KEYENCE

D69GB

AC Servo System

# SV2 Series

## User's Manual

Please read this Manual before use.
Keep this Manual in a safe place for later reference.

# Preface

This Manual describes how to connect/maintain and operate SV2 series AC servo system, as well as specifications and use methods of servo amplifier and servo motor.
Please keep this Manual in a safe place so that you can retrieve it whenever necessary.
Please handover this Manual to the end-users.

## ■ SV2 series related manuals

All the following PDF manuals can be found and opened in the help file of setting software. In addition, the latest version of PDF manuals can be downloaded from the Keyence web site.

| Name | Description |
|---|---|
| SV2 Series AC Servo System User's Manual | This manual describes specifications, operation methods, operating procedures and parameterizing of SV2 series AC servo system. |
| KV-XH16ML/XH04ML User's Manual | This manual describes specifications, operation methods and operating procedures of positioning/motion unit KV-XH16ML/XH04ML. |

# Safety Precautions

## ■ Symbols

This manual uses the following symbols so important notes can be easily recognized at a glance. Be sure to read these points.

| | |
|---|---|
| DANGER | **It indicates a hazardous situation which, if not avoided, will result in death or serious injury.** |
| WARNING | **It indicates a hazardous situation which, if not avoided, could result in death or serious injury.** |
| CAUTION | **It indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.** |
| *NOTICE* | **It indicates a situation which, if not avoided, could result in product damage as well as property damage.** |

Important — **It indicates cautions and limitations that must be followed during operation.**

Point — **It indicates cautions about operations prone to misoperation.**

Reference — It indicates tips for better understanding or useful information.

It indicates the pages that you should refer to as well as reference pages in other manuals.

## ■ General precautions

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| DANGER | • **Do not use this product to protect human bodies or a part of a human body.**<br>• **This product is not intended for use as an explosion-proof product. Do not use this product in hazardous locations and/or potentially explosive atmospheres.** |
| WARNING | • **To ensure fail-safe operation, provide a safety circuit that does not interfere with the servo amplifier so that the overall system operates safely even when a failure occurs in the servo amplifier.**<br>• **Malfunctions in the output and/or internal circuits may interfere with proper control. A safety circuit must be installed for control which may cause serious accidents such as fire.** |
| CAUTION | • **Verify that this product is operating normally in terms of functionality and performance before the start of work and when operating the product.**<br>• **If the product is used in any way other than prescribed in this instruction manual, the protection afforded to the product may be impaired.** |
| *NOTICE* | • **Proceed with care when modifying the product, or when using it in a manner that falls outside of the ranges indicated in its specifications, as KEYENCE is unable to guarantee product functionality or performance in such situations.**<br>• **Use this product in combination with other devices only after careful consideration, as it may fail to satisfy its functionality and performance capabilities as a result of the conditions and environment in which it is used.** |

## ■ Selecting and handling the system

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| WARNING | • **The system must be selected by engineering designers who have sufficient knowledge and experience, and based on the specifications, operating conditions, environment and application. Analyses and tests must be performed as necessary before selection.**<br>• **This instruction manual is written for those who have sufficient knowledge and experience of servo systems. Assembly, operation (including parameter setup), maintenance and inspection must be performed only by such personnel.**<br>• **Before conducting assembly, operation (including parameter setup), maintenance and inspection, read this instruction manual thoroughly.** |

## ■ Precautions

### ● General precautions

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| DANGER | • Be sure to read this manual for the safe use of this product.<br>• Keep this manual handy for future reference and ensure that end users have this manual handy as well for future reference.<br>• Do not remove the covers, cables, connectors, and optional devices while the servo amplifier is in an energized state. Otherwise, this may cause the product to cease its operation and be burned out. |
| WARNING | • Use the product using the power supply specifications (number of phases, voltages, and AC/DC frequencies) best suitable for the product. Otherwise, this may cause burnout, electric shock, or fire.<br>• Be sure to connect the ground terminals of the servo amplifier and the servo motor to the ground pole (class D ground). Otherwise, this may cause electric shock or fire.<br>• Do not disassemble, repair, and modify the product. Otherwise, this may cause fire or malfunction. |
| CAUTION | • The servo amplifier heat sink, regenerative resistor, servo motor, etc. may remain hot for a while being powered on or after powering off the mains. Take safety measures such as installing covers, etc., to prevent the contact of the hands or components (cables, etc.) by mistake. Otherwise, this may cause burns.<br>• Use a double insulated device or one equipped with reinforced insulation for a 24 VDC power supply. Otherwise, this may cause electric shock.<br>• Do not give damage to, pull strongly, apply excessive force to, place heavy objects on, or tuck in the cables. Otherwise, this may cause malfunction, damage to the machine, or electric shock.<br>• The person who designs the system that uses the Safe Torque OFF safety function must have a complete knowledge of the related safety standards and a complete understanding of the instructions in this document. Otherwise, this may cause damage to the product or machine.<br>• Never use the product close to a location where water falls on it, the corrosive atmosphere, or inflammable objects. Otherwise, this may cause electric shock or fire. |
| *NOTICE* | • Do not use the servo amplifier and the servo motor if they are damaged or have missing parts.<br>• Install an external emergency circuit so that the product can be powered off and cease its operation immediately in case of an error.<br>• Install a protective device (an AC reactor, etc.) in a location where power supply conditions are not good so power can be supplied to the product using the voltages that are within the specified variable range. Otherwise, this may cause damage to the servo amplifier.<br>• Use a noise filter or other measures to minimize the influence of electromagnetic interference. This may cause electromagnetic disturbance to electronic devices used close to the servo amplifier.<br>• Refer to the manual for the power supply voltage and capacity suitable to the servo motor model and select the proper brake power supply of the servo motor equipped with the electromagnetic brake. Also, refer to the manual for the input voltage to the electromagnetic brake.<br>• Be sure to configure a protective circuit between the brake power supply and the servo motor (surge suppressor) before using the product. Otherwise, this may cause damage to the servo motor.<br>• Depending on the type of protective circuit, the electromagnetic brake operating time varies. The operating time also varies when connecting multiple electromagnetic brakes in parallel. Due to this, check the electromagnetic brake operating time on the actual device before operating the servo motor.<br>• Ensure the proper combination of the servo amplifier and the servo motor before using the product.<br>• Do not touch the servo amplifier and the servo motor with wet hands. Otherwise, this may cause damage to the product. |

### ● Storage and inspection precautions

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| DANGER | • Do not change the wiring while the product is being energized. Otherwise, this may cause electric shock or injury. |
| WARNING | • Maintenance and inspection tasks should be performed by a competent person. Otherwise, this may cause electric shock or product malfunction.<br>• To replace the servo motor equipped with the electromagnetic brake, fix it on the side facing the product before replacing it. Otherwise, this may cause injuries or damage to the product due to the fall of the product. |

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| CAUTION | • **Check that the CHARGE indicator is out after more than 6 minutes have passed since the product has been powered off before performing wiring and inspection tasks. Even when powered off, high voltage remains in the servo amplifier. Do not touch the power terminals while the CHARGE indicator lights. Otherwise, this may cause electric shock.**<br>• **To replace the servo amplifier, back up the servo amplifier parameters in advance. Copy the backed up parameters to the new servo amplifier. Also check that the parameters have been successfully copied. If the backed up parameters are not copied or have not been successfully copied yet, the servo amplifier may not operate properly, causing damage to the machine or devices.**<br>• **Follow the proper procedure to replace the battery.**<br>• **If the battery (including the encoder) is removed with the servo amplifier control power turned off, data saved to the absolute value encoder is lost, causing displacement.** |
| *NOTICE* | • **Be sure to eliminate static electricity before operating the buttons and switches located inside the servo amplifier front cover. Otherwise, this may cause damage to the device.** |

- **Storage precautions**

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| CAUTION | • **Do not overload the product (follow the illustrative instructions). Otherwise, this may cause injuries or malfunction.** |
| *NOTICE* | • **Store or install the product in the following locations:**<br>  • **A location which gets no direct sunlight;**<br>  • **A location where the ambient temperature will not exceed the temperature defined by the product specifications;**<br>  • **A location where the relative humidity will not exceed the humidity defined by the product specifications;**<br>  • **A location where no condensation will not be formed due to rapid temperature changes;**<br>  • **A location where no corrosive or flammable gas will be generated;**<br>  • **A location away from flammable substances;**<br>  • **A location where dust, dirt, salt, or metallic fragments will rarely be visible;**<br>  • **A location where the product is not subjected to water, oil, or chemicals;**<br>  • **A location where no vibration or shock is transmitted to the product (where transmitted levels will not exceed the levels defined by the product specifications);**<br>  • **A location where there is no risk of radiation exposure;**<br>  **Should the product be stored or installed in locations other than the ones mentioned above, it may cause malfunction or damage to the product.**<br>• **Anti-corrosion treatment is applied to the product using an anti-corrosive agent prior to shipment. However, rust may be formed depending on the storage conditions or period. If the product is stored for more than 6 months, reapply an anti-corrosive agent to the machined surface such as the motor shafts.** |

- **Transport precautions**

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| CAUTION | • **Transport the product properly according to the weight.**<br>• **Do not hold the cables or motor shafts when transporting the servo motor. Otherwise, this may cause broken wires, malfunction, or injuries.**<br>• **Take extra care with sharp objects such as the corners of the device when handling the servo amplifier and/or the servo motor. Otherwise, this may cause injury.**<br>• **Do not overload the product (follow the illustrative instructions). Otherwise, this may cause injuries or malfunction.** |
| *NOTICE* | • **Do not hold the front cover or connectors when transporting the servo amplifier. Otherwise, this may cause the servo amplifier to drop.**<br>• **The servo amplifier and the servo motor are precision devices. Do not drop or subject to strong impact. Otherwise, this may cause malfunction or damage to these devices.**<br>• **Do not subject the connectors to impact. Otherwise, this may cause poor connection or malfunction.**<br>• **If wood packaging materials (such as wooden frames, plywood and pallets) require disinfection and pest control, be sure to apply methods other than fumigation.**<br>  **Example: Heat treatment (at a material core temperature of 56°C or higher for more than 30 minutes)**<br>  **Also, treat the packaging materials prior to packaging instead of treating the entire package. If electric products (standalone products or those built into machine) are packaged with fumigated wood materials, this may cause critical damage to electronic parts due to gas and/or steam generated from the materials. Particularly, halogen based disinfectants (such as fluorine, chlorine, bromine, and iodine) can lead to corrosion of the interior of the condenser.** |

## ● Installation precautions

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| ⚠ CAUTION | • **If the motor is equipped with key seat on the shaft ends, do not touch the key seat with bear hands. Otherwise, this may cause injury.**<br>• **Be sure to fix the servo motor securely to the machine. If it is not fixed completely, the servo motor may be disconnected from the machine.**<br>• **Refer to the manual and install the servo amplifier and the servo motor in a location which can withstand their weight.**<br>• **Install the servo amplifier, the servo motor, and the regenerative resistor to non-flammable materials. Direct installation on or close to flammable materials may cause fire.**<br>• **Provide defined spacing between the servo amplifier and the inner surface of the control plate, or other devices, when installing them. Otherwise, this may cause fire or malfunction.**<br>• **Install the servo amplifier in the defined orientation. Otherwise, this may cause fire or malfunction.**<br>• **Do not climb onto the product or place heavy load on it. Otherwise, this may cause malfunction, damage, or injuries.**<br>• **Be sure to prevent foreign materials from entering the servo amplifier and the servo motor. Otherwise, this may cause malfunction or fire.**<br>• **Take safety measures such as installing covers, etc., to prevent the contact with the rotating parts of the servo motor during operation by mistake.** |
| *NOTICE* | • **Store or install the product in the following locations:**<br>  • **A location which gets no direct sunlight;**<br>  • **A location where the ambient temperature will not exceed the temperature defined by the product specifications;**<br>  • **A location where the relative humidity will not exceed the humidity defined by the product specifications;**<br>  • **A location where no condensation will not be formed due to rapid temperature changes;**<br>  • **A location where no corrosive or flammable gas will be generated;**<br>  • **A location away from flammable substances;**<br>  • **A location where dust, dirt, salt, or metallic fragments will rarely be visible;**<br>  • **A location where the product is not subjected to water, oil, or chemicals;**<br>  • **A location where no vibration or shock is transmitted to the product (where transmitted levels will not exceed the levels defined by the product specifications);**<br>  • **A location where there is no risk of radiation exposure;**<br>  **Should the product be stored or installed in locations other than the ones mentioned above, it may cause malfunction or damage to the product.**<br>• **Use the product in an environment suitable to the product specifications. Should the product be used in environments beyond the product specifications, it may cause malfunction or damage to the product.**<br>• **The servo amplifier and the servo motor are precision devices. Do not drop or subject to strong impact. Otherwise, this may cause malfunction or damage to these devices.**<br>• **Be sure to install the servo amplifier inside the control panel.**<br>• **Be sure not to block the inlet and outlet ducts of the servo amplifier, or be sure to prevent foreign materials from entering it. Otherwise, this may cause malfunction.**<br>• **The servo motor is a precision device. Do not subject the servo motor output shaft or the servo motor itself to strong impact.**<br>• **Design thrust and radial loads applied to the motor shafts during operation so they will be within the acceptable range of values provided in the manual.**<br>• **When installing keys to the motor shafts, be sure not to subject the key seat to direct impact.**<br>• **When using oil as a gear lubricant, be sure to inject the designated oil prior to operation.**<br>• **The servo motor can be installed in either the horizontal or vertical direction.**<br>• **The shaft penetration parts of the servo motor are not of waterproof and oil proof structure. Take measures on the machine side to prevent water or coolant oil from entering inside the servo motor. Otherwise, this may cause malfunction.**<br>• **When using the product for applications in which it is subjected to a large amount of water and/oil droplets, protect the servo motor with a cover or shield against water and/oil droplets so the servo motor will not be subjected to a large amount of liquids.**<br>• **In environments with high humidity and high concentrations of oil mist, install the servo motor wire leads and connectors facing downward and install a cable trap. Otherwise, this may cause malfunction or fire due to insulation failures or short circuit accidents.** |

## ● Wiring precautions

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| ⚠ DANGER | • Do not change the wiring while the product is being energized. Otherwise, this may cause electric shock or injury. |
| ⚠ WARNING | • Maintenance and inspection tasks should be performed by a competent person. Otherwise, this may cause electric shock or product malfunction.<br>• Perform wiring or power supply inspection with care. The output circuit may be subject to malfunction due to short circuits caused by improper wiring or abnormal voltage to it. Should this type of malfunction occur, the electromagnetic brake will not be activated, with damage to the machine leading to personal injuries.<br>• Connect the AC power supply, DC power supply and servo amplifier to their respective designated terminals.<br>• Connect the AC power supply to the L1/L2/L3 terminals and L1C/L2C terminals of the servo amplifier.<br>• Connect the DC power supply to the B1/⊕ and ⊖2 terminals and L1C/L2C terminals of the servo amplifier. Otherwise, this may cause malfunction or fire. |
| ⚠ CAUTION | • Check that the CHARGE indicator is out after more than 6 minutes have passed since the product has been powered off before performing wiring and inspection tasks. Even when powered off, high voltage remains in the servo amplifier. Do not touch the power terminals while the CHARGE indicator lights. Otherwise, this may cause electric shock.<br>• Observe the precautions and procedures provided in this manual for wiring and trial runs. Wiring the brake circuit improperly or applying abnormal voltage causes malfunction of the servo amplifier, leading to damage to the machine or personal injuries.<br>• Perform wiring properly and without fail. The alignment of the connector and connector pins varies across the model. Be sure to refer to the technical document of the model that you are using to check the alignment of the pins. Otherwise, this may cause malfunction or incorrect operation.<br>• When connecting electrical wires to the power supply terminals and connection terminals, be sure to tighten these wires using the specified procedure at the defined tightening torque for proper wiring. If these are not tightened securely enough, it may cause these wires and terminal blocks to generate heat, leading to fire.<br>• Use a shielded twisted pair cable or multiple conductors common shielded twisted pair cable as the I/O and encoder cables.<br>• Be sure to observe the following precautions when wiring the main circuit terminals of the servo amplifier:<br>  • Power on the servo amplifier after wiring terminals including the main circuit terminals have been all completed.<br>  • If the main circuit terminals are terminal connectors, remove the connectors from the servo amplifier main unit for wiring.<br>  • Insert only one electrical wire into each wire hole on the main circuit terminals.<br>  • When inserting electrical wires, be careful not to allow the core wire whiskers to make contact with adjacent electrical wires, which may cause short circuits.<br>  • Install a safety device such as a circuit breaker in case of possible short circuits in external wires. Otherwise, this may cause fire or malfunction. |
| *NOTICE* | • Use as many of our specified cables as possible for wiring. If you use cables other than our specified cables, check the rated current and operating environment of the model that you are using and use our specified wiring materials or equivalent materials.<br>• Tighten the fixing screws and lock mechanism of cable connectors securely without fail. If these are not tightened securely enough, it may cause the cable connectors to be disconnected during operation.<br>• Do not pass high power electric wires (main circuit cables) and low power electric wires ( I/O and encoder cables) through the same duct or bind them. If you do not pass high power electric wires through one duct and low power electric wires through another duct, maintain a distance of 30 cm or greater between them when wiring. If they are wired too close to each other, this may cause improper operation due to the effects of noise on low power electric wires.<br>• Install a battery in either the host controller or encoder cable. If batteries are installed in both the host controller and encoder cable, this may cause an unintentional current to flow between the batteries, leading to damage or burnout.<br>• When connecting batteries, connect with the correct polarity. Otherwise, this may cause the destruction of the battery and/or encoder. |

## ● Operating/running precautions

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| ⚠ WARNING | • **Always check safety when turning the servo amplifier on. Some unintended operations may be caused by just turning the servo amplifier on, leading to equipment damage or injury.**<br>• **Configure the switches and parameters according to the machine that you are using before installing in that machine and starting operation. Otherwise, this may cause an unexpected behavior or malfunction of the machine, or personal injuries.**<br>• **Do not set extreme values for the parameters. Otherwise, the behavior may become stable, leading to damage to the machine or injuries.**<br>• **To prevent unexpected accidents, install a limit switch or stopper on the end of the moving parts of the machine. Otherwise, this may cause damage to the machine or injuries.**<br>• **Perform a trial run with the servo motor fixed and disconnected from the machine. Otherwise, this may cause injury.**<br>• **When performing a Z-phase search, note that the forced stop function activated by the limit switch is disabled. Otherwise, this may cause damage to the machine or injuries.**<br>• **When alarm occurs, the servo motor will free run stop or stop by dynamic brake according to the setting of the servo amplifier. The distance of inertia running depends on load inertia moment. Check the distance of inertia running during a trial run and consider installing a safety device on the machine side.**<br>• **Do not enter the moving range of the machine during a trial run. Otherwise, this may cause injury.**<br>• **Do not touch the servo motor or machine moving parts during a trial run. Otherwise, this may cause injury.** |
| ⚠ CAUTION | • **Design a system that ensures the safety if trouble such as a broken signal wire occurs. For example, by default, the LSP and LSN signals function on the safe side when a wire is broken. Do not reverse the polarity of these types of signals.**<br>• **When detecting the limit switch, the motor is de-energized and the brake is released. When using the servo motor for vertical direction driving, set the settings so the servo motor enters a zero clamp state after it has been brought to a stop. Also, concurrently use a safety device (such as an external brake and counterweight) to prevent the machine moving parts from dropping.**<br>• **Do not use the electromagnetic brake built into the servo motor to provide brake control. The electromagnetic brake is designed to hold the motor shafts, not a stop device to ensure the safety of the machine. Install a stop device for ensured safety on the machine side. Otherwise, this may cause malfunction of the brake due to wear or injuries.**<br>• **To rotate the servo motor, energize and release the electromagnetic brake first. For more details, refer to the timing chart provided in the manual.**<br>• **Check that the electromagnetic brake operates properly during a trial run.**<br>• **Be sure to enter the Servo Off state before powering off. If the main or control circuit is powered off without entering the Servo OFF state during operation, bring the servo motor to a stop in the following manner:**<br>  • **If the main circuit is powered off without entering the Servo OFF state, the servo motor is brought to a rapid stop by dynamic braking.**<br>  • **If the control circuit is powered off without entering the Servo OFF state, how to stop the servo motor varies across the servo amplifier model. For more details, refer to the servo amplifier manual.**<br>• **Do not use the dynamic brake for any other purposes than emergency stops. Otherwise, this may cause the elements inside the servo amplifier to deteriorate early and behave unexpectedly, leading to damage to the machine, burnout, or injuries.** |

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| NOTICE | • Be sure to measure vibrations with the servo motor installed in the machine to check vibrations are within the acceptable range of values. If vibrations are strong, the servo motor may be damaged early, and the bolts may be loosened.<br>• Observe torque/speed waveforms with a measuring gauge for gain control when starting the system and check that there are no vibrations. If vibrations occur due to high gain, the servo motor may be damaged early.<br>• Do not power on and off the mains frequently. After starting actual operation (normal operation), consider intervals of at least one hour as a reference to power on and off the mains. Do not use this product for applications that require powering on/off frequently. Otherwise, this may cause the elements of the servo amplifier to deteriorate early.<br>• Note an alarm or warning may occur if communicating with the host controller using KV STUDIO during a trial run. If an alarm or warning occurs, the process in action may be canceled, brining the system to a stop.<br>• Once the trial run of the machine and devices has been completed, use KV STUDIO to create a backup file for the servo amplifier parameters. This file will be used as the parameters when replacing the servo amplifier. If the backed up parameters are not copied, the servo amplifier may not operate properly, causing damage to the machine or devices. |

## ● Precautions about corrective action in case of an error

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| ⚠ DANGER | • If the safety device (such as a circuit breaker and fuse) installed in the power line is activated, resolve the cause, and then energize the servo amplifier. Also, perform repairs, replacements, and wiring inspections if necessary to resolve the cause that activated the safety device without fail. Otherwise, this may cause fire, an electric shock or injuries. |
| ⚠ WARNING | • After the power has been restored from an instantaneous power failure, the product may be restarted abruptly. Design the machine to ensure personal safety even if the product may be restarted. Otherwise, this may cause injury. |
| ⚠ CAUTION | • In case of an alarm, resolve the cause that set off the alarm for ensured safety. Then, either reset the alarm or turn the product back on to resume operation. Otherwise, this may cause damage to the machine or injuries.<br>• If the alarm is reset with the Servo ON signal still being input to the servo amplifier, the product may be restarted abruptly. Check that the product is in the Servo Off state and ensure the safety before resetting the alarm. Otherwise, this may cause damage to the machine or injuries.<br>• Be sure to wire an electromagnetic contactor in the wiring connection from the main circuit power supply to the servo amplifier main circuit power supply terminal so the mains can be powered off on the servo amplifier main circuit power supply side. Should the servo amplifier become defective, high current may flow through the wires with no electromagnetic contactor connected, causing fire.<br>• In case of an alarm, power off the main circuit. The regenerative resistor may be overheated due to malfunction of the regenerative transistor, etc., causing fire.<br>• Install a ground circuit fault interrupter to provide both short circuit and overload protection, or a ground circuit fault interrupter to provide ground fault protection by combing with a circuit breaker. In case of a ground fault, this may cause malfunction of the servo amplifier or fire.<br>• If a dangerous situation can be considered due to displacement by an external force (such as gravity) when the product is powered off or stopped due to an error, the servo motor electromagnetic brake alone cannot ensure the safety. Should this occur, provide an external braking mechanism for ensured safety. |

## ● Disposal precautions

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| ▶ Important | When disposing of the product, treat it as general industrial waste. Note that the ordinances enacted by local and municipal governments and laws in countries should take precedence and that you should put labels or notices on the product regarding them if necessary. |

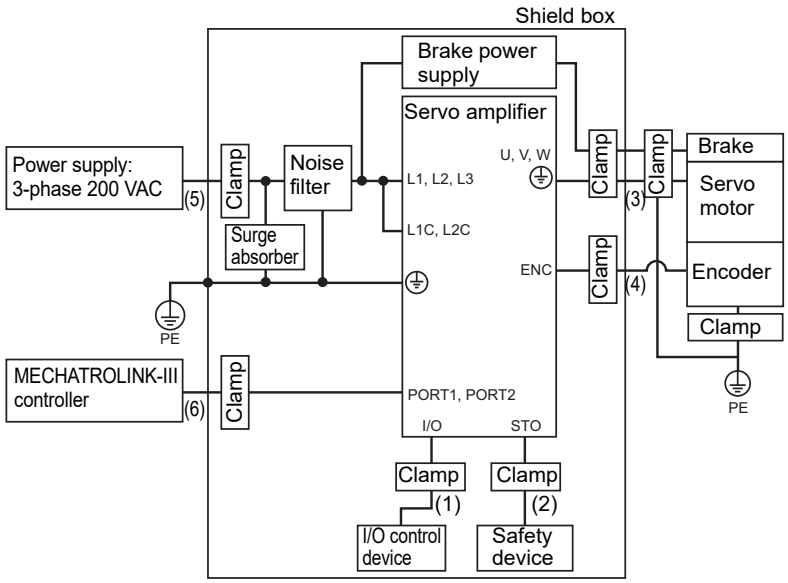
# Precautions for Regulations and Standards

## ■ CE marking

We have confirmed that this product meets the essential requirements of the EU directives in accordance with the following requirements. Be sure to consider the following specifications when using this product in the Member States of the European Union.

