ordering.

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

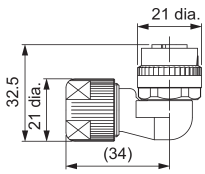
Connector Type
S: Straight plug
A: L-shaped plug

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

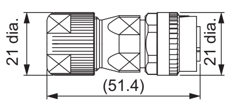
*1. The standard kit includes medium size connectors.
*2. Use the following crimping tool made by DDK Ltd.: 357J-50448T
For details, contact DDK.

• L-shaped Plug



Unit: mm

• Straight Plug



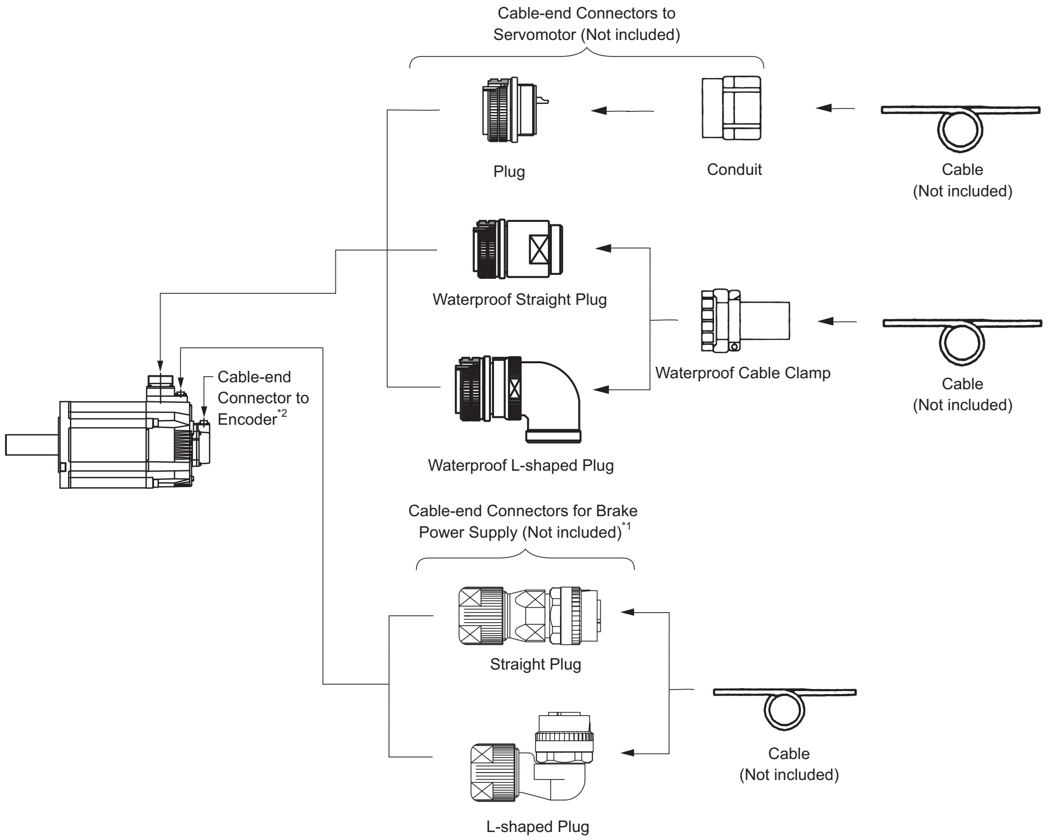
Unit: mm

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

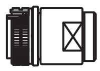
Connector Configuration

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.

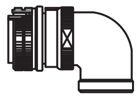


*1. When using servomotors without holding brakes, the cable-end connector for the brake power supply is not required.
*2. For information on cable-end connectors to encoders, refer to *2.2.1 (2) Encoder Cable*.

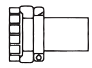
• Cable-end connectors to servomotors



Waterproof Straight Plug



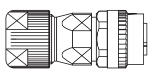
Waterproof L-shaped Plug



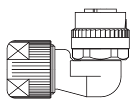
Waterproof Cable Clamp

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 1.3 1.8	CE05-2A18-10PD-D	CE05-6A18-10SD-D-BSS	CE05-8A18-10SD-D-BAS	CE3057-10A-1-D	10.5 to 14.1	DDK Ltd.
				CE3057-10A-2-D	8.5 to 11.0	
				CE3057-10A-3-D	6.5 to 8.7	
2.9 4.4	CE05-2A22-22PD-D	CE05-6A22-22SD-D-BSS	CE05-8A22-22SD-D-BAS	CE3057-12A-1-D	12.5 to 16.0	
				CE3057-12A-2-D	9.5 to 13.0	
				CE3057-12A-3-D	6.8 to 10.0	
				CE3057-12A-7-D	14.5 to 17.0	
5.5 7.5	CE05-2A32-17PD-D	CE05-6A32-17SD-D-BSS	CE05-8A32-17SD-D-BAS	CE3057-20A-1-D	22 to 23.8	
				CE3057-20A-2-D	24 to 26.6	
				CE3057-20A-3-D	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 to 7.5	CM10-R2P-D	CM10-SP2S-S-D Applicable Cable: 4.0 mm dia. to 6.0 mm dia.	CM10-AP2S-S-D Applicable Cable: 4.0 mm dia. to 6.0 mm dia.	DDK Ltd.
		CM10-SP2S-M-D Applicable Cable: 6.0 mm dia. to 9.0 mm dia.	CM10-AP2S-M-D Applicable Cable: 6.0 mm dia. to 9.0 mm dia.	
		CM10-SP2S-L-D Applicable Cable: 9.0 mm dia. to 11.6 mm dia.	CM10-AP2S-L-D Applicable Cable: 9.0 mm dia. to 11.6 mm dia.	

Note: For the brake power cable, the cable-end connectors are available from Yaskawa Control Co., Ltd. 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 Model	Connector Housing Model	Electrical Contact Model	Wire Size	Manufacturer
CACR-JU028A	1-917807-2	1318697-6	AWG10	Tyco Electronics Japan G.K.
CACR-JU036A	DK-5200S-04R	DK-5RECLLP1 (D3)	AWG8	DDK Ltd.
CACR-JU014D	1-917807-2	316041-6	AWG14	Tyco Electronics Japan G.K.
CACR-JU018D	DK-5200S-04R	DK-5RECMLP1-100	AWG10	DDK Ltd.

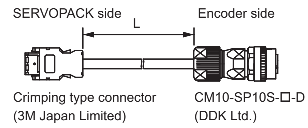
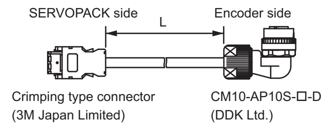
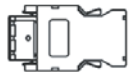
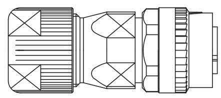
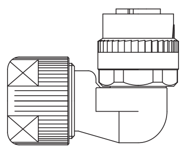
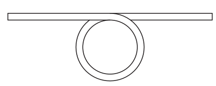
Note: For other SERVOPACKs, they have screw terminals. For details, refer to *7.2.1 (1) Wire Sizes and Tightening Torques*.

■ 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 *7.2.1 (1) Wire Sizes and Tightening Torques*.

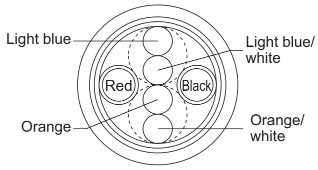
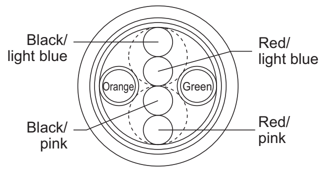
(2) Encoder Cable

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. Standard Type	Order No. Flexible Type[*1]	External Appearance
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) 36310-3200-008 (Shell)		Soldered  (3M Japan Limited)
Straight Plugs (IP67-rated) – Used as cable-end connectors to encoder		JZSP-CVP9-1-E[*2]	Connector Specifications Plug: CM10-SP10S-M-D Electrical Contact: (Crimped)[*3] CM10-#22SC(C4)-100 Applicable Cable Diameter: 6.0 mm to 9.0 mm	 (DDK Ltd.)
		JZSP-CVP9-3-E[*2]	Connector Specifications Plug: CM10-SP10S-M-D Electrical Contact: (Soldered) CM10-#22SC(S1)-100 Applicable Cable Diameter: 6.0 mm to 9.0 mm	
L-shaped Plugs (IP67-rated) – Used as cable-end connectors to encoder		JZSP-CVP9-2-E[*2]	Connector Specifications Plug: CM10-AP10S-M-D Electrical Contact: (Crimped)[*3] CM10-#22SC(C4)-100 Applicable Cable Diameter: 6.0 mm to 9.0 mm	 (DDK Ltd.)
		JZSP-CVP9-4-E[*2]	Connector Specifications Plug: CM10-AP10S-M-D Electrical Contact: (Soldered) CM10-#22SC(S1)-100 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) AWG22×2C+AWG24×2P AWG22 (0.33 mm^2) Outer diameter of insulating sheath: 1.15 mm dia. AWG24 (0.20 mm^2) Outer diameter of insulating sheath: 1.09 mm dia.	UL20276 (Rated temperature: 80°C) AWG22×2C+AWG24×2P AWG22 (0.33 mm^2) Outer diameter of insulating sheath: 1.35 mm dia. AWG24 (0.20 mm^2) Outer diameter of insulating sheath: 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)

Compatible Devices

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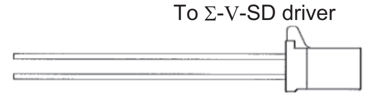
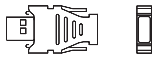
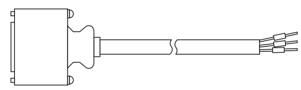
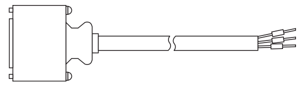
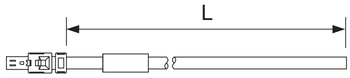
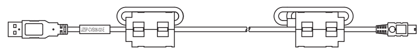
2.2.2 Σ-V-SD Driver

(1) Cables for Σ-V-SD Drivers

The necessary cables for wiring Σ-V-SD drivers are shown here. The cables with order numbers can be obtained from Yaskawa Controls Co., Ltd.

Name		Length	Order No.	External Appearance	Reference
Cable for 24-volt control power supply • With loose leads on one end • Connects one Σ-V-SD driver to 24-volt control power supply		1 m	JZSP-CNG00-01-E		2.2.2 (2)
		2 m	JZSP-CNG00-02-E		
		3 m	JZSP-CNG00-03-E		
Cable for 24-volt control power supply • With connectors on both ends • Connects two Σ-V-SD drivers		0.2 m	JZSP-CNG01-A2-E		2.2.2 (3)
		0.3 m	JZSP-CNG01-A3-E		
Cables for local bus communications		0.5 m	JUPIT-W6004-A5		2.2.2 (4)
Terminating resister for local bus		–	JUPIT-W6024		2.2.2 (5)
Cable for converter I/O		1 m	JZSP-CJI01-01-E		2.2.2 (6)
		2 m	JZSP-CJI01-02-E		
		3 m	JZSP-CJI01-03-E		
Cable for SERVOPACK[*1]		1 m	JZSP-CSI02-1-E		2.2.2 (7)
		2 m	JZSP-CSI02-2-E		
		3 m	JZSP-CSI02-3-E		
Cable for MECHATROLINK-III communications		0.2 m	JEPMC-W6012-A2-E		2.2.2 (8)
		0.5 m	JEPMC-W6012-A5-E		
		1 m	JEPMC-W6012-01-E		
		2 m	JEPMC-W6012-02-E		
		3 m	JEPMC-W6012-03-E		
		4 m	JEPMC-W6012-04-E		
		5 m	JEPMC-W6012-05-E		
		10 m	JEPMC-W6012-10-E		
		20 m	JEPMC-W6012-20-E		
		30 m	JEPMC-W6012-30-E		
		50 m	JEPMC-W6012-50-E		
Safety function device cables	Cable with connector	1 m	JZSP-CVH03-01-E		2.2.2 (9)
		3 m	JZSP-CVH03-03-E		
Cable for analog monitor[*2]		1 m	JZSP-CA01-E		2.2.2 (10)

(cont'd)

Name		Length	Order No.	External Appearance	Reference
Cable for personal computer connection*2		2.5 m	JZSP-CVS06-02-E	To computer To SERVOPACK 	2.2.2 (11)

*1. If you make your own SERVOPACK I/O cables, refer to *2.2.2 (7) SERVOPACK I/O Cable Specifications* to select suitable materials.
*2. 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)

Item	Specification
Order No.*	JZSP-CNG00-□□-E
Cable Length	1 m, 2 m, 3 m
Cable and Connector	Cable: UL1015 AWG14 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)

Item	Specification
Order No.*1	JZSP-CNG01-A□-E
Cable Length*2	0.2 m, 0.3 m
Cable and Connector	Cable: UL1015 AWG14 Connector: 175362-1 (PIN: 353717-2) 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-JU45A3B converter.

(4) Cable Specifications for Local Bus Communications

Item	Specification
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

Item	Specification
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

Item	Specification
Order No.*	JZSP-CJI01-□□-E
Cable Length	1 m, 2 m, 3 m
Cable and Connector	Cable: HP-SB/20276SR #28×6P 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)

Compatible Devices

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(7) SERVOPACK I/O Cable Specifications

Item	Length	Specification
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 Shell: 10326-52A0-008 (3M Japan Limited) 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) Cable Specifications for Use with MECHATROLINK-III Communications

Item	Specification
Order No.*	JEPMC-W6012-□□-E
Cable Length	0.2 m, 0.5 m, 1 m, 2 m, 3 m, 4 m, 5 m, 10 m, 20 m, 30 m, 50 m
Cable and connector	Cable: RS-M III (20276) Connector: 2040008-2
Remarks	• Use a 0.2 m cable to connect two SERVOPACKs. • Select a cable of the appropriate length to connect a host controller with a SERVOPACK.

* Specify the cable length in □□ of the order number.
Example: JEPMC-W6012-A2-E (0.2 m), JEPMC-W6012-01-E (1 m)

(9) Safety Function Device Cable Specifications

Item	Length	Specification
Order No.	1 m	JZSP-CVH03-01-E
	3 m	JZSP-CVH03-03-E
Cable and connector		Cable: CM/2464-1061/II A-SB LF 26AWG×3P (from Taiyo Cabletec Corporation) Connector Kit: 2013595-1 (from Tyco Electronics Japan G.K.), Product name: Industrial Mini I/O D-shape Type 1 Plug Connector Kit

(10) Cable Specifications for Use with an Analog Monitor

Item	Specification
Order No.	JZSP-CA01-E
Cable length	1 m
Connectors	Cable: STYLE 1007 AWM E74037 AWG24 VW-1 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

Item	Specification
Order No.	JZSP-CVS06-02-E
Cable length	2.5 m
Connectors	Cable-end connector to SERVOPACK: USB Type miniB 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 on power supply capacity, input current, and inrush current per power regeneration converter 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 on power supply capacity, input current, and inrush current per power regeneration converter 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 (Continuous Ratings) kW	Power Regeneration Converter Model	Power Supply Capacity per Power Regeneration Converter (kVA)	Input Current (Continuous Ratings) Arms	Inrush Current (Main Circuit) A_{0-P}
200 V	11	CACP-JU15A	22.5	54	83
	15	CACP-JU19A	30.5	73	83
	18.5	CACP-JU22A	37.5	90	83
	22	CACP-JU30A	45.0	107	178
	30	CACP-JU37A	61.5	145	178
	37	CACP-JU45A	75.0	179	178
400 V	11	CACP-JU15D	22.5	27	173
	15	CACP-JU19D	30.5	36	173
	18.5	CACP-JU22D	37.5	45	173
	37	CACP-JU45D	75.0	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 BA000518 battery for absolute encoders. This battery can be obtained from Yaskawa Controls 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.

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*.

Power Regeneration Converter		AC Reactor Model
Input Voltage	Model	
Three-phase 200 VAC	CACP-JU15A	X008017
	CACP-JU19A	X008018
	CACP-JU22A	X008019
	CACP-JU30A	X008020
	CACP-JU37A	X008029
	CACP-JU45A	X008022
Three-phase 400 VAC	CACP-JU15D	X008010*
		X008023
	CACP-JU19D	X008011
	CACP-JU22D	X008012
	CACP-JU45D	X008024

* This AC reactor does not comply with UL standards.

2.3.5 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 *5.3 Noise Filter*.

Power Regeneration Converter		Noise Filter Model
Input Voltage	Model	
Three-phase 200 VAC	CACP-JU15A	HF3060C-SZC-47EDD
	CACP-JU19A	HF3080C-SZC-47EDD
	CACP-JU22A	HF3100C-SZC-47EDD
	CACP-JU30A	HF3150C-SZC-47EDD
	CACP-JU37A	HF3150C-SZC-47EDD
	CACP-JU45A	HF3200C-SZC-49EDE*
Three-phase 400 VAC	CACP-JU15D	HF3030C-SZC-47DDD
	CACP-JU19D	HF3040C-SZC-47EDD
	CACP-JU22D	HF3050C-SZC-47EDD
	CACP-JU45D	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 (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 of Servomotors

3.1 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

3.1.1 200 V Class: Standard Type

Servomotor Model: SGMGV-□□A8A		09	13	20	30	44	55	75
Rated Output*	kW	0.85	1.3	1.8	2.9	4.4	5.5	7.5
Rated Torque*	N·m	5.39	8.34	11.5	18.6	28.4	35.0	48.0
Instantaneous Peak Torque*	N·m	13.8	23.3	28.7	45.1	71.1	87.6	119
Rated Current*	Arms	6.9	10.7	16.7	23.8	32.8	42.1	54.7
Instantaneous Max. Current*	Arms	17	28	42	56	84	110	130
Rated Speed*	min^{-1}	1500						
Max. Speed*	min^{-1}	3000						
Torque Constant	N·m/Arms	0.859	0.891	0.748	0.848	0.934	0.851	0.957
Rotor Moment of Inertia	$\times 10^{-4}$ kg·m^2	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	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	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-09A, -13A, -20A : 400 mm × 400 mm × 20 mm (iron)
SGMGV-30A, -44A, -55A, -75A : 550 mm × 550 mm × 30 mm (iron)

3.1.2 200 V Class: High-speed Type

Servomotor Model: SGMGV-□□A8M		09	13	20	30	44	55	75
Rated Output*	kW	0.85	1.3	1.8	2.9	4.4	5.5	7.5
Rated Torque*	N·m	5.39	8.34	11.5	18.6	28.4	35.0	48.0
Instantaneous Peak Torque*	N·m	20	30	46	60	92	107	130
Rated Current*	Arms	6.9	10.7	16.7	23.8	32.8	42.1	54.7
Instantaneous Max. Current*	Arms	28	40	75	81	110	136	140
Rated Speed*	min^{-1}	1500						
Max. Speed*	min^{-1}	4000						
Torque Constant	N·m/Arms	0.859	0.891	0.748	0.822	0.934	0.851	0.957
Rotor Moment of Inertia	$\times10^{-4}$ kg·m^2	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	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	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-09A, -13A, -20A : 400 mm × 400 mm × 20 mm (iron)
SGMGV-30A, -44A, -55A, -75A : 550 mm × 550 mm × 30 mm (iron)

3.1.3 400 V Class: Standard Type

Servomotor Model: SGMGV-□□D8A		09	13	20	30	44	55	75
Rated Output*	kW	0.85	1.3	1.8	2.9	4.4	5.5	7.5
Rated Torque*	N·m	5.39	8.34	11.5	18.6	28.4	35.0	48.0
Instantaneous Peak Torque*	N·m	13.8	23.3	28.7	45.1	71.1	87.6	119
Rated Current*	Arms	3.5	5.4	8.4	11.9	16.5	20.8	25.7
Instantaneous Max. Current*	Arms	8.5	14	20	28	40.5	52	65
Rated Speed*	min^{-1}	1500						
Max. Speed*	min^{-1}	3000						
Torque Constant	N·m/Arms	1.72	1.78	1.50	1.70	1.93	1.80	1.92
Rotor Moment of Inertia	$\times10^{-4}$ kg·m^2	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	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	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-09D, -13D, -20D : 400 mm × 400 mm × 20 mm (iron)
SGMGV-30D, -44D, -55D, -75D : 550 mm × 550 mm × 30 mm (iron)

3.1.4 400 V Class: High-speed Type

Servomotor Model: SGMGV-□□D8M		09	13	20	30	44	55	75
Rated Output*	kW	0.85	1.3	1.8	2.9	4.4	5.5	7.5
Rated Torque*	N·m	5.39	8.34	11.5	18.6	28.4	35.0	48.0
Instantaneous Peak Torque*	N·m	20	30	46	60	92	107	130
Rated Current*	Arms	3.5	5.4	8.4	11.9	16.5	20.8	25.7
Instantaneous Max. Current*	Arms	14	20	37.6	40.5	55	65	70
Rated Speed*	min^{-1}	1500						
Max. Speed*	min^{-1}	4000						
Torque Constant	N·m/Arms	1.72	1.78	1.50	1.64	1.93	1.80	1.92
Rotor Moment of Inertia	$\times 10^{-4}$ kg·m^2	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	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	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.

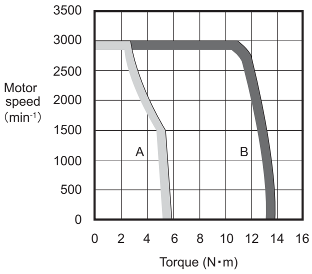
SGMGV-09D, -13D, -20D : 400 mm × 400 mm × 20 mm (iron)
SGMGV-30D, -44D, -55D, -75D : 550 mm × 550 mm × 30 mm (iron)

3.2 Torque-Motor Speed Characteristics

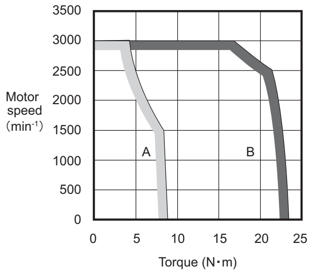
3.2.1 200 V, 400 V Class: Standard Type

A : Continuous Duty Zone B : Intermittent Duty Zone

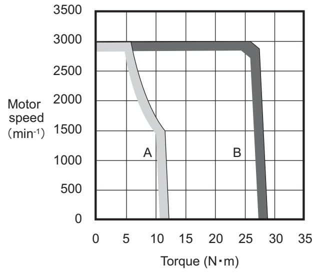
SGMGV-09A□A, -09D□A



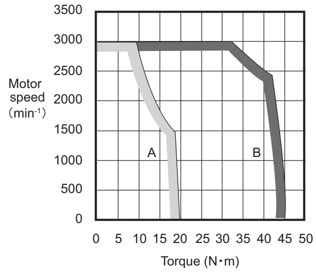
SGMGV-13A□A, -13D□A



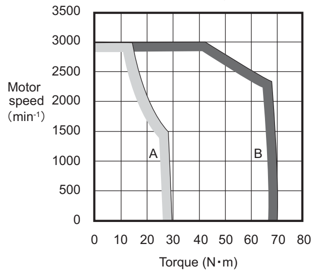
SGMGV-20A□A, -20D□A



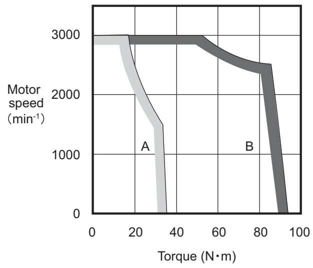
SGMGV-30A□A, -30D□A



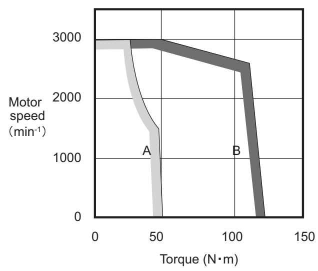
SGMGV-44A□A, -44D□A



SGMGV-55A□A, -55D□A



SGMGV-75A□A, -75D□A

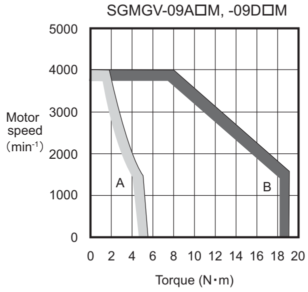


Note 1. When the effective torque during intermittent duty is within the rated torque, the servomotor can be used within the intermittent duty zone.
2. When the main circuit cable length exceeds 20 m, the intermittent duty zone will shrink due to the voltage drop.
3. These torque-motor speed characteristics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

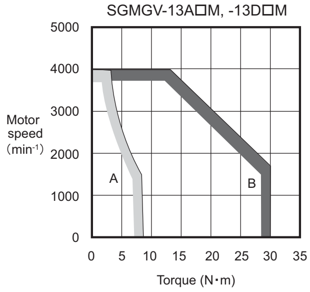
3.2.2 200 V, 400 V Class: High-speed Type

A : Continuous Duty Zone B : Intermittent Duty Zone

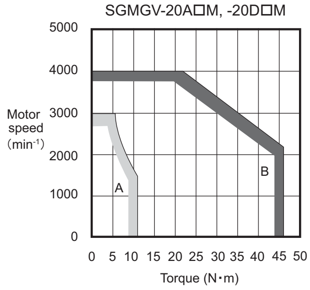
SGMGV-09A□M, -09D□M



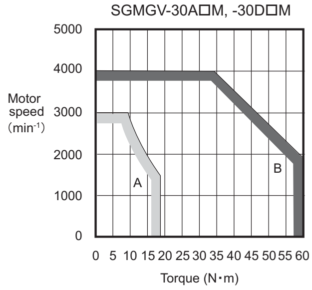
SGMGV-13A□M, -13D□M



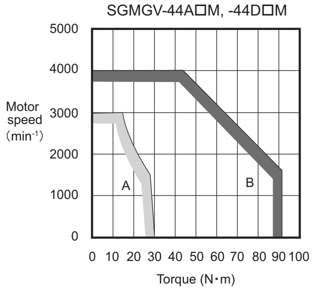
SGMGV-20A□M, -20D□M



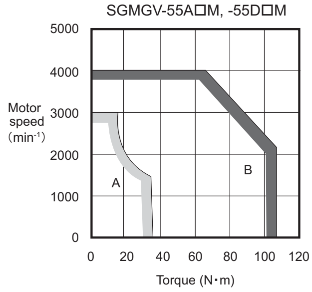
SGMGV-30A□M, -30D□M



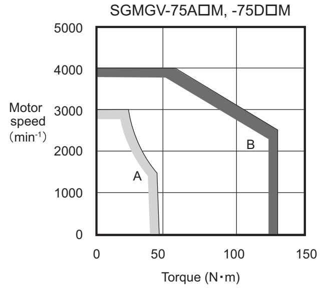
SGMGV-44A□M, -44D□M



SGMGV-55A□M, -55D□M



SGMGV-75A□M, -75D□M



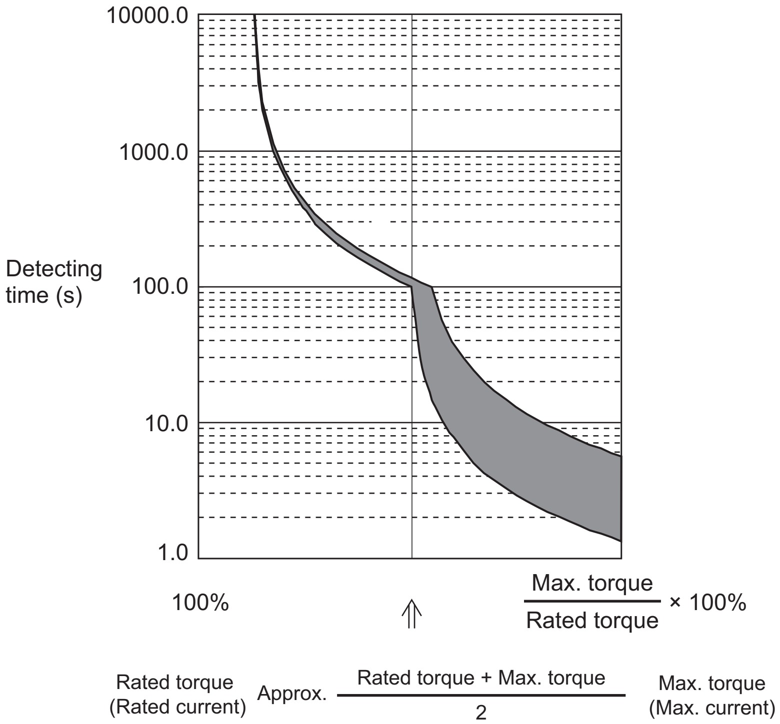
Note 1. When the effective torque during intermittent duty is within the rated torque, the servomotor can be used within the intermittent duty zone.
2. When the main circuit cable length exceeds 20 m, the intermittent duty zone will shrink due to the voltage drop.
3. These torque-motor speed characteristics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

Specifications and External Dimensions of Servomotors

3

3.3 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 Torque-Motor Speed Characteristics*.

3.4 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-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 *8.2.3 (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.

3.5 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.

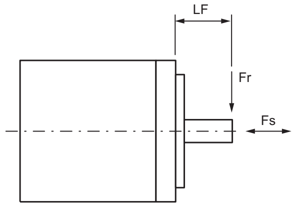
Servomotor Model	Servomotor Rated Output	Allowable Load Moment of Inertia (Rotor Moment of Inertia Ratio)
SGMGV-09 to -75	0.85 to 7.5 kW	5 times

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.

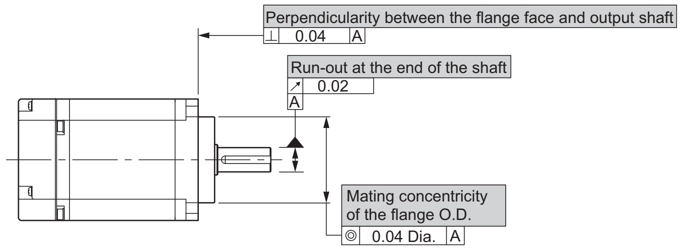
3.6 Allowable Radial and Thrust Loads

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.

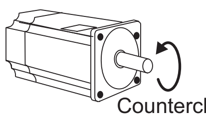
Servomotor Model	Allowable Radial Load Fr (N)	Allowable Thrust Load Fs (N)	LF (mm)	Reference Diagram
SGMGV-09	490	98	58	
SGMGV-13	686	343	58	
SGMGV-20	980	392	58	
SGMGV-30	1470	490	79	
SGMGV-44	1470	490	79	
SGMGV-55	1764	588	113	
SGMGV-75	1764	588	113	

3.7 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.

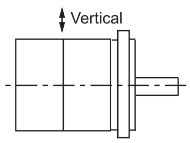


3.8 Rotation Direction



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 *8.2.1 Servomotor Rotation Direction*.

3.9 Shock Resistance

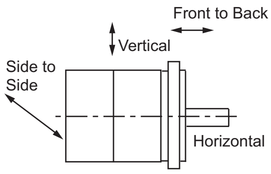


Impact Applied to the Servomotor

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

3.10 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-09 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

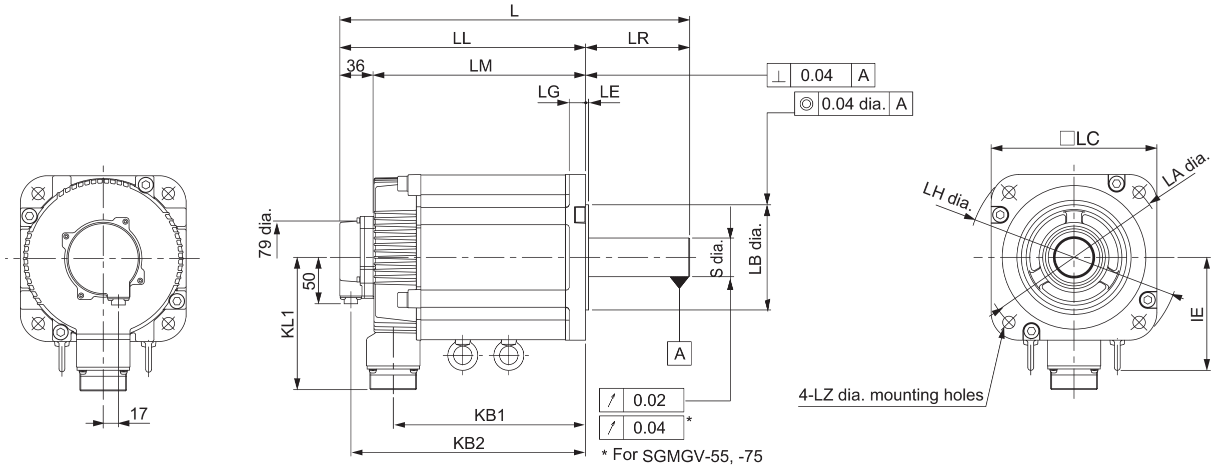
The amount of vibration the servomotor endures will vary depending on the application. Check the vibration acceleration being applied to your servomotor for each application.

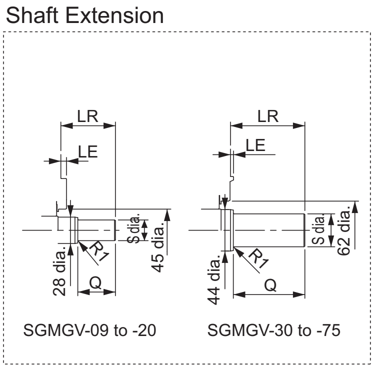
3.11 Vibration Class

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.)

3.12 External Dimensions

3.12.1 Without Holding Brakes





Unit: mm

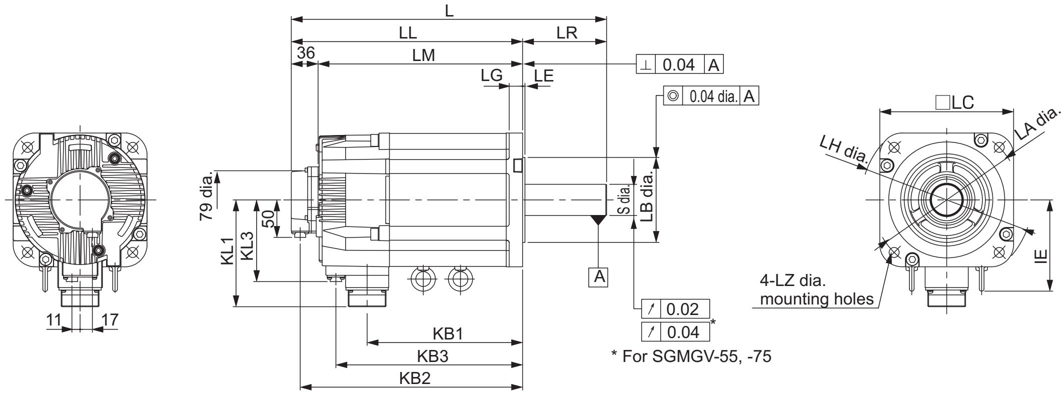
Note: For the specifications of the other shaft ends, refer to *3.12.3 Shaft End Specifications*.

Unit: mm

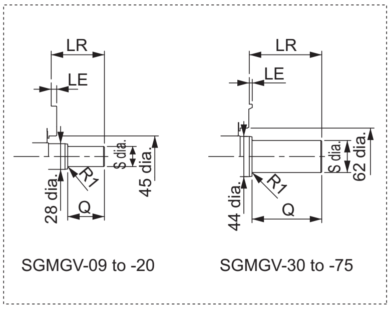
Model SGMGV-	L	LL	LM	LR	KB1	KB2	IE	KL1	Flange Face Dimensions							Shaft End Dimensions		Approx. Mass kg
									LA	LB	LC	LE	LG	LH	LZ	S	Q	
09□8□21	195	137	101	58	83	125	–	104	145	$110^{\ 0}_{-0.035}$	130	6	12	165	9	$19^{\ 0}_{-0.013}$	40	5.5
13□8□21	211	153	117	58	99	141	–	104	145	$110^{\ 0}_{-0.035}$	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.

3.12.2 With Holding Brakes



Shaft Extension



Unit: mm

Note: For the specifications of the other shaft ends, refer to *3.12.3 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

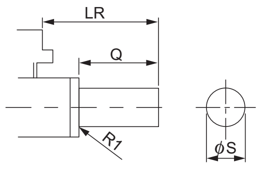
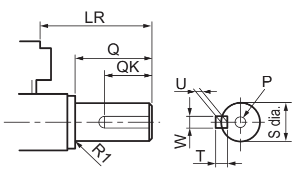
Note: Models with oil seals are of the same configuration.

3.12.3 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-					
		09□□□	13□□□	20□□A	20□□M	30□□□, 44□□□	55□□□, 75□□□
Code: 2 (Straight without key)							
	LR	58	58	58	58	79	113
	Q	40	40	40	40	76	110
	S	$19^{\ 0}_{-0.013}$	$22^{\ 0}_{-0.013}$	$24^{\ 0}_{-0.013}$	$24^{\ 0}_{-0.013}$	$35^{+0.01}_{\ 0}$	$42^{\ 0}_{-0.016}$
Code: 6 (Straight with key and tap)							
	LR	58	58	58	58	79	113
	Q	40	40	40	40	76	110
	QK	25	25	32	32	60	90
	S	$19^{\ 0}_{-0.013}$	$22^{\ 0}_{-0.013}$	$24^{\ 0}_{-0.013}$	$24^{\ 0}_{-0.013}$	$35^{+0.01}_{\ 0}$	$42^{\ 0}_{-0.016}$
	W	5	6	8	8	10	12
	T	5	6	7	7	8	8
	U	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 of 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□,
CACP-JU□□D3□</th><th>15</th><th>19</th><th>22</th><th>30*1</th><th>37*1</th><th>45</th></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="9">Basic Specifications</td><td rowspan="2">Input Power</td><td colspan="2">Main Circuits L1, L2, and L3</td><td colspan="6">CACP-JU□□A: Three-phase 200 to 230 V (50/60 Hz)
CACP-JU□□D: Three-phase 380 to 480 V (50/60 Hz)
Allowable voltage fluctuation: +10% to -15%
Allowable frequency fluctuation: ±5%
Line voltage unbalance: 5% max.</td></tr>
<tr><td colspan="2">Control Power*2</td><td colspan="6">24 VDC
Allowable voltage fluctuation: ±15%
Output holding time: 100 ms min.</td></tr>
<tr><td rowspan="2">Output Power</td><td colspan="2">Main Circuit Power Output +/-</td><td colspan="6">CACP-JU□□A: 270 to 310 VDC +10 to -15%
CACP-JU□□D: 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
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 2.1.2 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.
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>

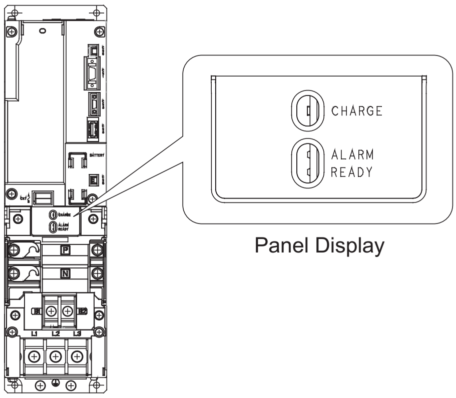
∗1. Available only for three-phase 200 VAC models.
∗2. Use an SELV-compliant power supply according to EN/IEC 60950-1 to input 24 VDC to the control power supply input terminals.

Note: The ratings are different when a spindle motor is used. For details, refer to the *Σ-V-SD Series User's Manual SERVOPACK with MECHATROLINK-III Communications References for Rotary Servomotor* (Manual No.: SIEP S800000 78).

(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. Not lit when main circuit power is off.
ALARM	Red	Lit when alarm occurs. Not lit when no alarm occurs.
READY	Green	Lit when CPU of power regeneration converter works normally. Not lit when CPU of power regeneration converter not working.



Panel Display

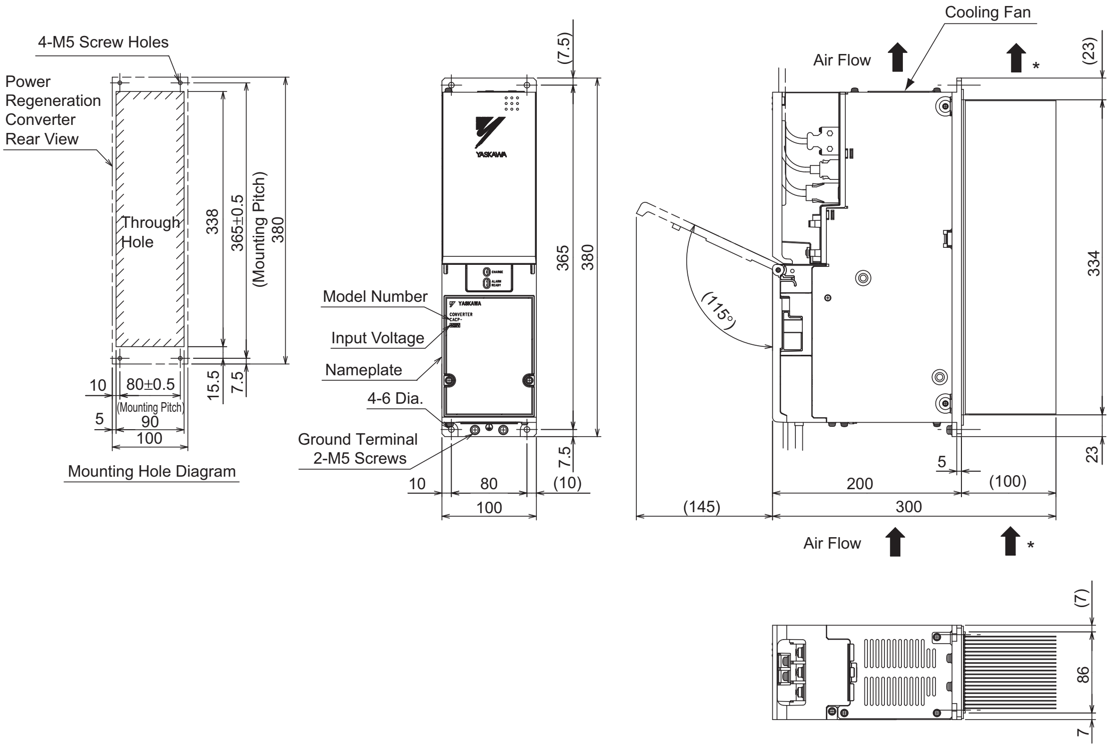
Power Regeneration Converter

(3) I/O Current and Inrush Current

Voltage	Capacity (Continuous Ratings) kW	Model	Input Current (Continuous Ratings) Arms	Output Current (Continuous Ratings) Arms	Inrush Current (Main Circuit) A_{0-P}
200 V	11	CACP-JU15A	54	51	83
	15	CACP-JU19A	73	69	83
	18.5	CACP-JU22A	90	85	83
	22	CACP-JU30A	107	102	178
	30	CACP-JU37A	145	138	178
	37	CACP-JU45A	179	170	178
400 V	11	CACP-JU15D	27	27	173
	15	CACP-JU19D	36	36	173
	18.5	CACP-JU22D	45	45	173
	37	CACP-JU45D	86	86	78

4.1.2 External Dimensions

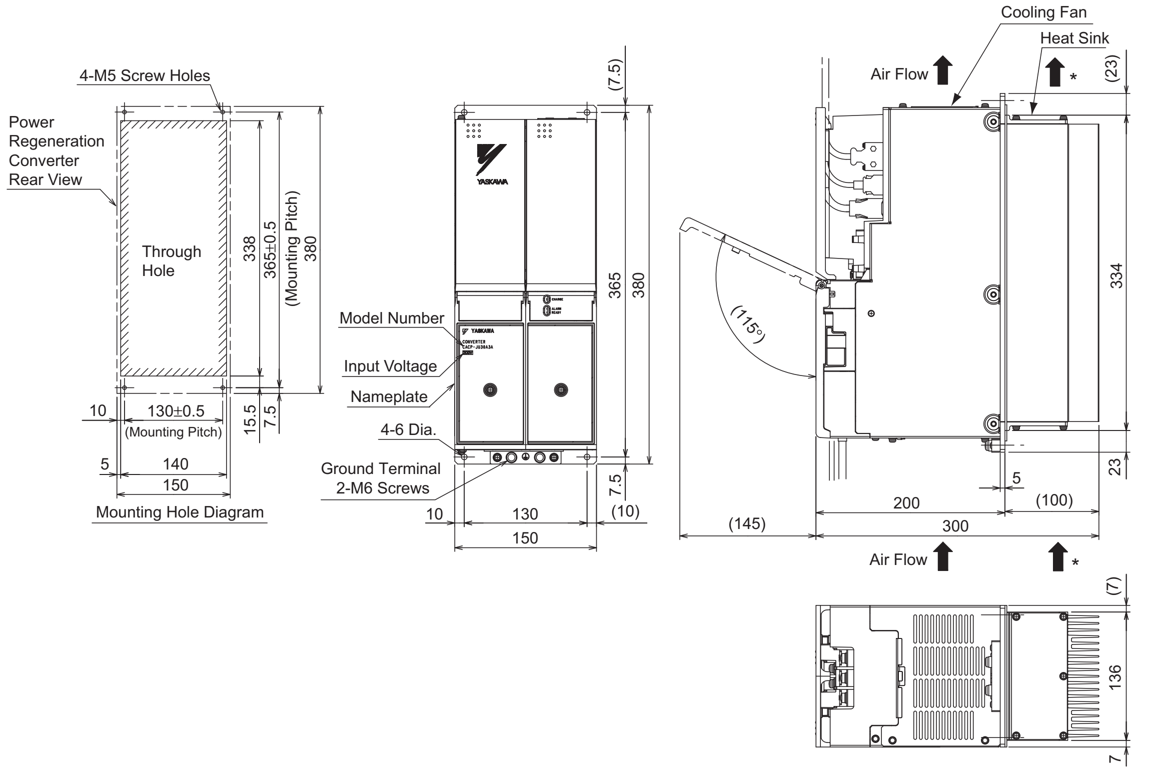
(1) Models: CACP-JU15□, -JU19□, and -JU22□



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.

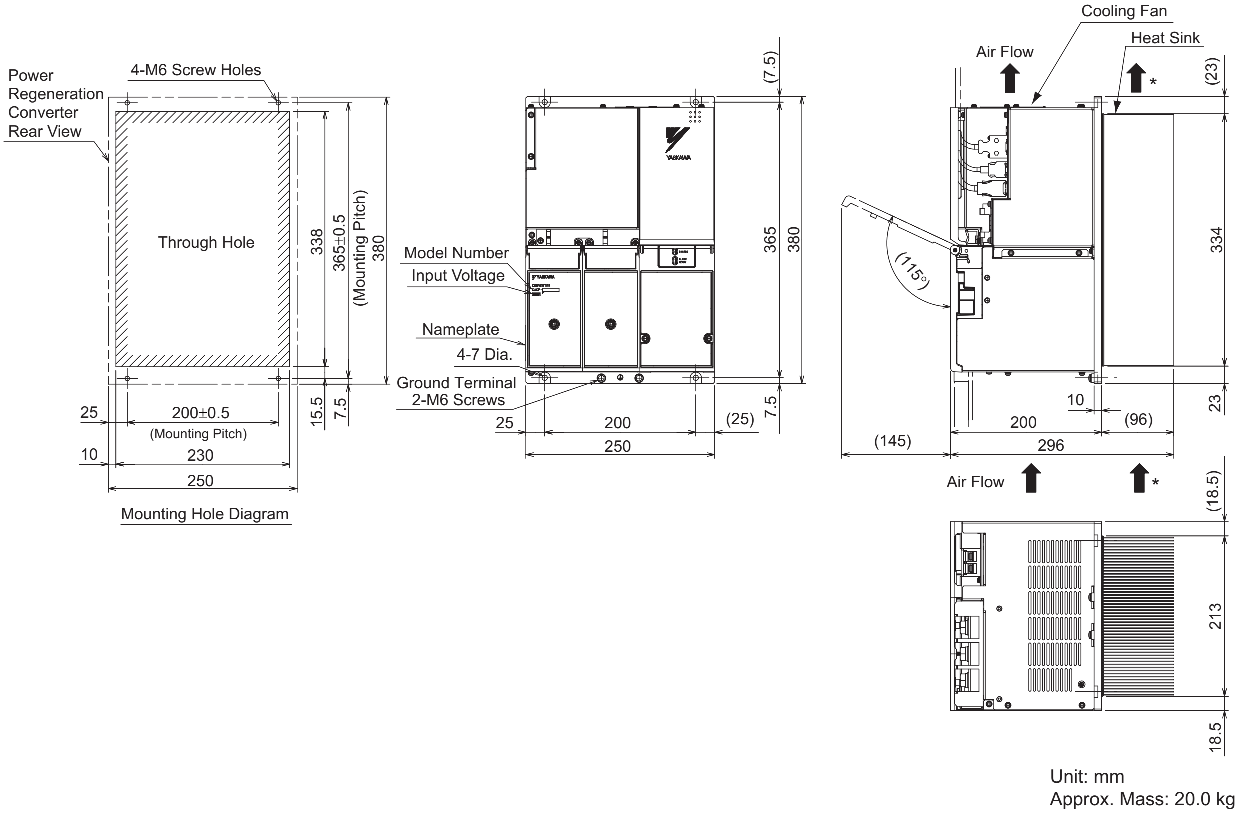
(2) Models: CACP-JU30A and -JU37A



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) Models: CACP-JU45☐



∗ 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			Specification
Control Method			Sine-wave current drive with PWM control of IGBT
Applicable Motors Model			SGMGV
Functions	Feedback	Motor	Serial encoder (absolute), Standard type: 20 bits, 4-Mbps communications
		Fully-closed Loop Control	Cannot be used.
	Indications		CHARGE (orange), RDY (green), and ERR (red)
	Station Address Setting		16-position rotary switch
	Dynamic Brake 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) Control power: Built in
	Protective Functions		Overcurrent, overload, main circuit voltage error, heat sink overheating, 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
	Full-closed Loop Control		Cannot be used.
	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)
		Communication 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:
- CACR-JU028A, CACR-JU036A, CACR-JU014D, and CACR-JU018D

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)

Item				Specification	
Functions (cont'd)	Sequence Signal	External Input Power	Input Power Voltage	24 VDC ±5%	
			Current Required per Channel	3 mA for normal input, 10 mA for latch input	
		Input Signals	Number of Channels	3 for each axis (isolated) 3 latch inputs (isolated)	
		Output Signals (Brake)	Number of Channels	1 for each axis (isolated)	
			Maximum Output Current	50 mA	
			Maximum Applicable Voltage	30 V	
			Delay	Depends on brake or relay circuit.	
	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			1:5000	
	Safety-function-part	Number of Functions		2	
		Safety Function A	Inputs: Number of Channels	2	
			Inputs: Function	Safety Request Input Signal (SRI-A1, SRI-A2)	
			Output: Number of Channels	1	
			Output: Function	External Device Monitor Output Signal (EDM-A)	
		Safety Function B	Inputs: Number of Channels	2	
			Inputs: Function	Safety Request Input Signal (SRI-B1, SRI-B2)	
			Output: Number of Channels	1	
			Output: Function	External Device Monitor Output Signal (EDM-B)	
	Stopping Methods			Safety Functions (IEC61800-5-2)	Safety-function-part Function Name
				Safe Torque Off (STO)	Safe BaseBlock Function (SBB function)
				Safe Stop 1 (SS1)	Safe BaseBlock with Delay Function (SBB-D function)
				Safe Stop 2 (SS2)	Safe Position Monitor with Delay Function (SPM-D function)?
				Safety-Limited Speed (SLS)	Safely Limited Speed with Delay Function (SLS-D function)
	Response Time			Max. 200 ms	
	Proof Test Interval			10 years	

*3. Do not use this for the CACR-JU028A, -JU036A, -JU014D, and -JU018D SERVOPACKS. These models have a built-in dynamic brake function.

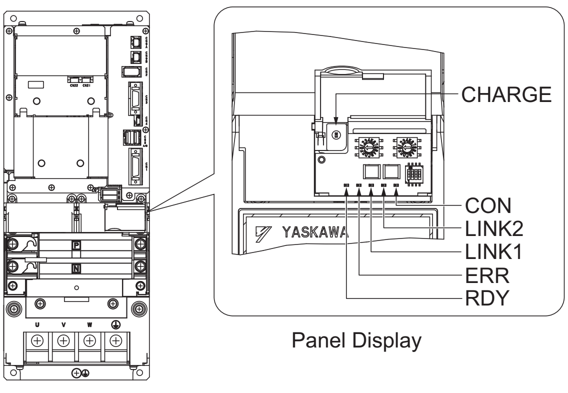
(2) MECHATROLINK-III Communications Specifications

Function		Specifications
MECHATROLINK-III Communication	Communication Protocol	MECHATROLINK-III
	Station Address	03H to EFH (Max. number of stations: 62) Use the rotary switches S1 and S2 to set the station address.
	Baud Rate	100 Mbps
	Transmission Cycle	250 µs, 500 µs, 750 µs, and 1.0 ms to 4.0 ms (increments of 0.5 ms)
	Number of Words in Link Communication	32, or 48 bytes per station Use the DIP switch S3 to select the number of words.
Operator Function	Panel Display	LINK_LED (green) × 2 CONNECT_LED (yellow) × 1
	Setting Switch	DIP switch × 1, rotary switch × 2

(3) Panel Display

The SERVOPACK status can be checked on the panel display.

Name	LED Color	Meaning
CHARGE	Orange	Lit when main circuit power is on. Not lit when main circuit power is off.
RDY	Green	Lit when CPU of SERVOPACK works normally. Not lit when CPU of SERVOPACK not working.
ERR	Red	Lit when alarm occurs. Not lit when no alarm occurs.
LNK1	Green	Lit when communication port of CN9A connector transmits/receives normally. Not lit when communication port of CN9A connector not transmitting/receiving. (Example: disconnected cable)
LNK2		Lit when communication port of CN9B connector transmits/receives normally. Not lit when communication port of CN9B connector not transmitting/receiving. (Example: disconnected cable)
CON	Yellow	Lit when Σ-V-SD driver normally receives CONNECT command in application layer. Not lit when CONNECT command not received in application layer.

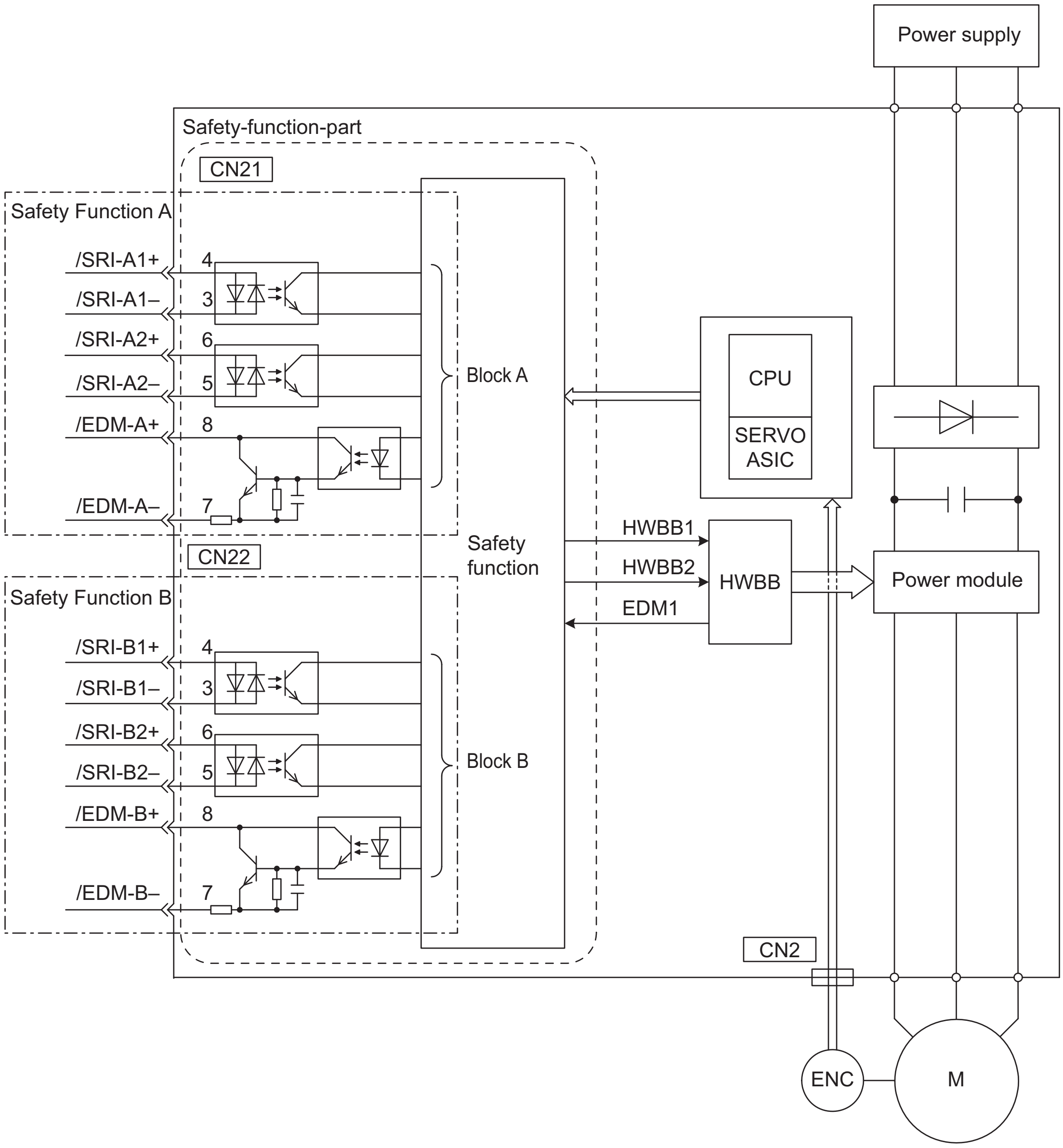


(4) I/O Current

Voltage	Capacity (Continuous Ratings) kW	Model	Input Current (Continuous Ratings) Arms	Output Current (Continuous Ratings) Arms
270 VDC	3.7	CACR-JU028A	17	28
	5.5	CACR-JU036A	26	36
	11	CACR-JU065A	51	65
	15	CACR-JU084A	69	84
	18.5	CACR-JU102A	85	102
	22	CACR-JU125A	102	125
	37	CACR-JU196A	170	196
540 VDC	3.7	CACR-JU014D	9	14
	5.5	CACR-JU018D	13	18
	11	CACR-JU033D	27	32.5
	15	CACR-JU042D	36	42
	18.5	CACR-JU051D	45	51
	37	CACR-JU098D	86	98

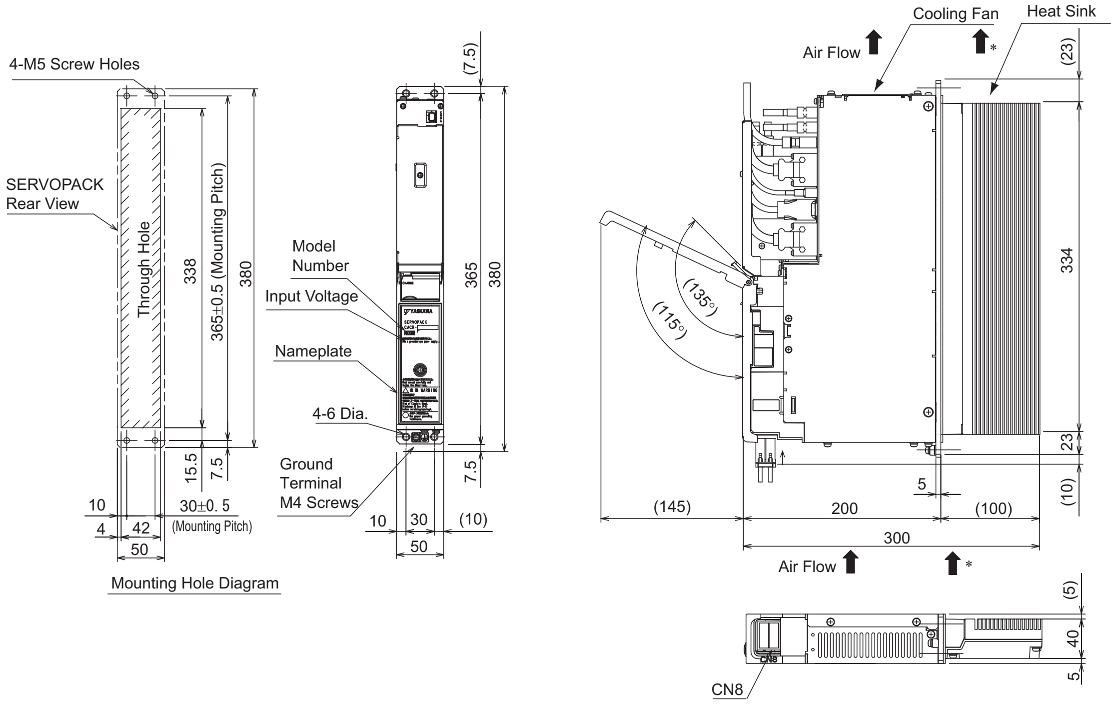
4.2.2 Internal Block Diagram of Safety-function-part

This figure shows a typical internal block diagram.



4.2.3 External Dimensions

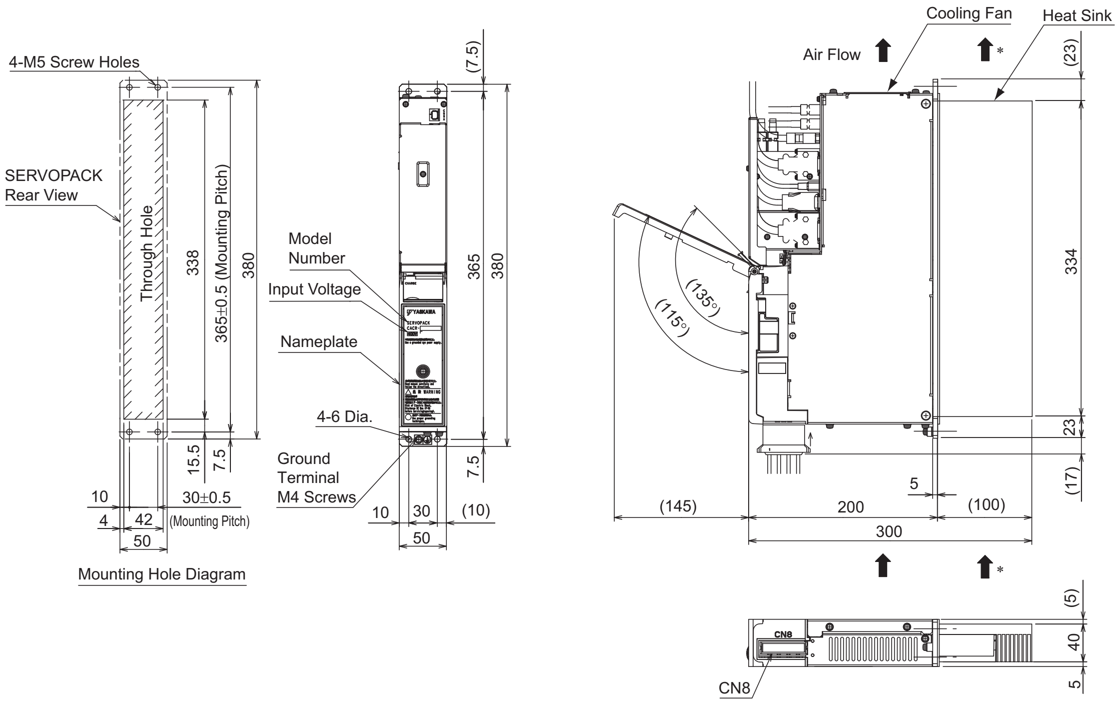
(1) Model: CACR-JU028A2B20, -JU014D2B20



Unit: mm
Approx. Mass: 4.6 kg

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

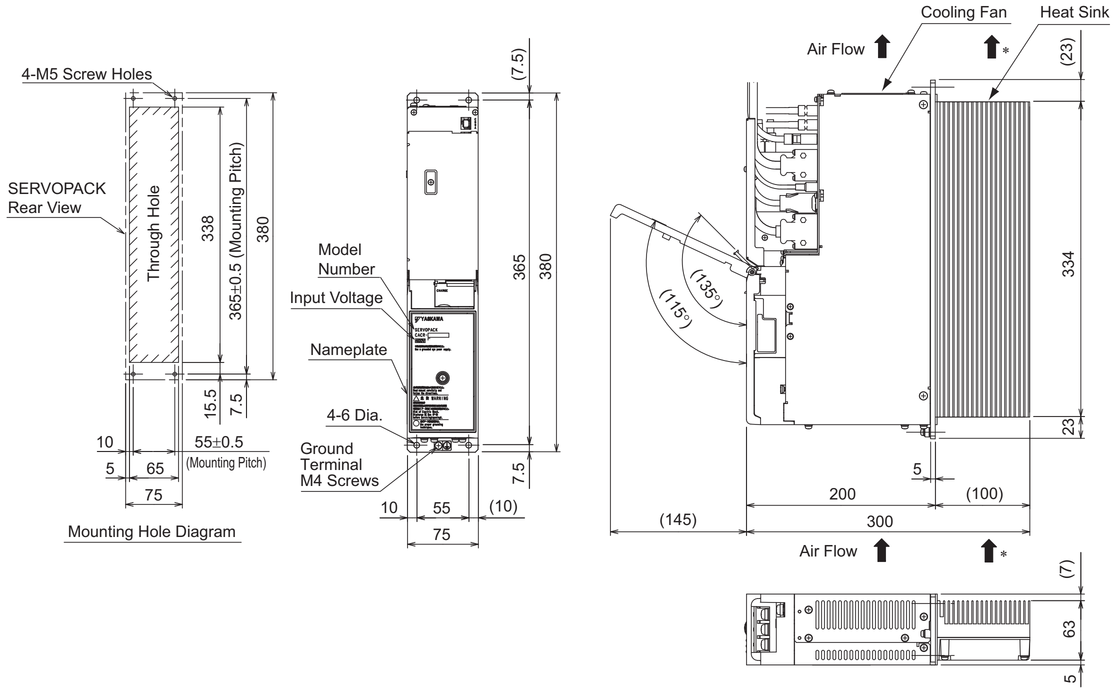
(2) Model: CACR-JU036A2B20, -JU018D2B20



Unit: mm
Approx. Mass: CACR-JU036A: 5.3 kg
CACR-JU018D: 5.1 kg

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

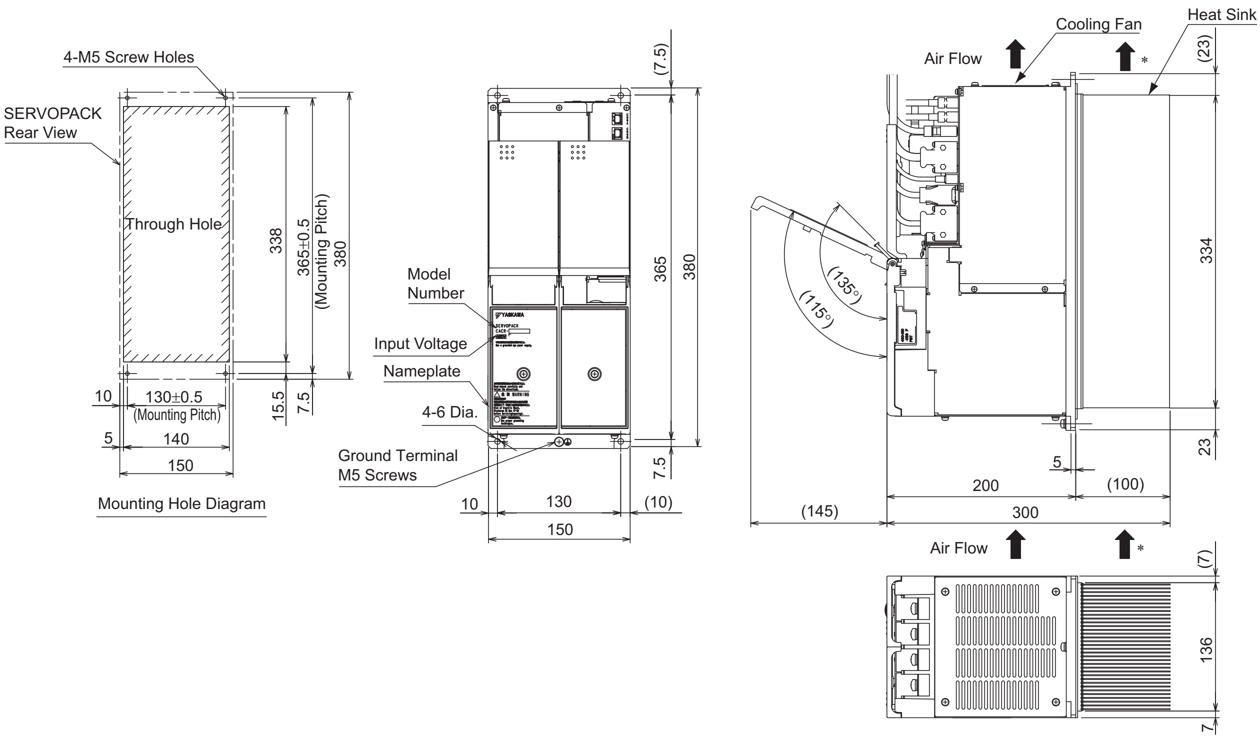
(3) Model: CACR-JU065A2B20, -JU033D2B20



Unit: mm
Approx. Mass: 6.8 kg

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

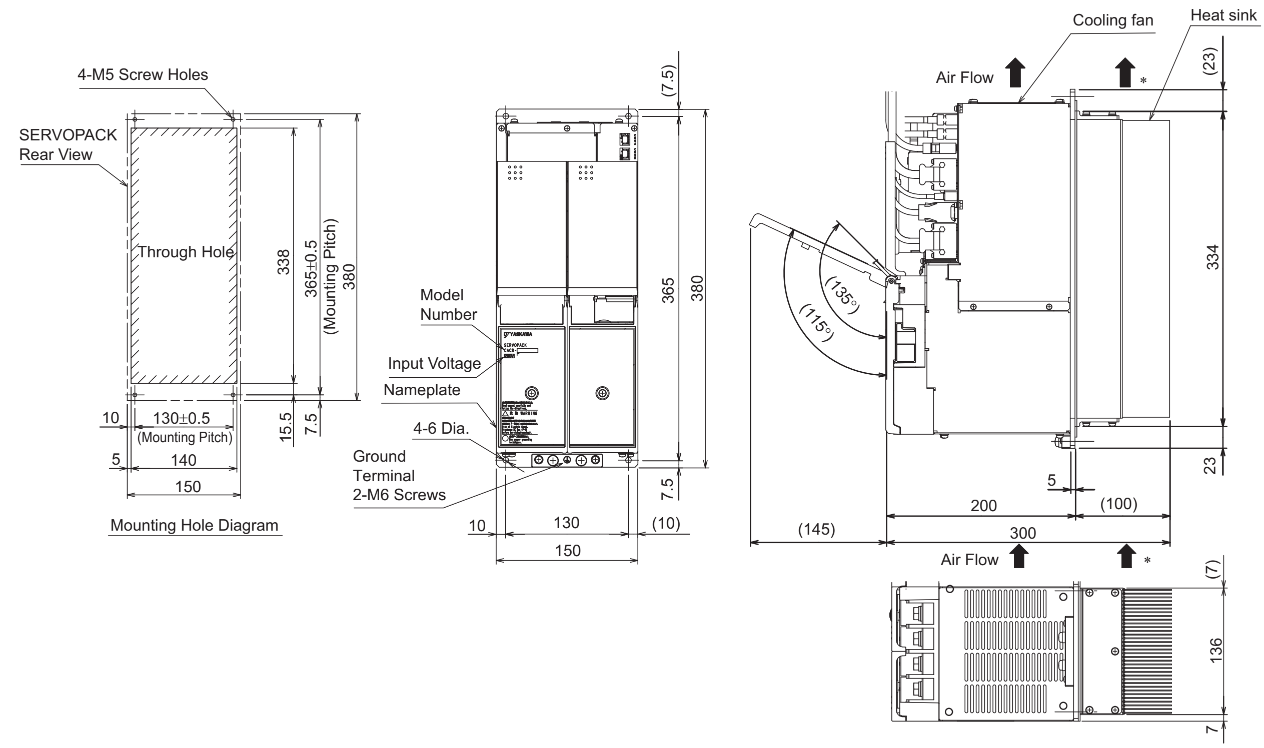
(4) Model: CACR-JU084A2B20, -JU102A2B20, -JU042D2B20, -JU051D2B20



Unit: mm
Approx. Mass: 12.2 kg

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

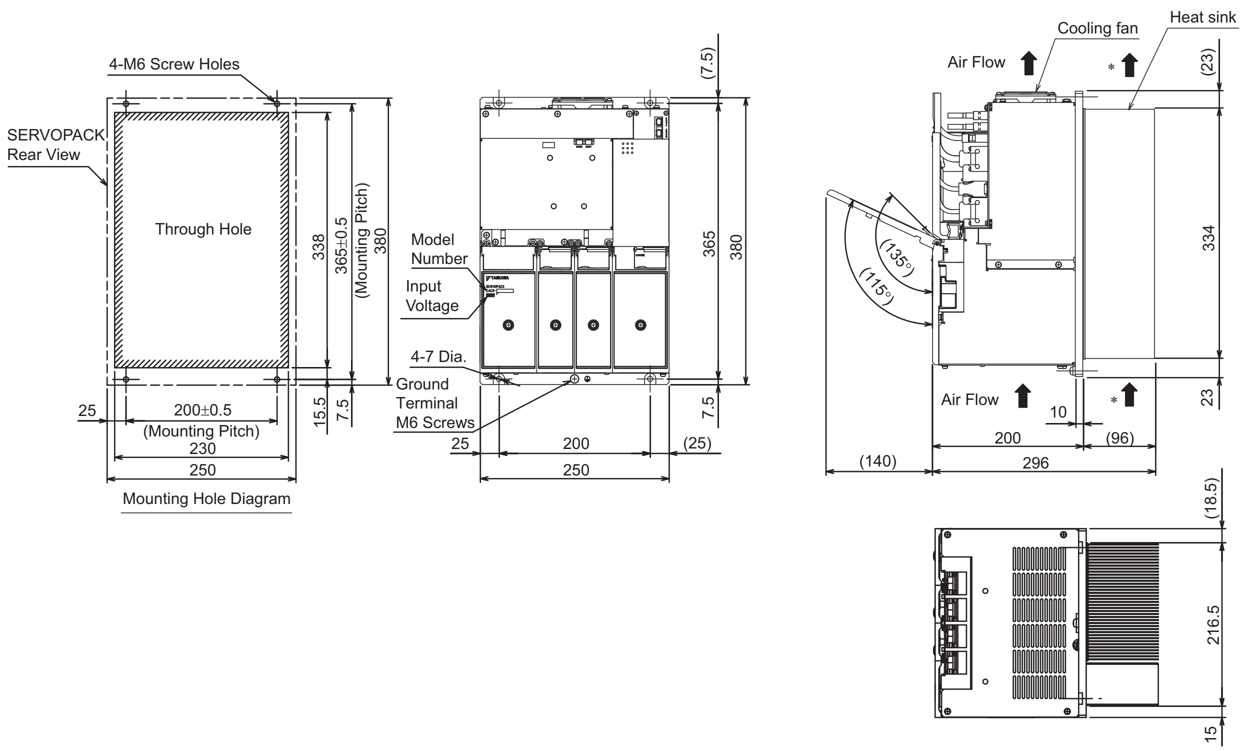
(5) Model: CACR-JU125A2B20



Unit: mm
Approx. Mass: 12.4 kg

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

(6) Model: CACR-JU196A2B20, -JU098D2B20



Unit: mm
Approx. Mass: 20.1 kg

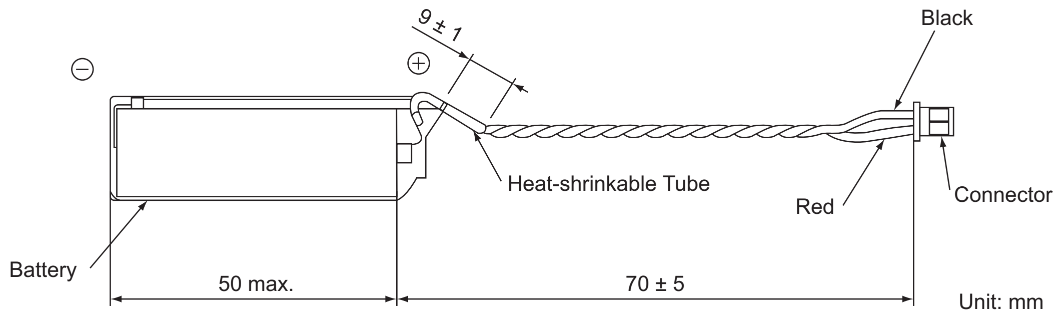
* The cooling air speed of heat sink must be at least 2.5 m/s at the point closest to the heat sink.

5

Specifications and External Dimensions of Peripheral Devices

5.1 Absolute Encoder Battery

5.1.1 Specifications



Use the following absolute encoder battery unit.

Model: BA000518 (a connector included)
Manufacturer: Yaskawa Controls Co., Ltd.