### ● EMC Directive

- Applicable standards EN55011
  EN61000-6-2
  EN61000-6-4
  EN61800-3
- Installation conditions (three-phase, 200 VAC)




| No. | Cable name | Specifications |
|---|---|---|
| (1) | I/O cable | Shielded wire |
| (2) | Safety signal cable | Shielded wire |
| (3) | Motor power cable | Shielded wire |
| (4) | Encoder cable | Shielded wire |
| (5) | Main circuit/control circuit power cable | Shielded wire |
| (6) | MECHATROLINK-III cable | Shielded wire |

These requirements do not ensure that the entire machine into which this product is incorporated meets the essential requirements of the EMC Directives. The manufacturer of the end-product is solely responsible that it complies with the EMC Directive.

## ● Low-voltage directive

This product complies with the following EN Standards and has been certified by TÜV SÜD Product Service GmbH.

- Applicable Standard EN61800-5-1
- Installation Environment and Insulation Conditions

| | | |
|---|---|---|
| **Overvoltage Category** | III | Applicable standard: IEC60364-4-44 and IEC60664-1 |
| **Pollution Degree** | 2 | Applicable standard: IEC60364-4-44 and IEC60664-1 |
| **Surrounding Air Temperature** | -5°C to + 60°C | Apply the derating rates when you use at +55°C or higher. |
| **Altitude** | 2000m max. | Apply the derating rates when you use at 1000m or higher. |
| **Degree of Protection** | IP20:<br>SV2-005L2/010L2/020L2/<br>040L2/075L2/100L2/150L2<br>IP10:<br>SV2-200L2/300L2/500L2 | Applicable standard: IEC60529 |
| **Protective Class** | I | Applicable standard: IEC61140 |
| **Input Power Supply** | AC power supply | CE Marking is not applicable if a DC power supply input is used. |

- External Power Supply for Control Circuits
  For the DC power supply for the control signal I/O circuits (I/O and STO), use a power supply device with double insulation or reinforced insulation.
- Installation of a Short-Circuit Protection Element
  Always use Fuses that comply with UL standards on the main circuit power supply line.
  Use either non-time delay fuses or semiconductor fuses.
  Refer to the followings for information on selecting fuse voltage and current ratings.
- Using an AC Power Supply
  Use a molded-case circuit breaker and fuse to protect the power supply line. They protect the power line by shutting OFF the circuit when overcurrent is detected. Select these devices based on the information in the following tables.

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| NOTICE | **The current capacity and inrush current in the table below are the net values. Select a fuse and circuit breaker that have the following cut-off characteristics.**<br>**• Main/control circuit: Do not cut off with the value three times that provided in the table or after 5 seconds.**<br>**• Inrush current: Do not cut off with the value provided in the table after 20ms.** |

| Main circuit voltage | Model | Capacity (W) | Power capacity per servo amplifier (kVA) | Current capacity | | Inrush current | | Rated voltage | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Main circuit (Arms) | Control circuit (Arms) | Main circuit (A0-p) | Control circuit (A0-p) | Fuse (V) | Circuit breaker (V) |
| 3-phase 200 VAC | SV2-005L2 | 50 | 0.2 | 0.4 | 0.2 | 34 | 34 | 250 | 240 |
| | SV2-010L2 | 100 | 0.3 | 0.8 | | | | | |
| | SV2-020L2 | 200 | 0.5 | 1.3 | | | | | |
| | SV2-040L2 | 400 | 1.0 | 2.5 | | | | | |
| | SV2-075L2 | 750 | 1.6 | 4.1 | | | | | |
| | SV2-100L2 | 1.0 k | 2.3 | 5.7 | | | | | |
| | SV2-150L2 | 1.5 k | 3.2 | 7.3 | | | | | |
| | SV2-200L2 | 2.0 k | 4.0 | 10 | 0.25 | | | | |
| | SV2-300L2 | 3.0 k | 5.9 | 15 | | | | | |
| | SV2-500L2 | 5.0 k | 7.5 | 25 | 0.3 | 68 | | | |
| Single-phase 200 VAC | SV2-005L2 | 50 | 0.2 | 0.8 | 0.2 | 34 | | | |
| | SV2-010L2 | 100 | 0.3 | 1.6 | | | | | |
| | SV2-020L2 | 200 | 0.6 | 2.4 | | | | | |
| | SV2-040L2 | 400 | 1.2 | 5.0 | | | | | |
| | SV2-075L2 | 750 | 1.9 | 8.7 | | | | | |

## ● Machinery Directive

This product complies with the following EN Standards and has been certified by TÜV SÜD Product Service GmbH.

- Applicable standards
  - EN61800-5-2 SIL3
  - EN61508 Part1,2,4 SIL3
  - EN62061 SIL CL3
  - EN ISO 13849-1:2015 Category3 PLe
  - EN60204-1
- Safety parameters (STO functions)

| Item | Standard | Performance level |
|---|---|---|
| Safety Integrity Level | IEC 61508 | SIL3 |
| | IEC 62061 | SILCL3 |
| Probability of dangerous failure per hour | IEC 61508<br>IEC 62061 | PFH = $4.04\times10^{-9}$ [1/h]<br>(4.04% of SIL3) |
| Performance Level | EN ISO 13849-1 | PLe (Category 3) |
| Mean time to dangerous failure of each channel | EN ISO 13849-1 | MTTFd: High |
| Average diagnostic coverage | EN ISO 13849-1 | DCavg: Medium |
| Stop category | IEC 60204-1 | Stop category 0 |
| Safety function | IEC 61800-5-2 | STO |
| Mission time | IEC 61508 | 20 years |
| Hardware fault tolerance | IEC 61508 | HFT = 1 |
| Subsystem | IEC 61508 | B |

## ■ UL Certification

This product has acquired the following UL/c-UL certification.

| Item | Servo amplifier | Servo motor |
|---|---|---|
| UL File No. | E231699 | E223442 |
| Category | NMMS, NMMS7 | PRHZ2, PRHZ8 |
| Applicable UL standards | UL61800-5-1<br>(Adjustable Speed Electrical Power Drive Systems) | UL1004-1<br>UL1004-6 |
| Applicable cUL standards | CSA C22.2 No.274<br>(Adjustable speed drives) | CSA C22.2 No.100 |

Be sure to consider the following specifications when using this product as a UL certified product.

- Installation environment and insulation conditions

| | | |
|---|---|---|
| **Overvoltage Category** | III | Applicable standard: IEC60364-4-44 and IEC60664-1 |
| **Pollution Degree** | 2 | Applicable standard: IEC60364-4-44 and IEC60664-1 |
| **Surrounding Air Temperature** | -5°C to + 60°C | Apply the derating rates when you use at +55°C or higher. |
| **Altitude** | 2000m max. | Apply the derating rates when you use at 1000m or higher. |
| **Degree of Protection** | IP20:<br>SV2-005L2/010L2/020L2/040L2/075L2/100L2/150L2<br>IP10:<br>SV2-200L2/300L2/500L2 | Applicable standard: IEC60529 |
| **Protective Class** | I | Applicable standard: IEC61140 |
| **Input Power Supply** | AC power supply | The UL/cUL applicable standards are not applicable if a DC power supply input is used. |

### ● External Power Supply for Control Circuits

The DC power supplies connected to the control signal I/O circuits must meet one of the following conditions.

- Use a class 2 power supply (compliance standard: UL 1310).
- Connect the control signal I/O circuits to a circuit with a maximum voltage of 30 Vrms and a peak voltage of 42.4 V that uses a UL 5085-3 (previous standard: UL 1585)-compliant class 2 transformer as its power supply.

### ● Wiring the Main Circuit Terminals

Wire the main circuit terminals according to the National Electrical Code (NEC/NFPA70) of the United States.

♦ SERVOAMPs with Enclosed Main Circuit Connectors and Motor Connectors

To comply with UL/cUL applicable standards when using the following models, always use the connectors that are provided with the servo amplifier to wire the main circuit terminals.

- SV2-005L2, SV2-010L2, SV2-020L2, SV2-040L2, SV2-075L2, SV2-100L2, SV2-150L2

♦ SERVOAMPs with Screw Terminal Blocks for the Main Circuit Terminals

To comply with UL/cUL applicable standards when using the following models, always crimp ring crimp terminals (that conform to UL standards) to the main circuit terminal wiring.

- SV2-200L2, SV2-300L2, SV2-500L2

Note:
1. Use the tool recommended by the crimp terminal manufacturer to attach the crimp terminals.
2. Use copper wires that withstand 75°C or the equivalent.
   Use wires with 300 V min. rated voltage for the main circuit.
3. Refer to the following section for the wire sizes and tightening torques. Use the maximum tightening torque given in the following section to connect the wires.
   "About crimp terminals and insulating sleeves", Page 4-3
4. Refer to the following section for the recommended UL-compliant closed-loop crimp terminals and insulating sleeves..
   "About crimp terminals and insulating sleeves", Page 4-3
5. A Terminal Kit for specific connection terminals is packed with the SERVOAMPs given in the following table. If you connect a cable to the connection terminals given in the following table, use the enclosed Terminal Kit.

| Model | Terminal name | Crimp terminal model (JST Mfg. Co., Ltd.) | Sleeve model (Tokyo Dip Co., Ltd.) |
|---|---|---|---|
| SV2-200L2<br>SV2-300L2 | Motor power supply connection terminal (U, V, W) | 5.5-S4 | TP-005 (black) |

### ● Installing Branch Circuit Protection and Short-Circuit Current Rating

To provide protection for short-circuit accidents in internal circuits, always connect molded-case circuit breakers or Fuses on the input side of the SERVOAMP as branch circuit protective devices.
Use UL-listed molded-case circuit breakers and UL-recognized fuses.
The short-circuit current rating (SCCR) of the SERVOAMP will depend on the type of branch circuit protective device that you connect.
The maximum applicable voltage for compliance with UL/cUL applicable standards, regardless of the short-circuit current rating, is given below.

♦ 200V range: 240 Vrms

- Short-circuit current rating (SCCR): 5,000 Arms (sine waves). Use a Class CC, Class J, or Class T fuse as a delay fuse or fast-acting fuse.

| Model | Rated output current (Arms) | Maximum allowable current rating | | |
|---|---|---|---|---|
| | | Circuit breaker (A) | Time-delay fuse (A) | Fast-acting fuse (A) |
| SV2-005L2 | 0.66 | 15 | 1 | 1 |
| SV2-010L2 | 0.91 | 15 | 1*1 | 3 |
| SV2-020L2 | 1.6 | 15 | -*2 | 6 |
| SV2-040L2 | 2.8 | 15 | 3*1 | 6 |
| SV2-075L2 | 5.5 | 15 | 6 | 15 |
| SV2-100L2 | 7.6 | 15 | 6*1 | 20 |
| SV2-150L2 | 11.6 | 20 | 10 | 30 |
| SV2-200L2 | 18.5 | 30 | 20 | 50 |
| SV2-300L2 | 19.6 | 30 | 30 | 50 |
| SV2-500L2 | 32.9 | 80 | 30 | 90 |

*1 For a single-phase power supply, there are no applicable time delay fuses.
*2 There are no applicable time delay fuses.

- Short circuit capacity (SCCR): 42,000 Arms (sine waves)

| Model (SV2-) | Semiconductor protection fuse | | |
|---|---|---|---|
| | Model* | Current rating [A] | Voltage rating [V] |
| 005L2, 010L2<br>020L2, 040L2 | FWH-35B | 35 | 500 |
| 075L2, 100L2<br>150L2 | FWH-45B | 45 | |
| 200L2, 300L2 | FWH-70B | 70 | |
| 500L2 | FWH-100B | 100 | |

* Manufactured by Bussmann.

### ● Attaching of Warning Label Concerning Safe Handling During Maintenance andInspection

In order to specify the instructions for the safe handling of this product for inspection and maintenance personnel, a self-adhesive warning label is included in the box with this SERVOAMP.
Affix this label to the inside of the enclosure (panel) in which the SERVOAMP is installed in a location that is visible during maintenance.

### ● Servomotor Overtemperature Protection

Motor overtemperature protection that complies with UL standards (i.e., has speed-sensitive overload protection) is not provided. Motor overtemperature protection must be provided in the end use when required by the NEC/ NFPA70 (Article 430, Chapter X, 430.126).
When used with a SV2 Series Servomotor, external overtemperature protection may not be needed because the motor is rated for continuous torque from 0 to the rated speed.

## ■ KC Certificate (South Korea)

Class A equipment
This is a class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

A급 기기 (업무용 방송통신기자재)

이 기기는 업무용 (A 급 ) 전자파적합기기로서 판매자 또는 사용자는 이 점을
주의하시기 바라며 , 가정외의 지역에서 사용하는 것을 목적으로 합니다 .

# How This Manual Is Organized

| | | |
|---|---|---|
| Chapter 1 | BEFORE USING | This chapter describes the models and system configuration of SV2 series. |
| Chapter 2 | CONFIGURATION & SPECIFICATIONS | This chapter describes package contents, part names, functions and specifications of SV2 series. |
| Chapter 3 | INSTALLATION AND MAINTENANCE | This chapter describes how to install and maintain the servo amplifier and servo motor. |
| Chapter 4 | SIGNALS AND WIRING | This chapter describes wiring method, specifications of signals and how to avoid noise and high harmonic generated in SV2 series. |
| Chapter 5 | PARAMETER SETTINGS | This chapter describes the servo parameter and I/O settings. |
| Chapter 6 | CONFIGURATION AND OPERATION OF MECHATROLINK-III | Here, we will explain about the configuration of MECHATROLINK-III. Please use as a reference together with "Chapter 5 PARAMETER SETTINGS". |
| Chapter 7 | TUNING | This chapter describes tuning for servo motor and other applications. |
| Chapter 8 | SAFETY FUNCTION | This section describes details of the SV2 series safety functions. |
| Chapter 9 | ABSOLUTE POSITION SYSTEM | This chapter describes how to use ABS encoder to keep absolute position and read absolute position data. |
| Chapter 10 | FULLY CLOSED CONTROL | This chapter describes the details of the fully closed control. |
| Chapter 11 | ANALOG FEEDBACK CONTROL FUNCTIONS | This chapter describes the details of the analog feedback control functions. |
| Chapter 12 | SV2 SERIES SETTING SOFTWARE | This chapter describes SV2 series setting software. |
| | APPENDIX | This section describes the parameter list, control block diagram, list of alarm/warning messages, MECHATROLINK-III communication commands and motorless test. |

# Contens



## Chapter 1 BEFORE USING



## Chapter 2 CONFIGURATION & SPECIFICATIONS



## Chapter 3 INSTALLATION AND MAINTENANCE

## Chapter 4 SIGNALS AND WIRING



## Chapter 5 PARAMETER SETTINGS

## Chapter 6 CONFIGURATION AND OPERATION OF MECHATROLINK-III



## Chapter 7 TUNING

## Chapter 8 SAFETY FUNCTION

## Chapter 9 ABSOLUTE POSITION SYSTEM



## Chapter 10 FULLY CLOSED CONTROL



## Chapter 11 ANALOG FEEDBACK CONTROL FUNCTIONS

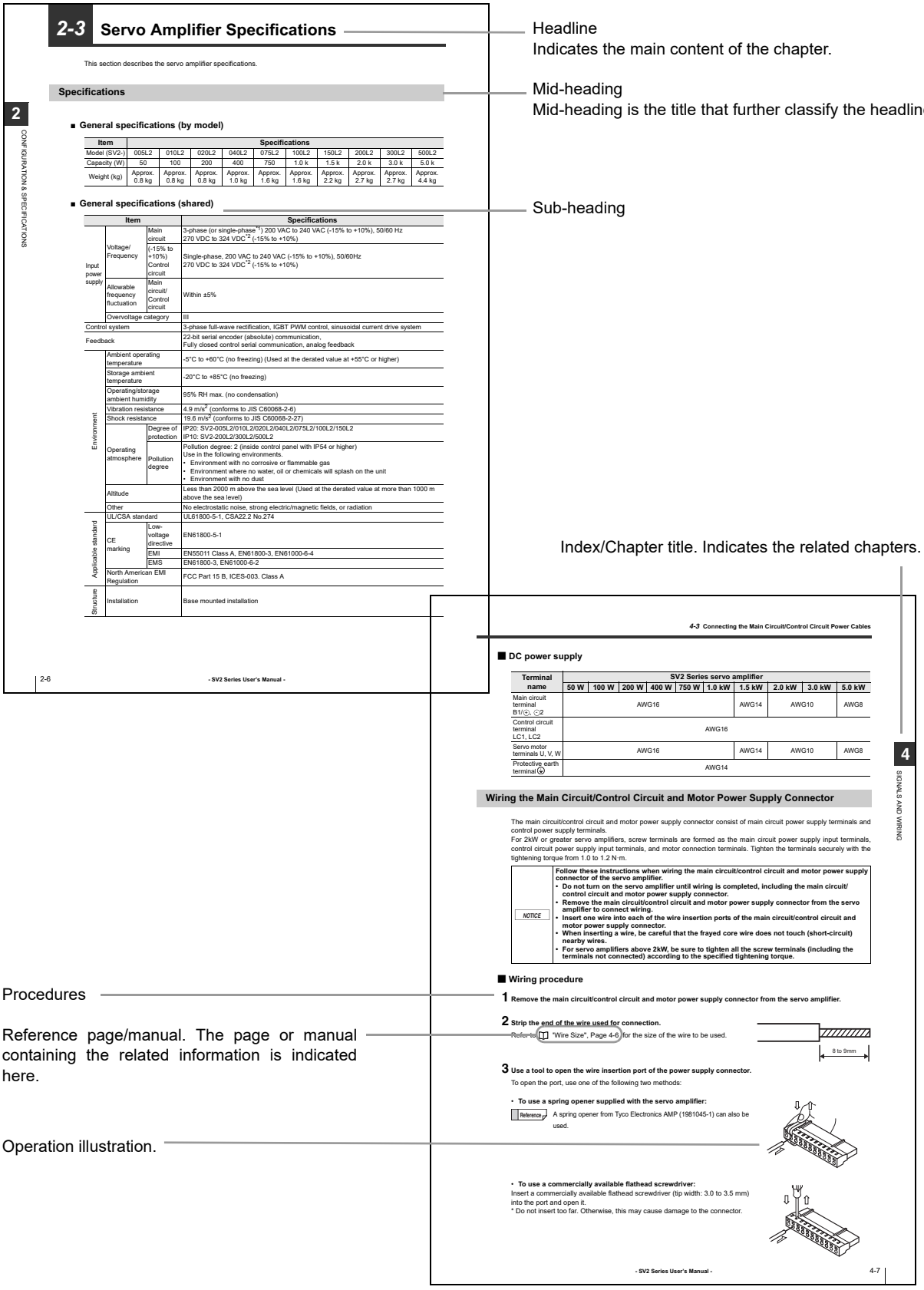
## Chapter 12 SV2 SERIES SETTING SOFTWARE

## Chapter A APPENDIX

# Conventions Used in This Manual

The following shows how pages are configured, and the symbols and terminology used in this Manual.

## Page Configuration and Symbols



2-3 Servo Amplifier Specifications

This section describes the servo amplifier specifications.

Specifications

■ General specifications (by model)

| Item | Specifications | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Model (SV2-) | 005L2 | 010L2 | 020L2 | 040L2 | 075L2 | 100L2 | 150L2 | 200L2 | 300L2 | 500L2 |
| Capacity (W) | 50 | 100 | 200 | 400 | 750 | 1.0 k | 1.5 k | 2.0 k | 3.0 k | 5.0 k |
| Weight (kg) | Approx. 0.8 kg | Approx. 0.8 kg | Approx. 0.8 kg | Approx. 1.0 kg | Approx. 1.6 kg | Approx. 1.6 kg | Approx. 2.2 kg | Approx. 2.7 kg | Approx. 2.7 kg | Approx. 4.4 kg |

■ General specifications (shared)

| Item | | | Specifications |
|---|---|---|---|
| Input power supply | Voltage/ Frequency | Main circuit (-15% to +10%) | 3-phase (or single-phase*1) 200 VAC to 240 VAC (-15% to +10%), 50/60 Hz<br>270 VDC to 324 VDC*2 (-15% to +10%) |
| | | Control circuit | Single-phase, 200 VAC to 240 VAC (-15% to +10%), 50/60Hz<br>270 VDC to 324 VDC*2 (-15% to +10%) |
| | Allowable frequency fluctuation | Main circuit/ Control circuit | Within ±5% |
| | Overvoltage category | | III |
| Control system | | | 3-phase full-wave rectification, IGBT PWM control, sinusoidal current drive system |
| Feedback | | | 22-bit serial encoder (absolute) communication,<br>Fully closed control serial communication, analog feedback |
| Environment | Ambient operating temperature | | -5°C to +60°C (no freezing) (Used at the derated value at +55°C or higher) |
| | Storage ambient temperature | | -20°C to +85°C (no freezing) |
| | Operating/storage ambient humidity | | 95% RH max. (no condensation) |
| | Vibration resistance | | 4.9 m/s² (conforms to JIS C60068-2-6) |
| | Shock resistance | | 19.6 m/s² (conforms to JIS C60068-2-27) |
| | Operating atmosphere | Degree of protection | IP20: SV2-005L2/010L2/020L2/040L2/075L2/100L2/150L2<br>IP10: SV2-200L2/300L2/500L2 |
| | | Pollution degree | Pollution degree: 2 (inside control panel with IP54 or higher)<br>Use in the following environments.<br>• Environment with no corrosive or flammable gas<br>• Environment where no water, oil or chemicals will splash on the unit<br>• Environment with no dust |
| | Altitude | | Less than 2000 m above the sea level (Used at the derated value at more than 1000 m above the sea level) |
| | Other | | No electrostatic noise, strong electric/magnetic fields, or radiation |
| Applicable standard | UL/CSA standard | | UL61800-5-1, CSA22.2 No.274 |
| | CE marking | Low-voltage directive | EN61800-5-1 |
| | | EMI | EN55011 Class A, EN61800-3, EN61000-6-4 |
| | | EMS | EN61800-3, EN61000-6-2 |
| | North American EMI Regulation | | FCC Part 15 B, ICES-003. Class A |
| Structure | Installation | | Base mounted installation |

2-6 - SV2 Series User's Manual -

2 CONFIGURATION & SPECIFICATIONS

Headline
Indicates the main content of the chapter.

Mid-heading
Mid-heading is the title that further classify the headline.

Sub-heading

Index/Chapter title. Indicates the related chapters.

4-3 Connecting the Main Circuit/Control Circuit Power Cables

■ DC power supply

| Terminal name | SV2 Series servo amplifier | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 50 W | 100 W | 200 W | 400 W | 750 W | 1.0 kW | 1.5 kW | 2.0 kW | 3.0 kW | 5.0 kW |
| Main circuit terminal B1/⊕, ⊖2 | AWG16 | | | | | | AWG14 | AWG10 | | AWG8 |
| Control circuit terminal LC1, LC2 | AWG16 | | | | | | | | | |
| Servo motor terminals U, V, W | AWG16 | | | | | | AWG14 | AWG10 | | AWG8 |
| Protective earth terminal ⏚ | AWG14 | | | | | | | | | |

Wiring the Main Circuit/Control Circuit and Motor Power Supply Connector

The main circuit/control circuit and motor power supply connector consist of main circuit power supply terminals and control power supply terminals.
For 2kW or greater servo amplifiers, screw terminals are formed as the main circuit power supply input terminals, control circuit power supply input terminals, and motor connection terminals. Tighten the terminals securely with the tightening torque from 1.0 to 1.2 N·m.

NOTICE

**Follow these instructions when wiring the main circuit/control circuit and motor power supply connector of the servo amplifier.**
- **Do not turn on the servo amplifier until wiring is completed, including the main circuit/ control circuit and motor power supply connector.**
- **Remove the main circuit/control circuit and motor power supply connector from the servo amplifier to connect wiring.**
- **Insert one wire into each of the wire insertion ports of the main circuit/control circuit and motor power supply connector.**
- **When inserting a wire, be careful that the frayed core wire does not touch (short-circuit) nearby wires.**
- **For servo amplifiers above 2kW, be sure to tighten all the screw terminals (including the terminals not connected) according to the specified tightening torque.**

■ Wiring procedure

**1 Remove the main circuit/control circuit and motor power supply connector from the servo amplifier.**

**2 Strip the end of the wire used for connection.**
Refer to "Wire Size", Page 4-6 for the size of the wire to be used.

8 to 9mm

**3 Use a tool to open the wire insertion port of the power supply connector.**
To open the port, use one of the following two methods:

- **To use a spring opener supplied with the servo amplifier:**
Reference A spring opener from Tyco Electronics AMP (1981045-1) can also be used.

- **To use a commercially available flathead screwdriver:**
Insert a commercially available flathead screwdriver (tip width: 3.0 to 3.5 mm) into the port and open it.
* Do not insert too far. Otherwise, this may cause damage to the connector.

- SV2 Series User's Manual - 4-7

4 SIGNALS AND WIRING

Procedures

Reference page/manual. The page or manual containing the related information is indicated here.

Operation illustration.

## Terminology

This manual uses the following terminology excluding some instances.

| Terminology | Explanation |
|---|---|
| Servo amplifier | Collectively referred to as SV2 series SV2-□□□L2. |
| Servo motor | SV2 series is the overall system of SV2-M□□□□□ (standard motor) and SV2-B□□□□□ (electromagnetic brake motor). |
| PLC | This refers to the overall system of programmable logic controller mounted in basic unit or CPU unit. |
| Host equipment | This refers to PLC and other controllers which send operation commands to the servo amplifier. |
| KV-XH16ML/XH04ML | Referred to as the MECHATROLINK-III compatible positioning/motion unit that can be connected to our own programmable controller KV-7000 series. |
| MECHATROLINK-III | This refers to a type of motion LAN, which allows to build the motion control network with servo motor inverter, step motor or I/Os. It is omitted to "ML-III" in the tables in this Manual. |
| CCW | This refers to counterclockwise rotation from the output axis end of the servo motor. |
| CW | This refers to clockwise rotation from the output axis end of the servo motor. |
| ABS | Short for absolute encoder. |
| Servo lock | This refers to the motor stop status when building position loop with position command 0. |
| Electromagnetic brake | This refers to the brake equipped on servo motor to perform hold function when powering OFF. |
| Dynamic brake stop (DB stop) | This refers to the stop method which make power terminal short-circuit of servo motor to achieve emergency stop. |
| Free-run stop | This refers to the stop method of natural stop via frictional resistance during the motor rotation without applying braking force to the servo motor. |
| Regenerative energy (Regenerative power) | This refers to the rotation energy fed back to servo amplifier load (including servo motor). |
| Load moment of inertia | This refers to degree of rotation difficulty or degree of stop difficulty of the object. The larger the load moment of inertia is, the larger the torque required by the object to begin rotation, additionally, larger regenerative power will be generated at stop. |
| Tuning | This refers to the characteristic to coordinate with the mechanical system, so response characteristic of the servo amplifier may be optimized. |
| Gain | This refers to parameter position control gain or speed control gain etc for adjustment of follow-up relative to the commands. |
| Auto tuning | This refers to a method of executing auto tuning. |
| Manual tuning | This refers to a method of executing manual tuning. SV2 series equipment are equipped Gain search PRO (w/o higher-level command), Gain search PRO (w/ higher-level command), Gain tuning PRO and other functions. |

**MEMO**

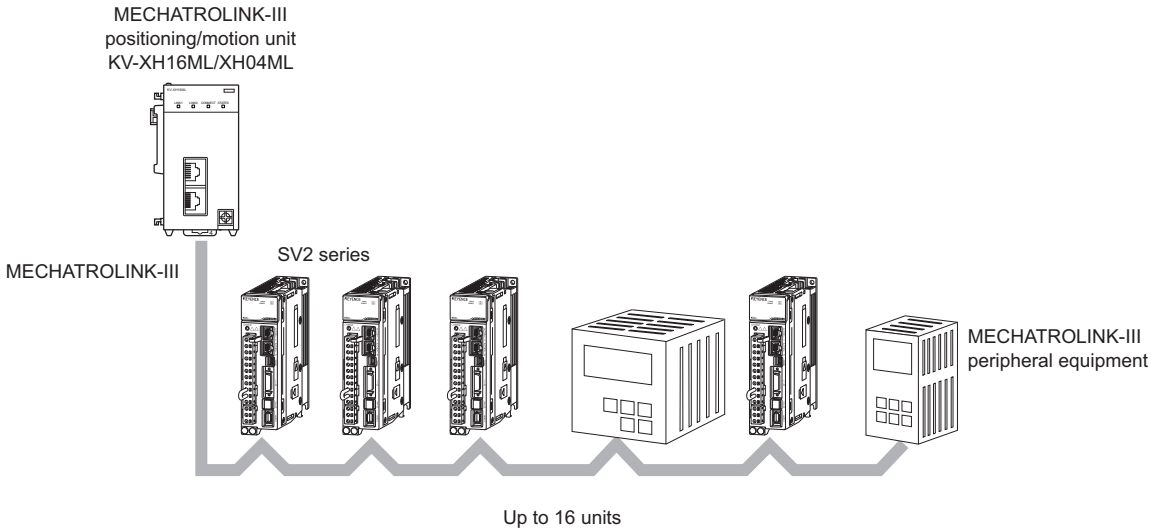
# 1

# BEFORE USING

This chapter describes the models and system configuration of SV2 series.

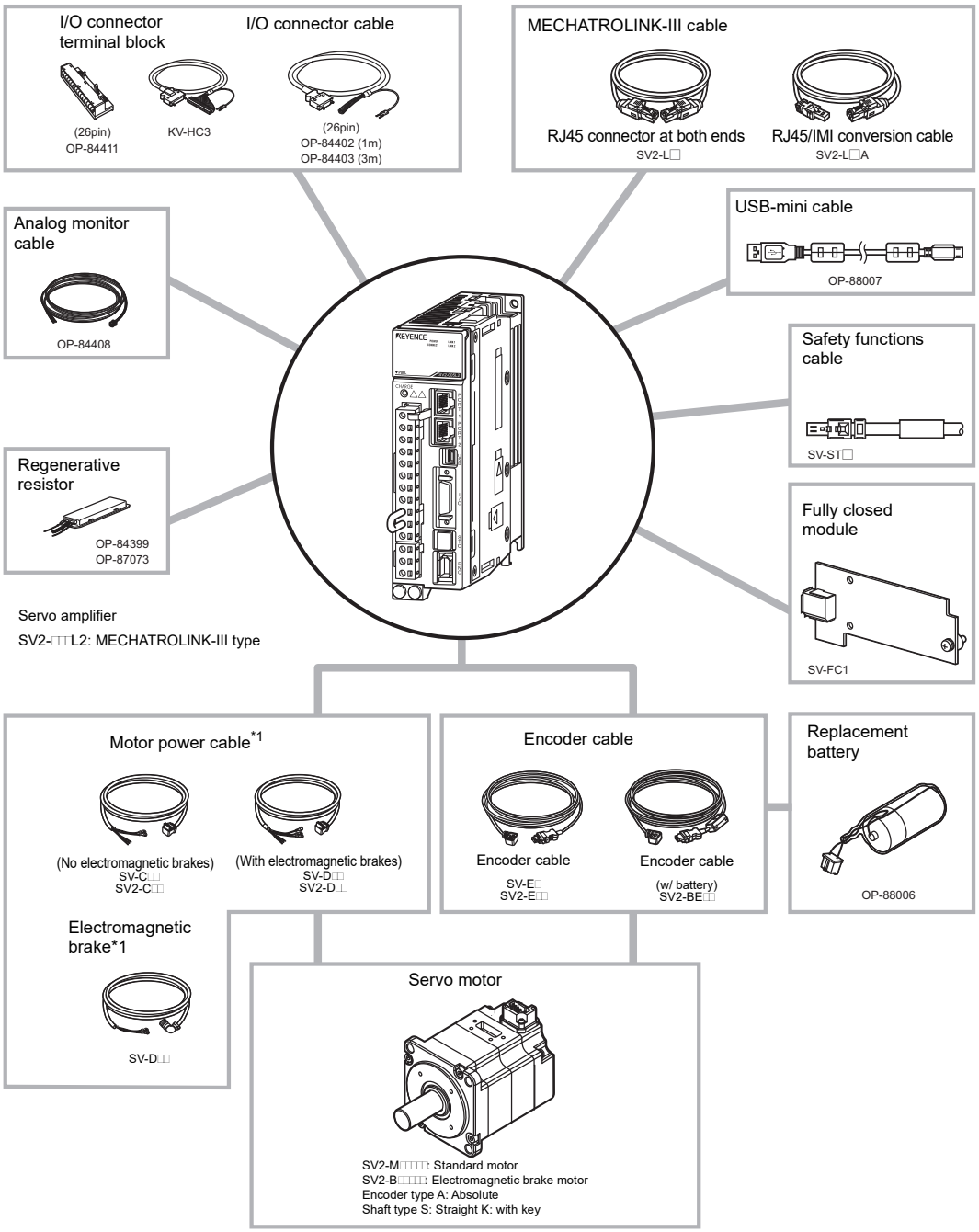
## About SV2 Series

SV2 series is comprised of a servo amplifier and a servo motor and is an AC servo system allowing a servo amplifier to be connected with its own dedicated cable alone by using MECHATROLINK-III, a motion field network.
For example, the following configuration can be considered to perform MECHATROLINK-III communication based control by combining with the KV-7000 series positioning/motion unit KV-XH16ML/XH04ML.



## Peripheral Equipment Configuration

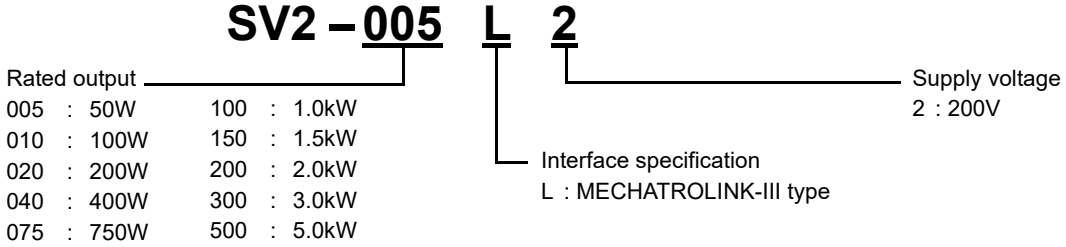
The configuration of the SV2 series AC servo system and peripheral equipment is shown as follows.




*1 When using SV2-100L2/150L2/200L2/300L2/500L2, the motor power cable, electromagnetic brake power cable are supplied to each model.

## Model Series of Servo Amplifier

Models of servo amplifier are shown as follows.



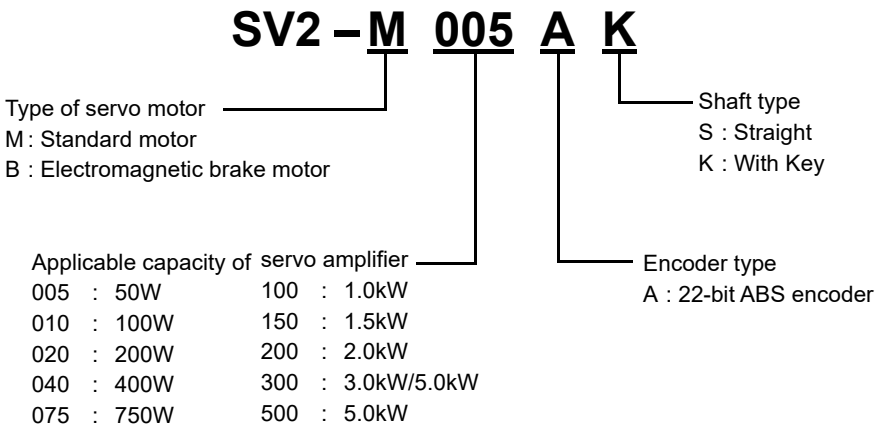

| Supply voltage | Rated output | Model of servo amplifier | Supported servo motor |
|---|---|---|---|
| 200V | 50W | SV2-005L2 | SV2-□005A□ |
| | 100W | SV2-010L2 | SV2-□010A□ |
| | 200W | SV2-020L2 | SV2-□020A□ |
| | 400W | SV2-040L2 | SV2-□040A□ |
| | 750W | SV2-075L2 | SV2-□075A□ |
| | 1.0kW | SV2-100L2 | SV2-□100A□ |
| | 1.5kW | SV2-150L2 | SV2-□150A□ |
| | 2.0kW | SV2-200L2 | SV2-□200A□ |
| | 3.0kW | SV2-300L2 | SV2-□300A□ *1 |
| | 5.0kW | SV2-500L2 | SV2-□300A□ *1<br>SV2-□500A□ |

*1 Rated values depend on connected servo amplifier. "2-3 Servo Amplifier Specifications", Page 2-6.

| NOTICE | **Do not use with a combination other than the above mentioned one.** |
|---|---|

## Model Series of Servo Motor

Servo motor models vary depending on the rated output, whether electromagnetic braking is provided, and the shaft shape.
Models of servo motor are shown as follows.




| Model | | | Model/Applicable capacity of servo amplifier | | | | |
|---|---|---|---|---|---|---|---|
| **Motor type** | **Axis type** | **Encoder** | **50W** | **100W** | **200W** | **400W** | **750W** |
| Standard motor | Straight | ABS | SV2-M005AS | SV2-M010AS | SV2-M020AS | SV2-M040AS | SV2-M075AS |
| | With key | ABS | SV2-M005AK | SV2-M010AK | SV2-M020AK | SV2-M040AK | SV2-M075AK |
| Electromagnetic brake motor | Straight | ABS | SV2-B005AS | SV2-B010AS | SV2-B020AS | SV2-B040AS | SV2-B075AS |
| | With key | ABS | SV2-B005AK | SV2-B010AK | SV2-B020AK | SV2-B040AK | SV2-B075AK |

| Model | | | Model/Applicable capacity of servo amplifier | | | | |
|---|---|---|---|---|---|---|---|
| **Motor type** | **Axis type** | **Encoder** | **1.0kW** | **1.5kW** | **2.0kW** | **3.0kW** | **5.0kW** |
| Standard motor | Straight | ABS | SV2-M100AS | SV2-M150AS | SV2-M200AS | SV2-M300AS*1 | SV2-M500AS<br>SV2-M300AS*1 |
| | With key | ABS | SV2-M100AK | SV2-M150AK | SV2-M200AK | SV2-M300AK*1 | SV2-M500AK<br>SV2-M300AK*1 |
| Electromagnetic brake motor | Straight | ABS | SV2-B100AS | SV2-B150AS | SV2-B200AS | SV2-B300AS*1 | SV2-B500AS<br>SV2-B300AS*1 |
| | With key | ABS | SV2-B100AK | SV2-B150AK | SV2-B200AK | SV2-B300AK*1 | SV2-B500AS<br>SV2-B300AS*1 |

*1 Rated values depend on connected servo amplifier. "2-3 Servo Amplifier Specifications", Page 2-6.

## Option List

Option configuration of SV2 series are as follows.

| Category | Designation | | Model | Notes |
|---|---|---|---|---|
| Cable | Encoder cable (For 50W to 750W) | Standard cable | SV2-E3 | Cable length 3m |
| | | | SV2-E5 | Cable length 5m |
| | | | SV2-E10 | Cable length 10m |
| | | | SV2-E20 | Cable length 20m |
| | | Flexible cable | SV2-E3G | Cable length 3m |
| | | | SV2-E5G | Cable length 5m |
| | | | SV2-E10G | Cable length 10m |
| | | | SV2-E20G | Cable length 20m |
| | | Standard cable equipped with battery | SV2-BE3 | Cable length 3m |
| | | | SV2-BE5 | Cable length 5m |
| | | | SV2-BE10 | Cable length 10m |
| | | | SV2-BE20 | Cable length 20m |
| | | Flexible cable equipped with battery | SV2-BE3G | Cable length 3m |
| | | | SV2-BE5G | Cable length 5m |
| | | | SV2-BE10G | Cable length 10m |
| | | | SV2-BE20G | Cable length 20m |
| | Encoder cable (For 1kW to 5kW) | Standard cable | SV-E3A | Cable length 3m |
| | | | SV-E5A | Cable length 5m |
| | | | SV-E10A | Cable length 10m |
| | | | SV-E20A | Cable length 20m |
| | | Standard cable equipped with battery | SV2-BE3A | Cable length 3m |
| | | | SV2-BE5A | Cable length 5m |
| | | | SV2-BE10A | Cable length 10m |
| | | | SV2-BE20A | Cable length 20m |
| | Motor power cable (For 50W/100W) | Standard cable | SV2-C3A | Cable length 3m |
| | | | SV2-C5A | Cable length 5m |
| | | | SV2-C10A | Cable length 10m |
| | | | SV2-C20A | Cable length 20m |
| | | Flexible cable | SV2-C3AG | Cable length 3m |
| | | | SV2-C5AG | Cable length 5m |
| | | | SV2-C10AG | Cable length 10m |
| | | | SV2-C20AG | Cable length 20m |
| | | Standard cable with electromagnetic brake | SV2-D3A | Cable length 3m |
| | | | SV2-D5A | Cable length 5m |
| | | | SV2-D10A | Cable length 10m |
| | | | SV2-D20A | Cable length 20m |
| | | Flexible cable with electromagnetic brake | SV2-D3AG | Cable length 3m |
| | | | SV2-D5AG | Cable length 5m |
| | | | SV2-D10AG | Cable length 10m |
| | | | SV2-D20AG | Cable length 20m |
| | Motor power cable (For 200W/400W) | Standard cable | SV2-C3B | Cable length 3m |
| | | | SV2-C5B | Cable length 5m |
| | | | SV2-C10B | Cable length 10m |
| | | | SV2-C20B | Cable length 20m |
| | | Flexible cable | SV2-C3BG | Cable length 3m |
| | | | SV2-C5BG | Cable length 5m |
| | | | SV2-C10BG | Cable length 10m |
| | | | SV2-C20BG | Cable length 20m |
| | | Standard cable with electromagnetic brake | SV2-D3B | Cable length 3m |
| | | | SV2-D5B | Cable length 5m |
| | | | SV2-D10B | Cable length 10m |
| | | | SV2-D20B | Cable length 20m |
| | | Flexible cable with electromagnetic brake | SV2-D3BG | Cable length 3m |
| | | | SV2-D5BG | Cable length 5m |
| | | | SV2-D10BG | Cable length 10m |
| | | | SV2-D20BG | Cable length 20m |

| Category | Designation | | Model | Notes |
|---|---|---|---|---|
| Cable | Motor power cable (For 750W) | Standard cable | SV2-C3C | Cable length 3m |
| | | | SV2-C5C | Cable length 5m |
| | | | SV2-C10C | Cable length 10m |
| | | | SV2-C20C | Cable length 20m |
| | | Flexible cable | SV2-C3CG | Cable length 3m |
| | | | SV2-C5CG | Cable length 5m |
| | | | SV2-C10CG | Cable length 10m |
| | | | SV2-C20CG | Cable length 20m |
| | | Standard cable with electromagnetic brake | SV2-D3C | Cable length 3m |
| | | | SV2-D5C | Cable length 5m |
| | | | SV2-D10C | Cable length 10m |
| | | | SV2-D20C | Cable length 20m |
| | | Flexible cable with electromagnetic brake | SV2-D3CG | Cable length 3m |
| | | | SV2-D5CG | Cable length 5m |
| | | | SV2-D10CG | Cable length 10m |
| | | | SV2-D20CG | Cable length 20m |
| | Motor power cable (For 1kW/1.5kW) | Standard cable | SV-C3D | Cable length 3m |
| | | | SV-C5D | Cable length 5m |
| | | | SV-C10D | Cable length 10m |
| | | | SV-C20D | Cable length 20m |
| | Motor power cable (For 2kW) | Standard cable | SV-C3E | Cable length 3m |
| | | | SV-C5E | Cable length 5m |
| | | | SV-C10E | Cable length 10m |
| | | | SV-C20E | Cable length 20m |
| | Motor power cable (For 3kW/5kW) | Standard cable | SV-C3F | Cable length 3m |
| | | | SV-C5F | Cable length 5m |
| | | | SV-C10F | Cable length 10m |
| | | | SV-C20F | Cable length 20m |
| | Electromagnetic brake power cable (For 1kW to 5kW) | Standard cable | SV-D3D | Cable length 3m |
| | | | SV-D5D | Cable length 5m |
| | | | SV-D10D | Cable length 10m |
| | | | SV-D20D | Cable length 20m |
| MECHATROLINK-III | MECHATROLINK-III cable | RJ45 connector - RJ45 connector | SV2-LA2 | Cable length 0.2m |
| | | | SV2-LA5 | Cable length 0.5m |
| | | | SV2-L1 | Cable length 1m |
| | | | SV2-L3 | Cable length 3m |
| | | | SV2-L5 | Cable length 5m |
| | | | SV2-L10 | Cable length 10m |
| | | | SV2-L20 | Cable length 20m |
| | | RJ45 connector - IMI connector | SV2-LA5A | Cable length 0.5m |
| | | | SV2-L1A | Cable length 1m |
| | | | SV2-L3A | Cable length 3m |
| | | | SV2-L5A | Cable length 5m |
| | | | SV2-L10A | Cable length 10m |
| | | | SV2-L20A | Cable length 20m |
| Components for I/O connection of servo amplifier | I/O connector cable | 26 pin | OP-84402 | Cable length 1m, single-end barbed wire |
| | | | OP-84403 | Cable length 3m, single-end barbed wire |
| | Terminal block cable for I/O connector | 26 pin | KV-HC3 | Cable length 1m |
| | I/O connector | 26 pin | OP-84407 | |
| | Terminal block for I/O connector | 26 pin | OP-84411 | |
| | Safety function cable | | SV-ST1 | Cable length 1m |
| | | | SV-ST3 | Cable length 3m |
| | Linear encoder connection cable | | SV-LN1 | *2 |
| | Fully closed module | | SV-FC1 | |

| Category | Designation | | Model | Notes |
|---|---|---|---|---|
| Other servo amplifiers | Regenerative resistor | | OP-84399 | Support 50Ω, 50W to 1kW |
| | | | OP-87073 | Support 20Ω, 1.5kW*1 |
| | Analog monitor cable | | OP-84408 | Cable length 1m |
| | Lithium battery option | | OP-88006 | |
| | Connector set for encoder /motor power supply | For 50W/100W | SV-CN1 | |
| | | For 200W/400W | SV-CN2 | |
| | | For 750W | SV-CN3 | |
| | Connector set for encoder | For 1kW to 5kW | OP-87066 | Angle connector |
| | | | OP-87065 | Straight connector |
| | Connector set for motor power supply | For 1kW to 2kW | OP-87064 | Angle connector |
| | | | OP-87063 | Straight connector |
| | | For 3kW/5kW | OP-87071 | Angle connector |
| | | | OP-87070 | Straight connector |
| | Connector set for electromagnetic brake | For 1kW to 5kW | OP-87068 | Angle connector |
| | | | OP-87067 | Straight connector |
| | Terminal kit | For 2kW/3kW | SV-T1 | Attached with SV2-200L2/ 300L2 |
| | USB-mini cable | | OP-88007 | Cable length 2m |

*1 2kW to 5kW can also be used depending on operational conditions. "5-4 Regenerative Resistor Setting", Page 5-20.