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

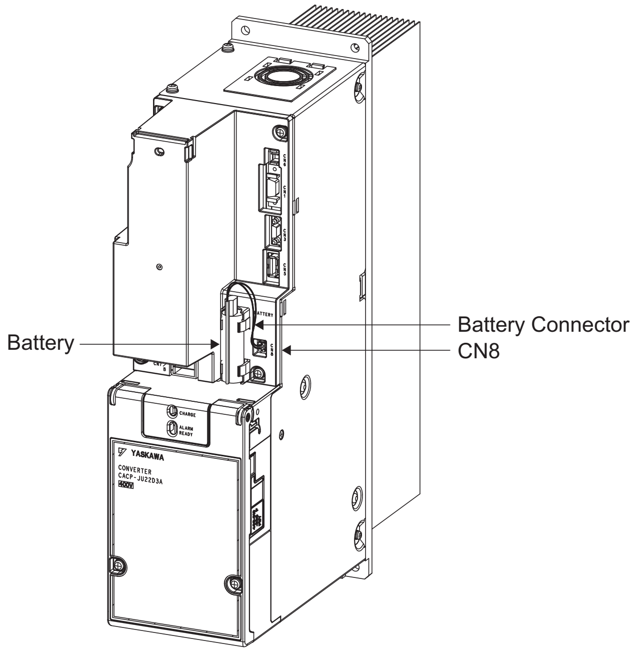
Battery model: ER6V
Connector Model: Housing DF3-2S-2C2C (Hirose Electric Co., Ltd.)
Contact DF3-2428SCFC (Hirose Electric Co., Ltd.) or DF3-2428SCC (Hirose Electric Co., Ltd.)

⚠ 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 to CN8 of the power regeneration converter.



For the battery replacement, refer to *8.5.3 Battery Replacement*.

5.2 AC Reactor

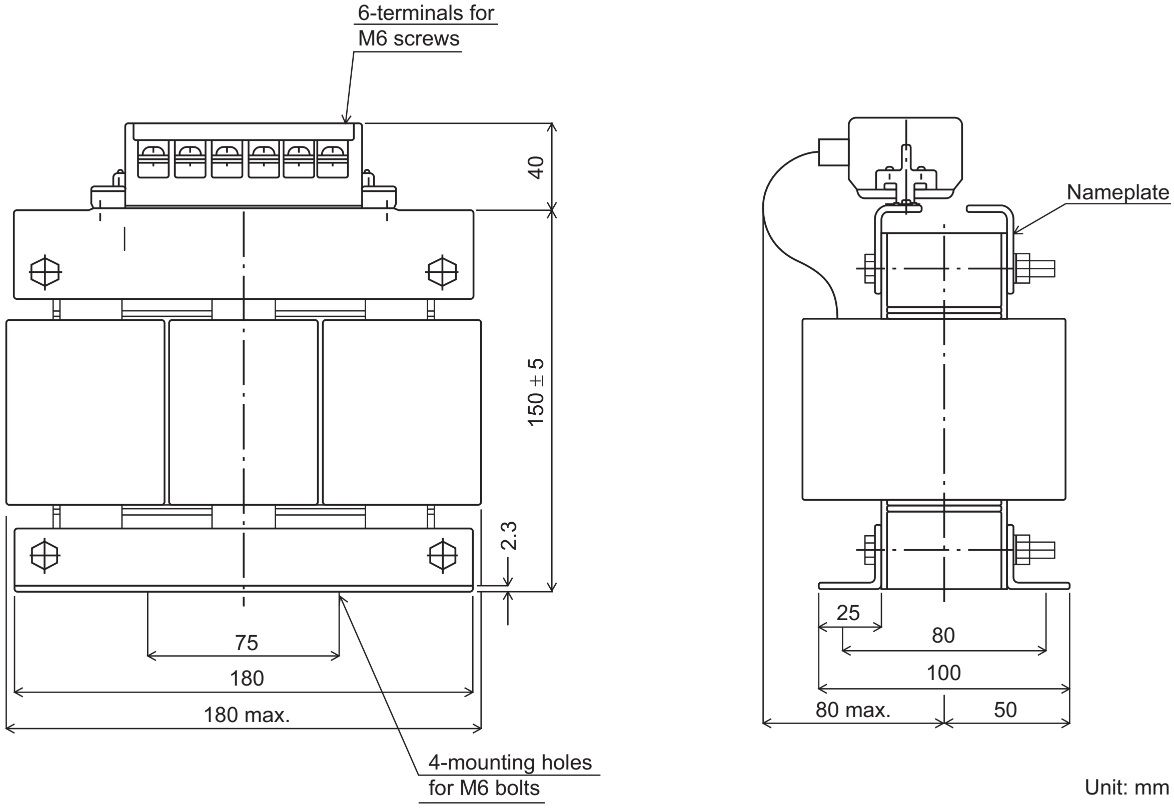
5.2.1 Specifications

Power Regeneration Converter Model	AC Reactor Model	Rated Voltage (V)	Frequency (Hz)	Rated Current (A)	Inductance (mH)	Insulation Class (class)	Watt Data Loss (W)	Ambient Temperature	Storage Temperature	Approx. Mass (kg)
CACP-JU15A	X008017	230	50/60	56	0.21	H	55	-10 to 55°C	-20 to 85°C	8
CACP-JU19A	X008018	230	50/60	73	0.17	H	70	-10 to 55°C	-20 to 85°C	8
CACP-JU22A	X008019	230	50/60	90	0.14	H	80	-10 to 55°C	-20 to 85°C	12
CACP-JU30A	X008020	230	50/60	107	0.1	H	85	-10 to 55°C	-20 to 85°C	12
CACP-JU37A	X008029	230	50/60	145	0.09	H	93	-10 to 55°C	-20 to 85°C	12
CACP-JU45A	X008022	230	50/60	179	0.07	H	130	-10 to 55°C	-20 to 85°C	25
CACP-JU15D	X008010* / X008023	480	50/60	27	0.82	H	70	-10 to 55°C	-20 to 85°C	7.3
CACP-JU19D	X008011	480	50/60	36	0.67	H	80	-10 to 55°C	-20 to 85°C	7.3
CACP-JU22D	X008012	480	50/60	45	0.56	H	120	-10 to 55°C	-20 to 85°C	11.2
CACP-JU45D	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.

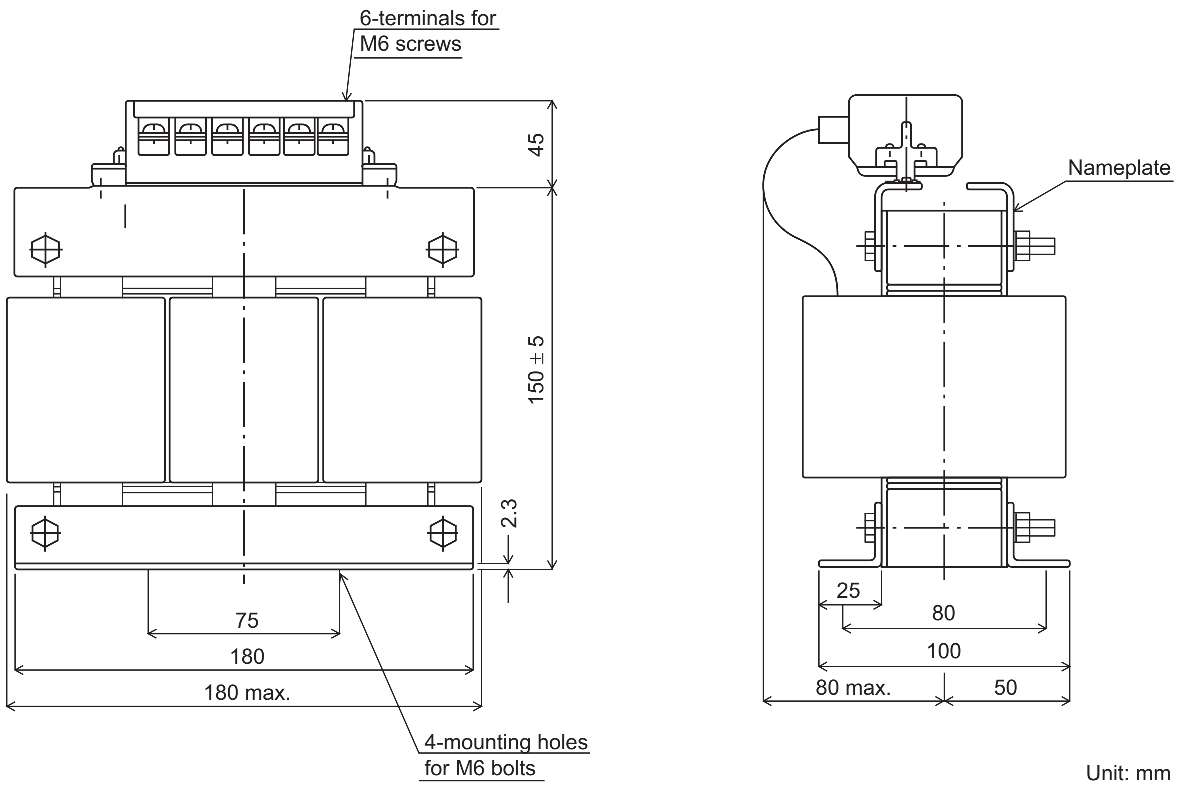
5.2.2 External Dimensions

(1) Model: X008017



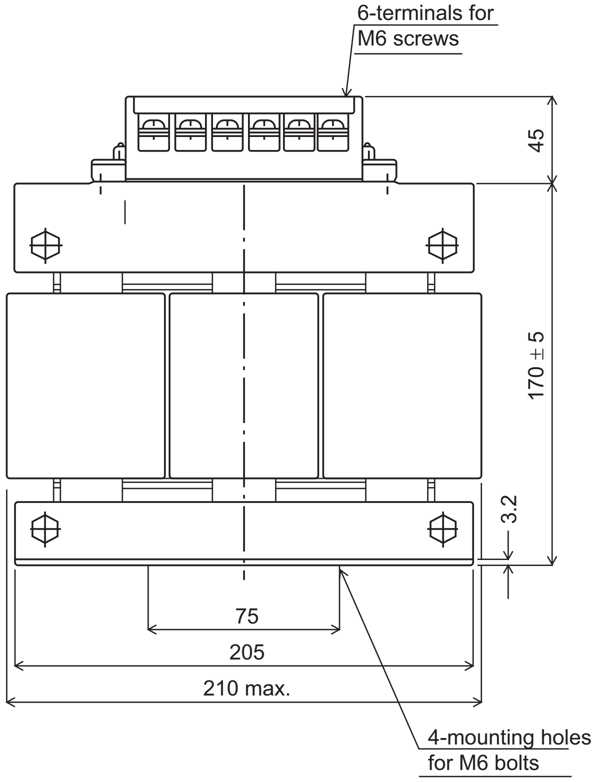
Unit: mm

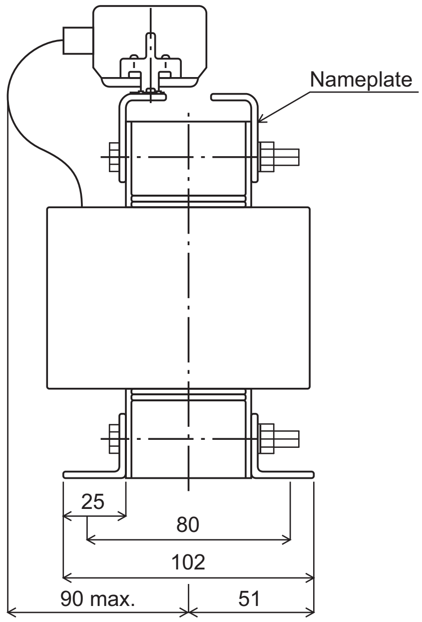
(2) Model: X008018



Unit: mm

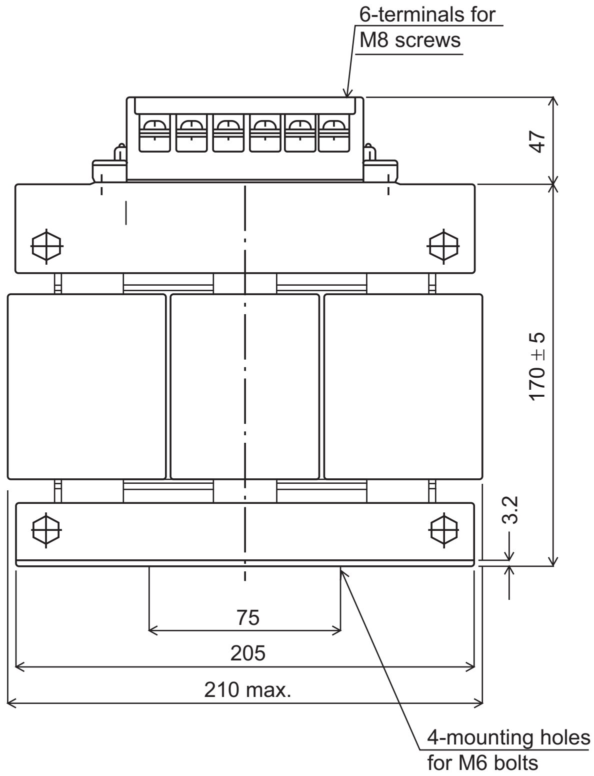
(3) Model: X008019

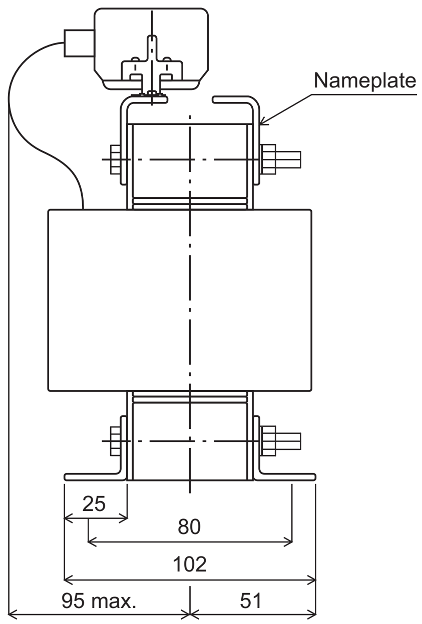




Unit: mm

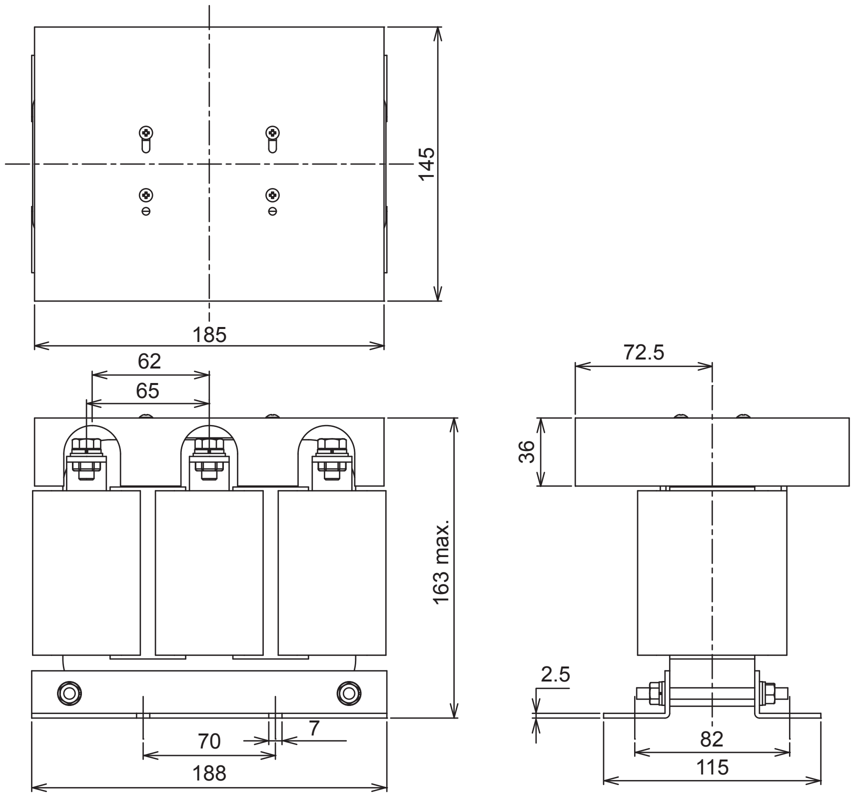
(4) Model: X008020





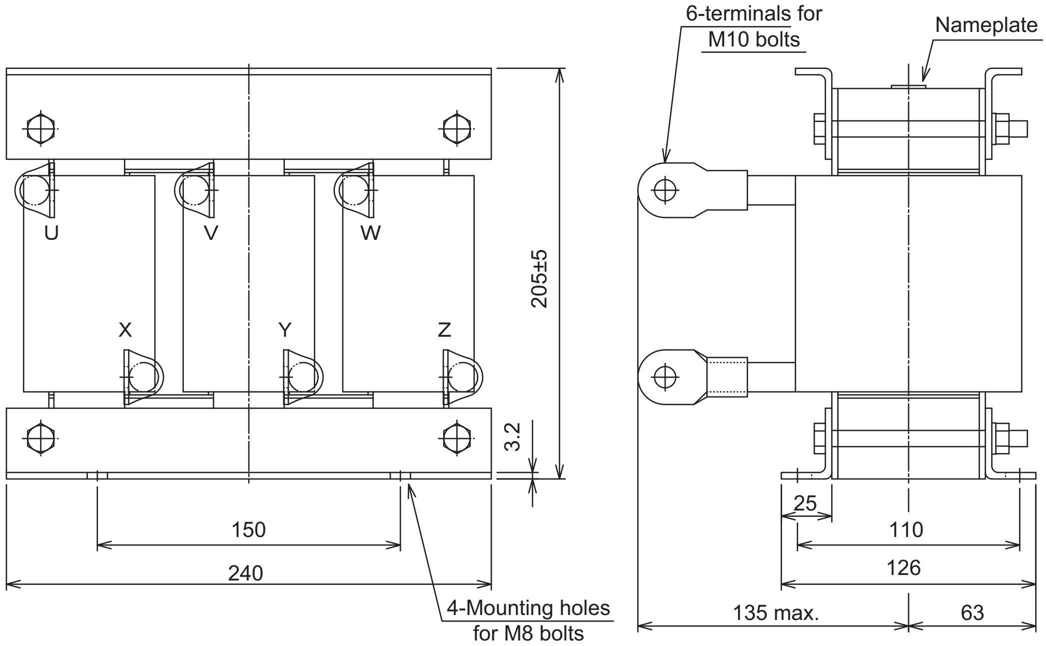
Unit: mm

(5) Model: X008029



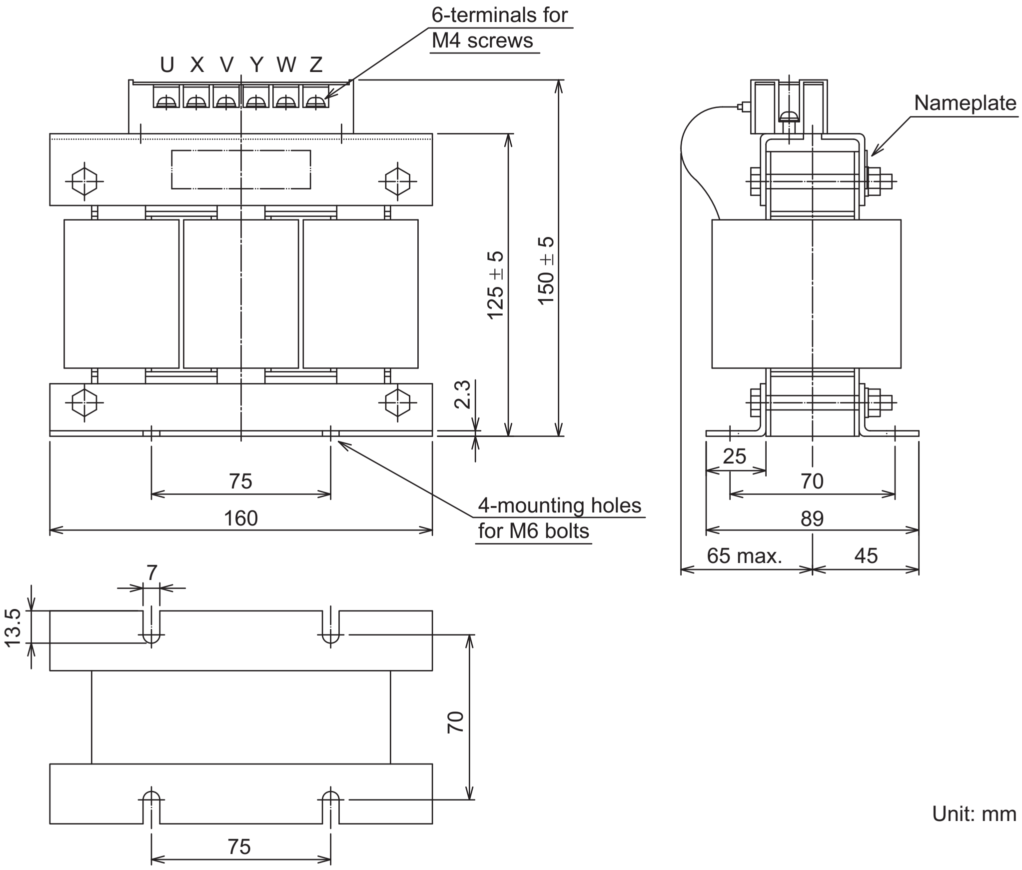
Unit: mm

(6) Model: X008022

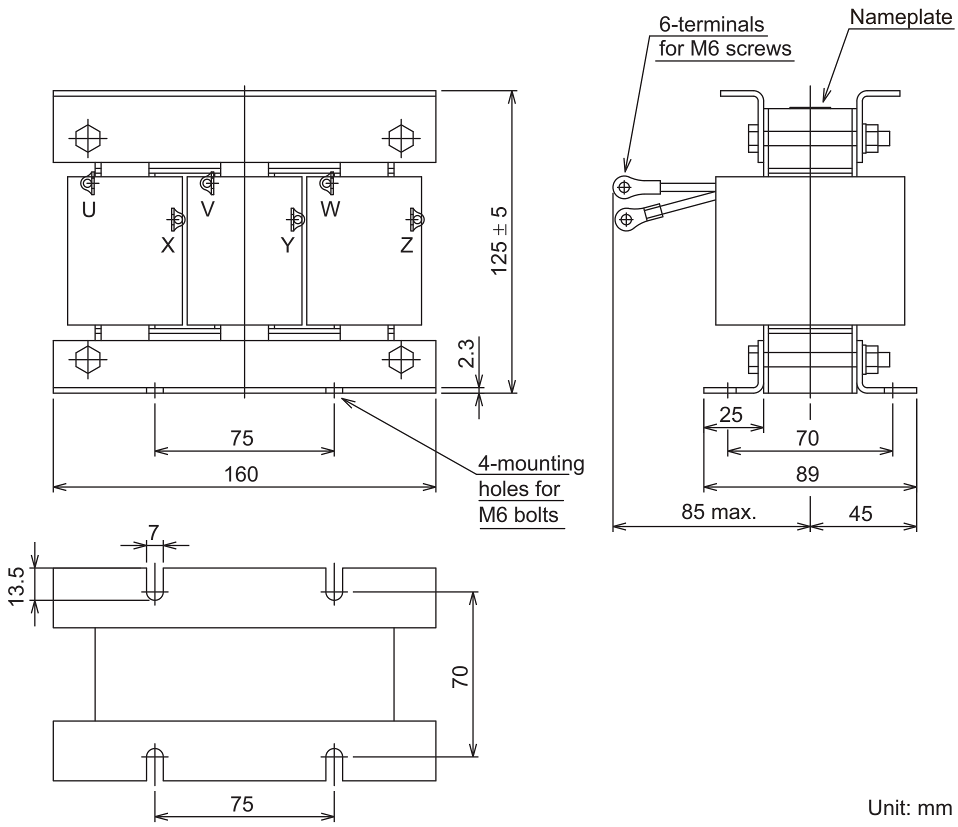


Unit: mm

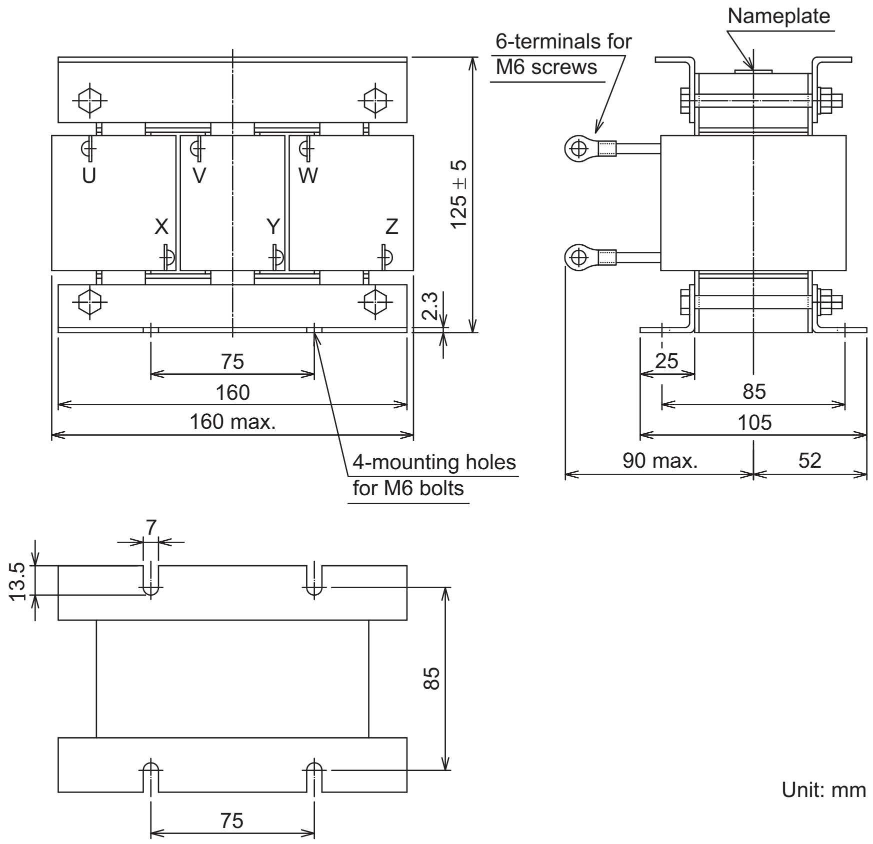
(7) Model: X008010



(8) Model: X008023

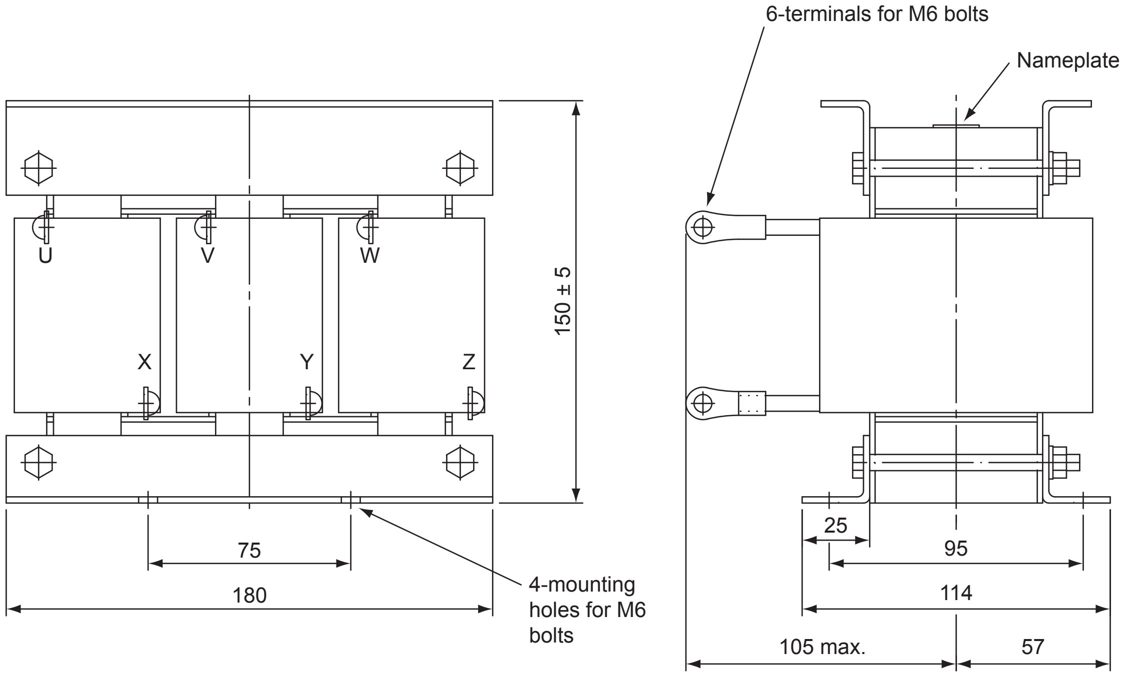


(9) Model: X008011



Unit: mm

(10) Model: X008012

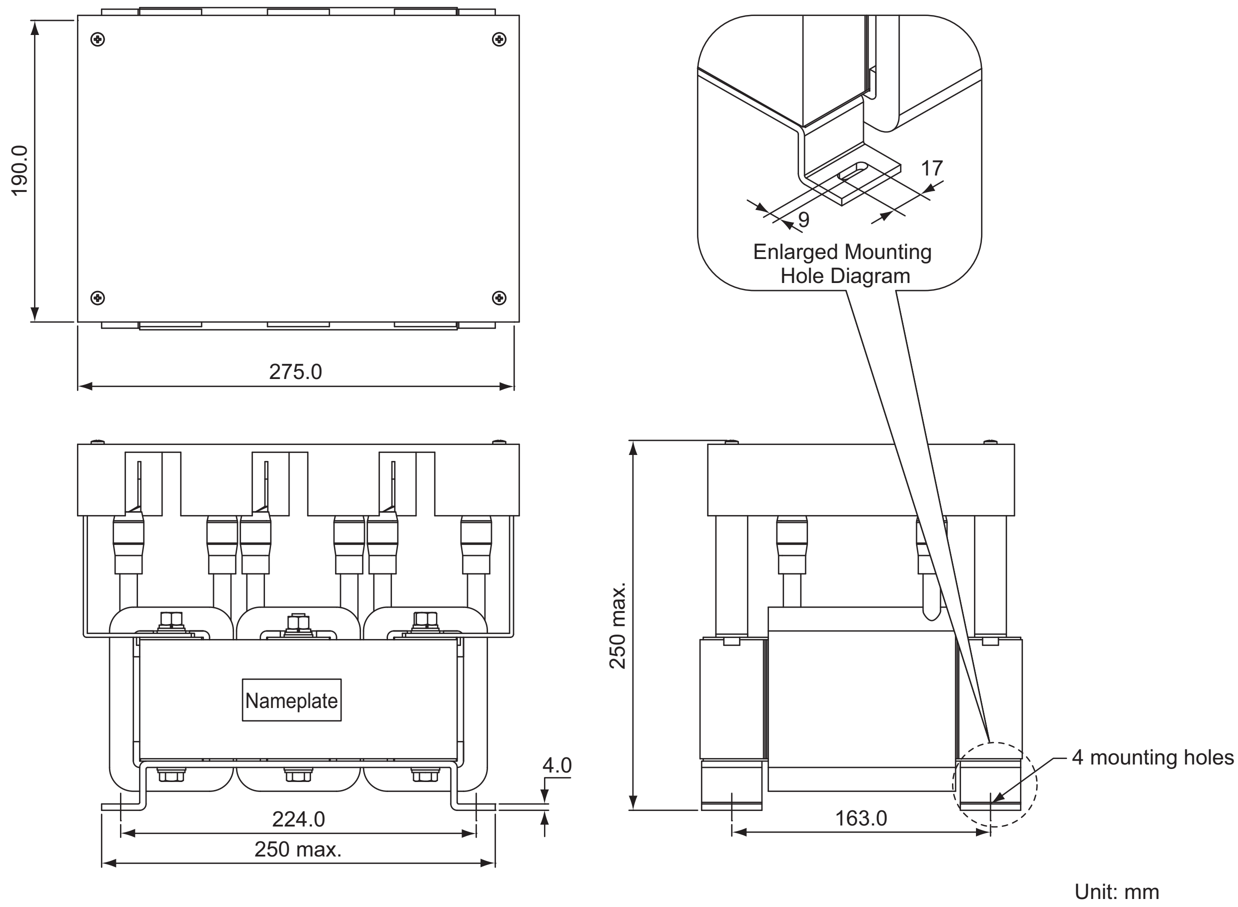


Unit: mm

Specifications and External Dimensions of Peripheral Devices

5

(11) Model: X008024



5.3 Noise Filter

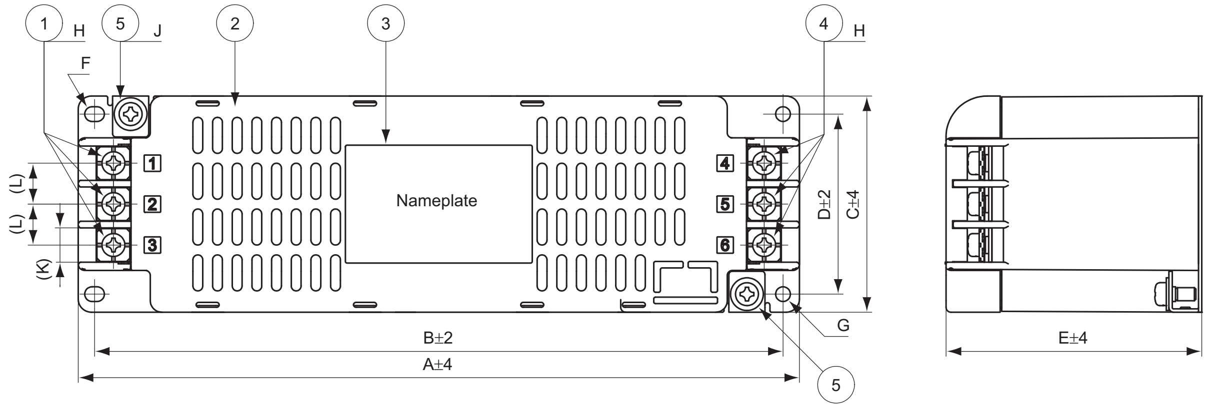
5.3.1 Specifications

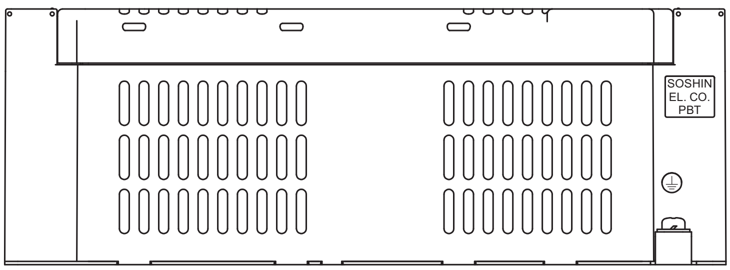
Power Regeneration Converter		Noise Filter					
Input Voltage	Model	Model	Rated Current (A)	Classification	Rated Voltage	Leakage Current (mA)	Manufacturer
Three-phase 200 VAC	CACP-JU15A	HF3060C-SZC-47EDD	60	Three-phase three-wire	480 VAC	8 (for 200 VAC, 60 Hz)	Soshin Electric Co., Ltd
	CACP-JU19A	HF3080C-SZC-47EDD	80				
	CACP-JU22A	HF3100C-SZC-47EDD	100				
	CACP-JU30A	HF3150C-SZC-47EDD	150				
	CACP-JU37A	HF3150C-SZC-47EDD	150			25 (for 200 VAC, 60 Hz)	
	CACP-JU45A	HF3200C-SZC-49EDE*	200				
Three-phase 400 VAC	CACP-JU15D	HF3030C-SZC-47DDD	30	Three-phase three-wire	480 VAC	13 (for 400 VAC, 50 Hz)	Soshin Electric Co., Ltd
	CACP-JU19D	HF3040C-SZC-47EDD	40				
	CACP-JU22D	HF3050C-SZC-47EDD	50				
	CACP-JU45D	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 (Soshin Electric Co., Ltd.)
Refer to *12.3.1 EMC Installation Conditions* for the installation location of the capacitor.

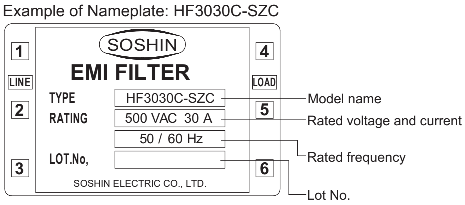
5.3.2 External Dimensions

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





Example of Nameplate: HF3030C-SZC



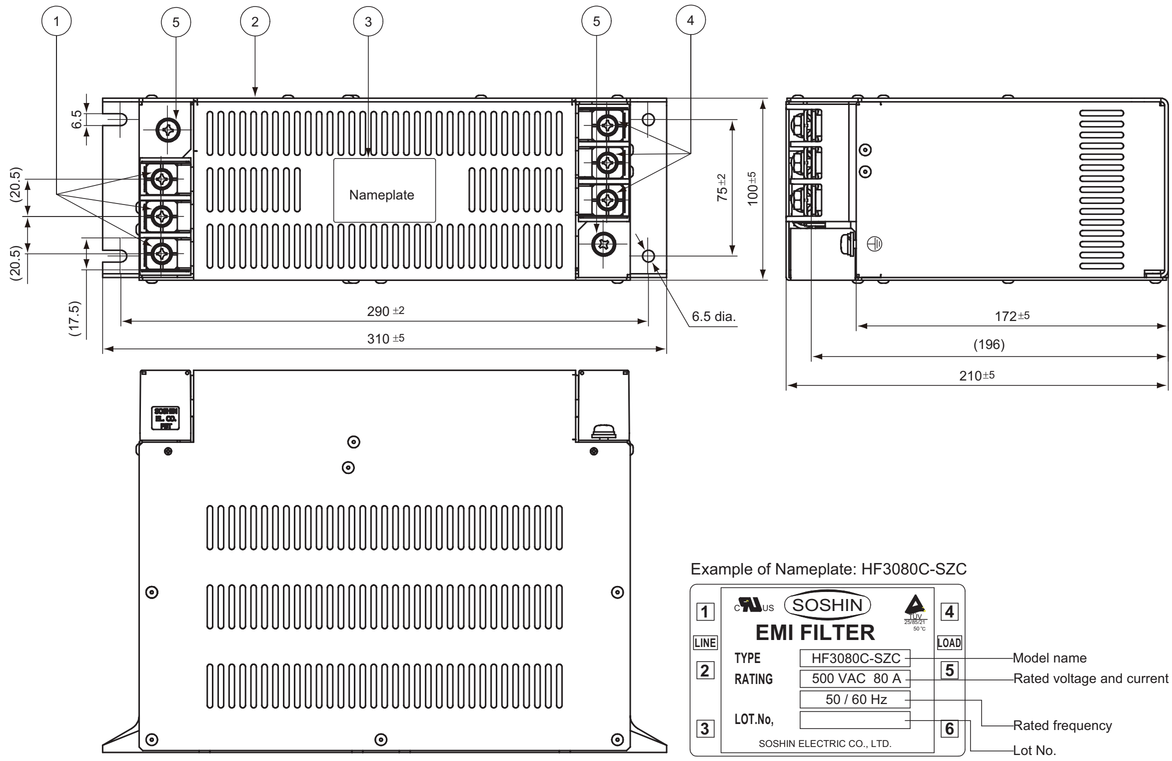
1. Input terminal
2. Case
3. Nameplate
4. Output terminal
5. Earth terminal

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											

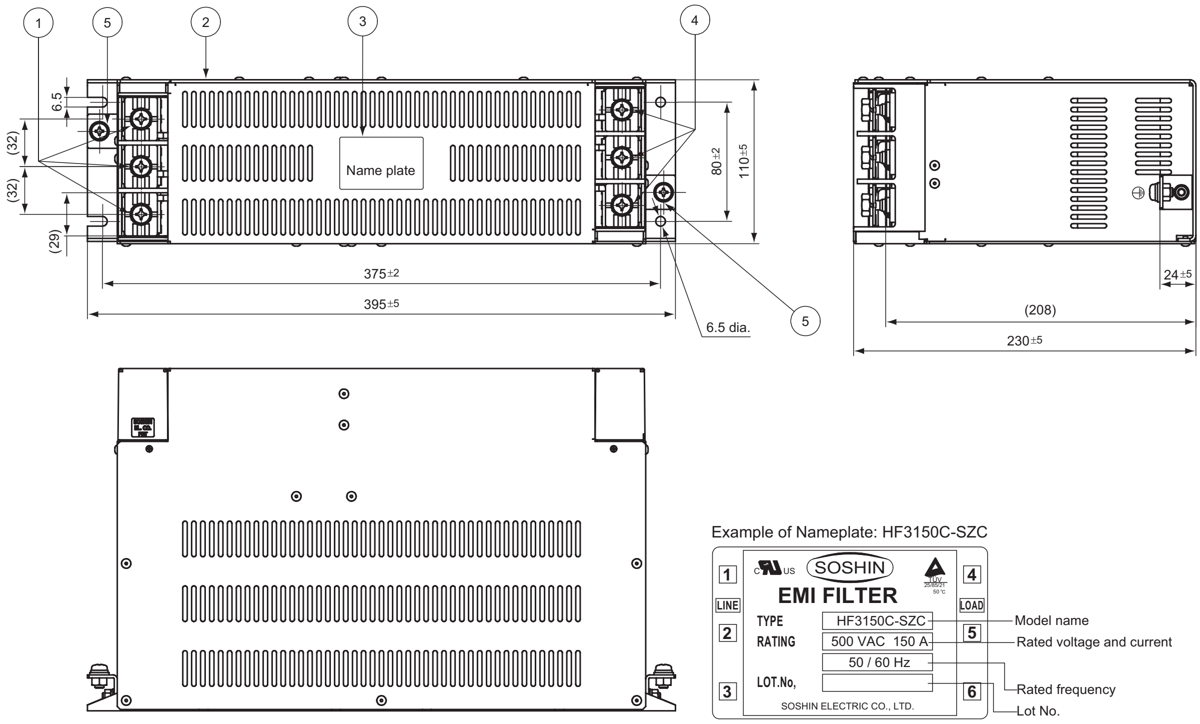
(2) Model: HF3080C-SZC-47EDD, HF3100C-SZC-47EDD



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

Specifications and External Dimensions of Peripheral Devices

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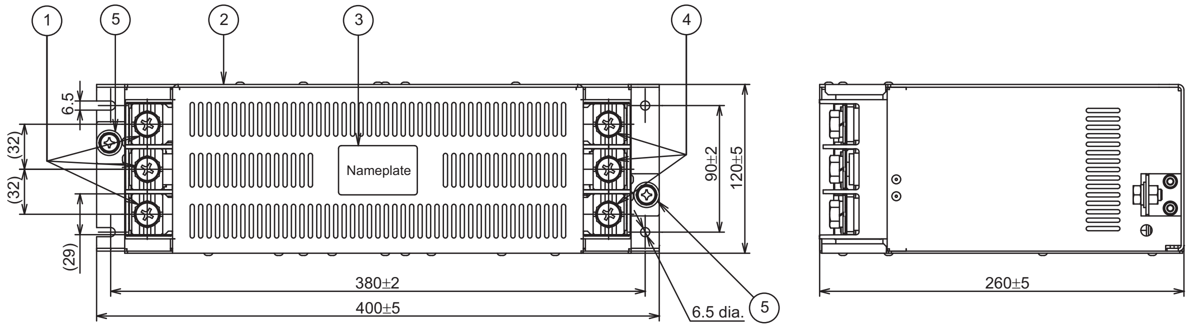
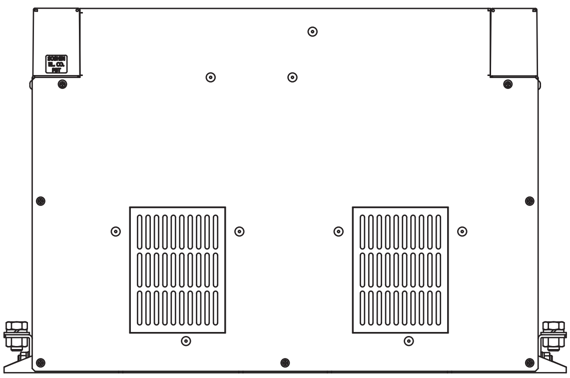
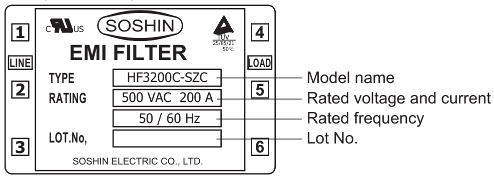
(4) Model: HF3200C-SZC-49EDE





Example of Nameplate: HF3200C-SZC

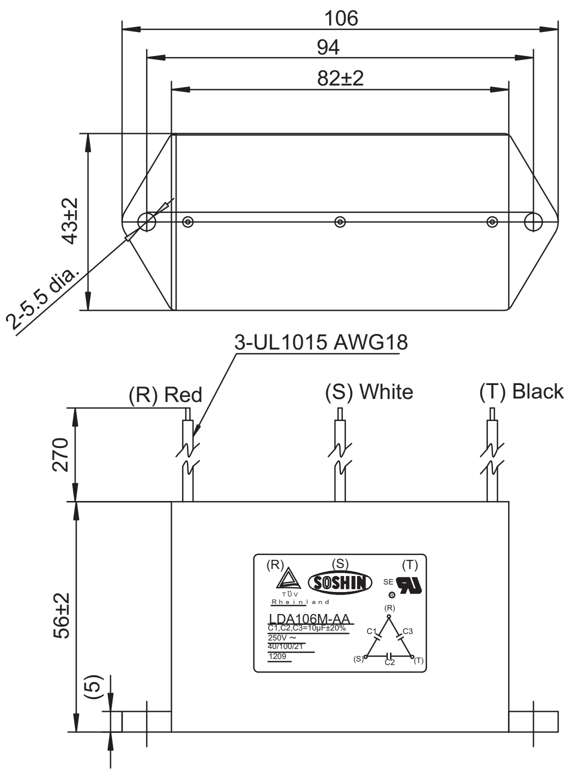


1 Input terminal: M10	4 Output terminal: M10
2 Case	5 Earth terminal: M8
3 Nameplate	

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

5.4 Base Mounting Units

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

5.4.1 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.

5.4.2 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-JU15A	JUSP-JUBM100AA
	CACP-JU19A	
	CACP-JU22A	
	CACP-JU30A	JUSP-JUBM150AA
	CACP-JU37A	
	CACP-JU45A	JUSP-JUBM250AA
Three-phase 400 VAC	CACP-JU15D	JUSP-JUBM100AA
	CACP-JU19D	
	CACP-JU22D	
	CACP-JU45D	JUSP-JUBM250AA

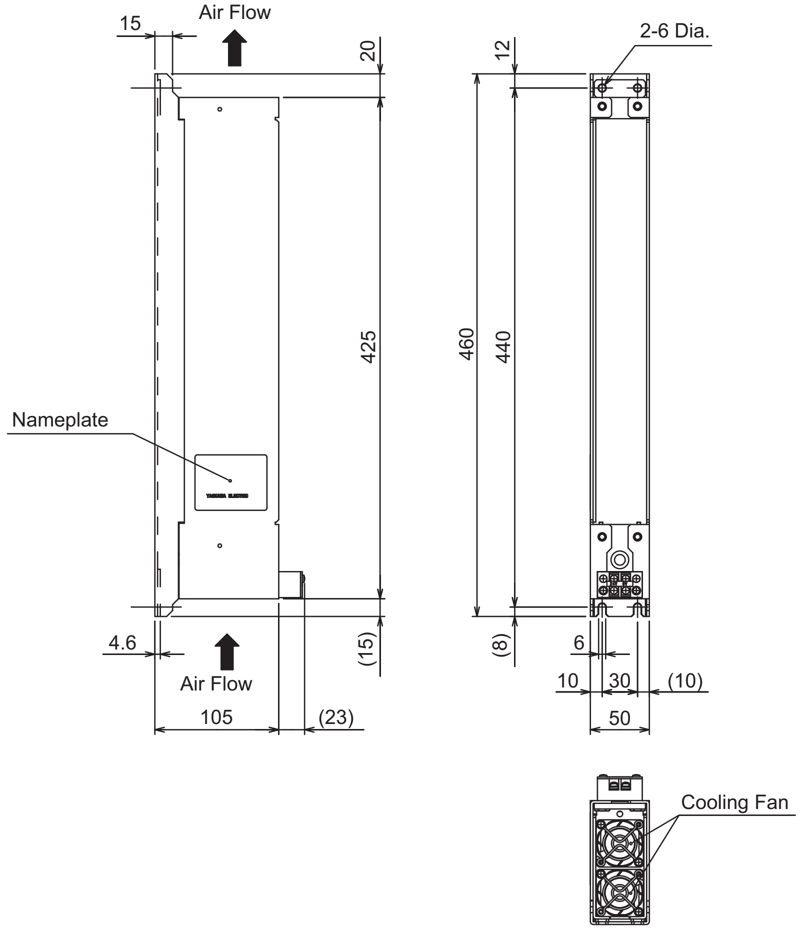
(2) SERVOPACK

SERVOPACK		Base Mounting Unit
Input Voltage	Model	Model
270 VDC	CACR-JU028A	JUSP-JUBM050AA
	CACR-JU036A	
	CACR-JU065A	JUSP-JUBM075AA
	CACR-JU084A	JUSP-JUBM150AA
	CACR-JU102A	
	CACR-JU125A	
	CACR-JU196A	JUSP-JUBM250AA
540 VDC	CACR-JU014D	JUSP-JUBM050AA
	CACR-JU018D	
	CACR-JU033D	JUSP-JUBM075AA
	CACR-JU042D	JUSP-JUBM150AA
	CACR-JU051D	
	CACR-JU098D	JUSP-JUBM250AA

5.4.3 External Dimensions

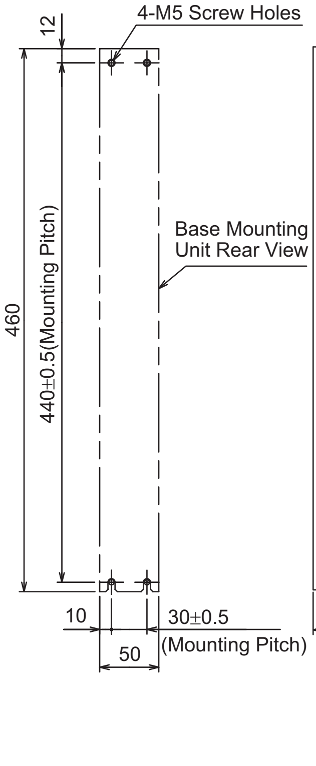
(1) Model: JUSP-JUBM050AA

Unit: mm

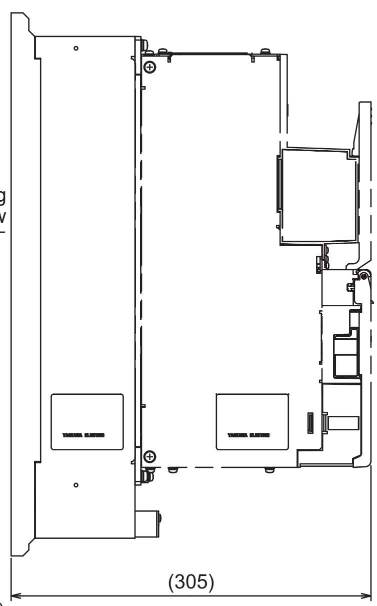


Approx. Mass: 2.7 kg

<Mounting Hole Diagram>

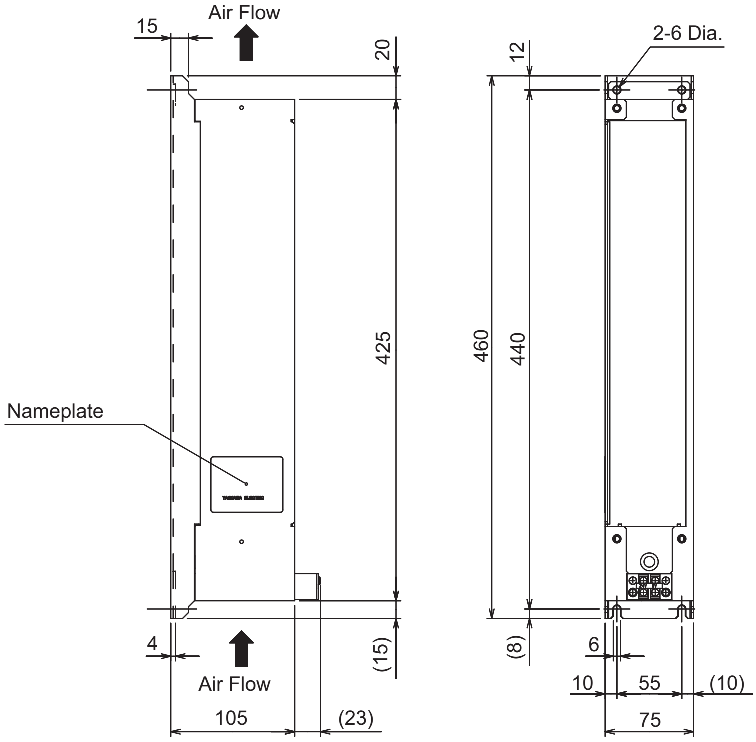


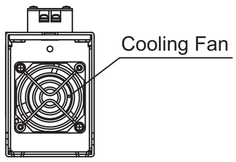
<Unit Mounted Diagram>



(2) Model: JUSP-JUBM075AA

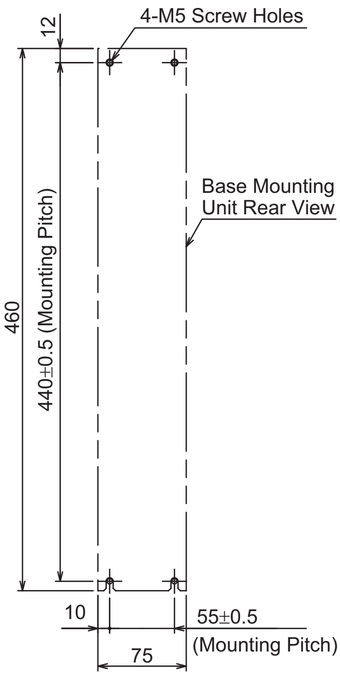
Unit: mm



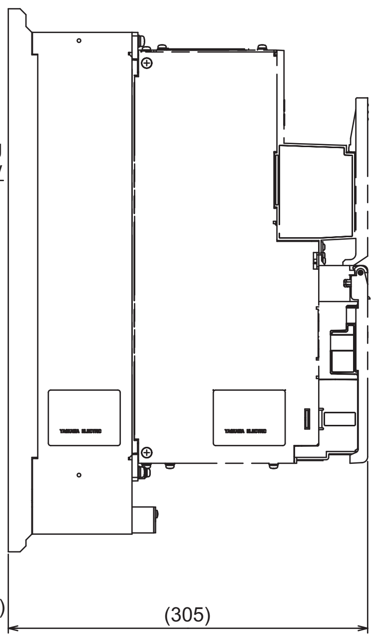


Approx. Mass: 2.7 kg

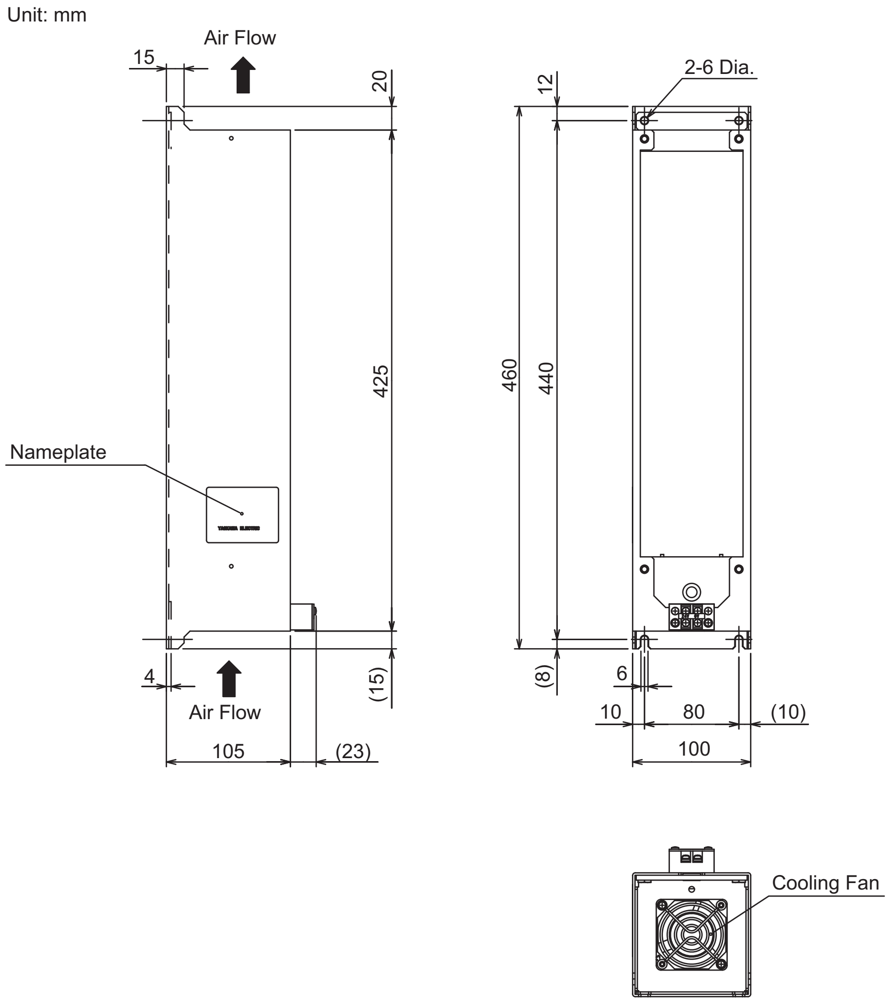
<Mounting Hole Diagram>



<Unit Mounted Diagram>

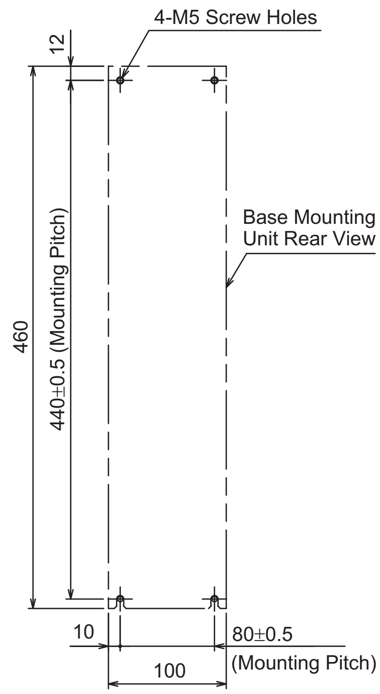


(3) Model: JUSP-JUBM100AA

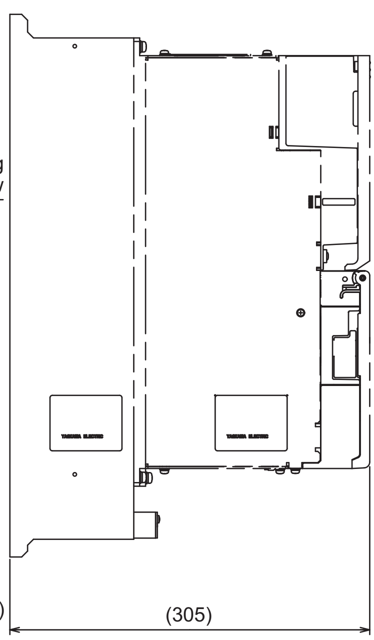


Approx. Mass: 2.8 kg

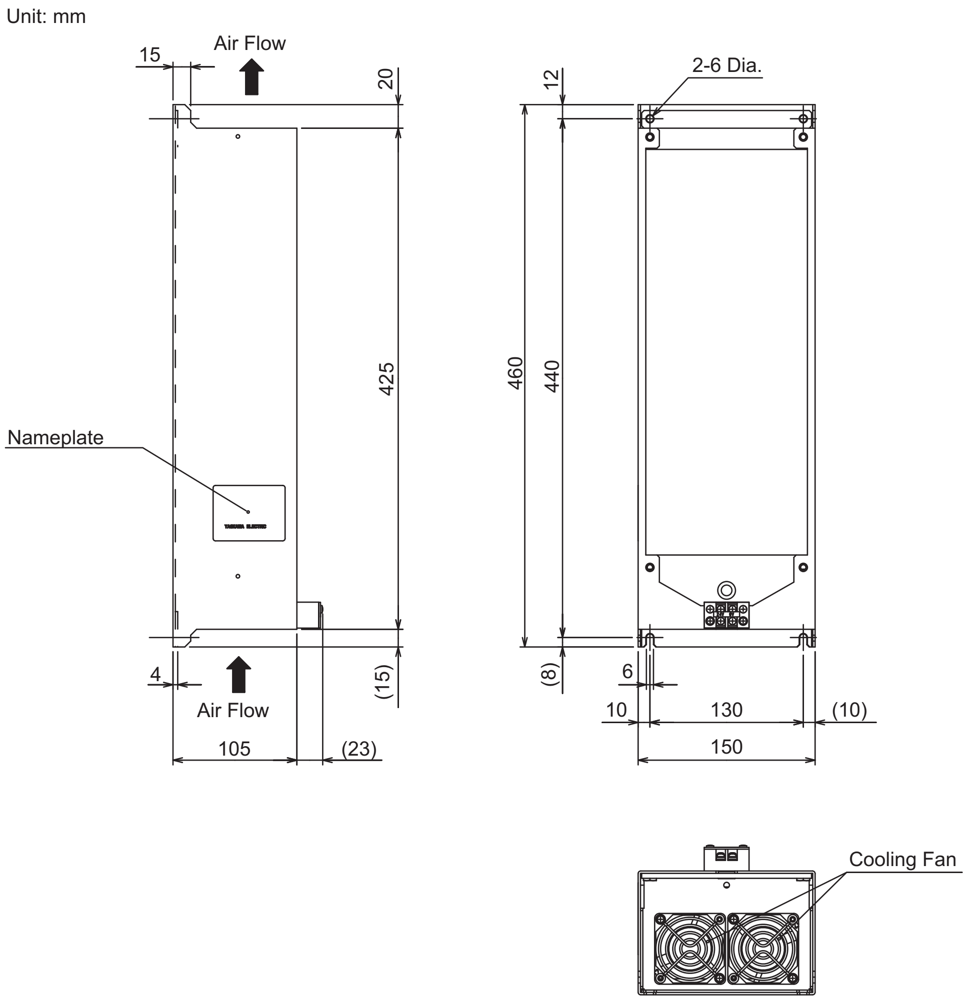
<Mounting Hole Diagram>



<Unit Mounted Diagram>

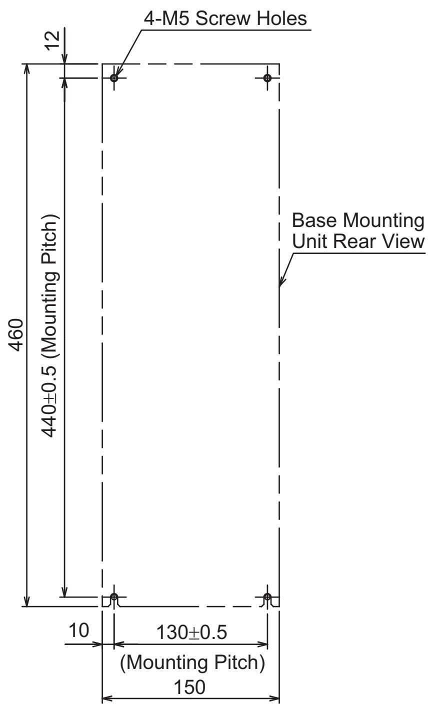


(4) Model: JUSP-JUBM150AA

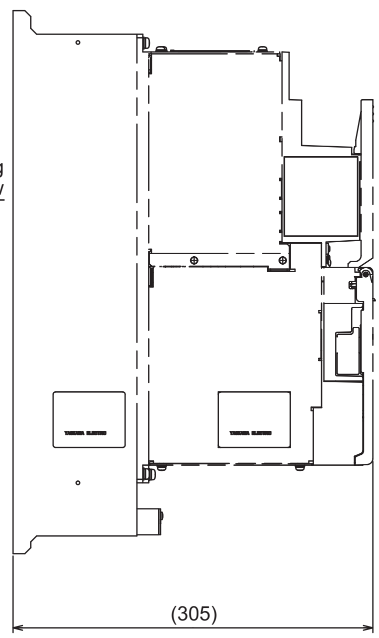


Approx. Mass: 3.5 kg

<Mounting Hole Diagram>

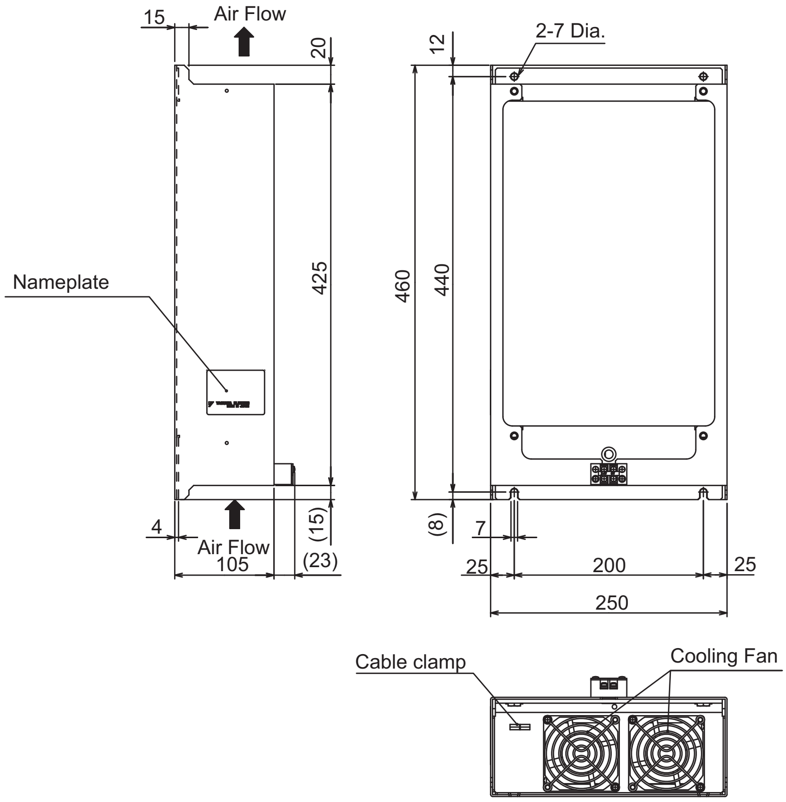


<Unit Mounted Diagram>



(5) Model: JUSP-JUBM250AA

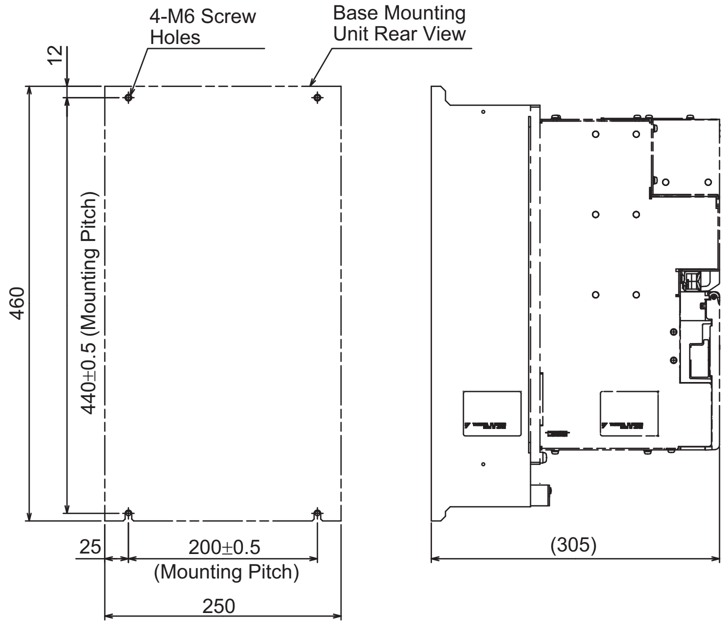
Unit: mm



Approx. Mass: 4.9 kg

<Mounting Hole Diagram>

<Unit Mounted Diagram>

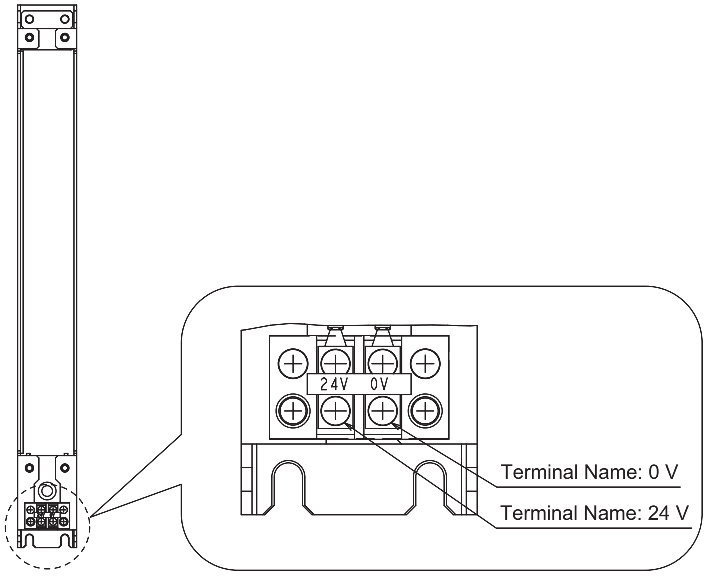


5.4.4 Wiring

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.



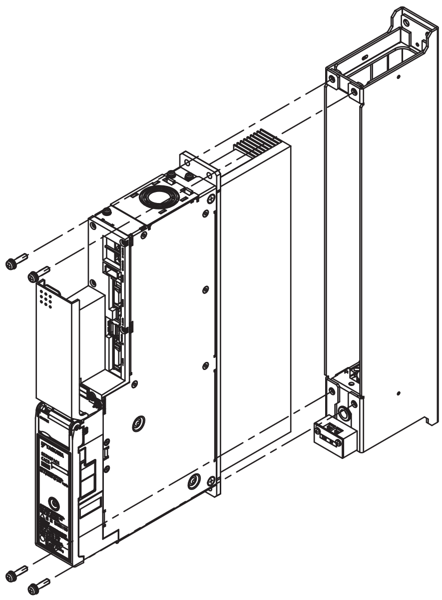
5.4.5 Mounting Method

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 (23.0 to 28.3 lbf·in)
JUSP-JUBM075AA		
JUSP-JUBM100AA		
JUSP-JUBM150AA		
JUSP-JUBM250AA	M6	4.3 to 4.9 N·m (38.1 to 43.4 lbf·in)

6

Installation

6.1 Motors

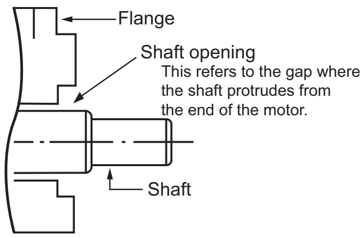
The service life of the motor will be shortened or unexpected problems will occur if the motor is installed incorrectly or in an inappropriate location. Always observe the following installation instructions.

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 • Well-ventilated and free of dust and moisture • Facilitates inspection and cleaning. • Elevation:1,000 m max. • Free of high magnetic field • Free of oil
Storage Environment	Store the motor in the following environment if it is stored with the power cable disconnected. Ambient temperature during storage: -20 to +60°C (no freezing) Ambient humidity during storage: 20% to 80%RH (no condensation)

6.1.2 Enclosure

The protective structure of the servomotor when the special cable is used provides IP67 protection. However, this does not apply to the shaft opening. (Refer to the following figure.) If the servomotor is used where the shaft opening is subject to oil mist, use a servomotor with an oil seal.



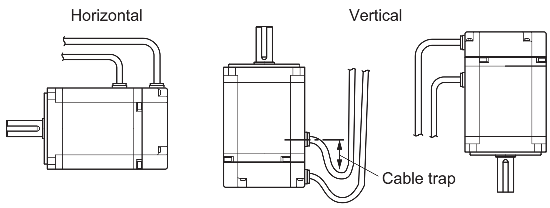
Use a servomotor with an oil seal in a location that meets the following conditions.

■ 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

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.



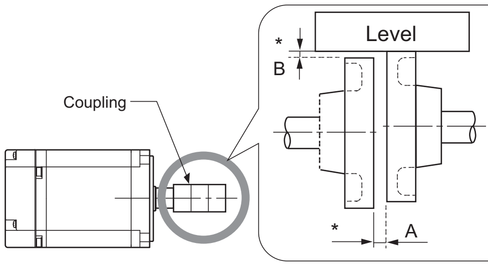
6.1.4 Coupling Motor and Machinery

The motor and machine are coupled directly. Take the following conditions into consideration.

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.

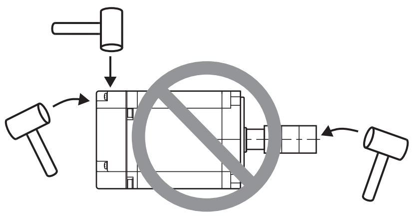


* : Alignment Accuracy

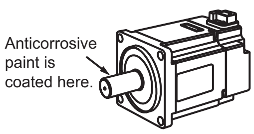
	Spindle Motor		Servomotor
	Standard	High-speed type	
Tolerance A	0.03 mm max.	0.01 mm max.	0.03 mm max.
Surface irregularity B	0.03 mm max.	0.01 mm max.	0.03 mm max.

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.



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
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/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.
• Free of corrosive or flammable gases
• Free of exposure to water, oil, or chemicals
• Free of dust, salts, or iron dust</td></tr>
<tr><td>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-JU15A	116.4	13.1	103.3	10.3	93.0
CACP-JU19A	154.3	13.1	141.2	14.1	127.1
CACP-JU22A	183.8	13.1	170.7	17.1	153.6
CACP-JU30A	247.2	14.7	232.5	23.2	209.3
CACP-JU37A	276.2	14.7	261.5	26.2	235.3
CACP-JU45A	394.7	14.7	380.0	38.0	342.0
CACP-JU15D	66.8	13.1	53.7	5.4	48.4
CACP-JU19D	90.5	13.1	77.4	7.7	69.7
CACP-JU22D	104.8	13.1	91.7	9.1	82.6
CACP-JU45D	203.7	14.7	189.0	18.9	170.1

■ SERVOPACKs

Model	Calorific Value at Continuous Rated Operation				
	Total (W)	Loss of Control Block (W)	Loss of Power Block (W)		
			Total	Inside	Duct
CACR-JU028A2B20	151.1	16.0	135.1	27.0	108.1
CACR-JU036A2B20	178.0	16.0	162.0	32.4	129.6
CACR-JU065A2B20	321.2	15.9	305.3	30.5	274.8
CACR-JU084A2B20	421.6	18.6	403.0	40.3	362.7
CACR-JU102A2B20	475.8	18.6	457.2	45.7	411.5
CACR-JU125A2B20	611.5	25.6	585.9	58.6	527.3
CACR-JU196A2B20	1319.4	26.8	1292.6	129.3	1163.3
CACR-JU014D2B20	139.1	16.6	122.5	24.5	98.0
CACR-JU018D2B20	165.6	16.6	149.0	29.8	119.2
CACR-JU033D2B20	305.4	16.0	289.4	28.9	260.5
CACR-JU042D2B20	365.5	18.6	346.9	34.7	312.2
CACR-JU051D2B20	421.9	18.6	403.3	40.3	363.0
CACR-JU098D2B20	1002.6	25.0	977.6	97.8	879.8

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

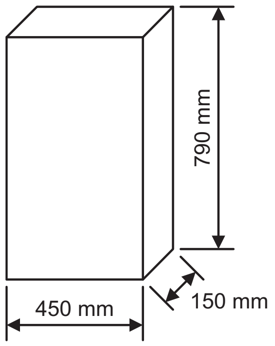
Design the control panel so that the internal air temperature will be no more than 10°C higher than the reference value. If the rise in air temperature in the control panel exceeds 10°C, a cooling system must be installed. For details, refer to *6.2.2 (3) Cooling System Installation*.

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

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

- 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)
- 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 ΔT 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.

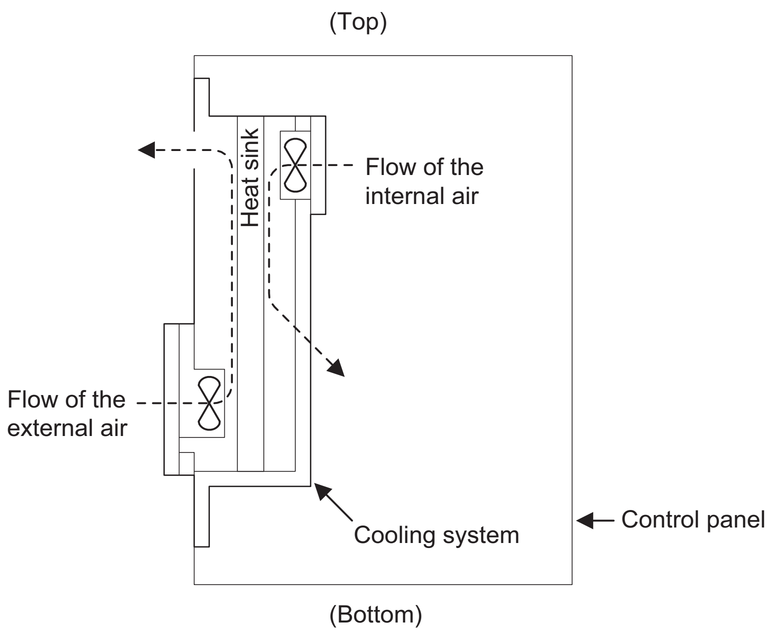
$$\Delta T = \frac{P}{qe} = \frac{P}{k \cdot (A - B) + qh}$$

- 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.



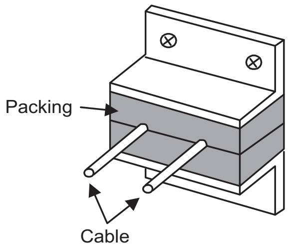
Cooling System Installation

Installation
6

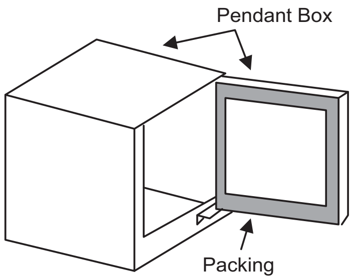
6.2.3 Control Panel Dust-proof Design

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.

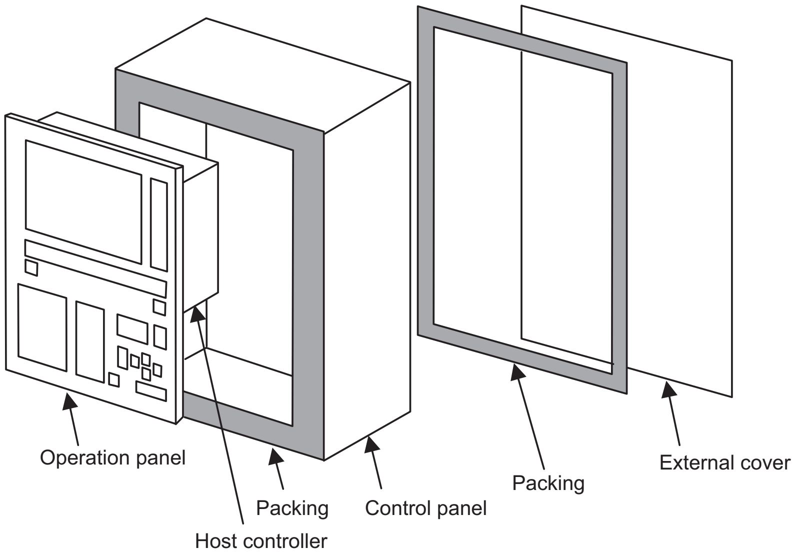
- Always use a sealed structure for the control panel.
- Block cable openings with packing. (Refer to the figure labeled Cable Openings given below.)
- Install packing on the door and external cover to seal them. (Refer to the figure labeled Door Packing given below.)
- Block all gaps.
- Oil may collect 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

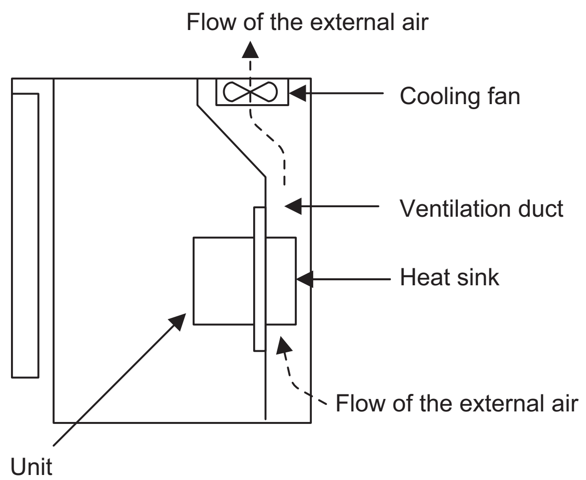
General precautions are given below.

- 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.



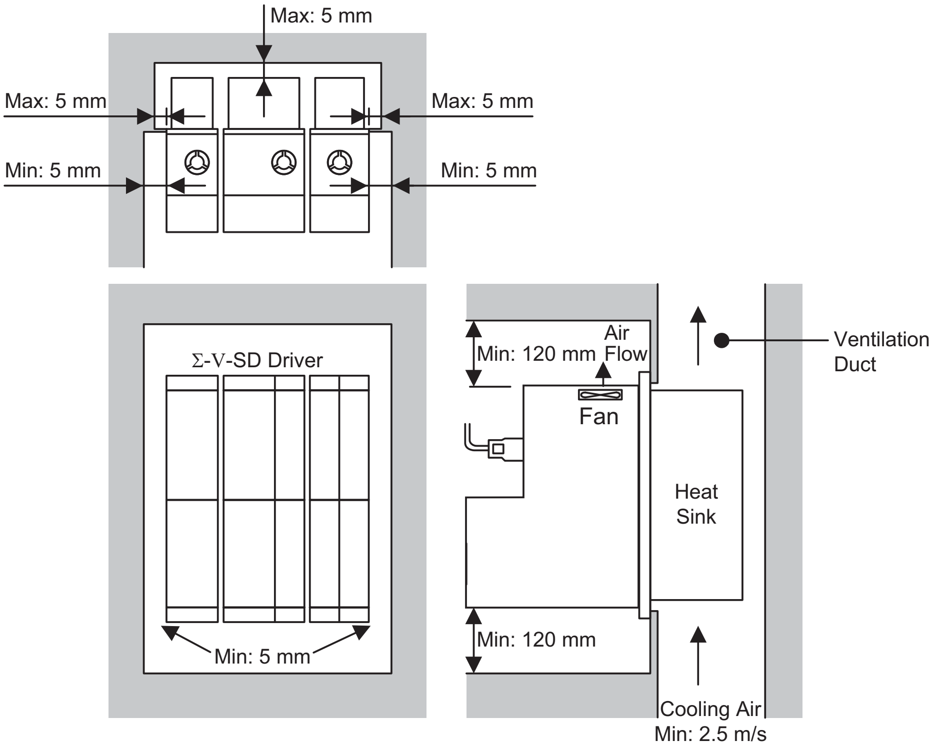
Σ-V-SD Driver Installation

Installation

6

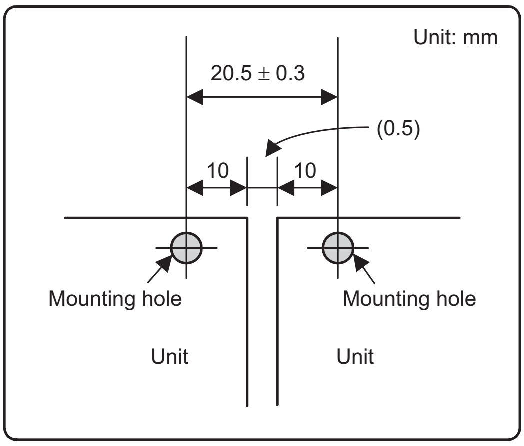
6.2.5 Installation Orientation and Space

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.
- Refer to the external dimension diagrams for external dimensions and mounting dimensions of the products (*4.1.2 External Dimensions* and *4.2.3 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.



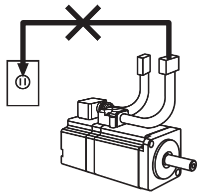
7

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.

7.1.2 Servomotors

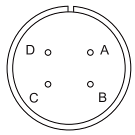
⚠ CAUTION

- 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

■ 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-JU028A, -JU036A, -JU014D, and -JU018D

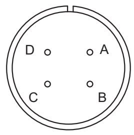
SERVOPACK End (CN8)		Motor End	
Pin No.	Signal Name	Pin No.	Signal Name
1	U	A	U
2	V	B	V
3	W	C	W
4	⏚	D	⏚

• CACR-JU065A, -JU084A, -JU102A, -JU033D, -JU042D, and -JU051D

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

■ Servomotor With Holding Brake

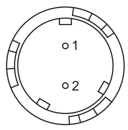
- Cable Specifications for Servomotor-end Connector



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.

Brake terminal
Brake terminal

Note: No polarity for connection to the brake terminals.

- Wiring Specifications
  - CACR-JU028A, -JU036A, -JU014D, and -JU018D

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

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

Note: No polarity for connection to the brake terminals.

- CACR-JU065A, -JU084A, -JU102A, -JU033D, -JU042D, and -JU051D

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

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

Note: No polarity for connection to the brake terminals.

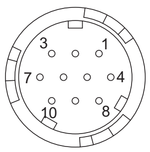
(2) Serial Encoder Wiring (SERVOPACK Connector: CN2)

- 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	Encoder for battery	4	PGBAT–	O	Encoder for battery (–)
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 terminals.

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

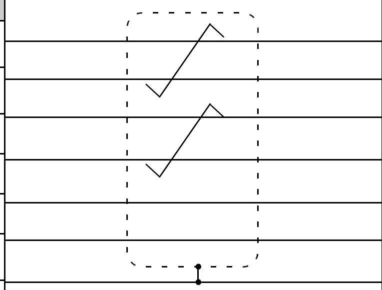


Receptacle: CM10-R10P-D
Applicable plug (To be provided by the customer)
Plug: CM10-AP10S-☐-D (L-shaped)
CM10-SP10S-☐-D (Straight)
(Boxes (☐) indicate a value that varies, depending on cable size.)
Manufacturer: DDK Ltd.

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

- Wiring Specifications

SERVOPACK End (CN2)		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



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	CACR-JU028A	15
	CACR-JU036A	20
	CACR-JU065A	20
	CACR-JU084A	20
	CACR-JU102A	25
	CACR-JU125A	25
	CACR-JU196A	25
Three-phase 400 VAC	CACR-JU014D	10
	CACR-JU018D	15
	CACR-JU033D	15
	CACR-JU042D	15
	CACR-JU051D	15
	CACR-JU098D	20

- 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	15A	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
	19A	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
	22A	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
	30A	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
	37A	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
	45A	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	15D	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
	19D	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
	22D	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
	45D	L1, L2, L3	M10	30	AWG3
		B1, B2	M5	2.0 to 2.4	AWG14
		⏚	M6	2.5 to 3.0	AWG4

■ SERVOPACKs

Input voltage	Model: CACR-JU	Terminal Symbols	Terminal Screw	Tightening Torque [N·m]	Wire Sizes
Three-phase 200 VAC	028A	U, V, W	(connector)	–	AWG10
		motor ⏚	(connector)	–	AWG10
		⏚	M4	1.2 to 1.4	AWG10
	036A	U, V, W	(connector)	–	AWG8
		motor ⏚	(connector)	–	AWG8
		⏚	M4	1.2 to 1.4	AWG8
	065A	U, V, W	M6	2.5 to 3.0	AWG6
		motor ⏚	M6	2.5 to 3.0	AWG6
		⏚	M4	1.2 to 1.4	AWG6
	084A	U, V, W	M6	2.5 to 3.0	AWG4
		motor ⏚	M6	2.5 to 3.0	AWG4
		⏚	M5	2.0 to 2.4	AWG4
	102A	U, V, W	M6	2.5 to 3.0	AWG4
		motor ⏚	M6	2.5 to 3.0	AWG4
		⏚	M5	2.0 to 2.4	AWG4
	125A	U, V, W	M8	2.5 to 3.0	AWG3
		motor ⏚	M8	2.5 to 3.0	AWG3
		⏚	M6	2.5 to 3.0	AWG4
	196A	U, V, W	M10	30	–
		motor ⏚	M10	30	–
		⏚	M6	2.5 to 3.0	–
Three-phase 400 VAC	014D	U, V, W	(connector)	–	AWG14
		motor ⏚	(connector)	–	AWG14
		⏚	M4	1.2 to 1.4	AWG14
	018D	U, V, W	(connector)	–	AWG10
		motor ⏚	(connector)	–	AWG10
		⏚	M4	1.2 to 1.4	AWG10
	033D	U, V, W	M6	2.5 to 3.0	AWG10
		motor ⏚	M6	2.5 to 3.0	AWG10
		⏚	M4	1.2 to 1.4	AWG10
	042D	U, V, W	M6	2.5 to 3.0	AWG8
		motor ⏚	M6	2.5 to 3.0	AWG8
		⏚	M5	2.0 to 2.4	AWG8
	051D	U, V, W	M6	2.5 to 3.0	AWG8
		motor ⏚	M6	2.5 to 3.0	AWG8
		⏚	M5	2.0 to 2.4	AWG8
	098D	U, V, W	M10	30	AWG1
		motor ⏚	M10	30	AWG1
		⏚	M6	2.5 to 3.0	AWG4

(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.

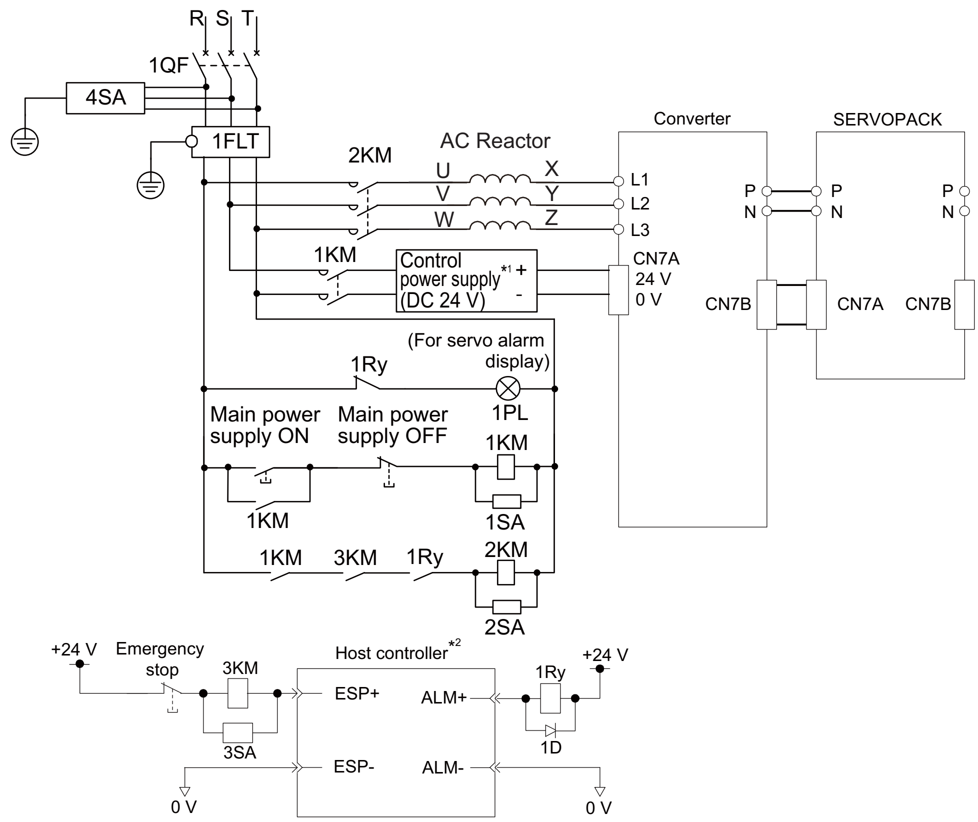
- The main circuit power supply must turn ON only after it has been confirmed that no servo alarm has occurred.
- The main circuit power supply must turn OFF when a servo alarm occurs during operation. The state of the motor must be considered when the main circuit power supply is turned OFF during operation. 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

∗1. Use an SELV-compliant power supply according to EN/IEC 60950-1 to input 24 VDC to the control power supply input terminals.
∗2. A host controller is not provided by Yaskawa.

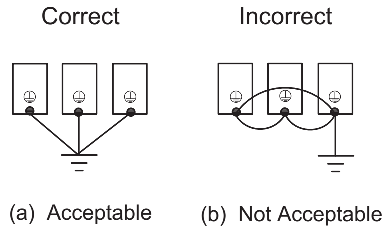
Wiring

7

(10) Grounding

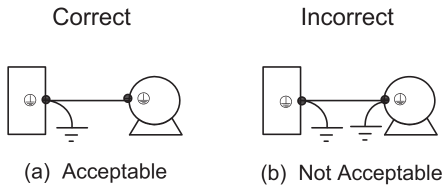
Use the following information to ensure that the ground is sufficient.

- 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-JU15A	1 A
	CACP-JU19A	
	CACP-JU22A	
	CACP-JU30A	
	CACP-JU37A	
	CACP-JU45A	1.5 A
Three-phase, 400 VAC	CACP-JU15D	1 A
	CACP-JU19D	
	CACP-JU22D	
	CACP-JU45D	

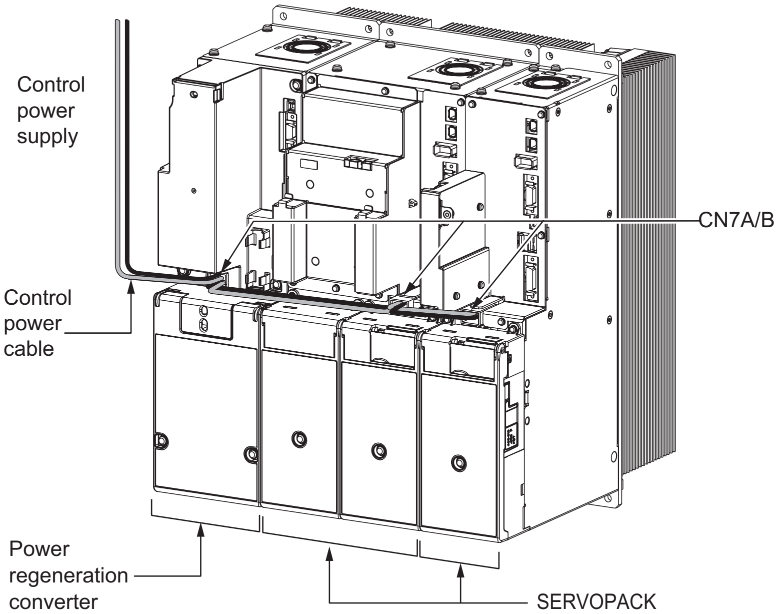
- SERVOPACKs

Input Voltage	Model	Specification
270 VDC	CACR-JU028A	1.2 A
	CACR-JU036A	
	CACR-JU065A	
	CACR-JU084A	1.5 A
	CACR-JU102A	
	CACR-JU125A	
	CACR-JU196A	2 A
540 VDC	CACR-JU014D	1.2 A
	CACR-JU018D	
	CACR-JU033D	
	CACR-JU042D	1.5 A
	CACR-JU051D	
	CACR-JU098D	2.5A

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 *2.1.2 Power Regeneration Converter, SERVOPACK, and Motor* for the maximum number of connected drives.
- Use an SELV-compliant power supply according to EN/IEC 60950-1 to input 24 VDC to the control power supply input terminals.

(2) Connections



Control Power 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

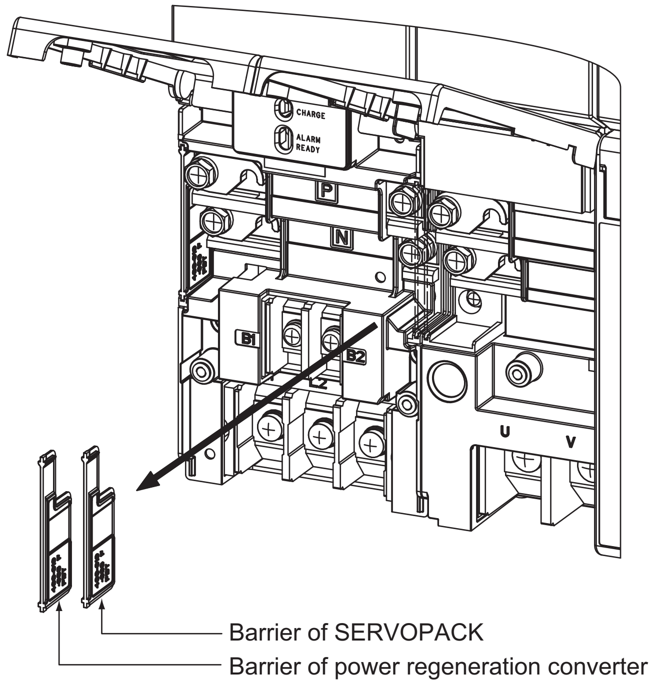
CN7A/B			CN7A/B	
Pin No.	Signal Name		Pin No.	Signal Name
A	24 VDC	—	A	24 VDC
B	0 V	—	B	0 V

7.2.3 DC-bus

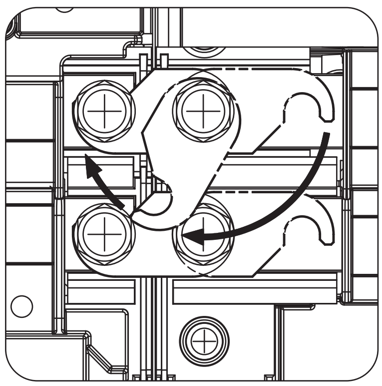
A bus bar built into the Σ-V-SD driver connects the power regeneration converter and a SERVOPACK or two SERVOPACKs.

The bus bar connection procedure is given below.

1. Remove the barriers between the devices to connect.

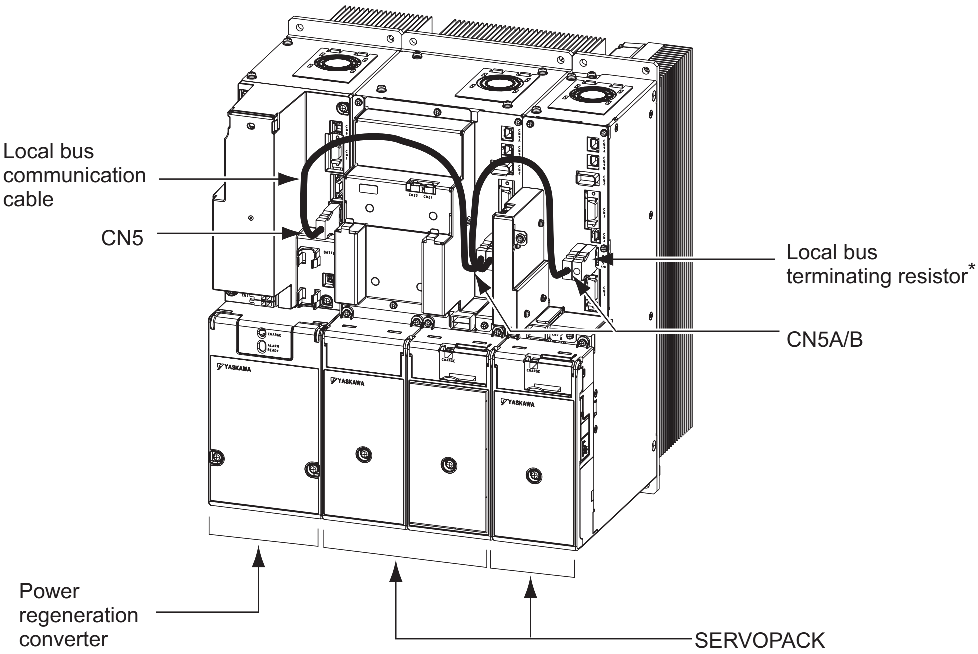


2. Rotate the bus bar of the device on the right 180° clockwise, and then hook it on the terminals of the device on the left.



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.

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

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	/EXT1	I	External latch 1	15	–	O	*2
3	/EXT2	I	External latch 2	16	–	O	*2
4	/EXT3	I	External latch 3	17	–	I	*2
5	/DEC1	I	Deceleration limit input	18	–	I	*2
6	P-OT1	I	Forward overtravel	19	–	I	*2
7	N-OT1	I	Reverse overtravel	20	–	I	*2
8*1	(NC)	–	–	21	–	O	*2
9	/BK1+	O	Brake	22	–	O	*2
10	/BK1–	O	Brake	23	DBA1	I	External dynamic brake answer signal
11*1	(NC)	–	–	24	DBA2	I	External dynamic brake answer signal
12*1	(NC)	–	–	25	DBON	O	External dynamic brake
13*1	(NC)	–	–	26	DB24V	O	External dynamic brake

∗1. Do not use NC signal.
∗2. For details, refer to *7.2.5 (2) Connection Diagrams*.
Note: Connect the shielded wires to the CN1 connector shell.

Wiring

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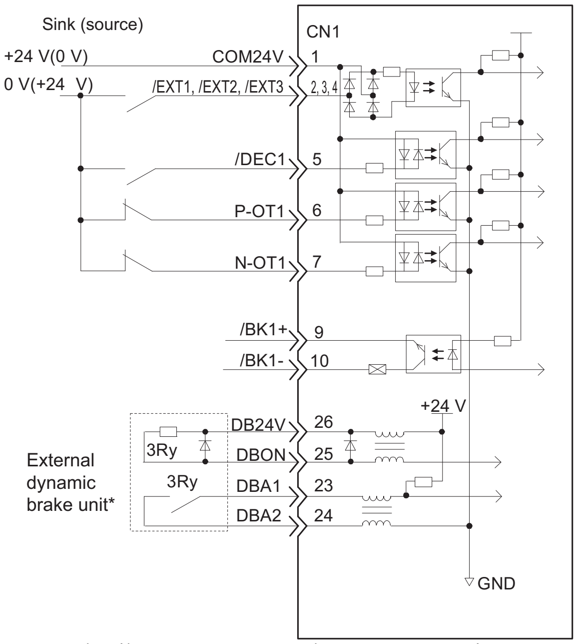
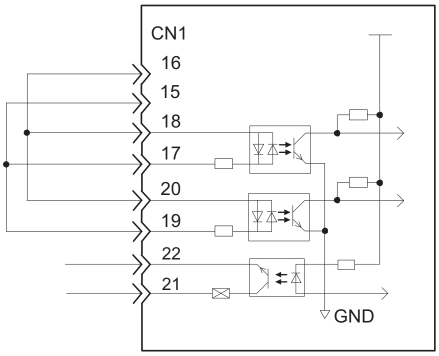
(2) Connection Diagrams

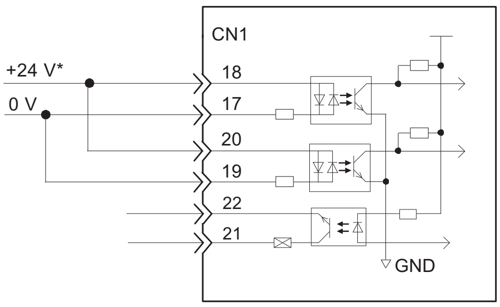


* Not provided by Yaskawa. For details, contact your Yaskawa representative.

Connect pins 15 to 20 as shown below. Do not connect anything to pins 21 and 22.



Use the following connections to supply power from an external source. Do not connect anything to pins 15 and 16.



* External input power
  Voltage: 24 VDC ±5%
  Current required: 6 mA

7.2.6 Safety-function-part

This section gives the names and functions of the I/O signals of the safety function A I/O connector (CN21) and the safety function B I/O connector (CN22). These signals must be wired for the safety-function-part.

(1) Terminal Layout

■ I/O Connector for Safety Function A (CN21)

Pin No.	Signal	Name	Function	Reference Section
1	–	–	–	–
2	–	–	–	–
3	/SRI-A1-	Safety Request Input Signal A1	Input signal for Safety Function A	9.5.2
4	/SRI-A1+			
5	/SRI-A2-	Safety Request Input Signal A2		
6	/SRI-A2+			
7	EDM-A-	External Device Monitor Output Signal A	Output signal indicates that Safety Function A activates without failure.	9.5.3
8	EDM-A+			

■ I/O Connector for Safety Function B (CN22)

Pin No.	Signal	Name	Function	Reference Section
1	–	–	–	–
2	–	–	–	–
3	/SRI-B1-	Safety Request Input Signal B1	Input signal for Safety Function B	9.5.2
4	/SRI-B1+			
5	/SRI-B2-	Safety Request Input Signal B2		
6	/SRI-B2+			
7	EDM-B-	External Device Monitor Output Signal B	Output signal indicates that Safety Function B activates without failure.	9.5.3
8	EDM-B+			

(2) Electrical Specifications and Connections of Input Circuit

This section describes the characteristics of the input signals assigned to the CN21 and CN22 connectors on the safety-function-part.

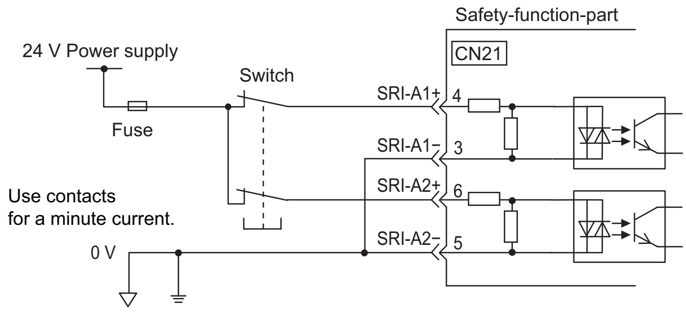
■ Specifications

Name	Signal	Pin No.	Input Status	Meaning
Safety Request Input Signal A	SRI-A1	CN21-4 CN21-3	ON	The SERVOPACK is operating normally.
			OFF	Safety Function A activates.
	SRI-A2	CN21-6 CN21-5	ON	The SERVOPACK is operating normally.
			OFF	Safety Function A activates.
Safety Request Input Signal B	SRI-B1	CN22-4 CN22-3	ON	The SERVOPACK is operating normally.
			OFF	Safety Function B activates.
	SRI-B2	CN22-6 CN22-5	ON	The SERVOPACK is operating normally.
			OFF	Safety Function B activates.

Electrical characteristics of Safety Request Input Signal are as follows.

Items	Characteristics	Remarks
Input Current	5 mA (Typ.)	This is the value per channel.
ON Input Voltage Range	+20 V to +26 V	–
OFF Input Voltage Range	0 V to +2 V	–
Maximum Pulse Width	20 ms	The Safety Request Input Signal will not detect pulses with pulse widths of 0.5 ms or shorter.

■ Connection Example



Note: This is the same for Safety Request Input Signal B.

(3) Electrical Specifications and Connections of Output Circuit

This section describes the characteristics of the output signals assigned to the CN21 and CN22 connectors on the safety-function-part.

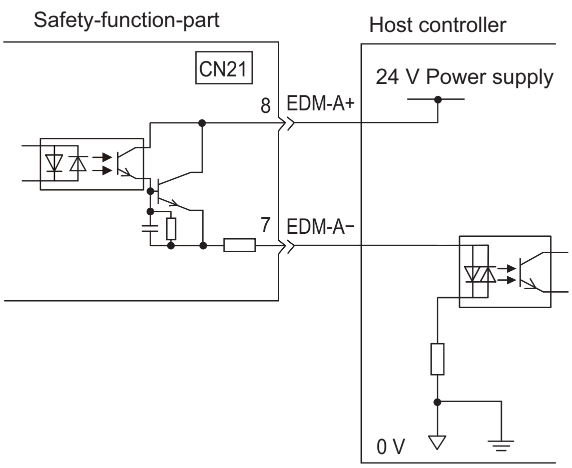
■ Specifications

Name	Signal	Pin No.	Input Status	Meaning
External Device Monitor Output Signal A	EDM-A	CN21-8 CN21-7	ON	Safety Function A activates without failure.
			OFF	The SERVOPACK is operating normally, or Safety Function A is faulty.
External Device Monitor Output Signal B	EDM-B	CN22-8 CN22-7	ON	Safety Function B activates without failure.
			OFF	The SERVOPACK is operating normally, or Safety Function B is faulty.

Electrical characteristics of External Device Monitor Output Signal are as follows.

Items	Characteristics	Remarks
Maximum Allowable Voltage	30 VDC	–
Maximum Current	50 mADC	–
Maximum Voltage Drop at ON	1.5 V	• Voltage between EDM-A+ to EDM-A– at current 50 mA. • Voltage between EDM-B+ to EDM-B– at current 50 mA.
Operating Current at ON	5 mA to 50 mA	–

■ Connection Example



Note: This is the same for External Device Monitor Output Signal B.

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Operation

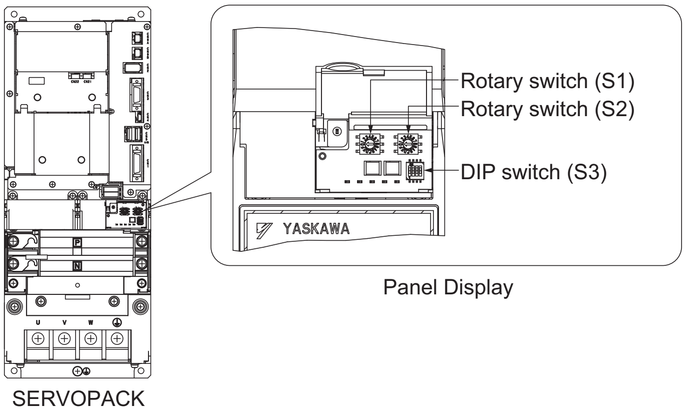
8.1 MECHATROLINK-III Communications Settings

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

8.1.1 Setting Switches S1, S2 and S3

The station address is set using the rotary switches S1 and S2.

The S3 DIP switch is used to make the settings for MECHATROLINK-III communications.



(1) Setting Switches S1 and S2

The station address is set using the rotary switches S1 and S2.

Station Address	S1	S2
00H to 02H: Not valid (Do not set.)	0	0 to 2
03H (Factory setting)	0	3
04H	0	4
. . .		
EFH	E	F
F0H to FFH: Not valid (Do not set.)	F	0 to F

(2) Setting DIP Switch S3

The following table shows the settings of the DIP switch S3.

Switch No.	Function	Setting			Factory Setting
1, 2	Sets the number of transmission bytes.	1	2	Set value	1: OFF 2: ON
		OFF	OFF	Reserved. (Do not use.)	
		ON	OFF	32 bytes	
		OFF	ON	48 bytes	
		ON	ON	Reserved. (Do not use.)	
3	Reserved. (Do not change.)				OFF
4	Reserved. (Do not change.)				OFF

IMPORTANT

- When using the MECHATROLINK-III standard servo profile commands, set the number of transmission bytes to 32 or 48.
- Turn the power OFF and then ON again to validate the new settings.
- S2 rotary switch is also used to set the address for the local bus that connects the converter and the SERVOPACK. When several SERVOPACKs are connected to a converter, use the S2 rotary switch to set different addresses to each of the SERVOPACKs. Examples of address settings for three SERVOPACKs.
  Good (2nd digits different): 48H, 49H, 4AH
  Bad (2nd digits same): 48H, 58H, 5AH

8.1.2 MECHATROLINK-III Commands

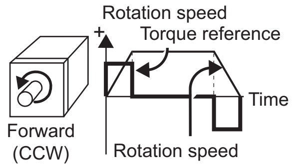
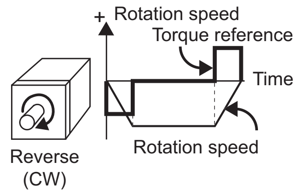
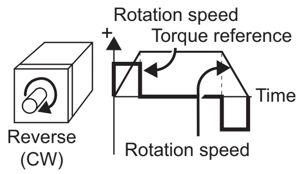
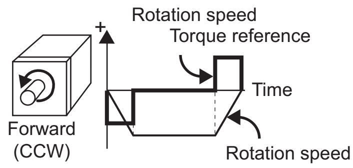
Refer to the *Σ-V-SD Series User's Manual MECHATROLINK-III Standard Servo Profile Commands* (Manual No.: SIEP S800000 76) for information on the MECHATROLINK-III commands.

Operation
8

8.2 Basic Functions Settings

8.2.1 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		Forward/Reverse Reference	Direction of Motor Rotation	Applicable Overtravel (OT)
Pn000	n.□□□0 The encoder counts up by a forward reference. [Factory setting]	Forward Reference		P-OT
		Reverse Reference		N-OT
	n.□□□1 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.

8.2.2 Overtravel

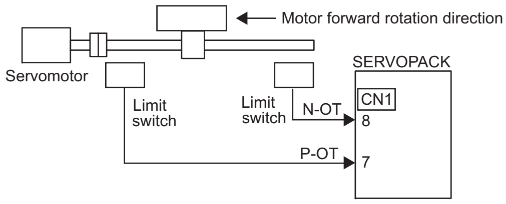
If movable machine parts overtravel and exceed the allowable range of motion, the overtravel limit function forces the parts to stop by activating the limit switch.

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

(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.
- 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 *14.2.2 List of Parameters*.

Parameter		Stop Method	Mode After Stopping	When Enabled	Classification
Pn001	n.□□00	DB	Coast	After restart	Setup
	n.□□01				
	n.□□02	Coast			
	n.□□1□	Deceleration to a stop	Zero clamp		
	n.□□2□		Coast		

- 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 *8.2.4 Stopping Servomotor after SV_OFF Command or Alarm Occurrence*.

■ When Servomotor Stopping Method is Set to Decelerate to Stop

Emergency stop torque can be set with Pn406.

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

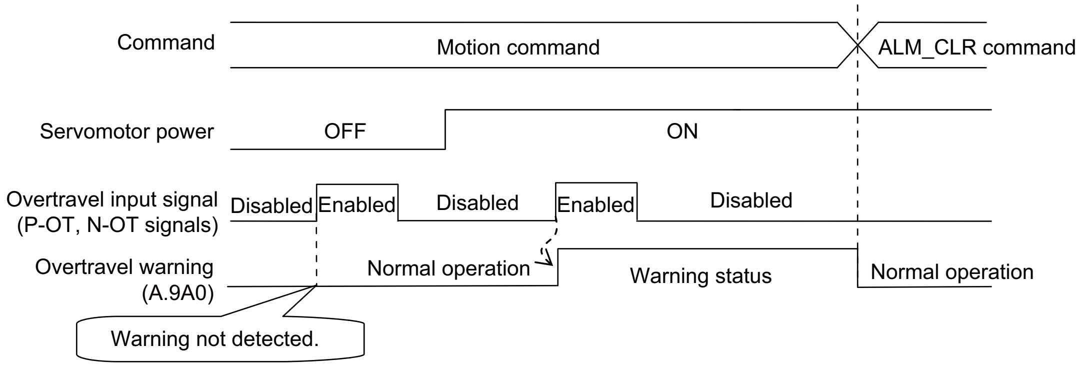
- The setting unit is a percentage of the rated torque.
- The factory setting is 800% so that the setting is large enough a value to operate the servomotor at maximum torque. The maximum value of emergency stop torque that is actually available, however, is limited to the maximum torque of the servomotor.

(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.
- To clear the overtravel warning, send an ALM_CLR command regardless of the status of the servomotor power and the overtravel signal. If the warning is cleared by this method during an overtravel state, the occurrence of the warning will not be indicated until the overtraveling is corrected and reset.
- 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.

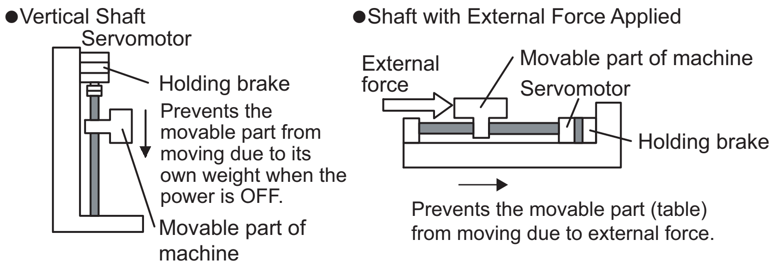
■ Related Parameter

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

8.2.3 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.

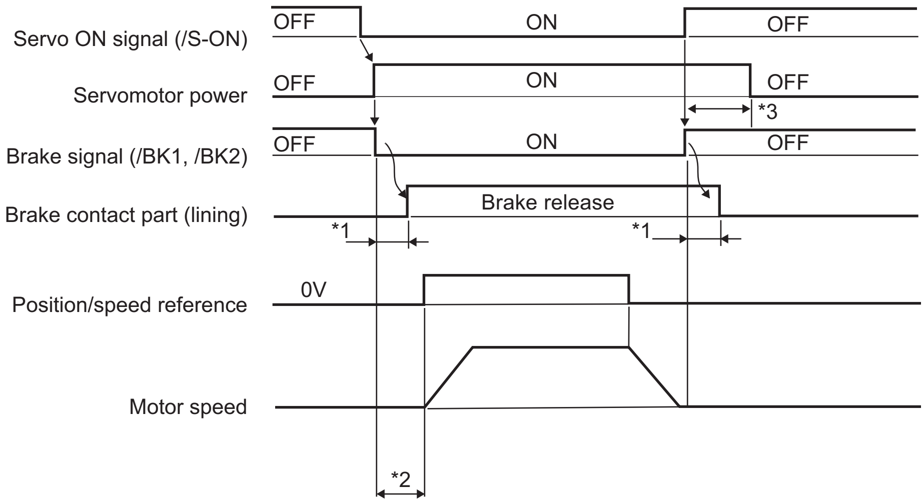
The holding brake is used in the following cases.



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

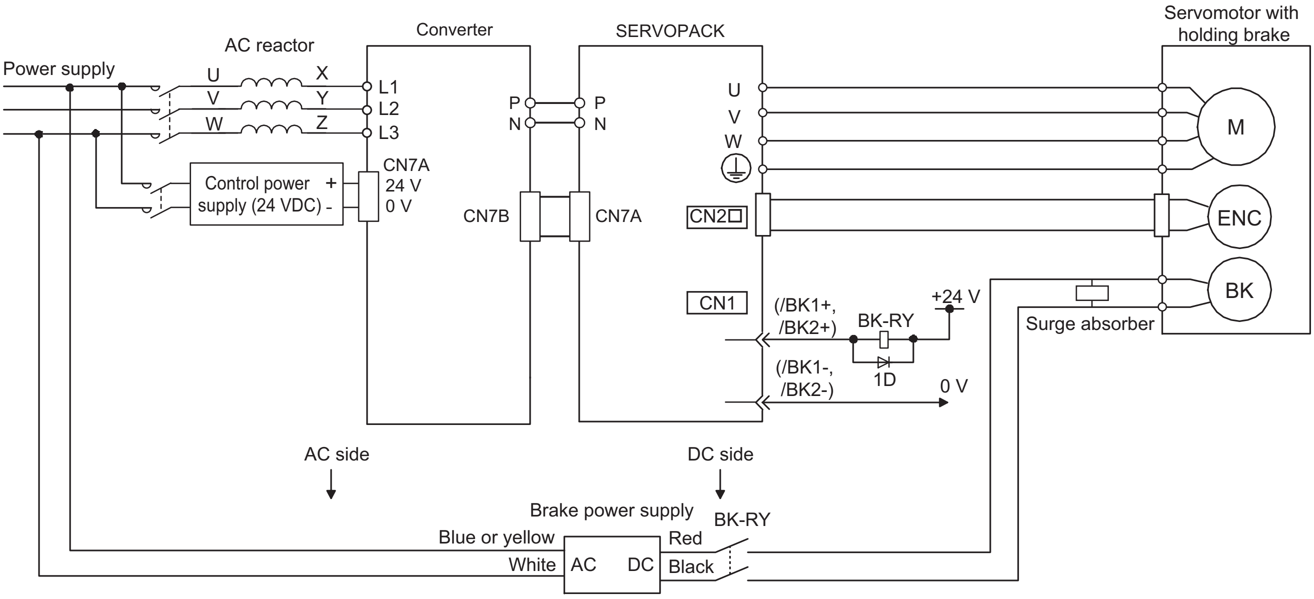
Model	Voltage	Brake Release Time (ms)	Brake Applied Time (ms)
SGMGV-09 to 20	24 VDC, 90 VDC	100	80
SGMGV-30, -44		170	100 (24 VDC), 80 (90 VDC)
SGMGV-55, -75		170	80

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

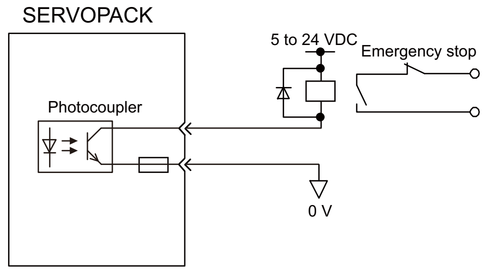
Input voltage 100-V models: LPDE-1H01-E

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

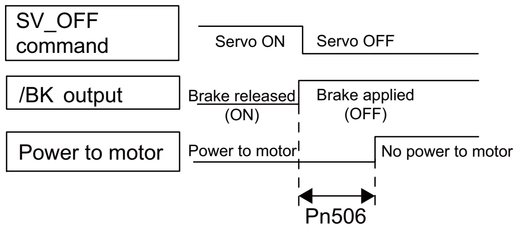
The /BK signals remain ON during overtravel. The brake is released.

(3) Brake ON Timing after the Servomotor Stops

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

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

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



IMPORTANT

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

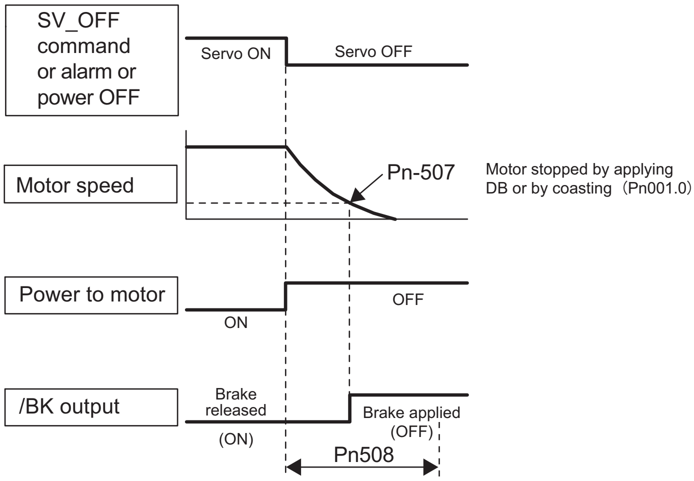
Note: If the servomotor is set so that it comes to a zero-speed stop for an alarm, follow the information in *(3) Brake ON Timing after the Servomotor Stops* after the servomotor comes to a stop for a zero position reference.

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

/BK Signal Output Conditions When Servomotor Rotating

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

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



IMPORTANT

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

8.2.4 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 *13.2.1 List of Alarms*.
  - Turning OFF the control power supply without turning OFF the servo: Refer to the following table.

SERVOPACK Model: CACR-	Condition	Stopping Method
JU036A, JU018D	–	Coast
JU028A, JU014D	–	DB
JU065A, JU084A, JU102A, JU125A, JU196A, JU033D, JU042D, JU051D, JU098D	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.

(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 *14.2.2 List of Parameters*.

Parameter		Stop Mode	Mode After Stopping	When Enabled	Classification
Pn001	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 *13.2.1 List of 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		Stop Mode	Mode After Stopping	When Enabled	Classification
Pn001	n.□□□0	DB	DB	After restart	Setup
	n.□□□1		Coast		
	n.□□□2	Coast	Coast		

■ Stopping Method for Servomotor for Gr.2 Alarms

Parameter		Stop Mode	Mode After Stopping	When Enabled	Classification
Pn00B	Pn001				
n.□□0□ [Factory setting]	n.□□□0	Zero-speed stopping*	DB	After restart	Setup
	n.□□□1		Coast		
	n.□□□2				
n.□□1□	n.□□□0	DB	DB		
	n.□□□1		Coast		
	n.□□□2	Coast			

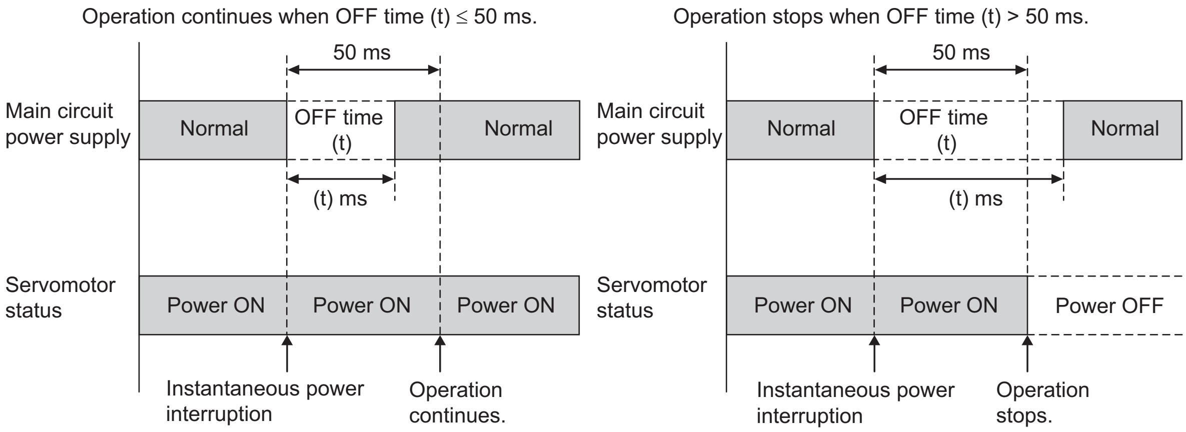
* Zero-speed stopping: The speed reference is set to 0 to stop quickly.

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

8.2.5 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 MECHATROLINK-III 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.

Operation

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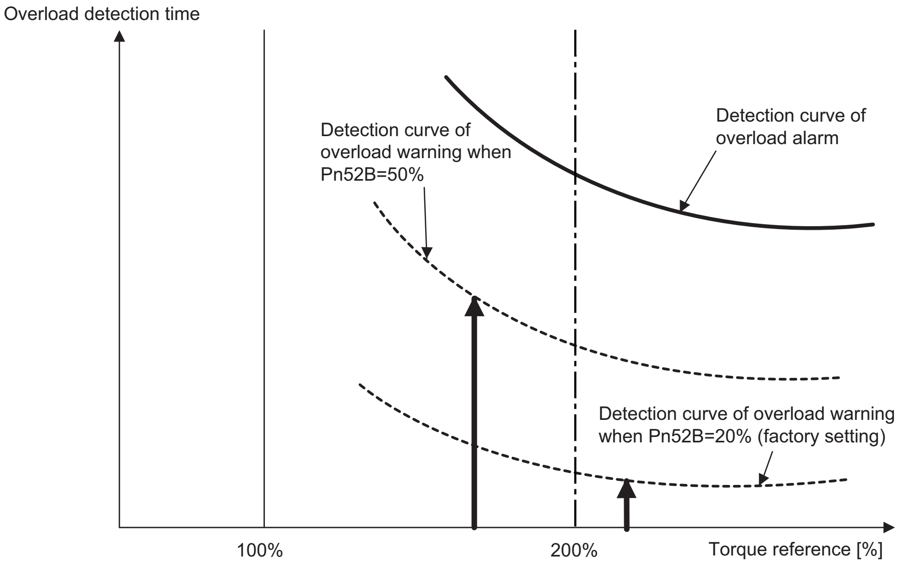
8.2.6 Setting Motor Overload Detection Level

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

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

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



Pn52B	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)

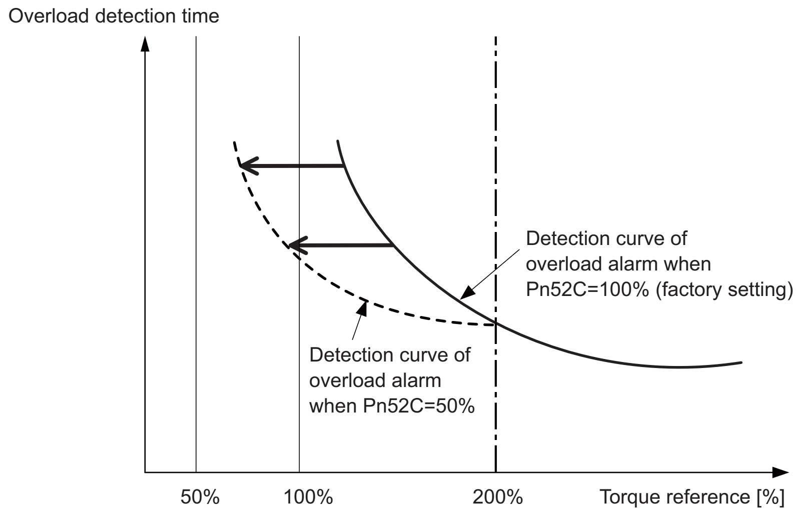
An overload (low load) alarm (A.720) can be detected earlier to protect the servomotor from overloading. The time required to detect an overload alarm can be shortened by using the derated motor base current obtained with the following equation. The detection level of the overload (high load) alarm (A.710) 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	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

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8.3 Trial Operation

This section describes a trial operation using MECHATROLINK-III communications.

8.3.1 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 *13.1 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?

8.3.2 Trial Operation via MECHATROLINK-III

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

Step	Description	Reference
1	Confirm that the wiring is correct, and then connect the I/O signal connector (CN1 connector).	*Chapter 7 Wiring*
2	Turn ON the power supply to the Σ-V-SD driver. When the control power is supplied, the SERVOPACK RDY indicator will light. When the main circuit power is supplied normally, the SERVOPACK charge indicator (CHARGE) will light. When a communication is established, the LINK1 or LINK2 indicator for the connector to which the MECHATROLINK-III cable is connected (CN9A or CN9B) will light. Note: If the LINK1 or LINK2 indicator does not light, check the settings of the MECHATROLINK-III setting switches and turn the power supply OFF and then ON again.	–
3	Send the CONNECT command from the host controller. If the Σ-V-SD driver receives the CONNECT command normally, the CN indicator will light. Note: If the CN indicator does not light, the values set for the CONNECT command are wrong. Resend a CONNECT command with the correct settings.	*Σ-V-SD Series User's Manual MECHATROLINK-III Standard Servo Profile Commands* (Manual No.: SIEP S800000 76)
4	Check the product model number using the ID_RD command. The product model number will be returned from the Σ-V-SD driver.	–
5	Set the following items to the necessary settings for a trial operation. • Rotational direction of servomotor • Overtravel	*8.2.1 Servomotor Rotation Direction* *8.2.2 Overtravel*
6	Save these settings (step 5). If saving the settings in the host controller, use the SVPRM_WR command. If saving settings in the SERVOPACK, use the SVPRM_WR command.	*Σ-V-SD Series User's Manual MECHATROLINK-III Standard Servo Profile Commands* (Manual No.: SIEP S800000 76)
7	Send the CONFIG command to enable the settings.	–
8	Send the SENS_ON command to get the position information to prepare the encoder.	–
9	Send the SV_ON command. A reply showing that the servomotor has switched to Drive status and that SVON=1 (servomotor power is ON) is received.	–
10	Run the servomotor at low speed. <Example using a positioning command> Command used: POSING Command setting: Positioning position =10000 (If using the absolute encoder, add 10000 to the present position), rapid traverse speed =400	–
11	Check the following points while running the servomotor at low speed (step 10). • Confirm that the rotational direction of the servomotor correctly coincides with the forward rotation or reverse rotation reference. If they do not coincide, reset the direction. • Confirm that no unusual vibrations, noises, or temperature rises occur. If any abnormalities are seen, correct the conditions. Note: Because the running-in of the load machine is not sufficient at the time of the trial operation, the servomotor may become overloaded.	*8.2.1 Servomotor Rotation Direction* *13.4 Troubleshooting Malfunction Based on Operation and Conditions of the Motor*

8.4 Limiting Torque

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

Limiting Method	Description	Reference
Internal torque limit	Always limits torque by setting the parameter.	8.4 ■ *Internal Torque Limit*
Torque limit with TLIM data of commands *	Limit torque by using the TLIM command.	–
Torque limit with P_CL/N_CL in SVCMD_IO of commands *	Limit torque by using P_CL/N_CL in servo command output signal (SVCMD_IO) of commands.	–

* For details, refer to the *Σ-V-SD Series User's Manual MECHATROLINK-III Standard Servo Profile Commands* (Manual No.: SIEP S800000 76).

■ Internal Torque Limit

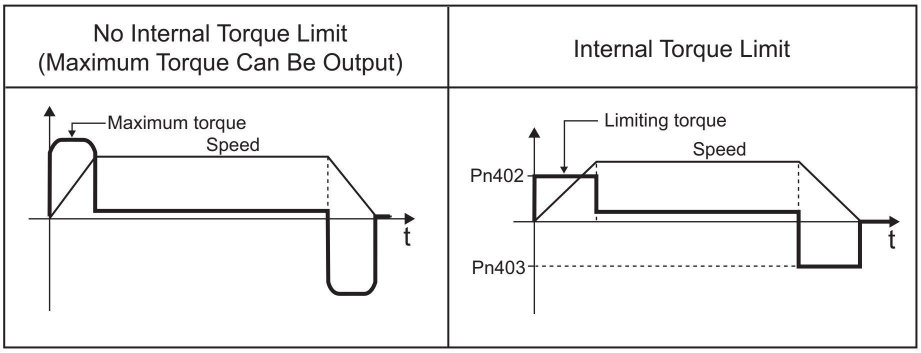
This function always limits maximum output torque by setting values of following parameters.

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



8.5 Absolute Encoders

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

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

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

8.5.2 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*.

8.5.3 Battery Replacement

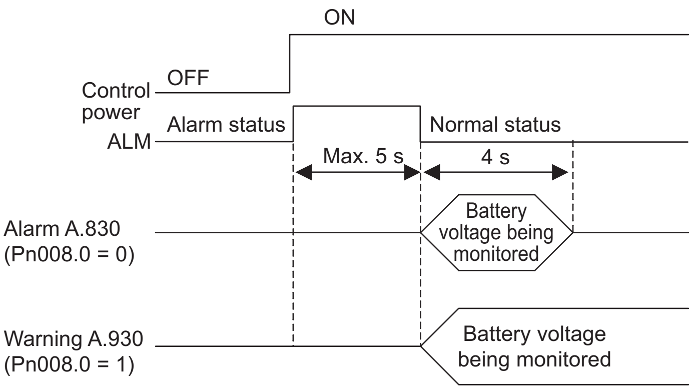
If the battery voltage drops to approximately 2.7 V or less, an absolute encoder battery error alarm (A.830) or an absolute encoder battery error warning (A.930) will be displayed.

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).

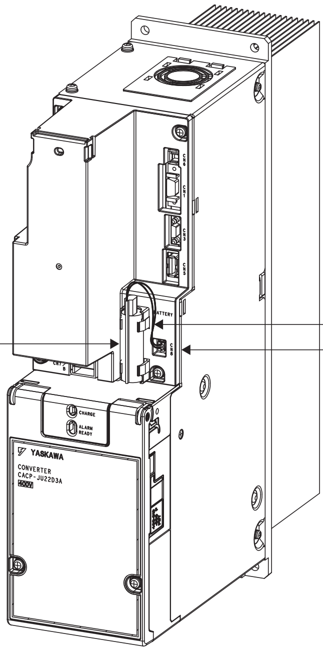
Parameter		Meaning	When Enabled	Classification
Pn008	n.□□□0 [Factory setting]	Outputs the alarm A.830 when the battery voltage drops.	After restart	Setup
	n.□□□1	Outputs the warning A.930 when the battery voltage drops.		

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



■ 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 (BA000518).
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.

8.5.4 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). If the host controller has a setting window, use it.

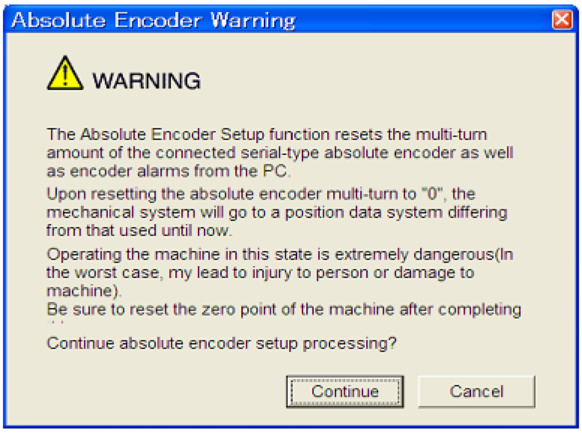
■ Procedure for Setup

Follow the steps below to setup the absolute encoder.

Setup (Initialization) can be performed using MEM_WR command. Refer to the *Σ-V-SD Series User's Manual MECHATROLINK-III Standard Servo Profile Commands* (Manual No.: SIEP S800000 76) for information on the MEM_WR command.

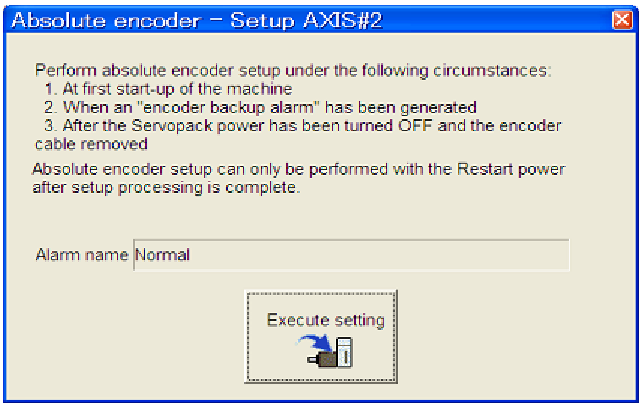
1. Make sure that the motor power is OFF.

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.



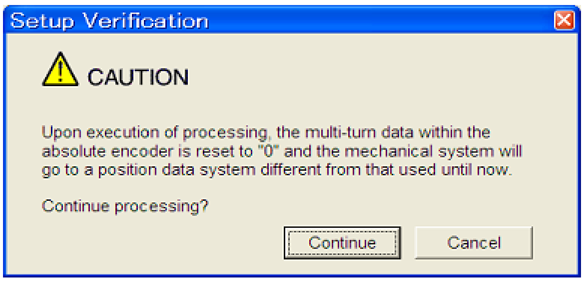
Click **Cancel** to return to the main window without resetting the absolute encoder.

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.

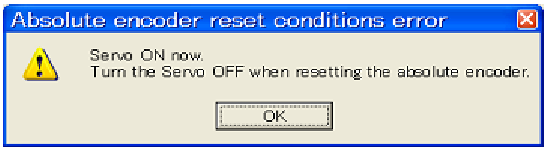


Click **Cancel** to return to the previous window without resetting the absolute encoder.

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

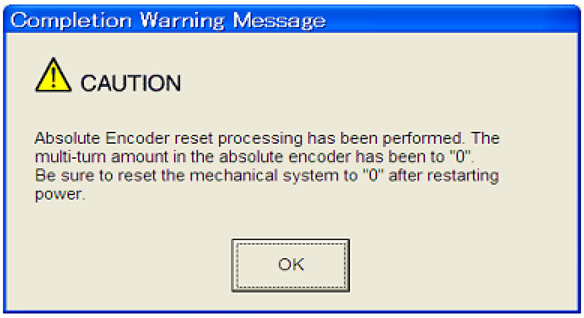
< If Setup is Unsuccessful >

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 >

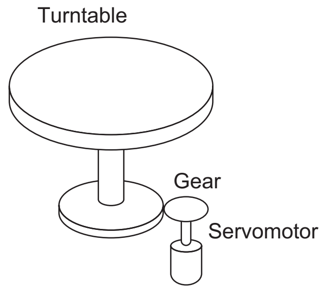


If the encoder is set up successfully, a warning message will appear reminding you that the coordinate system has changed and must also be reset.

6. Click **OK** to return to the main window.
7. Restart the servo, and perform an origin search.

8.5.5 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.

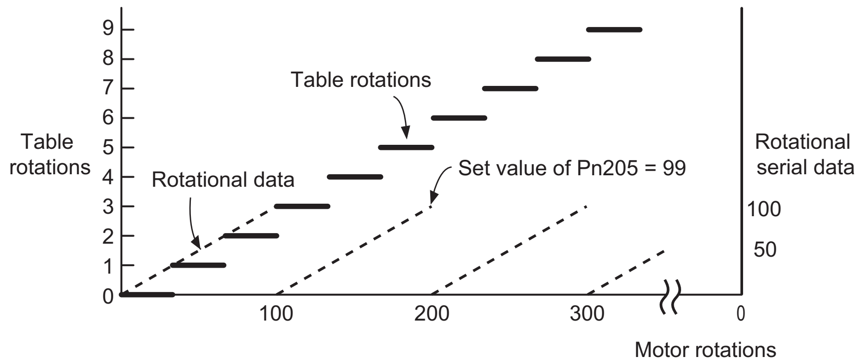
For a machine with a gear ratio of n:m, as shown above, the value of m minus 1 will be the setting for the multiturn limit setting (Pn205).

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

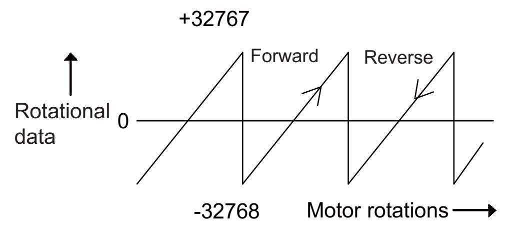
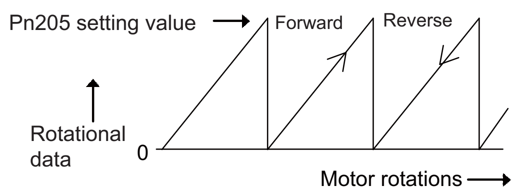


Pn205	Multiturn Limit Setting Speed Position				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 65535	1 Rev	65535	After restart	Setup

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

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)
	

8.5.6 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.

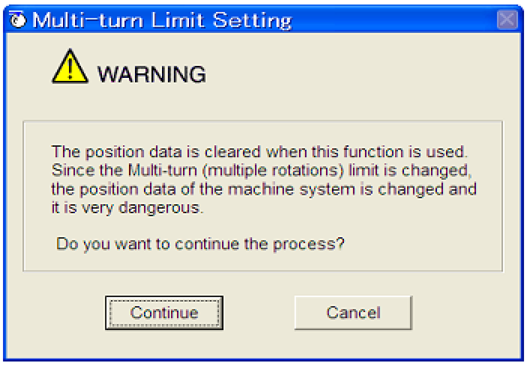
Alarm Display	Alarm Name	Alarm Output	Meaning
A.CC0	Multiturn Limit Disagreement	OFF (H)	Different multiturn limits have been set in the encoder and SERVOPACK.

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.

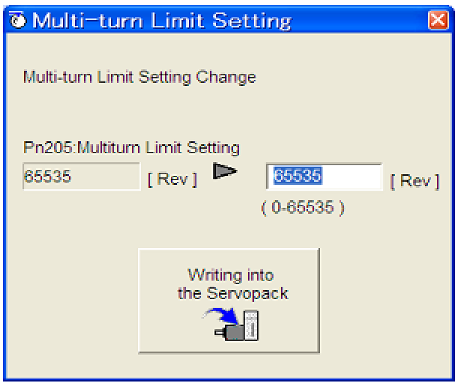
This setting can be performed with MEM_WR command.
Refer to the *Σ-V-SD Series User's Manual MECHATROLINK-III Standard Servo Profile Commands* (Manual No.: SIEP S800000 76) for information on the MEM_WR command.

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.

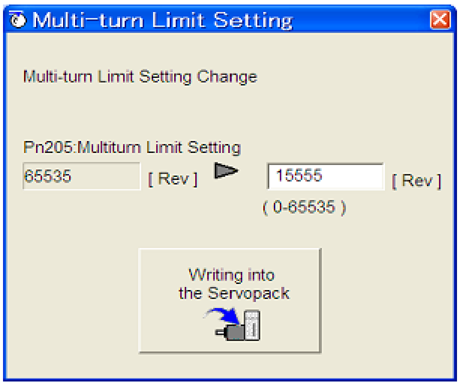


Click **Cancel** to return to the main window without setting the multiturn limit.

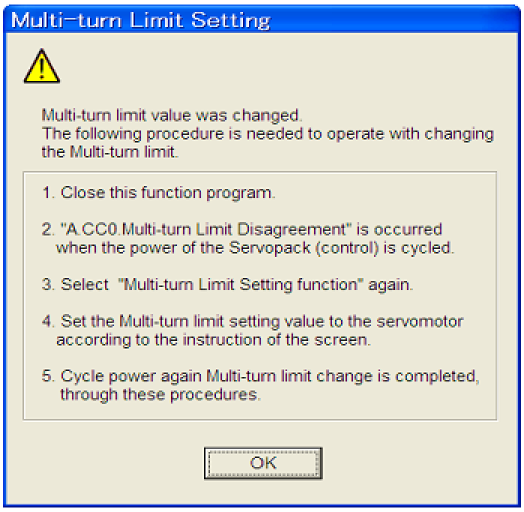
2. Click **Continue**, and the Multi-Turn Limit Setting box appears.



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



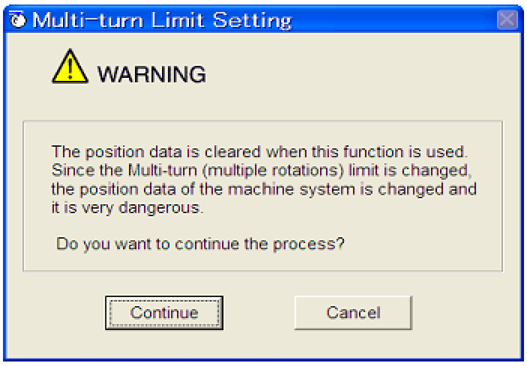
4. To save the settings, click **Writing into the Servopack**, and a warning message appears.



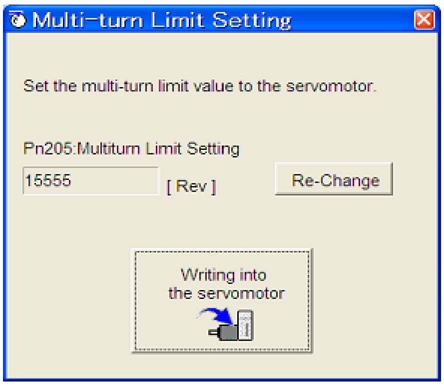
5. Click **OK** and the settings are changed to the new ones.

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 an alarm occurs.

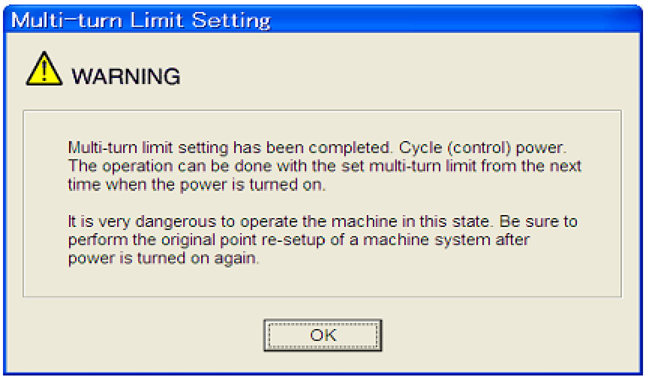
7. Return to the SigmaWin for Σ-V-SD (MT) component main window. To make the settings for the motor, click **Setup** and then click **Multi-Turn Limit Setting** again. A verification message appears confirming if you want to continue although the position data will change.



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**.

8.5.7 Absolute Encoder Origin Offset

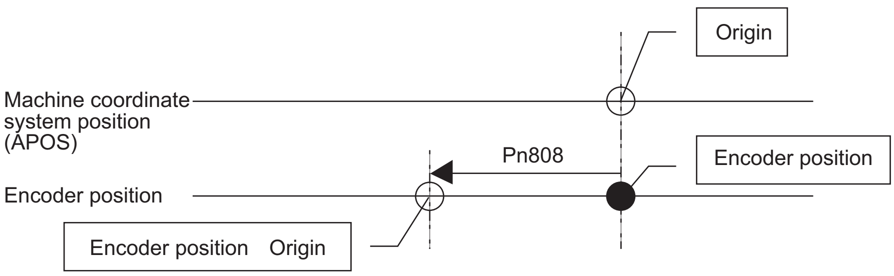
If using the absolute encoder, the positions of the encoder and the offset of the machine coordinate system (APOS) can be set. Use Pn808 to make the setting.

Pn808	Absolute Encoder Origin Offset		Position		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	-1073741823 to 1073741823	1 reference unit	0	Immediately*	Setup

* Available after the SENS_ON command is input.

<Example>

If the encoder position (X) is set at the origin of the machine coordinate system (0), Pn808 = X.



9

Safety Functions

This chapter provides information on using the safety functions of the safety-function-part.

9.1 Safety Precautions for Using the Safety Functions

Carefully read the following important precautions and observe them when using the safety functions.

⚠ WARNING

- Installation, disassembly, or repair must be performed only by authorized personnel.
  Failure to observe this precaution may result in electric shock or injury.
- Engineers designing a mechanical system using the safety functions of the safety-function-part must have complete knowledge of the relative safety standards and a full understanding of the safety functions of the safety-function-part.
  Improper use may result in injury or damage to the product.
- When creating a safety design for a mechanical system using the safety functions of the safety-function-part, always perform risk assessment of the system to identify residual risks.
  Improper use may result in injury or damage to the product.
- The dynamic brake is not a safety-related part of a control system. Create the safety design of the mechanical system in such a way that any trouble in the dynamic brake function does not pose a threat when the safety functions of the safety-function-part operate.
  Improper use may result in injury or damage to the product.
- Connect device conforming to the relative safety standards to the connector for Safety Request Input Signals.
  Improper use may result in injury or damage to the product.
- The safety functions of the safety-function-part are not for emergency stopping. To use the safety functions for emergency stopping, separately shut OFF the power supply from the electromechanical section to the motor.
  Improper use may result in injury or damage to the product.
- The safety functions of the safety-function-part are not for shutting off the power supply to the SERVOPACK and do not provide electrical isolation. Be sure to separately shut OFF the power supply to the SERVOPACK when performing maintenance or inspection of the SERVOPACK.
  Failure to observe this warning may result in electric shock.
- Be sure to check the safety-related parameters and safety-related servo parameters before using the safety functions of the safety-function-part.
  Improper use may result in injury or damage to the product.
- If the SERVOPACK is changed when starting the servo system or during maintenance or inspection, be sure to check the operation of the safety functions in the actual application after performing wiring.
  Improper use may result in injury or damage to the product.
- Make sure that CN1 pins 15 to 20 are connected correctly.
  Refer to *7.2.5 (2) Connection Diagrams* for details on the connections. If CN1 pins 15 to 20 are not connected correctly, the safety functions may not operate properly, which may result in injury or equipment damage.

Safety Functions

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9.2 Risk Assessment

When using the safety functions, be sure to perform risk assessment of the servo system in advance. Make sure that the safety level of the standards is met. For details on standards, refer to *Chapter 12 Standards Compliance*.

The following residual risks can be present even when the safety functions operate. Therefore, safety must always be given consideration during risk assessment.

- If external forces (such as gravitational force with a vertical axis) are applied when the safety functions of the safety-function-part are operating, the motor will operate due to the action of these external forces. Provide a separate mechanical brake to secure the motor.
- If the SERVOPACK fails, the motor may operate within a range of 180 electrical degrees. Make sure that safety is ensured even in hazardous situations.
  The number of motor rotations is given below.
  Rotary servomotor: 1/6 rotation max. (rotational angle calculated at the motor shaft)

9.3 Basic Settings Required before Starting Operation

The setting procedures for the basic settings that are required before operation to use the safety functions of the safety-function-part are listed in the following table.

Step	Item	Description or Reference
1	Disabling the external encoder	Confirm that the parameters are set to disable using an external encoder (i.e., Pn002 should be set to n.0□□□ and Pc5A should be set to n.□□□0 [factory settings].)
2	Setting motor information (motor direction)	*8.2.1 Servomotor Rotation Direction*
3	Setting encoder information (number of encoder output pulses)	*9.5.5 Setting Encoder Output Pulse*
4	Safety-related Parameters Settings	*14.4 Safety-related Parameters*
5	Safety-related Servo Parameter Updating	*14.5 Safety-related Servo Parameters*

Note: Perform steps 4 and 5 with the actual motor connected.

9.4 Checking the Operation

When starting the system or replacing a SERVOPACK for maintenance or inspection purposes, make sure that the relevant External Device Monitor Output Signal turns ON when the redundant Safety Request Input Signals turn OFF.

Failure of the safety functions can be detected by monitoring the Safety Request Input Signals and the External Device Monitor Output Signals.

The following table shows the logic for the Safety Request Input Signals and the External Device Monitor Output Signals.

Signal Name	Code	Logic			
Safety Request Input Signal A1	SRI-A1	ON	ON	OFF	OFF
Safety Request Input Signal A2	SRI-A2	ON	OFF	ON	OFF
External Device Monitor Output Signal A	EDM-A	OFF	OFF	OFF	ON

Note 1. For details on the Safety Request Input Signals, refer to *9.5.2 Safety Request Input Signals*.
2. For details on the External Device Monitor Output Signals, refer to *9.5.3 External Device Monitor Output Signals*.
3. This logic is the same for the Safety Request Input Signal B.

9.5 Common Items

9.5.1 Selecting a Safety Function

The safety-function-part has two safety functions with the same features and these functions can be allocated separately. Either or both of these safety functions can be used.

The setup parameters of safety functions are as follows:

Parameter No.	Name	Setting Range	Units	Factory Setting	When Enabled
Pc00	Safety Function Selection Switch	–	–	0002	After resetting the system

Details		Safety Function Selection Basic Switch
Pc00.0		Safety Function A Selection
	0	No safety function.
	1	Safe BaseBlock Function (SBB function)
	2	Safe BaseBlock with Delay Function (SBB-D function) [factory setting]
	3	Safe Position Monitor with Delay Function (SPM-D function)
	4	Safely Limited Speed with Delay Function (SLS-D function)
Pc00.1		Safety Function B Selection
	0	No safety function [factory setting].
	1	Safe BaseBlock Function (SBB function)
	2	Safe BaseBlock with Delay Function (SBB-D function)
	3	Safe Position Monitor with Delay Function (SPM-D function)
	4	Safely Limited Speed with Delay Function (SLS-D function)
Pc00.2	0	Reserved (Do not change.)
Pc00.3	0	Reserved (Do not change.)

Note 1. For details on safety functions, refer to *9.6 Safe BaseBlock Function (SBB Function)* through *9.9 Safely Limited Speed with Delay Function (SLS-D Function)*.
2. The SERVOPACK functions will be limited when safety functions are used. For details, refer to *1.3 Restrictions*.

9.5.2 Safety Request Input Signals

(1) Safety Request Input Signals

Safety Request Input Signals initiate the execution of the safety functions. Safety functions are executed when a Safety Request Input Signal is input.

To improve safety, two Safety Request Input Signal channels are allocated to each safety function.