*2 Can be connected with the Mitsutoyo linear encoder.

# 2

# CONFIGURATION & SPECIFICATIONS

This chapter describes package contents, part names, functions and specifications of SV2 series.

# 2-1 Check the Package Contents

Take out servo amplifier and servo motor from the packing box, and verify that the following accessories are enclosed. Please check the models and combination of the servo amplifier and motor.

"1-2 SV2 Series Model", Page 1-4

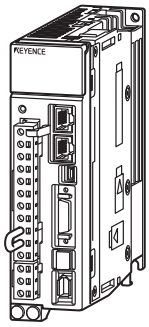


## Packages Attached with the Product

The following accessories should be supplied together with the product. Please check if the accessories are complete.

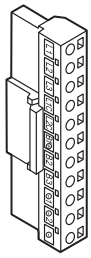
### ■ Servo amplifier

#### ● Packages attached with the product

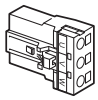


□Main unit


□User's Manual
□Warning labels



□Main circuit/control circuit power supply connector



□Motor power supply connector

□Connector wiring lever

□Cover for the full-closed module connector

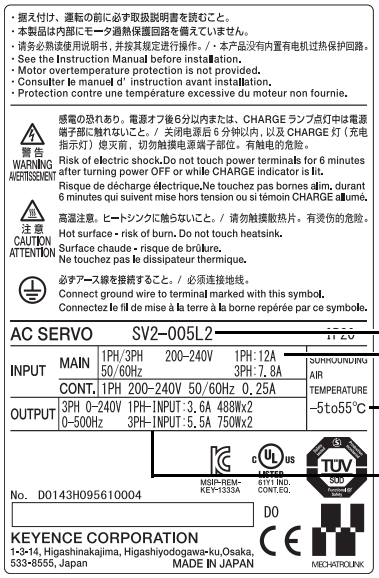
□Safety jumper connector

*Incorporated into the servo amplifier body when shipped

**Point**

- **The 2 kW and 3 kW servo amplifiers (SV2-200L2/300L2) include a terminal kit for the terminal block.**
- **Servo amplifiers over 2 kW (SV2-200L2/300L2/500L2) use screw terminals, so connectors and levers are not supplied.**

#### ● Nameplate

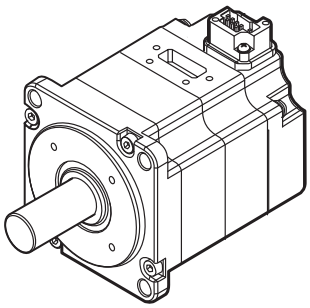


## ■ Servo motor

### ● Packages attached with the product

- 50W to 750W

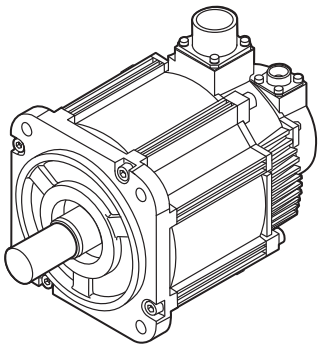
☐ Motor



☐ User's Manual


- 1kW to 5kW

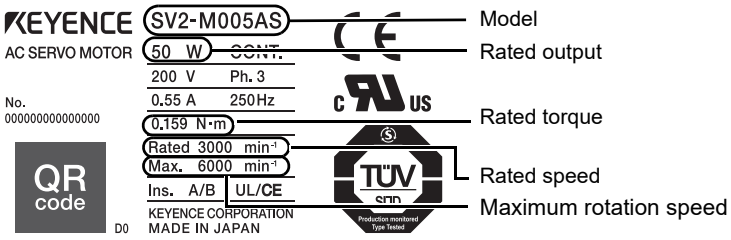
☐ Motor



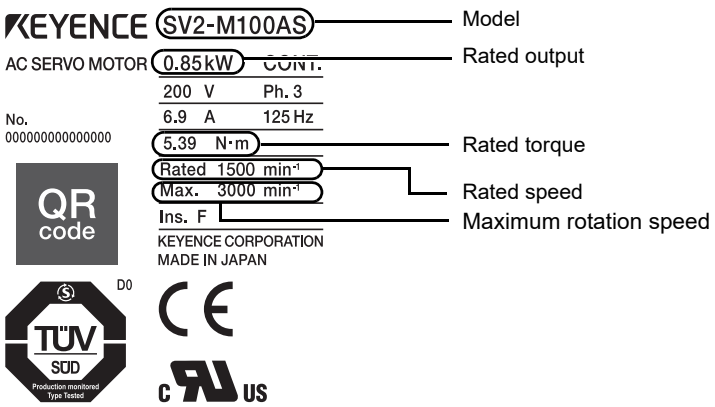
☐ User's Manual


### ● Nameplate

- 50W to 750W



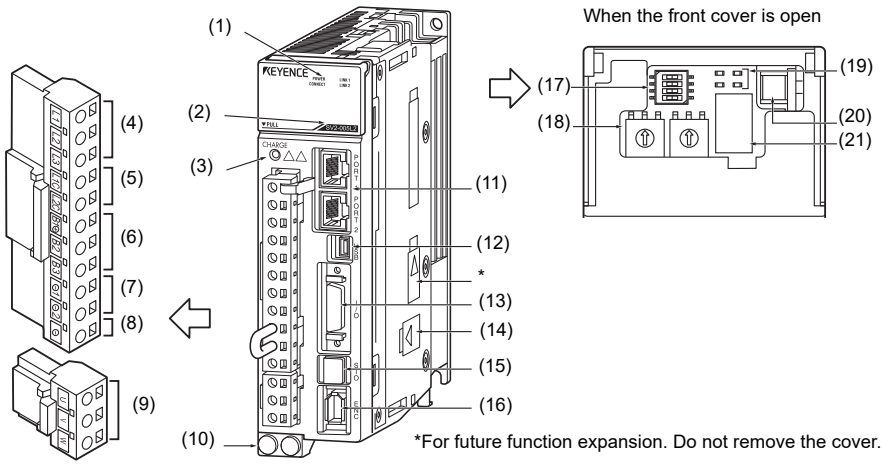

- 1kW to 5kW



# 2-2 Names and Functions of Parts

This section describes names and functions of each part of the SV2 series.

## Part Names and Functions of the Servo Amplifier

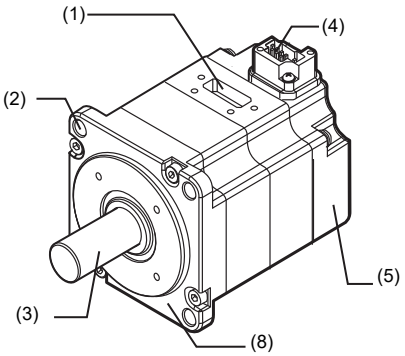



| No. | Name | | Function |
|---|---|---|---|
| (1) | Front cover | | - |
| (2) | Model | | Indicates the servo amplifier model. |
| (3) | CHARGE | | Lights when the main circuit power supply is ON.<br>Caution: Even if the main circuit power supply is OFF, if there is any electrical charge remaining in the internal servo amplifier condenser it will stay lit. When lit, do not touch the main circuit or motor terminal. Otherwise, this may cause electric shock. |
| (4) | Main circuit terminal (L1, L2, L3) | | Used to connect the main circuit power supply. |
| (5) | Control circuit terminal (L1C, L2C) | | Used to connect the control circuit power supply. |
| (6) | Regenerative resistor connection terminal (B1/⊕, B2, B3) | | Used to connect the external regenerative resistor.<br>*Terminal B1/⊕ is used as the main circuit power supply terminal when using a DC power supply.<br>* B2 and B3 are shorted on the 750 W to 5 kW models. (There is an internal regenerative resistor) |
| (7) | DC reactor (⊖1, ⊖2) | | Used to connect the DC reactor.<br>* ⊖2 is used as the main circuit power supply terminal when using a DC power supply. |
| (8) | ⊖ | | Do not wire this terminal. |
| (9) | Servo motor terminal (U, V, W) | | Used to connect the motor power cable (power line). |
| (10) | Protective earth terminal | | Earth terminal to prevent electric shocks. Be sure to connect the earth cable. |
| (11) | MECHATROLINK-III communication connector | | Used to connect to apparatus compatible with MECHATROLINK-III. |
| (12) | USB connector | | Connect to the computer. |
| (13) | I/O connector | | Used to connect to sequence I/O signals. |
| (14) | Fully closed module connector | | Used to connect full-closed modules. |
| (15) | STO I/O signal safety connector | | Used to connect safety devices. |
| (16) | Encoder connector | | Used to connect to the encoder in the servo motor. |
| (17) | DIP switches | | Used for MECHATROLINK communication No. of bytes settings. |
| (18) | Rotary switches | | For setting up the MECHATROLINK station address |
| (19) | Status LED indicator | POWER | Lights when the control power source is ON. |
| | | CONNECT | Lights when a CONNECT command is successfully received. |
| | | LINK1, LINK2 | Lights when communicating with MECHATROLINK. |
| (20) | Analog monitor connector | | Connecting the analog monitor with a special cable (peripheral) allows the motor rotation speed or torque command value to be monitored as analog output voltage. |
| (21) | Panel display section | | A seven-segment LED displays the servo status.<br>"A-4 How to Check the Panel Display", Page A-24 |

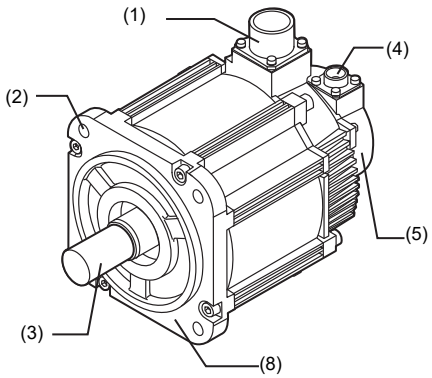
## Name and Function of Each Part of the Servo Motor

### ■ Standard motor

• 50W to 750W

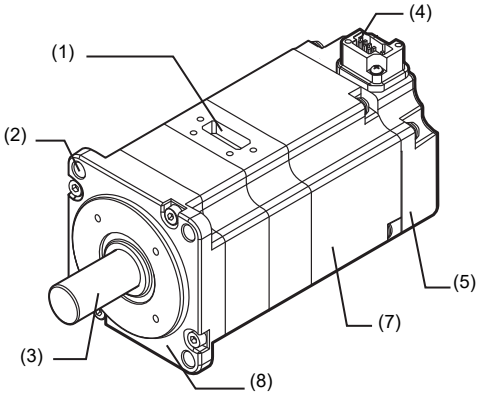



• 1kW to 5kW

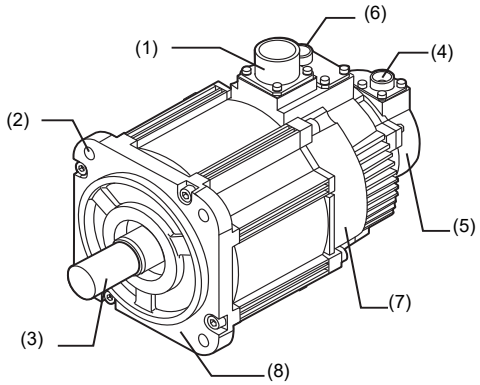



### ■ Electromagnetic brake motor

• 50W to 750W




• 1kW to 5kW




| No. | Name | Function |
|---|---|---|
| (1) | Connector for motor power cable*1 | To connect motor power cables. Protective sealing strips (covers for 1kW to 5kW servo motors) are attached at ex-factory. |
| (2) | Mounting hole | To mount the servo motor. (2 holes for 50W and 100W servo motors, 4 holes for 200W to 5kW servo motors) |
| (3) | Output shaft | Rotating axis of the servo motor. Including straight shaft and shaft with key. |
| (4) | Encoder cable connector | To connect encoder cables. Attached with a cover at ex-factory. |
| (5) | Encoder | Built-in encoder. |
| (6) | Electromagnetic brake cable connector*1 | To connect electromagnetic brake cables. Attached with a cover at ex-factory. |
| (7) | Electromagnetic brake | Built-in electromagnetic brake. |
| (8) | Flange | The surface on the machine for mounting a servo motor. |

*1 For 50W to 750W electromagnetic brake motors, the electromagnetic brake cable connector and the motor power cable connector are integrated.

# 2-3 Servo Amplifier Specifications

This section describes the servo amplifier specifications.

## Specifications



### ■ General specifications (by model)

| Item | Specifications | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Model (SV2-) | 005L2 | 010L2 | 020L2 | 040L2 | 075L2 | 100L2 | 150L2 | 200L2 | 300L2 | 500L2 |
| Capacity (W) | 50 | 100 | 200 | 400 | 750 | 1.0 k | 1.5 k | 2.0 k | 3.0 k | 5.0 k |
| Weight (kg) | Approx. 0.8 kg | Approx. 0.8 kg | Approx. 0.8 kg | Approx. 1.0 kg | Approx. 1.6 kg | Approx. 1.6 kg | Approx. 2.2 kg | Approx. 2.7 kg | Approx. 2.7 kg | Approx. 4.4 kg |

### ■ General specifications (shared)

| Item | | | Specifications |
|---|---|---|---|
| Input power supply | Voltage/ Frequency | Main circuit | 3-phase (or single-phase[*1]) 200 VAC to 240 VAC (-15% to +10%), 50/60 Hz<br>270 VDC to 324 VDC[*2] (-15% to +10%) |
| | | (-15% to +10%) Control circuit | Single-phase, 200 VAC to 240 VAC (-15% to +10%), 50/60Hz<br>270 VDC to 324 VDC[*2] (-15% to +10%) |
| | Allowable frequency fluctuation | Main circuit/ Control circuit | Within ±5% |
| | Overvoltage category | | III |
| Control system | | | 3-phase full-wave rectification, IGBT PWM control, sinusoidal current drive system |
| Feedback | | | 22-bit serial encoder (absolute) communication,<br>Fully closed control serial communication, analog feedback |
| Environment | Ambient operating temperature | | -5°C to +60°C (no freezing) (Used at the derated value at +55°C or higher) |
| | Storage ambient temperature | | -20°C to +85°C (no freezing) |
| | Operating/storage ambient humidity | | 95% RH max. (no condensation) |
| | Vibration resistance | | 4.9 $m/s^2$ (conforms to JIS C60068-2-6) |
| | Shock resistance | | 19.6 $m/s^2$ (conforms to JIS C60068-2-27) |
| | Operating atmosphere | Degree of protection | IP20: SV2-005L2/010L2/020L2/040L2/075L2/100L2/150L2<br>IP10: SV2-200L2/300L2/500L2 |
| | | Pollution degree | Pollution degree: 2 (inside control panel with IP54 or higher)<br>Use in the following environments.<br>• Environment with no corrosive or flammable gas<br>• Environment where no water, oil or chemicals will splash on the unit<br>• Environment with no dust |
| | Altitude | | Less than 2000 m above the sea level (Used at the derated value at more than 1000 m above the sea level) |
| | Other | | No electrostatic noise, strong electric/magnetic fields, or radiation |
| Applicable standard | UL/CSA standard | | UL61800-5-1, CSA22.2 No.274 |
| | CE marking | Low-voltage directive | EN61800-5-1, EN50178 |
| | | EMI | EN55011 Class A, EN61800-3, EN61000-6-4 |
| | | EMS | EN61800-3, EN61000-6-2 |
| | North American EMI Regulation | | FCC Part 15 B, ICES-003. Class A |
| Structure | Installation | | Base mounted installation |

| Item | | Specifications |
|---|---|---|
| Safety Functions | Safety functions | STO function (STO/EN61800-5-2) |
| | Safety parameters | SIL 3/EN61508, SIL CL 3/EN62061,<br>PL e (Category 3)/EN ISO13849-1:2015 |
| | Response time | 8ms (max.) |
| | Input | STO1 and STO2: Base block signals to the power module<br>Internal impedance: 4.7 kΩ<br>Voltage range at which operation is possible: +24 V ±20%<br>Maximum delay time: 8 ms<br>(Time until the motor current is shut off after STO1 and STO2 has been powered off) |
| | Output | EDM: Monitor the state of the built-in safety circuit (fixed output)<br>Maximum allowable voltage: 30 VDC<br>Maximum allowable current: 50 mA DC<br>Maximum voltage drop when powered on: 1.5V<br>Maximum delay time: 8 ms<br>(Time until EDM changes after STO1 and STO2 changed) |
| | Applicable standard | EN61800-5-2, EN ISO13849-1:2015, EN61508, EN62061, EN60204-1, EN61326-3-1 |
| Protective functions | | Overcurrent, overvoltage, low voltage, overload, regeneration error, etc. |
| Minimum insulation resistance | | 1 MΩ min. with 500 VDC insulation resistance tester |
| Insulation withstand voltage | | 1500 VAC min. (between primary side and ground)<br>3000 VAC min. (between primary and secondary side)<br>350 VAC: between secondary circuit and earth |

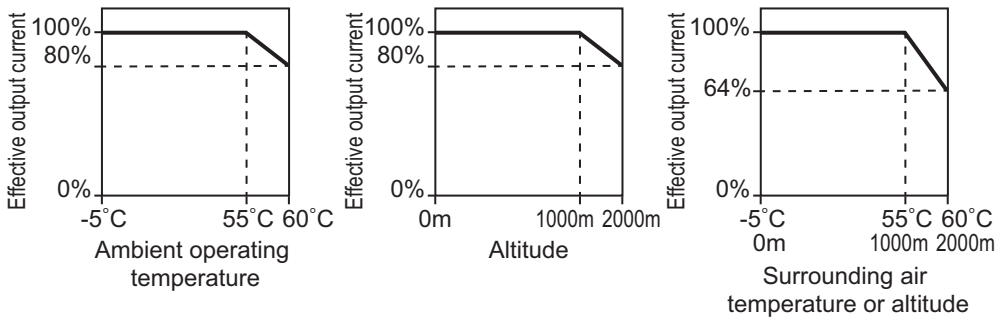
*1 Single-phase supplies can only used for SV2-005L2, SV2-010L2, SV2-020L2, SV2-040L2, and SV2-075L2.

*2 To use DC power source input, set "*AC/DC power source" to "DC".

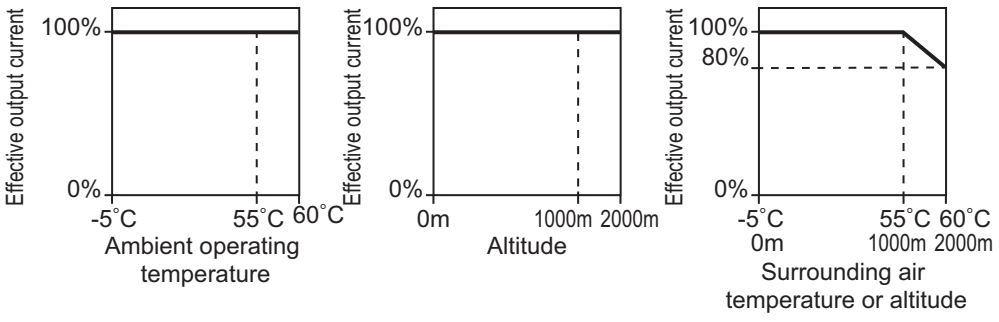
## ■ Derating specifications

When using a servo amplifier in an surrounding air temperature of 55°C to 60°C, or when using it at an altitude of 1000 m to 2000 m, refer to the derating ratios below.

- **SV2-005L2/010L2/020L2/040L2**




- **SV2-075L2/100L2/150L2/200L2/300L2/500L2**



## Power Supply/Current Capacity and Power Loss

| Main circuit power supply | Maximum applied motor capacity (W) | Model | Power supply capacity (VA) per unit | Output current (Arms) | | Main circuit power loss (W) | Built-in regen-erative resistor power loss (W) | Control circuit power loss (W) | Total power loss (W) | Input rated current | | Inrush current* | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Contin-uous | Maxi-mum | | | | | Main circuit (Arms) | Control circuit (Arms) | Main circuit (A) | Control circuit (A) |
| 3-phase 200 VAC | 50 | SV2-005L2 | 200 | 0.66 | 2.1 | 5.1 | - | 17 | 22.1 | 0.4 | 0.2 | 34 | 34 |
| | 100 | SV2-010L2 | 300 | 0.91 | 3.2 | 7.3 | | | 24.3 | 0.8 | | | |
| | 200 | SV2-020L2 | 500 | 1.6 | 5.9 | 13.5 | | | 30.5 | 1.3 | | | |
| | 400 | SV2-040L2 | 1000 | 2.8 | 9.3 | 24.0 | | | 41 | 2.5 | | | |
| | 750 | SV2-075L2 | 1600 | 5.5 | 16.9 | 43.8 | 8 | | 68.8 | 4.1 | | | |
| | 1.0 k | SV2-100L2 | 2300 | 7.6 | 17 | 53.6 | | | 78.6 | 5.7 | | | |
| | 1.5 k | SV2-150L2 | 3200 | 11.6 | 28 | 65.8 | 10 | 22 | 97.8 | 7.3 | | | |
| | 2.0 k | SV2-200L2 | 4000 | 18.5 | 42 | 111.9 | 16 | | 149.9 | 10 | 0.25 | | |
| | 3.0 k | SV2-300L2 | 5900 | 19.6 | 56 | 113.8 | | | 151.8 | 15 | | | |
| | 5.0 k | SV2-500L2 | 7500 | 32.9 | 84 | 263.7 | 36 | 27 | 326.7 | 25 | 0.3 | 68 | |
| Single-phase 200 VAC | 50 | SV2-005L2 | 200 | 0.66 | 2.1 | 5.1 | - | 17 | 22.1 | 0.8 | 0.2 | 34 | |
| | 100 | SV2-010L2 | 300 | 0.91 | 3.2 | 7.3 | | | 24.3 | 1.6 | | | |
| | 200 | SV2-020L2 | 600 | 1.6 | 5.9 | 13.5 | | | 30.5 | 2.4 | | | |
| | 400 | SV2-040L2 | 1200 | 2.8 | 9.3 | 24.0 | | | 41.0 | 5.0 | | | |
| | 750 | SV2-075L2 | 1900 | 5.5 | 16.9 | 43.8 | 8 | | 68.8 | 8.7 | | | |
| 270 VDC | 50 | SV2-005L2 | 200 | 0.66 | 2.1 | 4.4 | - | 12 | 16.4 | 0.5 | 0.2 | 34 | 34 |
| | 100 | SV2-010L2 | 300 | 0.91 | 3.2 | 5.9 | | | 17.9 | 1 | | | |
| | 200 | SV2-020L2 | 600 | 1.6 | 5.9 | 9.8 | | | 21.8 | 1.5 | | | |
| | 400 | SV2-040L2 | 1000 | 2.8 | 9.3 | 17.5 | | | 29.5 | 3 | | | |
| | 750 | SV2-075L2 | 1600 | 5.5 | 16.9 | 30.7 | | 14 | 44.7 | 4.9 | | | |
| | 1.0 k | SV2-100L2 | 2300 | 7.6 | 17 | 38.7 | | | 52.7 | 6.9 | | | |
| | 1.5 k | SV2-150L2 | 3200 | 11.6 | 28 | 55.8 | | 15 | 70.8 | 11 | | | |
| | 2.0 k | SV2-200L2 | 4000 | 18.5 | 42 | 82.7 | | 16 | 98.7 | 14 | 0.25 | | |
| | 3.0 k | SV2-300L2 | 5900 | 19.6 | 56 | 83.5 | | | 99.5 | 20 | | | |
| | 5.0 k | SV2-500L2 | 7500 | 32.9 | 84 | 146.2 | | 19 | 165.2 | 34 | 0.3 | 68 | |

* When used at the current capacity above, incoming current duration is 20 ms or less.