Safety Request Input Signal A

Signal Name	Signal State	Meaning
SRI-A1	ON	Cancels the safety function operation request.
	OFF	Requests operation of the safety function.
SRI-A2	ON	Cancels the safety function operation request.
	OFF	Requests operation of the safety function.

Note: This is the same for Safety Request Input Signal B.

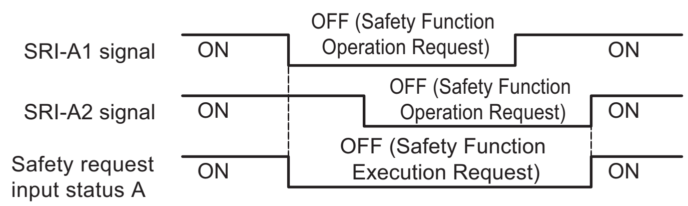
(2) Safety Request Input State

The status when the safety-function-part recognizes a request for operation of a safety function based on the states of the redundant Safety Request Input Signals is called the safety request input status.

Safety Request Input State	ON	Cancels the safety function execution request.
	OFF	Requests execution of the safety function.

Relationship between Safety Request Input Signal and Safety Request Input Status

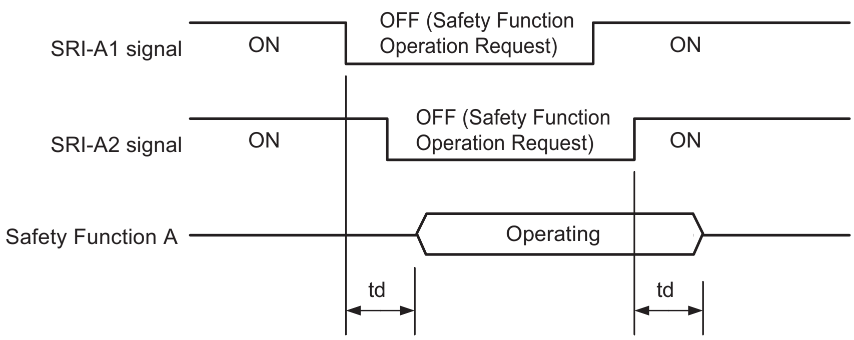
Operation Timing



(3) Relationship between the Safety Request Input Signal and Safety Function

Relationship between the Safety Request Input Signal and Safety Function

Operation Timing



td: Operation delay time = 200 ms max.

Note 1. Make sure that the Safety Request Input Signal has a pulse width that is 200 ms or longer.
2. Safety Request Input Signal with a pulse width that is 0.5 ms or shorter cannot be detected.

(4) Error Detection for Safety Request Input Signals

The safety-function-part monitors the states of redundant Safety Request Input Signals allocated to each safety function to detect errors.

The process of error detection is as follows:

1. The time period until the ON/OFF state of the redundant Safety Request Input Signals matches is measured.
2. If the measured time period exceeds the specified time period, an error is detected in the Safety Request Input Signal.
3. The power supply to the motor is shut OFF by executing the HWBB function.

■ Time Measurement Timing

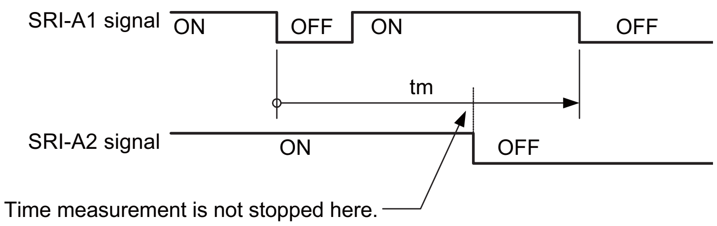
The timing of measuring the time period until the ON/OFF state of the redundant Safety Request Input Signals match is described below.

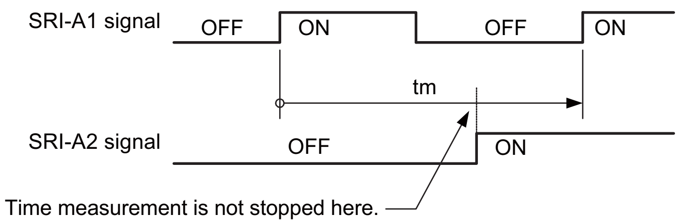
- Measurement starts when the edge of either the SRI-A1 signal or SRI-A2 signal is detected.
- The condition for ending measurement depends on the condition when measurement was started.

The conditions for starting and ending the measurement of time period are as follows:

Condition for Starting Measurement	Condition for Ending Measurement
When either the SRI-A1 signal or SRI-A2 signal changes from ON to OFF	Measurement ends when both the Safety Request Input Signals turn OFF.
When either the SRI-A1 signal or SRI-A2 signal changes from OFF to ON	Measurement ends when both the Safety Request Input Signals turn ON.

Operation Timing





tm: Measured time

■ Alarms

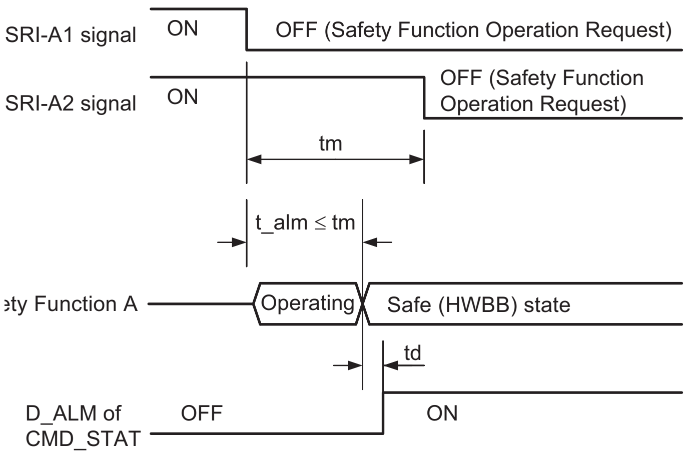
The following alarms occur if an error is detected in the Safety Request Input Signals.

To cancel an alarm, remove the cause of the alarm, and then reset the system.

Alarm No.	Alarm Name	Alarm Meaning	Servomotor Stopping Method	Alarm Reset
A.EB5	Safety-function-part Safety Request Input Signal A - Timing Error	The ON/OFF state of the Safety Request Input Signals A1 and A2 did not match within the specified time period.	Gr.1	N/A
A.EB6	Safety-function-part Safety Request Input Signal B - Timing Error	The ON/OFF state of the Safety Request Input Signals B1 and B2 did not match within the specified time period.	Gr.1	N/A

The timing of the occurrence of an alarm when an error is detected in the Safety Request Input Signals is shown below.

Operation Timing



tm: Time period during which time measurement is performed: Measurement is performed until an alarm occurs.
t_alm: Specified value (average 10 s)
td: Alarm output delay time (40 ms max.)

Safety Functions

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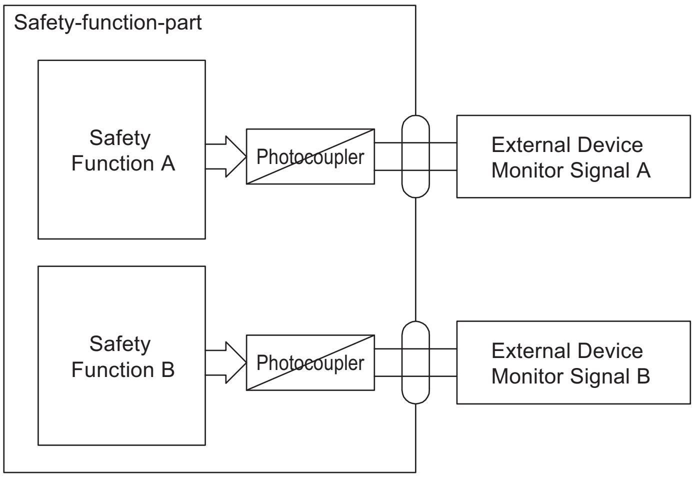
9.5.3 External Device Monitor Output Signals

These signals are output when the following two conditions are met:

- The safety function is operating normally.
- No malfunction occurs in the safety function.

If a malfunction occurs in the safety function when the safety function is operating, this signal will not be output.
By monitoring this signal from an external device, a sequence can be designed for returning to normal operations from the safety function operation state.

The following figure shows the relationship between the External Device Monitor Signal and safety function.



The specifications of the External Device Monitor Output Signal are as follows:

Signal Name	Output State	Meaning
External Device Monitor Output Signal A	ON	Safety Function A is operating normally and no malfunction occurs in the safety function.
	OFF	–
External Device Monitor Output Signal B	ON	Safety Function B is operating normally and no malfunction occurs in the safety function.
	OFF	–

(1) Output Conditions

The output signal turns ON when all of the following conditions are met:

- Application Safety Request Input Signals are OFF (Safety Function Operation Request).
- The safety function is either operating, or is in the safe state.
- Output of the External Device Monitor Signal is set by using parameters. For details, refer to *(2) Selecting Output Conditions*.
- No malfunction is being detected in the safety-function-part.
- There is no malfunction in the safety-related parts of the SERVOPACK.
- A system reset or recalculation of parameters is not in progress.

(2) Selecting Output Conditions

The output conditions of the External Device Monitor Output Signals can be selected by using the parameters.

Parameter No.	Name	Setting Range	Units	Factory Setting	When Enabled
Pc01	EDM Signal Output Selection Switch	–	–	0011	After resetting the system

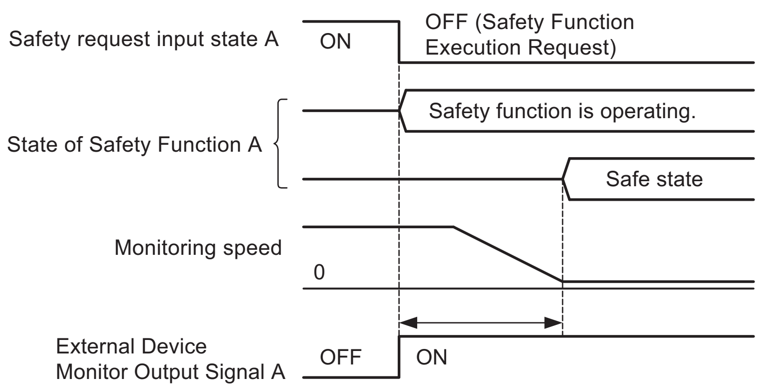
Details			EDM Signal Output Setting
	Pc01.0	EDM Signal A Output Setting	
		0	The EDM-A signal turns ON while the safety function of safety function A is operating.
		1	The EDM-A signal turns ON while safety function A is in the safe state.* [default setting]
	Pc01.1	EDM Signal B Output Setting	
		0	The EDM-B signal turns ON while the safety function of safety function B is operating.
		1	The EDM-B signal turns ON while safety function B is in the safe state.* [default setting]
	Pc01.2	Reserved (Do not change.)	
	Pc01.3	Reserved (Do not change.)	

* The kind of the safe state depends on the type of the Safety Function used. For details, refer to *Description of Technical Terms* at the front of this manual.

An example of the output timing of External Device Monitor Output Signal is shown below.

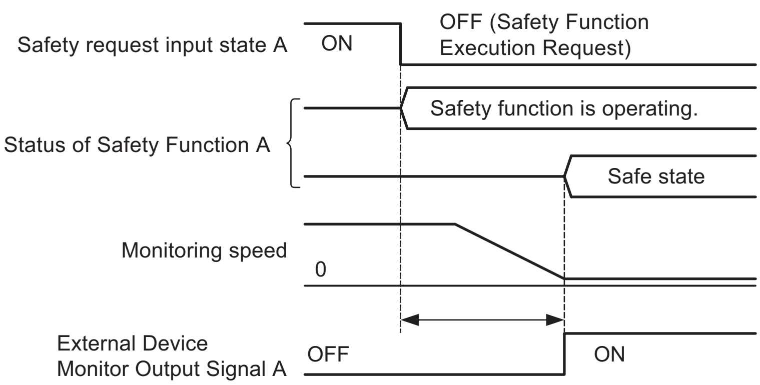
■ When Pc01.0 = 0 (Output Condition = Safety Function Operation)

Operation Timing



■ When Pc01.0 = 1 (Output Condition = Safe State)

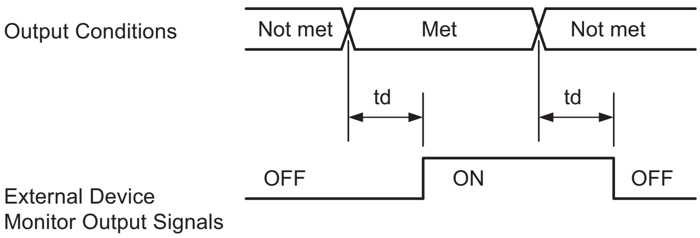
Operation Timing



(3) Output Delay Time

The output delay time of the External Device Monitor Output Signals is shown below.

Operation Timing



td: Output delay time of the External Device Monitor Output Signal (40 ms max.)

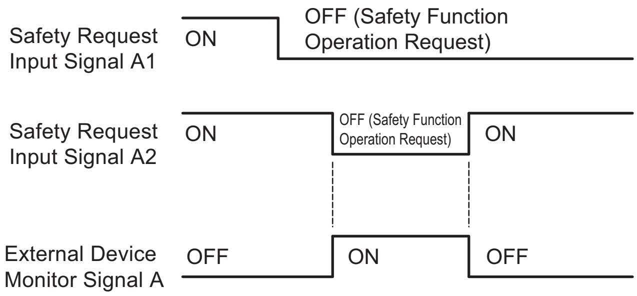
■ Timing Charts

The timing chart for each output condition is shown below.

Note: All other output conditions are met, and the output delay time is applicable.

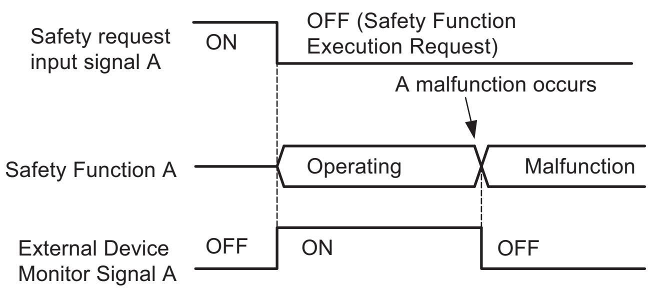
a) When the Safety Request Input Signals A1 and A2 are OFF

Operation Timing



b) When a Malfunction Occurs in Safety Function A

Operation Timing



Note: Safety Function Operation is set as the output condition in this example. Regardless of the state of the Safety Request Input Signals, if a malfunction is detected in the safety function, the External Device Monitor Signal will turn OFF.

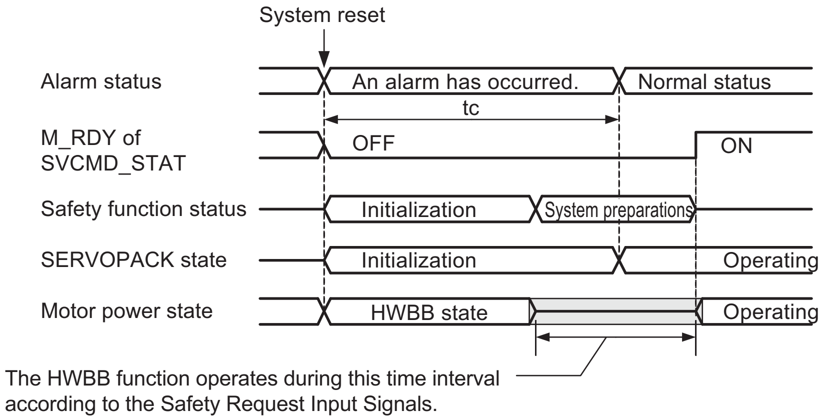
9.5.4 Operations After Alarms and Resetting Systems, and While Recalculating Parameters

The safety-function-part operates in a different manner after the system is reset, an alarm occurs, or while parameters are recalculated.

(1) After Resetting the System

After the system is reset, the safety-function-part forcibly shuts OFF the power supply to the motor by executing the HWBB function. After the startup processes of the safety-function-part and the SERVOPACK have been completed, the ALM signal turns OFF and normal operation starts. The timing of system startup of the safety-function-part is shown below.

Operation Timing



tc: Time period until the safety-function-part is started (10 s max.)

(2) While Recalculating Parameters

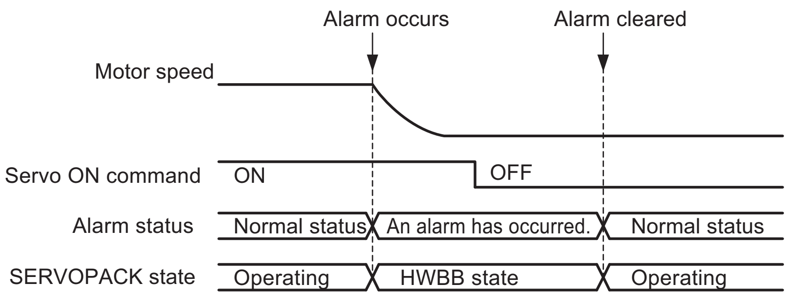
While parameters are being recalculated, the safety-function-part shuts OFF the power supply to the motor by executing the HWBB function according to the safety request input state.

(3) After an Alarm Occurs

After an alarm occurs, the safety-function-part shuts OFF the power supply to the motor by executing the HWBB function regardless of the input states of the Safety Request Input Signals.

The timing of the execution of the HWBB function of the SERVOPACK during an alarm is shown below.

Operation Timing



For information on alarms, refer to *13.2 Troubleshooting*.

To cancel the HWBB state after an alarm has occurred, perform the following:

- Remove the cause of the alarm.
- Set the safety request input state to ON.
- Set the servo ON command to OFF.

9.5.5 Setting Encoder Output Pulse

Set the encoder output pulse using the following parameter.

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

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

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

Setting Range of Encoder Output Pulses (P/Rev)	Setting Unit	Encoder Resolution			Upper Limit of Servomotor Speed for Set Encoder Output Pulses (min^{-1})
		13 bits (8,192 pulses)	17 bits (131,072 pulses)	20 bits (1,048,576 pulses)	
16 to 2048	1	✓	–	–	6000
16 to 16384	1	–	✓	✓	6000
16386 to 32768	2	–	✓	✓	3000
32772 to 65536	4	–	–	✓	1500
65544 to 131072	8	–	–	✓	750
131088 to 262144	16	–	–	✓	375

Note 1. The setting range varies with the encoder resolution for the servomotor used.
Alarm A.041 (Encoder Output Pulse Setting Error) will occur if the setting is outside the allowable range or does not satisfy the setting conditions.
Pn212 = 25000 (P/Rev) is accepted, but
Pn212 = 25001 (P/Rev) is not accepted. The alarm A.041 is output because the setting unit differs from that in the above table.

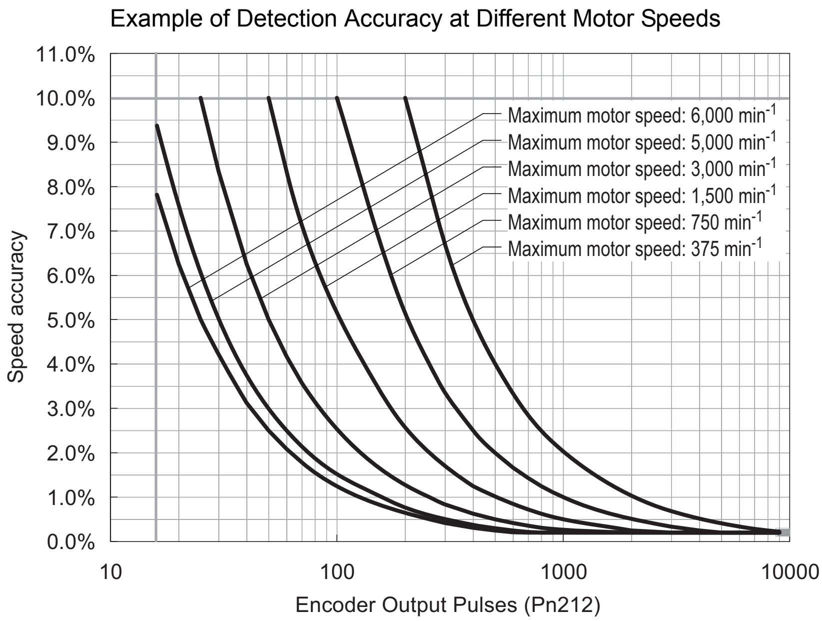
2. The upper limit of the pulse frequency is approx. 1.6 Mpps.
The servomotor speed is limited if the setting value of the encoder output pulses (Pn212) is large.
Alarm A.511 (Encoder Output Pulse Overspeed) will occur if the motor speed exceeds the upper limit specified in the above table.

3. Set the encoder output pulses to a value that is higher than the lower limit calculated with the following formula. If a value lower than the lower limit of the encoder output pulses is set, alarm A.EB2 (Safety-related Parameter Setting Error) will occur.

- Lower limit of Pn212 [pulses/rev] = 75000/Motor Max. Speed [min^{-1}]

Lower Limit of Encoder Output Pulse

Motor Max. Speed [min^{-1}]	Lower Limit [pulses/rev] of Encoder Output Pulses (Pn212)
6000	16 (If the results of the above formula is lower than the setting range of Pn212, the lower limit will be 16 instead of the results of the calculation.)
5000	
3000	25
1500	50
750	100
375	200



The Motor Max. Speed (Pc62) of the Safety-related Servo Parameters depends on the connected rotational servomotor.

The number of encoder output pulses is multiplied by 4 when counted in the safety-function-part.

For example, if Pn212 is set to 16 (16 pulses output per rotation), the safety-function-part counts 16 × 4, or 64 edges (i.e., 64 edges per rotation).

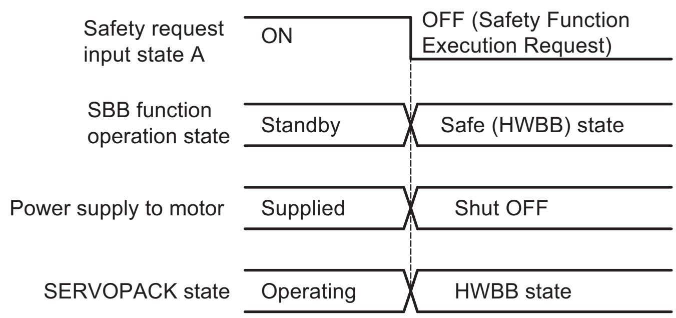
9.6 Safe BaseBlock Function (SBB Function)

9.6.1 Basic Operation

The Safe BaseBlock Function (hereafter called the SBB function) operates based on Safe Torque Off (STO) function that is defined in IEC 61800-5-2. This function implements the HWBB function according to the safety request input status, and cuts OFF the power supply to the motor.

The safe state in the SBB function indicates the safe (HWBB) state in which the power supply to the motor has been shut OFF.

Operation Timing



9.6.2 Settings

To use the SBB function, make the settings for using the SBB function of either Safety Function A or Safety Function B in the parameters. For details on the settings of the safety functions, refer to *9.5.1 Selecting a Safety Function*.

9.6.3 Returning Method

(1) Returning Conditions

When the SERVOPACK state changes to the safe (HWBB) state by the SBB function, the safe (HWBB) state can be cleared to return to normal operation when all of the following conditions are met.

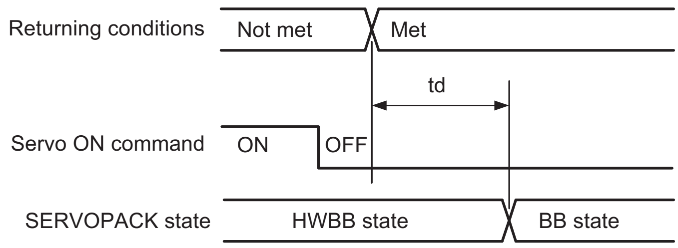
- The input states of all safety request must be ON.
- The servo ON command must be OFF.
- The following utility functions for turning ON the servo must not be active. If they are in progress, end them.

Function Name
JOG Operation
Origin Search
Program Jog Operation
Motor Current Detection Signal Offset Adjustment
Automatic Adjustment without Host Reference
EasyFFT

(2) Returning Timing

■ When the Servo ON Command Is Not Input

Operation Timing

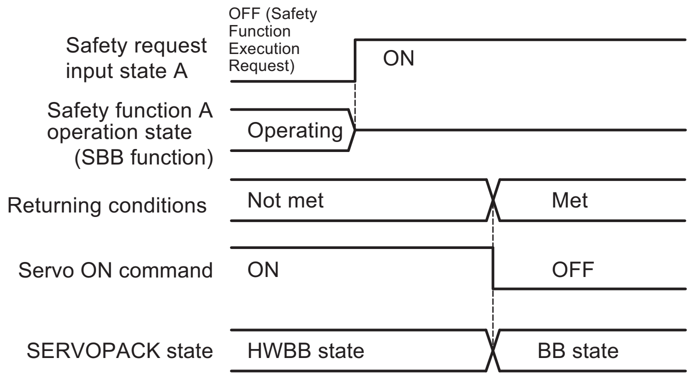


td: Delay time (40 ms max.)

■ When the Servo ON Command Is Input

When the safety request input status is ON, the SBB function stops operating. However, if the servo ON command is input at that point, the SERVOPACK continues in the HWBB state. To return to normal operation, send the SV_OFF command (Servo OFF: 32 hex) to place the SERVOPACK in the BB state and then send the SV_ON command (Servo ON: 31 hex).

Operation Timing



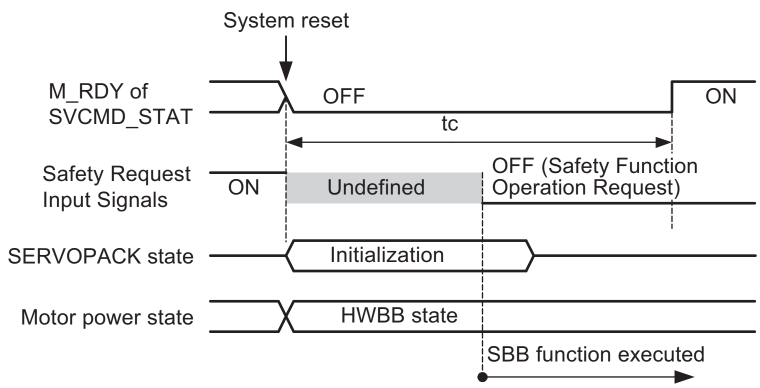
9.6.4 Exceptional Operation

(1) After Resetting the System

After the system is reset, the SBB function is executed according to the Safety Request Input Signals during completion of the initialization processing.

For details on how to return to normal operation from the HWBB state, refer to *9.6.3 Returning Method*.

Operation Timing

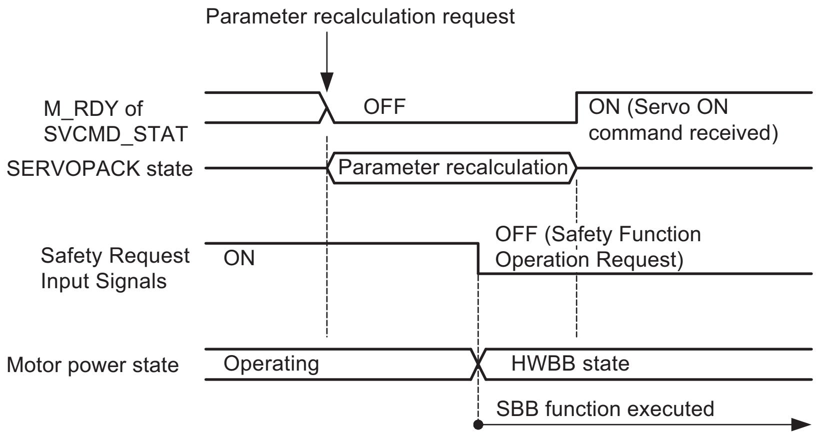


(2) While Recalculating Parameters

When parameters are being recalculated, the SBB function is executed according to the Safety Request Input Signal after recalculation of parameters.

For details on how to return to normal operation from the HWBB state, refer to *9.6.3 Returning Method*.

Operation Timing



9.6.5 Related SERVOPACK Functions

The SERVOPACK functions and operations related to the operation of the SBB function are described below.

- Motor stop mode
- Zero-speed setting
- Overtravel
- Motor energization ready (M_RDY) status
- Brake sequence
- Relationship with MECHATROLINK-III commands

(1) Motor Stop Mode

When the SBB function is operating, the motor will stop according to the method specified in the SERVO-PACK parameter Pn001.0 (Application Function Select Switch 1).

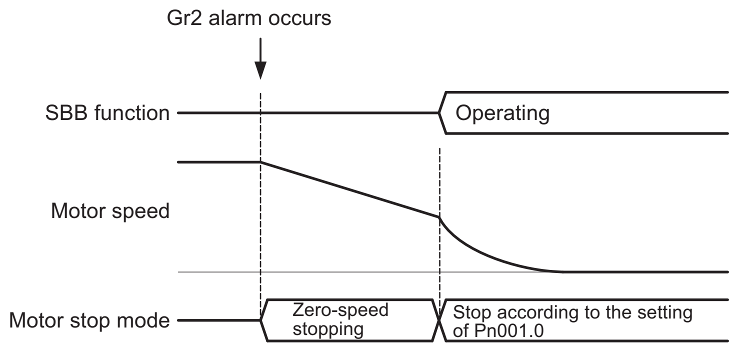
Refer to *8.2.4 Stopping Servomotor after SV_OFF Command or Alarm Occurrence* for details.

(2) Zero-speed Stopping

■ When the SBB Function is Turned ON (Operating) while Zero-speed Stopping

When the SBB function is turned ON while zero-speed stopping (during a GR2 alarm), zero-speed stopping is canceled and the motor is stopped according to the method specified in parameter Pn001.0 (Application Function Select Switch).

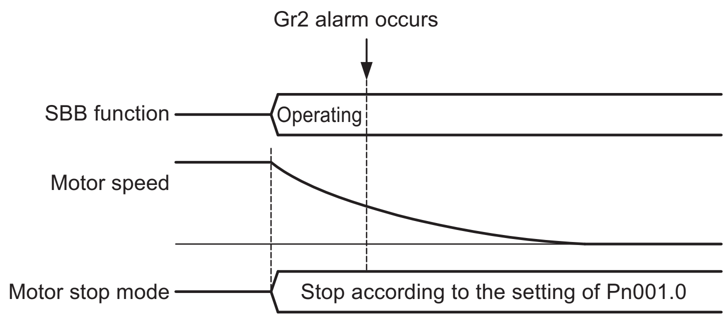
Operation Timing



■ When a Gr2 Alarm Occurs while the SBB Function Is Operating

When a Gr2 alarm occurs while the SBB function is operating, the motor is not stopped by zero-speed stopping. Instead, the stopping method specified in Pn001.0 (Application Function Select Switch) is used.

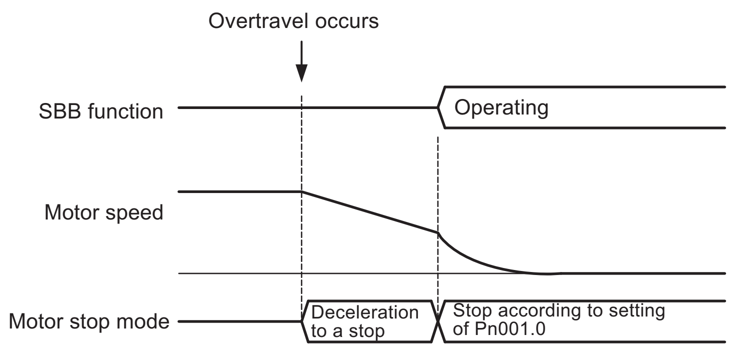
Operation Timing



(3) Overtravel

When the SBB function operates during overtravel, the motor is stopped with the method specified in parameter Pn001.0 (Application Function Select Switch). The overtravel function does not operate while the SBB function is operating.

Operation Timing



Safety Functions

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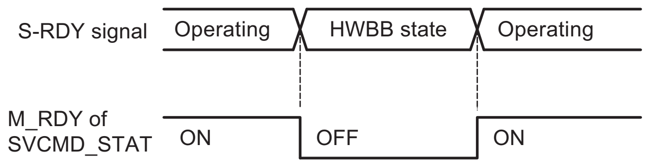
(4) Motor Energization Ready (M_RDY) Status

When the SBB function is operating, the M_RDY of SVCMD_STAT turns OFF (i.e., the servo cannot be turned ON) during operation of the SBB function. After returning from the HWBB state, the M_RDY turns ON (i.e., the servo can be turned ON).

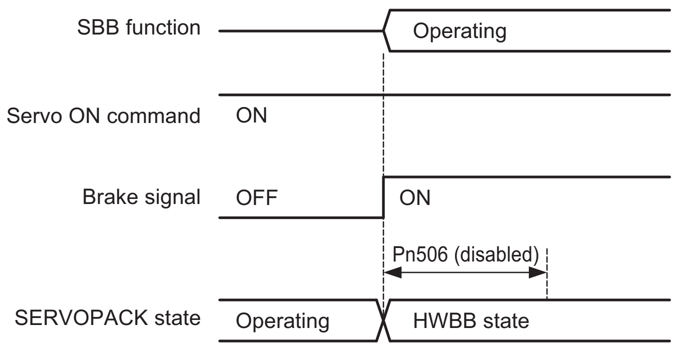
Operation Timing



(5) Brake Sequence

When the SBB function is operating, the SERVOPACK parameter Pn506 (Brake Reference-Servo OFF Delay Time) is disabled, and the SERVOPACK changes to the HWBB state.

Operation Timing



(6) Relationship with MECHATROLINK-III Commands

If the SERVOPACK changes to the HWBB state during the execution of any of the following MECHATROLINK-III commands, a command warning will occur. A command warning will also occur if a MECHATROLINK-III command now being executed is canceled with the CMD_CANCEL (cancellation of move command) control bit.

If a warning occurs, cancel the HWBB state first, and then send a new motion command, or disable the CMD_CANCEL control bit to resume the operation.

MECHATROLINK-III Commands Related with SBB Function

Command	Function Name
SV_ON	Servo ON
INTERPOLATE	Interpolation
POSING	Positioning
FEED	Constant speed feed

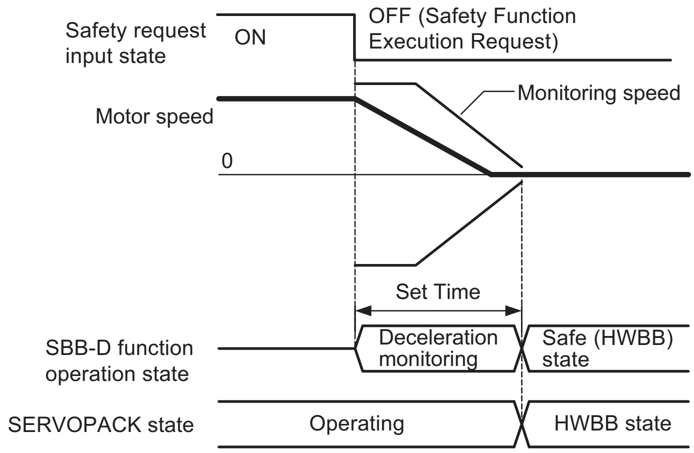
9.7 Safe BaseBlock with Delay Function (SBB-D Function)

9.7.1 Basic Operation

The Safety BaseBlock with Delay Function (hereafter called the SBB-D function) operates based on the Safe Stop 1 (SS1) function that is defined in IEC 61800-5-2. This function monitors the deceleration operation (deceleration monitoring) of the motor depending on the safety request input status until the time period specified in the parameter elapses, and then executes the HWBB function and shuts OFF the power supply to the motor.

The safe state in the SBB-D function indicates the safe (HWBB) state in which the power supply to the motor has been shut OFF.

Operation Timing



■ Operation during Deceleration Monitoring

• Alarms

When the motor speed exceeds the monitoring speed during deceleration monitoring, the following alarms occur. When an alarm is detected, motor speed monitoring is ended, following which the HWBB function is implemented and the power supply to the motor is shut OFF. Because these alarms are not an indication of any malfunction in the safety-function-part, the External Device Monitor Output Signal will be ON.

Alarm No.	Alarm Name	Alarm Meaning	Servomotor Stopping Method	Alarm Reset
A.EB7	Safety-function-part: Safety Function A Monitoring Alarm	The motor speed has exceeded the monitoring speed specified for Safety Function A. Alternatively, the distance that the motor moved has exceeded the allowable distance for monitoring that was specified for Safety Function A.	Gr.1	Available
A.EB8	Safety-function-part: Safety Function B Monitoring Alarm	The motor speed has exceeded the monitoring speed specified for Safety Function B. Alternatively, the distance that the motor moved has exceeded the allowable distance for monitoring that was specified for Safety Function B.	Gr.1	Available

Safety Functions

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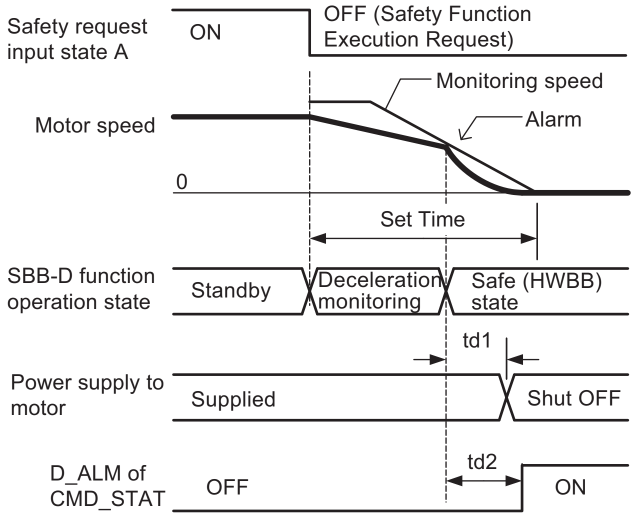
Operation Timing

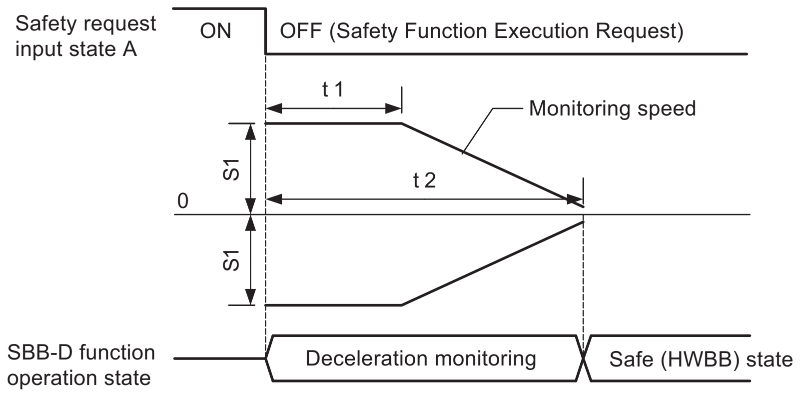


td1: Power shut-OFF delay time (40 ms max.)
td2: Alarm signal output delay time (40 ms max.)

- Related Parameters

The schematic diagram and related parameters for monitoring the speed are shown below.

Operation Timing



Remarks

t1: Deceleration Waiting Time (Pc10 and Pc20)
t2: Deceleration Monitoring Time (Pc11 and Pc21)
s1: Limited Speed on Waiting for Deceleration (Pc12 and Pc22)
Setting conditions
t1 ≤ t2
s1 ≤ Motor Max. Speed

Parameter No.	Name	Setting Range	Units	Factory Setting	When Enabled
Pc10	Deceleration Waiting Time A (Safety Function A)	0 to 10000	10 ms	0	After resetting the system
Pc11	Deceleration Monitoring Time A (Safety Function A)	0 to 10000	10 ms	500	After resetting the system
Pc12	Limited Speed A on Waiting for Deceleration (Safety Function A)	0 to 10000	1 min^{-1}	0	After resetting the system
Pc20	Deceleration Waiting Time B (Safety Function B)	0 to 10000	10 ms	0	After resetting the system
Pc21	Deceleration Monitoring Time B (Safety Function B)	0 to 10000	10 ms	500	After resetting the system
Pc22	Limited Speed B on Waiting for Deceleration (Safety Function B)	0 to 10000	1 min^{-1}	0	After resetting the system

Note 1. The deceleration waiting time (t1) cannot be longer than the deceleration monitoring time (t2). If it is longer, alarm A.EB2 (Safety-related Parameter Setting Error) will occur.
2. The deceleration waiting monitoring speed (S1) cannot be faster than the Motor Max. Speed. If it is faster, alarm A.EB2 (Safety-related Parameter Setting Error) will occur.

9.7.2 Settings

To use the SBB-D function, make the settings for using the SBB-D function of either Safety Function A or Safety Function B in the parameters. For details on the settings of the safety functions, refer to *9.5.1 Selecting a Safety Function*.

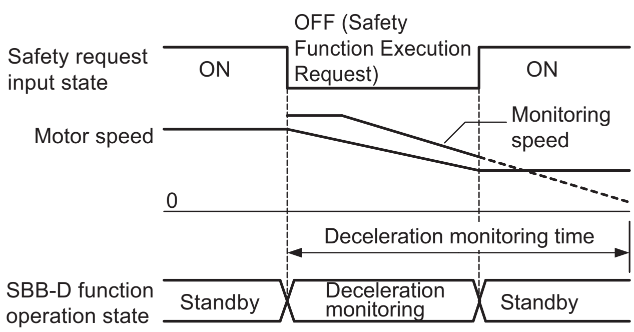
9.7.3 Returning Method

The method of returning to normal operation depends on the operation state of the SBB-D function.

(1) During Deceleration Monitoring

The SERVOPACK will return to normal operation when the input state of safety request is turned to ON.

Operation Timing



(2) During Safe (HWBB) State

The method of returning to normal operation after deceleration monitoring has ended and the SERVOPACK has changed to the safe (HWBB) state is the same as that for the SBB function. For details, refer to *9.6.3 Returning Method*.

9.7.4 Exceptional Operation

(1) After Resetting the System

The operation after the system is reset is the same as the operation after the system is reset for the SBB function. For details, refer to *9.6.4 Exceptional Operation*.

(2) While Recalculating Parameters

The operation when parameters are being recalculated is the same as the operation when parameters are being recalculated for the SBB function. For details, refer to *9.6.4 Exceptional Operation*.

9.7.5 Related SERVOPACK Functions

The SERVOPACK functions and operations related to the safe (HWBB) state after deceleration monitoring are the same as that for the SBB function. These are listed below. For details, refer to *9.6.5 Related SERVOPACK Functions*.

- Motor stop mode
- Zero-speed stopping
- Overtravel
- Motor energization ready (M_RDY) status
- Brake sequence
- Relationship with MECHATROLINK-III commands

Other related SERVOPACK functions are described below.

(1) Utility Functions

When the SBB-D function is being executed, any adjustments made with the following functions will not be successfully completed.

Execute these functions when the SBB-D function is not operating.

Function Name
Speed/Torque Reference Offset Adjustment
Motor Current Detection Signal Offset Adjustment
Vibration Detection Level Initialization
Autotuning with Reference Input
Custom Adjustment
Anti-resonance Control Function
Vibration Suppression Function
Online Vibration Monitor

(2) Sensor ON (SENS_ON) Command

While M_RDY of SVCMD_STAT is OFF for the Sensor ON (SENS_ON) command, the SBB function will operate rather than the safety functions selected with Pc00. If the Safety Request Input Signal turns OFF at this time, the safe (HWBB) state will be entered.

9.8 Safe Position Monitor with Delay Function (SPM-D Function)

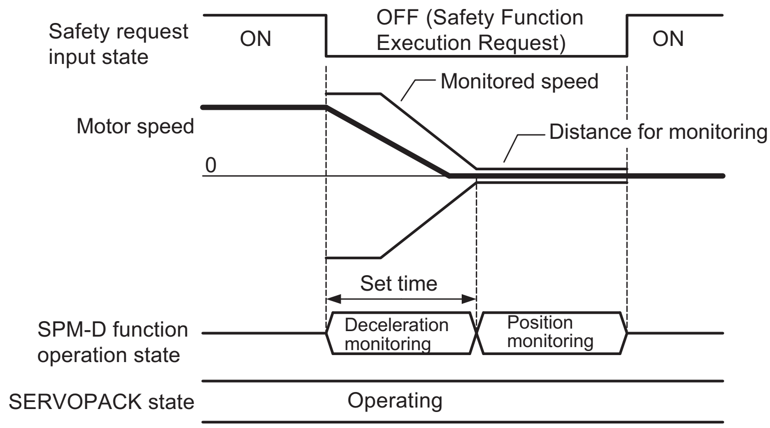
9.8.1 Basic Operation

The Safe Position Monitor with Delay Function (hereafter called the SPM-D function) operates based on the Safe Stop 2 (SS2) function that is defined in IEC 61800-5-2. This function monitors the deceleration operation (deceleration monitoring) of the motor according to the safety request input state until the time period specified in the parameter elapses, and then switches to position monitoring and monitors the distance that the motor moved to make sure it is within the allowable range.

The safe state resulting from use of the SPM-D function indicates the state during position monitoring.

The HWBB function is executed when the specified speed is exceeded during deceleration monitoring or when the distance that the motor moved exceeds the allowable range during position monitoring. In either case, the power supply to the motor is cut OFF. In either case, the power supply to the motor is shut OFF. If so, the safe state resulting from use of the SPM-D function indicates the state during the power supply to the motor has been shut OFF.

Operation Timing



■ Operation during Deceleration Monitoring

The operation when the motor speed exceeds the monitoring speed during deceleration monitoring is the same as the operation during speed monitoring of the SBB-D function. For details, refer to ■ *Operation during Deceleration Monitoring* in *9.7.1*.

■ Operation during Position Monitoring

• Alarms

When the motor position exceeds the distance for monitoring specified in the parameters during position monitoring, the following alarms occur. When an alarm is detected, position monitoring is ended, following which the HWBB function is executed and the power supply to the motor is shut OFF. Because these alarms are not an indication of any malfunction in the safety-function-part, the External Device Monitor Output Signal will be ON.

Alarm No.	Alarm Name	Alarm Meaning	Servomotor Stopping Method	Alarm Reset
A.EB7	Safety-function-part: Safety Function A Monitoring Alarm	The motor speed has exceeded the monitoring speed specified for Safety Function A. Alternatively, the distance that the motor moved has exceeded the allowable distance for monitoring that was specified for Safety Function A.	Gr.1	Available

Safety Functions

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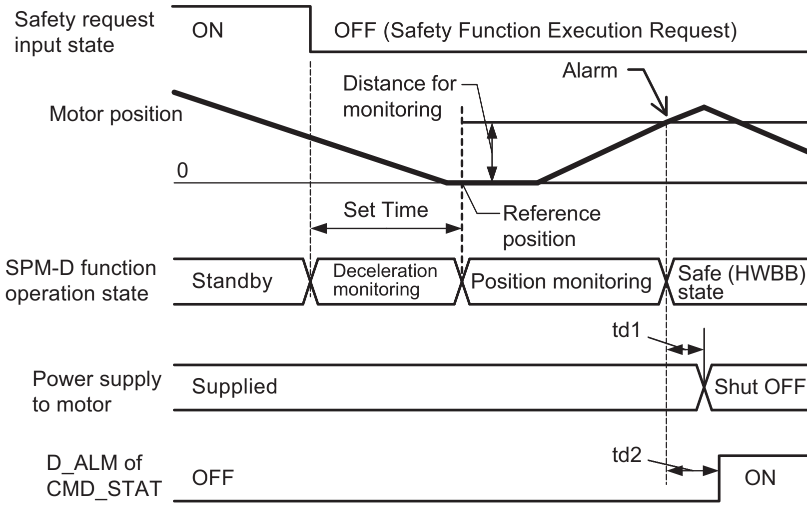
Alarm No.	Alarm Name	Alarm Meaning	Servomotor Stopping Method	Alarm Reset
A.EB8	Safety-function-part: Safety Function B Monitoring Alarm	The motor speed has exceeded the monitoring speed specified for Safety Function B. Alternatively, the distance that the motor moved has exceeded the allowable distance for monitoring that was specified for Safety Function B.	Gr.1	Available

Operation Timing



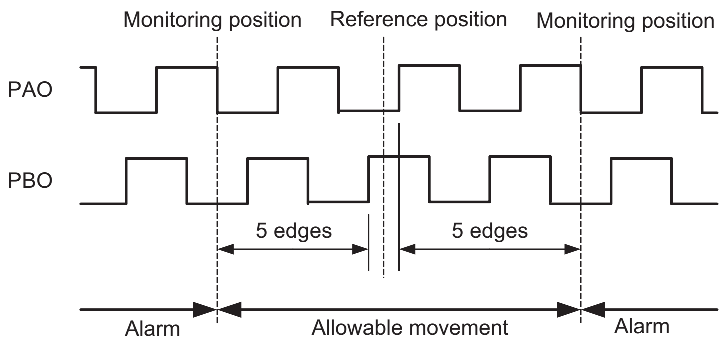
td1: Power shut-OFF delay time (40 ms max.)
td2: Alarm signal output delay time (40 ms max.)

- Related Parameters

Parameters related to the distance for monitoring are described below.
The edge of encoder output pulse that is output from the SERVOPACK is used as the unit when setting the distance for monitoring.

Operation Timing

Example: When distance for monitoring is 5 edges



Parameter No.	Name	Setting Range	Units	Factory Setting	When Enabled
Pc13	Limited Distance A (Safety Function A)	1 to 65535	edge	10	After resetting the system
Pc23	Limited Distance B (Safety Function B)	1 to 65535	edge	10	After resetting the system

Because the output pulse count of the encoder output pulses for one rotation can be specified in the SERVOPACK parameters, the detectable distance that the motor moved will differ from that set for the parameter.

The relationship between the set value of encoder output pulses and the detectable distance that the motor moved is described below:

- The smaller the set value of encoder output pulses, the higher the detection accuracy of the distance that the motor moved.
- The larger the set value of encoder output pulses, the lower the detection accuracy of the distance that the motor moved.

For details on the set value of encoder output pulses and the distance that the motor moved per edge, refer to *9.5.5 Setting Encoder Output Pulse*.

9.8.2 Settings

To use the SPM-D function, make the settings for using the SPM-D function of either Safety Function A or Safety Function B in the parameters. For details on selecting the safety functions, refer to *9.5.1 Selecting a Safety Function*.

9.8.3 Returning Method

The method of returning to normal operation depends on the operation state of the SPM-D function.

(1) During Deceleration Monitoring or Position Monitoring

The SERVOPACK will return to normal operation when the input state of safety request is turned to ON.

(2) During Safe (HWBB) State

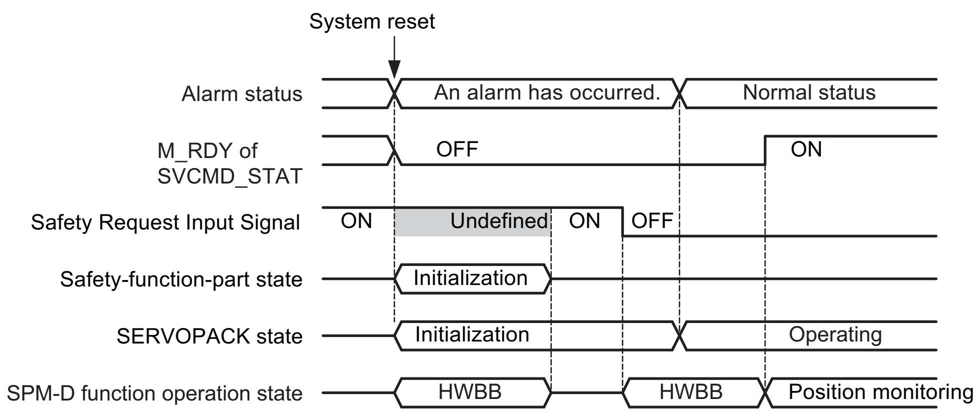
The method of returning after an alarm has occurred and the SERVOPACK has changed to the safe (HWBB) state is the same as that for the SBB function. For details, refer to *9.6.3 Returning Method*.

9.8.4 Exceptional Operation

(1) After Resetting the System

After the system is reset, if M_RDY of SVCMD_STAT turns OFF while the Safety Request Input Signal is OFF (Safety Function Execution Request), the safety-function-part performs position monitoring instead of deceleration monitoring.

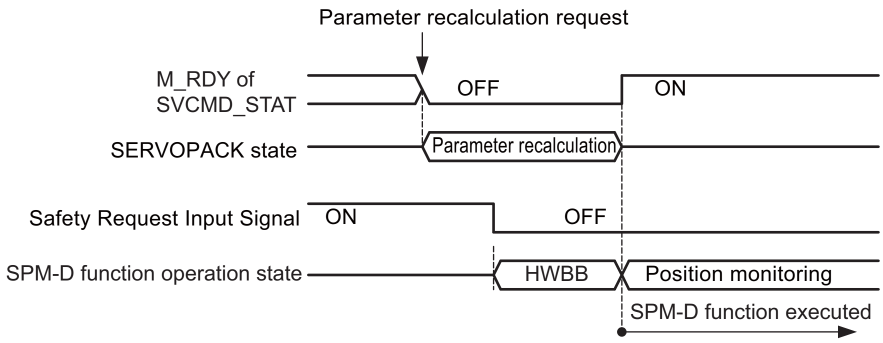
Operation Timing



(2) While Recalculating Parameters

Similar to the CONFIG command for MECHATROLINK-III communications, if the M_RDY of SVCMD_STAT signal turns OFF while the Safety Request Input Signal is OFF (Safety Function Execution Request) during parameter recalculation to enable the specified parameters, position monitoring is performed instead of deceleration monitoring.

Operation Timing



9.8.5 Related SERVOPACK Functions

The SERVOPACK functions and operations related to the operation of the SPM-D function are same as that for the SBB-D function. There are listed below. For details, refer to *9.7.5 Related SERVOPACK Functions*.

- Motor stop mode
- Zero-speed stopping
- Overtravel
- Motor energization ready (M_RDY) status
- Brake sequence
- Relationship with MECHATROLINK-III commands
- Utility functions
- Sensor ON (SENS_ON) command

9.9 Safely Limited Speed with Delay Function (SLS-D Function)

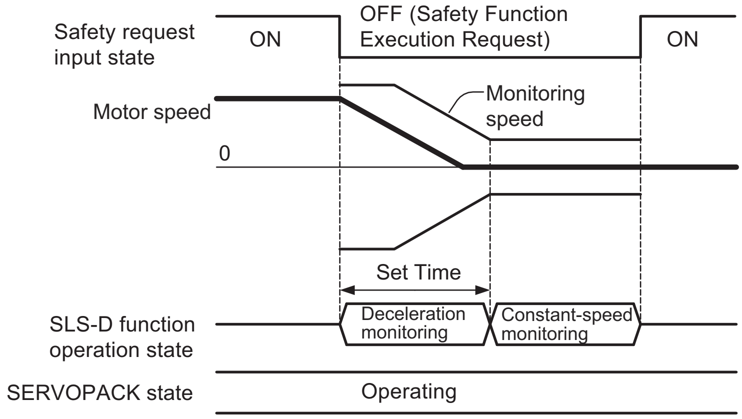
9.9.1 Basic Operation

The Safely Limited Speed with Delay Function (hereafter called the SLS-D function) operates based on Safely-Limited Speed (SLS) that is defined in IEC 61800-5-2. This function monitors the deceleration operation (deceleration monitoring) of the motor according to the safety request input state until the time period specified in the parameter elapses, and then monitors the motor speed to make sure it is within the allowable range (within a constant speed range).

The safe state in the SLS-D function indicates the state when the motor speed is within the allowable range.

If the specified speed is exceeded during motor speed monitoring, the power supply to the motor is shut OFF by executing the HWBB function. If so, the safe state resulting from use of the SLS-D function indicates the state while the power supply to the motor is shut OFF.

Operation Timing



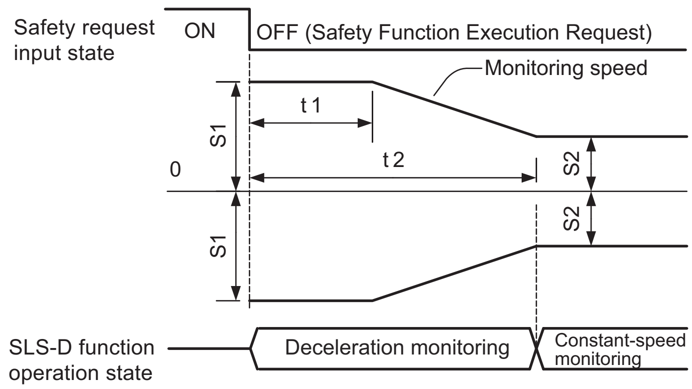
■ Operation during Deceleration Monitoring and Constant-speed Monitoring

- Alarms

The operation when the motor speed exceeds the monitoring speed during deceleration monitoring and constant-speed monitoring is the same as the operation during deceleration monitoring of the SBB-D function. For details, refer to *■ Operation during Deceleration Monitoring* in *9.7.1*.

- Related Parameters

Parameters related to monitoring speed are described below.

Operation Timing	Remarks
	t1: Deceleration Waiting Time (Pc10 and Pc20) t2: Deceleration Monitoring Time (Pc11 and Pc21) s1: Limited Speed on Waiting for Deceleration (Pc12 and Pc22) s2: Limited Constant Speed (Pc14 and Pc24) Setting Conditions t1 ≤ t2 s1 ≥ s2

Parameter No.	Name	Setting Range	Units	Factory Setting	When Enabled
Pc10	Deceleration Waiting Time A (Safety Function A)	0 to 10000	10 ms	0	After resetting the system
Pc11	Deceleration Monitoring Time A (Safety Function A)	0 to 10000	10 ms	500	After resetting the system
Pc12	Limited Speed A on Waiting Deceleration (Safety Function A)	0 to 10000	1 min^{-1}	0	After resetting the system
Pc14	Limited Constant Speed A (Safety Function A)	0 to 10000	1 min^{-1}	0	After resetting the system
Pc20	Deceleration Waiting Time B (Safety Function B)	0 to 10000	10 ms	0	After resetting the system
Pc21	Deceleration Monitoring Time B (Safety Function B)	0 to 10000	10 ms	500	After resetting the system
Pc22	Limited Speed B on Waiting Deceleration (Safety Function B)	0 to 10000	1 min^{-1}	0	After resetting the system
Pc24	Limited Constant Speed B (Safety Function B)	0 to 10000	1 min^{-1}	0	After resetting the system

Note 1. The deceleration waiting time (t1) cannot be longer than the deceleration monitoring time (t2). If it is longer, alarm A.EB2 (Safety-related Parameter Setting Error) will occur.
2. The limited constant speed (S2) cannot be faster than the deceleration waiting monitoring speed (S1). If it is faster, alarm A.EB2 (Safety-related Parameter Setting Error) will occur.

9.9.2 Settings

To use the SLS-D function, make the settings for using the SLS-D function of either Safety Function A or Safety Function B in the parameters. For details on the settings of the safety functions, refer to *9.5.1 Selecting a Safety Function*.

9.9.3 Returning Method

The method of returning to normal operation depends on the operation state of the SLS-D function.

(1) During Deceleration Monitoring or Constant-speed Monitoring

The SERVOPACK will return to normal operation when the input state of safety request is turned to ON.

(2) During Safe (HWBB) State

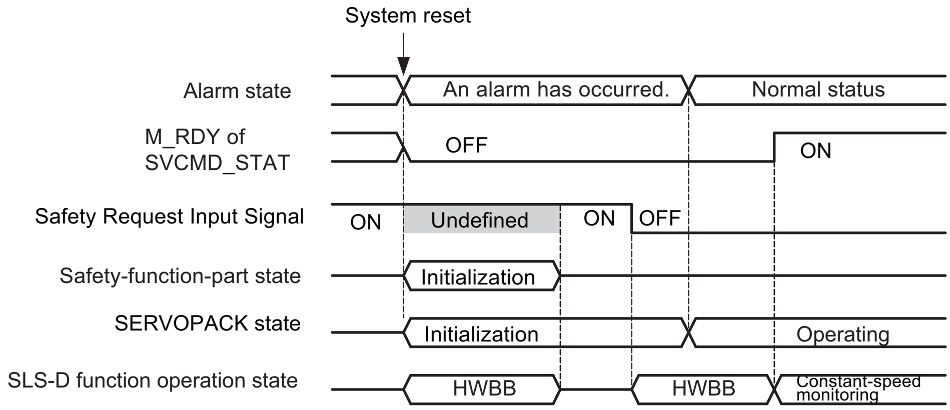
The method of returning after an alarm has occurred and the SERVOPACK has changed to the safe (HWBB) state is the same as that for the SBB function. For details, refer to *9.6.3 Returning Method*.

9.9.4 Exceptional Operation

(1) After Resetting the System

After the system is reset, if M_RDY of SVCMD_STAT turns OFF while the Safety Request Input Signal is OFF (Safety Function Execution Request), the safety-function-part performs constant-speed monitoring instead of deceleration monitoring.

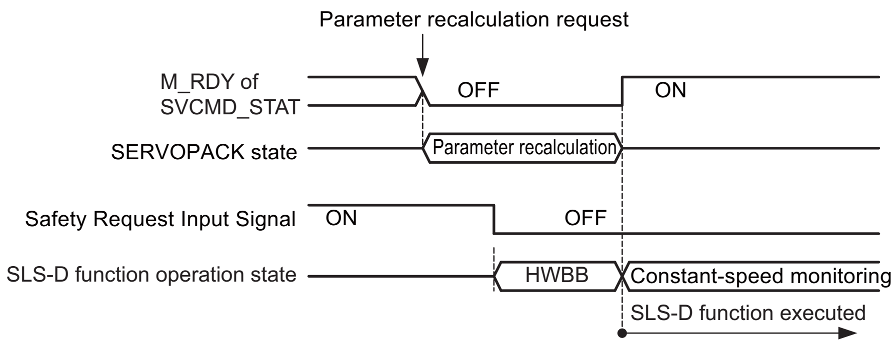
Operation Timing



(2) While Recalculating Parameters

Similar to the CONFIG command of MECHATROLINK-III communications, if M_RDY of SVCMD_STAT turns OFF while the Safety Request Input Signal is OFF (Safety Function Execution Request) during recalculation to enable the specified parameters, constant-speed monitoring is performed instead of deceleration monitoring.

Operation Timing



Safety Functions

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9.9.5 Related SERVOPACK Functions

The SERVOPACK functions and operations related to the operation of the SLS-D function are same as that for the SBB-D function. These are listed below. For details, refer to *9.7.5 Related SERVOPACK Functions*.

- Motor stop mode
- Zero-speed stopping
- Overtravel
- Motor energization ready (M_RDY) status
- Brake sequence
- Relationship with MECHATROLINK-III commands
- Utility functions
- Sensor ON (SENS_ON) command

9.10 Order of Priority of Safety Functions

Safety functions can be set individually for Safety Function A and Safety Function B. Two safety functions may be executed under the following two conditions:

- If one of the two safety functions is changed to the safe (HWBB) state, the other function will also be changed to the safe (HWBB) state.
- Both safety functions operate independently.

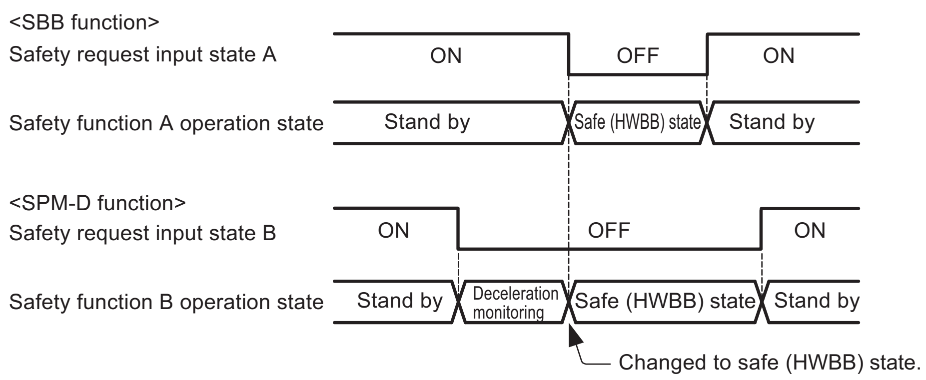
Examples of these two conditions are given below.

(1) When Both Safety Functions are Changed to the Safe (HWBB) State

During the execution of two safety functions, if one safety function is changed to the safe (HWBB) state, the other will also be forcibly changed to the safe (HWBB) state.

Example: When the SBB function is set as Safety Function A and the SPM-D function is set as Safety Function B

Operation Timing



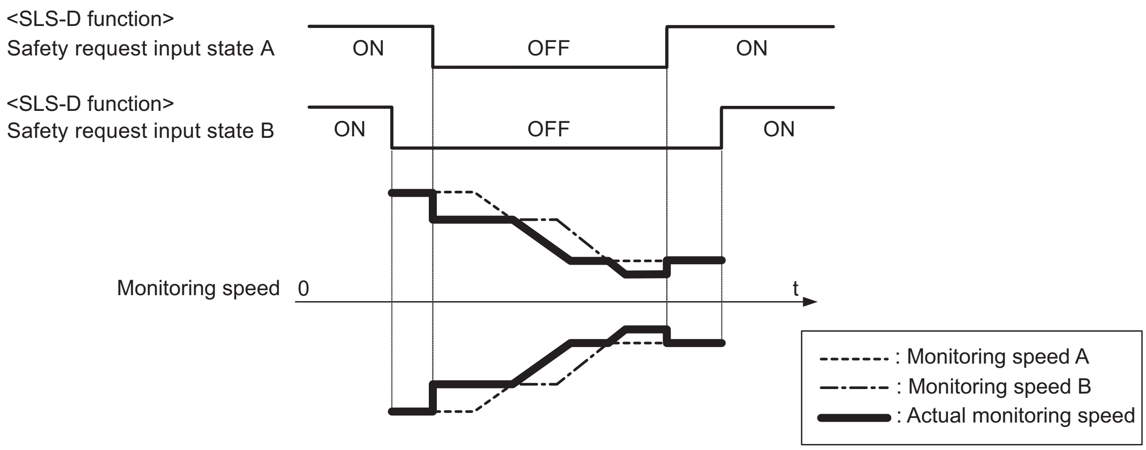
The returning method is the same as that for the SBB function. For details, refer to *9.6.3 Returning Method*.

(2) When Two Safety Functions Operate Independently

Safety Function A and Safety Function B independently monitor the motor speed.

Example: When the SLS-D Function is set as Safety Function A and Safety Function B

Operation Timing



Safety Functions

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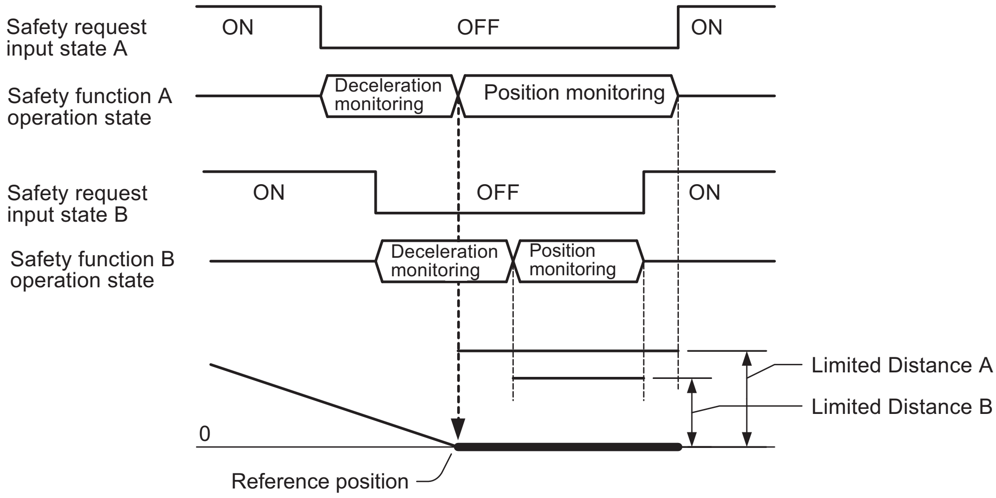
■ Reference Position When the SPM-D Function Is Set for Both Safety Functions

When the SPM-D function is set for Safety Function A and Safety Function B, the motor position set in the safety function that is the first to reach the position monitoring state is treated as the reference position of Safety Function A and Safety Function B.

Operation Timing



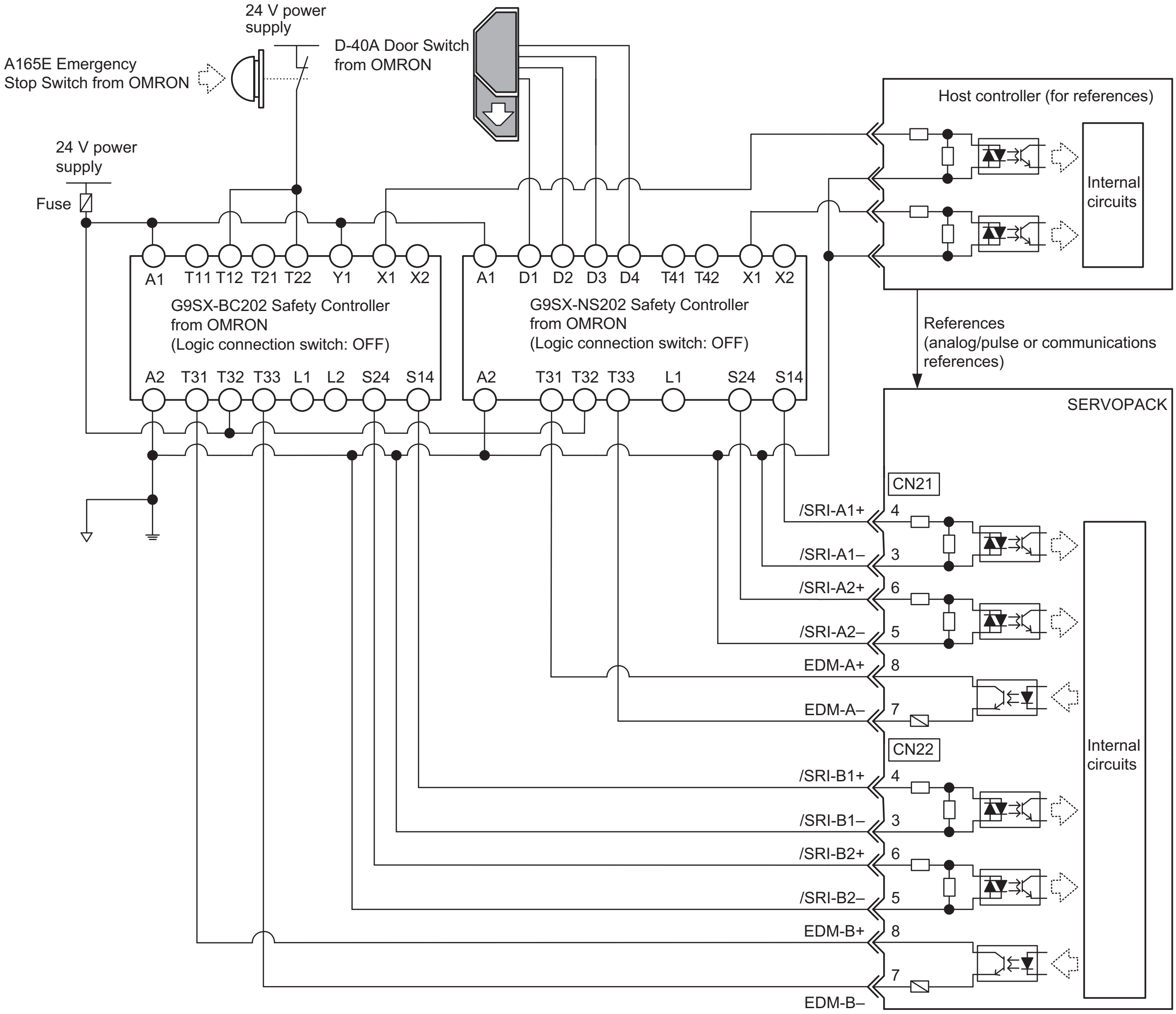
9.11 Application Example of Safety Functions

An application example of the safety functions is described below.

(1) Connection Example

This section provides a connection example in which the safety functions operate under the following conditions.

- Safety Function A: Safety Function A (SLS-D function) operates when the door switch opens.
- Safety Function B: Safety Function B (SBB-D function) operates when the emergency stop switch is pressed.



Note 1. For details on how to use OMRON products, contact an OMRON representative.

2. Use signals EDM-A and EDM-B as sourcing outputs. Make connections so that the electric current flows from EDM-A+ to EDM-A– or EDM-B+ to EDM-B–.

(2) Operation Example

■ Safety Function A

<When Door Switch Is Closed>

The X1 signal of the Safety Controller is OFF and the S14 and the S24 signals are ON. Signals /SRI-A1 and /SRI-A2 both are ON and Safety Function A (SLS-D function) does not operate. Normal operation is executed.

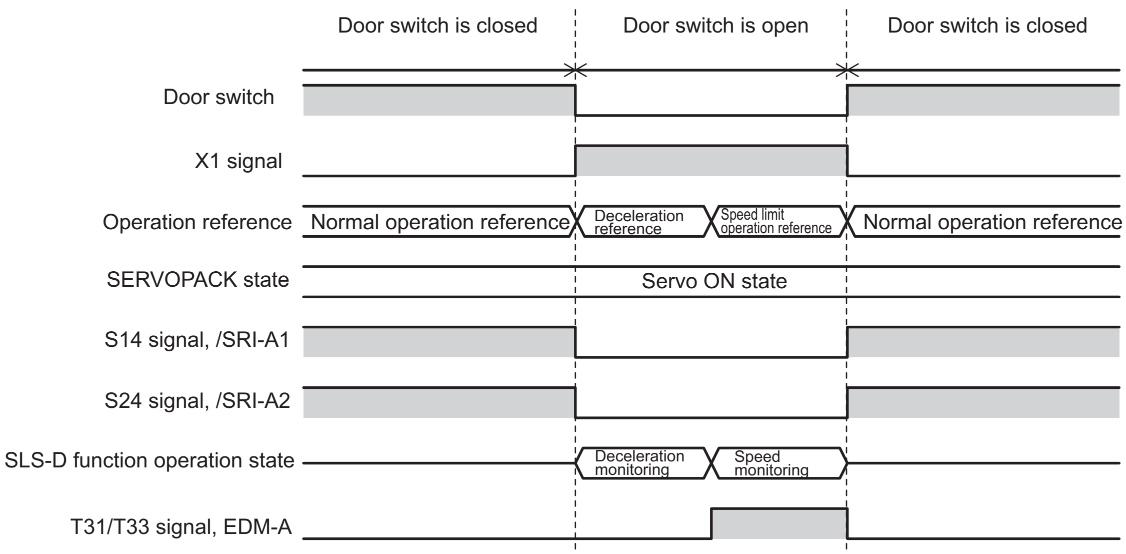
<When Door Switch Is Opened>

The X1 signal of the Safety Controller turns ON and the S14 and the S24 signals turn OFF. Due to the state of the X1 signal, the host controller switches from the normal operation reference to a deceleration reference toward the speed limit. The safety-function-part monitors the speed. If the speed is within the specified Limited Constant Speed (Pc14) after the specified Deceleration Monitoring Time (Pc11) has elapsed, the EDM-A signal turns ON.

<When the Door Switch Closes after Opening>

If the speed is within the speed limit, the EDM-A signal remains ON. If the door switch is closed in this state, the X1 signal turns OFF and the S14 and the S24 signals turn ON because the Safety Controller is in the Auto Reset state. Due to the state of the X1 signal, the host controller switches from the speed limit operation reference to the normal operation reference, and normal operation is returned.

Operation Timing



■ Safety Function B

<When the Emergency Stop Switch Is Not Pressed>

The X1 signal of the Safety Controller is OFF and the S14 and the S24 signals are ON. Signals /SRI-B1 and /SRI-B2 are both ON and Safety Function B (SBB-D function) does not operate. Normal operation is executed.

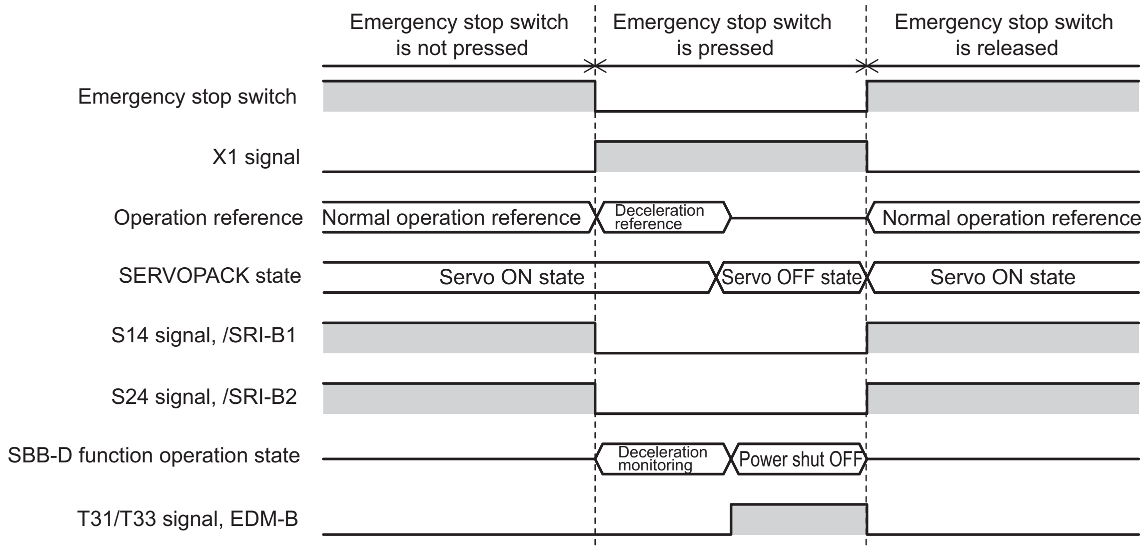
<When the Emergency Stop Switch Is Pressed>

The X1 signal of the Safety Controller turns ON and the S14 and the S24 signals turn OFF. Due to the state of the X1 signal, the host controller switches from the normal operation reference to the deceleration reference to stop. The motor is stopped and the servo is turned OFF. The safety-function-part monitors the speed, and shuts OFF the power supply to the motor after the specified Deceleration Monitoring Time (Pc21) has elapsed. EDM-B turns ON when the power supply is shut OFF.

<When the Emergency Stop Switch Is Released>

The EDM-B signal is ON while no power is being supplied to the motor. If the emergency stop switch is released in this state, the X1 signal turns OFF and the S14 and the S24 signals turn ON because the Safety Controller is in the Auto Reset state. Due to the state of the X1 signal, the host controller switches to the normal operation reference, and normal operation is returned.

Operation Timing



(3) Checking the Operation of Safety Functions

If the SEVOPACK is changed when starting the equipment or during maintenance or inspection, be sure to check the following after performing wiring.

- Make sure that the safety request input signals A1, A2, B1, and B2 in the input signal monitor operate correctly when signals /SRI-A1 and /SRI-A2 or signals /SRI-B1 and /SRI-B2 are switched between ON and OFF. For information on monitoring input signals, refer to *11.2.2 Status Monitor, Motion Monitor, Input Signal Monitor, and Output Signal Monitor*.
  ⇒ If the ON/OFF timing of the signals does not match or if the signals are not operating, the external wiring may have been disconnected or there may be a short-circuit. Another possible reason is malfunctioning of the safety equipment or SERVOPACK. Find the cause and take proper action.
- If signals /SRI-A1 and /SRI-A2, or /SRI-B1 and /SRI-B2 turn OFF, EDM-A or EDM-B must turn ON after the specified time elapses.
- If signals /SRI-A1 and /SRI-A2, or /SRI-B1 and /SRI-B2 turn ON, the motor must operate properly according to the reference from the host controller.

10

Adjustments

10.1 Type of Adjustments and Basic Adjustment Procedure

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

10.1.1 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.

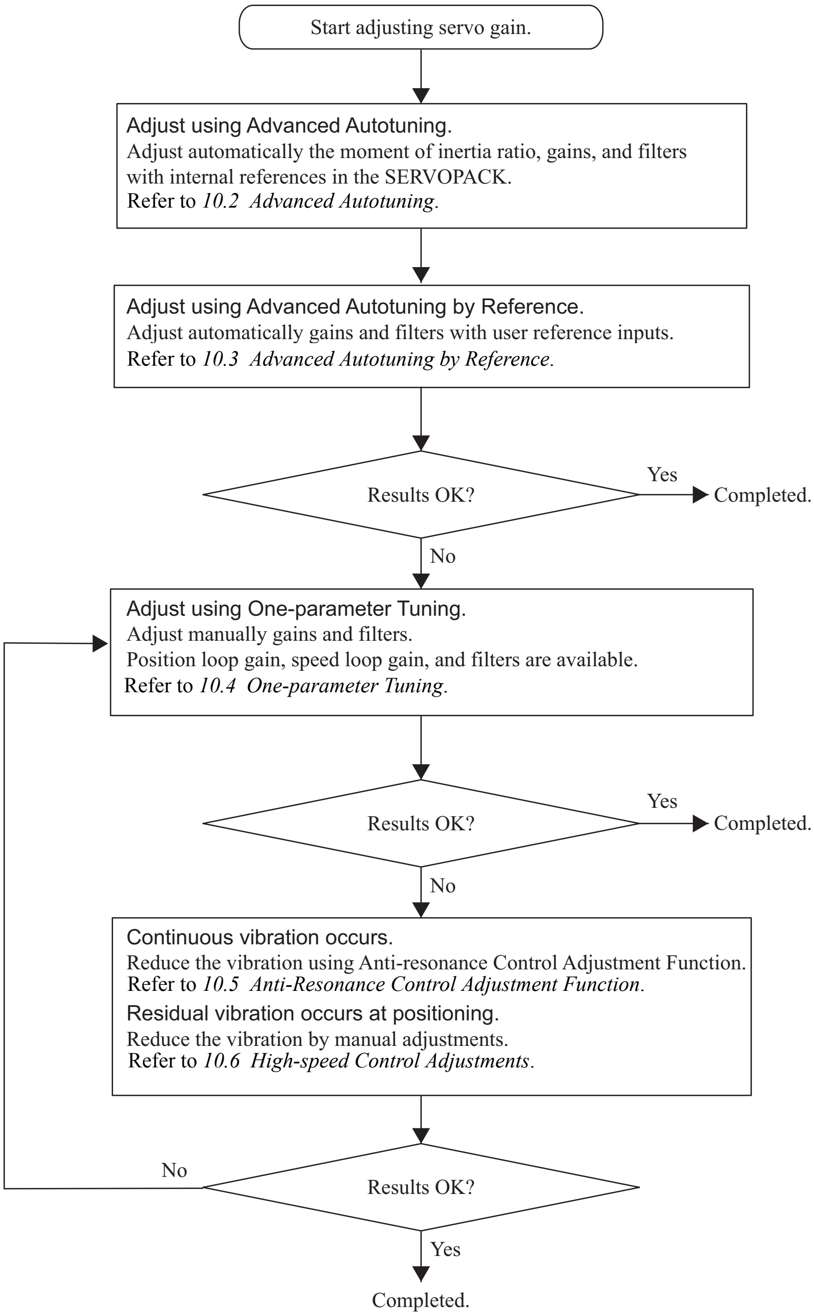
The servo gains are factory-set to stable values. The following utility function can be used to adjust the servo gain to increase the responsiveness of the machine in accordance with the actual conditions. With this function, parameters related to adjustment above will be adjusted automatically and the 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. • Moment of inertia ratio • Gains (position loop gain, speed loop gain, etc.) • Filters (torque reference filter, notch filter) • 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. • Gains (position loop gain, speed loop gain, etc.) • Filters (torque reference filter, notch filter) • 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. • Gains (position loop gain, speed loop gain, etc.) • Filters (torque reference filter, notch filter) • Anti-resonance control adjustment function	Speed and Position
Anti-Resonance Control Adjustment Function	This function effectively suppresses continuous vibration.	Speed and Position

10.1.2 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.



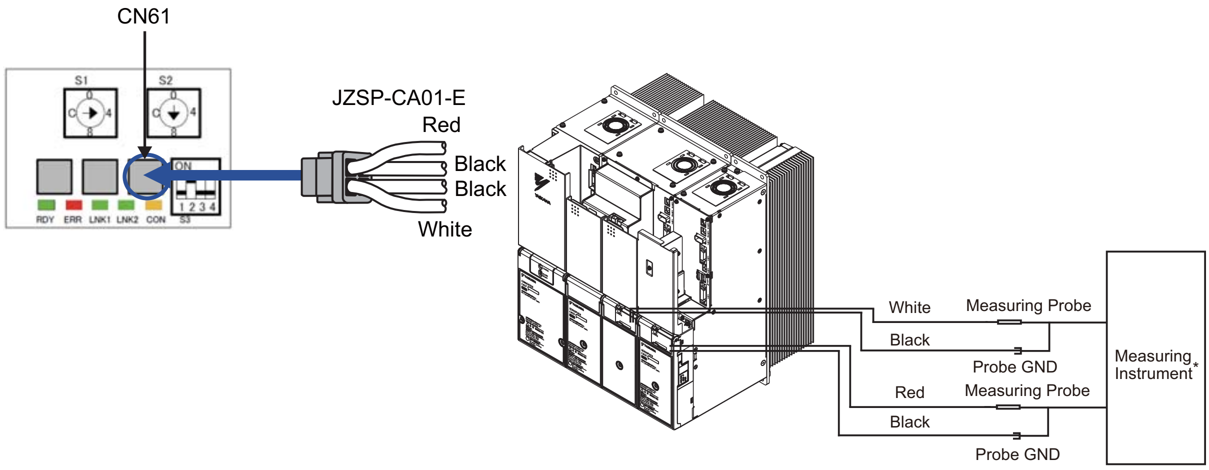
10.1.3 Monitoring Analog Signals

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 (JZSP-CA01-E) to the connectors CN61 and CN62.

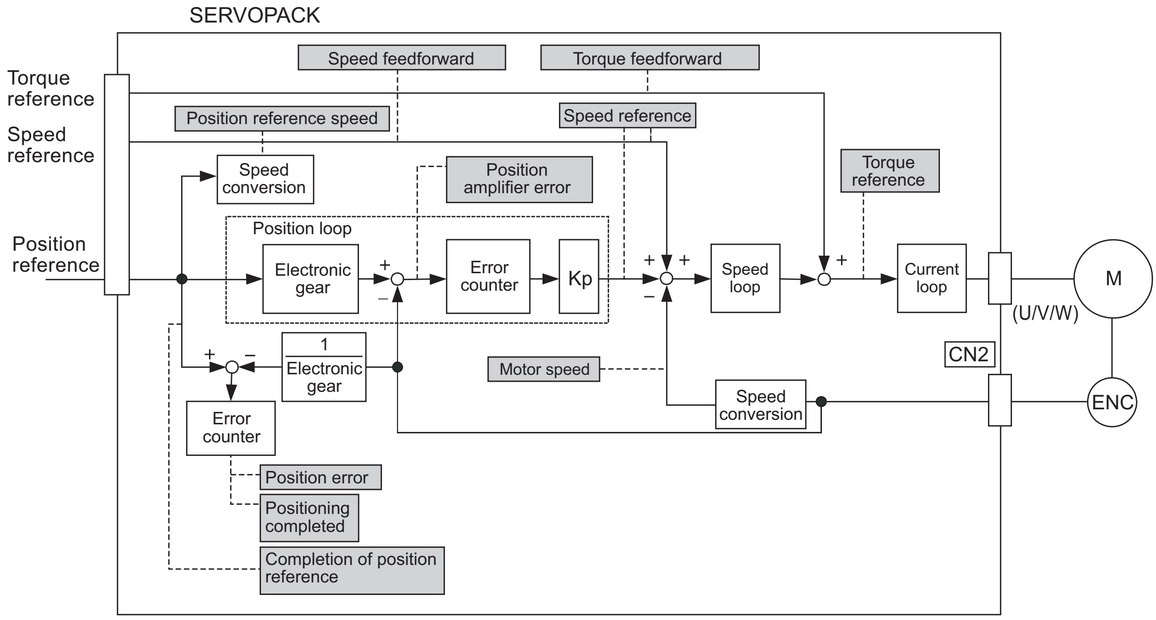


*Measuring instrument is not included.
The user is responsible for providing it.

Line Color	Signal Name	Factory Setting
White	Analog monitor 1	Torque reference: 1 V/100% rated torque (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		Description		
		Monitor Signal	Unit	Remarks
Pn006 Pn007	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	1 V/100% rated torque	–
	n.□□03	Position error	0.05 V/1 reference unit	0 V at speed/torque control
	n.□□04	Position amplifier error	0.05 V/1 encoder pulse unit	–
	n.□□05	Position reference speed	1 V/1000 min^{-1}	–
	n.□□06	Reserved	–	–
	n.□□07	Reserved setting (Do not use.)	–	–
	n.□□08	Positioning completed	Completed: 5 V 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 Not completed: 0 V	Completion indicated by output voltage.
	n.□□0D	Reserved setting (Do not use.)	–	–
	n.□□46	Reserved setting (Do not use.)	–	–
	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.

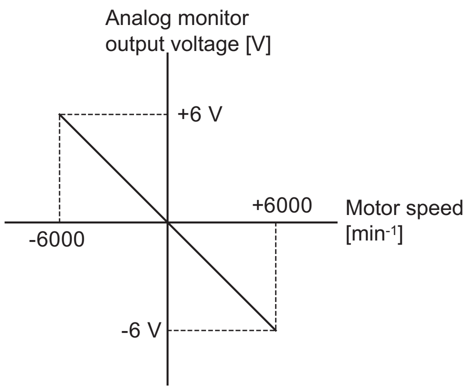
Analog monitor 1 output voltage = (-1) × (Signal selection (Pn006=n.00□□) × Multiplier (Pn552) + Offset voltage [V] (Pn550))

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

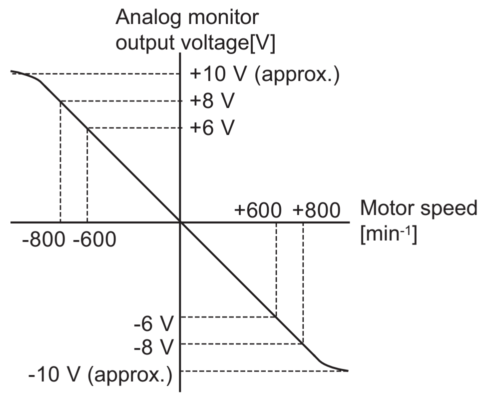
<Example>

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

When multiplier is set to × 1:



When multiplier is set to × 10:



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

(4) Related Parameters

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

Pn550	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	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	Analog Monitor Magnification (× 1)		Speed Position		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	-10000 to 10000	× 0.01	100	Immediately	Setup

Pn553	Analog Monitor Magnification (× 2)		Speed Position		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	-10000 to 10000	× 0.01	100	Immediately	Setup

10.1.4 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 *8.2.2 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 *8.4 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.

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

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

$$\text{Pn520} > \frac{\text{Max. Motor Speed [min}^{-1}]}{60} \times \frac{\text{Encoder Resolution}^{*1}}{\text{Pn102 (1/s)}^{*2}} \times (1.2 \text{ to } 2)^{*3}$$

*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	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	Excessive Position Error Alarm Level at Servo ON Position				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	1 to 1073741823	1 reference unit	5242880	Immediately	Setup

Pn528	Excessive Position Error Warning Level at Servo ON Position				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	10 to 100	1%	100	Immediately	Setup

Pn529	Speed Limit Level at Servo ON Position				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 10000	1 min^{-1}	10000	Immediately	Setup

■ Related Alarms

Alarm Display	Alarm Name	Meaning
A.D01	Position Error Overflow Alarm at Servo ON	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 13 Inspection, Maintenance, and Troubleshooting* and take the corrective actions.

10.2 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.)

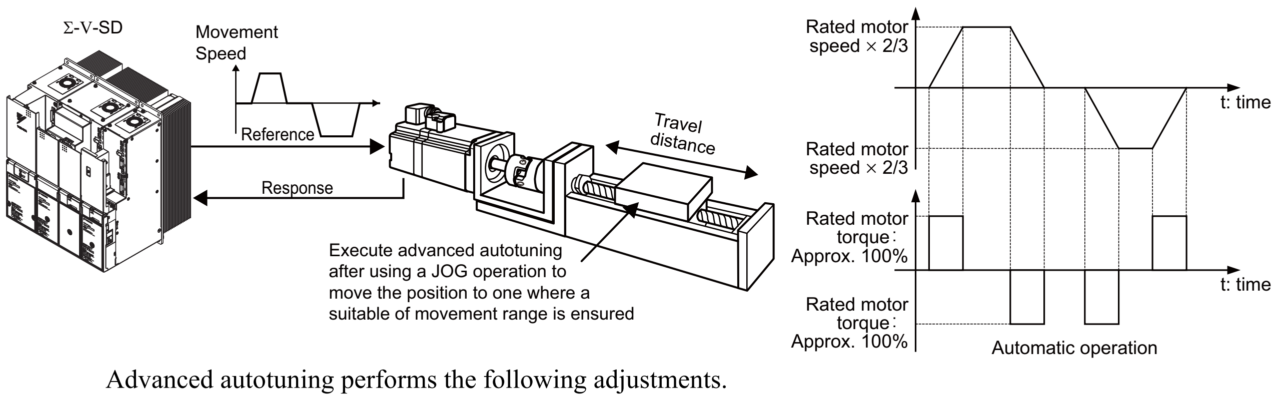
  Pn408=n.00□0 (Does not use friction compensation, 1st notch filter, or 2nd notch filter.)

10.2.1 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 *10.2.2 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.

Adjustments

10

(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 *10.3 Advanced Autotuning by Reference* and *10.4 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 *10.3 Advanced Autotuning by Reference* and *10.4 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	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.

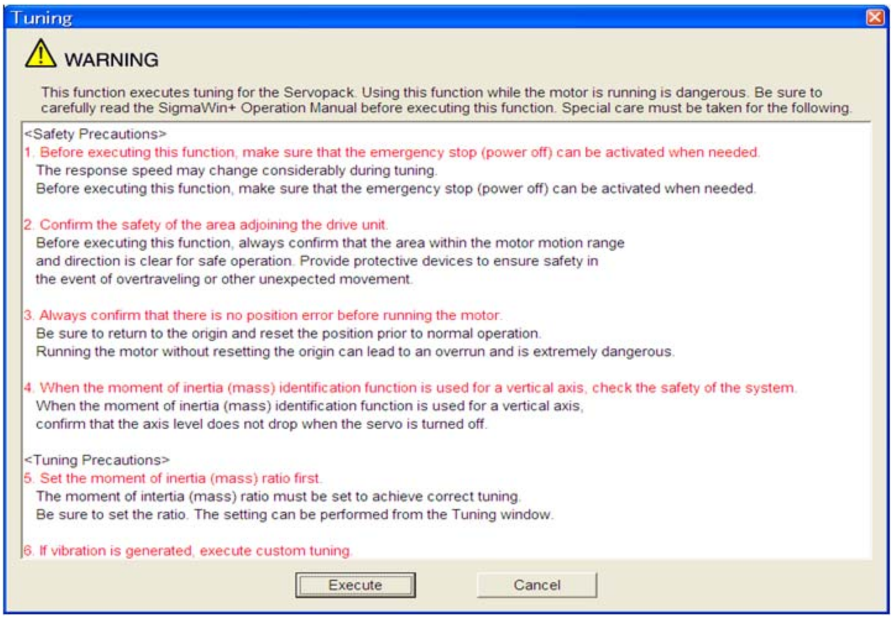
- If the SERVO OFF button is used, the motor will stop according to the stopping method after servo off specified by the parameters.
- If the CANCEL button is used, the motor will decelerate to a stop and then enter a zero clamp state.
  Note: The CANCEL button may be invalid in some SERVOPACKs.

The operating procedure from the SigmaWin for Σ-V-SD (MT) is described here.

⚠ CAUTION

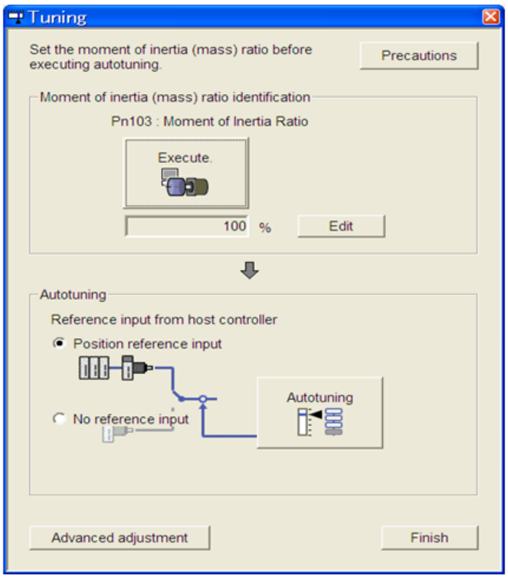
- When using the SERVOPACK with Jcalc = OFF (load moment of inertia is not calculated), be sure to set a suitable value for the moment of inertia ratio (Pn103). If the setting greatly differs from the actual moment of inertia ratio, normal control of the SERVOPACK may not be possible, and vibration may result.

1. In the SigmaWin Σ-V-SD (MT) component main window, click **Tuning** and then click **Tuning**.

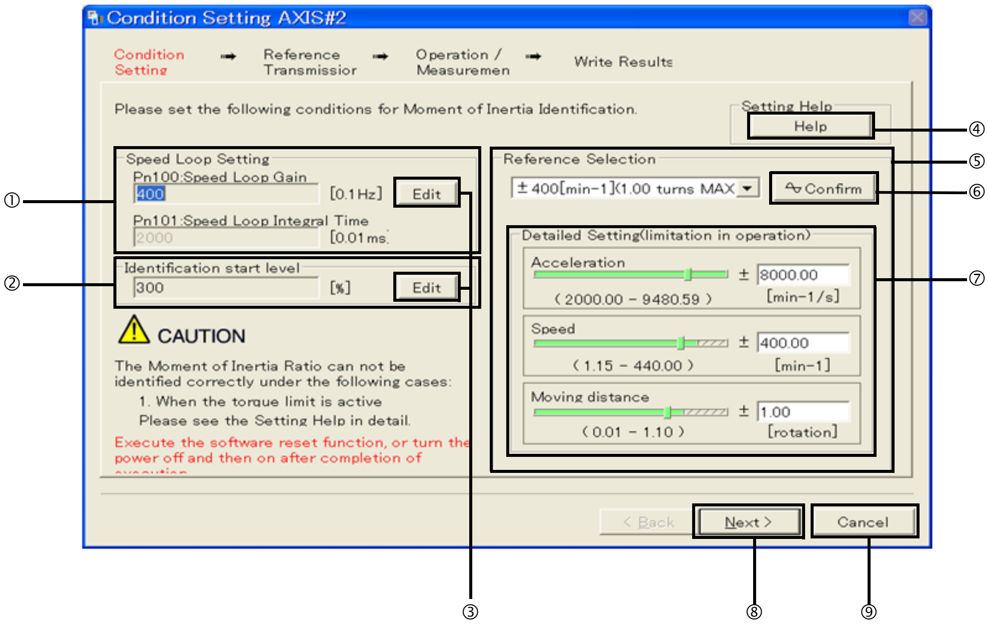


Click **Cancel** to return to the SigmaWin Σ-V-SD (MT) component main window without executing tuning.

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

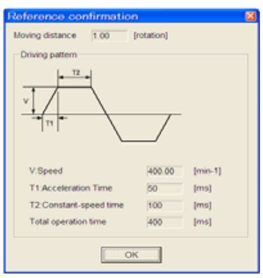
Select a reference pattern from the Reference Selection box or create the reference pattern by directly entering the values.

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.



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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.

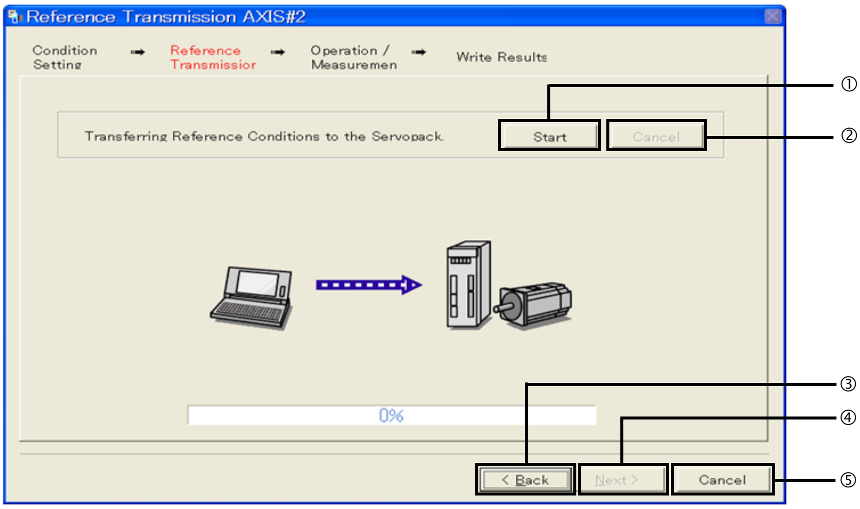
⚠ CAUTION

- 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.

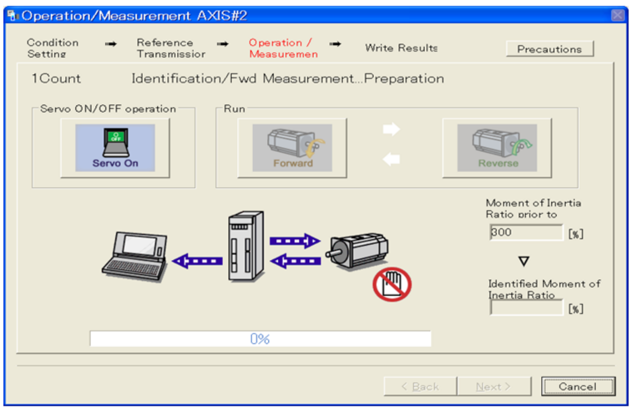
Click **Next** to view the Operation/Measurement box.

⑤Cancel

Click **Cancel** to stop processing and return to the main window.

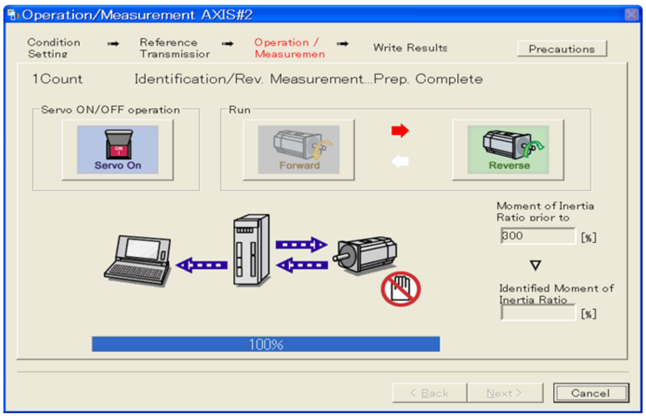
5. Click **Start** to transfer the reference conditions to the SERVOPACK.

6. Click **Next**. The following window appears.

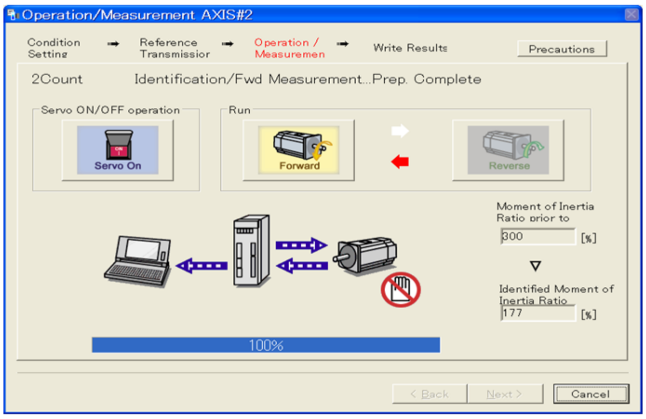


7. Click **Servo On**.

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.

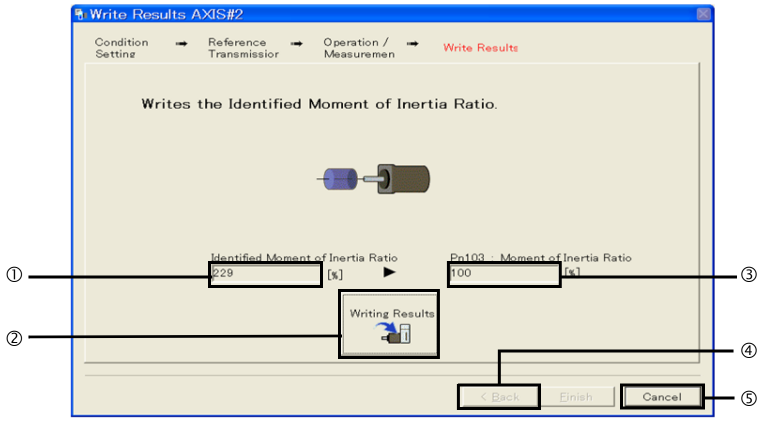


10. Repeat steps 7 through 9 until all the measurements have been taken.

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

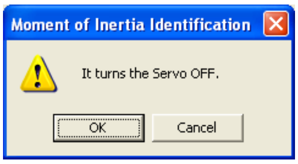
The **Back** button is unavailable.

⑤Cancel

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

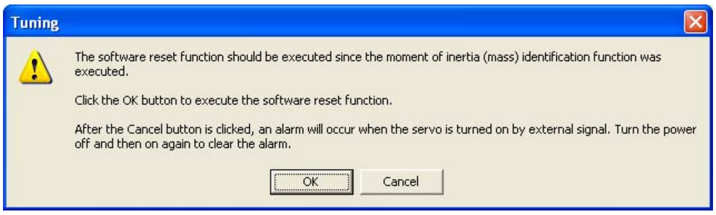
<Supplement>

When **Next** is clicked without turning to the servo OFF status, the following message appears. Click **OK** to turn to the servo OFF status.



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.



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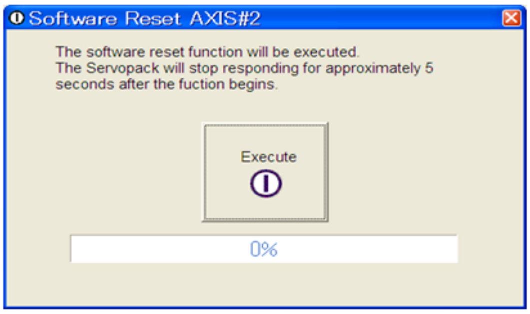
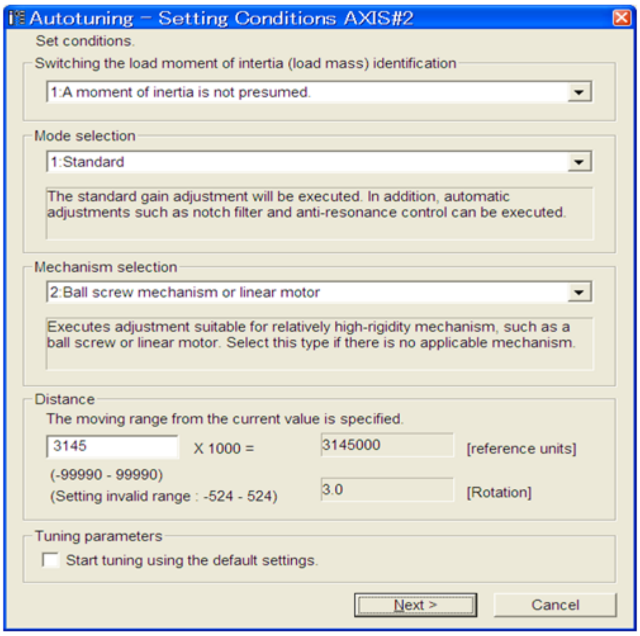
15. Click **OK**. The following window appears.



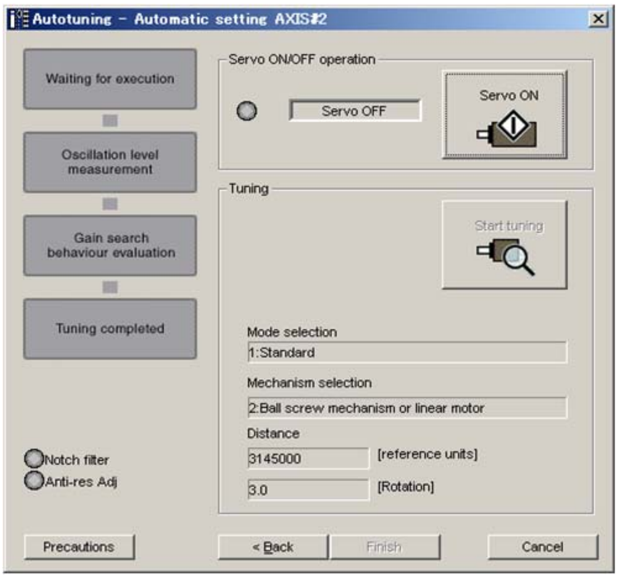
16. Click **Execute** to save the change of Pn103 (Moment of Inertia (Mass) Ratio) to SERVOPACK. After the saving is finished, the tuning main window appears.

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.

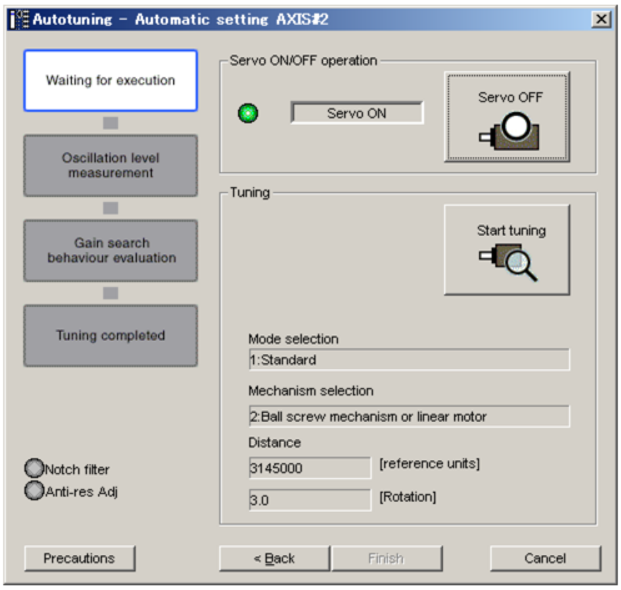


18. Select whether or not to use the load moment of inertia (load mass) identification from the **Switching the load moment of inertia (load mass) identification** box, the mode from the **Mode selection** box, the mechanism from the **Mechanism selection** box, and enter the moving distance. Then, click **Next**.

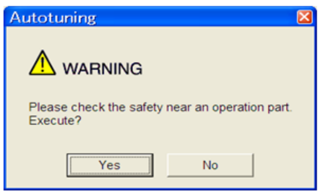
When the **Start tuning using the default settings**. check box is selected in the Autotuning-Setting Conditions box, tuning will be executed using the tuning parameters set to the default values.



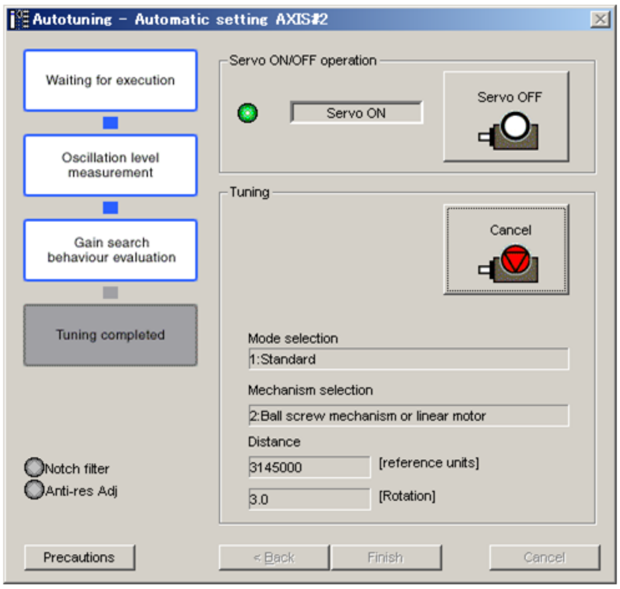
19. Click **Servo ON**. The following window appears.



20. Click **Start tuning**. The following box appears.



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.

10.2.2 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
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
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

10.3 Advanced Autotuning by Reference

Adjustments with advanced autotuning by reference are described below.

IMPORTANT

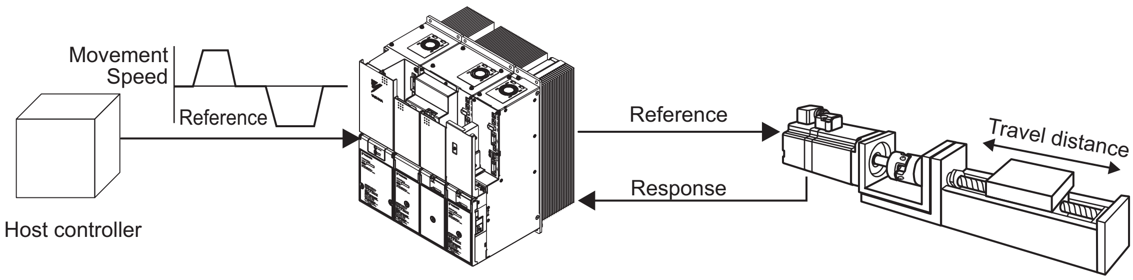
Advanced autotuning by reference starts adjustments based on the set speed loop gain (Pn100). Therefore, precise adjustments cannot be made if there is vibration when starting adjustments. In this case, make adjustments after lowering the speed loop gain (Pn100) until vibration is eliminated.

10.3.1 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 *10.3.2 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.
- 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 *10.4 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 stopping time, i.e., the period while the positioning completed PSET bit (SVCMD_IO bit 14) is ON, is 10 ms or less.
- 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	Overshoot Detection Level		Speed Position		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 100	1%	50	Immediately	Setup

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(3) Advanced Autotuning by Reference Procedure

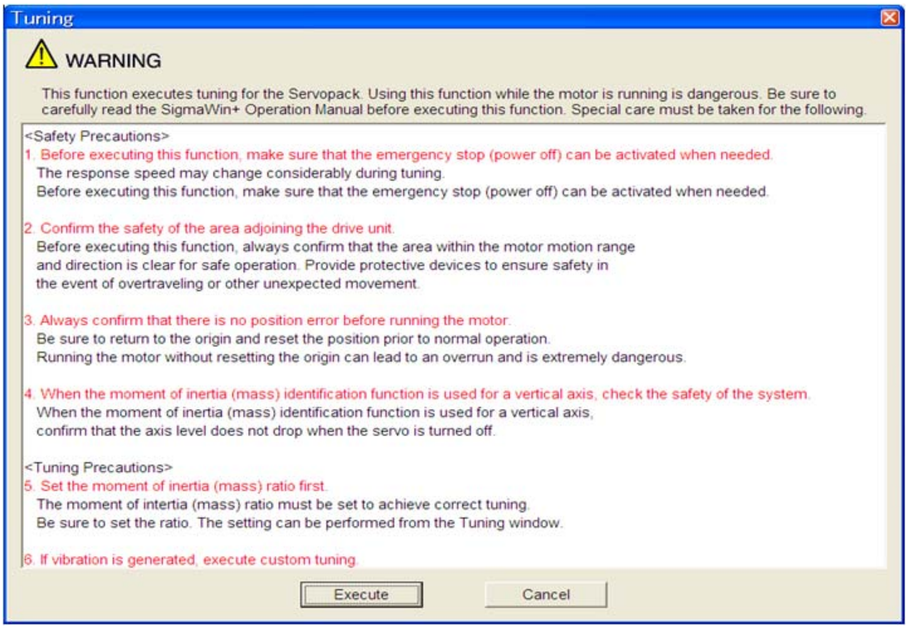
The following procedure is used for advanced autotuning by reference.

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.

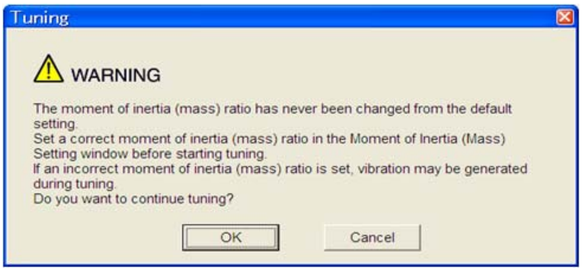
1. Confirm that the correct moment of inertia ratio in Pn103 is set by using the advanced autotuning.

2. In the SigmaWin Σ-V-SD (MT) component main window, click **Tuning** and then click **Tuning**.

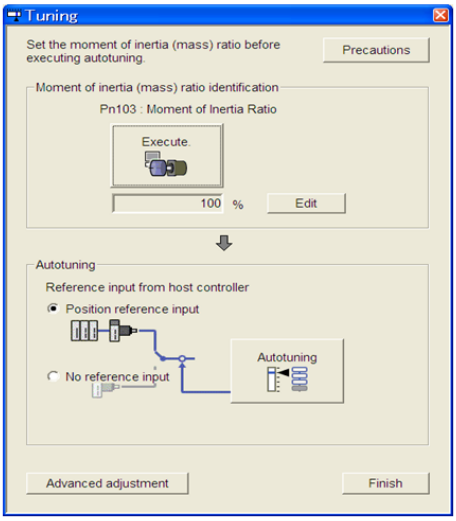


Click **Cancel** to return to the SigmaWin Σ-V-SD (MT) component main window without executing tuning.

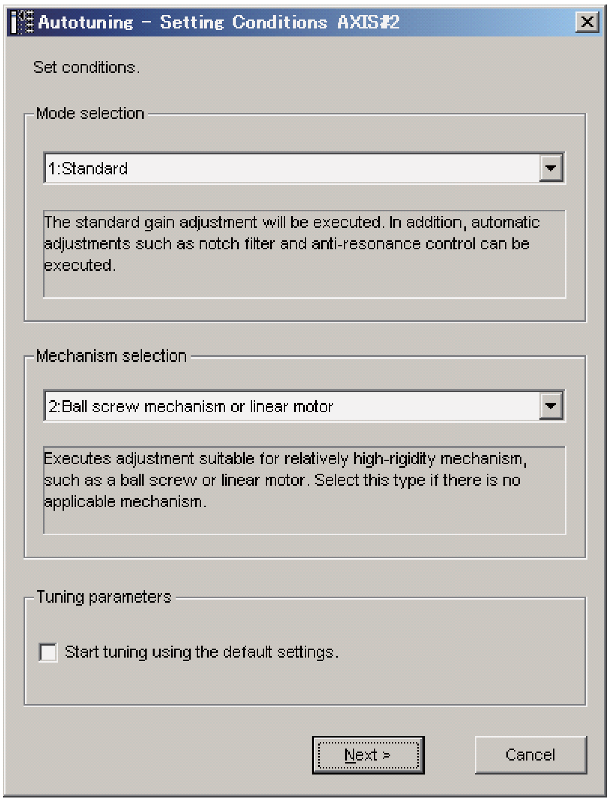
3. Click **Execute**. The following window appears.



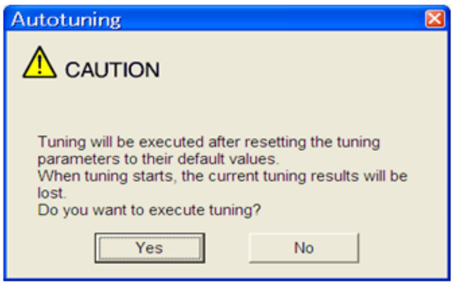
4. After confirming that there is no problem, click **OK**. The following window appears.



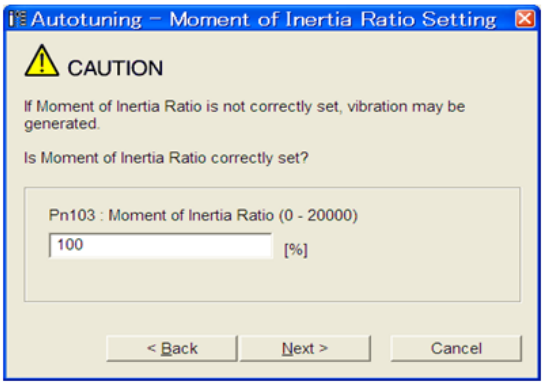
5. Select the **Position reference input** option under **Reference input from host controller** in the Tuning main window, and then click **Autotuning**. The following window appears.



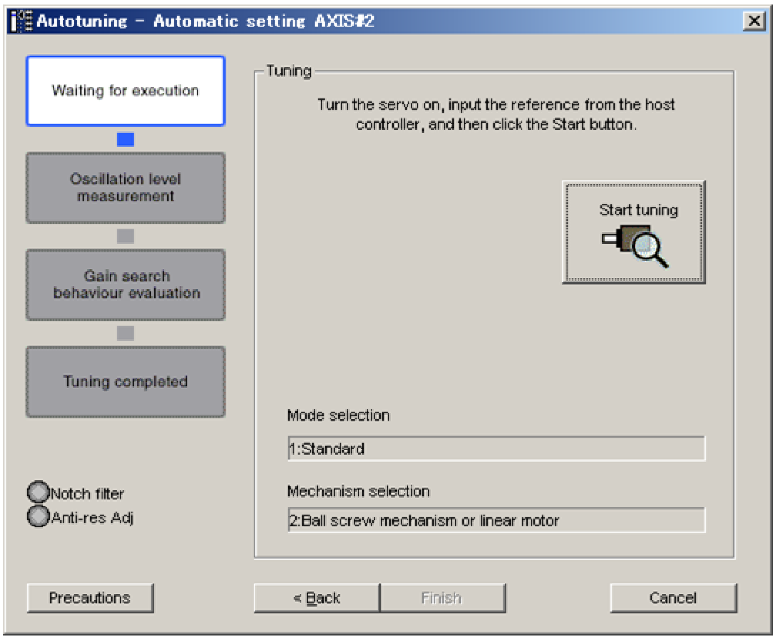
6. Select the mode from the **Mode selection** combo box and the mechanism from **Mechanism selection** combo box, and then click **Next**. When the **Start tuning using the default settings**. check box is selected in the Autotuning-Setting Conditions box, tuning will be executed using tuning parameters set to the default value.



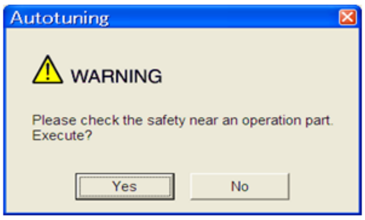
7. Click **Yes**. The following box appears.



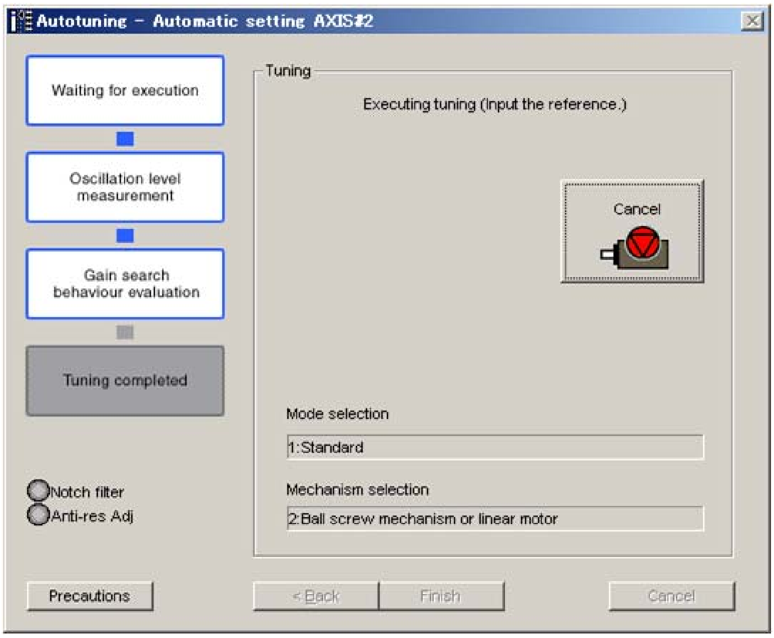
8. Enter the correct moment of inertia ratio and then click **Next**. The following window appears.



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.

10.3.2 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
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

10.4 One-parameter Tuning

Adjustments with one-parameter tuning are described below.

10.4.1 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 *10.4.2 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 *10.6 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

The following procedure is used for one-parameter tuning.

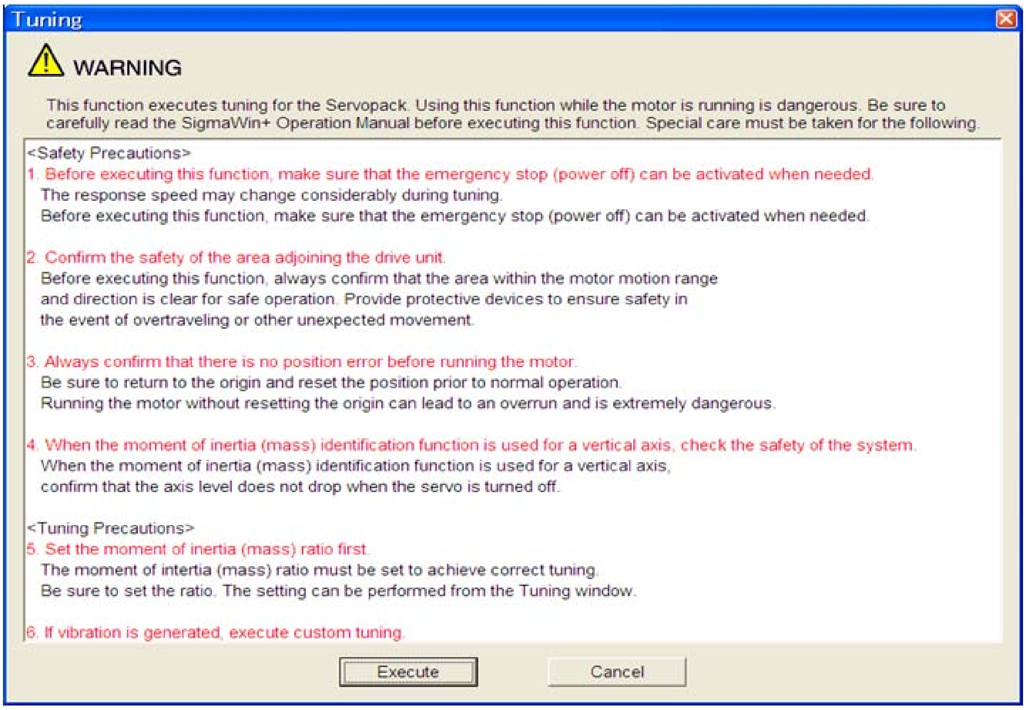
One-parameter tuning is performed from the SigmaWin for Σ-V-SD (MT).

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, this new level is applied after the positioning completion signal is output (after bit 14 (PSET) of SVCMD_IO is changed to 1).

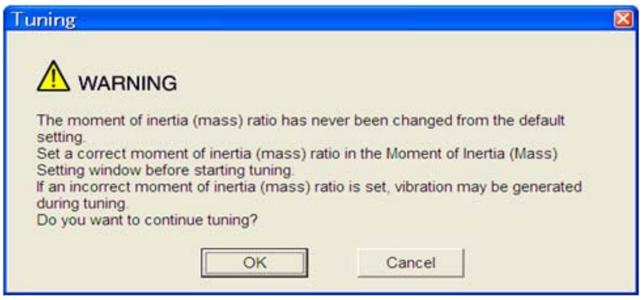
1. Confirm that the correct moment of inertia ratio in Pn103 is set.

2. In the SigmaWin Σ-V-SD (MT) component main window, click **Tuning** and then click **Tuning**.

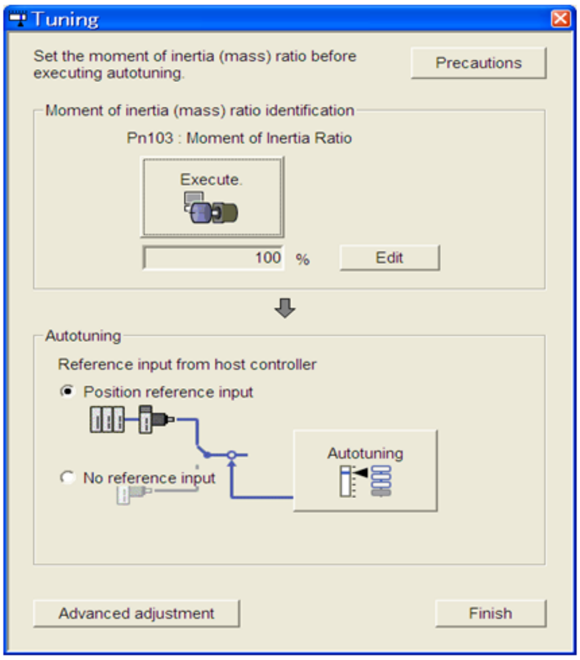


Click **Cancel** to return to the SigmaWin Σ-V-SD (MT) component main window without executing tuning.

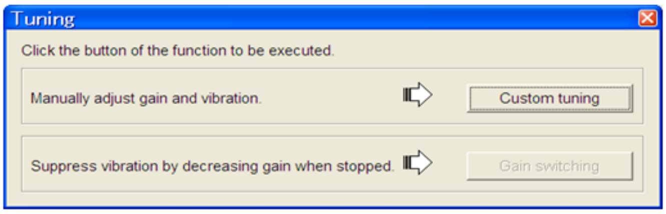
3. Click **Execute**. The following window appears.



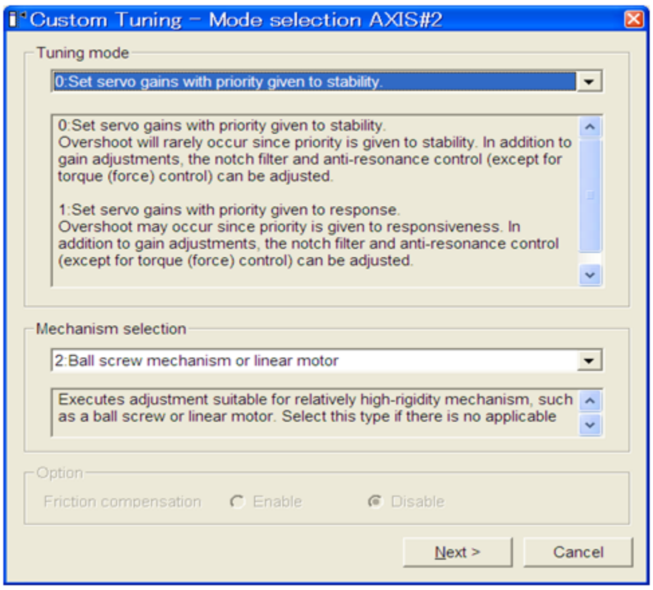
4. Click **OK**. The following window appears.



5. Click **Advanced adjustment**. The following box appears.



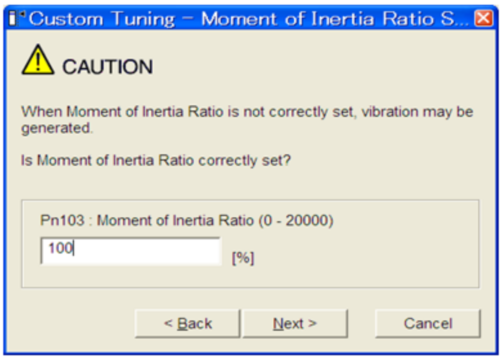
6. Click **Custom tuning**. The following box appears.



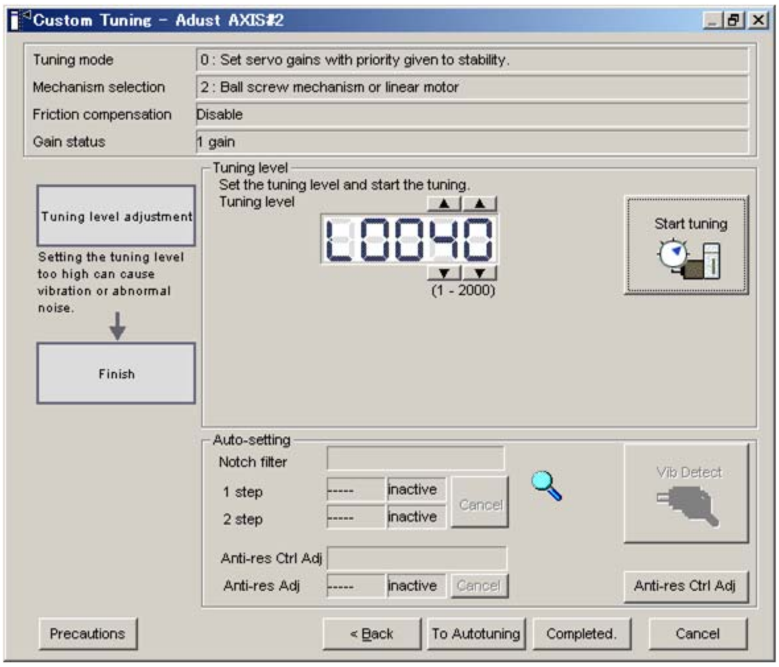
7. Select the tuning mode and the mechanism.

The tuning modes that can be selected will vary according to the SERVOPACK setting.

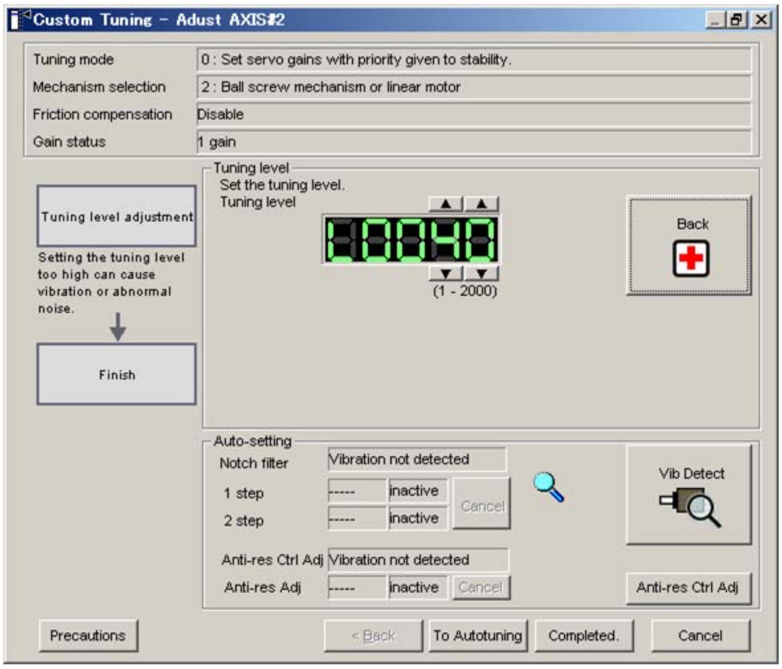
8. Click **Next**. The following box appears.



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**.



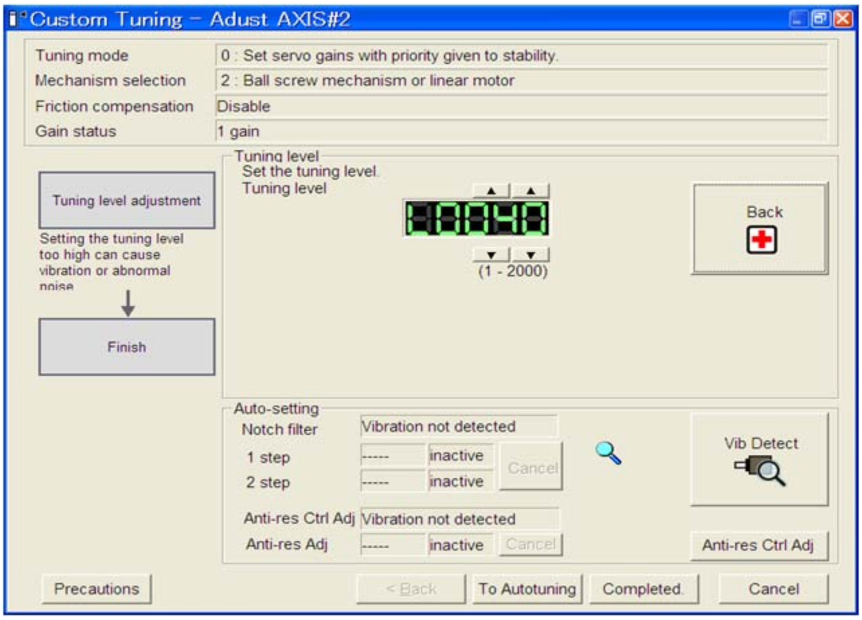
11. Change the tuning level by clicking the setting arrows. Continue to raise the level until an overshoot occurs.

Note:The new tuning level is applied after the positioning completion signal is output (after bit 14 (PSET) of SVC-MD_IO 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.

See ■ *Functions To Suppress Vibration* for details.

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.

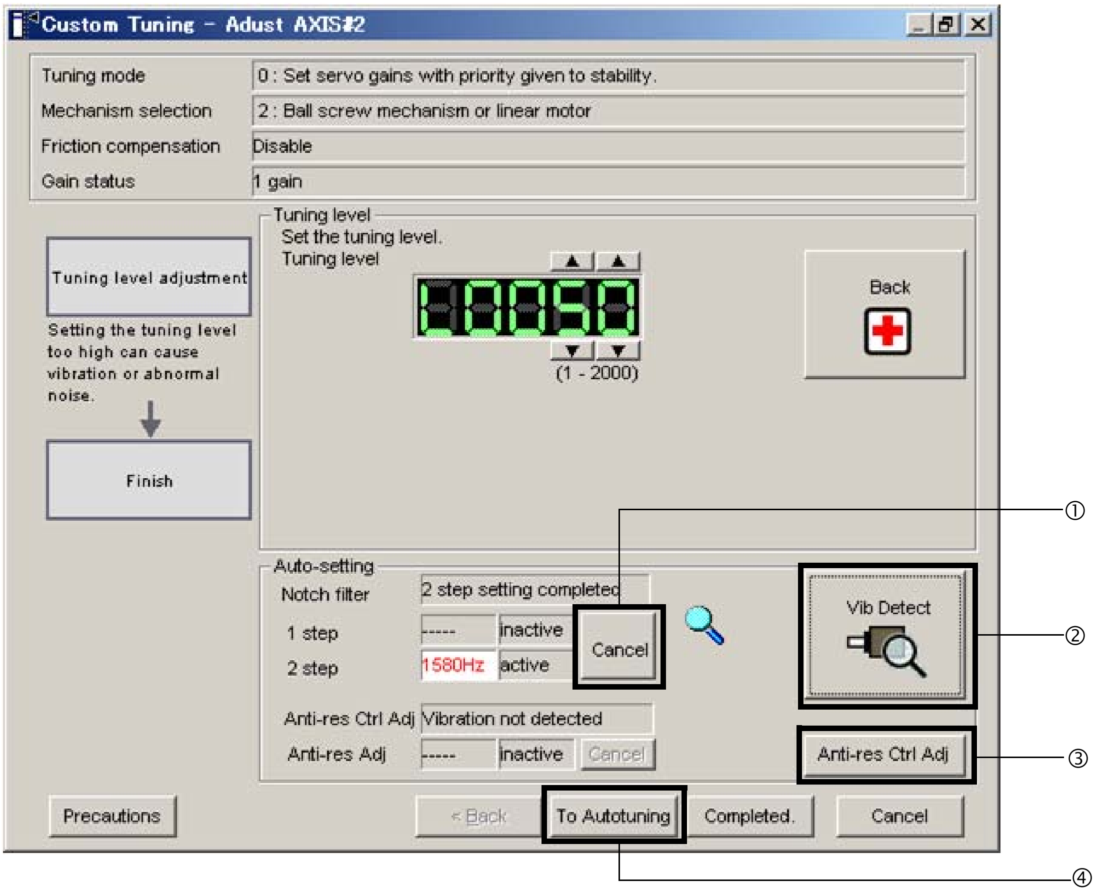
■ Functions To Suppress Vibration

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 *10.5 Anti-Resonance Control Adjustment Function* for details.

④ **To Autotuning**

Click **To Autotuning** to execute autotuning using reference inputs from the host controller. See *10.3.1 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		Function	When Enabled	Classification
Pn460	n.□□□0	Does not set the 1st notch filter automatically with the utility function.	Immediately	Tuning
	n.□□□1 [Factory setting]	Sets the 1st notch filter automatically with the utility function.		
	n.□0□□	Does not set the 2nd notch filter automatically with the utility function.		
	n.□1□□ [Factory setting]	Sets the 2nd notch filter automatically with the utility function.		

■ Anti-Resonance Control Adjustment

This function reduces low vibration frequency, which the notch filter does not detect.

Usually, set this function to Auto Setting. (The anti-resonance control is factory-set to Auto Setting.)
When this function is set to Auto Setting, vibration will be automatically detected during one-parameter tuning and anti-resonance control will be automatically adjusted and set.

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

10.4.2 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	Yes
Pn104	2nd Speed Loop Gain	No	No
Pn105	2nd Speed Loop Integral Time Constant	No	No
Pn106	2nd Position Loop Gain	No	No
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	No

10.5 Anti-Resonance Control Adjustment Function

This section describes the anti-resonance control adjustment function.

10.5.1 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.**

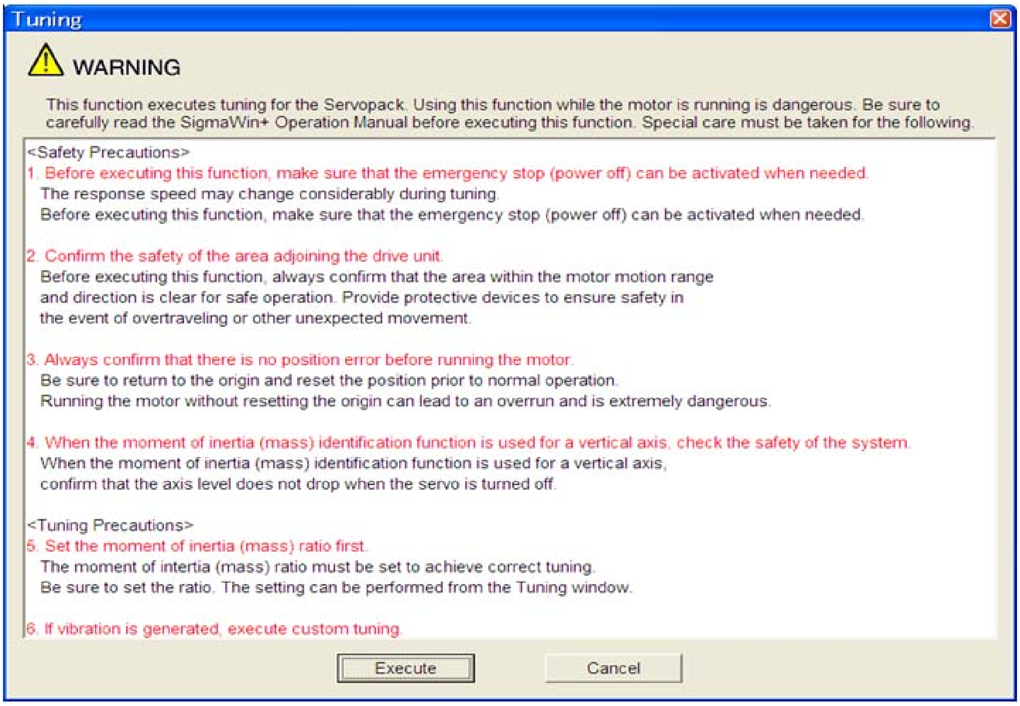
  If it is not correctly set, satisfactory anti-resonance control cannot be achieved.
- **This function is generally only used to adjust the servo gain, as you should avoid considerable change in the frequency.**

  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.

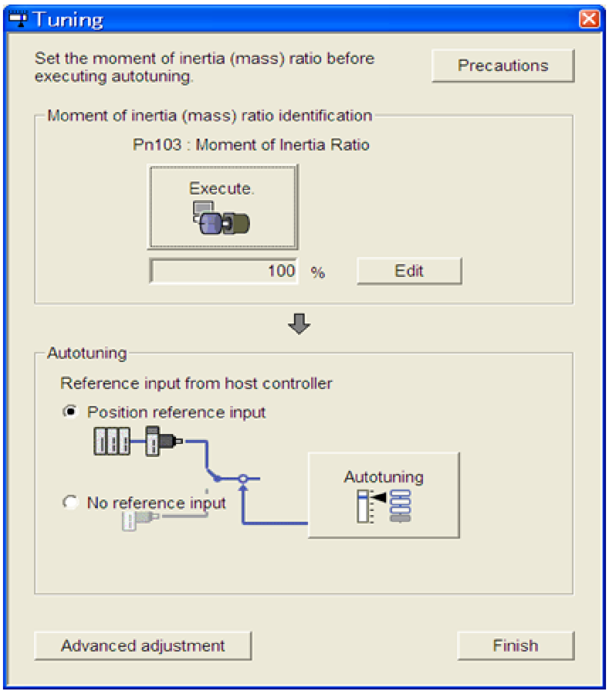
■ With Undetermined Vibration Frequency

1. In the SigmaWin Σ-V-SD (MT) component main window, click **Tuning** and then click **Tuning**.

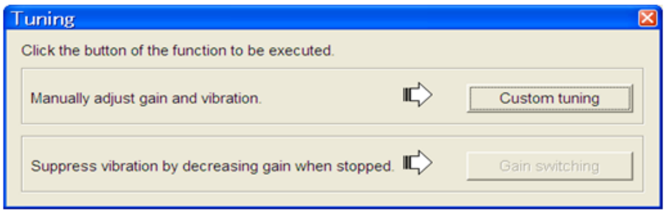


Click **Cancel** to return to the SigmaWin Σ-V-SD (MT) component main window without executing tuning.

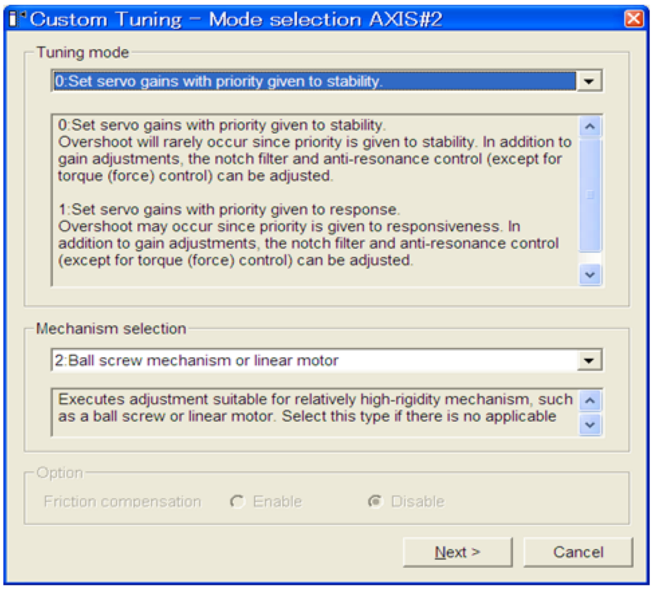
2. Click **Execute**. The following window appears.



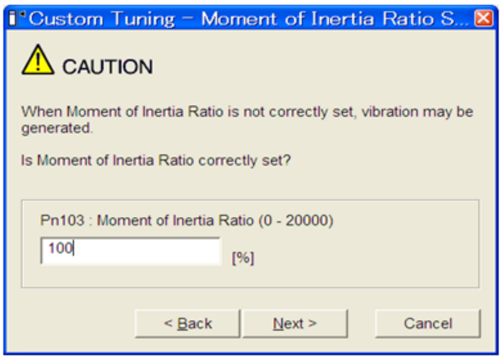
3. Click **Advanced adjustment**. The following box appears.



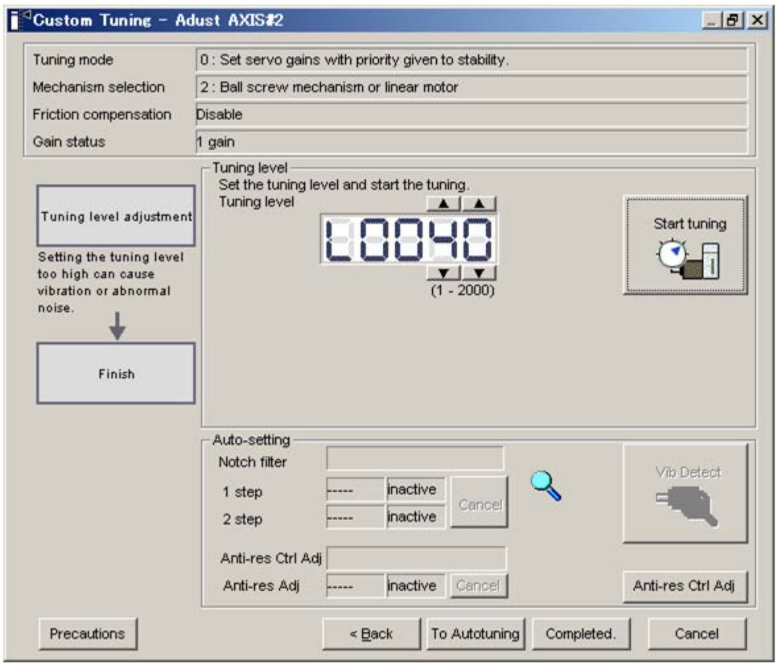
4. Click **Custom tuning**. The following box appears.



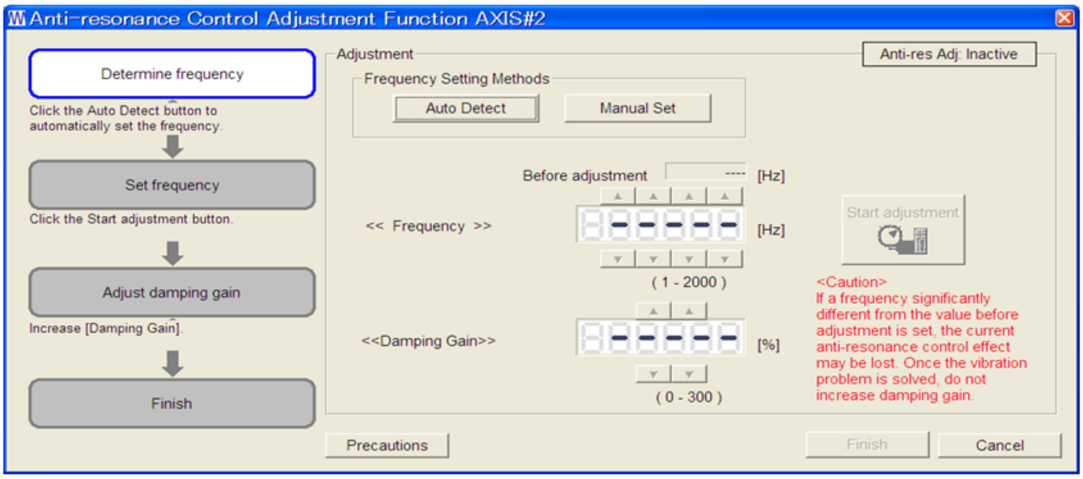
5. Select the tuning mode and the mechanism, and then click **Next**. The following box appears.



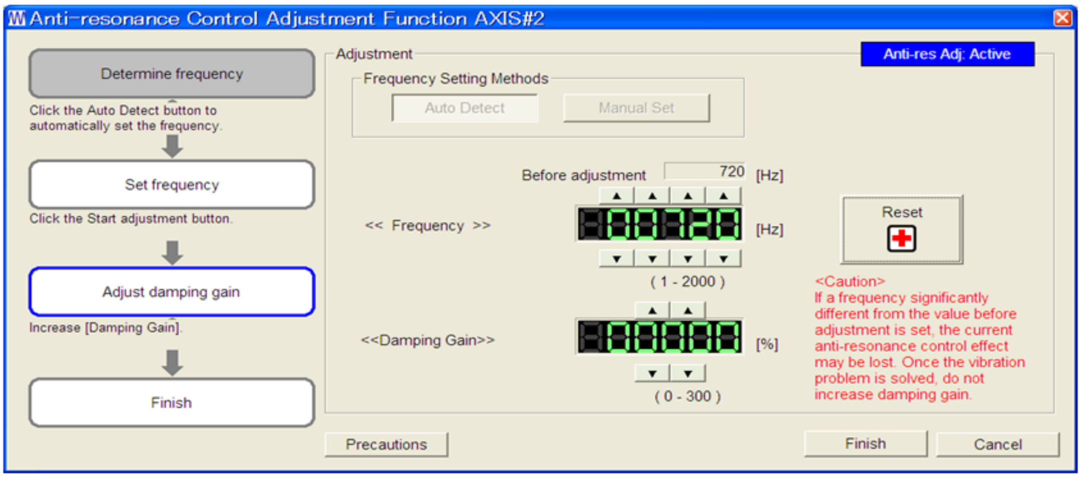
6. Enter the correct moment of inertia ratio and then click **Next**. The following window appears.



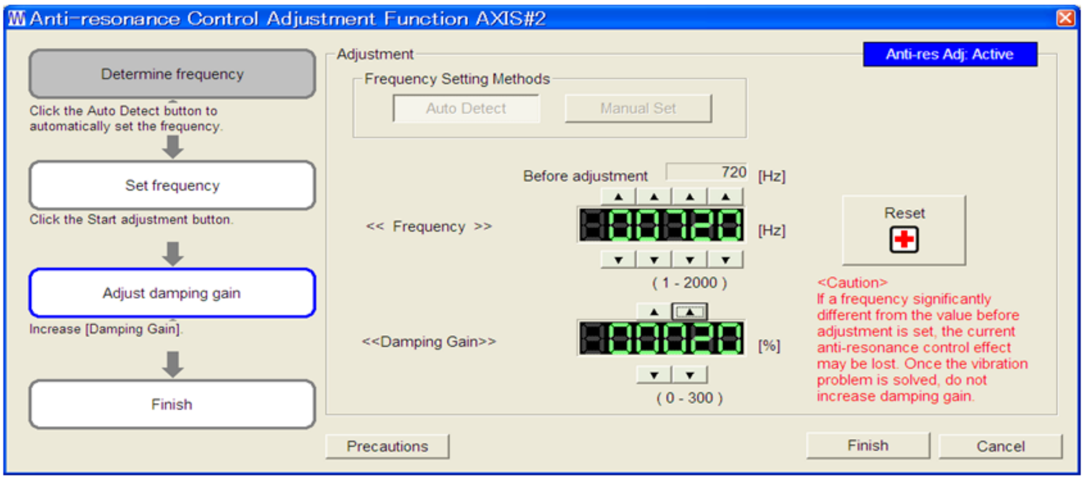
7. Click **Anti-res Ctrl Adj**. The following window appears.



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.