## Performance Specifications

| Item | | | Specifications |
|---|---|---|---|
| Performance | Speed control range | | 1:5000 (Under the condition when rated torque is greater than or equal to load torque) |
| | Speed fluctuation rate | When load fluctuates | ±0.01% max. with a load fluctuation from 0 to 100% (at rated rotation speed) |
| | | When main circuit voltage fluctuates | 0% with the rated voltage fluctuation of ±10% (at rated rotation speed) |
| | | When ambient temperature fluctuates | ±0.1% max. at an ambient temperature between 0 and +50°C (at rated rotation speed) |
| | Torque control accuracy (repeatability) | | ±1% |
| | Speed frequency response frequency | | 2.6kHz |
| Dynamic brake | | | Operates when main circuit power is off, during servo alarm, when servo is off,during limit switch detection (LSP/LSN), and during forced stop detection (FSTOP) |
| Regenerative resistor | | | Built-in regenerative resistor: 50W to 400W: N/A<br>750W to 5.0kW: Available<br>External regenerative resistor: OP-84399 (50W to 1.0kW), OP-87073 (1.5kW*1) |
| Display function | Panel function | | Seven-segment LED<br>Rotary switch × 2 (16CH)<br>Dip switch × 1 (4CH) |
| | Status LED indicator | | CHARGE : For checking main power supply input (orange)<br>POWER : For checking control circuit power supply input (green)<br>CONNECT : For checking connections (green)<br>LINK1 and LINK2 : For checking MECHATROLINK communication (green) |
| Auxiliary function | | | Gain control, alarm history, Z-phase search, etc. |

*1 It may be usable for 2 kW, 3 kW and 5kW servo amplifiers depending on the operating conditions.

## I/O Specifications

### ■ Sequence input signal

| Item | Circuit | Specifications | |
|---|---|---|---|
| | | High-speed input | General input |
| No. of inputs | | 3 inputs | 4 inputs |
| Maximum input voltage | | 28.8 VDC | |
| Input rated voltage | | 24 VDC | |
| Minimum ON voltage | | 19 VDC | |
| Maximum OFF current/voltage | | 0.6 mA | 0.3 mA |
| Common method | | 7 inputs/1 common (a single terminal) (bi-directional) | |
| Input time constant | | 250 µs, 500 µs, 1 ms, 2.5 ms, 5 ms, 10 ms<br>* When external latch signals 1 to 3 (EXT1, EXT2, EXT3) are assigned for function assignment, input time constants will be 0. | |
| Input current | | 4.5 mA | 3.7 mA |
| Input impedance | | Approx. 4.7 kΩ | |
| Assignable input signals | | Assignment and logical setting of all signals is possible.<br>Forced stop (FSTOP), External latch signal 1 to 3 (EXT1, EXT2, EXT3)<br>Origin return deceleration switch (DEC), forward limit switch (LSP), reversal limit switch (LSN), forward torque limit selection (PTL), reversal torque limit selection (NTL) | |

### ■ Sequence output signal

| Item | Specifications |
|---|---|
| No. of outputs | 4 inputs |
| Output form | Transistor NPN output |
| Rated load | 30 VDC/50 mA |
| Leakage OFF current | 0.1 mA |
| Residual voltage at ON | 1.5 VDC max. |
| Common method | Independent common |
| Assignable output signals | Excluding the ALARM signal, assignment and logical setting of all signals is possible.<br>Alarm (ALARM), in-position (INPOS), speed match (VCMP), zero speed detection (ZSP), ready to operate (RDY), Torque limit enable (TLM), speed limit enable (VLM), electromagnetic brake timing (BRAKE), warning (WARN), near positioning (NEAR) |

### ■ Analog feedback input signal

| Item | Specifications |
|---|---|
| Maximum input voltage | ±12 V |
| Accuracy | ±1% of F.S. |
| Resolution | ±12 bits |
| Input impedance | 30 kΩ |

### ■ Encoder frequency division pulse output signal

| Item | Specifications |
|---|---|
| Output form | A phase (A+/A-), B phase (B+/B-), Z phase (Z+/Z-): Differential line driver output |
| Line driver | SN75ALS174(T.I.) or equivalent |
| Output frequency | 1.6Mpps (2-phase and 4-multiplication, 6.4 MHz equivalent)* |

* The division ratio can be set to any value using parameters.

### ■ Analog monitor output

| Item | Specifications |
|---|---|
| No. of channels | 2 ch |
| Output range | ±10 V (linearity valid range ± 8 V) |
| Resolution | 16 bits |
| Conversion accuracy | ±20 mV (typ.) |
| Allowable maximum load current | ±10mA |
| Conversion speed | 1.2 ms (typ.) |

## Communication Specifications

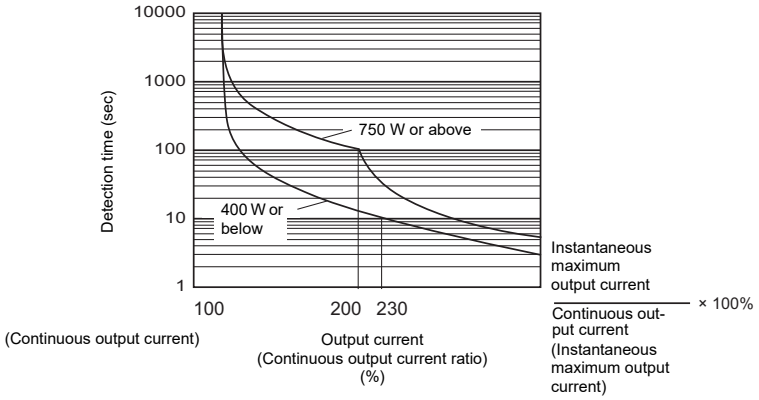
| Item | | Specifications |
|---|---|---|
| MECHATROLINK-III communication | Communication protocol | MECHATROLINK-III |
| | Station address | 03H to EFH (Max. No. of connectable slave stations: 62) |
| | Transmission speed | 100 Mbps |
| | Transmission cycle | 125 µs, 250 µs, 500 µs, 750 µs, 1 ms to 4 ms (multiples of 0.5 ms) |
| | Communication cycle | From transmission cycle × 1 |
| | No. of bytes transmitted | 32 bytes per station, 48 bytes per station |
| | Transmission medium, cable | Category 5e standard STP cross cable |
| | Operation specification | Position/speed/torque control |
| | Command input | MECHATROLINK-III command<br>(Sequence, motion, monitoring, adjustments, etc.) |
| | Maximum transmission distance | 50 m*1 |
| USB communication | Connection device | Computer |
| | Communication standards | Conforms to USB 2.0 |
| | Function | Status display, parameter setting, tuning, etc. |

*1 When the distance is 30 m or greater, double-wire a ferrite core (OP-84409) to both ends.

## Overload Protection Characteristics

The following are overload detection level characteristics when the ambient temperature around the motor is 55°C under the hot start conditions.
When the detection time is reached, the "Overload (Peak)" Alarm (710) or "Overload (Continuous)" Alarm (720) is issued.
For the actual overload level, a detection level lower than the respective overload protection characteristics of the connected servo amplifier and servo motor supersede.

### ■ Servo amplifier overload protection characteristics



# 2-4 Servo Motor Specifications

This section describes the SV2 series servo motor specifications.

## General Specifications

- **50 W to 750 W**

| Model type | | | Specifications | | | | |
|---|---|---|---|---|---|---|---|
| Model | Standard motor | | SV2-M005A□ | SV2-M010A□ | SV2-M020A□ | SV2-M040A□ | SV2-M075A□ |
| | Electromagnetic brake motor | | SV2-B005A□ | SV2-B010A□ | SV2-B020A□ | SV2-B040A□ | SV2-B075A□ |
| Compatible servo amplifier (SV2-) | | | SV2-005L2 | SV2-010L2 | SV2-020L2 | SV2-040L2 | SV2-075L2 |
| Rated output [W] | | | 50 | 100 | 200 | 400 | 750 |
| Rated torque [N·m]*1 | | | 0.159 | 0.318 | 0.637 | 1.27 | 2.39 |
| Momentary maximum torque [N·m] | | | 0.557 | 1.11 | 2.23 | 4.46 | 8.36 |
| Rated current [Arms] | | | 0.55 | 0.85 | 1.6 | 2.5 | 4.4 |
| Instantaneous maximum current [Arms] | | | 2.0 | 3.1 | 5.8 | 9.3 | 16.9 |
| Rated rotation speed [$min^{-1}$] | | | 3000 | | | | |
| Maximum rotation speed [$min^{-1}$] | | | 6000 | | | | |
| Torque constant [N·m/Arms] | | | 0.316 | 0.413 | 0.444 | 0.544 | 0.584 |
| Rotor inertia moment [× $10^{-4}$ $kg/m^2$]<br>Values in parentheses indicate the values for an electromagnetic brake motor. | | | 0.0395<br>(0.0475) | 0.0659<br>(0.0739) | 0.263<br>(0.333) | 0.486<br>(0.556) | 1.59<br>(1.77) |
| Rated power rate [kW/s]<br>Values in parentheses indicate the values for an electromagnetic brake motor. | | | 6.40<br>(5.32) | 15.3<br>(13.6) | 15.4<br>(12.1) | 33.1<br>(29.0) | 35.9<br>(32.2) |
| Rated angle speed [$rad/s^2$]<br>Values in parentheses indicate the values for an electromagnetic brake motor. | | | 40200<br>(33400) | 48200<br>(43000) | 24200<br>(19100) | 26100<br>(22800) | 15000<br>(13500) |
| Excitation method | | | Permanent magnet | | | | |
| Encoder for position/speed detection | Resolution | | 22 bits | | | | |
| | Type | | Absolute type (ABS) | | | | |
| Environment | Enclosure rating | | Fully closed, self-cooling, IP67 standard (excluding connectors and shaft penetration parts) | | | | |
| | Ambient operating temperature | | 0°C to +60°C (Used at the derated value at +40°C or higher) | | | | |
| | Ambient storage temperature | | -20°C to +60°C | | | | |
| | Operating/storage ambient humidity | | 20%RH to 80%RH (no condensation) | | | | |
| | Operating atmosphere | | Indoors (no corrosive gas, flammable gas, oil mist, or dust) | | | | |
| | Altitude | | Max. 2000 m (can be used under reduced ratings at 1000 m or above) | | | | |
| | Vibration class | | V15 | | | | |
| | Vibration resistance | | 49 $m/s^2$ (3 directions: up/down, left/right, and forward/backward), with the servo motor flange used as the reference surface | | | | |
| | Shock resistance | | 490 $m/s^2$ with the servo motor flange used as the reference surface, twice | | | | |
| Insulation class | | | UL: Class A, CE: Class B | | | | |
| Minimum insulation resistance | | | 10 MΩ min. with 500 VDC insulation resistance tester | | | | |
| Allowable insulation withstand voltage | | | 1500 VAC for 1 minute | | | | |
| Applicable standard | UL/CSA standards | | UL1004-1, UL1004-6, CSA C22.2 No.100 | | | | |
| | CE marking | Low-voltage directive | EN60034-1, EN60034-5 | | | | |
| | | EMI | EN55011 Class A, EN61800-3, EN61000-6-4 | | | | |
| | | EMS | EN61800-3, EN61000-6-2 | | | | |
| | North American EMI Regulation | | FCC Part 15 B, ICES-003. Class A | | | | |
| Ratio of allowable load to moment of inertia | | | 35 times | | 15 times | 10 times | 12 times |
| Approximate weight [kg] | Standard motor | | 0.3 | 0.4 | 0.8 | 1.1 | 2.2 |
| | Electromagnetic brake motor | | 0.6 | 0.7 | 1.4 | 1.7 | 2.8 |

*1 Rated torque is the continuous allowable torque value in the following conditions:
- Ambient temperature: 40°C
- The aluminum heat sink to be attached (the section to which it is attached to the motor)
  50 W and 100 W: 200 × 200 × 6 [mm]
  200 W to 750 W: 250 × 250 × 6 [mm]

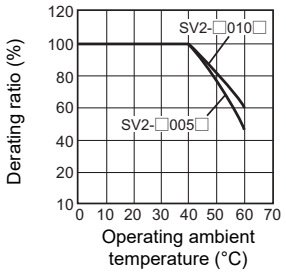
- **1.0kW to 5.0kW**

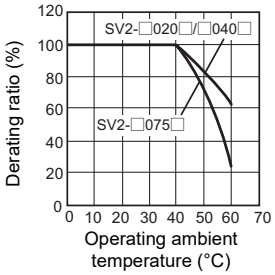
| Model type | | | Specifications | | | | | |
|---|---|---|---|---|---|---|---|---|
| Model | Standard motor | | SV2-M100A□ | SV2-M150A□ | SV2-M200A□ | SV2-M300A□ | | SV2-M500A□ |
| | Electromagnetic brake motor | | SV2-B100A□ | SV2-B150A□ | SV2-B200A□ | SV2-B300A□ | | SV2-B500A□ |
| Compatible servo amplifier (SV2-) | | | SV2-100L2 | SV2-150L2 | SV2-200L2 | SV2-300L2 | SV2-500L2 | SV2-500L2 |
| Rated output [W] | | | 0.85 | 1.3 | 1.8 | 2.4 | 2.9 | 4.4 |
| Rated torque [N·m]*1 | | | 5.39 | 8.34 | 11.5 | 15.1 | 18.6 | 28.4 |
| Momentary maximum torque [N·m] | | | 14.2 | 23.3 | 28.7 | 45.1 | 54.0 | 71.6 |
| Rated current [Arms] | | | 6.9 | 10.7 | 16.7 | 19.6 | 23.8 | 32.8 |
| Instantaneous maximum current [Arms] | | | 17 | 28 | 42 | 56 | 70 | 84 |
| Rated rotation speed [$min^{-1}$] | | | 1500 | | | | | |
| Maximum rotation speed [$min^{-1}$] | | | 3000 | | | | | |
| Torque constant [N·m/Arms] | | | 0.859 | 0.891 | 0.748 | 0.848 | 0.848 | 0.934 |
| Rotor inertia moment [× $10^{-4}$ $kg/m^2$] Values in parentheses indicate the values for an electromagnetic brake motor. | | | 13.9 (16.0) | 19.9 (22.0) | 26.0 (28.1) | 46.0 (53.9) | 46.0 (53.9) | 67.5 (75.4) |
| Rated power rate [kW/s] Values in parentheses indicate the values for an electromagnetic brake motor. | | | 20.9 (18.2) | 35.0 (31.6) | 50.9 (47.1) | 49.5 (42.2) | 75.2 (64.2) | 119 (107) |
| Rated angle speed [$rad/s^2$] Values in parentheses indicate the values for an electromagnetic brake motor. | | | 3880 (3370) | 4190 (3790) | 4420 (4090) | 3280 (2800) | 4040 (3450) | 4210 (3770) |
| Excitation method | | | Permanent magnet | | | | | |
| Encoder for position/ speed detection | Resolution | | 22 bits | | | | | |
| | Type | | Absolute type (ABS) | | | | | |
| Environment | Enclosure rating | | Fully closed, self-cooling, IP67 standard (excluding connectors and shaft penetration parts) | | | | | |
| | Ambient operating temperature | | 0°C to +60°C (Used at the derated value at +40°C or higher) | | | | | |
| | Ambient storage temperature | | -20°C to +60°C | | | | | |
| | Operating/storage ambient humidity | | 20%RH to 80%RH (no condensation) | | | | | |
| | Operating atmosphere | | Indoors (no corrosive gas, flammable gas, oil mist, or dust) | | | | | |
| | Altitude | | Max. 2000 m (can be used under reduced ratings at 1000 m or above) | | | | | |
| | Vibration class | | V15 | | | | | |
| | Vibration resistance | | 49 $m/s^2$ (2 directions: up/down and left/right) and 24.5 $m/s^2$ (forward/backward), with the servo motor flange used as the reference surface | | | | | |
| | Shock resistance | | 490 $m/s^2$ with the servo motor flange used as the reference surface, twice | | | | | |
| Insulation class | | | F Class | | | | | |
| Minimum insulation resistance | | | 10 MΩ min. with 500 VDC insulation resistance tester | | | | | |
| Allowable insulation withstand voltage | | | 1500 VAC for 1 minute | | | | | |
| Applicable standard | UL/CSA standards | | UL1004-1, UL1004-6, CSA C22.2 No.100 | | | | | |
| | CE marking | Low-voltage directive | EN60034-1, EN60034-5 | | | | | |
| | | EMI | EN55011 Class A, EN61800-3, EN61000-6-4 | | | | | |
| | | EMS | EN61800-3, EN61000-6-2 | | | | | |
| | North American EMI Regulation | | FCC Part 15 B, ICES-003. Class A | | | | | |
| Allowable load inertia moment ratio | | | 5 times | | | 3 times | 5 times | |
| Approximate weight [kg] | Standard motor | | 5.5 | 7.1 | 8.6 | 13.5 | | 17.5 |
| | Electromagnetic brake motor | | 7.5 | 9.0 | 11.0 | 19.5 | | 23.5 |

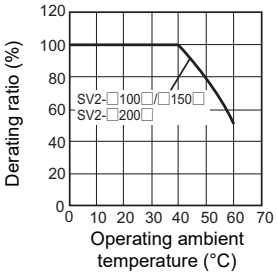
*1 Rated torque is the continuous allowable torque value in the following conditions:
- Ambient temperature: 40°C
- The iron heat sink to be attached (the section to which it is attached to the motor)
  1 kW to 2 kW: 400 × 400 × 20 [mm]
  3 kW to 5 kW: 550 × 550 × 30 [mm]

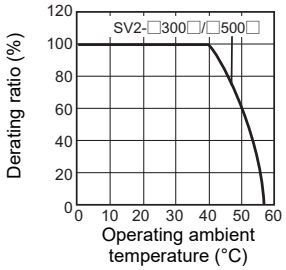
## ● Using the servo motor at operating ambient temperature of 40°C or greater

The servo motor ratings are the continuous allowable values for use at operating ambient temperature of up to 40°C. When using the servo motor at ambient temperature at operating ambient temperature of 40°C or greater, refer to the derating ratios as shown in the following charts.



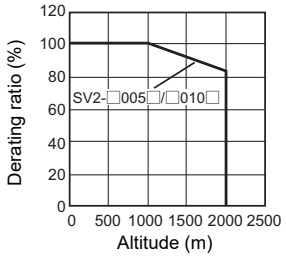



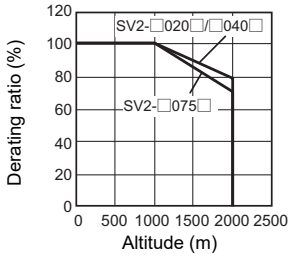



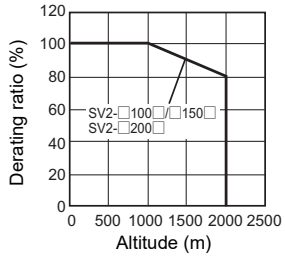

| | |
|---|---|
| ***NOTICE*** | • The maximum ambient operating temperature is 60°C.<br>• Be sure to use servo amplifier and servo motor combinations in conditions which satisfy the derating specifications for each device.<br>• The derating ratio is intended for conditions in which the average rotational speed is equal to or lower than the rated rotational speed. When the average rotational speed exceeds the rated speed, contact our sales office. |

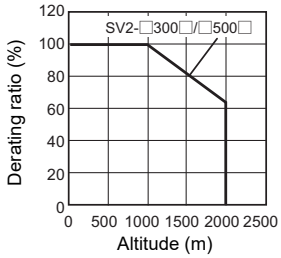
## ● Using the servo motor at 1000 m or higher above the sea level

The servo motor ratings are the continuous allowable values for use at 1000 m or lower above the sea level.
When using the servo motor at 1000 m or higher above the sea level, air-induced heat discharge effects are lowered. Refer to the derating ratios shown in the charts below.