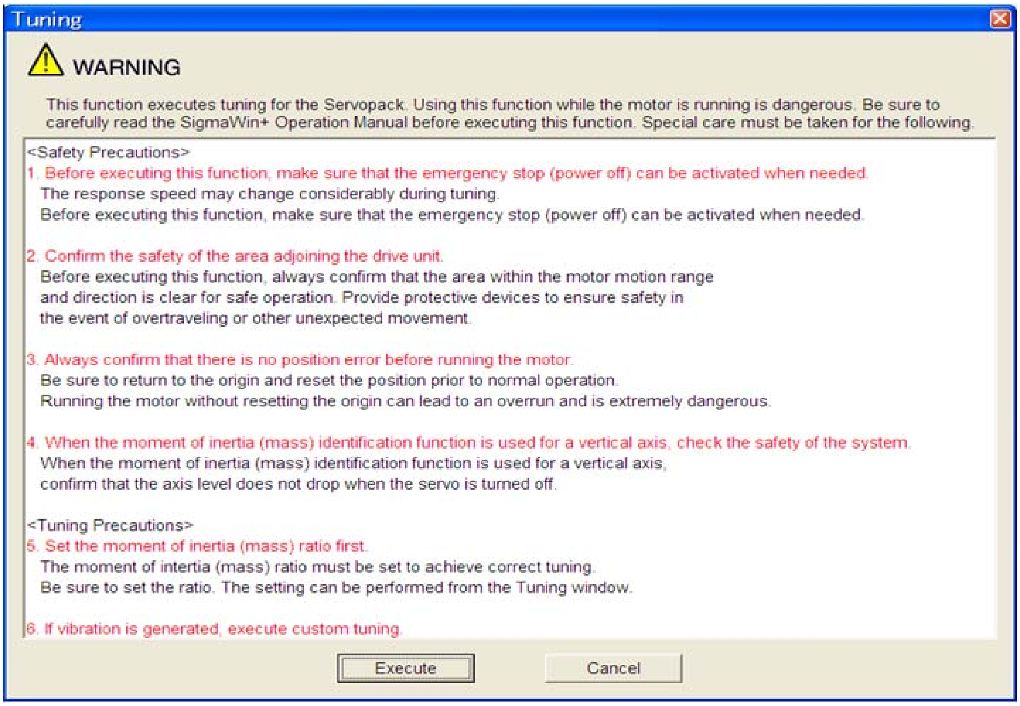


Click **Reset** to reset the settings to their original values during adjustment.

10. When the adjustment is complete, click **Finish** to return to the main window. The set values will be written in the SERVOPACK.

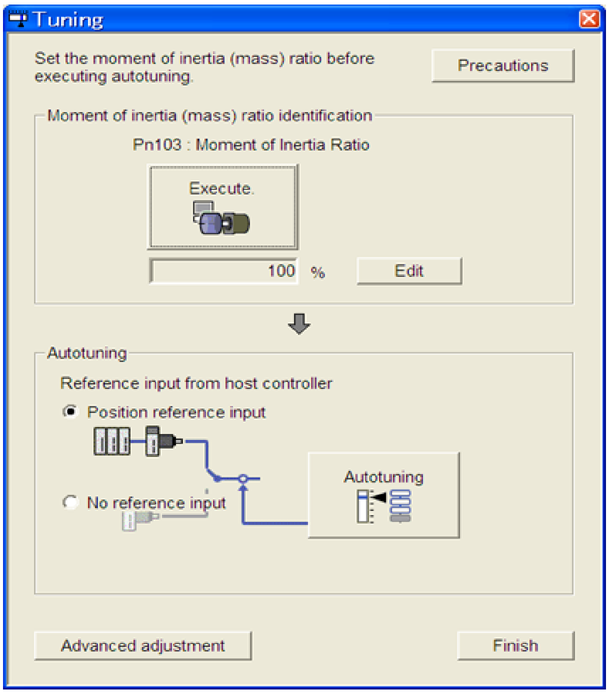
■ With Determined Vibration Frequency

1. In the SigmaWin Σ-V-SD (MT) component main window, click **Tuning** and then click **Tuning**.

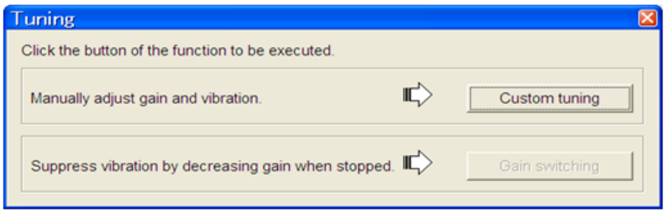


Click **Cancel** to return to the SigmaWin Σ-V-SD (MT) component main window without executing tuning.

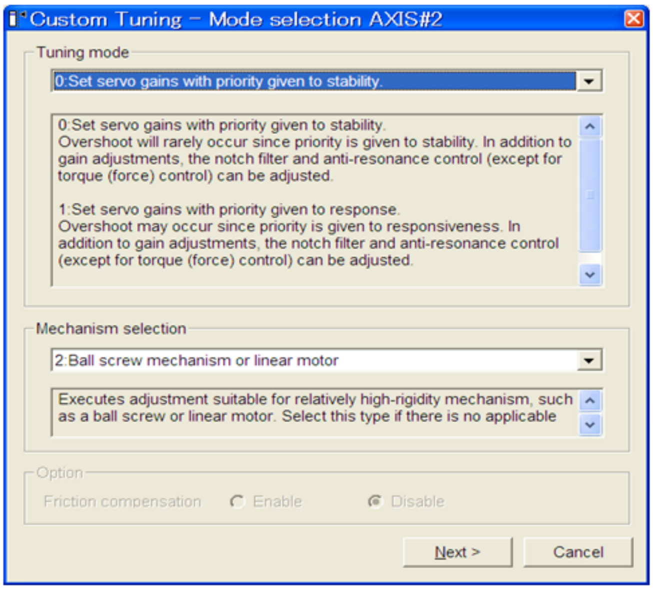
2. Click **Execute**. The following window appears.



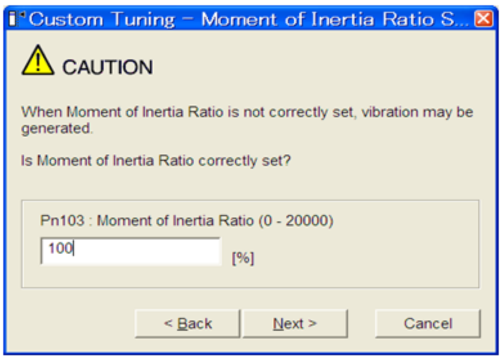
3. Click **Advanced adjustment**. The following box appears.



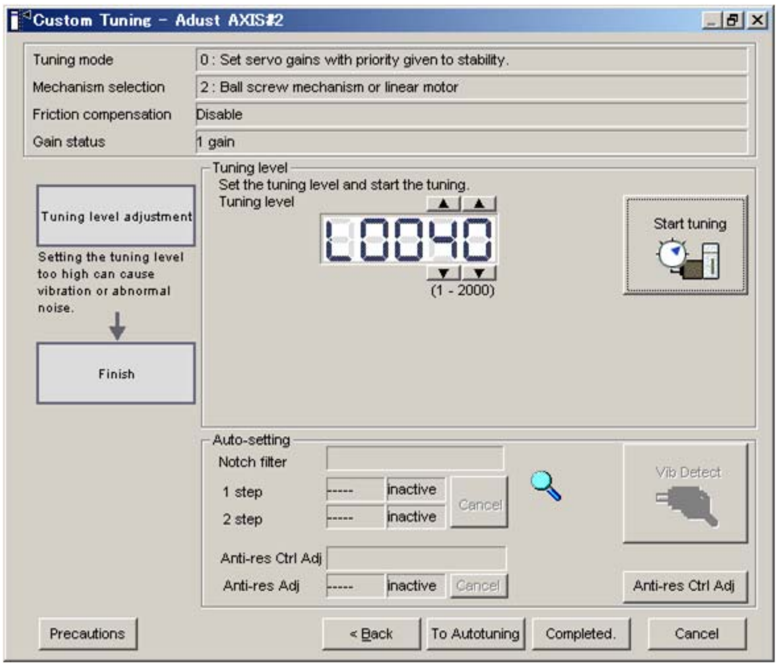
4. Click **Custom tuning**. The following box appears.



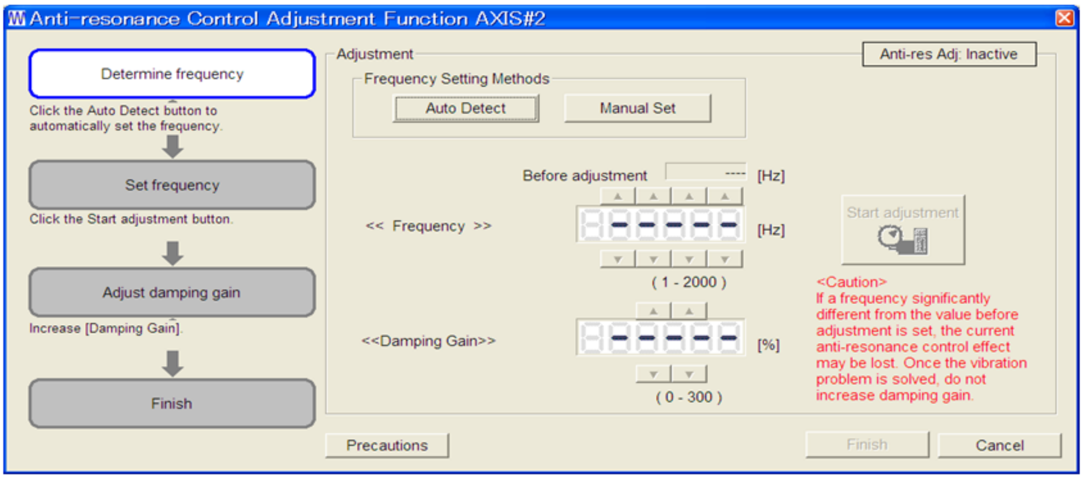
5. Select the tuning mode and the mechanism, and then click **Next**. The following box appears.



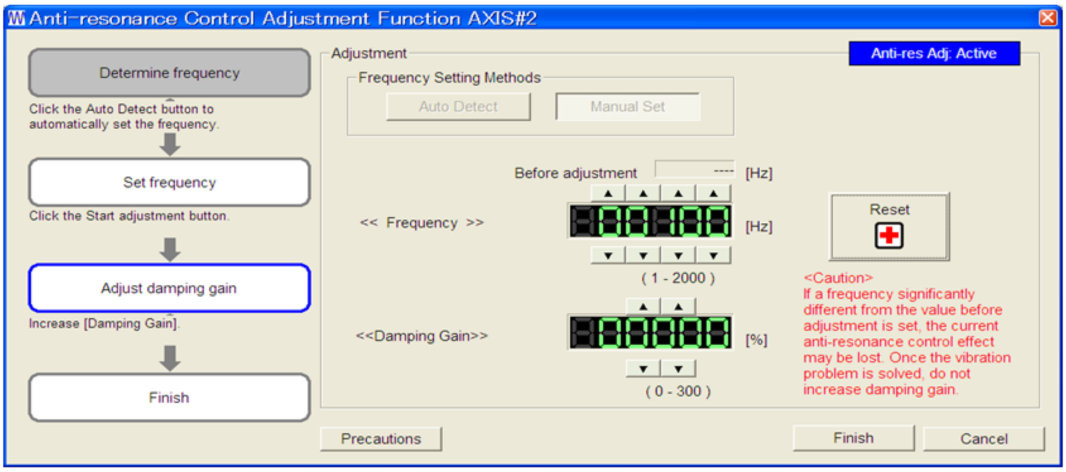
6. Enter the correct moment of inertia ratio and then click **Next**. The following window appears.



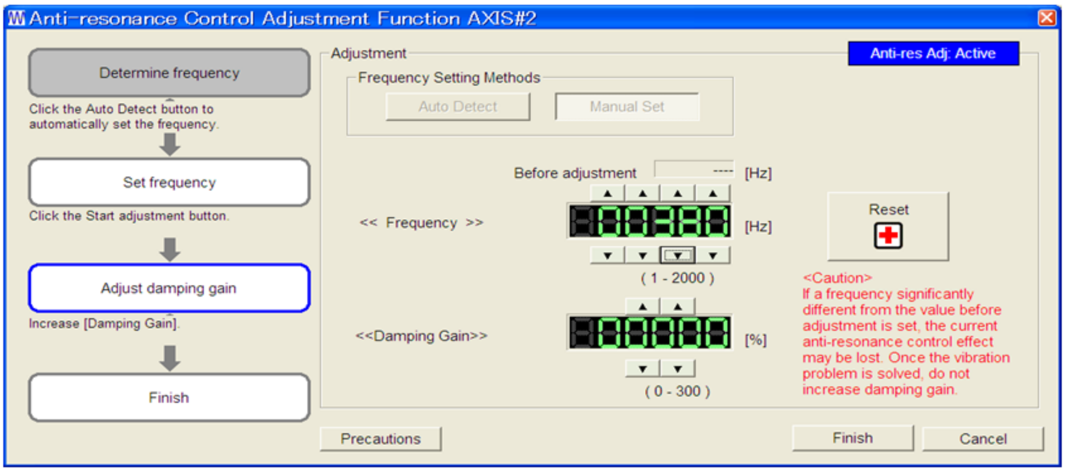
7. Click **Anti-res Ctrl Adj**. The following window appears.



8. Click **Manual Set** to set the frequency and click **Start adjustment**. The following window appears.

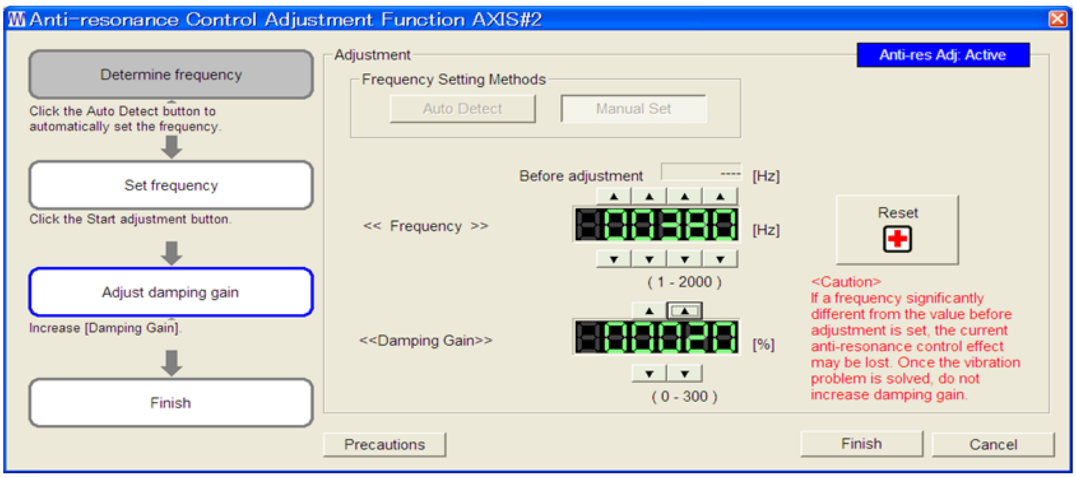


9. Adjust the frequency by clicking the setting arrows.



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.

10.5.2 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

10.6 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

2. Set SVCMD_IO* in the command and the related parameters.

Refer to the following table to make the required settings for SVCMD_IO and the parameters.

* For details, refer to the *Σ-V-SD Series User's Manual MECHATROLINK-III Standard Servo Profile Commands* (Manual No.: SIEP S800000 76).

<table>
<tr><th rowspan="4">Operation Mode</th><th colspan="4">SVCMD_IO (Output)</th><th colspan="3" rowspan="2">Control Function</th><th rowspan="4">Remark</th></tr>
<tr><th colspan="4">G-SEL</th></tr>
<tr><th>Bit11</th><th>Bit10</th><th>Bit9</th><th>Bit8</th><th>Pn070.0</th><th>Pn070.1</th><th>Pn071.0</th></tr>
<tr><th colspan="2">Operation Mode</th><th colspan="2">Gain Selection</th><th>Predictive Control</th><th>Quadrant Projection Compensation</th><th>Internal speed feedforward control and model following control</th></tr>
<tr><td rowspan="4">Cutting operation</td><td colspan="2" rowspan="4">0</td><td colspan="2" rowspan="4">Gain bank 0 (Fixed)</td><td>0</td><td>0</td><td>–</td><td rowspan="4">Cannot use internal speed feedforward control function.</td></tr>
<tr><td>0</td><td>1 or 2</td><td>–</td></tr>
<tr><td>1</td><td>0</td><td>–</td></tr>
<tr><td>1</td><td>1 or 2</td><td>–</td></tr>
<tr><td>High-speed feeding operation</td><td colspan="2">1</td><td colspan="2">Gain bank 1 (Fixed)</td><td>–</td><td>–</td><td>0 or 1 or 2</td><td>–</td></tr>
</table>

• Related Parameters

<table>
<tr><th colspan="2">Parameter</th><th>Function</th><th>When Enabled</th><th>Classification</th></tr>
<tr><td rowspan="5">Pn070</td><td>n.□□□0 [Factory setting]</td><td>Disables predictive function.</td><td rowspan="5">After restart</td><td rowspan="5">Setup</td></tr>
<tr><td>n.□□□1</td><td>Enables predictive function.</td></tr>
<tr><td>n.□□0□ [Factory setting]</td><td>Disables quadrant projection compensation function.</td></tr>
<tr><td>n.□□1□</td><td>Enables quadrant projection compensation function 1.</td></tr>
<tr><td>n.□□2□</td><td>Enables quadrant projection compensation function 2.</td></tr>
<tr><td rowspan="3">Pn071.0</td><td>n.□□□0 [Factory setting]</td><td>No function</td><td rowspan="3">After restart</td><td rowspan="3">Setup</td></tr>
<tr><td>n.□□□1</td><td>Uses internal speed FF function.</td></tr>
<tr><td>n.□□□2</td><td>Uses model following control function.</td></tr>
</table>

• Parameters for Gain Bank 0 to 3

Parameter	Gain Bank	
	0	1
Speed Loop Gain	Pn100	Pn104
Speed Loop Integral Time Constant	Pn101	Pn105
Position Loop Gain	Pn102	Pn106
Torque Reference Filter Time Constant	Pn401	Pn412

11

Monitoring

11.1 Monitoring Product Information

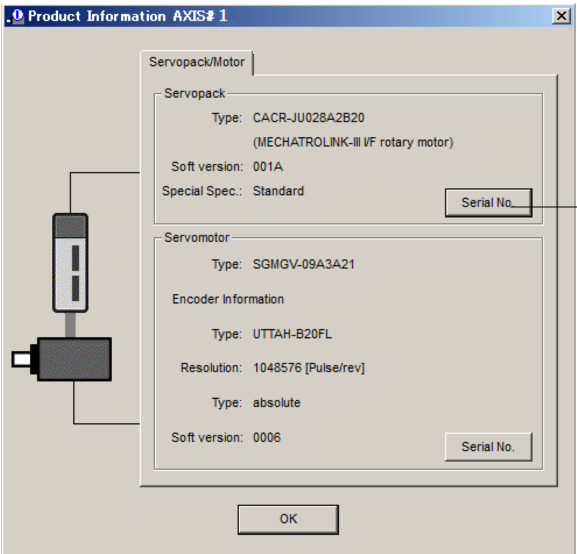
11.1.1 Items That You Can Monitor

Monitor Items	
Information on SERVOPACKs	• SERVOPACK model • SERVOPACK software version • SERVOPACK special specifications • SERVOPACK serial number • SERVOPACK manufacturing date
Information on Servomotors	• Servomotor model • Servomotor serial number • Servomotor manufacturing date
Information on Encoders	• Encoder model • Encoder type • Encoder software version • Encoder serial number • Encoder manufacturing date

11.1.2 Operating Procedure

Use the following procedure to display the product information monitor dialog box.

• Select ***Monitor - Read Product Information*** from the menu bar of the main window of SigmaWin for Σ-V-SD(MT).



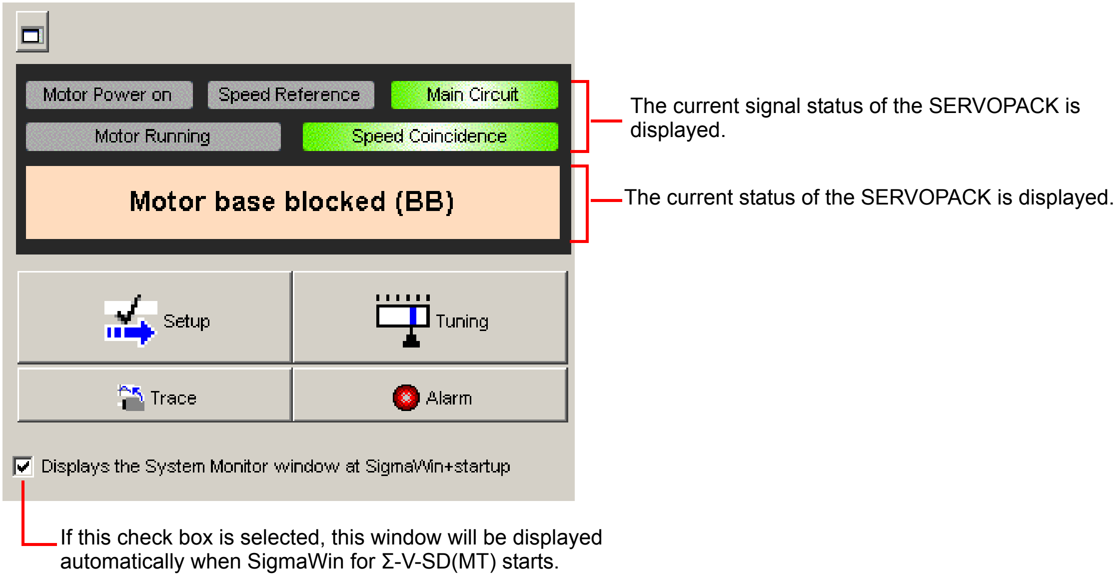
Click the **Serial No.** Buttons to display the serial numbers and manufacturing dates of the Servomotor and SERVOPACK.

11.2 Monitoring SERVOPACK Status

11.2.1 System Monitor

Use one of the following methods to display the System Monitor Window.

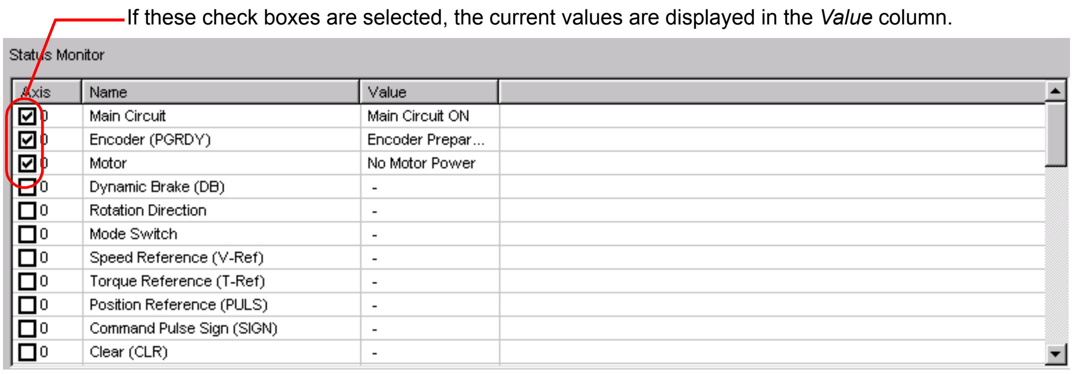
- Start SigmaWin for Σ-V-SD(MT). The System Monitor Window will be automatically displayed.
- Select ***Monitor - Monitor - System Monitor*** from the menu bar of the main window of SigmaWin for Σ-V-SD(MT).



11.2.2 Status Monitor, Motion Monitor, Input Signal Monitor, and Output Signal Monitor

Use the following method to display the SERVOPACK Status Monitor Window, Motion Monitor Window, Input Signal Monitor Window, or Output Signal Monitor Window.

- Select ***Monitor - Monitor*** followed by **Status Monitor**, **Motion Monitor**, **Input Signal Monitor**, or **Output Signal Monitor** from the menu bar of the main window of SigmaWin for Σ-V-SD(MT).



Monitoring

11

(1) Monitor Items

The items that you can monitor on the Status Monitor Window, Motion Monitor Window, Input Signal Monitor Window, and Output Signal Monitor Window are listed below.

• Motion Monitor

Item
Current Alarm State
Motor Speed
Speed Reference
Internal Torque Reference
Rotation Angle 1 (Number of Pulses from the Origin)
Rotation Angle 2 (Angle from the Origin)
Input Reference Pulse Speed
Deviation Counter (Position Deviation)
Cumulative Load
Reference Pulse Counter
Feedback Pulse Counter
Total Operation Time
Alarm Traceback Time Stamps No. 1 to No. 10
Axis Address Setup
Number of Transmission Bytes
Transmission Cycle
Communications Cycle
Receive Error Counter Monitor
00 to 47 Command Data Monitor at Alarm/Warning Occurrence (The number at the beginning is the number of bytes from the beginning of the MECHATROLINK-III command data.)
00 to 47 Response Data Monitor at Alarm/Warning Occurrence (The number at the beginning is the number of bytes from the beginning of the MECHATROLINK-III response data.)
Time A until Arrival at Safe Speed*
Time B until Arrival at Safe Speed*
Safety-function-part Motor Speed*
Safety-function-part Motor Travel Distance*
Safety-function-part Monitoring Speed A*
Safety-function-part Monitoring Speed B*

* When any one of the following errors occurs, these parameters are not displayed on the SigmaWin.
- Alarm A.C90 (Encoder Communications Error)
- Alarm A.C91 (Encoder Communications Position Data Error)
- Alarm A.C92 (Encoder Communications Timer Error)

• Status Monitor

Item
Main Circuit
Encoder (PGRDY)
Motor Power (Request)
Motor Power ON
Dynamic Brake (DB)
Rotation Direction

(cont'd)

Item
Speed Reference (V-Ref)
Torque Reference (T-Ref)
Position Reference (PULS)
Position Reference Direction
AC Power ON
Overcurrent
Origin Not Passed
/S-ON
P-OT
N-OT
/P-CL
/N-CL
/ALM-RST
Gain Selection (/G-SEL)
Emergency Stop (EMG-STP)
Deceleration Limit Switch Input Signal (/DEC)
External Latch Input 1 Signal (/EXT1)
External Latch Input 2 Signal (/EXT2)
External Latch Input 3 Signal (/EXT3)
ALM
/COIN
/V-CMP
/TGON
/S-RDY
/CLT
/VLT
Brake Interlock (/BK)
/WARN
/NEAR
/C-PHASE
Safety Function A - Monitoring*
Safety Function A - Safe*
Safety Function A - HWBB*
Safety Function B - Monitoring*
Safety Function B - Safe*
Safety Function B - HWBB*
Safety Function - Monitoring*
Safety Function - Safe*
Safety Function - HWBB*

* When any one of the following errors occurs, these parameters are not displayed on the SigmaWin.
- Alarm A.C90 (Encoder Communications Error)
- Alarm A.C91 (Encoder Communications Position Data Error)
- Alarm A.C92 (Encoder Communications Timer Error)

• Input Signal Monitor

Item
External DB Answer Signal
/EMG
Safety Request Input Signal A1*
Safety Request Input Signal A2*
Safety Request Input Signal B1*
Safety Request Input Signal B2*

* When any one of the following errors occurs, these parameters are not displayed on the SigmaWin.
- Alarm A.C90 (Encoder Communications Error)
- Alarm A.C91 (Encoder Communications Position Data Error)
- Alarm A.C92 (Encoder Communications Timer Error)

• Output Signal Monitor

Item
External DB Signal
External Device Monitor Output Signal A*
External Device Monitor Output Signal B*

* When any one of the following errors occurs, these parameters are not displayed on the SigmaWin.
- Alarm A.C90 (Encoder Communications Error)
- Alarm A.C91 (Encoder Communications Position Data Error)
- Alarm A.C92 (Encoder Communications Timer Error)

(2) Details on Safety-function-part Monitor Displays

This section provides details on the safety-function-part monitor displays.

■ Safety Function Operation Status

This monitor item displays the operation of the safety-function-part according to the status of safety function A and safety function B. If the values of all of the items are INACT, the current status is standby status.

Name	Value	Description	Remarks
Safety Function - Monitoring	INACT	–	Monitoring is in progress for either Safety Function A or Safety Function B, or for both.
	ACT	Monitoring is in progress.	
Safety Function - Safe	INACT	–	Both Safety Function A and Safety Function B are in the safe state.
	ACT	Safe state	
Safety Function - HWBB	INACT	–	The HWBB function is operating for either Safety Function A, Safety Function B, or both.
	ACT	HWBB function is operating.	

■ Safety Function Operation Status A and B

In the monitor displays of the safety function operations for the safety-function-part, the operating status of one safety function is affected by the operating status of the other safety functions.

The relationship between the operating status of the safety functions and the monitor display is described below.

<table>
<tr><th rowspan="2">Operating State of the Other Safety Function</th><th colspan="4">Operating Status of One Safety Function</th></tr>
<tr><th>Standby</th><th>Monitoring</th><th>Safe</th><th>HWBB</th></tr>
<tr><td>Standby</td><td rowspan="4">Monitoring = INACT
Safe = INACT
HWBB = INACT</td><td rowspan="3">Monitoring = ACT
Safe = INACT
HWBB = INACT</td><td rowspan="3">Monitoring = ACT
Safe = ACT
HWBB = INACT</td><td rowspan="4">Monitoring = INACT
Safe = ACT
HWBB = ACT</td></tr>
<tr><td>Monitoring</td></tr>
<tr><td>Safe state</td></tr>
<tr><td>HWBB</td><td>Monitoring = INACT
Safe = ACT
HWBB = ACT</td><td>Monitoring = INACT
Safe = ACT
HWBB = ACT</td></tr>
</table>

■ Times until Arrival at Safe Speed

This monitor mode displays the time period until the motor reaches a safe speed after the safety request signal is input.

Name	Unit	Remarks
Time A until Arrival at Safe Speed	ms	Initial display after system reset: 0
Time B until Arrival at Safe Speed	ms	

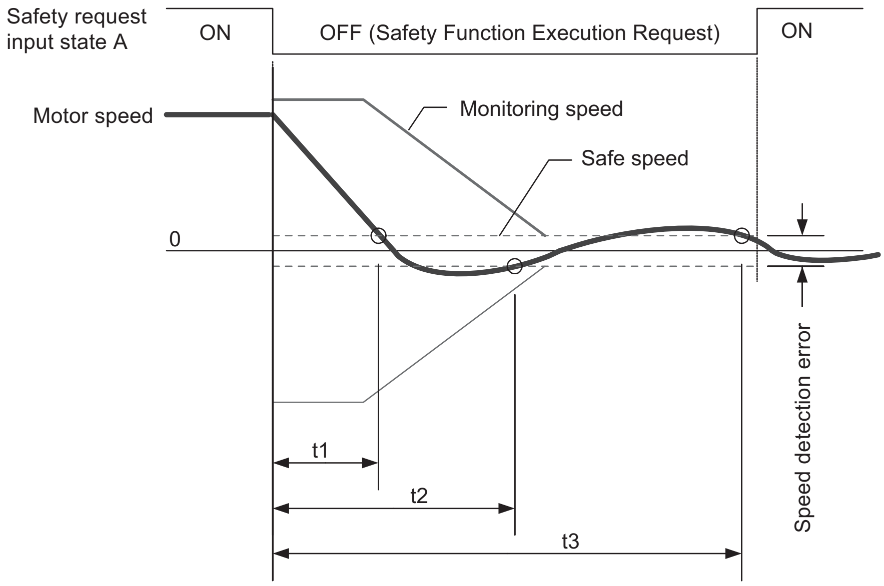
The measurement of the time period until the motor reaches a safe speed depends on the selected safety function as shown below:

Safety Function	Measurement of Safe Speed
SBB	The time period until the motor reaches a safe speed is not measured. The value is always “0.”
SBB-D	The time period is measured by assuming that a speed value within the speed detection error is the safe speed.
SPM-D	The time period is measured by assuming that a speed value within the speed detection error is the safe speed.
SLS-D	The time period is measured by assuming that the constant monitoring speed is the safe speed.

The characteristics of measuring the time period until the motor reaches a safe speed are as follows:

- The time period is measured from the time the safety request input state turns ON until the motor speed reaches the safe speed.
- The measured time is updated whenever the motor speed reaches the safe speed.
- Monitoring is performed until the safety request input state turns OFF.

The specifications of measuring the time period until the motor reaches a safe speed are shown below.

<table>
<tr><th>Operation Timing</th><th>Remarks</th></tr>
<tr><td>Example: When the SBB-D Function Is Selected as the Safety Function


</td><td>In the figure, the measured time is updated from t1 to t2, and finally to t3.</td></tr>
</table>

■ Safety-function-part Motor Speed

This monitor mode displays the motor speed that is detected by the safety-function-part. The speed is shown as an absolute value regardless of the rotation (travel) direction.

Name	Unit	Remarks
Safety-function-part Motor Speed	1 min^{-1}	–

■ Safety-function-part Motor Travel Distance

If you select the SPM-D function, the motor travel distance detected by the safety-function-part is displayed.

Name	Unit	Remarks
Safety-function-part Motor Travel Distance	edge	Pulses multiplied by 4

■ Safety-function-part Monitoring Speeds

This monitor mode displays the monitoring speed when a safety function is in operation (Safety Function A or Safety Function B). The speed is shown as an absolute value regardless of the rotation (travel) direction.

Name	Unit	Remarks
Safety-function-part Monitoring Speed A	1 min^{-1}	–
Safety-function-part Monitoring Speed B	1 min^{-1}	–

11.2.3 Monitoring Over the Network

You can monitor the SERVOPACK through MECHATROLINK-III communications.

When Option Monitor 1 or 2 is allocated to MONITOR 1, 2, 3, or 4 in the Monitor Selection (SEL_MON1/2/3/4) Field, the I/O signals of the safety-function-part and the operating status of the safety functions can be monitored via MECHATROLINK-III communications when a specified value is set in the following parameters.

■ Allocating Monitor Information

Parameter No.	Name	Set Value	Contents
Pn824	Option Monitor 1	003C	The monitor information of the safety-function-part is allocated to Option 2.
Pn825	Option Monitor 2	003C	The monitor information of the safety-function-part is allocated to Option 2.

Note: Refer to the *Σ-V-SD Series User's Manual MECHATROLINK-III Standard Servo Profile Commands* (Manual No.: SIEP S800000 76).

■ Monitor Information

The monitor information of the safety-function-part is described below.

<table>
<tr><th>Bit</th><th colspan="2">Name</th><th>Display Contents</th></tr>
<tr><td>d0</td><td colspan="2">Safety Request Input Signal A1</td><td>0 = OFF, 1 = ON</td></tr>
<tr><td>d1</td><td colspan="2">Safety Request Input Signal A2</td><td>0 = OFF, 1 = ON</td></tr>
<tr><td>d2</td><td colspan="2">Safety Request Input Signal B1</td><td>0 = OFF, 1 = ON</td></tr>
<tr><td>d3</td><td colspan="2">Safety Request Input Signal B2</td><td>0 = OFF, 1 = ON</td></tr>
<tr><td>d4</td><td colspan="2">External Device Monitor Signal A</td><td>0 = OFF, 1 = ON</td></tr>
<tr><td>d5</td><td colspan="2">External Device Monitor Signal B</td><td>0 = OFF, 1 = ON</td></tr>
<tr><td>d6-7</td><td colspan="2">Reserved</td><td>–</td></tr>
<tr><td>d8</td><td rowspan="4">Safety Function</td><td>Monitoring</td><td>0 = –, 1 = Deceleration monitoring is in progress.</td></tr>
<tr><td>d9</td><td>Safe</td><td>0 = –, 1 = Safe state</td></tr>
<tr><td>d10</td><td>HWBB</td><td>0 = –, 1 = HWBB function is operating.</td></tr>
<tr><td>d11</td><td>Reserved</td><td>–</td></tr>
<tr><td>d12-31</td><td colspan="2">Reserved</td><td>–</td></tr>
</table>

11.3 Monitoring Machine Operation Status and Signal Waveforms

To monitor waveforms, use the SigmaWin for Σ-V-SD (MT) trace function or a measuring instrument, such as a memory recorder.

11.3.1 Items That You Can Monitor

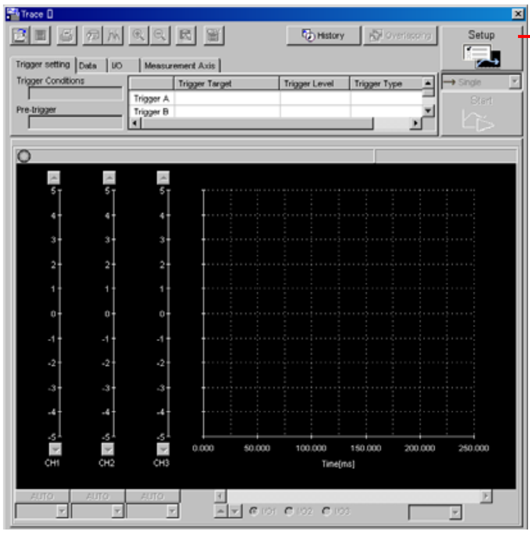
For details, refer to *10.1.3 (2) Monitor Signal*.

11.3.2 Using the SigmaWin for Σ-V-SD(MT)

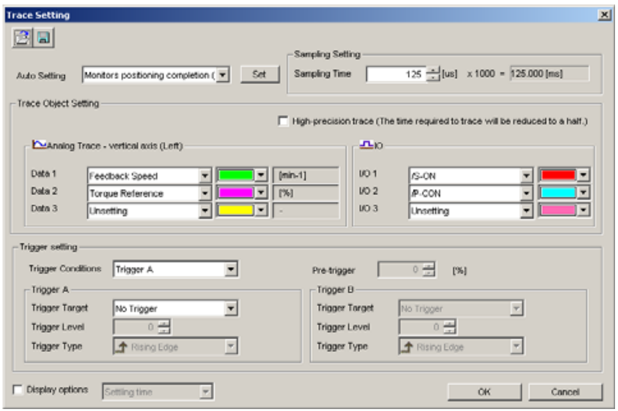
This section describes how to trace data and I/O with the SigmaWin for Σ-V-SD (MT).

(1) Operating Procedure

Select ***Trace - Trace*** from the menu bar of the main window of SigmaWin for Σ-V-SD (MT).



Click this button to display the Trace Setting Dialog Box shown below, and then set the data to trace and the trace conditions.



(2) Trace Objects

You can trace the following items.

• Data Tracing

Trace Objects
• Feedback Speed • Torque Reference • Reference Speed • Position Reference Speed • Position Error • Position Amplifier Error • Speed Feedforward • Torque Feedforward • Effective Gain

• I/O Tracing

Item	Description
/S-ON	Servo ON Request (L = Requested.)
P-OT	Forward Run Prohibited (H = Prohibited)
N-OT	Reverse Run Prohibited (H = Prohibited)
/ALM-RST	Alarm Reset Request (Low edge = Requested)
EMG	Emergency Stop (H = Requested)
/DEC	Homing Deceleration Switch (L = Requested)
/EXT1	External Latch Request 1 (L = Requested)
/EXT2	External Latch Request 2 (L = Requested)
/EXT3	External Latch Request 3 (L = Requested)
/HWBB1	(Do not use.)
/HWBB2	(Do not use.)
ALM	Alarm (H = Alarm)
/COIN	Positioning Completion (L = Completed)
/V-CMP	Speed Coincidence Detection (L = Detected)
/TGON	Rotation Detection (L = Detected)
/S-RDY	Servo Ready (L = Ready)
/CLT	Torque Limit (L = Detected)
/VLT	Speed Limit (L = Detected)
/EXTDBO	Dynamic Brake Request (L = Requested)
WSTA	(Do not use.)
/W-CMP	(Do not use.)

11.3.3 Using a Measuring Instrument

For details, refer to *10.1.3 Monitoring Analog Signals*.

(1) Analog Monitor Output Adjustment

You can manually adjust the offset and gain for the analog monitor outputs for the torque reference monitor and motor speed monitor.

The offset is adjusted to compensate for offset in the zero point caused by output voltage drift or noise in the monitoring system.

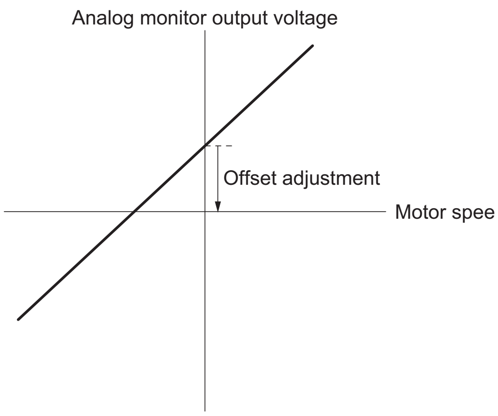
The gain is adjusted to match the sensitivity of the measuring system.

The offset and gain are adjusted at the factory. You normally do not need to adjust them.

■ Adjustment Example

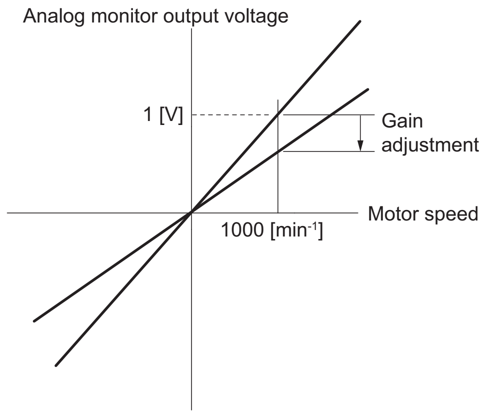
An example of adjusting the output of the motor speed monitor is provided below.

Offset Adjustment



Item	Specification
Offset Adjustment Range	-2.4 V to 2.4 V
Adjustment Unit	18.9 mV/LSB

Gain Adjustment



Item	Specification
Gain Adjustment Range	100 ±50%
Adjustment Unit	0.4%/LSB

The gain adjustment range is made using a 100% output value (gain adjustment of 0) as the reference value with an adjustment range of 50% to 150%. A setting example is given below.

- Setting the Adjustment Value to -125
  100 + (-125 × 0.4) = 50[%]
  Therefore, the monitor output voltage goes to 50% of the original value.
- Setting the Adjustment Value to 125
  100 + (125 × 0.4) = 150[%]
  Therefore, the monitor output voltage goes to 150% of the original value.

Supplemental Information

- The adjustment values do not use parameters, so they will not change even if the parameter settings are initialized.
- Adjust the offset with the measuring instrument connected so that the analog monitor output value goes to zero. The following setting example achieves a zero output.
  - While power is not supplied to the Servomotor, set the monitor signal to the torque reference.
  - In speed control, set the monitor signal to the position deviation.

■ Preparations

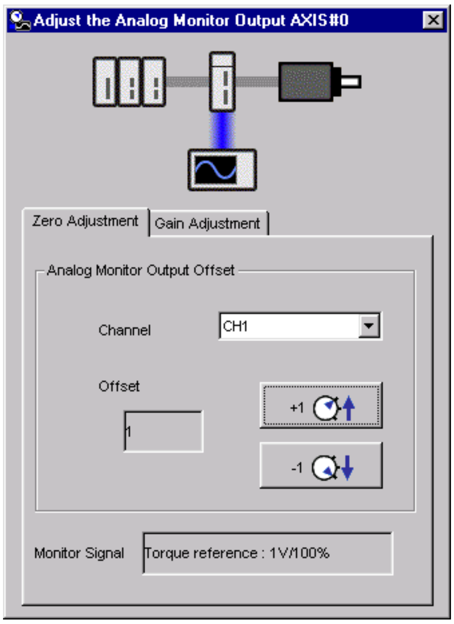
Always check the following before you adjust the analog monitor output.

• The parameters must not be write prohibited.

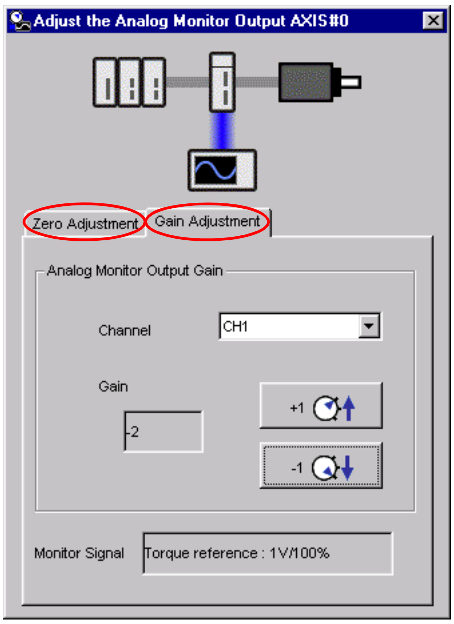
■ Operating Procedure

Use the following procedure.

1. Select ***Setup - Adjust Offset*** from the menu bar of the main window of SigmaWin for Σ-V-SD(MT).
   The Adjust the Analog Monitor Output Dialog Box will be displayed.



2. Click the **Zero Adjustment** or **Gain Adjustment** Tab.



Monitoring

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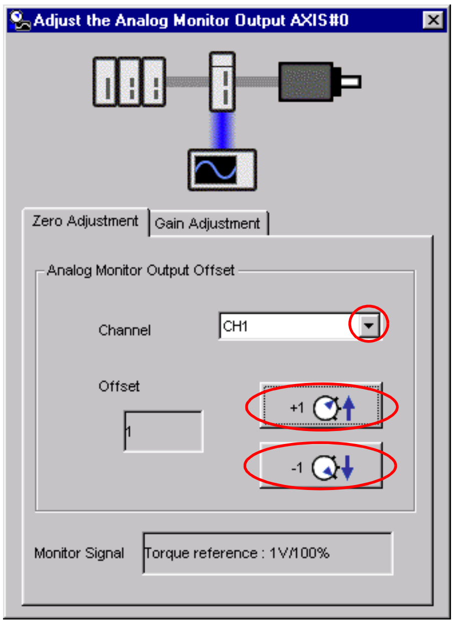
3. While watching the analog monitor, use the **+1** and **-1** Buttons to adjust the offset.
   There are two channels: CH1 and CH2. If necessary, click the down arrow on the **Channel** Box and select the channel.



This concludes adjusting the analog monitor output.

12

Standards Compliance

12.1 Harmonized 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	UL Standards (UL File No.)
Power regeneration converter (CACP-JU□□□3□), SERVOPACK (CACR-JU□□□□2□)	UL508C (E147823)

(2) EU Directives

Products and Models	EU Directives	Harmonized Standards
Power regeneration converter (CACP-JU□□□3□), SERVOPACK (CACR-JU□□□□2□)	Machinery Directive 2006/42/EC	EN ISO13849-1: 2008/AC: 2009*
	EMC Directive 2014/30/EU	EN 55011 group1 classA EN 61000-6-2 EN 61000-6-4 EN 61800-3 (Category C2, Second Environment)
	Low Voltage Directive 2014/35/EU	EN 61800-5-1
	RoHS Directive 2011/65/EU	EN 50581

* For details, refer to *(3) Safety Standards*.

(3) Safety Standards

Products and Models	Safety Standards	Standards
SERVOPACK (CACR-JU□□□□2□)	Safety of Machinery	EN ISO13849-1: 2008/AC: 2009
	Functional Safety	IEC 61508 series IEC 62061 IEC 61800-5-2
	EMC	IEC 61326-3-1

■ Safe Performance

Items	Standards	Performance Level
Safety Integrity Level	IEC 61508	SIL2
	IEC 62061	SILCL2
Probability of Dangerous Failure per Hour	IEC 61508 IEC 62061	PFH $\leq 3.3 \times 10^{-7}$ [1/h] (3.3% of SIL2)
Performance Level	EN ISO 13849-1	PL d (Category 2)
Mean Time to Dangerous Failure of Each Channel	EN ISO 13849-1	MTTFd: High
Average Diagnostic Coverage	EN ISO 13849-1	DCavg: Medium
Safety Function	IEC 61800-5-2	STO/SS1/SS2/SLS
Mission Time	IEC 61508	10 years
Hardware Fault Tolerance	IEC 61508	HFT = 1
Subsystem	IEC 61508	B

Although the SERVOPACKs described in this manual are not certified for IEC 60204-1, some of the defined safety functions are included in IEC 61800-5-2, as shown in the following table.

IEC 60204-1	IEC 61800-5-2
Stop category 0	STO
Stop category 1	SS1
Stop category 2	SS2

12.2 Models in Compliance by Standard

The following table shows the models that are in compliance by standard.

Note: Contact your Yaskawa representative for details on models for which certification is pending.

■ Power Regeneration Converter

Note: Although the safety standards and safety performance do not apply to the power regeneration converters when they are used alone, they do apply when they are used together with a SERVOPACK.

Model	North American Safety Standards (UL)	EU Directives
CACP-JU15A3A	Not available	Compliant
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		

■ SERVOPACKs

Model	North American Safety Standards (UL)	EU Directives	Safety Standards and Safe Performance
CACR-JU028A	Certified	Compliant	Certified
CACR-JU036A			
CACR-JU065A			
CACR-JU084A			
CACR-JU102A			
CACR-JU125A			
CACR-JU196A			
CACR-JU014D			
CACR-JU018D			
CACR-JU033D			
CACR-JU042D			
CACR-JU051D			
CACR-JU098D			

12.3 Precautions for Complying with European Standards

12.3.1 EMC Installation Conditions

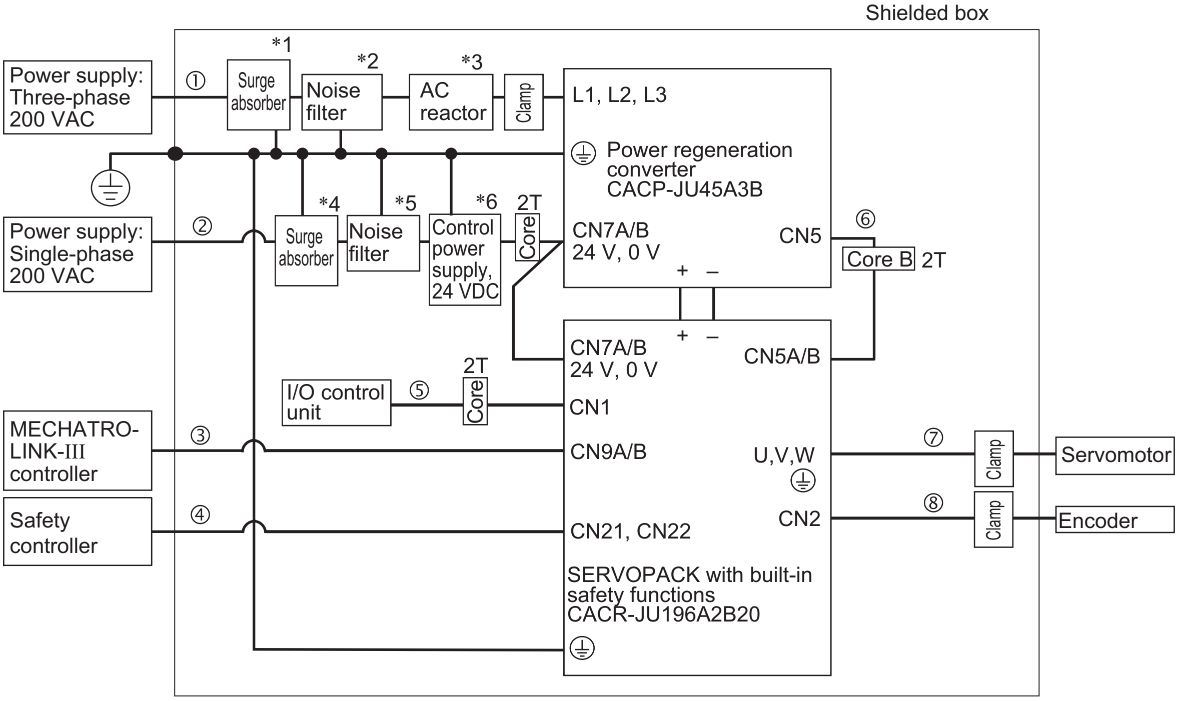
This section describes the recommended installation conditions that satisfy EMC guidelines for the Σ-V-SD driver.

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 group1 classA, EN 61000-6-2, EN 61000-6-4 and EN 61800-3 (Category C2, Second Environment).

(1) Basic Wiring

This section shows the basic wiring that was used for EMC certification testing.



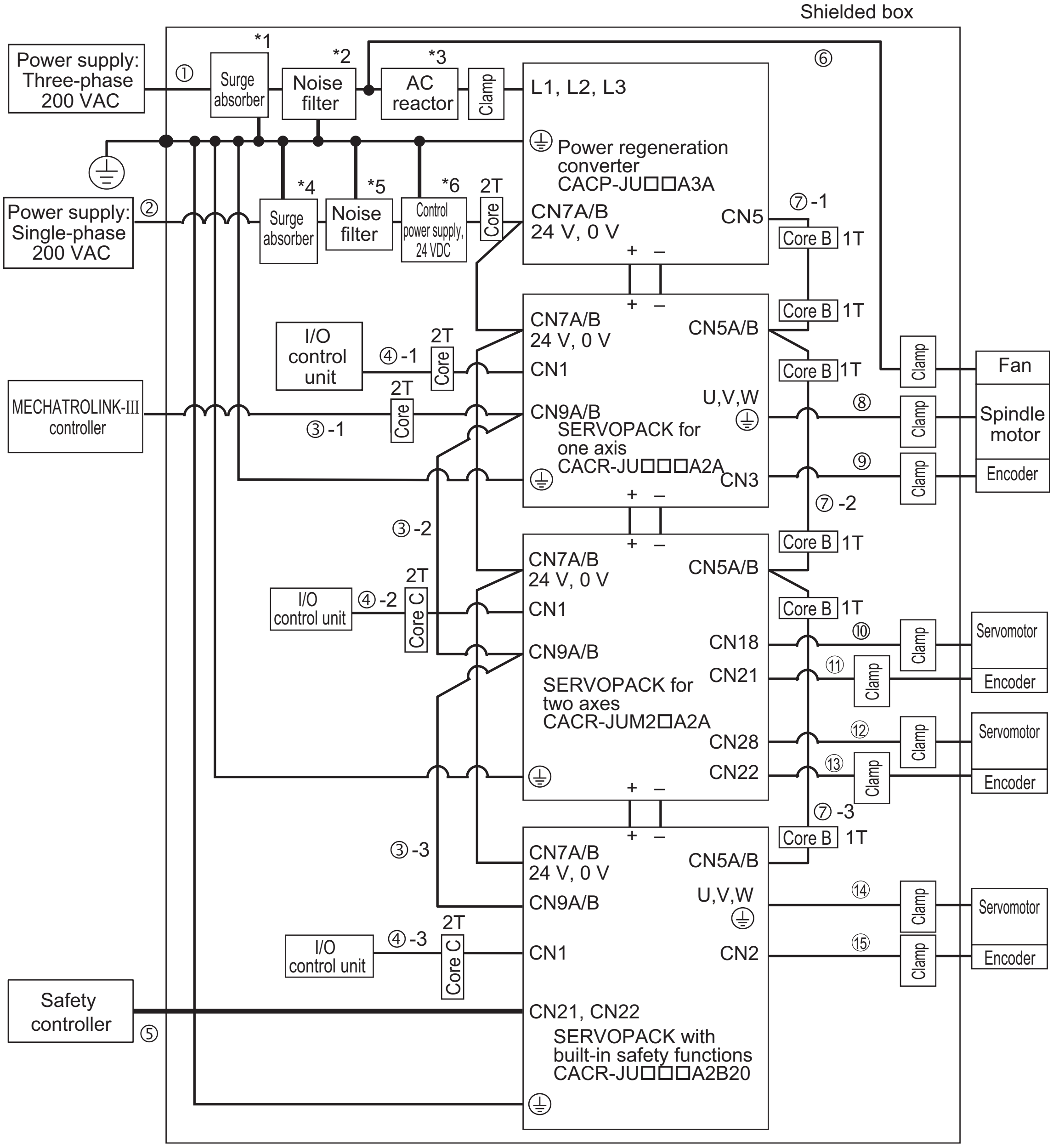
Symbol	Cable Name	Specification
①	Main circuit cable	Shielded cable
②	Control power cable	Non-shielded cable
③	MECHATROLINK-III communication cable	Shielded cable
④	Safety function device cable	Shielded cable
⑤	Input/output signal cable	Shielded cable
⑥	Local bus cable	Shielded cable
⑦	Servomotor main circuit cable	Shielded cable
⑧	Servomotor encoder cable	Shielded cable

∗1. Surge absorber: LT-C32G801WS (Soshin Electric Co., Ltd.)
∗2. Noise filter: HF3200C-SZC-49EDE (Soshin Electric Co., Ltd.)
∗3. AC reactor: X008022
∗4. Surge absorber: LT-C12G801WS (Soshin Electric Co., Ltd.)
∗5. Noise filter: HF2005A-UP (Soshin Electric Co., Ltd.)
∗6. Use a 24-VDC control power supply with double insulation or reinforced insulation.

(2) Wiring Example

A wiring example for EMC certification testing is provided below. This wiring example is based on the wiring shown in *(1) Basic Wiring*.

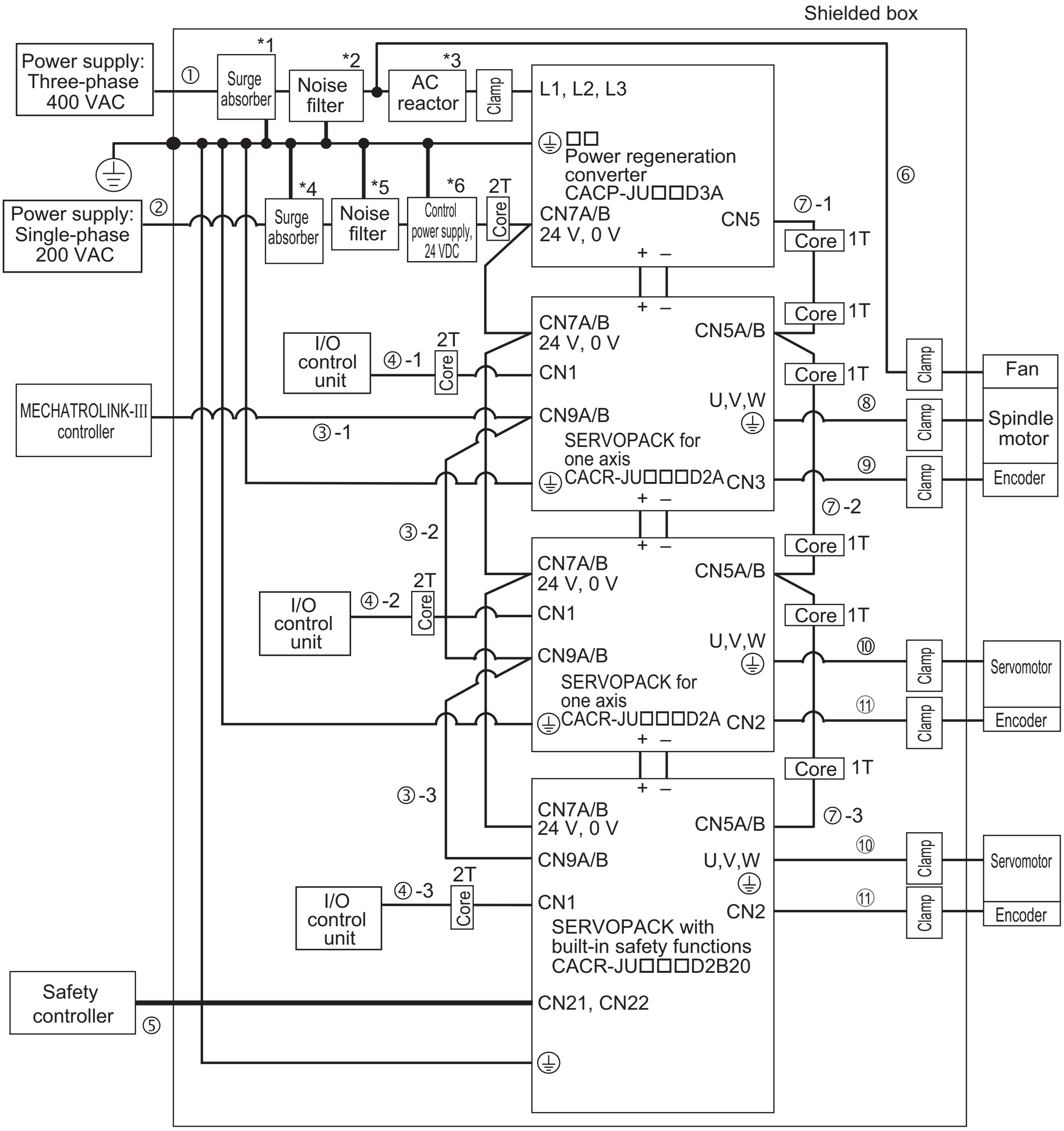
■ Example for 200 V



Symbol	Cable Name	Specification
①	Main circuit cable	Shielded cable
②	Control power cable	Non-shielded cable
③-1, ③-2, ③-3	MECHATROLINK-III communication cable	Shielded cable
④-1, ④-2, ④-3	Input/output signal cable	Shielded cable
⑤	Safety function device cable	Shielded cable
⑥	Spindle motor fan cable	Shielded cable
⑦-1, ⑦-2, ⑦-3	Local bus cable	Shielded cable
⑧	Spindle motor main circuit cable	Shielded cable
⑨	Spindle motor encoder cable	Shielded cable
⑩	Servomotor main circuit cable for 1st axis	Shielded cable
⑪	Servomotor encoder cable for 1st axis	Shielded cable
⑫	Servomotor main circuit cable for 2nd axis	Shielded cable
⑬	Servomotor encoder cable for 2nd axis	Shielded cable
⑭	Servomotor main circuit cable	Shielded cable
⑮	Servomotor encoder cable	Shielded cable

*1. Recommended surge absorber model: LT-C32G801WS (Soshin Electric Co., Ltd.)
*2. For more information on this noise filter, refer to *2.3.5 Noise Filter*.
*3. For more information on this AC reactor, refer to *2.3.4 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.
Model number: 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.
Model number: HF2005A-UP (Soshin Electric Co., Ltd.)
*6. Use a 24-VDC control power supply with double insulation against primary or reinforced insulation.

■ Example for 400 V



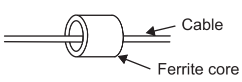
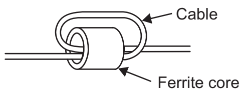
Symbol	Cable Name	Specification
①	Main circuit cable	Shielded cable
②	Control power cable	Non-shielded cable
③-1, ③-2, ③-3	MECHATROLINK-III communication cable	Shielded cable
④-1, ④-2, ④-3	Input/output signal cable	Shielded cable
⑤	Safety function device cable	Shielded cable
⑥	Spindle motor fan cable	Shielded cable
⑦-1, ⑦-2, ⑦-3	Local bus cable	Shielded cable
⑧	Spindle motor main circuit cable	Shielded cable
⑨	Spindle motor encoder cable	Shielded cable
⑩	Servomotor main circuit cable	Shielded cable
⑪	Servomotor encoder cable	Shielded cable

*1. Recommended surge absorber model: LT-C35G102WS (Soshin Electric Co., Ltd.)
*2. For more information on this noise filter, refer to *2.3.5 Noise Filter*.
*3. For more information on this AC reactor, refer to *2.3.4 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.
Model number: 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.
Model number: HF2005A-UP (Soshin Electric Co., Ltd.)
∗6. Use a 24-VDC control power supply with double insulation against primary or reinforced insulation.

12.3.2 Precautions

(1) Attachment Methods of Ferrite Cores

One turn	Two turn
	

(2) Recommended Ferrite Core

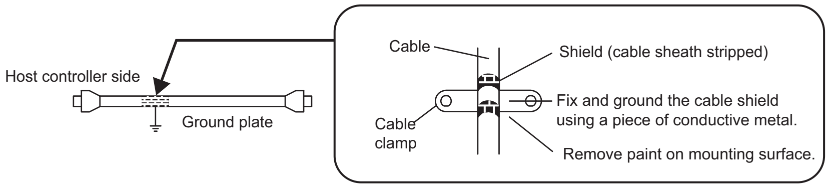
Core Name (Used in diagrams)*	Model	Manufacturer
Core	SFT-72SN	TAKEUCHI INDUSTRY Co., Ltd.
Core B	TFT-112514N	
Core C	TFT-274015S	

∗ For details, refer to diagrams in *12.3.1 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

12

12.3.3 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.

12.4 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) 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 *5.4 Base Mounting Units* for information on the base mounting unit.

(7) 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.

13

Inspection, Maintenance, and Troubleshooting

13.1 Inspection and Maintenance

13.1.1 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. 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	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.

Part	Standard Replacement Period	Remarks
Oil seal	5,000 hours	A part must be replaced if there is any problem, even if the standard replacement period has not yet elapsed.
Bearing	20,000 hours or 5 years	

13.1.2 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 • Load Factor: 80% max. • 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.

13.2 Troubleshooting

The following sections describe troubleshooting in response to alarm displays.

The alarm name, alarm meaning, alarm stopping method and alarm reset capability are listed in order of the alarm numbers in *13.2.1 List of Alarms*.

The causes of alarms and troubleshooting methods are provided in *13.2.2 Troubleshooting of Alarms*.

13.2.1 List of Alarms

If an alarm occurs, the motor can be stopped by doing either of the following operations.

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.

Available: Removing the cause of alarm and then executing the alarm reset can clear the alarm.
N/A: Executing the alarm reset cannot clear the alarm.

Alarm Display	Alarm Name	Meaning	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.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.04A	Option Parameter Setting Error	There is a setting error for the input signal monitor.	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.05B	Converter Combination Error	The converter and SERVOPACK are not combined correctly.	Gr.1	N/A

(cont'd)

Alarm Display	Alarm Name	Meaning	Motor Stop Method	Alarm Reset
A.0B0	Cancelled Servo ON Command Alarm	The host controller reference was sent to turn the Servo ON after the Servo ON function was used with the utility function.	Gr.1	Available
A.100	Overcurrent	An overcurrent flowed through the IGBT. 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
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.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 **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.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

(cont'd)

Alarm Display	Alarm Name	Meaning	Motor Stop Method	Alarm Reset
A.7AB	Built-in Fan in SERVOPACK Stopped*	The fan inside the SERVOPACK stopped.	Gr.1	Available
A.7AC	Built-in Fan in Converter Stopped*	The fan inside the power regeneration converter stopped.	Gr.1	Available
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.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.B6A	MECHATROLINK Communications ASIC Error 1	ASIC error 1 occurred during MECHATROLINK communications.	Gr.1	N/A
A.B6B	MECHATROLINK Communications ASIC Error 2	ASIC error 2 occurred during MECHATROLINK communications.	Gr.2	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

* 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.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.D00	Position Error Pulse Overflow	Position error pulses exceeded parameter (Pn520).	Gr.1	Available
A.D01	Position Error Pulse Overflow Alarm at Servo ON	Position error pulses accumulated too much.	Gr.1	Available
A.D02	Position Error Pulse Overflow Alarm by Speed Limit at Servo ON	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.E01	System Alarm 5	Internal program error 5 occurred in the SERVOPACK.	Gr.1	N/A
A.E02	System Alarm 6	Internal program error 6 occurred in the SERVOPACK.	Gr.1	N/A
A.E40	MECHATROLINK Transmission Cycle Setting Error	The setting of the MECHATROLINK transmission cycle is incorrect.	Gr.2	Available
A.E41	MECHATROLINK Communications Data Size Setting Error	The setting of the MECHATROLINK communications data size is incorrect.	Gr.2	Available
A.E42	MECHATROLINK Station Address Setting Error	The setting of the MECHATROLINK station address is incorrect.	Gr.2	N/A
A.E50	MECHATROLINK Synchronization Error	A synchronization error occurs during MECHATROLINK communications.	Gr.2	Available
A.E51	MECHATROLINK Synchronization Failed	A synchronization failure occurs in MECHATROLINK communications.	Gr.2	Available
A.E60	MECHATROLINK Communications Error (Reception error)	A communications error occurs continuously during MECHATROLINK communications.	Gr.2	Available
A.E61	MECHATROLINK Transmission Cycle Error (Synchronization interval error)	The transmission cycle fluctuates during MECHATROLINK communications.	Gr.2	N/A*3
A.E62	MECHATROLINK Communications Error (FCS error)	Communications error occurs continuously during MECHATROLINK communications.	Gr.2	Available
A.E6A	Network Reception Error (Event-driven Communications)	A reception error occurred in the event-driven frame during MECHATROLINK communications.	Gr.2	Available
A.E71	Safety-function-part Detection Failure	An error occurred in the CPU of the safety-function-part or peripheral circuits.	Gr.1	N/A
A.E74	Safety-function-part Nonsupport	An error occurred in the CPU of the safety-function-part or peripheral circuits.	Gr.1	N/A
A.EA0	SERVOPACK Failure (DRV alarm 0)	SERVOPACK alarm 0 occurred.	Gr.1	N/A

(cont'd)

Alarm Display	Alarm Name	Meaning	Motor Stop Method	Alarm Reset
A.EA1	SERVOPACK Initial Access Error	The SERVOPACK initial access alarm occurred.	Gr.2	N/A
A.EA2	DRV Alarm 2 (SERVOPACK WDC error)	A SERVOPACK DRV alarm 0 occurs.	Gr.2	N/A
A.EB0	Safety-function-part: System Malfunction	An error occurred in the CPU of the safety-function-part or in a peripheral circuit.	Gr.1	N/A
A.EB1	Safety-function-part Signal Input Timing Error	The safety-function-part signal input timing is faulty.	Gr.1	N/A
A.EB2	Safety-related Parameter Setting Error	An error occurred in a safety-related parameter.	Gr.1	Available
A.EB3	HWBB Circuit Malfunction	An error occurred in the HWBB circuit of the SERVOPACK.	Gr.1	N/A
A.EB4	Safety-function-part: Feedback Data Malfunction	The feedback data is incorrect. (The output data of encoder pulse is incorrect.)	Gr.1	N/A
A.EB5	Safety-function-part: Timing Error of Safety Request Input Signal A	The ON/OFF timing of Safety Request Input Signals A1 and A2 does not match the specified time period.	Gr.1	N/A
A.EB6	Safety-function-part: Timing Error of Safety Request Input Signal B	The ON/OFF timing of Safety Request Input Signals B1 and B2 does not match the specified time period.	Gr.1	N/A
A.EB7	Safety-function-part: Safety Function A Monitoring Alarm	The motor speed has exceeded the monitoring speed set for Safety Function A. Alternatively, the distance that the motor moved has exceeded the distance for monitoring set for Safety Function A.	Gr.1	Available
A.EB8	Safety-function-part: Safety Function B Monitoring Alarm	The motor speed has exceeded the monitoring speed set for Safety Function B. Alternatively, the distance that the motor moved has exceeded the distance for monitoring set for Safety Function B.	Gr.1	Available
A.EB9	Safety-function-part: Parameter Change Alarm	A safety-function-part parameter for which the power must be turned OFF and ON again to enable the settings was changed.	Gr.1	Available
A.EC0	Safety-function-part: Setup Confirmation Alarm	The safety-function-part parameters were initialized.	Gr.1	Available
A.EC1	Safety-related Servo Parameter Unmatch Alarm	The settings of a safety-related servo parameter and the corresponding SERVOPACK parameter do not match.	Gr.1	Available
A.EC8	Gate Drive Error 1	An error occurred in the gate drive circuit.	Gr.1	N/A
A.EC9	Gate Drive Error 2	An error occurred in the gate drive circuit.	Gr.1	N/A
A.ED1	Command Execution Timeout	A timeout error occurred when using a MECHATROLINK command.	Gr.2	Available
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

(cont'd)

Alarm Display	Alarm Name	Meaning	Motor Stop Method	Alarm Reset
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

13.2.2 Troubleshooting of 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 set to initialize the parameter.
	The power supply went OFF while changing a parameter setting.	Note the circumstances when the power supply went OFF.	Set to initialize the parameter and then set the parameter again.
	The number of times that parameters were written exceeded the limit.	Check to see if the parameters were frequently changed through the host controller.	The SERVOPACK may be faulty. Repair or replace the SERVOPACK. Reconsider the method of writing parameters.
	Malfunction caused by noise from the AC power supply or grounding line, static electricity noise, etc.	Turn the power supply ON and OFF several times. If the alarm still occurs, there may be noise interference.	Take countermeasures against noise.
	Gas, water drops, or cutting oil entered the SERVOPACK and caused failure of the internal components.	Check the installation conditions.	The SERVOPACK may be faulty. 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.
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.

(cont'd)

Alarm: Alarm Name	Cause	Investigative Actions	Corrective Actions
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."
A.04A Option Parameter Setting Error	Input Signal Monitor Setting Error	Check bit allocations in Pn860 and Pn861 for duplications.	Do not duplicate bit allocations in Pn860 and Pn861.
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) $\geq$ 1/4, and (Servomotor capacity)/(SERVOPACK capacity) $\leq$ 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.

* Detection Condition Formulas
An alarm is detected if either of the following two conditions is met.

- $$\frac{\text{Pn585 [mm/s]}}{\text{Linear scale pitch [}\mu\text{m]}} \times \frac{\text{Division number of serial converter unit}}{10} \leq 1$$
- $$\frac{\text{Pn385 [100 mm/s]}}{\text{Linear scale pitch [}\mu\text{m]}} \times \frac{\text{Division number of serial converter unit}}{\text{approx. } 6.10 \times 10^5} \geq 1$$

Inspection, Maintenance, and Troubleshooting

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(cont'd)

Alarm: Alarm Name	Cause	Investigative Actions	Corrective Actions
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 SERVO-PACK is abnormally high.)	• For 200 VAC SERVOPACKs with DC-bus power supply input: The power supply voltage exceeded 410 V. • 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. • The AC power supply voltage of 200 VAC SERVOPACK was in the range between 230 V and 270 V. • 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. • 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. • The AC power supply voltage of 200 VAC SERVOPACK was in the range between 230 V and 270 V. • 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.
	A mistake occurred when selecting the power regenerative converter capacity.	Check the power regenerative converter's instantaneous maximum capacity and the total capacity during regeneration of the SERVOPACK.	Change the power regenerative converter capacity.
	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. • 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. • 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. • 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. • For 200 VAC power regeneration converter: The power supply was 50 V or less. • 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.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.
A.710: A.720: Overload A.710: High Load A.720: Low Load	Incorrect wiring or contact fault of servomotor and encoder.	Check the wiring.	Confirm that the servomotor and encoder are correctly wired.
	Operation beyond the overload protection characteristics.	Check the servomotor overload characteristics and 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: Converter Electric Operation Overload (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.

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Alarm: Alarm Name	Cause	Investigative Actions	Corrective Actions
A.72B: Converter Power Supply Regenerative Overload (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: A.731: Dynamic Brake Overload (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. • Reduce the moment of inertia ratio. • Reduce the number of times of the DB stop operation.
	SERVOPACK failure	–	The SERVOPACK may be faulty. Replace the SERVOPACK.
A.74A: Converter Inrush Resistance Overload (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.
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.

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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.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.B6A: MECHATROLINK Communications ASIC Error 1	SERVOPACK MECHATROLINK communication section failure	–	Replace the SERVOPACK.

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Alarm: Alarm Name	Cause	Investigative Actions	Corrective Actions
A.B6B: MECHATROLINK Communications ASIC Error 2	SERVOPACK MECHATROLINK communication section failure	–	Replace the SERVOPACK.
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.
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.

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Alarm: Alarm Name	Cause	Investigative Actions	Corrective Actions
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.C80: Absolute Encoder Clear Error and 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.
A.C90: Encoder Communications Error	Contact fault of encoder connector or incorrect encoder wiring.	Check the encoder connector contact status.	Re-insert the encoder connector and confirm that the encoder is correctly wired.
	Encoder cable disconnection or short-circuit. Or, incorrect cable impedance.	Check the encoder cable.	Use the encoder cable with the specified rating.
	Corrosion caused by improper temperature, humidity, or gas Short-circuit caused by intrusion of water drops or cutting oil Connector contact fault caused by vibration.	Check the operating environment.	Improve the operating environmental conditions, and replace the cable. If the alarm still occurs, 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 to another SERVOPACK, and turn ON the control power. If no alarm occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.
A.C91: Encoder Communications Position Data Error	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.

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Alarm: Alarm Name	Cause	Investigative Actions	Corrective Actions
A.C92: Encoder Communications Timer Error	Noise interference occurred on the input/output signal line from the encoder.	–	Take countermeasures against noise.
	Excessive vibration and shocks were applied to the encoder.	Check the operating environment.	Reduce the machine vibration, or correctly install the servomotor.
	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.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.

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Alarm: Alarm Name	Cause	Investigative Actions	Corrective Actions
A.D00: Position Error Pulse Overflow (Position error exceeded the value set in the excessive position error alarm level (Pn520))	The contact in the servomotor U, V, and W wirings is faulty.	Check the motor main circuit cable connection.	Confirm that there is no contact fault in the motor wiring of encoder wiring.
	The frequency of the position reference is too high.	Reduce the reference frequency, and operate the SERVOPACK.	Reduce the position reference frequency or reference acceleration. Or, reconsider the electronic gear ratio.
	The position reference acceleration is too fast.	Reduce the reference acceleration, and operate the SERVOPACK.	Reduce the reference acceleration of the position reference using a MECHATROLINK command, or smooth the acceleration of the position reference by selecting the position reference filter (ACCFIL) using a MECHATROLINK command.
	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 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). Or, adjust the speed limit level at servo turns ON (Pn529).
A.E01: System Alarm 5	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.E02: System Alarm 6	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.E40: MECHATROLINK Transmission Cycle Setting Error	Setting of MECHATROLINK transmission cycle is out of specifications range.	Check the MECHATROLINK transmission cycle setting.	Set the MECHATROLINK transmission cycle to the proper value.
A.E41: MECHATROLINK Communications Data Size Setting Error	The number of transmission bytes set by the DIP switch S3 is incorrect.	Check the MECHATROLINK communications data size of the host controller.	Reset the setting of the DIP switch S3 to change the number of transmission bytes to the proper value.