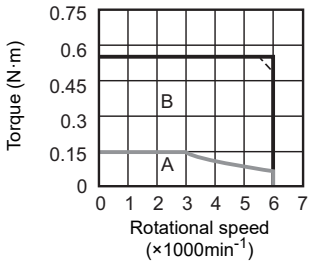




| | |
|---|---|
| ***NOTICE*** | • The height above sea level is 2000 m.<br>• Be sure to use servo amplifier and servo motor combinations in conditions which satisfy the derating specifications for each device.<br>• The derating ratio is intended for conditions in which the average rotational speed is equal to or lower than the rated rotational speed. When the average rotational speed exceeds the rated speed, contact our sales office. |

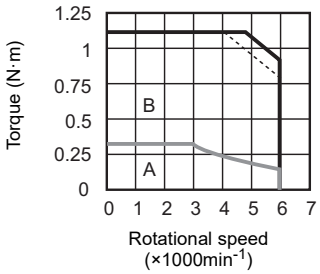
## Torque - Rotational Speed Characteristics

- **50W to 750W**

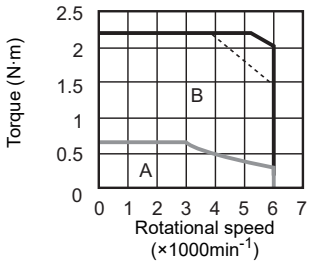
SV2-M005A□



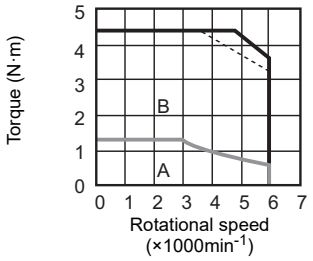

SV2-M010A□



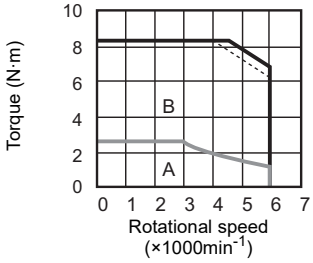

SV2-M020A□




SV2-M040A□



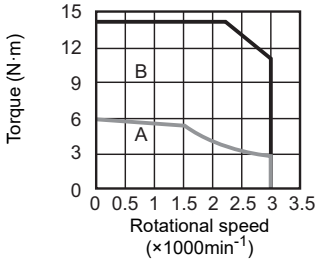

SV2-M075A□



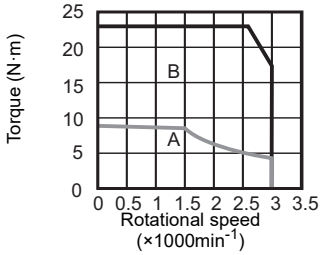

A: Use region for continuous use
B: Short-term operation region
Solid line: 3-phase, 200 V is input
Dotted line: single phase, 200 V is input

- **1.0kW to 5.0kW**

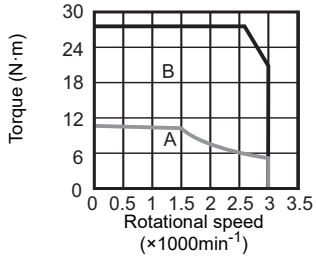
SV2-M100A□



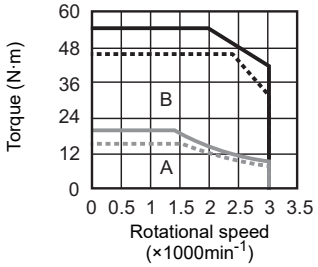

SV2-M150A□



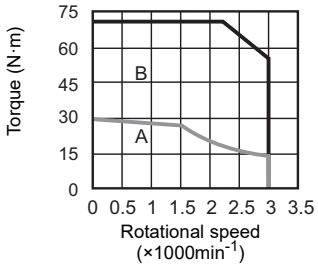

SV2-M200A□




SV2-M300A□




SV2-M500A□




A: Use region for continuous use
B: Short-term operation region
(Solid line): Input with 3-phase, 200 V
(Dotted line): When combined with SV2-300L2

**Point**

- **Characteristics in the operation region for short time operation vary depending on the power supply voltage.**
- **If the motor's power supply cable exceeds 20 m, the operation region for short time operation becomes smaller due to a great drop in voltage.**

## Electromagnetic Brake Specifications

| Model | SV2-B005A□ | SV2-B010A□ | SV2-B020A□ | SV2-B040A□ | SV2-B075A□ |
|---|---|---|---|---|---|
| Capacity [W] | 5.5 | 5.5 | 6 | 6 | 6.5 |
| Rated voltage | 24 VDC ±10% | | | | |
| Rated current [A] (@20°C) | 0.23 | 0.23 | 0.25 | 0.25 | 0.27 |
| Holding torque [N·m] | 0.159 | 0.318 | 0.637 | 1.27 | 2.39 |
| Release time [ms] | 60 | 60 | 60 | 60 | 80 |
| Operating time [ms] | 100 | 100 | 100 | 100 | 100 |

| Model | SV2-B100A□ | SV2-B150A□ | SV2-B200A□ | SV2-B300A□ | SV2-B500A□ |
|---|---|---|---|---|---|
| Capacity [W] | 10 | 10 | 10 | 18.5 | 18.5 |
| Rated voltage | 24 VDC 0% to +10% | | | | |
| Rated current [A] (@20°C) | 0.41 | 0.41 | 0.41 | 0.77 | 0.77 |
| Holding torque [N·m] | 12.7 | 19.6 | 19.6 | 43.1 | 43.1 |
| Release time [ms] | 100 | 100 | 100 | 170 | 170 |
| Operating time [ms] | 80 | 80 | 80 | 100 | 100 |

| *NOTICE* | **Electromagnetic brake release/operating times differ according to the discharge circuit.** |
|---|---|

**Point**

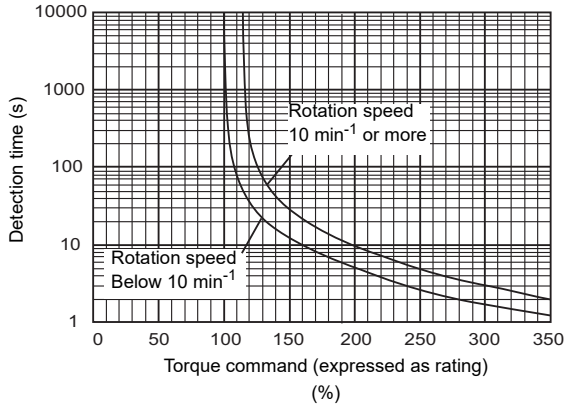
- **The servo motor with an electromagnetic brake has a slight play even during the non-energized state as an electromagnetic brake backlash occurs.**
  **Backlash: 1.5° or below (when shipped)**
- **The servo motor with an electromagnetic brake may generate braking sound due to the brake rotating disc while accelerating, stopping, or operating at a low speed.**

## Overload Protection Characteristics

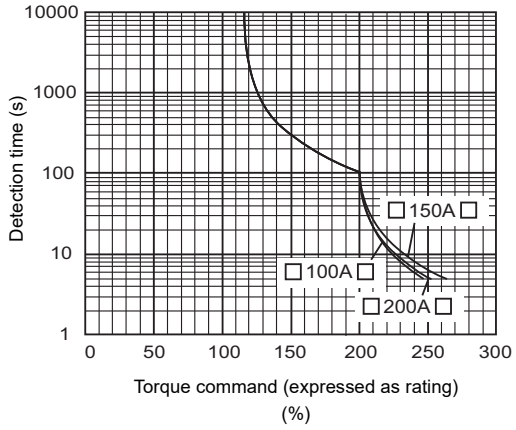
The following are overload detection level characteristics when the ambient temperature around the motor is 40°C under the hot start conditions.
When the detection time is reached, the "Overload (Peak)" Alarm (710) or "Overload (Continuous)" Alarm (720) is issued.

### ■ Servo motor overload protection characteristics

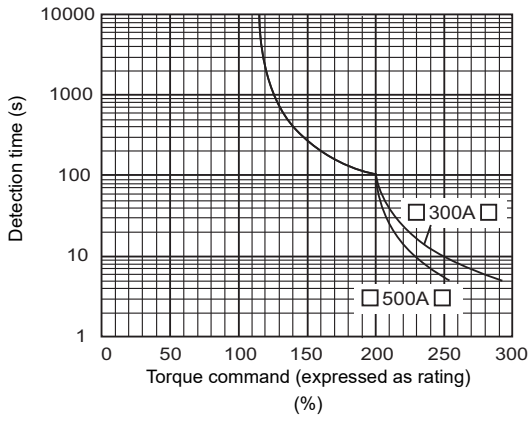
#### ● 50 W to 750 W




#### ● 1 kW to 2 kW



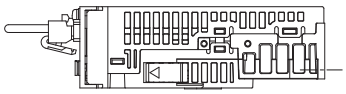

#### ● 3 kW to 5 kW

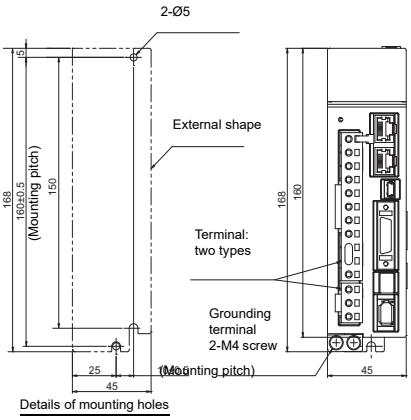


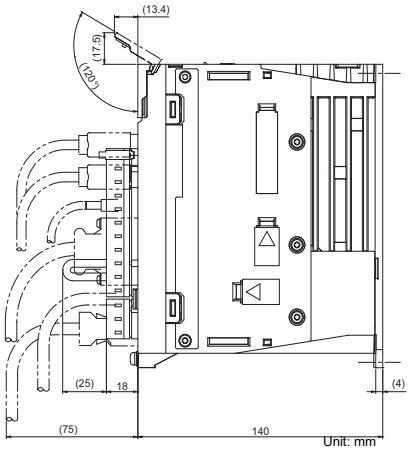

| | |
|---|---|
| *NOTICE* | **The above mentioned overload protection characteristics do not guarantee continuous operation with an output of 100% or more.**<br>**Use the motor so that the actual torque is within the range of the operation region for continuous operation shown in "Torque – rotation Speed Characteristic".** |

## ■ Servo amplifier

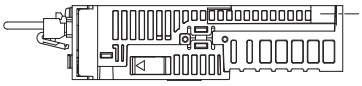
**SV2-005L2**
**SV2-010L2**
**SV2-020L2**

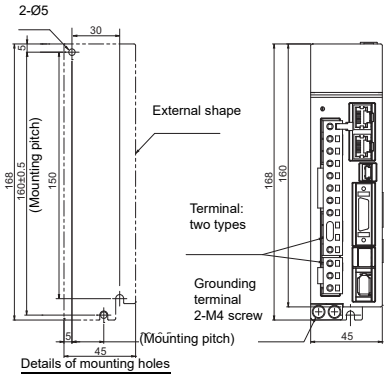


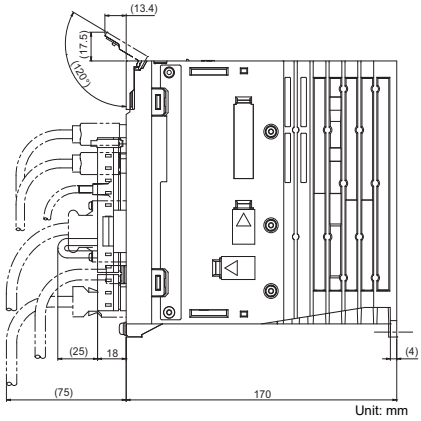


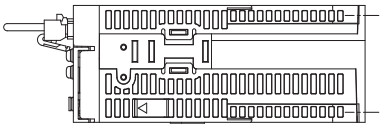

**SV2-040L2**

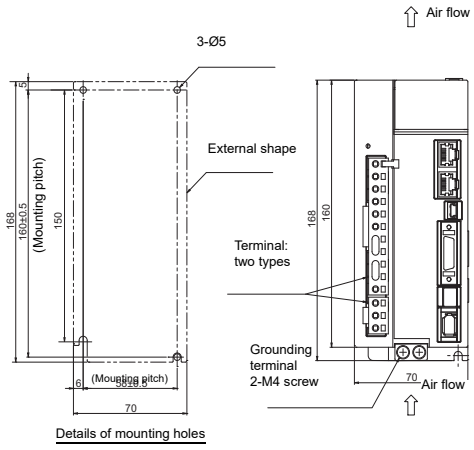


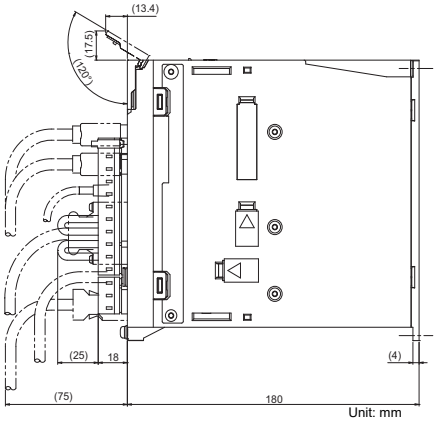


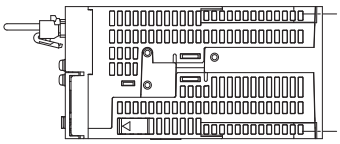

**SV2-075L2**
**SV2-100L2**

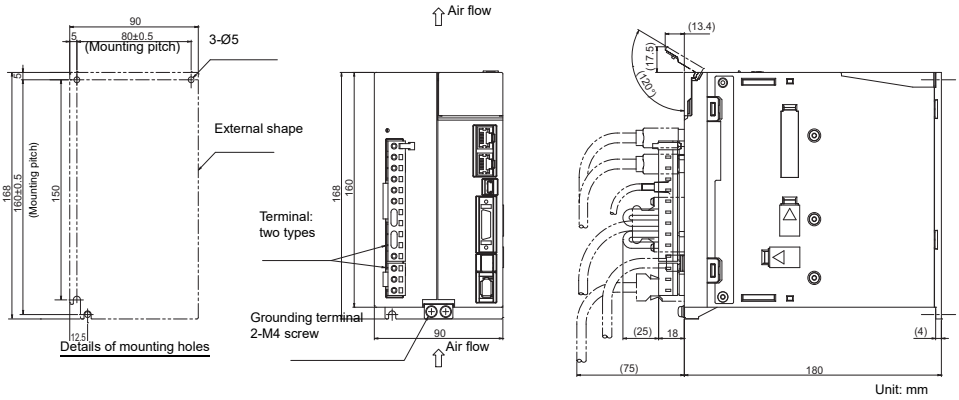




**SV2-150L2**

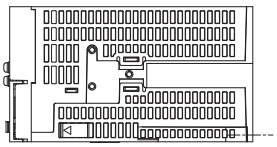


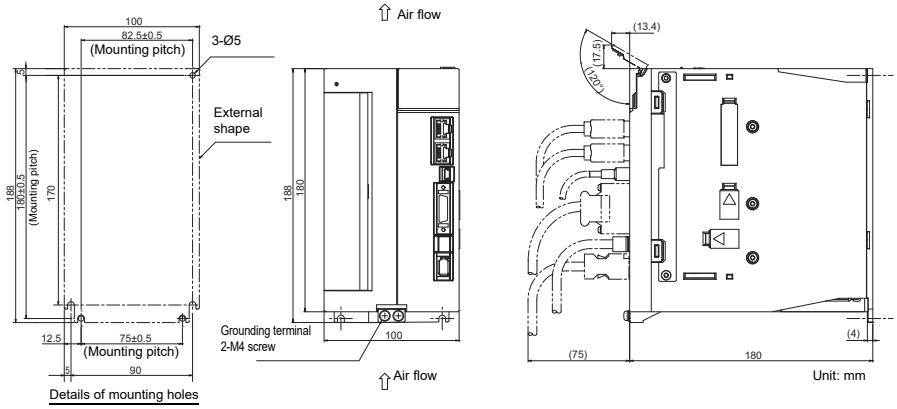



Unit: mm

**SV2-200L2**

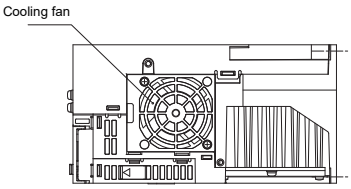
**SV2-300L2**

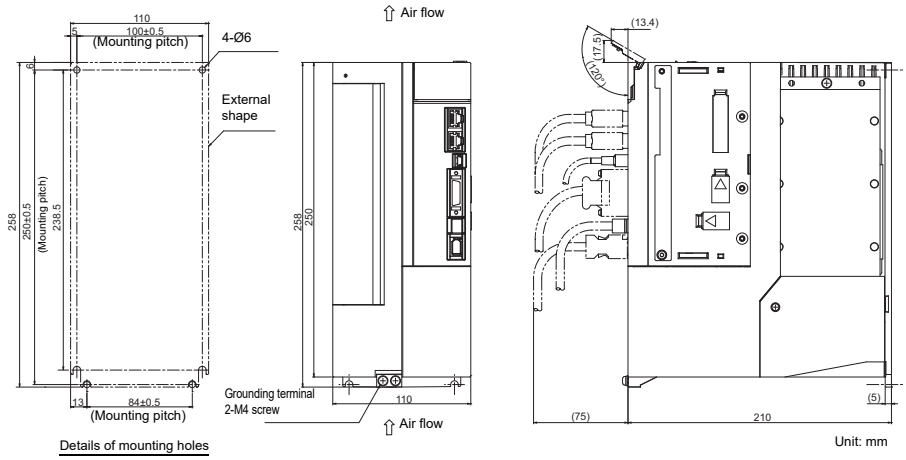





Unit: mm

**SV2-500L2**



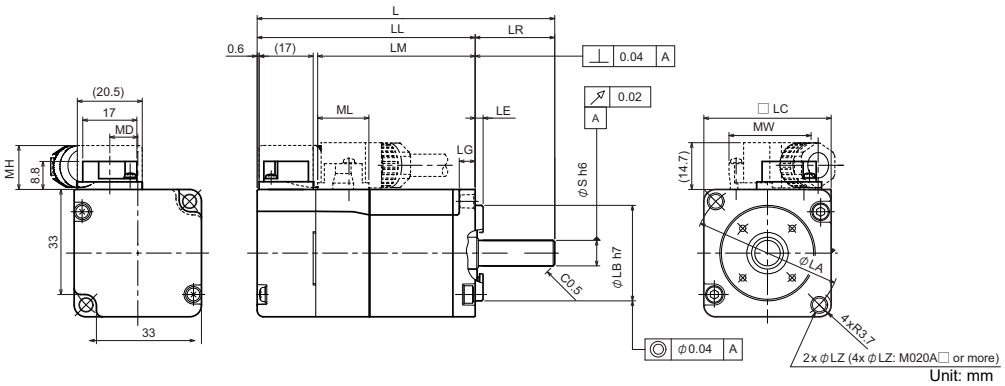




Unit: mm

## ■ Servo motor

### ● Standard motor

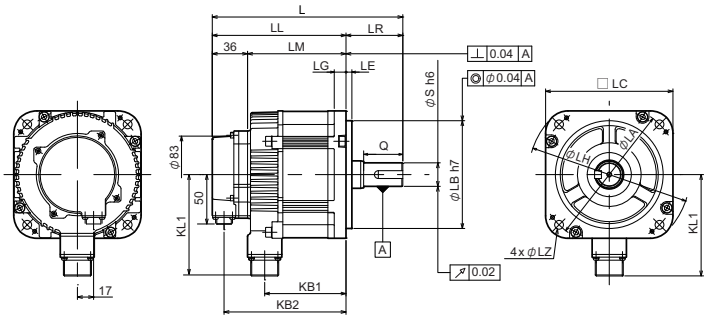
**SV2-M005A□/M010A□/M020A□/M040A□/M075A□**




Unit: mm

| Model | SV2-M005A□ | SV2-M010A□ | SV2-M020A□ | SV2-M040A□ | SV2-M075A□ |
|---|---|---|---|---|---|
| L | 81.5 | 93.5 | 99.5 | 115.5 | 137 |
| LL | 56.5 | 68.5 | 69.5 | 85.5 | 97 |
| LM | 37.9 | 49.9 | 51.2 | 67.2 | 78.5 |
| LR | 25 | 25 | 30 | 30 | 40 |
| LA | 46 | 46 | 70 | 70 | 90 |
| LB | $30^{0}_{-0.021}$ | $30^{0}_{-0.021}$ | $50^{0}_{-0.025}$ | $50^{0}_{-0.025}$ | $70^{0}_{-0.030}$ |
| LC | 40 | 40 | 60 | 60 | 80 |
| LE | 2.5 | 2.5 | 3 | 3 | 3 |
| LG | 5 | 5 | 6 | 6 | 8 |
| LZ | 4.3 | 4.3 | 5.5 | 5.5 | 7 |
| S | $8^{0}_{-0.009}$ | $8^{0}_{-0.009}$ | $14^{0}_{-0.011}$ | $14^{0}_{-0.011}$ | $19^{0}_{-0.013}$ |
| MD | 8.8 | 8.8 | 8.5 | 8.5 | 13.6 |
| MW | 25.8 | 25.8 | 28.7 | 28.7 | 38 |
| MH | 14 | 14 | 14.7 | 14.7 | 14.7 |
| ML | 16.1 | 16.1 | 17.1 | 17.1 | 19.3 |

**SV2-M100A□/M150A□/M200A□/M300A□/M500A□**




Unit: mm

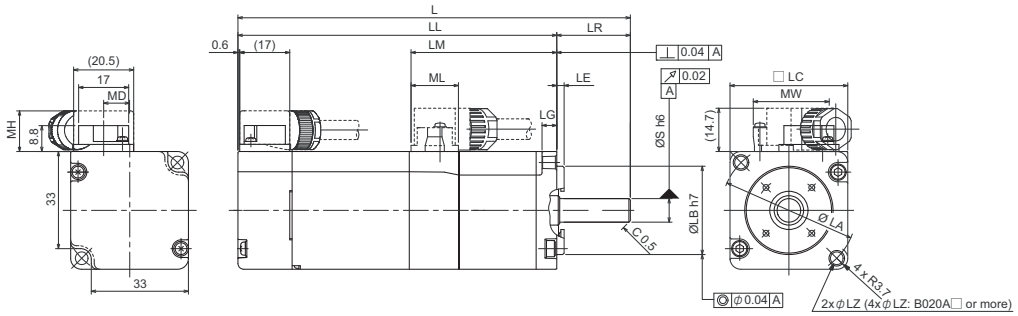
| Model | SV2-M100A□ | SV2-M150A□ | SV2-M200A□ | SV2-M300A□ | SV2-M500A□ |
|---|---|---|---|---|---|
| L | 195 | 211 | 229 | 239 | 263 |
| LL | 137 | 153 | 171 | 160 | 184 |
| LM | 101 | 117 | 135 | 124 | 148 |
| LR | 58 | 58 | 58 | 79 | 79 |
| KB1 | 83 | 99 | 117 | 108 | 132 |
| KB2 | 125 | 141 | 159 | 148 | 172 |
| LA | 145 | 145 | 145 | 200 | 200 |
| KL1 | 104 | 104 | 104 | 134 | 134 |
| LB | $110^{0}_{-0.035}$ | $110^{0}_{-0.035}$ | $110^{0}_{-0.035}$ | $114.3^{0}_{-0.025}$ | $114.3^{0}_{-0.025}$ |
| LC | 130 | 130 | 130 | 180 | 180 |
| LE | 6 | 6 | 6 | 3.2 | 3.2 |
| LG | 12 | 12 | 12 | 18 | 18 |
| LH | 165 | 165 | 165 | 230 | 230 |
| LZ | 9 | 9 | 9 | 13.5 | 13.5 |
| S | $24^{0}_{-0.013}$ *1 | $24^{0}_{-0.013}$ *1 | $24^{0}_{-0.013}$ | $35^{+0.01}_{0}$ *2 | $35^{+0.01}_{0}$ *2 |
| Q | 40 | 40 | 40 | 76 | 76 |

*1 The shaft diameter (the S dimension above) of the SV2-M100A□/M150A□ differs from the same capacity SV Series.

*2 The tolerance of SV2-M300A□/SV2-M500A□ is as indicated, but it does not fit the tolerance zone class h6.

## ● Electromagnetic brake motor

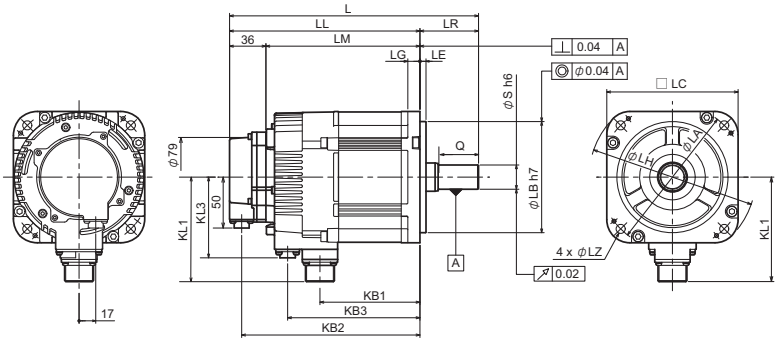
**SV2-B005A□/B010A□/B020A□/B040A□/B075A□**




Unit: mm

| Model | SV2-B005A□ | SV2-B010A□ | SV2-B020A□ | SV2-B040A□ | SV2-B075A□ |
|---|---|---|---|---|---|
| L | 122 | 134 | 140 | 156 | 184 |
| LL | 97 | 109 | 110 | 126 | 144 |
| LM | 37.9 | 49.9 | 51.2 | 67.2 | 78.5 |
| LR | 25 | 25 | 30 | 30 | 40 |
| LA | 46 | 46 | 70 | 70 | 90 |
| LB | $30^{0}_{-0.021}$ | $30^{0}_{-0.021}$ | $50^{0}_{-0.025}$ | $50^{0}_{-0.025}$ | $70^{0}_{-0.030}$ |
| LC | 40 | 40 | 60 | 60 | 80 |
| LE | 2.5 | 2.5 | 3 | 3 | 3 |
| LG | 5 | 5 | 6 | 6 | 8 |
| LZ | 4.3 | 4.3 | 5.5 | 5.5 | 7 |
| S | $8^{0}_{-0.009}$ | $8^{0}_{-0.009}$ | $14^{0}_{-0.011}$ | $14^{0}_{-0.011}$ | $19^{0}_{-0.013}$ |
| MD | 8.8 | 8.8 | 8.5 | 8.5 | 13.6 |
| MW | 25.8 | 25.8 | 28.7 | 28.7 | 38 |
| MH | 14 | 14 | 14.7 | 14.7 | 14.7 |
| ML | 16.1 | 16.1 | 17.1 | 17.1 | 19.3 |

**SV2-B100A□/B150A□/B200A□/B300A□/B500A□**




Unit: mm

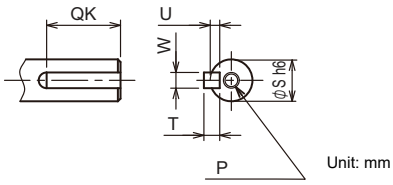
| Model | SV2-B100A□ | SV2-B150A□ | SV2-B200A□ | SV2-B300A□ | SV2-B500A□ |
|---|---|---|---|---|---|
| L | 231 | 247 | 265 | 287 | 311 |
| LL | 173 | 189 | 207 | 208 | 232 |
| LM | 137 | 153 | 171 | 172 | 196 |
| LR | 58 | 58 | 58 | 79 | 79 |
| KB1 | 83 | 99 | 117 | 108 | 132 |
| KB2 | 161 | 177 | 195 | 196 | 220 |
| KB3 | 115 | 131 | 149 | 148 | 172 |
| KL1 | 104 | 104 | 104 | 134 | 134 |
| KL3 | 80 | 80 | 80 | 110 | 110 |
| LA | 145 | 145 | 145 | 200 | 200 |
| LB | $110^{0}_{-0.035}$ | $110^{0}_{-0.035}$ | $110^{0}_{-0.035}$ | $114.3^{0}_{-0.025}$ | $114.3^{0}_{-0.025}$ |
| LC | 130 | 130 | 130 | 180 | 180 |
| LE | 6 | 6 | 6 | 3.2 | 3.2 |
| LG | 12 | 12 | 12 | 18 | 18 |
| LH | 165 | 165 | 165 | 230 | 230 |
| LZ | 9 | 9 | 9 | 13.5 | 13.5 |
| S | $24^{0}_{-0.013}$ *1 | $24^{0}_{-0.013}$ *1 | $24^{0}_{-0.013}$ | $35^{+0.01}_{0}$ *2 | $35^{+0.01}_{0}$ *2 |
| Q | 40 | 40 | 40 | 76 | 76 |

*1 The shaft diameters of SV2-B100A□/B150A□ (dimensions S in the above table) vary from SV series having the same capacity.