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Alarm: Alarm Name	Cause	Investigative Actions	Corrective Actions
A.E42: MECHATROLINK Station Address Setting Error	Two or more stations on the communications network have the same address.	Check that two or more stations on the communications network have the same address.	Check the setting for the station address of the host controller, and reset the setting of the rotary switches, S1 and S2 to change the address to the proper value between 03 and EF.
	The station address is out of the allowable setting range.	Check the rotary switches, S1 and S2, to see if the station address is within the allowable range from 03 to EF.	Check the setting for the station address of the host controller, and reset the setting of the rotary switches, S1 and S2 to change the address to the proper value between 03 and EF.
A.E50: MECHATROLINK Synchronization Error	WDT data of host controller was not updated correctly.	Check the WDT data updating for the host controller.	Update the WDT data at the host controller correctly.
	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.E51: MECHATROLINK Synchronization Failed	WDT data of the host controller was not updated correctly at the synchronization communications start, and synchronization communications could not start.	Check the WDT data updating for the host controller.	Update the WDT data at the host controller correctly.
	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.E60: MECHATROLINK Communications error (Reception error)	MECHATROLINK wiring is incorrect.	Check the MECHATROLINK wirings.	Correct the MECHATROLINK wiring.
	MECHATROLINK data reception error occurred due to noise interference.	–	Take measures against noise. Check the MECHATROLINK communications cable and FG wiring and take measures such as adding ferrite core on the MECHATROLINK communications cable.
	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.E61: MECHATROLINK Transmission Cycle Error (Synchronization interval error)	MECHATROLINK transmission cycle fluctuated.	Check the MECHATROLINK transmission cycle setting.	Remove the cause of transmission cycle fluctuation at the host controller.
	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.E62: MECHATROLINK Communications error (FCS error)	MECHATROLINK wiring is incorrect.	Check the MECHATROLINK wirings.	Correct the MECHATROLINK wiring.
	MECHATROLINK data reception error occurred due to noise interference.	–	Take measures against noise. Check the MECHATROLINK communications cable and FG wiring and take measures such as adding ferrite core on the MECHATROLINK communications cable.
	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.E6A: Network Reception Error (Event-driven Communications) (A reception error occurred in the event-driven frame during MECHATROLINK communications.)	A parameter was changed by the personal computer during MECHATROLINK communications.	Confirm the way the parameters are edited.	Stop changing parameters using the personal computer during MECHATROLINK communications.
	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.E71: Safety-function-part Detection Failure	SERVOPACK failure	–	Replace the SERVOPACK.
A.E74: Safety-function-part Nonsupport	Nothing is connected to CN1 pins 17 to 20 or the wiring is incorrect.	Check the connections to CN1 pins 17 to 20.	Connect CN1 pins 17 to 20 correctly. For details, refer to *7.2.5 (2) Connection Diagrams*.
	SERVOPACK failure	–	Replace the SERVOPACK.
A.EA0: SERVOPACK Failure (DRV alarm 0) (SERVOPACK alarm 0 occurred.)	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.EA1: SERVOPACK Initial Access Error (The SERVOPACK initial access alarm occurred.)	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.EA2: DRV Alarm 2 (SERVOPACK WDC error)	A parameter was changed by the personal computer during MECHATROLINK communications.	Confirm the way the parameters are edited.	Stop changing parameters using the personal computer during MECHATROLINK communications.
	MECHATROLINK transmission cycle fluctuated.	Check the MECHATROLINK transmission cycle setting.	Remove the cause of transmission cycle fluctuation at the host controller.
	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.EB0: Safety-function-part: System Malfunction	An error occurred in the system of the safety-function-part.	–	• Restart the system. • Make improvements in the EMC installation environment. • Replace the SERVOPACK.
	An encoder is not connected to CN2.	–	• Connect an encoder to CN2 and restart the system.
A.EB1: Safety-function-part Signal Input Timing Error	Nothing is connected to CN1 pins 17 to 20 or the wiring is incorrect.	Check the connections to CN1 pins 17 to 20.	Connect CN1 pins 17 to 20 correctly. For details, refer to *7.2.5 (2) Connection Diagrams*.
	A 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.EB2: Safety-related Parameter Setting Error	The settings of the safety functions do not conform to the settings of the external encoder usage method.	Check the set values of Pc00 and Pc5A.	• Set Pn002 to n.0□□□ (Do not use external encoder), and then update the safety-related servo parameter. For details, refer to *14.5.2 (2) Updating Safety-related Servo Parameters*. • Turn the control power OFF and then ON again, and confirm that Pc5A.0 = 0 (External Encoder Setting = Does not use the external encoder).
	The set value of deceleration waiting time does not conform to the set value of deceleration monitoring time.	Check the set values of Pc10 and Pc11, and also those of Pc20 and Pc21.	Set the appropriate values.
	The set value of deceleration waiting monitoring speed does not conform to the maximum speed of the servomotor.	Check the set values of Pc12 and Pc62, and also those of Pc22 and Pc62.	Set the appropriate values.
	The set value of deceleration waiting monitoring speed does not conform to the set value of constant monitoring speed.	Check the set values of Pc12 and Pc14, and also those of Pc22 and Pc24.	Set the appropriate values.
	The set value of encoder output pulses does not conform to the servomotor that is being used.	Check the model of the motor that is being used and also the set value of Pn212.	Set the appropriate values.
	An error occurred in a safety-related parameter.	–	Initialize the safety-related parameters. For details, refer to *14.4.2 (3) Initializing Safety-related Parameters*.
A.EB3: HWBB Circuit Malfunction	An error occurred in the HWBB circuit of the SERVOPACK.	Check the connections to CN1 pins 17 to 20.	Connect CN1 pins 17 to 20 correctly. For details, refer to *7.2.5 (2) Connection Diagrams*
		–	• Restart the system. • Replace the SERVOPACK.
A.EB4: Safety-function-part: Feedback Data Malfunction	An error occurred in the position data of the motor.	–	• Restart the system. • Replace the SERVOPACK.
A.EB5: Safety-function-part: Timing Error of Safety Request Input Signal A	When either Safety Request Input Signal A1 or A2 was turned OFF, the other signal did not turn OFF within 10 seconds.	• Check the status of the input signal on the input signal monitor of SigmaWin for Σ-V-SD(MT). • Check the wiring. • Check the waveform of the input signal with measuring device such as an oscilloscope.	• Correct the wiring. • Make improvements in the EMC installation environment. • Restart the system. • Replace the SERVOPACK.
	When either Safety Request Input Signal A1 or A2 was turned ON, the other signal did not turn ON within 10 seconds.		
A.EB6: Safety-function-part: Timing Error of Safety Request Input Signal B	When either Safety Request Input Signal B1 or B2 was turned OFF, the other signal did not turn OFF within 10 seconds.	• Check the status of the input signal on the input signal monitor of SigmaWin for Σ-V-SD(MT). • Check the wiring. • Check the waveform of the input signal with measuring device such as an oscilloscope.	• Correct the wiring. • Make improvements in the EMC installation environment. • Restart the system. • Replace the SERVOPACK.
	When either Safety Request Input Signal B1 or B2 was turned ON, the other signal did not turn ON within 10 seconds.		

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Alarm: Alarm Name	Cause	Investigative Actions	Corrective Actions
A.EB7: Safety-function-part: Safety Function A Monitoring Alarm	When SBB-D, SPM-D, or SLS-D was selected as Safety Function A, the motor speed exceeded the monitoring speed set for Safety Function A.	–	• Correct the deceleration reference. • Correct the monitoring speed.
	When SPM-D was selected as Safety Function A, the distance that the motor moved exceeded the distance for monitoring set for Safety Function A.	–	• Correct the position reference. • Correct the distance for monitoring.
A.EB8: Safety-function-part: Safety Function B Monitoring Alarm	When SBB-D, SPM-D, or SLS-D was selected as Safety Function B, the motor speed exceeded the monitoring speed set for Safety Function B.	–	• Correct the deceleration reference. • Correct the monitoring speed.
	When SPM-D was selected as Safety Function B, the distance that the motor moved exceeded the distance for monitoring set for Safety Function B.	–	• Correct the position reference. • Correct the distance for monitoring.
A.EB9: Safety-function-part: Parameter Change Alarm	A safety-related parameter (Pc00 to Pc4F) was changed.	–	• Restart the system. • Recalculate the parameters.
	A safety-related servo parameter (Pc50 to Pc6F) was changed.		
	The safety-related parameters were initialized.		
A.EC0: Safety-function-part: Setup Confirmation Alarm	The safety-related parameters were initialized.	–	Execute a Safety-function-part Setup Confirmation Alarm Clear operation. For details, refer to *14.4.2 (3) Initializing Safety-related Parameters*.
A.EC1: Safety-related Servo Parameter Unmatch Alarm	The settings of a safety-related servo parameter and the corresponding SERVOPACK parameter do not match.	• Check the safety-related servo parameters. • Check the SERVOPACK parameters related to the safety-related servo parameters.	Update the safety-related servo parameters and set the SERVOPACK parameters that correspond to them so that the settings agree. For details, refer to *14.5.2 (2) Updating Safety-related Servo Parameters*.
	The safety-related parameters were initialized, therefore the safety-related servo parameters were initialized.		
	The motor or encoder connected to the SERVOPACK was changed.	Check the encoder connection.	
A.EC8: Gate Drive Error 1 (An error occurred in the gate drive circuit.)	SERVOPACK failure	–	Turn the power supply to the SERVOPACK OFF and then ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.
A.EC9: Gate Drive Error 2 (An error occurred in the gate drive circuit.)			
A.ED1: Command Execution Timeout	A timeout error occurred when using a MECHATROLINK command.	Check the motor status when the command is executed.	Execute the SV_ON or SENS_ON command only when the motor is not running.

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Alarm: Alarm Name	Cause	Investigative Actions	Corrective Actions
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 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.
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.

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Alarm: Alarm Name	Cause	Investigative Actions	Corrective Actions
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.
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.

Inspection, Maintenance, and Troubleshooting

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Alarm: Alarm Name	Cause	Investigative Actions	Corrective Actions
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.

13.3 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 *13.3.1 List of Warnings*.

The causes of warnings and troubleshooting methods are provided in *13.3.2 Troubleshooting of Warnings*.

13.3.1 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*1
A.930	Absolute Encoder Battery Error	This warning occurs when the voltage of absolute encoder's battery is lowered.	Required	Pn008.2
A.94A	Data Setting Warning 1 (Parameter Number Error)	Incorrect command parameter number was set.	Auto reset*2	Pn800.1
A.94B	Data Setting Warning 2 (Out of Range)	Command input data is out of range.	Auto reset*2	Pn800.1
A.94C	Data Setting Warning 3 (Calculation Error)	Calculation error was detected.	Auto reset*2	Pn800.1
A.94D	Data Setting Warning 4 (Parameter Size)	Data size does not match.	Auto reset*2	Pn800.1

*1. 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.
*2. The alarm is automatically reset if a MECHATROLINK-III standard servo profile command is received normally.
Note: If Pn008.2 is set to 1 to prevent detection of warnings, only the following warnings will be detected:
A.91A, A.91B, A.92A, A.92B, A.94F, A.97B

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Warning Number	Warning Name	Meaning	Reset	Setting Parameter
A.95A	Command Warning 1 (Unsatisfying Command)	Command was sent although the conditions for sending a command were not satisfied.	Auto reset*2	Pn800.1
A.95B	Command Warning 2 (Non-supported Command)	Unsupported command was sent.	Auto reset*2	Pn800.1
A.95D	Command Warning 4 (Command Interference)	Command, especially latch command, interferes.	Auto reset*2	Pn800.1
A.95E	Command Warning 5 (Subcommand Disable)	Subcommand and main command interfere.	Auto reset*2	Pn800.1
A.95F	Command Warning 6 (Undefined Command)	Undefined command was sent.	Auto reset*2	Pn800.1
A.960	MECHATROLINK Communications Warning	Communications error occurred during MECHATROLINK communications.	Required	Pn800.1
A.962	MECHATROLINK Communications Warning (FCS error)	Communications error occurred during MECHATROLINK communications.	Required	Pn800.1
A.963	MECHATROLINK Communications Warning Synchronization Frame Not Received Warning	Synchronization frames are not received continuously during MECHATROLINK communications.	Required	Pn800.1
A.96A	Network Reception Warning (Event-driven communications)	This warning occurs before the network reception error (event-driven communications) alarm (A.E6A) occurs. If the warning is ignored and operation continues, a network reception error alarm may occur.	Required	–
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.97A	Command Warning 7 (Phase Error)	A command was received that cannot be executed for the current phase.	Auto reset*2	Pn800.1
A.97B	Data Setting Warning (Data Clamp)	The set command data is clamped to the minimum or maximum value of the range that was exceeded.	Auto reset*2	Pn800.1
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.9A0	Overtravel	Overtravel is detected while the servomotor power is ON.	Required	Pn00D.3

*2. The alarm is automatically reset if a MECHATROLINK-III standard servo profile command is received normally.
Note: If Pn008.2 is set to 1 to prevent detection of warnings, only the following warnings will be detected:
A.91A, A.91B, A.92A, A.92B, A.94F, A.97B

13.3.2 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: • Reduce the servomotor reference speed. • Reduce the moment of inertia ratio. • 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.94A: Data Setting Warning 1 (Parameter Number Error)	Disabled parameter number was used.	–	Use the correct parameter number.
A.94B: Data Setting Warning 2 (Out of Range)	Attempted to send values outside the range to the command data.	–	Set the value of the parameter within the allowable range.
A.94D: Data Setting Warning 4 (Parameter Size)	Parameter size set in command is incorrect.	–	Use the correct parameter size.
A.95A: Command Warning 1 (Unsatisfying Command)	Command sending condition is not satisfied.	–	Send a command after command sending condition is satisfied.
A.95B: Command Warning 2 (Non-supported Command)	SERVOPACK received unsupported command.	–	Do not sent an unsupported command.
A.95D: Command Warning 4 (Command Interference)	Command sending condition for latch-related commands is not satisfied.	–	Send a command after command sending condition is satisfied.
A.95E: Command Warning 5 (Subcommand Disable)	Subcommand sending condition is not satisfied.	–	Send a command after command sending condition is satisfied.
A.95F: Command Warning 6 (Undefined Command)	Undefined command was sent.	–	Do not use an undefined command.

(cont'd)

Warning Number: Warning Name (Warning Description)	Cause	Investigative Actions	Corrective Actions
A.960: MECHATROLINK Communications Warning	MECHATROLINK wiring is incorrect.	Confirm the wiring.	Correct the MECHATROLINK wiring.
	MECHATROLINK data reception error occurred due to noise interference.	Confirm the installation conditions.	Take measures against noise. Check the MECHATROLINK communications cable and FG wiring and take measures such as adding ferrite core on the MECHATROLINK communications cable.
	SERVOPACK failure	–	The SERVOPACK may be faulty. Replace the SERVOPACK.
A.962: MECHATROLINK Communications Warning (FCS error)	MECHATROLINK wiring is incorrect.	Check the MECHATROLINK wirings.	Correct the MECHATROLINK wiring.
	MECHATROLINK data reception error occurred due to noise interference.	–	Take measures against noise. Check the MECHATROLINK communications cable and FG wiring and take measures such as adding ferrite core on the MECHATROLINK communications cable.
	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.963: MECHATROLINK Communications Warning Synchronization Frame Not Received Warning	MECHATROLINK wiring is incorrect.	Check the MECHATROLINK wirings.	Correct the MECHATROLINK wiring.
	MECHATROLINK data reception error occurred due to noise interference.	–	Take measures against noise. Check the MECHATROLINK communications cable and FG wiring and take measures such as adding ferrite core on the MECHATROLINK communications cable.
	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.96A: Network Reception Warning (Event-driven communications)	A parameter was changed by the personal computer during MECHATROLINK communications.	Confirm the way the parameters are edited.	Stop changing parameters using the personal computer during MECHATROLINK communications.
	SERVOPACK failure	–	Turn the power supply OFF and then ON again. If the warning still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.

(cont'd)

Warning Number: Warning Name (Warning Description)	Cause	Investigative Actions	Corrective Actions
A.971: Undervoltage	• For 200-VAC SERVOPACKs: The AC power supply voltage was in the range between 125 V and 170 V. • 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.97A: Command Warning 7 (Phase Error)	A command was received that cannot be executed for the current phase.	–	Send a command after command sending condition is satisfied.
A.97B: Data Setting Warning (Data Clamp)	Attempted to send values outside the range to the command data.	–	Set the value within the allowable range.
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.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 *13.4 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. • Do not specify movements that would cause overtravel from the host controller. • Check the wiring of the overtravel signals. • Take countermeasures for noise.

13.4 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.

Be sure to turn OFF the servo system before troubleshooting items shown in bold lines in the table.

Problem	Probable Cause	Investigative Actions	Corrective Actions
Motor Does Not Start	The control power supply is not ON.	Check voltage between control power terminals.	Correct the wiring.
	The main circuit power supply is not ON.	Check the voltage between main circuit power terminals.	Correct the wiring.
	Wiring of I/O signal connector CN1 faulty or disconnected.	Check if the connector CN1 is properly inserted and connected.	Correct the connector CN1 connection.
	Motor or encoder wiring disconnected.	Check the wiring.	Correct the wiring.
	Overloaded	Run under no load and check the load status.	Reduce load or replace with larger capacity 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 is not sent.	Check the command sent from the host controller.	Send the SV_ON command.
	SENS_ON command is not sent.	Check the command sent from the host controller.	Send the command in the correct SERVOPACK sequence.
	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.
	An HWBB state exists.	Check the SRI-A and SRI-B signals.	Turn ON the SRI-A and SRI-B signals if they are OFF.
	SERVOPACK failure	–	Replace the SERVOPACK.
Motor Moves Instantaneously, and then Stops	Servomotor wiring is incorrect.	Check the motor wiring.	Correct the wiring.
	Encoder wiring is incorrect.	Check the encoder wiring.	Correct the wiring.
Motor Speed Unstable	Wiring connection to motor is defective.	Check connections of power line (phases U, V, and W) and encoder connectors.	Tighten any loose terminals or connectors and correct the wiring.
Motor Rotates Without Reference Input	SERVOPACK failure	–	Replace the SERVOPACK.
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.	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.	Replace the SERVOPACK, and reduce the load.
	DB drive circuit fault	–	There is a defective component in the DB circuit. Replace the SERVOPACK.

(cont'd)

Problem	Probable Cause	Investigative Actions	Corrective Actions
Abnormal Noise from Servomotor	Mounting is not secured.	Check if there are any loose mounting screws.	Tighten the mounting screws.
		Check if there is misalignment of couplings.	Align the couplings.
		Check if there are unbalanced couplings.	Balance the couplings.
	Bearings are defective.	Check for noise and vibration around the bearings.	Replace the motor.
	Vibration source at the driven machine	Check for any foreign matter, damage, or deformations on the machinery's movable parts.	Contact the machine manufacturer.
	Noise interference due to incorrect I/O signal cable specifications	The I/O signal cable must be tinned annealed copper shielded twisted-pair or screened unshielded twisted-pair cable with a core of 0.12 mm^2 min.	Use the specified I/O signal cable.
	Noise interference due to length of I/O signal cable	Check the length of the I/O signal cable.	The I/O signal cable length must be no more than 3 m.
	Noise interference due to incorrect encoder cable specifications	The encoder cable must be tinned annealed copper shielded twisted-pair or screened unshielded twisted-pair cable with a core of 0.12 mm^2 min.	Use the specified encoder cable.
	Noise interference due to length of encoder cable	Check the length of the encoder cable.	The encoder cable must be no more than 20 m.
	Noise interference due to damaged encoder cable	Check if the encoder cable is bent and the sheath is damaged.	Replace the encoder cable and modify the encoder cable layout.
	Excessive noise to the encoder cable	Check if the encoder cable is bundled with a high-current line or near a high-current line.	Correct the 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.	Check if the machines are correctly grounded.	Properly ground the machines to separate from the encoder FG.
	SERVOPACK pulse counting error due to noise interference	Check if there is noise interference on the I/O signal line from the encoder.	Take measures against noise in the encoder wiring.
	Excessive vibration and shock to the encoder	Check if vibration from the machine occurred or motor installation is incorrect (mounting surface accuracy, fixing, alignment, etc.).	Reduce vibration from the machine, or secure the motor installation.
	Encoder failure	–	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). Factory setting: Kv = 40.0 Hz	Reduce the speed loop gain (Pn100).
	Position loop gain value (Pn102) too high	Check the position loop gain (Pn102). Factory setting: Kp = 40.0/s	Reduce the position loop gain (Pn102).
	Incorrect speed loop integral time constant (Pn101)	Check the speed loop integral time constant (Pn101). Factory setting: Ti = 20.0 ms	Correct the speed loop integral time constant (Pn101).
	Incorrect moment of inertia ratio (Pn103)	Check the moment of inertia ratio (Pn103).	Correct the moment of inertia ratio (Pn103).

(cont'd)

Problem	Probable Cause	Investigative Actions	Corrective Actions
High Motor Speed Overshoot on Starting and Stopping	Unbalanced servo gains	Check to see if the servo gains have been correctly adjusted.	Execute the advanced autotuning.
	Speed loop gain value (Pn100) too high	Check the speed loop gain (Pn100). Factory setting: Kv = 40.0 Hz	Reduce the speed loop gain (Pn100).
	Position loop gain value (Pn102) too high	Check the position loop gain (Pn102). Factory setting: Kp = 40.0/s	Reduce the position loop gain (Pn102).
	Incorrect speed loop integral time constant (Pn101)	Check the speed loop integral time constant (Pn101). Factory setting: Ti = 20.0 ms	Correct the speed loop integral time constant (Pn101).
	Incorrect moment of inertia ratio data (Pn103)	Check the moment of inertia ratio (Pn103).	Correct the moment of inertia ratio (Pn103).
Absolute Encoder Position Difference Error (The position saved in the host controller when the power was turned OFF is different from the position when the power was next turned ON.)	Noise interference due to improper encoder cable specifications	The encoder cable must be tinned annealed copper shielded twisted-pair or screened unshielded twisted-pair cable with a core of 0.12 mm^2 min.	Use the specified encoder cable.
	Noise interference due to length of encoder cable	Check the encoder cable length.	The encoder cable length must be no more than 20 m.
	Noise interference due to damaged encoder cable	Check if the encoder cable is bent or if its sheath is damaged.	Replace the encoder cable and correct the encoder cable layout.
	Excessive noise interference at the encoder cable	Check if the encoder cable is bundled with a high-current line or near high-current line.	Change the encoder cable layout so that no surge is applied.
	FG potential varies because of influence of machines such as welders at the servomotor.	Check if the machines are correctly grounded.	Ground machines correctly, and prevent diversion to the FG on the encoder side.
	SERVOPACK pulse counting error due to noise interference	Check if there is noise interference on the I/O signal line from the encoder.	Take measures against noise in the encoder wiring.
	Excessive vibration and shock to the encoder	Check if vibration from the machine occurred or motor installation is incorrect (mounting surface accuracy, fixing, alignment, etc.).	Reduce vibration from the machine, or secure the motor installation.
	Encoder failure	–	Replace the motor.
	SERVOPACK failure (The pulse count does not change.)	–	Replace the SERVOPACK.
	Host controller multiturn data reading error	Check the error detection section of the host controller.	Correct the error detection section of the host controller.
		Check if the host controller is executing data parity checks.	Execute a multiturn data parity check.
		Check noise in the cable between the SERVOPACK and the host controller.	Take measures against noise, and again execute a multiturn data parity check.

(cont'd)

Problem	Probable Cause	Investigative Actions	Corrective Actions
Overtravel (OT)	Forward or reverse run prohibited signal is input.	Check the external power supply (+24 V) voltage for the input signal.	Correct the external power supply (+24 V) voltage.
		Check if the overtravel limit switch operates properly.	Correct the overtravel limit switch.
		Check if the overtravel limit switch is wired correctly.	Correct the overtravel limit switch wiring.
	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.

(cont'd)

Problem	Probable Cause	Investigative Actions	Corrective Actions
Position Error (Without Alarm)	Noise interference due to incorrect encoder cable specifications	The encoder cable must be tinned annealed copper shielded twisted-pair or screened unshielded twisted-pair cable with a core of 0.12 mm^2 min.	Use the specified encoder cable.
	Noise interference due to length of encoder cable	Check the length of the encoder cable.	The encoder cable must be no more than 20 m.
	Noise influence due to damaged encoder cable	Check if the encoder cable is bent and its sheath is damaged.	Replace the encoder cable and modify the encoder cable layout.
	Excessive noise to encoder cable	Check if the encoder cable is bundled with a high-current line or near a high-current line.	Change the 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.	Check if the machines are correctly grounded.	Properly ground the machines encoder FG.
	SERVOPACK pulse count error due to noise	Check if the I/O signal line from the encoder is influenced by noise.	Take measures against noise in the encoder wiring.
	Excessive vibration and shock to the encoder	Check if vibration from the machine occurred or 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	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	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	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.)	–	Replace the motor.
	SERVOPACK failure	–	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	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.

14

Parameters

14.1 Types of Parameters

To operate the SERVOPACK, you must set the parameters according to your Servo System. There are four types of SERVOPACK parameters, as described in the following table.

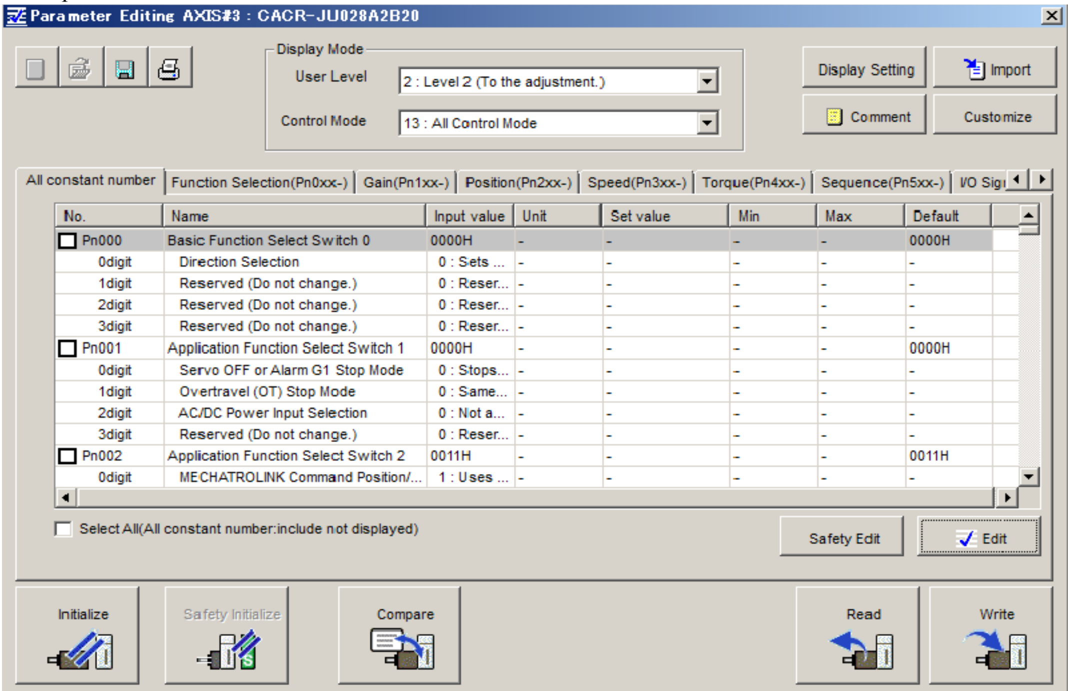
Parameters	Overview
Parameters	These SERVOPACK parameters include parameters for basic settings required for operation and parameters that are used to adjust servo performance. The parameter numbers have a prefix of Pn.
MECHATROLINK-III Common Parameters	These parameters are used to make settings from the host controller via MECHATROLINK communications. Do not change the settings with SigmaWin for Σ-V-SD(MT) or any other device. The parameter numbers have a prefix of a two-digit number followed by Pn.
Safety-related Parameters	These parameters are used to set safety functions. These parameters are used only for the safety-function-part. The parameter numbers have a prefix of Pc.
Safety-related Servo Parameters	These parameters contain information about the safety functions of the SERVOPACK and servomotor and are managed by the safety-function-part. This information is maintained in the SERVOPACK, but it is also managed in the safety-function-part with different parameter numbers. To change safety-related servo parameters, change the corresponding SERVOPACK parameters and then update the safety-related servo parameters to write the changes to the safety-function-part of the SERVOPACK. For details, refer to *14.5.2 (2) Updating Safety-related Servo Parameters*. The parameter numbers have a prefix of Pc.

14.2 Parameters

14.2.1 Operating Procedure

This section describes how to display the windows used to display and edit parameters online.

In the menu bar of SigmaWin for Σ-V-SD(MT) component's main window, click **Parameters** and then click **Edit Parameters**. The following window will be displayed. Follow the information displayed in the window to perform the rest of the procedure.



14.2.2 List of Parameters

This section contains a tables of parameters.

Note: Do not change the following parameters from the factory settings.

- Reserved parameters
- Parameters not described in this manual.

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Motor Type	Reference Section
Pn000	2	Basic Function Select Switch 0	0000 to 00B3	–	0000	After restart	Setup	spindle motor, servo-motor	–

Pn000: n.□□□□ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit:

Direction Selection		Reference Section
0	Forward reference for forward rotation.	8.2.1
1	Forward reference for reverse rotation.	
2 and 3	Reserved (Do not use.)	

2nd digit: Reserved (Do not change.)

3rd digit: Reserved (Do not change.)

4th digit: Reserved (Do not change.)

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(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Motor Type	Reference Section
Pn001	2	Application Function Select Switch 1	0100 to 1222	–	*1	After restart	Setup	spindle motor, servo-motor	–

Pn001

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

1st digit:

Servomotor power OFF or Alarm Gr.1 Stop Mode		Reference Section
0	Stops the motor by applying DB (dynamic brake).	8.2.4
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).	8.2.2
1	Sets the torque of Pn406 to the maximum value, decelerates the motor to a stop, and then sets it to servo-lock 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.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Motor Type	Reference Section
Pn002	2	Application Function Select Switch 2	0000 to 4113	–	0011	After restart	Setup	spindle motor, servo-motor	–

Pn002

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

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.	8.5.1
1	Uses absolute encoder as an incremental encoder.	

4th digit:

External Encoder Usage (Do not change the setting of this parameter for the SERVOPACKs described in this manual.)	
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.)

*1. Varies in accordance with the SERVOPACK used.
SERVOPACK CACR-JU028A, -JU036A, -JU014D, or -JU018D: 0200
Other models: 0202

(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Motor Type	Reference Section
Pn006	2	Application Function Select Switch 6	0000 to 005F	–	0002	Immedi-ately	Setup	spindle motor, servo-motor	10.1.3

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%)
03	Position error (0.05 V/1 reference unit)
04	Position amplifier error (after electronic gears) (0.05 V/ 1 encoder pulse unit)
05	Position reference speed (1 V / 1000 min^{-1})
06	Reserved (Do not use.)
07	Reserved (Do not use.)
08	Positioning completion (positioning completed: 5 V, positioning not completed: 0 V)
09	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	Reserved (Do not use.)
46	Reserved (Do not use.)
47	Quadrant error compensation (1 V/100%)

3rd digit: **Reserved (Do not change.)**

4th digit: **Reserved (Do not change.)**

(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Motor Type	Reference Section
Pn007	2	Application Function Select Switch 7	0000 to 005F	–	0000	Immedi-ately	Setup	spindle motor, servo-motor	10.1.3

Pn007

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

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%)
03	Position error (0.05 V/1 reference unit)
04	Position amplifier error (after electronic gears) (0.05 V/ 1 encoder pulse unit)
05	Position reference speed (1 V / 1000 min^{-1})
06	Reserved (Do not use.)
07	Reserved (Do not use.)
08	Positioning completion (positioning completed: 5 V, positioning not completed: 0 V)
09	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	Reserved (Do not use.)
46	Reserved (Do not use.)
47	Quadrant error compensation (1 V/100%)

3rd digit: Reserved (Do not change.)

4th digit: Reserved (Do not change.)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Motor Type	Reference Section
Pn008	2	Application Function Select Switch 8	0000 to 7121	–	4000	After restart	Setup	spindle motor, servo-motor	–

Pn008

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

1st digit:

Lowered Battery Voltage Alarm/Warning Selection		Reference Section
0	Outputs alarm (A.830) for lowered battery voltage.	8.5.4
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.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Motor Type	Reference Section
Pn00B	2	Application Function Select Switch B	0000 to 1111	–	0001	After restart	Setup	spindle motor, servo-motor	–

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

- 1st digit: Reserved (Do not change.)
- 2nd digit: Alarm Gr.2 Stop Method Selection

Alarm Gr.2 Stop Method Selection		Reference Section
0	Stops the motor by setting the speed reference to "0."	8.2.4
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.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Motor Type	Reference Section
Pn00D	2	Application Function Select Switch D	0000 to 1101	–	0000	After restart	Setup	spindle motor, servo-motor	–

Pn00D 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

Fan Stop Error Detection Selection	
0	Issues an alarm after the fan stops.
1	Issues a warning for a specified time and then an alarm after the fan stops.

- 4th digit: Overtravel Warning Detection Selection

Overtravel Warning Detection Selection		When Enabled
0	Does not detect overtravel warning.	Immediately
1	Detects overtravel warning.	

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Motor Type	Reference Section
Pn01B	2	Application Function Select Switch 1B	0000 to 0011	–	0000	After restart	Setup	spindle motor, servo-motor	–

Pn01B n.□□□□ (4th digit, 3rd digit, 2nd digit, 1st digit)

- 1st digit: Emergency Stop Signal Selection

Emergency Stop Signal Selection	
0	Disables the emergency stop signal.
1	Enables the emergency stop signal.

- 2nd digit: Contactor Control Function Selection

Contactor Control Function Selection	
0	Disables MCON signal.
1	Enables MCON signal.

- 3rd digit: Reserved (Do not change.)
- 4th digit: Reserved (Do not change.)

(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Motor Type	Reference Section
Pn01C	2	Application Function Select Switch 1C	0000 to 0003	–	0000	After restart	Setup	spindle motor	–

Pn01C: n.□□□□ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit: Load Ratio Output Level Selection (Do not change the setting of this parameter for the SERVOPACKs described in this manual.)

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.)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Motor Type	Reference Section
Pn01E	2	Application Function Select Switch 1E	0000 to 0016	–	0000	After restart	Setup	spindle motor, servo-motor	–

Pn01E: n.□□□□ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit: Motor Type (Do not change the setting of this parameter for the SERVOPACKs described in this manual.)

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: Reserved (Do not change.)

3rd digit: Reserved (Do not change.)

4th digit: Reserved (Do not change.)

(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Motor Type	Reference Section
Pn01F	2	Application Function Select Switch 1F	0000 to 0002	–	0000	After restart	Setup	spindle motor, servo-motor	–
	n.□□□□ (4th digit, 3rd digit, 2nd digit, 1st digit) 1st digit: Encoder Type (Do not change the setting of this parameter for the SERVOPACKs described in this manual.) 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.)								
Pn030	2	Reserved (Do not change.)	–	–	0000	–	Setup	spindle motor, servo-motor	–
Pn070	2	Function at Cutting Feed	0000 to 0021	–	0000	After restart	Setup	spindle motor, servo-motor	–
	n.□□□□ (4th digit, 3rd digit, 2nd digit, 1st digit) 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.)								

(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Motor Type	Reference Section
Pn071	2	Function at Fast-forward	0000 to 0022	–	0000	After restart	Setup	spindle motor, servo-motor	–
	n.□□□□ (4th digit, 3rd digit, 2nd digit, 1st digit) 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.)								
Pn07F	2	Reserved (Do not change.)	0000 to 0002	–	0000	After restart	Setup	spindle motor, servo-motor	–
Pn100	2	Speed Loop Gain	10 to 20000	0.1 Hz	400	Immedi-ately	Tuning	spindle motor, servo-motor	–
Pn101	2	Speed Loop Integral Time Constant	15 to 51200	0.01 ms	2000	Immedi-ately	Tuning	spindle motor, servo-motor	–
Pn102	2	Position Loop Gain	10 to 20000	0.1/s	400	Immedi-ately	Tuning	spindle motor, servo-motor	–
Pn103	2	Moment of Inertia Ratio	0 to 20000	1%	100	Immedi-ately	Tuning	spindle motor, servo-motor	–
Pn104	2	2nd Speed Loop Gain	10 to 20000	0.1 Hz	400	Immedi-ately	Tuning	spindle motor, servo-motor	–
Pn105	2	2nd Speed Loop Integral Time Constant	15 to 51200	0.01 ms	2000	Immedi-ately	Tuning	spindle motor, servo-motor	–
Pn106	2	2nd Position Loop Gain	10 to 20000	0.1/s	400	Immedi-ately	Tuning	spindle motor, servo-motor	–
Pn109	2	Feedforward Gain	0 to 100	1%	0	Immedi-ately	Tuning	spindle motor, servo-motor	–
Pn10A	2	Feedforward Filter Time Constant	0 to 6400	0.01 ms	0	Immedi-ately	Tuning	spindle motor, servo-motor	–

(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Motor Type	Reference Section
Pn10B	2	Application Function for Gain Select Switch	0000 to 5334	–	0000	–	Setup	spindle motor, servo-motor	–

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

1st digit: Reserved (Do not change.)

2nd digit:

Speed Loop Control Method		When Enabled
0	PI control	After restart
1	I-P control	
2 and 3	Reserved (Do not use.)	

3rd digit: Reserved (Do not change.)

4th digit: Reserved (Do not change.)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Motor Type	Reference Section
Pn121	2	Friction Compensation Gain	10 to 1000	1%	100	Immedi-ately	Tuning	spindle motor, servo-motor	–
Pn123	2	Friction Compensation Coefficient	0 to 100	1%	0	Immedi-ately	Tuning	spindle motor, servo-motor	–
Pn124	2	Friction Compensation Frequency Correction	-10000 to 10000	0.1 Hz	0	Immedi-ately	Tuning	spindle motor, servo-motor	–
Pn125	2	Friction Compensation Gain Correction	1 to 1000	1%	100	Immedi-ately	Tuning	spindle motor, servo-motor	–
Pn12B	2	Reserved (Do not change.)	10 to 20000	0.1 Hz	400	Immedi-ately	Tuning	spindle motor, servo-motor	–
Pn12C	2	Reserved (Do not change.)	15 to 51200	0.01 ms	2000	Immedi-ately	Tuning	spindle motor, servo-motor	–
Pn12D	2	Reserved (Do not change.)	10 to 20000	0.1/s	400	Immedi-ately	Tuning	spindle motor, servo-motor	–
Pn12E	2	Reserved (Do not change.)	10 to 20000	0.1 Hz	400	Immedi-ately	Tuning	spindle motor, servo-motor	–
Pn12F	2	Reserved (Do not change.)	15 to 51200	0.01 ms	2000	Immedi-ately	Tuning	spindle motor, servo-motor	–
Pn130	2	Reserved (Do not change.)	10 to 20000	0.1/s	400	Immedi-ately	Tuning	spindle motor, servo-motor	–

(cont'd)

<table>
<tr><th>Parameter 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 rowspan="2">**Pn140**</td><td>2</td><td>Model Following Control Related Switch</td><td>0000 to 1020</td><td>–</td><td>0000</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
n.□□□□
1st digit: Reserved (Do not change.)
2nd digit: Reserved (Do not change.)
3rd digit: Reserved (Do not change.)
4th digit: Selection of Speed Feedforward (VFF) / Torque Feedforward (TFF)
0: Does not use model following control and speed/torque feedforward together.
1: Uses model following control and speed/torque feedforward together.</td></tr>
<tr><td>**Pn141**</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**</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**</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**</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**</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.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Motor Type	Reference Section
Pn150	2	Predictive Control Function Select Switch	0000 to 0014	–	0012	After restart	Setup	spindle motor, servo-motor	–

4th digit 3rd digit 2nd digit 1st digit

n.□□□□

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.)

Pn151	2	Predictive Control Acceleration/Deceleration Gain	0 to 300	1%	100	Immediately	Tuning	spindle motor, servo-motor	–
Pn152	2	Predictive Control Ratio of Weight	0 to 300	1%	100	Immediately	Tuning	spindle motor, servo-motor	–
Pn153	2	Predictive Control Equivalent Kp Ratio	10 to 300	1%	100	Immediately	Tuning	spindle motor, servo-motor	–
Pn154	2	Predictive Control Speed FF Gain	0 to 5000	0.1%	0	Immediately	Tuning	spindle motor, servo-motor	–
Pn155	2	Predictive Control Torque FF Gain	0 to 5000	0.1%	0	Immediately	Tuning	spindle motor, servo-motor	–
Pn156	2	Predictive Control Torque FF Filter Time Constant	0 to 65535	0.01 ms	0	Immediately	Tuning	spindle motor, servo-motor	–
Pn157	2	Predictive Control Parameter Kph(C)	0 to 100	0.1	80	Immediately	Tuning	spindle motor, servo-motor	–
Pn158	2	Predictive Control Parameter Cd	0 to 5000	0.1	0	Immediately	Tuning	spindle motor, servo-motor	–
Pn159	2	Predictive Control Parameter α	-90 to 1000	0.01	0	Immediately	Tuning	spindle motor, servo-motor	–

(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Motor Type	Reference Section
Pn15A	2	Predictive Control Equivalent Kp Fine Adjustment Amount	-10000 to 32767	0.1/s	0	Immedi-ately	Tuning	spindle motor, servo-motor	–
Pn160	2	Anti-Resonance Control Related Switch	0000 to 0011	–	0010	Immedi-ately	Tuning	spindle motor, servo-motor	10.5

4th digit 3rd digit 2nd digit 1st digit

n.□□□□

1st digit:

Anti-Resonance Control Selection	
0	Does not use anti-resonance control.
1	Uses anti-resonance control.

2nd digit:

Anti-Resonance Control Adjustment Selection	
0	Does not adjust anti-resonance control automatically using utility function.
1	Adjusts anti-resonance control automatically using utility function.

3rd digit: Reserved (Do not change.)

4th digit: Reserved (Do not change.)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Motor Type	Reference Section
Pn161	2	Anti-Resonance Frequency	10 to 20000	0.1 Hz	1000	Immedi-ately	Tuning	spindle motor, servo-motor	–
Pn162	2	Anti-Resonance Gain Compensation	1 to 1000	1%	100	Immedi-ately	Tuning	spindle motor, servo-motor	–
Pn163	2	Anti-Resonance Damping Gain	0 to 300	1%	0	Immedi-ately	Tuning	spindle motor, servo-motor	–
Pn164	2	Anti-Resonance Filter Time Constant 1 Compensation	-1000 to 1000	0.01 ms	0	Immedi-ately	Tuning	spindle motor, servo-motor	–
Pn165	2	Anti-Resonance Filter Time Constant 2 Compensation	-1000 to 1000	0.01 ms	0	Immedi-ately	Tuning	spindle motor, servo-motor	–
Pn205	2	Multiturn Limit Setting	0 to 65535	1 Rev	65535	After restart	Setup	servo-motor	8.5.5
Pn20A	4	Reserved (Do not change.)	4 to 1048576	1 pitch/rev	32768	After restart	Setup	spindle motor, servo-motor	–
Pn20E	4	Reserved (Do not change.)	–	–	–	–	–	spindle motor, servo-motor	–
Pn210	4	Reserved (Do not change.)	–	–	–	–	–	spindle motor, servo-motor	–

(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Motor Type	Reference Section
Pn212	4	Number of Encoder Output Pulses	16 to 1073741824	1 pitch/rev	2048	After restart	Setup	Servomotor	9.5.5
Pn22A	2	Reserved (Do not change.)	0000 to 1003	–	0000	After restart	Setup	spindle motor, servomotor	–
Pn230	4	Reserved (Do not change.)	100 to 1048576	1 pitch/rev	1024	After restart	Setup	spindle motor	–
Pn232	2	Reserved (Do not change.)	-20 to 20	1 pulse	0	After restart	Setup	spindle motor	–
Pn233	2	Reserved (Do not change.)	-18000 to 18000	0.01 deg	0	After restart	Setup	spindle motor	–
Pn234	2	Reserved (Do not change.)	0000 to 0001	–	0000	Immediately	Setup	spindle motor	–
Pn304	2	JOG Speed	0 to 10000	1 min^{-1}	500	Immediately	Setup	spindle motor, servomotor	–
Pn305	2	Soft Start Acceleration Time	0 to 10000	1 ms	0	Immediately	Setup	spindle motor, servomotor	–
Pn306	2	Soft Start Deceleration Time	0 to 10000	1 ms	0	Immediately	Setup	spindle motor, servomotor	–
Pn311	2	Vibration Detection Sensibility	50 to 500	1%	100	Immediately	Tuning	spindle motor, servomotor	–
Pn324	2	Moment of Inertia Calculating Start Level	0 to 20000	1%	300	Immediately	Setup	spindle motor, servomotor	10.2
Pn401	2	1st Step 1st Torque Reference Filter Time Constant	0 to 65535	0.01 ms	100	Immediately	Tuning	spindle motor, servomotor	–
Pn402	2	Forward Torque Limit	0 to 800	1%	800	Immediately	Setup	servomotor	–
Pn403	2	Reverse Torque Limit	0 to 800	1%	800	Immediately	Setup	servomotor	–
Pn404	2	Forward External Torque Limit	0 to 800	1%	100	Immediately	Setup	servomotor	–
Pn405	2	Reverse External Torque Limit	0 to 800	1%	100	Immediately	Setup	servomotor	–
Pn406	2	Emergency Stop Torque	0 to 800	1%	800	Immediately	Setup	spindle motor, servomotor	8.2.2
Pn407	2	Speed Limit during Torque Control	0 to 10000	1 min^{-1}	10000	Immediately	Setup	spindle motor, servomotor	–

(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Motor Type	Reference Section
Pn408	2	Torque Related Function Switch	0000 to 1111	–	0000	–	Setup	spindle motor, servo-motor	–

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

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.)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Motor Type	Reference Section
Pn409	2	1st Notch Filter Frequency	50 to 2000	1 Hz	2000	Immedi-ately	Tuning	spindle motor, servo-motor	–
Pn40A	2	1st Notch Filter Q Value	50 to 1000	0.01	70	Immedi-ately	Tuning	spindle motor, servo-motor	–
Pn40B	2	1st Notch Filter Depth	0 to 1000	0.001	0	Immedi-ately	Tuning	spindle motor, servo-motor	–
Pn40C	2	2nd Notch Filter Frequency	50 to 2000	1 Hz	2000	Immedi-ately	Tuning	spindle motor, servo-motor	–
Pn40D	2	2nd Notch Filter Q Value	50 to 1000	0.01	70	Immedi-ately	Tuning	spindle motor, servo-motor	–
Pn40E	2	2nd Notch Filter Depth	0 to 1000	0.001	0	Immedi-ately	Tuning	spindle motor, servo-motor	–
Pn412	2	1st Step 2nd Torque Reference Filter Time Constant	0 to 65535	0.01 ms	100	Immedi-ately	Tuning	spindle motor, servo-motor	–
Pn413	2	Reserved (Do not change.)	0 to 65535	0.01 ms	100	Immedi-ately	Tuning	spindle motor, servo-motor	–

(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Motor Type	Reference Section
Pn414	2	Reserved (Do not change.)	0 to 65535	0.01 ms	100	Immedi-ately	Tuning	spindle motor, servo-motor	–
Pn416	2	Torque Related Function Switch 2	0000 to 0011	–	0000	Immedi-ately	Setup	spindle motor, servo-motor	–

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

1st digit: 3rd Step Notch Filter Selection

0	N/A
1	Uses 3rd step notch filter for torque reference.

2nd digit: 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.)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Motor Type	Reference Section
Pn417	2	3rd Notch Filter Frequency	50 to 2000	1 Hz	2000	Immedi-ately	Tuning	spindle motor, servo-motor	–
Pn418	2	3rd Notch Filter Q Value	50 to 1000	0.01	70	Immedi-ately	Tuning	spindle motor, servo-motor	–
Pn419	2	3rd Notch Filter Depth	0 to 1000	0.001	0	Immedi-ately	Tuning	spindle motor, servo-motor	–
Pn41A	2	4th Notch Filter Frequency	50 to 2000	1 Hz	2000	Immedi-ately	Tuning	spindle motor, servo-motor	–
Pn41B	2	4th Notch Filter Q Value	50 to 1000	0.01	70	Immedi-ately	Tuning	spindle motor, servo-motor	–
Pn41C	2	4th Notch Filter Depth	0 to 1000	0.001	0	Immedi-ately	Tuning	spindle motor, servo-motor	–
Pn430	2	Reserved (Do not change.)	0 to 800	1%	150	Immedi-ately	Setup	spindle motor	–
Pn431	2	Reserved (Do not change.)	0 to 800	1%	150	Immedi-ately	Setup	spindle motor	–
Pn432	2	Reserved (Do not change.)	10 to 100	1%	15	Immedi-ately	Setup	spindle motor	–
Pn433	2	Reserved (Do not change.)	30 to 100	1%	100	Immedi-ately	Setup	spindle motor	–
Pn434	2	Reserved (Do not change.)	100 to 500	1%	100	Immedi-ately	Setup	spindle motor	–

(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Motor Type	Reference Section
Pn435	2	Reserved (Do not change.)	30 to 100	1%	100	Immedi-ately	Setup	spindle motor	–
Pn436	2	Reserved (Do not change.)	100 to 500	1%	100	Immedi-ately	Setup	spindle motor	–
Pn43F	2	Reserved (Do not change.)	0 to 5000	ms	100	Immedi-ately	Tuning	spindle motor	–
Pn456	2	Sweep Torque Reference Amplitude	1 to 800	1%	15	Immedi-ately	Tuning	spindle motor, servo-motor	–
Pn460	2	Notch Filter Adjustment Switch	0000 to 0101	–	0101	Immedi-ately	Tuning	spindle motor, servo-motor	10.2
Pn481	2	Reserved (Do not change.)	10 to 20000	0.1 Hz	400	Immedi-ately	Tuning	spindle motor, servo-motor	–
Pn482	2	Reserved (Do not change.)	15 to 51200	0.01 ms	3000	Immedi-ately	Tuning	spindle motor, servo-motor	–
Pn486	2	Reserved (Do not change.)	0 to 100	1 ms	25	Immedi-ately	Tuning	spindle motor, servo-motor	–
Pn487	2	Reserved (Do not change.)	0 to 300	1 ms	0	Immedi-ately	Tuning	spindle motor, servo-motor	–
Pn488	2	Reserved (Do not change.)	50 to 500	1 ms	100	Immedi-ately	Tuning	spindle motor, servo-motor	–
Pn490	2	Reserved (Do not change.)	0 to 20000	1%	100	Immedi-ately	Tuning	spindle motor, servo-motor	–
Pn493	2	Reserved (Do not change.)	0 to 1000	1 min^{-1}	50	Immedi-ately	Tuning	spindle motor, servo-motor	–

Pn460

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

1st digit: Notch Filter Adjustment Selection 1

0	Does not adjust 1st step notch filter automatically using utility function.
1	Adjust 1st step notch filter automatically using utility function.

2nd digit: Reserved (Do not change.)

3rd digit: Notch Filter Adjustment Selection 2

0	Does not adjust 2nd step notch filter automatically using utility function.
1	Adjust 2nd step notch filter automatically using utility function.

4th digit: Reserved (Do not change.)

(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Motor Type	Reference Section
Pn494	2	Reserved (Do not change.)	1 to 65535	0.001 rev	250	Immedi-ately	Tuning	spindle motor, servo-motor	–
Pn495	2	Reserved (Do not change.)	0 to 200	1%	100	Immedi-ately	Tuning	spindle motor, servo-motor	–
Pn498	2	Reserved (Do not change.)	0 to 30	1 deg	10	Immedi-ately	Tuning	spindle motor, servo-motor	–
Pn499	2	Reserved (Do not change.)	–	–	15	–	Tuning	spindle motor, servo-motor	–
Pn49A	2	Reserved (Do not change.)	–	–	50	–	Tuning	spindle motor, servo-motor	–
Pn4B0	2	Acceleration Rate Cor-rection Switch	0000 to 0001	–	0000	After restart	Setup	servomo-tor	–

Pn4B0:

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.)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Motor Type	Reference Section
Pn4B1	2	Forward Compensation Number of Steps	1 to 65535	–	1	Immedi-ately	Tuning	servomo-tor	–
Pn4B2	2	Forward Compensation Torque	0 to 30000	0.01%	0	Immedi-ately	Tuning	servomo-tor	–
Pn4B3	2	Forward Offset Position Ratio	0 to 100	%	0	Immedi-ately	Tuning	servomo-tor	–
Pn4B4	2	Forward Offset Compen-sation Torque	0 to 30000	0.01%	0	Immedi-ately	Tuning	servomo-tor	–
Pn4B5	2	2nd Step Forward Com-pensation Position Ratio	0 to 600	%	0	Immedi-ately	Tuning	servomo-tor	–
Pn4B6	2	2nd Step Forward Com-pensation Torque	0 to 30000	0.01%	0	Immedi-ately	Tuning	servomo-tor	–
Pn4B7	2	Reverse Compensation Number of Steps	1 to 65535	–	1	Immedi-ately	Tuning	servomo-tor	–
Pn4B8	2	Reverse Compensation Torque	0 to 30000	0.01%	0	Immedi-ately	Tuning	servomo-tor	–
Pn4B9	2	Reverse Offset Position Ratio	0 to 100	%	0	Immedi-ately	Tuning	servomo-tor	–
Pn4BA	2	Reverse Offset Compen-sation Torque	0 to 30000	0.01%	0	Immedi-ately	Tuning	servomo-tor	–

(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Motor Type	Reference Section
Pn4BB	2	2nd Step Reverse Compensation Position Ratio	0 to 600	%	0	Immediately	Tuning	servomotor	–
Pn4BC	2	2nd Step Reverse Compensation Torque	0 to 30000	0.01%	0	Immediately	Tuning	servomotor	–
Pn4BD	2	Forward Compensation Step Correction Function Coefficient a	0 to 65535	–	0	Immediately	Tuning	servomotor	–
Pn4BE	2	Forward Compensation Step Correction Function Coefficient b	0 to 65535	–	0	Immediately	Tuning	servomotor	–
Pn4BF	2	Forward Compensation Torque Correction Function Coefficient a	0 to 10000	0.01	0	Immediately	Tuning	servomotor	–
Pn4C0	2	Forward Compensation Torque Correction Function Coefficient b	0 to 10000	0.01	0	Immediately	Tuning	servomotor	–
Pn4C1	2	Reverse Compensation Step Correction Function Coefficient a	0 to 65535	–	0	Immediately	Tuning	servomotor	–
Pn4C2	2	Reverse Compensation Step Correction Function Coefficient b	0 to 65535	–	0	Immediately	Tuning	servomotor	–
Pn4C3	2	Reverse Compensation Torque Correction Function Coefficient a	0 to 10000	0.01	0	Immediately	Tuning	servomotor	–
Pn4C4	2	Reverse Compensation Torque Correction Function Coefficient b	0 to 10000	0.01	0	Immediately	Tuning	servomotor	–
Pn4C5	2	Forward Acceleration Rate Correction Projection Compensation Limit Clamp Value	0 to 30000	0.01%	0	Immediately	Tuning	servomotor	–
Pn4C6	2	Reverse Acceleration Rate Correction Projection Compensation Limit Clamp Value	0 to 30000	0.01%	0	Immediately	Tuning	servomotor	–
Pn4F0	2	1st Positive Projection Compensation Gain	0 to 65535	100000 /s^3	10000	Immediately	Setup	servomotor	–
Pn4F1	2	1st Positive Projection Compensation Limit Offset	0 to 30000	0.01%	0	Immediately	Setup	servomotor	–
Pn4F2	2	2nd Positive Projection Compensation Gain	0 to 65535	100000 /s^3	1000	Immediately	Setup	servomotor	–
Pn4F3	2	2nd Positive Projection Compensation Limit Offset	0 to 30000	0.01%	0	Immediately	Setup	servomotor	–
Pn4F4	2	Positive Projection Compensation Limit Change Value	-30000 to 30000	0.01 %/ms	0	Immediately	Setup	servomotor	–
Pn4F5	2	Positive Projection Compensation Limit Clamp Value	0 to 30000	0.01%	0	Immediately	Setup	servomotor	–
Pn4F6	2	1st Negative Projection Compensation Gain	0 to 65535	100000 /s^3	10000	Immediately	Setup	servomotor	–

(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Motor Type	Reference Section
Pn4F7	2	1st Negative Projection Compensation Limit Offset	0 to 30000	0.01%	0	Immediately	Setup	servomotor	–
Pn4F8	2	2nd Negative Projection Compensation Gain	0 to 65535	100000 $/s^3$	1000	Immediately	Setup	servomotor	–
Pn4F9	2	2nd Negative Projection Compensation Limit Offset	0 to 30000	0.01%	0	Immediately	Setup	servomotor	–
Pn4FA	2	Negative Projection Compensation Limit Change Value	-30000 to 30000	0.01 %/ms	0	Immediately	Setup	servomotor	–
Pn4FB	2	Negative Projection Compensation Limit Clamp Value	0 to 30000	0.01%	0	Immediately	Setup	servomotor	–
Pn4FC	2	Projection Compensation Timing Constant	-350 to 32767	0.1/s	0	Immediately	Setup	servomotor	–
Pn501	2	Zero Clamp Level	0 to 10000	1 min^{-1}	10	Immediately	Setup	spindle motor, servomotor	–
Pn502	2	Rotation Detection Level	1 to 10000	1 min^{-1}	20	Immediately	Setup	servomotor	–
Pn503	2	Speed Coincidence Signal Output Width	0 to 100	1 min^{-1}	10	Immediately	Setup	servomotor	–
Pn506	2	Brake Reference - Servo OFF Delay Time	0 to 50	10 ms	0	Immediately	Setup	spindle motor, servomotor	8.2.3
Pn507	2	Brake Reference Output Speed Level	0 to 10000	1 min^{-1}	100	Immediately	Setup	spindle motor, servomotor	
Pn508	2	Waiting Time for Brake Signal When Motor Running	10 to 100	10 ms	50	Immediately	Setup	spindle motor, servomotor	
Pn50A	2	Input Signal Selection 1	0000 to FFF1	–	1881	After restart	Setup	spindle motor, servomotor	–

Pn50A

4th digit 3rd digit 2nd digit 1st digit

n. □ □ □ □

1st digit: Reserved (Do not change.)

2nd digit: Reserved (Do not change.)

3rd digit: Reserved (Do not change.)

4th digit:

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.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Motor Type	Reference Section
Pn50B	2	Input Signal Selection 2	0000 to FFFF	–	8882	After restart	Setup	spindle motor, servo-motor	–

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.	7.2.5
9 to F	Reverse run allowed when N-OT input signal is OFF (H-level).	7.2.5

2nd digit: Reserved (Do not change.)

3rd digit: Reserved (Do not change.)

4th digit: Reserved (Do not change.)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Motor Type	Reference Section
Pn517	2	OT Function	0000 to 0003	–	0000	Immedi-ately	Setup	spindle motor, servo-motor	–

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

1st digit:

Hardware OT Function	
0	Enables OT function.
1	Disables OT function for forward run.
2	Disables OT function for reverse run.
3	Disables OT function.

2nd digit: Reserved (Do not change.)

3rd digit: Reserved (Do not change.)

4th digit: Reserved (Do not change.)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Motor Type	Reference Section
Pn51B	4	Reserved (Do not change.)	0 to 1073741824	1 refer-ence unit	1000	Immedi-ately	Setup	spindle motor, servo-motor	–
Pn51E	2	Excessive Position Error Warning Level	10 to 100	1%	100	Immedi-ately	Setup	spindle motor, servo-motor	13.3.1
Pn520	4	Excessive Position Error Alarm Level	1 to 1073741823	1 refer-ence unit	5242880	Immedi-ately	Setup	spindle motor, servo-motor	10.1.4 13.3.1
Pn522	4	Positioning Completed Width	0 to 1073741824	1 refer-ence unit	7	Immedi-ately	Setup	spindle motor, servo-motor	–

(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Motor Type	Reference Section
Pn524	4	NEAR Signal Width	1 to 1073741824	1 reference unit	1073741824	Immediately	Setup	spindle motor, servomotor	–
Pn526	4	Excessive Position Error Alarm Level at Servo ON	1 to 1073741823	1 reference unit	5242880	Immediately	Setup	spindle motor, servomotor	13.3.1
Pn528	2	Excessive Position Error Warning Level at Servo ON	10 to 100	1%	100	Immediately	Setup	spindle motor, servomotor	13.3.1
Pn529	2	Speed Limit Level at Servo ON	0 to 10000	1 min^{-1}	10000	Immediately	Setup	spindle motor, servomotor	13.3.1
Pn52A	2	Reserved (Do not change.)	0 to 100	1%	20	Immediately	Tuning	spindle motor, servomotor	–
Pn52B	2	Overload Warning Level	1 to 100	1%	20	Immediately	Setup	spindle motor, servomotor	8.2.6
Pn52C	2	Derating of Base Current at Detecting Overload of Motor	10 to 100	1%	100	After restart	Setup	spindle motor, servomotor	8.2.6
Pn530	2	Program JOG Operation Related Switch	0000 to 0005	–	0000	Immediately	Setup	spindle motor, servomotor	–

Pn530

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

1st digit: Program JOG Operation Switch

0	(Waiting time Pn535 → Forward movement Pn531) × Number of movements Pn536
1	(Waiting time Pn535 → Reverse movement Pn531) × Number of movements Pn536
2	(Waiting time Pn535 → Forward movement Pn531) × Number of movements Pn536 (Waiting time Pn535 → Reverse movement Pn531) × Number of movements Pn536
3	(Waiting time Pn535 → Reverse movement Pn531) × Number of movements Pn536 (Waiting time Pn535 → Forward movement Pn531) × Number of movements Pn536
4	(Waiting time Pn535 → Forward movement Pn531 → Waiting time Pn535 → Reverse movement Pn531) × Number of movements Pn536
5	(Waiting time Pn535 → Reverse movement Pn531 → Waiting time Pn535 → Forward movement Pn531) × Number of movements Pn536

2nd digit: Reserved (Do not change.)

3rd digit: Reserved (Do not change.)

4th digit: Reserved (Do not change.)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Motor Type	Reference Section
Pn531	4	Program JOG Movement Distance	1 to 1073741824	1 reference unit	32768	Immediately	Setup	spindle motor, servomotor	–

(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Motor Type	Reference Section
Pn533	2	Program JOG Movement Speed	1 to 10000	1 min^{-1}	500	Immediately	Setup	spindle motor, servomotor	–
Pn534	2	Program JOG Acceleration/Deceleration Time	2 to 10000	1 ms	100	Immediately	Setup	spindle motor, servomotor	–
Pn535	2	Program JOG Waiting Time	0 to 10000	1 ms	100	Immediately	Setup	spindle motor, servomotor	–
Pn536	2	Number of Times of Program JOG Movement	0 to 1000	1 time	1	Immediately	Setup	spindle motor, servomotor	–
Pn541	2	Reserved (Do not change.)	100 to 65535	1 min^{-1}	65535	After restart	Setup	spindle motor	–
Pn542	2	Reserved (Do not change.)	10 to 50	1%	15	Immediately	Setup	spindle motor	–
Pn543	2	Reserved (Do not change.)	0 to 10000	0.01%	1000	Immediately	Setup	spindle motor	–
Pn544	2	Reserved (Do not change.)	0 to 10000	0.01%	100	Immediately	Setup	spindle motor	–
Pn545	2	Reserved (Do not change.)	0000 to 0031	–	0000	Immediately	Setup	spindle motor	–
Pn550	2	Analog Monitor 1 Offset Voltage	-10000 to 10000	0.1 V	0	Immediately	Setup	spindle motor, servomotor	10.1.3
Pn551	2	Analog Monitor 2 Offset Voltage	-10000 to 10000	0.1 V	0	Immediately	Setup	spindle motor, servomotor	10.1.3
Pn552	2	Analog Monitor Magnification (×1)	-10000 to 10000	×0.01	100	Immediately	Setup	spindle motor, servomotor	10.1.3
Pn553	2	Analog Monitor Magnification (×2)	-10000 to 10000	×0.01	100	Immediately	Setup	spindle motor, servomotor	10.1.3
Pn561	2	Overshoot Detection Level	0 to 100	1%	50	Immediately	Setup	spindle motor, servomotor	10.2.1 10.3.1
Pn601	2	DB Resistor Capacity	0 to 65535	10 W	0	After restart	Setup	spindle motor, servomotor	–
Pn630	2	Emergency Stop Execution Delay Time	0 to 10000	1 ms	0	Immediately	Setup	spindle motor, servomotor	–
Pn631	2	External Magnetic Contactor OFF Delay Time	0 to 10000	1 ms	0	After restart	Setup	spindle motor, servomotor	–

(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Motor Type	Reference Section
Pn800	2	Communications Control	1000 to 1FF3	–	1040	Immedi-ately	Setup	spindle motor, servo-motor	–

4th digit 3rd digit 2nd digit 1st digit

n.□□□□

1st digit: MECHATROLINK-II Communications Check Mask (for debug)

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

2nd digit: Warning Check Mask

0	No mask
1	Ignores data setting warning (A.94□).
2	Ignores command warning (A.95□).
3	Ignores both data setting warning (A.94□) and command warning (A.95□).
4	Ignores communications warning (A.96□).
5	Ignores both data setting warning (A.94□) and communications warning (A.96□).
6	Ignores both command warning (A.95□) and communications warning (A.96□).
7	Ignores data setting warning (A.94□), command warning (A.95□) and communications warning (A.96□).
8	Ignores data setting warning (A.97□).
9	Ignores both data setting warning (A.94□) and data setting warning (A.97□).
A	Ignores both command warning (A.95□) and data setting warning (A.97□).
B	Ignores data setting warning (A.94□), command warning (A.95□) and data setting warning (A.97□).
C	Ignores both communications warning (A.96□) and data setting warning (A.97□).
D	Ignores data setting warning (A.94□), communications warning (A.96□) and data setting warning (A.97□).
E	Ignores command warning (A.95□), communications warning (A.96□) and data setting warning (A.97□).
F	Ignores data setting warning (A.94□), command warning (A.95□), communications warning (A.96□) and data setting warning (A.97□).

3rd digit: Reserved (Do not change.)

4th digit: Reserved (Do not change.)

Pn801	2	Reserved (Do not change.)	–	–	–	–	–	spindle motor, servo-motor	–
Pn803	2	Origin Range	0 to 250	1 refer-ence unit	10	Immedi-ately	Setup	spindle motor, servo-motor	–
Pn804	4	Reserved (Do not change.)	–	–	–	–	–	spindle motor, servo-motor	–
Pn806	4	Reserved (Do not change.)	–	–	–	–	–	spindle motor, servo-motor	–

Parameters

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(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Motor Type	Reference Section
Pn808	4	Absolute Encoder Origin Offset	-1073741823 to 1073741823	1 reference unit	0	Immediately*1	Setup	spindle motor, servomotor	8.5.7
Pn810	2	Exponential Function Acceleration/Deceleration Bias	0 to 65535	100 reference unit/s	0	Immediately*2	Setup	spindle motor, servomotor	–
Pn811	2	Exponential Function Acceleration/Deceleration Time Constant	0 to 5100	0.1 ms	0	Immediately*2	Setup	spindle motor, servomotor	–
Pn812	2	Movement Average Time	0 to 5100	0.1 ms	0	Immediately*2	Setup	spindle motor, servomotor	–
Pn81F	2	Command Data Allocation	0000 to 1111	–	1010	After restart	Setup	spindle motor, servomotor	–

Pn81F

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: V_CMP Specification

0	Allocates V_CMP type 1.
1	Allocates V_CMP type 2.

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Motor Type	Reference Section
Pn820	4	Forward Latching Allowable Area	-2147483648 to 2147483647	1 reference unit	0	Immediately	Setup	spindle motor, servomotor	–
Pn822	4	Reverse Latching Allowable Area	-2147483648 to 2147483647	1 reference unit	0	Immediately	Setup	spindle motor, servomotor	–

*1. Available after the SENS_ON command is input.
*2. The settings are updated only if the sending of the reference has been stopped (DEN is set to 1).

(cont'd)

<table>
<tr><th>Parameter No.</th><th>Size</th><th colspan="2">Name</th><th>Setting Range</th><th>Units</th><th>Factory Setting</th><th>When Enabled</th><th>Classifi-cation</th><th>Motor Type</th><th>Reference Section</th></tr>
<tr><td rowspan="31">Pn824</td><td rowspan="31">2</td><td colspan="2">Option Monitor 1 Selection</td><td>0000 to FFFF</td><td>–</td><td rowspan="31">0000</td><td rowspan="31">Immedi-ately</td><td rowspan="31">Setup</td><td rowspan="31">spindle motor, servo-motor</td><td rowspan="31">–</td></tr>
<tr><td>0000H</td><td colspan="3">Motor movement speed [1000000H/overspeed detection position]</td></tr>
<tr><td>0001H</td><td colspan="3">Speed reference [1000000H/overspeed detection position]</td></tr>
<tr><td>0002H</td><td colspan="3">Torque [1000000H/max. torque]</td></tr>
<tr><td>0003H</td><td colspan="3">Position error (lower 32 bits) [reference unit]</td></tr>
<tr><td>0004H</td><td colspan="3">Position error (upper 32 bits) [reference unit]</td></tr>
<tr><td>0005H</td><td colspan="3">Reserved (Do not use.)</td></tr>
<tr><td>0006H</td><td colspan="3">Reserved (Do not use.)</td></tr>
<tr><td>000AH</td><td colspan="3">Encoder count (lower 32 bits) [reference unit]</td></tr>
<tr><td>000BH</td><td colspan="3">Encoder count (upper 32 bits) [reference unit]</td></tr>
<tr><td>000CH</td><td colspan="3">Reserved (Do not use.)</td></tr>
<tr><td>000DH</td><td colspan="3">Reserved (Do not use.)</td></tr>
<tr><td>0010H</td><td colspan="3">Un000: Motor movement speed [min^{-1}]</td></tr>
<tr><td>0011H</td><td colspan="3">Un001: Speed reference [min^{-1}]</td></tr>
<tr><td>0012H</td><td colspan="3">Un002: Torque reference [%]</td></tr>
<tr><td>0013H</td><td colspan="3">Un003: Movement angle 1 [encoder pulses to the origin]</td></tr>
<tr><td>0014H</td><td colspan="3">Un004: Movement angle 2 [deg]</td></tr>
<tr><td>0015H</td><td colspan="3">Un005: Input signal monitor</td></tr>
<tr><td>0016H</td><td colspan="3">Un006: Output signal monitor</td></tr>
<tr><td>0017H</td><td colspan="3">Un007: Input position reference speed [min^{-1}]</td></tr>
<tr><td>0018H</td><td colspan="3">Un008: Position error [reference unit]</td></tr>
<tr><td>0019H</td><td colspan="3">Un009: Accumulated load ratio [%]</td></tr>
<tr><td>001AH</td><td colspan="3">Reserved (Do not use.)</td></tr>
<tr><td>001BH</td><td colspan="3">Un00B: DB resistance consumption power [%]</td></tr>
<tr><td>001CH</td><td colspan="3">Un00C: Input reference counter [reference unit]</td></tr>
<tr><td>001DH</td><td colspan="3">Un00D: Feedback pulse counter [encoder pulse]</td></tr>
<tr><td>001EH</td><td colspan="3">Reserved (Do not use.)</td></tr>
<tr><td>001FH</td><td colspan="3">Reserved (Do not use.)</td></tr>
<tr><td>0023H</td><td colspan="3">Primary multiturn data [Rev]</td></tr>
<tr><td>0024H</td><td colspan="3">Primary incremental data [pulse]</td></tr>
<tr><td>0025H</td><td colspan="3">Reserved (Do not use.)</td></tr>
</table>

(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classifi-cation	Motor Type	Reference Section
Pn824	2	0026H	Reserved (Do not use.)		0000	Imme-diately	Setup	spindle motor, servo-motor	–
		003CH	Safety-function-part status						
		003EH	Reserved (Do not use.)						
		0080H	Reserved (Do not use.)						
		0081H	Reserved (Do not use.)						
		0084H	Reserved (Do not use.)						
Pn825	2	Option Monitor 2 Selection	0000 to FFFF	–	0000	Immedi-ately	Setup	spindle motor, servo-motor	–
		0000 to 0084	Same as Option Monitor 1 Selection.				–		–
Pn830	4	Reference Unit Amount per Machine Rotation	0 to 1073741823	1 refer-ence unit	4096	After restart	Setup	spindle motor, servo-motor	–
Pn850	2	Reserved (Do not change.)	–	–	–	–	–	spindle motor, servo-motor	–
Pn860	2	SVCMD_IO (Input) Field Allocation 1	0000 to 8888	–	0000	After restart	Setup	spindle motor, servo-motor	–

Pn860: n.□□□□ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit: ESTP2 Signal Allocation

0	No allocation
1	Allocates to bit 24.
2	Allocates to bit 25.
3	Allocates to bit 26.
4	Allocates to bit 27.
5	Allocates to bit 28.
6	Allocates to bit 29.
7	Allocates to bit 30.
8	Reserved

2nd digit: Reserved (Do not change.)

3rd digit: Reserved (Do not change.)

4th digit: Reserved (Do not change.)

(cont'd)

<table>
<tr><th>Parameter No.</th><th>Size</th><th>Name</th><th>Setting Range</th><th>Units</th><th>Factory Setting</th><th>When Enabled</th><th>Classifi-cation</th><th>Motor Type</th><th>Reference Section</th></tr>
<tr><td rowspan="2">Pn861</td><td>2</td><td>SVCMD_IO (Input) Field Allocation 2</td><td>0000 to 8888</td><td>–</td><td>0000</td><td>After restart</td><td>Setup</td><td>spindle motor, servo-motor</td><td>–</td></tr>
<tr><td colspan="9">4th digit 3rd digit 2nd digit 1st digit
n.□□□□

<table>
<tr><th colspan="2">SDET1 Signal Allocation</th></tr>
<tr><td>0</td><td>No allocation</td></tr>
<tr><td>1</td><td>Allocates to bit 24.</td></tr>
<tr><td>2</td><td>Allocates to bit 25.</td></tr>
<tr><td>3</td><td>Allocates to bit 26.</td></tr>
<tr><td>4</td><td>Allocates to bit 27.</td></tr>
<tr><td>5</td><td>Allocates to bit 28.</td></tr>
<tr><td>6</td><td>Allocates to bit 29.</td></tr>
<tr><td>7</td><td>Allocates to bit 30.</td></tr>
<tr><td>8</td><td>Reserved</td></tr>
</table>
<table>
<tr><th colspan="2">SDET2 Signal Allocation</th></tr>
<tr><td>0 to 8</td><td>Same as the allocation for SDET1 signal.</td></tr>
</table>
<table>
<tr><th colspan="2">TDET1 Signal Allocation</th></tr>
<tr><td>0 to 8</td><td>Same as the allocation for SDET1 signal.</td></tr>
</table>
<table>
<tr><th>Reserved (Do not change.)</th></tr>
</table>
</td></tr>
<tr><td>Pn960</td><td>4</td><td>Speed Detection 1 Signal Level</td><td>0 to 2097152000</td><td>ref/s</td><td>40960</td><td>Immedi-ately</td><td>Setup</td><td>spindle motor, servo-motor</td><td>–</td></tr>
<tr><td>Pn962</td><td>2</td><td>Speed Detection 1 Signal Hysteresis</td><td>0 to 10000</td><td>0.01%</td><td>1000</td><td>Immedi-ately</td><td>Setup</td><td>spindle motor, servo-motor</td><td>–</td></tr>
<tr><td>Pn963</td><td>4</td><td>Speed Detection 2 Signal Level</td><td>0 to 2097152000</td><td>ref/s</td><td>40960</td><td>Immedi-ately</td><td>Setup</td><td>spindle motor, servo-motor</td><td>–</td></tr>
<tr><td>Pn965</td><td>2</td><td>Speed Detection 2 Signal Hysteresis</td><td>0 to 10000</td><td>0.01%</td><td>1000</td><td>Immedi-ately</td><td>Setup</td><td>spindle motor, servo-motor</td><td>–</td></tr>
<tr><td>Pn966</td><td>2</td><td>Torque Detection Signal Level</td><td>50 to 3000</td><td>0.1%</td><td>100</td><td>Immedi-ately</td><td>Setup</td><td>spindle motor, servo-motor</td><td>–</td></tr>
<tr><td>Pn967</td><td>2</td><td>Torque Detection Signal Hysteresis</td><td>0 to 100</td><td>0.1%</td><td>10</td><td>Immedi-ately</td><td>Setup</td><td>spindle motor, servo-motor</td><td>–</td></tr>
</table>

(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classifi-cation	Motor Type	Reference Section
Pn968	2	TDET Output Method at Acceleration	0000 to 0001	–	0000	Immedi-ately	Setup	spindle motor, servo-motor	–

4th digit 3rd digit 2nd digit 1st digit

n. □ □ □ □

1st digit: Torque Acceleration/Deceleration Torque Detection Signal Output Condition Selection

0	Outputs TDET even during acceleration/deceleration.
1	Does not output TDET during acceleration/deceleration.

2nd digit: Reserved (Do not change.)

3rd digit: Reserved (Do not change.)

4th digit: Reserved (Do not change.)