*2 The tolerance of SV2-B300A□/SV2-B500A□ is as indicated, but it does not fit the tolerance zone class h6.

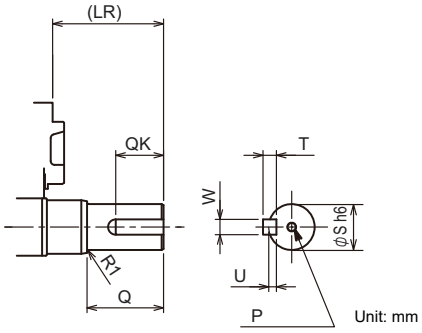
### ● Shaft shape - With key seat

**SV2-□005A□/□010A□/□020A□/□040A□/□075A□**




| Model | SV2-□005A□ | SV2-□010A□ | SV2-□020A□ | SV2-□040A□ | SV2-□075A□ |
|---|---|---|---|---|---|
| LR | 25 | 25 | 30 | 30 | 40 |
| QK | 14 | 14 | 14 | 14 | 22 |
| S | $8^{0}_{-0.009}$ | $8^{0}_{-0.009}$ | $14^{0}_{-0.011}$ | $14^{0}_{-0.011}$ | $19^{0}_{-0.013}$ |
| W | 3 | 3 | 5 | 5 | 6 |
| T | 3 | 3 | 5 | 5 | 6 |
| U | 1.8 | 1.8 | 3 | 3 | 3.5 |
| P | M3 screw<br>Depth 6 | M3 screw<br>Depth 6 | M5 screw<br>Depth 8 | M5 screw<br>Depth 8 | M6 screw<br>Depth 10 |

**SV2-□100A□/□150A□/□200A□/□300A□/□500A□**



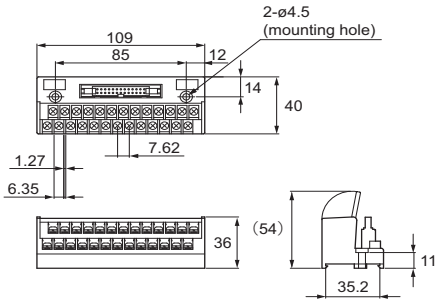

| Model | SV2-□100A□ | SV2-□150A□ | SV2-□200A□ | SV2-□300A□ | SV2-□500A□ |
|---|---|---|---|---|---|
| LR | 58 | 58 | 58 | 79 | 79 |
| Q | 40 | 40 | 40 | 76 | 76 |
| QK | 25 | 25 | 25 | 60 | 60 |
| S | $24^{0}_{-0.013}$ *1 | $24^{0}_{-0.013}$ *1 | $24^{0}_{-0.013}$ | $35^{+0.01}_{0}$ *2 | $35^{+0.01}_{0}$ *2 |
| W | 8 | 8 | 8 | 10 | 10 |
| T | 7 | 7 | 7 | 8 | 8 |
| U | 4 | 4 | 4 | 5 | 5 |
| P | M5 screw<br>Depth 12 | M5 screw<br>Depth 12 | M5 screw<br>Depth 12 | M12 screw<br>Depth 25 | M12 screw<br>Depth 25 |

*1 The shaft diameters of SV2-B100A□/B150A□ (dimensions S in the above table) vary from SV series having the same capacity.

*2 The tolerance of SV2-B300A□/SV2-B500A□ is as indicated, but it does not fit the tolerance zone class h6.

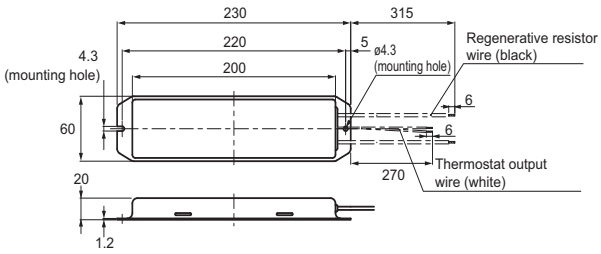
## ■ I/O connector terminal block

**OP-84411**



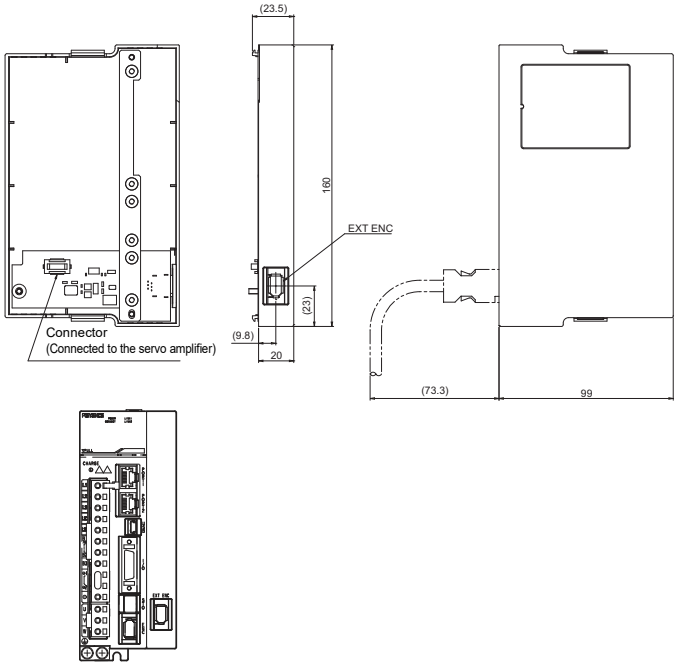
## ■ Regenerative resistor

**OP-84399/OP-87073**




## ■ Fully closed module

**SV-FC1**






Unit installation diagram

# 3

# INSTALLATION AND MAINTENANCE

This chapter describes how to install and maintain the servo amplifier and servo motor.

# 3-1 Installation

Be sure to read 📖 "Safety Precautions", Page 1 provided at the beginning of this manual before installing SV2 series.

## Installing Servo Amplifier

### ■ Precautions

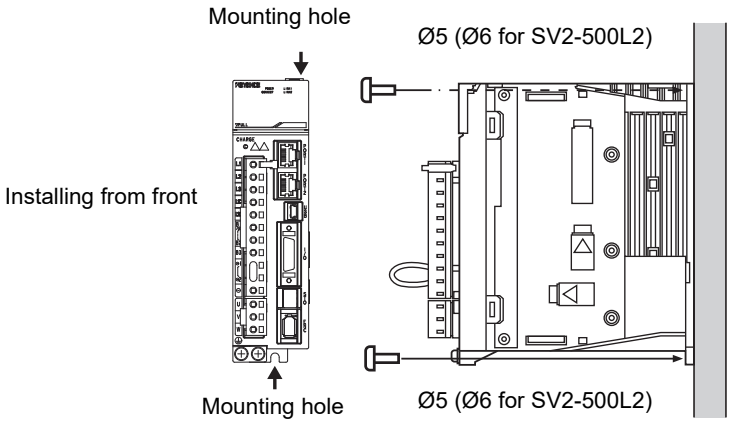
| | |
|---|---|
| ⚠ WARNING | • **When using a DC power supply, set "*AC/DC power source" to "DC" before inputting the main circuit power.**<br>**If the DC power is supplied without setting "*AC/DC power source" to "DC", the internal elements of the servo amplifier may burn out, causing fire or equipment damage.**<br>• **When using DC power input, it takes a while to discharge the servo amplifier after shutting off the mains power.**<br>**There may be high levels of voltage in the servo amplifier after the power is turned off, which may cause electric shock.**<br>**Refer to 📖 "Condenser discharge time", Page 3-9 for further information on condenser discharge time.**<br>• **The servo motor returns regenerative energy to the power supply when operating in the regenerative mode. When a DC power input is used for the servo amplifier it cannot perform regeneration, so be sure to process the regenerated energy on the power supply side.**<br>• **To use SV2-500L2 with a DC power supply, connect the anti-surge circuit externally so the power on/off sequence is executed as recommended by us.**<br>**Otherwise, the equipment may be damaged.**<br>**Refer to 📖 "Power On Sequence", Page 4-11 for further information on the power on/off sequence.** |
| *NOTICE* | • **Installation in a control panel:**<br>**Consider the size of the control panel, the placement of the servo amplifier, and cooling method so that the ambient temperature around the servo amplifier does not exceed 55°C.**<br>• **When installing a row of servo amplifiers in a control panel, leave a space between each servo amplifier and install a cooling fan above them. Leave a gap above and below each servo amplifier.**<br>• **Installation near a heat generating object:**<br>**Limit temperature increases due to the radiant heat or heat convection from the object so that the ambient temperature around the servo amplifier does not exceed 55°C.**<br>• **Installation near a source of vibration:**<br>**Attach a vibration insulator to the mounting surface of the servo amplifier so that the amplifier does not receive vibration.**<br>• **Installation in a location where corrosive gas may enter:**<br>**Take measures to prevent the entry of corrosive gas. Although corrosive gas does not have an immediate effect, it will eventually cause electronic components and contactor-using equipment to malfunction.**<br>• **Other**<br>**Do not install in a location where: temperature/humidity is extremely high, water or a cutting oil may splash onto it, there is large volume of dust or iron particles, or where radioactivity may affect the device.**<br>**Do not allow the SV2 series to freeze or form condensation.** |

## ■ Mounting method

Mount the servo amplifier vertically on the wall as shown in the figure below.
Follow "2-3 Servo Amplifier Specifications", Page 2-6 to mount the servo amplifier.

### ● Orientation

Firmly secure the servo amplifier to the mounting surface using 2 to 4 mounting holes (the number of holes varies depending on the model). Be sure to mount the servo amplifier so that the front side is at the front.



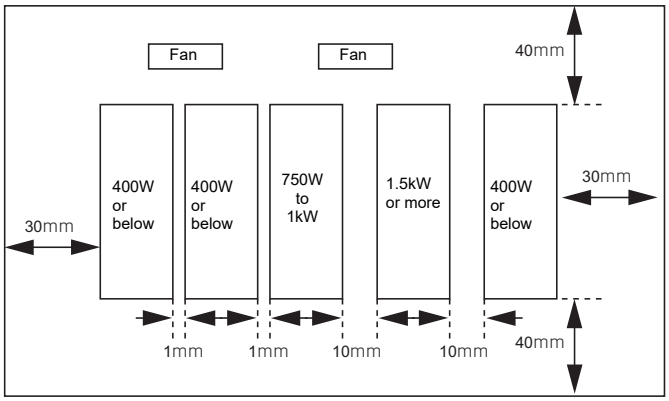

### ● Installation regulation

The installation regulation of control panel shown in the following diagram must be followed for amplifier installation including installing multiple servo amplifiers side by side in the control panel.

- Servo amplifier orientation
  Mount the servo amplifier vertically on a wall so that the front side is at the front.

- Cooling
  Refer to the below diagram when determining spacing dimensions to ensure that the Motor Driver can be cooled by the cooling fan and natural convection.
  Position the cooling fans so they operate at wind speeds of 0.5 m/s or faster when positioned 10 mm above the servo amplifier.
  Ensure uniform temperature distribution inside the control panel.

- When installing multiple servo amplifiers side by side in the control panel
  The space between two servo amplifiers is about 1 mm.
  However, at least 10mm space must be kept on the right side of the 750W and 1kW servo amplifier to ensure cooling with cooling fan. In addition, at least 10mm space should be left on both sides of 1.5kW to 5kW servo amplifier.



## Installing the Servo Motor

### ■ Precautions

| | |
|---|---|
| *NOTICE* | • **Use the servo motor in an environment appropriate for the enclosure rating of the motor. Otherwise, this may cause malfunction.**<br>• **The end of the motor shaft is coated with an anticorrosive agent. Be sure to wipe the agent off completely with a cloth soaked with cleaning solution before installation. Otherwise, the motor and mechanical system cannot be coupled properly.**<br>• **Use dedicated flexible servo motor coupling to couple the motor with the target equipment. We recommend using two flat springs that allow for a small amount of eccentricity or declination.**<br>• **Although tolerances for coupling centering vary depending on the operating rotational speed and type of coupling used, they should be 0.03 mm or less. Be sure to refer to the coupling manufacturer's catalog as well. Also, make proper adjustment to maximize the centering accuracy even if the tolerances are within the above range.**<br>• **If abnormal sounds are heard from the coupling, readjust centering so as not to generate such sounds.**<br>• **Center the coupling by rotating both shafts.**<br>• **The absolute value encoder is equipped with an electromagnetic sensor. Do not install equipment that can generate a strong magnetic field (more than 0.01 T (tesla) or 100 G (gauss) at the encoder cover section) near the servo motor.**<br>• **Select the proper belt that corresponds to the acceptable radial load and output of the servo motor. Be sure to do so as the counterforce of the acceleration/deceleration torque acts as the tensioning force in addition to initial belt tensioning especially when the servo motor is accelerating or decelerating.**<br>• **Use the belt that is able to rotate the shafts and withstand the acceptable radial load as well as skews caused by belt tensioning.** |

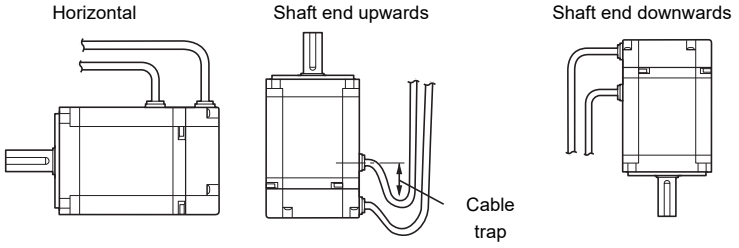
### ■ How to install

The following points must be followed for servo motor installation.

#### ● Mounting direction

Servo motor can be installed both in horizontal and vertical direction.

- For installation with upward shaft end, cable trap must be designed to prevent oil and water from entering servo motor.
- For installation with downward shaft end, be sure to take measures to prevent oil or water from entering servo motor from the shaft connecting part.

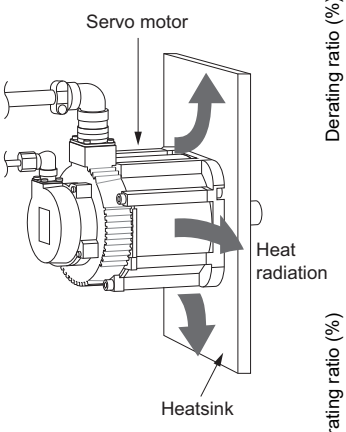


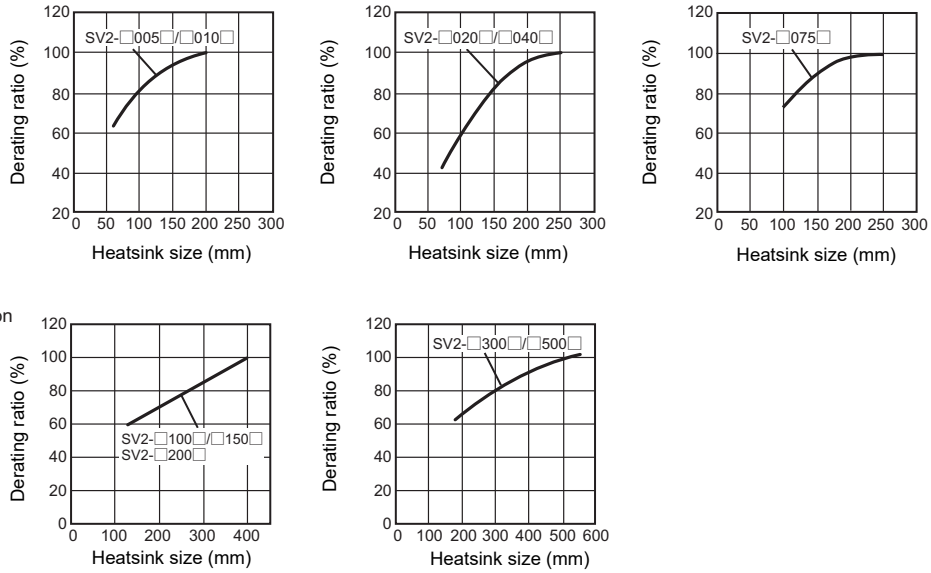
## ● Mounting requirements

The servo motor ratings (rated output, rated torque, and rated rotation speed) are the continuous allowable capacity when the motor is attached to the heatsink, and the ambient temperature is 40°C.
Even when the servo motor is mounted onto small equipment, provide an area sufficient for heat radiation to prevent a temperature increase of the servo motor. Attaching a heatsink or derating is required to limit the temperature increase within an appropriate range.
Also, if the servo motor is covered with the equipment housing or is located near a heat generating object, take the following countermeasures:

- Reduce the load ratio.
- Review the heat radiation condition of the servo motor.
- Install a cooling fan for forced cooling of the servo motor.

The relation between the heat sink (the section to which it is attached to the motor) and derating is as follows.

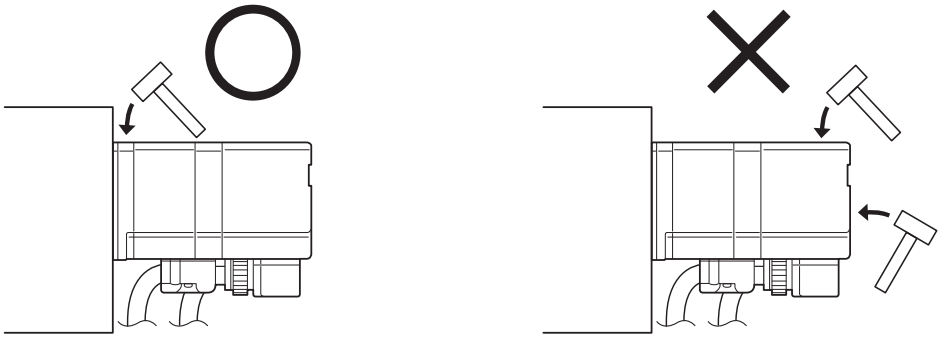


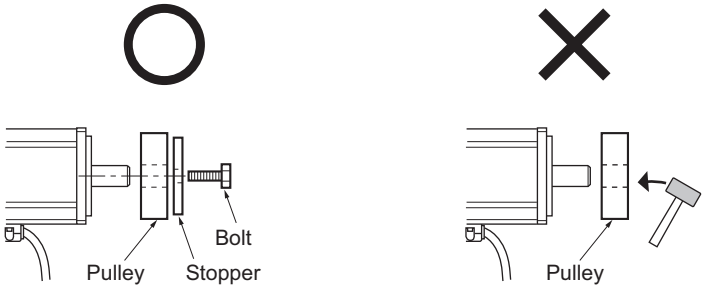
## ● Combining with machine

The anti-rust agent on the shaft coated end of servo motor must be cleaned before combining with machine.
For combination with machine, the shaft center of servo motor must be aligned with the shaft center of machine, before connecting them together with a coupling, otherwise, the shaft or bearings will be damaged.

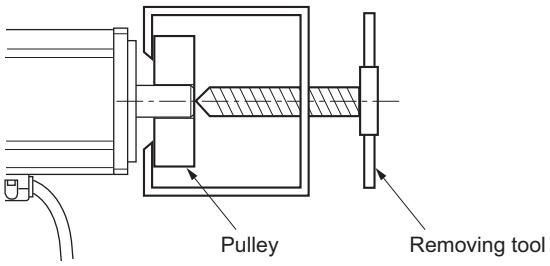
Direct shock to the shaft isn't allowed when coupling is installed on servo motor.
If necessary, servo motor must be knocked with rubber or plastic hammer etc., and it is preferable to knock the front flange part of servo motor.



High-precision installing holes must be machined for smooth connection when servo motor is installed on a machine. In addition, the installing surface must be flat. Otherwise, the shaft and bearings will be damaged.
The screw hole at shaft end is preferred other than impact when gears, pulley or couplings are installed.



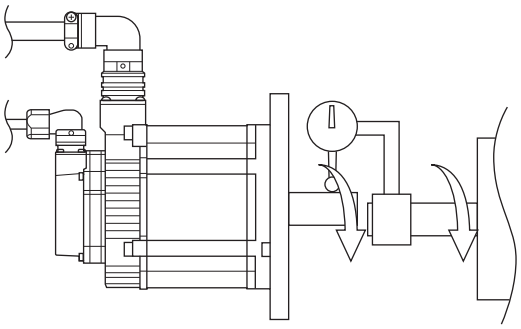

Special removing tool must be used when disassembling gears or pulley.




It is necessary to check that the shaft conversion value belt tension doesn't exceed the permissible value of radial load when belt drive is performed.

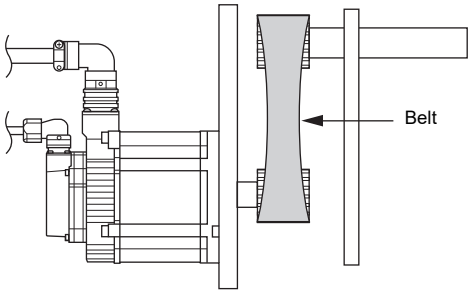
## ● Connecting couplings

- Center the coupling by rotating both shafts.
- It is recommended that the centering accuracy be verified using tools such as a dial gauge. If it is difficult to do so, slide the couplings on both shafts to a point where they do not get caught.

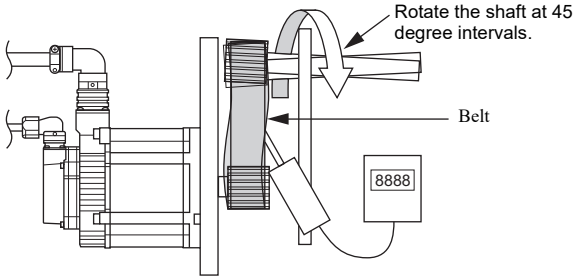


## ● Connecting the belt

- Select the proper belt that corresponds to the acceptable radial load and output of the servo motor. Be sure to do so as the counterforce of the acceleration/deceleration torque acts as the tensioning force in addition to initial belt tensioning especially when the servo motor is accelerating or decelerating.
- When installing the belt, set up belt tension so it is below the "acceptable radial loads" provided in the manual and catalog. Refer to the belt manufacturer's catalog for more details.