14.3 MECHATROLINK-III Common Parameters

The following list shows the common parameters used by all devices for MECHATROLINK-III. These common parameters are used to make settings from the host controller via MECHATROLINK communications.

Parameter No.	Size	Name	Setting Range	Units [Resolution]	Factory Setting	When Enabled	Classification	Motor Type
01 PnA02	4	Encoder Type (read only)	0 to 1	–	–	–	Device Information Related Parameters	spindle motor, servomotor
		0000H Absolute encoder						
		0001H Incremental encoder						
02 PnA04	4	Motor Type (read only)	0	–	–	–		spindle motor, servomotor
		0000H Rotational servomotor						
		0001H Not supported						
03 PnA06	4	Semi-closed/Fully-closed Type (read only)	0 to 1	–	–	–		spindle motor, servomotor
		0000H Semi-closed						
		0001H Fully-closed						
04 PnA08	4	Rated Speed (read only)	0 to FFFFFFFFH	min^{-1}	–	–		spindle motor, servomotor
05 PnA0A	4	Maximum Output Speed (read only)	0 to FFFFFFFFH	min^{-1}	–	–		spindle motor, servomotor
06 PnA0C	4	Speed Multiplier (read only)	–3FFFFFFF to 3FFFFFFF	–	–	–		spindle motor, servomotor
07 PnA0E	4	Rated Torque (read only)	0 to FFFFFFFFH	N·m	–	–		spindle motor, servomotor
08 PnA10	4	Maximum Output Torque (read only)	0 to FFFFFFFFH	N·m	–	–		spindle motor, servomotor
09 PnA12	4	Torque Multiplier (read only)	–3FFFFFFF to 3FFFFFFF	–	–	–		spindle motor, servomotor
0A PnA14	4	Resolution (read only)	0 to FFFFFFFFH	pulse/rev	–	–		spindle motor, servomotor

Note: When using parameters that are enabled after restarting the SERVOPACK, a CONFIG command must be input or the power must be turned OFF and then ON again.

(cont'd)

Parameter No.	Size	Name		Setting Range	Units [Resolution]	Factory Setting	When Enabled	Classification	Motor Type
21 PnA42	4	Reserved (Do not use.)		–	–	–	–	Machine Specification Related Parameters	spindle motor, servomotor
22 PnA44	4	Reserved (Do not use.)		–	–	–	–		spindle motor, servomotor
23 PnA46	4	Absolute Encoder Origin Offset		–1073741823 to 1073741823	1 reference unit	0	Immediately *1		spindle motor, servomotor
24 PnA48	4	Multiturn Limit Setting		0 to 65535	Rev	65535	After restart		servomotor
25 PnA4A	4	Limit Setting		0 to 33H	–	0000H	After restart		spindle motor, servomotor
		Bit 0	P-OT (0: Enabled, 1: Disabled)						
		Bit 1	N-OT (0: Enabled, 1: Disabled)						
		Bit 2 to 31	Reserved (Do not use.)						
26 PnA4C	4	Reserved (Do not use.)		–	–	–	–		spindle motor, servomotor
27 PnA4E	4	Reserved (Do not use.)		–	–	0	–		spindle motor, servomotor
28 PnA50	4	Reserved (Do not use.)		–	–	–	–		spindle motor, servomotor
29 PnA52	4	Reserved (Do not use.)		–	–	0	–		spindle motor, servomotor

*1. Available after the SENS_ON command is input.

Note: When using parameters that are enabled after restarting the SERVOPACK, a CONFIG command must be input or the power must be turned OFF and then ON again.

(cont'd)

Parameter No.	Size	Name		Setting Range	Units [Resolution]	Factory Setting	When Enabled	Classifi-cation	Motor Type
41 PnA82	4	Speed Unit		0 to 4	–	0	After restart	Unit System Related Parameters	spindle motor, servo-motor
		0000H	reference unit/sec						
		0001H	reference unit/min						
		0002H	Percentage (%) of rated speed						
		0003H	min^{-1} (rpm)						
		0004H	Max. motor speed/40000000H						
42 PnA84	4	Speed Base Unit (Set the value of "n" used as the exponent in 10^n when calculating the Speed Unit (41).)		–3 to 3	–	0	After restart		spindle motor, servo-motor
43 PnA86	4	Position Unit		0	–	0	After restart		spindle motor, servo-motor
		0000H	reference unit						
44 PnA88	4	Position Base Unit (Set the value of "n" used as the exponent in 10^n when calculating the Position Unit (43).)		0	–	0	After restart		spindle motor, servo-motor
45 PnA8A	4	Acceleration Unit		–	–	0	After restart		spindle motor, servo-motor
		0000H	reference unit/sec^2						
		0001H	Not supported						
46 PnA8C	4	Acceleration Base Unit (Set the value of "n" used as the exponent in 10^n when calculating the Acceleration Unit (45).)		3 to 6	–	4	After restart		spindle motor, servo-motor
47 PnA8E	4	Torque Unit		1 to 2	–	1	After restart		spindle motor, servo-motor
		0000H	Not supported						
		0001H	Percentage (%) of rated torque						
		0002H	Max. torque/40000000H						
48 PnA90	4	Torque Base Unit (Set the value of "n" used as the exponent in 10^n when calculating the Torque Unit (47).)		–5 to 0	–	–2	After restart		spindle motor, servo-motor

Note: When using parameters that are enabled after restarting the SERVOPACK, a CONFIG command must be input or the power must be turned OFF and then ON again.

(cont'd)

<table>
<tr><th>Parameter No.</th><th>Size</th><th colspan="2">Name</th><th>Setting Range</th><th>Units [Resolution]</th><th>Factory Setting</th><th>When Enabled</th><th>Classifi-cation</th><th>Motor Type</th></tr>
<tr><td rowspan="23">49
PnA92</td><td rowspan="23">4</td><td colspan="2">Compliance Unit System (read only)</td><td>–</td><td>–</td><td rowspan="23">0601011FH</td><td rowspan="23">–</td><td rowspan="23">Unit System Related Parameters</td><td rowspan="23">spindle motor, servo-motor</td></tr>
<tr><td colspan="4">Speed</td></tr>
<tr><td>Bit 0</td><td colspan="3">reference unit/s (1: Enabled)</td></tr>
<tr><td>Bit 1</td><td colspan="3">reference unit/min (1: Enabled)</td></tr>
<tr><td>Bit 2</td><td colspan="3">Percentage (%) of rated speed (1: Enabled)</td></tr>
<tr><td>Bit 3</td><td colspan="3">min^{-1} (rpm) (1: Enabled)</td></tr>
<tr><td>Bit 4</td><td colspan="3">Max. motor speed/4000000H [HEX] (1: Enabled)</td></tr>
<tr><td>Bit 5 to 7</td><td colspan="3">Reserved (0: Disabled)</td></tr>
<tr><td colspan="4">Position</td></tr>
<tr><td>Bit 8</td><td colspan="3">reference unit (1: Enabled)</td></tr>
<tr><td>Bit 9 to 15</td><td colspan="3">Reserved (0: Disabled)</td></tr>
<tr><td colspan="4">Acceleration</td></tr>
<tr><td>Bit 16</td><td colspan="3">reference unit/s^2 (1: Enabled)</td></tr>
<tr><td>Bit 17</td><td colspan="3">msec (Acceleration time taken to reach the rated speed) (0: Disabled)</td></tr>
<tr><td>Bit 18 to 23</td><td colspan="3">Reserved (0: Disabled)</td></tr>
<tr><td colspan="4">Torque</td></tr>
<tr><td>Bit 24</td><td colspan="3">N·m (N) (0: Disabled)</td></tr>
<tr><td>Bit 25</td><td colspan="3">Percentage (%) of rated torque (1: Enabled)</td></tr>
<tr><td>Bit 26</td><td colspan="3">Max. torque/40000000 [HEX] (1: Enabled)</td></tr>
<tr><td>Bit 27 to 31</td><td colspan="3">Reserved (0: Disabled)</td></tr>
<tr><td colspan="4"></td></tr>
<tr><td colspan="4"></td></tr>
<tr><td colspan="4"></td></tr>
<tr><td>61
PnAC2</td><td>4</td><td colspan="2">Speed Loop Gain</td><td>1000 to 2000000</td><td>0.001 Hz [0.1 Hz]</td><td>40000</td><td>Immedi-ately</td><td rowspan="4">Adjust-ment Related Parameters</td><td>spindle motor, servo-motor</td></tr>
<tr><td>62
PnAC4</td><td>4</td><td colspan="2">Speed Loop Integral Time Constant</td><td>150 to 512000</td><td>μs [0.01 ms]</td><td>20000</td><td>Immedi-ately</td><td>spindle motor, servo-motor</td></tr>
<tr><td>63
PnAC6</td><td>4</td><td colspan="2">Position Loop Gain</td><td>1000 to 2000000</td><td>0.001/s [0.1/s]</td><td>40000</td><td>Immedi-ately</td><td>spindle motor, servo-motor</td></tr>
<tr><td>64
PnAC8</td><td>4</td><td colspan="2">Feedforward Compensation</td><td>0 to 100</td><td>1%</td><td>0</td><td>Immedi-ately</td><td>spindle motor, servo-motor</td></tr>
</table>

Note: When using parameters that are enabled after restarting the SERVOPACK, a CONFIG command must be input or the power must be turned OFF and then ON again.

(cont'd)

Parameter No.	Size	Name		Setting Range	Units [Resolution]	Factory Setting	When Enabled	Classification	Motor Type
65 PnACA	4	Position Loop Integral Time Constant		0 to 5000000	μs [0.01 ms]	0	Immediately	Adjustment Related Parameters	spindle motor, servomotor
66 PnACC	4	Positioning Completed Width		0 to 1073741824	1 reference unit	7	Immediately	Adjustment Related Parameters	spindle motor, servomotor
67 PnACE	4	NEAR Signal Width		1 to 1073741824	1 reference unit	1073741824	Immediately	Adjustment Related Parameters	spindle motor, servomotor
81 PnB02	4	Exponential Function Accel/Decel Time Constant		0 to 510000	μs*3 [0.1 ms]	0	Immediately*2	Command Related Parameters	spindle motor, servomotor
82 PnB04	4	Movement Average Time		0 to 510000	μs*3 [0.1 ms]	0	Immediately*2	Command Related Parameters	spindle motor, servomotor
83 PnB06	4	Final Travel Distance for External Positioning		–1073741823 to 1073741823	1 reference unit	100	Immediately	Command Related Parameters	spindle motor, servomotor
86 PnB0C	4	Final Travel Distance for Homing		–1073741823 to 1073741823	1 reference unit	100	Immediately	Command Related Parameters	spindle motor, servomotor
87 PnB0E	4	Monitor Selection 1		0 to F	–	1	Immediately	Command Related Parameters	spindle motor, servomotor
		0000H	APOS						
		0001H	CPOS						
		0002H	PERR						
		0003H	LPOS1						
		0004H	LPOS2						
		0005H	FSPD						
		0006H	CSPD						
		0007H	TRQ						
		0008H	ALARM						
		0009H	MPOS						
		000AH	Reserved (Undefined value)						
		000BH	Reserved (Undefined value)						
		000CH	CMN1 (Common monitor 1)						
		000DH	CMN2 (Common monitor 2)						
		000EH	OMN1 (Optional monitor 1)						
		000FH	OMN2 (Optional monitor 2)						
88 PnB10	4	Monitor Selection 2		0 to F	–	0	Immediately	Command Related Parameters	spindle motor, servomotor
		0000H to 000FH	Same as Monitor Selection 1.						

∗2. Change the setting when the reference is stopped (DEN is set to 1), because the change will affect the output during operation.
∗3. Set the units to multiples of 100.

(cont'd)

<table>
<tr><th>Parameter No.</th><th>Size</th><th colspan="2">Name</th><th>Setting Range</th><th>Units [Resolution]</th><th>Factory Setting</th><th>When Enabled</th><th>Classifi-cation</th><th>Motor Type</th></tr>
<tr><td rowspan="9">89
PnB12</td><td rowspan="9">4</td><td colspan="2">Monitor Selection for SEL_MON1 (CMN1)</td><td>0 to 9</td><td>–</td><td rowspan="9">0</td><td rowspan="9">Immedi-ately</td><td rowspan="9">Command Related Parameters</td><td rowspan="9">spindle motor, servo-motor</td></tr>
<tr><td>0000H</td><td colspan="3">TPOS (Target position in the reference coordinates)</td></tr>
<tr><td>0001H</td><td colspan="3">IPOS (Reference position in the reference coordinates)</td></tr>
<tr><td>0002H</td><td colspan="3">POS_OFSET (Offset value set in the set coordinates command (POS_SET))</td></tr>
<tr><td>0003H</td><td colspan="3">TSPD (Target speed)</td></tr>
<tr><td>0004H</td><td colspan="3">SPD_LIM (Speed limit value)</td></tr>
<tr><td>0005H</td><td colspan="3">TRQ_LIM (Torque limit value)</td></tr>
<tr><td>0006H</td><td colspan="3">SV_STAT
Monitor
Byte 1: Current communications phase
00H: Phase 0
01H: Phase 1
02H: Phase 2
03H: Phase 3
Byte 2: Current control mode
00H: Position control mode
01H: Speed control mode
02H: Torque control mode
Byte 3: Reserved
Byte 4: Expansion signal monitor
<table>
<tr><th>Bit</th><th>Name</th><th>Contents</th><th>Value</th><th>Setting</th></tr>
<tr><td rowspan="2">Bit 0</td><td rowspan="2">LT_RDY1</td><td rowspan="2">Processing status for latch detection specified by SVCMD_CTRL, LT_REQ1</td><td>0</td><td>Latch detection not processed</td></tr>
<tr><td>1</td><td>During latch detection processing</td></tr>
<tr><td rowspan="2">Bit 1</td><td rowspan="2">LT_RDY1</td><td rowspan="2">Processing status for latch detection specified by SVCMD_CTRL, LT_REQ2</td><td>0</td><td>Latch detection not processed</td></tr>
<tr><td>1</td><td>During latch detection processing</td></tr>
<tr><td rowspan="4">Bit 2, Bit 3</td><td rowspan="4">LT_SEL1R</td><td rowspan="4">Latch signal</td><td>0</td><td>Phase C</td></tr>
<tr><td>1</td><td>External input signal 1</td></tr>
<tr><td>2</td><td>External input signal 2</td></tr>
<tr><td>3</td><td>External input signal 3</td></tr>
<tr><td rowspan="4">Bit 4, Bit 5</td><td rowspan="4">LT_SEL2R</td><td rowspan="4">Latch signal</td><td>0</td><td>Phase C</td></tr>
<tr><td>1</td><td>External input signal 1</td></tr>
<tr><td>2</td><td>External input signal 2</td></tr>
<tr><td>3</td><td>External input signal 3</td></tr>
<tr><td>Bit 6</td><td colspan="4">Reserved (0)</td></tr>
</table></td></tr>
<tr><td>0007H</td><td colspan="3">Reserved (Do not use.)</td></tr>
</table>

(cont'd)

Parameter No.	Size	Name		Setting Range	Units [Resolution]	Factory Setting	When Enabled	Classification	Motor Type
89 PnB12	4	0008H	INIT_PGPOS (Low) 64-bit data for the initial encoder value converted to a command value (lower 32 bits)			0	Immediately		spindle motor, servomotor
		0009H	INIT_PGPOS (High) 64-bit data for the initial encoder value converted to a command value (higher 32 bits)						
8A PnB14	4	Monitor Selection for SEL_MON2 (CMN2)		0 to 9	–	0	Immediately		spindle motor, servomotor
		0000H to 0009H	Same as Monitor Selection for SEL_MON1.						
8B PnB16	4	Origin Detection Range		0 to 250	1 reference unit	10	Immediately		spindle motor, servomotor
8C PnB18	4	Forward Torque Limit		0 to 800	1%	100	Immediately		servomotor
8D PnB1A	4	Reverse Torque Limit		0 to 800	1%	100	Immediately		servomotor
8E PnB1C	4	Zero Speed Detection Range		1000 to 10000000	10^{-3} min^{-1}	20000	Immediately		servomotor
8F PnB1E	4	Speed Coincidence Signal Output Width		0 to 100000	10^{-3} min^{-1}	10000	Immediately		servomotor
90 PnB20	4	Servo Command Control Field Enabled/Disabled (read only)		–	–	0FFF3F3FH	–	Command Related Parameters	spindle motor, servomotor
		Bit 0	CMD_PAUSE (1: Enabled)						
		Bit 1	CMD_CANCEL (1: Enabled)						
		Bit 2, 3	STOP_MODE (1: Enabled)						
		Bit 4, 5	ACCFIL (1: Enabled)						
		Bit 6, 7	Reserved (0: Disabled)						
		Bit 8	LT_REQ1 (1: Enabled)						
		Bit 9	LT_REQ2 (1: Enabled)						
		Bit 10, 11	LT_SEL1 (1: Enabled)						
		Bit 12, 13	LT_SEL2 (1: Enabled)						
		Bit 14, 15	Reserved (0: Disabled)						
		Bit 16 to 19	SEL_MON1 (1: Enabled)						
		Bit 20 to 23	SEL_MON2 (1: Enabled)						
		Bit 24 to 27	SEL_MON3 (1: Enabled)						
		Bit 28 to 31	Reserved (0: Disabled)						

(cont'd)

Parameter No.	Size	Name	Setting Range	Units [Resolution]	Factory Setting	When Enabled	Classification	Motor Type
91 PnB22	4	Servo Command Status Field Enabled/Disabled (read only)	–	–	0FFF3F33H	–	Command Related Parameters	spindle motor, servo-motor
		Bit 0 CMD_PAUSE_CMP (1: Enabled)						
		Bit 1 CMD_CANCEL_CMP (1: Enabled)						
		Bit 2, 3 Reserved (0: Disabled)						
		Bit 4, 5 ACCFIL (1: Enabled)						
		Bit 6, 7 Reserved (0: Disabled)						
		Bit 8 L_CMP1 (1: Enabled)						
		Bit 9 L_CMP2 (1: Enabled)						
		Bit 10 POS_RDY (1: Enabled)						
		Bit 11 PON (1: Enabled)						
		Bit 12 M_RDY (1: Enabled)						
		Bit 13 SV_ON (1: Enabled)						
		Bit 14, 15 Reserved (0: Disabled)						
		Bit 16 to 19 SEL_MON1 (1: Enabled)						
		Bit 20 to 23 SEL_MON2 (1: Enabled)						
		Bit 24 to 27 SEL_MON3 (1: Enabled)						
		Bit 28 to 31 Reserved (0: Disabled)						
92 PnB24	4	I/O Bit Enabled/Disabled (Output) (read only)	–	–	C0000FD0H	–		spindle motor, servo-motor
		Bit 0 to 3 Reserved (0: Disabled)						
		Bit 4 V_PPI (1: Enabled)						
		Bit 5 P_PPI (0: Disabled)						
		Bit 6 P_CL (1: Enabled)						
		Bit 7 N_CL (1: Enabled)						
		Bit 8 G_SEL (1: Enabled)						
		Bit 9 to 11 G_SEL (1: Enabled)						
		Bit 12 to 15 Reserved (0: Disabled)						
		Bit 16 to 19 BANK_SEL (0: Disabled)						
		Bit 20 to 22 SO1 to SO3 (0: Disabled)						
		Bit 23 MC-ON (1: Enabled)						
		Bit 24 to 29 Reserved (0: Disabled)						
		Bit 30 SV_CHG (1: Enabled)						
		Bit 31 WND_CHG (1: Enabled)						

(cont'd)

Parameter No.	Size	Name		Setting Range	Units [Resolution]	Factory Setting	When Enabled	Classifi-cation	Motor Type
93 PnB26	4	I/O Bit Enabled/Disabled (Input) (read only)		–	–	800FFCFCH	–	Command Related Parameters	spindle motor, servo-motor
		Bit 0	Reserved (0: Disabled)						
		Bit 1	DEC (0: Disabled)						
		Bit 2	P-OT (1: Enabled)						
		Bit 3	N-OT (1: Enabled)						
		Bit 4	EXT1 (1: Enabled)						
		Bit 5	EXT2 (1: Enabled)						
		Bit 6	EXT3 (1: Enabled)						
		Bit 7	ESTP (1: Enabled)						
		Bit 8	Reserved (0: Disabled)						
		Bit 9	BRK_ON (0: Disabled)						
		Bit 10	P-SOT (1: Enabled)						
		Bit 11	N-SOT (0: Disabled)						
		Bit 12	DEN (0: Disabled)						
		Bit 13	NEAR (1: Enabled)						
		Bit 14	PSET (1: Enabled)						
		Bit 15	ZPOINT (1: Enabled)						
		Bit 16	T_LIM (1: Enabled)						
		Bit 17	V_LIM (1: Enabled)						
		Bit 18	V_CMP (1: Enabled)						
		Bit 19	ZSPD (1: Enabled)						
		Bit 20 to 30	Reserved (0: Disabled)						
		Bit 31	WHD_MOD (1: Enabled)						

14.4 Safety-related Parameters

14.4.1 Overview

The following table lists the safety-related parameters.

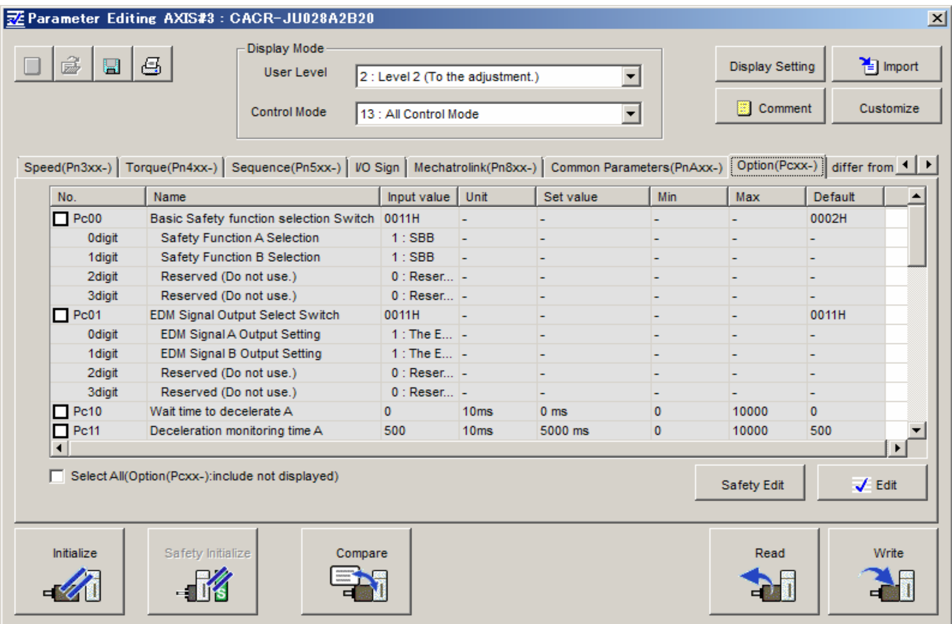
Parameter No.	Name
Pc00	Safety Function Selection Switch
Pc01	EDM Signal Output Selection Switch
Pc10	Deceleration Waiting Time A
Pc11	Deceleration Monitoring Time A
Pc12	Limited Speed A on Waiting for Deceleration
Pc13	Limited Distance A
Pc14	Limited Constant Speed A
Pc20	Deceleration Waiting Time B
Pc21	Deceleration Monitoring Time B
Pc22	Limited Speed B on Waiting for Deceleration
Pc23	Limited Distance B
Pc24	Limited Constant Speed B

14.4.2 Operating Procedure

This section gives the procedures for referencing, editing, and initializing the safety-related parameters.

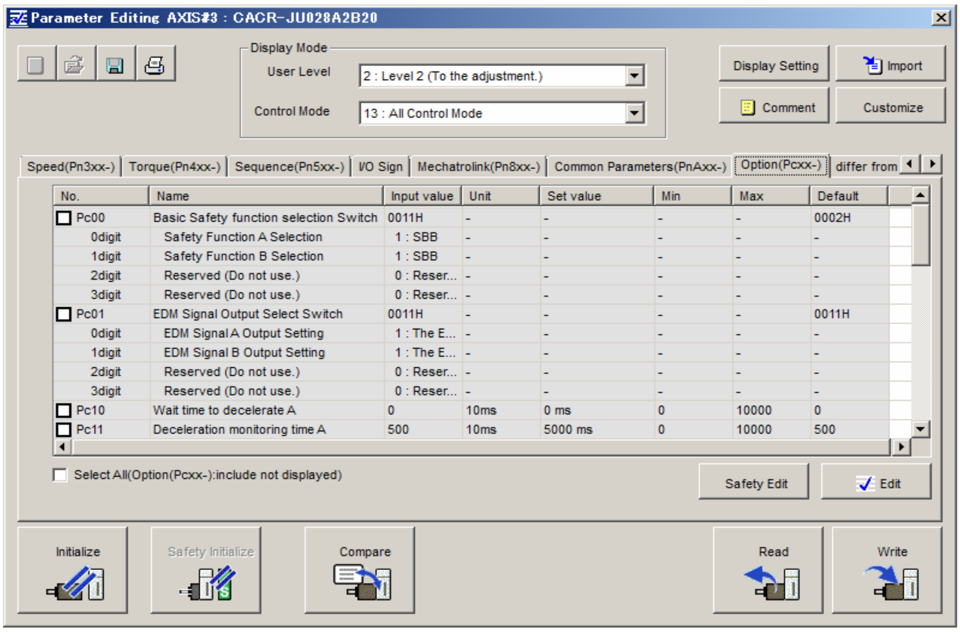
(1) Accessing Safety-related Parameters

In the menu bar of SigmaWin for Σ-V-SD(MT) component's main window, click **Parameters**, click **Edit Parameters**, and then click the **Option (Pcxx-)** Tab. The following window will be displayed. You can access the settings of the safety-related parameters from this window.

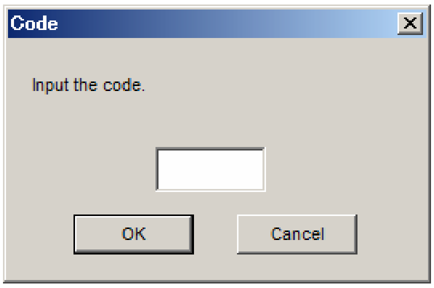


(2) Editing Safety-related Parameters

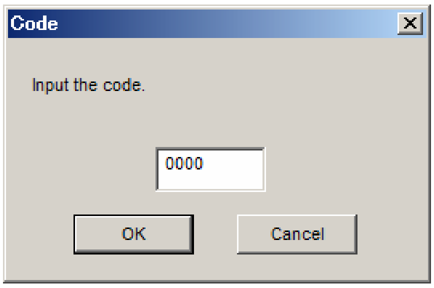
1. In the menu bar of SigmaWin for Σ-V-SD(MT) component's main window, click **Parameters**, click **Edit Parameters**, and then click the **Option (Pcxx-)** Tab. The following window will be displayed.



2. Click the **Safety Edit** Button. The following window will be displayed.



3. Enter 0000 and click the **OK** Button.



Parameters

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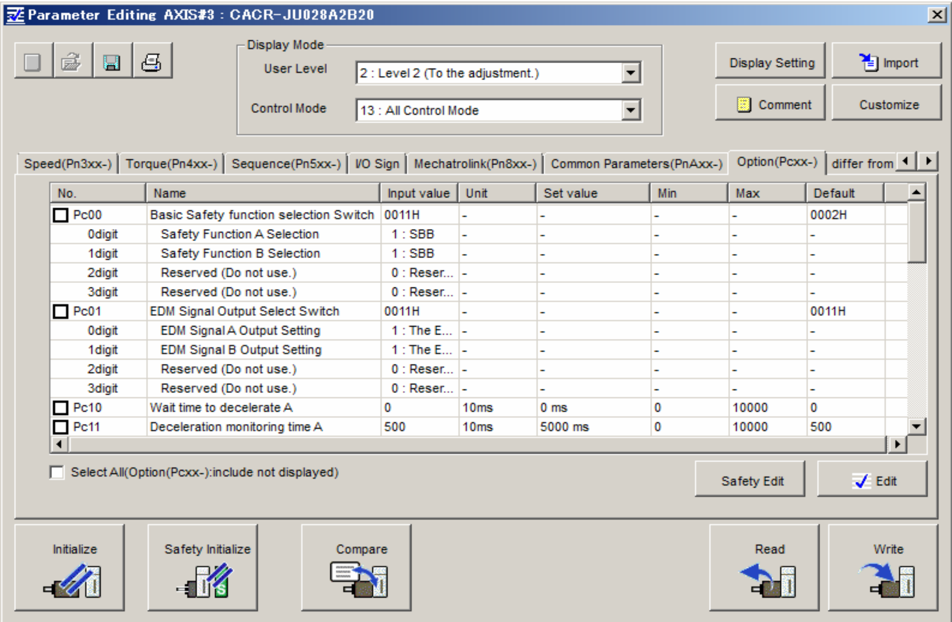
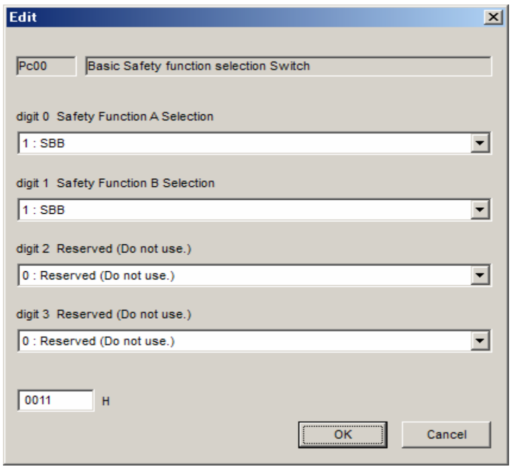
The background of the Option (Pcxx-) Tab Page in the Parameter Editing Dialog Box will change to white and editing will be enabled.

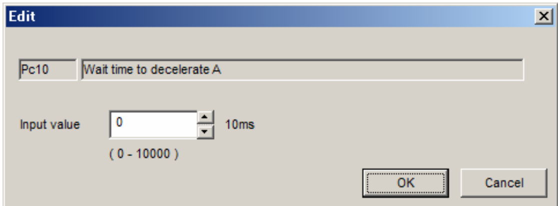


4. Select the parameter to edit. It will be highlighted. Click the **Edit** Button. One of the following dialog boxes will be displayed depending on the type of parameter.

Dialog Box for Parameters with Function Selections



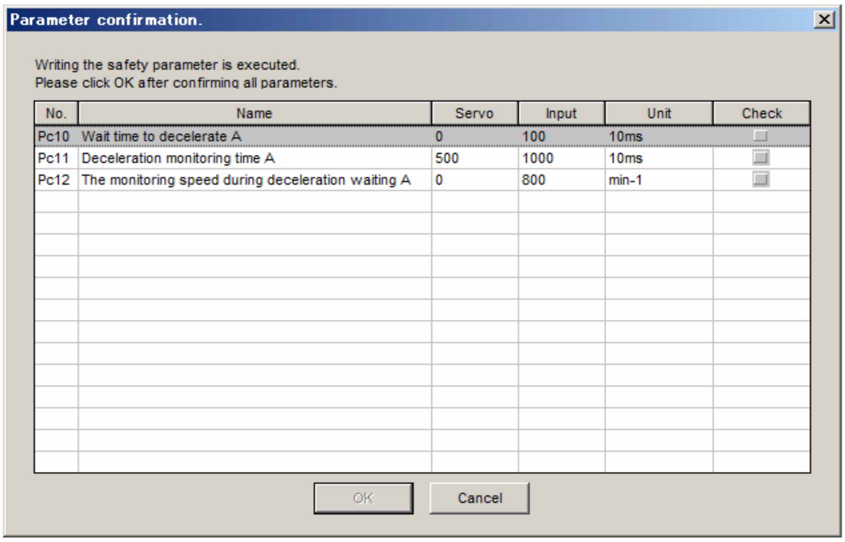
Parameters That Require Numeric Settings



5. Follow the information displayed in the dialog box and either select the function or enter a value, and then click the **OK** Button.

The rest of the procedure writes the edited parameters to the SERVOPACK. The following example shows the window when the settings of Pc10, Pc11, and Pc12 are being changed.

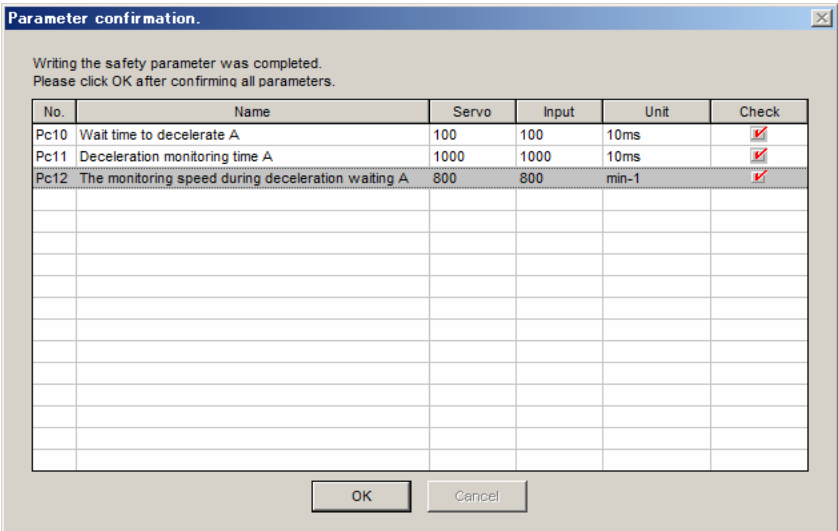
6. Click the **Write** Button after you edit parameter settings. The following window will be displayed.



7. Check the edited values and select the check boxes in the *Check* column.

The **OK** Button will be enabled after you select all of the check boxes.

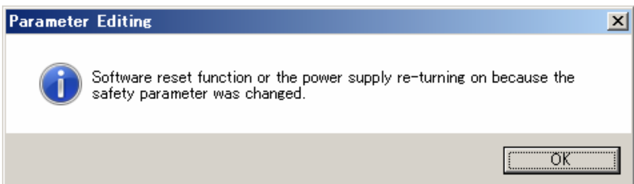
8. Click the **OK** Button. Writing the settings to the safety-function-part will start. The following window will be displayed when it is completed.



9. Check the values to write to the servo again and select the check boxes in the *Check* column again.

The **OK** Button will be enabled after you select all of the check boxes.

10. Click the **OK** Button. Updating the safety-related parameters will start. The following window will be displayed when it is completed.



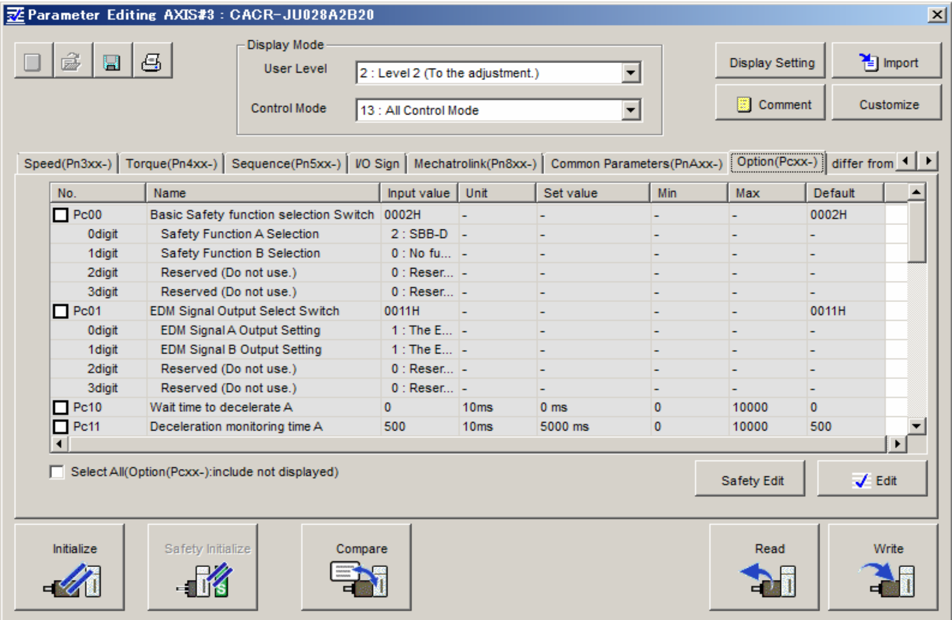
11. The Parameter Editing Window will close when you click the **OK** Button. Either perform a software reset or turn the power supply OFF and ON again.

This concludes the procedure to edit the safety-related parameters.

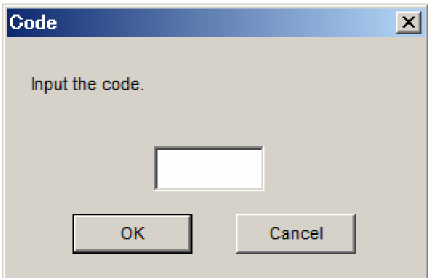
(3) Initializing Safety-related Parameters

> **IMPORTANT**
> When you initialize the safety-related parameters, the safety-related servo parameters will also be initialized.

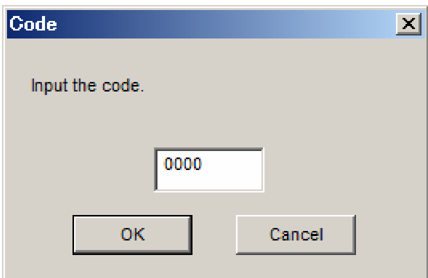
1. In the menu bar of SigmaWin for Σ-V-SD(MT) component's main window, click **Parameters**, click **Edit Parameters**, and then click the **Option (Pcxx-)** Tab. The following window will be displayed.



2. Click the **Safety Edit** Button. The following window will be displayed.

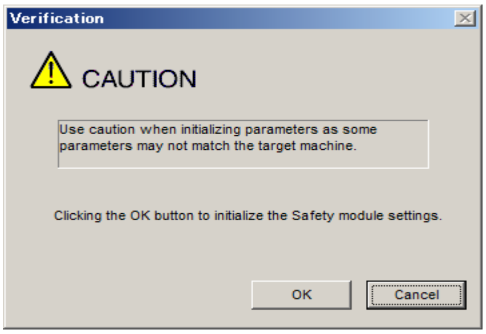


3. Enter 0000 and click the **OK** Button.

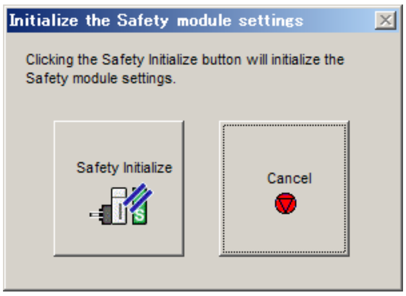


The **Safety Initialize** Button in the Parameter Editing Window will be enabled.

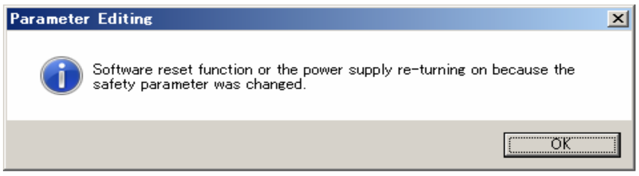
4. Click the **Safety Initialize** Button. The following window will be displayed.



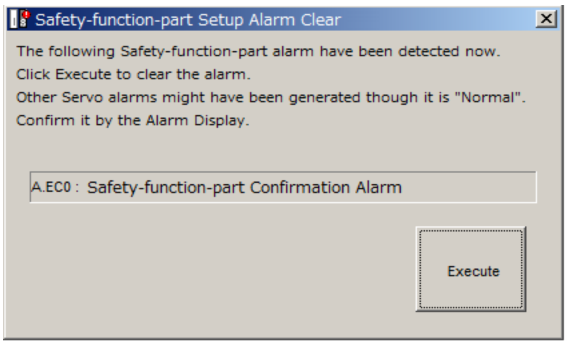
5. Click the **OK** Button. The following window will be displayed.



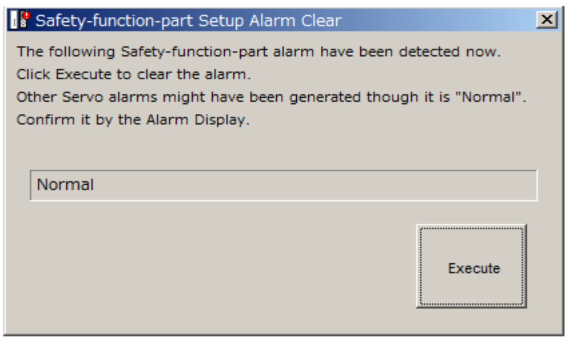
6. Click the **Safety Initialize** Button. Initialization will be started. When it is completed, the following dialog box will be displayed.



7. The Parameter Editing Window will close when you click the **OK** Button. Either perform a software reset or turn the power supply OFF and ON again. The A.EC0 error will occur and the following dialog box will be displayed.



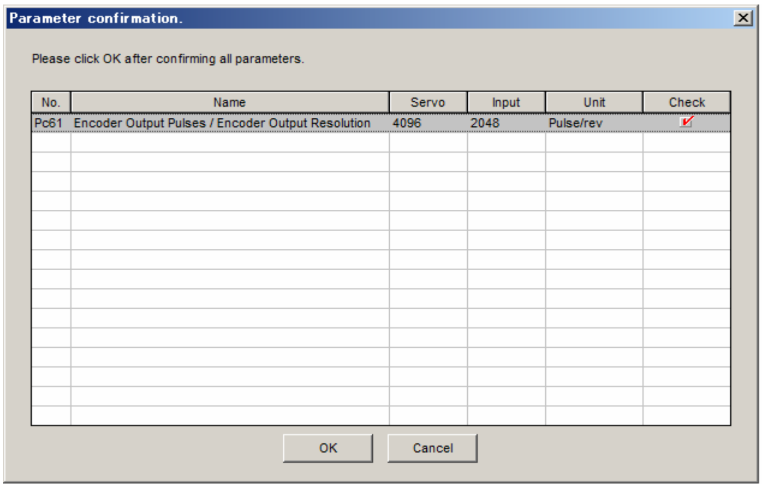
8. Click the **Execute** Button. If the A.EC1 error does no occur, the following dialog box will be displayed.



If alarm A.EC1 is displayed, proceed to step 10.

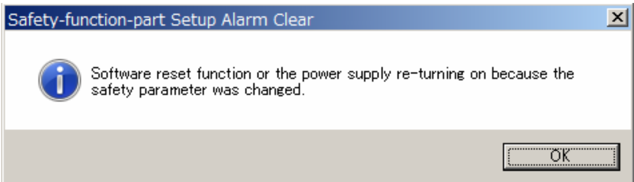
9. Close the Safety-function-part Setup Alarm Clear Dialog Box.

10. If the A.EC1 error occurs, the following dialog box will be displayed. Check the edited values and select the check boxes in the *Check* column.



The **OK** Button will be enabled after you select all of the check boxes.

11. Click the **OK** Button. Writing the settings to the safety-function-part will start. The following window will be displayed when it is completed.



12. The Safety-function-part Setup Alarm Clear Dialog Box will close when you click the **OK** Button. Either perform a software reset or turn the power supply OFF and ON again.

This concludes the procedure to initialize the safety-related parameters.

14.4.3 Safety-related Parameters

The parameters of the safety-function-part are listed in the following table.

<table>
<tr><th>Parameter No.</th><th>Name</th><th>Setting Range</th><th>Units</th><th>Factory Setting</th><th>When Enabled</th></tr>
<tr><td rowspan="2">Pc00</td><td>Safety Function Selection Switch</td><td>–</td><td>–</td><td>0002</td><td>After resetting the system</td></tr>
<tr><td colspan="5">
4th digit 3rd digit 2nd digit 1st digit
n. □ □ □ □
<table>
<tr><th colspan="2">Safety Function A Selection (1st digit)</th></tr>
<tr><td>0</td><td>No safety function.</td></tr>
<tr><td>1</td><td>Safe BaseBlock Function (SBB function)</td></tr>
<tr><td>2</td><td>Safe BaseBlock with Delay Function (SBB-D function)</td></tr>
<tr><td>3</td><td>Safe Position Monitor with Delay Function (SPM-D function)</td></tr>
<tr><td>4</td><td>Safely Limited Speed with Delay Function (SLS-D function)</td></tr>
<tr><td>5 to F</td><td>Reserved (Do not change.)</td></tr>
</table>
<table>
<tr><th colspan="2">Safety Function B Selection (2nd digit)</th></tr>
<tr><td>0</td><td>No safety function.</td></tr>
<tr><td>1</td><td>Safe BaseBlock Function (SBB function)</td></tr>
<tr><td>2</td><td>Safe BaseBlock with Delay Function (SBB-D function)</td></tr>
<tr><td>3</td><td>Safe Position Monitor with Delay Function (SPM-D function)</td></tr>
<tr><td>4</td><td>Safely Limited Speed with Delay Function (SLS-D function)</td></tr>
<tr><td>5 to F</td><td>Reserved (Do not change.)</td></tr>
</table>
Reserved (Do not change.) (3rd digit)
Reserved (Do not change.) (4th digit)
</td></tr>
<tr><td rowspan="2">Pc01</td><td>EDM Signal Output Selection Switch</td><td>–</td><td>–</td><td>0011</td><td>After resetting the system</td></tr>
<tr><td colspan="5">
4th digit 3rd digit 2nd digit 1st digit
n. □ □ □ □
<table>
<tr><th colspan="2">EDM Signal A Output Setting (1st digit)</th></tr>
<tr><td>0</td><td>The EDM-A signal turns ON while the safety function of Safety Function A is operating.</td></tr>
<tr><td>1</td><td>The EDM-A signal turns ON while Safety Function A is in the safe state.</td></tr>
<tr><td>2 to F</td><td>Reserved (Do not change.)</td></tr>
</table>
<table>
<tr><th colspan="2">EDM Signal B Output Setting (2nd digit)</th></tr>
<tr><td>0</td><td>The EDM-B signal turns ON while the Safety Function of safety function B is operating.</td></tr>
<tr><td>1</td><td>The EDM-B signal turns ON while Safety Function B is in the safe state.</td></tr>
<tr><td>2 to F</td><td>Reserved (Do not change.)</td></tr>
</table>
Reserved (Do not change.) (3rd digit)
Reserved (Do not change.) (4th digit)
</td></tr>
<tr><td>Pc02 to Pc0F</td><td colspan="5">Reserved (Do not change.)</td></tr>
<tr><td>Pc10</td><td>Deceleration Waiting Time A</td><td>0 to 10000</td><td>10 ms</td><td>0</td><td>After resetting the system</td></tr>
<tr><td>Pc11</td><td>Deceleration Monitoring Time A</td><td>0 to 10000</td><td>10 ms</td><td>500</td><td>After resetting the system</td></tr>
<tr><td>Pc12</td><td>Limited Speed A on Waiting for Deceleration</td><td>0 to 10000</td><td>1 min^{-1}</td><td>0</td><td>After resetting the system</td></tr>
<tr><td>Pc13</td><td>Limited Distance A</td><td>1 to 65535</td><td>edge</td><td>10</td><td>After resetting the system</td></tr>
<tr><td>Pc14</td><td>Limited Constant Speed A</td><td>0 to 10000</td><td>1 min^{-1}</td><td>0</td><td>After resetting the system</td></tr>
</table>

(cont'd)

Parameter No.	Name	Setting Range	Units	Factory Setting	When Enabled
Pc15 to Pc1F	Reserved (Do not change.)				
Pc20	Deceleration Waiting Time B	0 to 10000	10 ms	0	After resetting the system
Pc21	Deceleration Monitoring Time B	0 to 10000	10 ms	500	After resetting the system
Pc22	Limited Speed B on Waiting for Deceleration	0 to 10000	1 min^{-1}	0	After resetting the system
Pc23	Limited Distance B	1 to 65535	edge	10	After resetting the system
Pc24	Limited Constant Speed B	0 to 10000	1 min^{-1}	0	After resetting the system
Pc25 to Pc4F	Reserved (Do not change.)				

14.5 Safety-related Servo Parameters

14.5.1 Overview

Safety-related servo parameters contain information about the safety functions of the SERVOPACK and servomotor that is managed by the safety-function-part. This information is maintained in the SERVOPACK, but it is also managed in the safety-function-part with different parameter numbers. To change safety-related parameters, change the corresponding SERVOPACK parameters and then update the safety-related servo parameters to write the changes to the safety-function-part of the SERVOPACK. For details, refer to *14.5.2 (2) Updating Safety-related Servo Parameters*.

The following table shows the correspondence between the safety-related servo parameters and the corresponding SERVOPACK parameters.

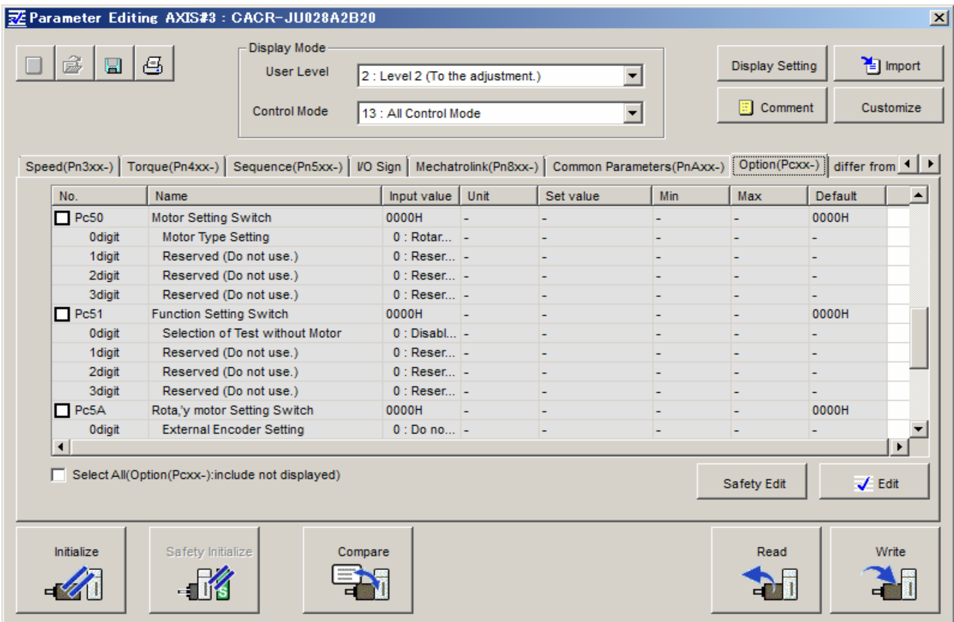
Safety-related servo parameter		SERVOPACK parameter	
Parameter No.	Name	Parameter No.	Name
Pc50.0	Motor Type Setting	–	–
Pc5A.0	External Encoder Setting	Pn002.3	External Encoder Usage
Pc60	Encoder Resolution	–	–
Pc61	Divided Encoder Pulse	Pn212	Number of Encoder Output Pulses

14.5.2 Operating Procedure

The procedures for referencing, updating, and initializing the safety-related servo parameters are given in this section.

(1) Accessing Safety-related Servo Parameters

In the menu bar of SigmaWin for Σ-V-SD(MT) component's main window, click **Parameters**, click **Edit Parameters**, and then click the **Option (Pcxx-)** Tab. The following window will be displayed. Parameters Pc50 and beyond are safety-related servo parameters. You can access the settings of the safety-related servo parameters from this window.

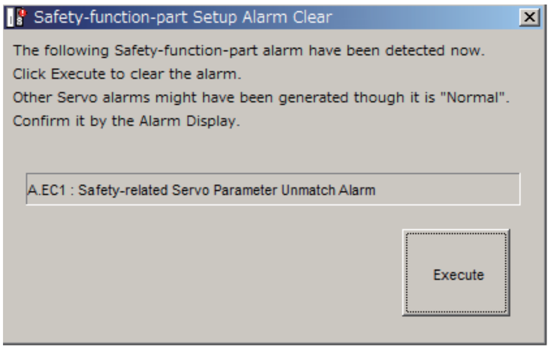


(2) Updating Safety-related Servo Parameters

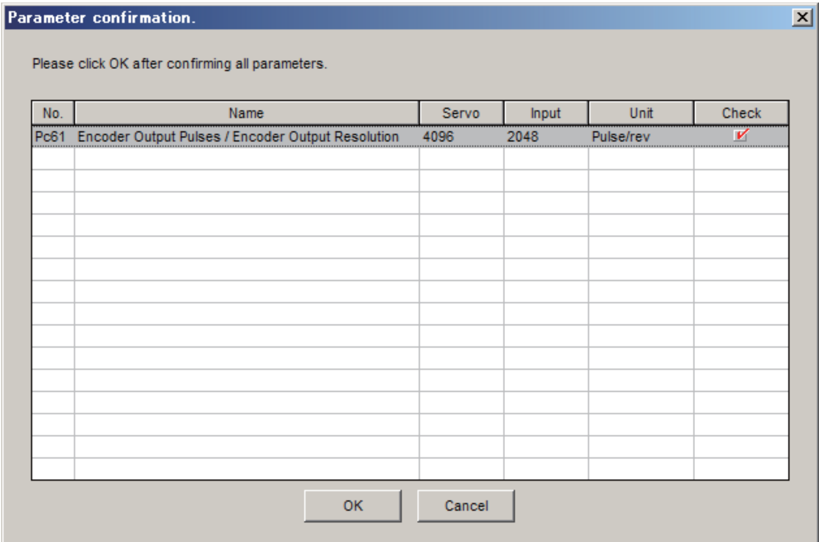
Update the safety-related servo parameters in the following cases.

- When you edit a SERVOPACK parameter that corresponds to a safety-related servo parameter
- When the A.EC1 alarm (Safety-related Servo Parameter Mismatch Alarm) occurs

1. The Safety-function-part Setup Alarm Clear Dialog Box will be displayed.

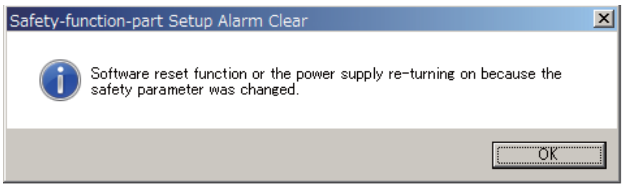


2. Click the **Execute** Button. The following window will be displayed. Check the edited values and select the check boxes in the *Check* column.



The **OK** Button will be enabled after you select all of the check boxes.

3. Click the **OK** Button. Writing the settings to the safety-function-part will start. The following window will be displayed when it is completed.



4. The Safety-function-part Setup Alarm Clear Dialog Box will close when you click the **OK** Button. Either perform a software reset or turn the power supply OFF and ON again.

This concludes the procedure to update the safety-related servo parameters.

(3) Initializing Safety-related Servo Parameters

> **IMPORTANT**
> When you initialize the safety-related servo parameters, the safety-related parameters will also be initialized.

The procedure to initialize the safety-related servo parameters is the same as the procedure to initialize the safety-related parameters. For details, refer to *14.4.2 (3) Initializing Safety-related Parameters* .

14.5.3 Safety-related Servo Parameters

Parameter No.	Name	Setting Range	Units	Factory Setting	When Enabled
Pc50	Motor Setting Switch	–	–	0000	After resetting the system
	n.□□□□ (4th digit, 3rd digit, 2nd digit, 1st digit) 1st digit: Motor Type Setting 0: Rotational motor 1 to F: Reserved (Do not change.) 2nd digit: Reserved (Do not change.) 3rd digit: Reserved (Do not change.) 4th digit: Reserved (Do not change.)				
Pc51	Reserved (Do not change.)	–	–	0011	After resetting the system
Pc52 to Pc59	Reserved (Do not change.)				
Pc5A	Rotary Motor Setting Switch	–	–	0000	After resetting the system
	n.□□□□ (4th digit, 3rd digit, 2nd digit, 1st digit) 1st digit: External Encoder Setting 0: Does not use external encoder. 1 to F: Reserved (Do not change.) 2nd digit: Reserved (Do not change.) 3rd digit: Reserved (Do not change.) 4th digit: Reserved (Do not change.)				
Pc5B to Pc5F	Reserved (Do not change.)				
Pc60	Encoder Resolution	–	bit	20	After resetting the system
Pc61	Encoder Output Pulses/ Encoder Output Resolution	–	pulses/rev	2048	After resetting the system
Pc62	Motor Max. Speed	–	1 min^{-1}	6000	After resetting the system
Pc64 to Pc6F	Reserved (Do not change.)				

14.6 Parameter Recording Table

Use the following table for recording parameters.

Parameter	Factory Setting						Name	When Enabled
Pn000	0000						Basic Function Select Switch 0	After restart
Pn001	*1						Application Function Select Switch 1	After restart
Pn002	0011						Application Function Select Switch 2	After restart
Pn006	0002						Application Function Select Switch 6	Immediately
Pn007	0000						Application Function Select Switch 7	Immediately
Pn008	4000						Application Function Select Switch 8	After restart
Pn00B	0001						Application Function Select Switch B	After restart
Pn00D	0000						Application Function Select Switch D	After restart
Pn01B	0000						Application Function Select Switch 1B	After restart
Pn01C	0000						Application Function Select Switch 1C	After restart
Pn01E	0000						Application Function Select Switch 1E	After restart
Pn01F	0000						Application Function Select Switch 1F	After restart
Pn030	0000						Reserved (Do not change.)	–
Pn070	0000						Function at Cutting Feed	After restart
Pn071	0000						Function at Fast-forward	After restart
Pn07F	0000						Reserved (Do not change.)	After restart
Pn100	400						Speed Loop Gain	Immediately
Pn101	2000						Speed Loop Integral Time Constant	Immediately
Pn102	400						Position Loop Gain	Immediately
Pn103	100						Moment of Inertia Ratio	Immediately
Pn104	400						2nd Speed Loop Gain	Immediately
Pn105	2000						2nd Speed Loop Integral Time Constant	Immediately
Pn106	400						2nd Position Loop Gain	Immediately
Pn109	0						Feedforward Gain	Immediately
Pn10A	0						Feedforward Filter Time Constant	Immediately
Pn10B	0000						Application Function for Gain Select Switch	–
Pn121	100						Friction Compensation Gain	Immediately
Pn123	0						Friction Compensation Coefficient	Immediately

*1. Varies in accordance with the SERVOPACK used.
SERVOPACK CACR-JU028A2☐, -JU036A2☐, -JU014D2☐, -JU018D2☐: 0200
Other models: 0202

Note: When using parameters that are enabled after restarting the SERVOPACK, a CONFIG command must be input or the power must be turned OFF and ON again.

(cont'd)

Parameter	Factory Setting						Name	When Enabled
Pn124	0						Friction Compensation Frequency Correction	Immediately
Pn125	100						Friction Compensation Gain Correction	Immediately
Pn12B	400						Reserved (Do not change.)	Immediately
Pn12C	2000						Reserved (Do not change.)	Immediately
Pn12D	400						Reserved (Do not change.)	Immediately
Pn12E	400						Reserved (Do not change.)	Immediately
Pn12F	2000						Reserved (Do not change.)	Immediately
Pn130	400						Reserved (Do not change.)	Immediately
Pn140	0000						Model Following Control Related Switch	Immediately
Pn141	500						Model Following Control Gain	Immediately
Pn142	1000						Model Following Control Gain Compensation	Immediately
Pn143	1000						Model Following Control Bias (Forward Direction)	Immediately
Pn144	1000						Model Following Control Bias (Reverse Direction)	Immediately
Pn147	1000						Model Following Control Speed Feedforward Compensation	Immediately
Pn150	0012						Predictive Control Function Select Switch	After restart
Pn151	100						Predictive Control Acceleration/ Deceleration Gain	Immediately
Pn152	100						Predictive Control Ratio of Weight	Immediately
Pn153	100						Predictive Control Equivalent Kp Ratio	Immediately
Pn154	0						Predictive Control Speed FF Gain	Immediately
Pn155	0						Predictive Control Torque FF Gain	Immediately
Pn156	0						Predictive Control Torque FF Filter Time Constant	Immediately
Pn157	80						Predictive Control Parameter Kph(C)	Immediately
Pn158	0						Predictive Control Parameter Cd	Immediately
Pn159	0						Predictive Control Parameter α	Immediately
Pn15A	0						Predictive Control Equivalent Kp Fine Adjustment Amount	Immediately
Pn160	0010						Anti-Resonance Control Related Switch	Immediately
Pn161	1000						Anti-Resonance Frequency	Immediately
Pn162	100						Anti-Resonance Gain Compensation	Immediately
Pn163	0						Anti-Resonance Damping Gain	Immediately
Pn164	0						Anti-Resonance Filter Time Constant 1 Compensation	Immediately
Pn165	0						Anti-Resonance Filter Time Constant 2 Compensation	Immediately

(cont'd)

Parameter	Factory Setting						Name	When Enabled
Pn205	65535						Multiturn Limit Setting	After restart
Pn20A	32768						Reserved (Do not change.)	After restart
Pn20E	1						Reserved (Do not change.)	–
Pn210	1						Reserved (Do not change.)	–
Pn212	2048						Number of Encoder Output Pulses	After restart
Pn22A	0000						Reserved (Do not change.)	After restart
Pn230	1024						Reserved (Do not change.)	After restart
Pn232	0						Reserved (Do not change.)	After restart
Pn233	0						Reserved (Do not change.)	After restart
Pn234	0000						Reserved (Do not change.)	Immediately
Pn304	500						JOG Speed	Immediately
Pn305	0						Soft Start Acceleration Time	Immediately
Pn306	0						Soft Start Deceleration Time	Immediately
Pn311	100						Vibration Detection Sensibility	Immediately
Pn324	300						Moment of Inertia Calculating Start Level	Immediately
Pn401	100						1st Step 1st Torque Reference Filter Time Constant	Immediately
Pn402	800						Forward Torque Limit	Immediately
Pn403	800						Reverse Torque Limit	Immediately
Pn404	100						Forward External Torque Limit	Immediately
Pn405	100						Reverse External Torque Limit	Immediately
Pn406	800						Emergency Stop Torque	Immediately
Pn407	10000						Speed Limit during Torque Control	Immediately
Pn408	0000						Torque Related Function Switch	–
Pn409	2000						1st Notch Filter Frequency	Immediately
Pn40A	70						1st Notch Filter Q Value	Immediately
Pn40B	0						1st Notch Filter Depth	Immediately
Pn40C	2000						2nd Notch Filter Frequency	Immediately
Pn40D	70						2nd Notch Filter Q Value	Immediately
Pn40E	0						2nd Notch Filter Depth	Immediately
Pn412	100						1st Step 2nd Torque Reference Filter Time Constant	Immediately
Pn413	100						Reserved (Do not change.)	Immediately
Pn414	100						Reserved (Do not change.)	Immediately
Pn416	0000						Torque Related Function Switch 2	Immediately
Pn417	2000						3rd Notch Filter Frequency	Immediately
Pn418	70						3rd Notch Filter Q Value	Immediately
Pn419	0						3rd Notch Filter Depth	Immediately
Pn41A	2000						4th Notch Filter Frequency	Immediately
Pn41B	70						4th Notch Filter Q Value	Immediately
Pn41C	0						4th Notch Filter Depth	Immediately
Pn430	150						Reserved (Do not change.)	Immediately

Note: When using parameters that are enabled after restarting the SERVOPACK, a CONFIG command must be input or the power must be turned OFF and ON again.

(cont'd)

Parameter	Factory Setting						Name	When Enabled
Pn431	150						Reserved (Do not change.)	Immediately
Pn432	15						Reserved (Do not change.)	Immediately
Pn433	100						Reserved (Do not change.)	Immediately
Pn434	100						Reserved (Do not change.)	Immediately
Pn435	100						Reserved (Do not change.)	Immediately
Pn436	100						Reserved (Do not change.)	Immediately
Pn43F	100						Reserved (Do not change.)	Immediately
Pn456	15						Sweep Torque Reference Amplitude	Immediately
Pn460	0101						Notch Filter Adjustment Switch	Immediately
Pn481	400						Reserved (Do not change.)	Immediately
Pn482	3000						Reserved (Do not change.)	Immediately
Pn486	25						Reserved (Do not change.)	Immediately
Pn487	0						Reserved (Do not change.)	Immediately
Pn488	100						Reserved (Do not change.)	Immediately
Pn490	100						Reserved (Do not change.)	Immediately
Pn493	50						Reserved (Do not change.)	Immediately
Pn494	250						Reserved (Do not change.)	Immediately
Pn495	100						Reserved (Do not change.)	Immediately
Pn498	10						Reserved (Do not change.)	Immediately
Pn499	15						Reserved (Do not change.)	–
Pn49A	50						Reserved (Do not change.)	–
Pn4B0	0000						Acceleration Rate Correction Switch	After restart
Pn4B1	1						Forward Compensation Number of Steps	Immediately
Pn4B2	0						Forward Compensation Torque	Immediately
Pn4B3	0						Forward Offset Position Ratio	Immediately
Pn4B4	0						Forward Offset Compensation Torque	Immediately
Pn4B5	0						2nd Step Forward Compensation Position Ratio	Immediately
Pn4B6	0						2nd Step Forward Compensation Torque	Immediately
Pn4B7	1						Reverse Compensation Number of Steps	Immediately
Pn4B8	0						Reverse Compensation Torque	Immediately
Pn4B9	0						Reverse Offset Position Ratio	Immediately
Pn4BA	0						Reverse Offset Compensation Torque	Immediately
Pn4BB	0						2nd Step Reverse Compensation Position Ratio	Immediately
Pn4BC	0						2nd Step Reverse Compensation Torque	Immediately
Pn4BD	0						Forward Compensation Step Correction Function Coefficient a	Immediately
Pn4BE	0						Forward Compensation Step Correction Function Coefficient b	Immediately
Pn4BF	0						Forward Compensation Torque Correction Function Coefficient a	Immediately

Note: When using parameters that are enabled after restarting the SERVOPACK, a CONFIG command must be input or the power must be turned OFF and ON again.

(cont'd)

Parameter	Factory Setting						Name	When Enabled
Pn4C0	0						Forward Compensation Torque Correction Function Coefficient b	Immediately
Pn4C1	0						Reverse Compensation Step Correction Function Coefficient a	Immediately
Pn4C2	0						Reverse Compensation Step Correction Function Coefficient b	Immediately
Pn4C3	0						Reverse Compensation Torque Correction Function Coefficient a	Immediately
Pn4C4	0						Reverse Compensation Torque Correction Function Coefficient b	Immediately
Pn4C5	0						Forward Acceleration Rate Correction Projection Compensation Limit Clamp Value	Immediately
Pn4C6	0						Reverse Acceleration Rate Correction Projection Compensation Limit Clamp Value	Immediately
Pn4F0	10000						1st Positive Projection Compensation Gain	Immediately
Pn4F1	0						1st Positive Projection Compensation Limit Offset	Immediately
Pn4F2	1000						2nd Positive Projection Compensation Gain	Immediately
Pn4F3	0						2nd Positive Projection Compensation Limit Offset	Immediately
Pn4F4	0						Positive Projection Compensation Limit Change Value	Immediately
Pn4F5	0						Positive Projection Compensation Limit Clamp Value	Immediately
Pn4F6	10000						1st Negative Projection Compensation Gain	Immediately
Pn4F7	0						1st Negative Projection Compensation Limit Offset	Immediately
Pn4F8	1000						2nd Negative Projection Compensation Gain	Immediately
Pn4F9	0						2nd Negative Projection Compensation Limit Offset	Immediately
Pn4FA	0						Negative Projection Compensation Limit Change Value	Immediately
Pn4FB	0						Negative Projection Compensation Limit Clamp Value	Immediately
Pn4FC	0						Projection Compensation Timing Constant	Immediately
Pn501	10						Zero Clamp Level	Immediately
Pn502	20						Rotation Detection Level	Immediately
Pn503	10						Speed Coincidence Signal Output Width	Immediately
Pn506	0						Brake Reference - Servo OFF Delay Time	Immediately
Pn507	100						Brake Reference Output Speed Level	Immediately
Pn508	50						Waiting Time for Brake Signal When Motor Running	Immediately

(cont'd)

Parameter	Factory Setting						Name	When Enabled
Pn50A	1881						Input Signal Selection 1	After restart
Pn50B	8882						Input Signal Selection 2	After restart
Pn517	0000						OT Function	Immediately
Pn51B	1000						Reserved (Do not change.)	Immediately
Pn51E	100						Excessive Position Error Warning Level	Immediately
Pn520	5242880						Excessive Position Error Alarm Level	Immediately
Pn522	7						Positioning Completed Width	Immediately
Pn524	1073741824						NEAR Signal Width	Immediately
Pn526	5242880						Excessive Position Error Alarm Level at Servo ON	Immediately
Pn528	100						Excessive Position Error Warning Level at Servo ON	Immediately
Pn529	10000						Speed Limit Level at Servo ON	Immediately
Pn52A	20						Reserved (Do not change.)	Immediately
Pn52B	20						Overload Warning Level	Immediately
Pn52C	100						Derating of Base Current at Detecting Overload of Motor	After restart
Pn530	0000						Program JOG Operation Related Switch	Immediately
Pn531	32768						Program JOG Movement Distance	Immediately
Pn533	500						Program JOG Movement Speed	Immediately
Pn534	100						Program JOG Acceleration/ Deceleration Time	Immediately
Pn535	100						Program JOG Waiting Time	Immediately
Pn536	1						Number of Times of Program JOG Movement	Immediately
Pn541	65535						Reserved (Do not change.)	After restart
Pn542	15						Reserved (Do not change.)	Immediately
Pn543	1000						Reserved (Do not change.)	Immediately
Pn544	100						Reserved (Do not change.)	Immediately
Pn545	0000						Reserved (Do not change.)	Immediately
Pn550	0						Analog Monitor 1 Offset Voltage	Immediately
Pn551	0						Analog Monitor 2 Offset Voltage	Immediately
Pn552	100						Analog Monitor Magnification (×1)	Immediately
Pn553	100						Analog Monitor Magnification (×2)	Immediately
Pn561	50						Overshoot Detection Level	Immediately
Pn601	0						DB Resistor Capacity	After restart
Pn630	0						Emergency Stop Execution Delay Time	Immediately
Pn631	0						External Magnetic Contactor OFF Delay Time	After restart

Note: When using parameters that are enabled after restarting the SERVOPACK, a CONFIG command must be input or the power must be turned OFF and ON again.

(cont'd)

Parameter	Factory Setting						Name	When Enabled
Pn800	1040						Communications Control	Immediately
Pn801	0003						Reserved (Do not change.)	–
Pn803	10						Origin Range	Immediately
Pn804	1073741823						Reserved (Do not change.)	–
Pn806	-1073741823						Reserved (Do not change.)	–
Pn808	0						Absolute Encoder Origin Offset	Immediately*2
Pn810	0						Exponential Function Accelera-tion/ Deceleration Bias	Immediately*3
Pn811	0						Exponential Function Accelera-tion/Deceleration Time Constant	Immediately*3
Pn812	0						Movement Average Time	Immediately*3
Pn81F	1010						Command Data Allocations	After restart
Pn820	0						Forward Latching Allowable Area	Immediately
Pn822	0						Reverse Latching Allowable Area	Immediately
Pn824	0000						Option Monitor 1 Selection	Immediately
Pn825	0000						Option Monitor 2 Selection	Immediately
Pn830	4096						Reference Unit Amount per Machine Rotation	After restart
Pn850	0						Reserved (Do not change.)	–
Pn860	0000						SVCMD_IO (Input) Field Allocation 1	After restart
Pn861	0000						SVCMD_IO (Input) Field Allocation 2	After restart
Pn960	40960						Speed Detection 1 Signal Level	Immediately
Pn962	1000						Speed Detection 1 Signal Hysteresis	Immediately
Pn963	40960						Speed Detection 2 Signal Level	Immediately
Pn965	1000						Speed Detection 2 Signal Hysteresis	Immediately
Pn966	100						Torque Detection Signal Level	Immediately
Pn967	10						Torque Detection Signal Hysteresis	Immediately
Pn968	0000						TDET Output Method at Acceleration	Immediately
01 PnA02	–						Encoder Type (read only)	–
02 PnA04	–						Motor Type (read only)	–
03 PnA06	–						Semi-closed/Fully-closed Type (read only	–

∗2. Available after the SENS_ON command is input.
∗3. The settings are updated only if the sending of the reference has been stopped (DEN is set to 1).
Note: When using parameters that are enabled after restarting the SERVOPACK, a CONFIG command must be input or the power must be turned OFF and then ON again.

(cont'd)

Parameter	Factory Setting						Name	When Enabled
04 PnA08	–						Rated Speed (read only)	–
05 PnA0A	–						Maximum Output Speed (read only)	–
06 PnA0C	–						Speed Multiplier (read only)	–
07 PnA0E	–						Rated Torque (read only)	–
08 PnA10	–						Maximum Output Torque (read only)	–
09 PnA12	–						Torque Multiplier (read only)	–
0A PnA14	–						Resolution (read only)	–
21 PnA42	1						Reserved (Do not change.)	–
22 PnA44	1						Reserved (Do not change.)	–
23 PnA46	0						Absolute Encoder Origin Offset	Immediately*2
24 PnA48	65535						Multiturn Limit Setting	After restart
25 PnA4A	0000H						Limit Setting	After restart
26 PnA4C	–						Reserved (Do not use.)	–
27 PnA4E	0						Reserved (Do not use.)	–
28 PnA50	–						Reserved (Do not use.)	–
29 PnA52	0						Reserved (Do not use.)	–
41 PnA82	0						Speed Unit	After restart
42 PnA84	0						Speed Base Unit	After restart
43 PnA86	0						Position Unit	After restart
44 PnA88	0						Position Base Unit	After restart
45 PnA8A	0						Acceleration Unit	After restart
46 PnA8C	4						Acceleration Base Unit	After restart
47 PnA8E	1						Torque Unit	After restart
48 PnA90	-2						Torque Base Unit	After restart

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

Note: When using parameters that are enabled after restarting the SERVOPACK, a CONFIG command must be input or the power must be turned OFF and then ON again.

(cont'd)

Parameter	Factory Setting						Name	When Enabled
49 PnA92	0601011FH						Compliance Unit System (read only)	–
61 PnAC2	40000						Speed Loop Gain	Immediately
62 PnAC4	20000						Speed Loop Integral Time Constant	Immediately
63 PnAC6	40000						Position Loop Gain	Immediately
64 PnAC8	0						Feedforward Compensation	Immediately
65 PnACA	0						Position Loop Integral Time Constant	Immediately
66 PnACC	7						Positioning Completed Width	Immediately
67 PnACE	1073741824						NEAR Signal Width	Immediately
81 PnB02	0						Exponential Function Accel/Decel Time Constant	Immediately*3
82 PnB04	0						Movement Average Time	Immediately*3
83 PnB06	–						Reserved (Do not use.)	–
86 PnB0C	–						Reserved (Do not use.)	–
87 PnB0E	1						Monitor Selection 1	Immediately
88 PnB10	0						Monitor Selection 2	Immediately
89 PnB12	0						Monitor Selection for SEL_MON1 (CMN1)	Immediately
8A PnB14	0						Monitor Selection for SEL_MON2 (CMN2)	Immediately
8B PnB16	10						Origin Detection Range	Immediately
8C PnB18	100						Forward Torque Limit	Immediately
8D PnB1A	100						Reverse Torque Limit	Immediately
8E PnB1C	20000						Zero Speed Detection Range	Immediately
8F PnB1E	10000						Speed Coincidence Signal Output Width (read only)	Immediately
90 PnB20	0FFF3F3FH						Servo Command Control Field Enabled/Disabled (read only)	–
91 PnB22	0FFF3F33H						Servo Command Status Field Enabled/Disabled (read only)	–
92 PnB24	C0800FD0H						I/O Bit Enabled/Disabled (Output) (read only)	–
93 PnB26	800FFCFCH						I/O Bit Enabled/Disabled (Input) (read only)	–
Pc00	0002						Safety Function Selection Switch	After resetting the system

*3. The settings are updated only if the sending of the reference has been stopped (DEN is set to 1).

(cont'd)

Parameter	Factory Setting						Name	When Enabled
Pc01	0011						EDM Signal Output Selection Switch	After resetting the system
Pc02 to Pc0F	–						Reserved (Do not change.)	–
Pc10	0						Deceleration Waiting Time A	After resetting the system
Pc11	500						Deceleration Monitoring Time A	After resetting the system
Pc12	0						Limited Speed A on Waiting for Deceleration	After resetting the system
Pc13	10						Limited Distance A	After resetting the system
Pc14	0						Limited Constant Speed A	After resetting the system
Pc15 to Pc1F	–						Reserved (Do not change.)	–
Pc20	0						Deceleration Waiting Time B	After resetting the system
Pc21	500						Deceleration Monitoring Time B	After resetting the system
Pc22	0						Limited Speed B on Waiting for Deceleration	After resetting the system
Pc23	10						Limited Distance B	After resetting the system
Pc24	0						Limited Constant Speed B	After resetting the system
Pc25 to Pc4F	–						Reserved (Do not change.)	–
Pc50	0000						Motor Setting Switch	After resetting the system
Pc51	0011						Reserved (Do not change.)	After resetting the system
Pc52 to Pc59	–						Reserved (Do not change.)	–
Pc5A	0000						Rotary Motor Setting Switch	After resetting the system
Pc5B to Pc5F	–						Reserved (Do not change.)	–
Pc60	20						Encoder Resolution	After resetting the system
Pc61	2048						Encoder Output Pulsed/Encoder Output Resolution	After resetting the system
Pc62	6000						Motor Max. Speed	After resetting the system
Pc64 to Pc6F	–						Reserved (Do not change.)	–

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Revision History

The date of publication, revision number, and web revision number are shown at the bottom right of the back cover. Refer to the following example.

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AC Servo Drives
Σ-V-SD Series
USER'S MANUAL
Rotational Motor
MECHATROLINK-III Communications Reference
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