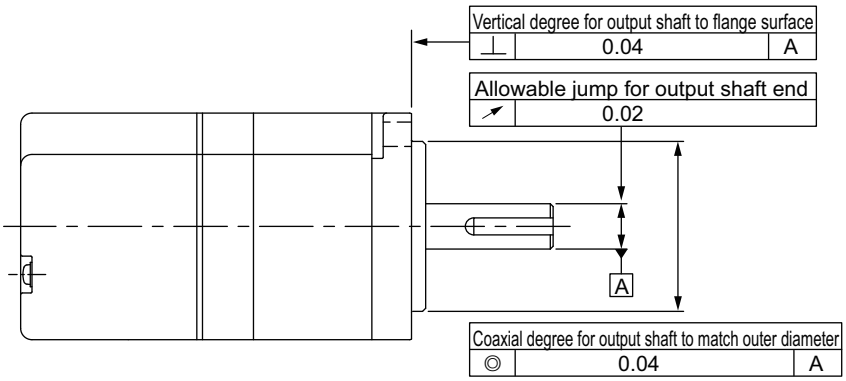



- Measure belt tensioning points using tools such as a belt tension meter by rotating the shaft at 45 degree intervals.



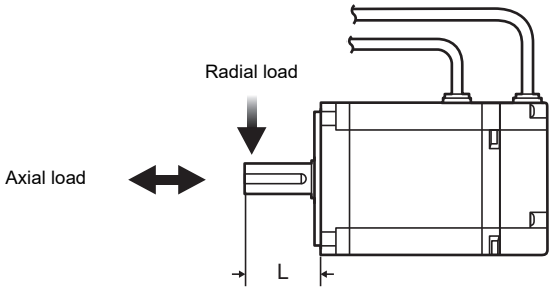
### ● Working precision

The instructions below must be followed for the precision of installing the output shaft of servo motor.
For the precision of each model, see "2-5 Dimensions", Page 2-17.




### ● Permissible load

The permissible radial load (load relative to the vertical direction of servo motor shaft) and axial load (relative to the horizontal direction of servo motor shaft) applied on the shaft end of servo motor is shown as follows.




| Model | Permissible radial load (N) | Permissible axial load (N) | L (mm) |
|---|---|---|---|
| SV2-□005A□ | 78 | 54 | 20 |
| SV2-□010A□ | | | |
| SV2-□020A□ | 245 | 74 | 25 |
| SV2-□040A□ | | | |
| SV2-□075A□ | 392 | 147 | 35 |
| SV2-□100A□ | 490 | 98 | 58 |
| SV2-□150A□ | 686 | 343 | |
| SV2-□200A□ | 980 | 392 | |
| SV2-□300A□ | 1470 | 490 | 79 |
| SV2-□500A□ | | | |

## ■ Degree of protection

The protection degree of the servo motor is IP67 (excluding the connectors and shaft penetration parts).
Take measures such as installing a cover in case of oil drops (oil or coolant).

# 3-2 Maintenance, Service and Inspection

Be sure to read "Safety Precautions", Page 1 provided at the beginning of this manual before performing maintenance and inspection.

| | |
|---|---|
| CAUTION | • **Before performing maintenance and inspection, check that the servo amplifier is powered off and its CHARGE indicator is off when viewed from the front, and then check the voltage between P and N of the servo amplifier using a voltage tester. Check that the main circuit voltage has been dropped before beginning inspection tasks. If the main circuit voltage remains, do not touch the servo motor and wiring sections. Otherwise, it can cause an electrical shock.**<br>• **Maintenance and inspection tasks should be performed by a competent person. Otherwise, it can cause an electric shock or injuries.**<br>• **Contact your local sales office for malfunction, repair, and parts replacement.** |



## Inspection of Servo Amplifier

No routine inspection is required, but for the following items, inspection must be performed at least one time per year.

| Inspecting item | Inspecting time | Inspecting contents | Measures |
|---|---|---|---|
| Visual check | At least one time per year | To check whether dirt, dust or oil, etc. is adhered. | To clean with air or a piece of cloth. |
| Loose screws | | To check whether installing screws on terminal blocks and connectors are loose. | To fasten the loose screws. |

## Life Cycle of Servo Amplifier Components

The expected life of components is shown as follows.
For matters about repairing, please contact the nearest sales agent (on the back cover of this manual).

| Component | Expected life | Notes |
|---|---|---|
| Cooling fan | 4 to 5 years | Operating rate: 20 hours/day (used under the condition of 80% rated load and average temperature of 30°C) |
| Electrolytic capacitor | 10 years | |
| Relay | 0.1 million times | ON/OFF circuit of relay contact |

| Consumables | Expected life | Notes |
|---|---|---|
| Replacement internal lithium battery (OP-88006) for encoder cable with battery (SV2-BE□□□) | 3 years when off | Non-energized state, ambient operating temperature 20°C |

* The expected life is a reference value. It depends on ambient conditions and application methods.

### ■ Condenser discharge time

Even when powered off, high voltage remains in the servo amplifier. Do not touch the power terminals during the condenser discharge time indicated below.
After the CHARGE indicator lights out, measure the voltage of the DC main line (between terminal codes "B1/⊕" and "⊖" or "⊖2") to ensure safety before performing wiring and inspection tasks.

| Model | Discharge time | |
|---|---|---|
| | When using an AC power supply | When using a DC power supply |
| SV2-005L2 | 6min (60ms*) | 6min |
| SV2-010L2 | 6min (60ms*) | 6min |
| SV2-020L2 | 6min (60ms*) | 6min |
| SV2-040L2 | 6min (70ms*) | 6min |
| SV2-075L2 | 140ms | 15min |
| SV2-100L2 | 140ms | 15min |
| SV2-150L2 | 50ms | 10min |
| SV2-200L2 | 60ms | 20min |
| SV2-300L2 | 60ms | 20min |
| SV2-500L2 | 70ms | 30min |

* The values in parentheses are the values when an external regenerative resistor with the minimum acceptable resistance value of 40Ω is connected.

▶ Important

- **When the parameter is set to an AC power supply input and the recommended power off sequence is configured, the condenser discharge time is the value listed in the "When using an AC power supply" column in the above table.**
- **When the control power is turned off before powering off the main circuit, the same discharge time applies as a DC power supply input if the parameter is set to an AC power supply input.**
- **When the servo amplifier becomes defective, the same discharge time applies as the DC power supply if the parameter is set to an AC power supply input.**

## Inspection of Servo Motor

Perform inspections at appropriate intervals depending on the usage conditions and environment by referring to the inspection intervals listed in the table below.

| Inspecting item | Inspecting time | Inspecting content | Measures |
|---|---|---|---|
| Vibration and sound check | Daily | To check with feeling and hearing. | Please contact the nearest sales agent. |
| Visual check | Depending on conditions of dirt and damage | To clean with a piece of cloth or compressed air. | - |
| Measure insulation resistance | At least one time per year | To measure the insulation resistance with a 500V megohmmeter by disconnecting from servo amplifier. It is normal if the insulation resistance exceeds 10MΩ. (Measured between one phase of the U, V, W phase of motor power line and F.G. ) | Please contact the nearest sales agent if the insulation resistance is less than 10MΩ. Do not perform measurement or voltage withstand test against the insulation resistance of encoder. |
| Comprehensive inspection | At least one time every 20,000 hours or every 5 years | - | Please contact the nearest sales agent. |

## Life Cycle of Servo Motor Components

The expected life of components is shown as follows:
For matters about repairing, please contact the nearest sales agent (on the back cover of this manual).

| Component | Expected life | Notes |
|---|---|---|
| Bearing | 20,000 hours | Check whether the sound or vibration is normal due to influence of operation conditions. |
| Brake | 20,000 hours | Depend on the operating conditions. When performing an inspection, check that there is no abnormal sound or vibration, that the brake is released when energized, and that no changes are observed in the braking time. |

* The expected life is a reference value. It depends on ambient conditions and application methods.

# 4

# SIGNALS AND WIRING

This chapter describes wiring method, specifications of signals and how to avoid noise and high harmonic generated in SV2 series.

# 4-1 Wiring Precautions

Be sure to read "Safety Precautions", Page 1 provided at the beginning of this manual before wiring.

## Wiring Precautions

Follow the precautions below when wiring.

| | |
|---|---|
| ⚠ WARNING | • **Be sure to properly ground the servo amplifier and servo motor. Otherwise, this may cause electric shock.**<br>• **Install the servo motor before connecting wiring. Otherwise, this may cause electric shock.**<br>• **Do not damage, excessively stress, pinch, or place heavy objects on the cables. Otherwise, this may cause electric shock.**<br>• **Be sure to connect wiring correctly and securely. Improper wiring may cause motor runaway, leading to injury.**<br>• **Be sure to connect the servo amplifier ground terminal to the protective earth on the control panel to prevent electrical shocks.**<br>• **Do not open the terminal cover while the servo amplifier is powered. Otherwise, this may cause electric shock.**<br>• **Connect the terminals correctly. Otherwise, this may cause bursting or damage.**<br>• **Confirm the orientation of the surge absorbing diode attached to the DC relay for control output. If the orientation is wrong, the diode may malfunction and signals may not be output, disabling the forced stop or other functions of the protection circuit.**<br>• **Be sure to use the proper connection cables as specified in the instruction manual and other documents.**<br>• **The servo amplifier does not have a built-in ground protection circuit. You must install a ground-fault interrupter which also serves as protection for overloads and short-circuits, or use a ground-fault interrupter for ground protection together with a circuit breaker.**<br>• **The servo amplifier is not insulated with a transformer or another form of insulation. Be sure to provide a circuit breaker or fuse.**<br>• **Do not frequently turn the servo amplifier on/off. Otherwise, this may cause deterioration of the main circuit elements inside the amplifier.** |
| *NOTICE* | • **The electromagnetic noise generated by the servo amplifier may interfere with other nearby electronic devices. Use a noise filter or other measures to minimize the influence of electromagnetic interference.**<br>• **Do not use a phase advancing capacitor or surge absorber for the power supply cable of the servo motor.**<br>• **When using a regenerative resistor, configure the system so that the power will shut down with an error signal. Otherwise, the regenerative resistor may become abnormally hot due to transistor malfunction, resulting in fire.**<br>• **Limit the length of the cables as follows:**<br>**I/O cable: 3 m max.**<br>**Encoder cable: 50 m max.**<br>**Motor power cable: 50 m max.**<br>• **Connect the main circuit power cable, I/O cable, and encoder cable at least 30 cm apart from one another. Do not pass them through the same duct or bind them.**<br>• **Provide Class D grounding (contact resistance: 100 Ω max.).**<br>• **Use a cable as wide as possible (at least 2.00mm$^2$) for the main circuit power cable.**<br>• **Be sure to connect at least a single ground point.**<br>• **When the servo motor is insulated from other equipment, directly ground the servo motor.**<br>• **Be careful not to bend the signal cables excessively and not to apply tension to them.** |

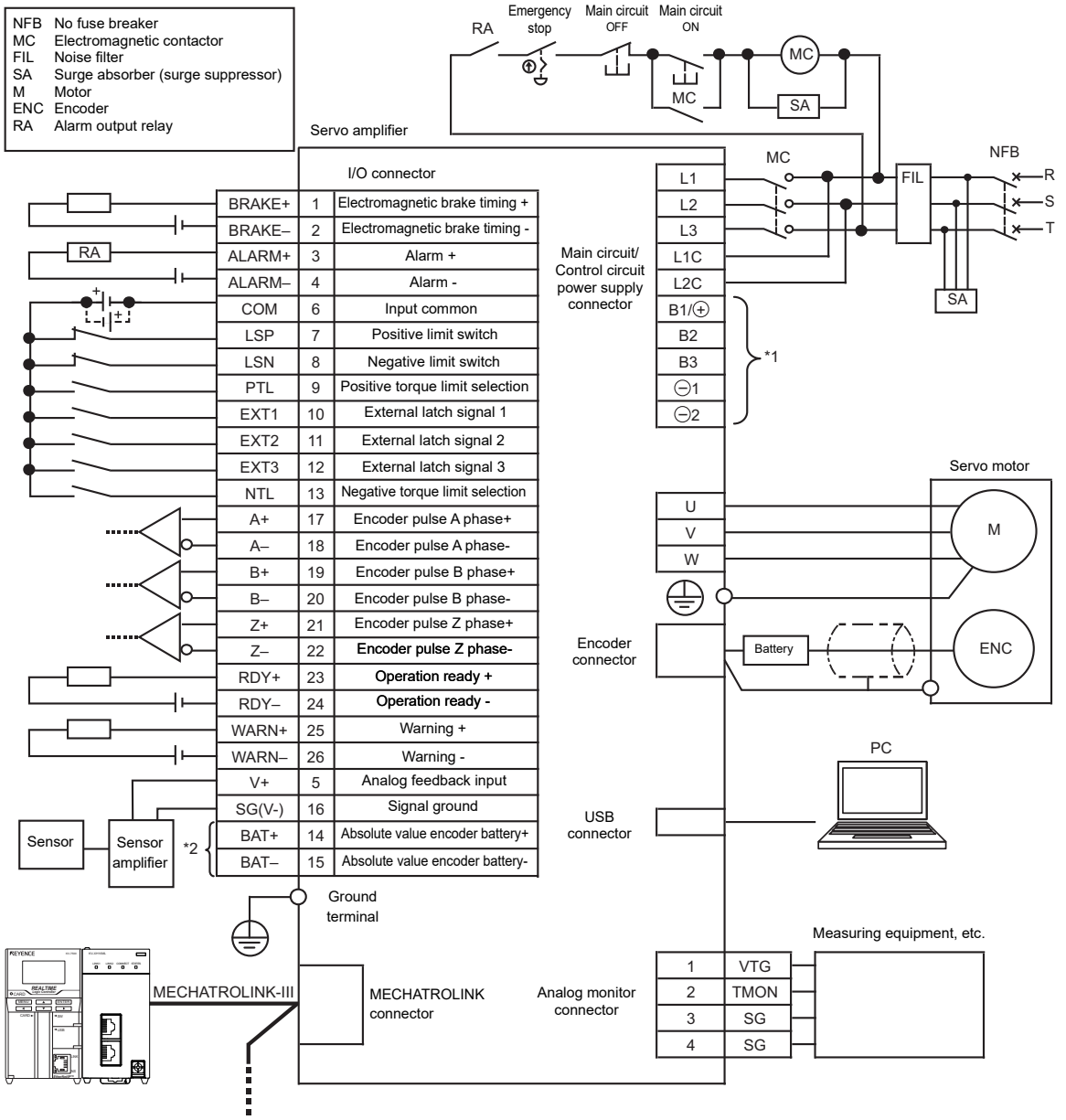
## ■ About crimp terminals and insulating sleeves

When wiring, use an insulating sleeve if you are using crimp terminals.
Also, be careful not to place a crimp terminal close to the neighboring terminals or casing when using one.
Use an UL listed round crimp terminal and insulating sleeve for UL conformity.
Use the tools recommended by the terminal manufacturer to crimp the crimp terminals.
The recommended ring crimp terminal size is shown below.

| Model (SV2-) | Main circuit terminal | Screw size | Tightening torque [N·m] | Crimp terminal width |
|---|---|---|---|---|
| 005L2, 010L2, 020L2, 040L2, 075L2, 100L2, 150L2 | Connector | - | - | - |
| | ⏚ | M4 | 1.2 to 1.4 | 10 mm or less |
| 200L2, 300L2 | Terminal block | M4 | 1.0 to 1.2 | 7.7 mm or less |
| | ⏚ | M4 | 1.2 to 1.4 | 10 mm or less |
| 500L2 | Terminal block | M4 | 1.0 to 1.2 | 9.9 mm or less |
| | ⏚ | M4 | 1.2 to 1.4 | 10 mm or less |

## ■ Standard wiring

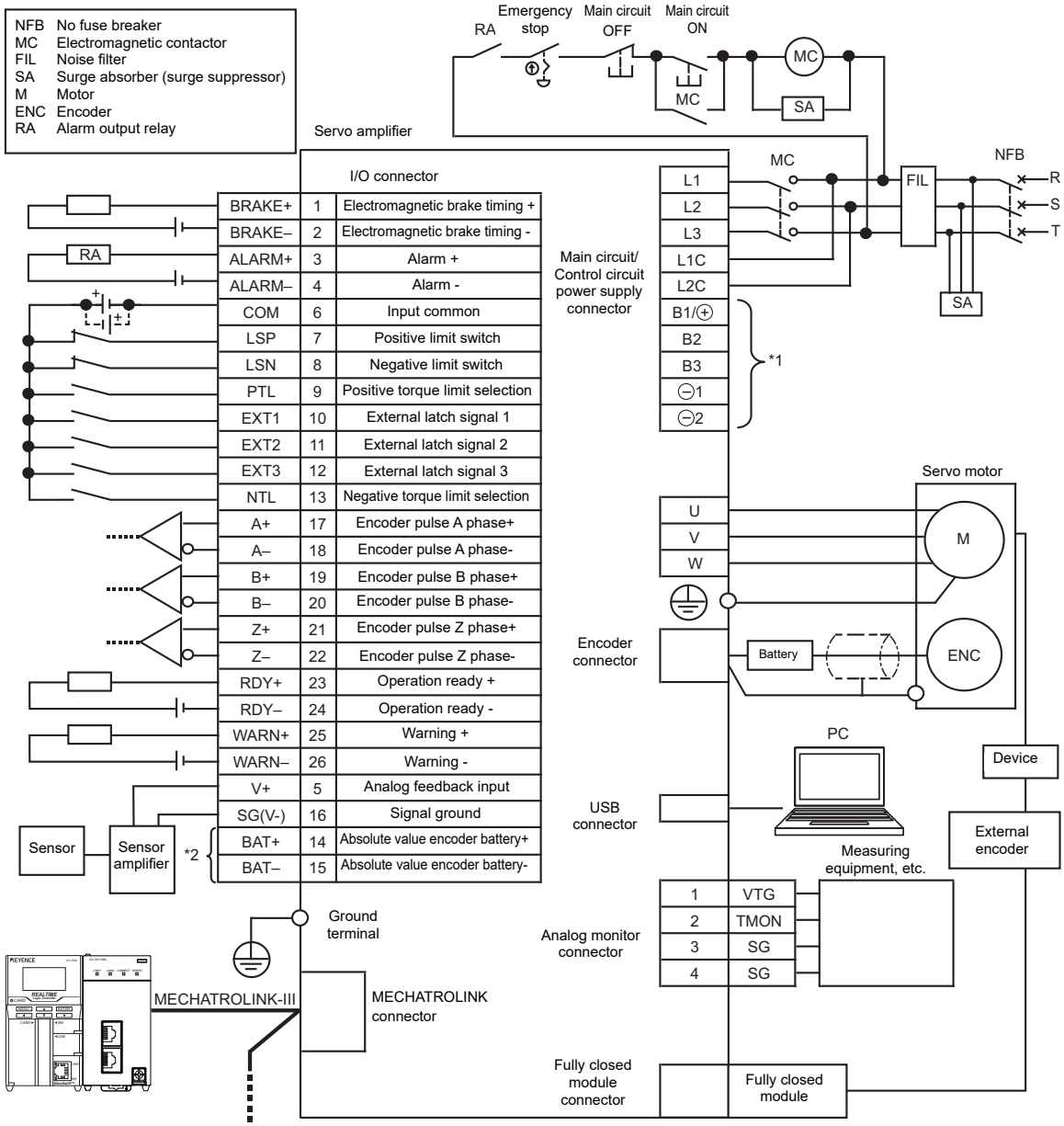
### ● MECHATROLINK-III standard wiring diagram




*1 Wiring varies whether or not to use an external regenerative resistor and DC reactor.

*2 Connect when using an absolute value encoder backup battery. Do not connect these components when using a battery-equipped encoder cable.

## ● Wiring when using a fully closed module




*1 Wiring varies whether or not to use an external regenerative resistor and DC reactor.

*2 Connect when using an absolute value encoder backup battery. Do not connect these components when using a battery-equipped encoder cable.

This section describes how to connect the main circuit/control circuit power cables.

## List of Terminal Names and Functions

The name and function of each main circuit/control circuit power cable terminal is as follows.

| Terminal name | Terminal symbol | Model | Function and Rating |
|---|---|---|---|
| Main circuit terminal | L1, L2, L3 | SV2-□□L2 | 3-phase (or a single-phase*2) 200 VAC to 240 VAC (-15% to +10%), 50/60Hz<br>270 VDC to 324 VDC*3 (-15% to +10%) |
| Control circuit terminal | L1C, L2C | SV2-□□L2 | Single-phase 200 VAC to 240 VAC (-15% to +10%), 50/60Hz<br>270 VDC to 324 VDC*3 (-15% to +10%) |
| Regenerative resistor connection terminal | B1/⊕, B2, B3*1 | SV2-005L2<br>SV2-010L2<br>SV2-020L2<br>SV2-040L2 | Connect an external regenerative resistor (optional) between B1/⊕ and B2 when the regenerative processing capability is not sufficient. |
| | | SV2-075L2<br>SV2-100L2<br>SV2-150L2<br>SV2-200L2<br>SV2-300L2<br>SV2-500L2 | Open between B2 and B3 and connect an external regenerative resistor (optional) between B1/⊕ and B2 when regenerative resistance provided from the regenerative resistor built in the amplifier is not sufficient. |
| DC reactor | ⊖1, ⊖2*1 | SV2-□□L2 | Connect a DC reactor between ⊖1 and ⊖2 when mains harmonics need to be controlled. |
| - | ⊖ | SV2-□□L2 | Do not wire this terminal. |

*1 Use terminals B1⊕/ and ⊖2 as the main circuit power cable terminals when using a DC power supply.
*2 SV2-100L2/150L2/200L2/300L2/500L2 use only three-phase terminals.
*3 To use DC power source input, set "*AC/DC power source" to "DC".

## Wire Size

This section describes the wire sizes that are used for the servo amplifier main circuit.

▶ Important

- **The specifications are for when the ambient temperature is 40°C, and rated current flows through a bundle of 3 wires.**
- **Use wires with 600 V or above withstand voltage for the main circuit.**
- **When placing bundled wires in hard plastic tubes or metal conduits, consider the decrease rate of the wire's allowable current.**
- **Use heat-resistant wire when the ambient temperature (temperature inside the control panel) is high. Normal insulated vinyl wires degrade quickly due to heat and become unusable in a short period of time.**

### ■ 200 VAC power supply

| Terminal name | SV2 Series servo amplifier | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 50 W | 100 W | 200 W | 400 W | 750 W | 1.0 kW | 1.5 kW | 2.0 kW | 3.0 kW | 5.0 kW |
| Main circuit terminal L1, L2, L3*1 | AWG16 | | | | *2 | | AWG14 | | AWG12 | AWG8 |
| Control circuit terminal L1C, L2C | AWG16 | | | | | | | | | |
| Servo motor terminals U, V, W | AWG16 | | | | | | AWG14 | AWG10 | | AWG8 |
| Regenerative resistor connection terminal B1/⊕, B2 | AWG16 | | | | | | | | | AWG14 |
| Protective earth terminal ⏚ | AWG14 | | | | | | | | | |

*1 When single-phase 200 VAC is used, L3 is not used.
*2 When a 750 W servo amplifier is used with single-phase 200 VAC, use main circuit terminal L1 and L2 for the AWG14 power cable.

### ■ DC power supply

| Terminal name | SV2 Series servo amplifier | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 50 W | 100 W | 200 W | 400 W | 750 W | 1.0 kW | 1.5 kW | 2.0 kW | 3.0 kW | 5.0 kW |
| Main circuit terminal B1/⊕, ⊖2 | AWG16 | | | | | | AWG14 | AWG10 | | AWG8 |
| Control circuit terminal LC1, LC2 | AWG16 | | | | | | | | | |
| Servo motor terminals U, V, W | AWG16 | | | | | | AWG14 | AWG10 | | AWG8 |
| Protective earth terminal ⏚ | AWG14 | | | | | | | | | |



## Wiring the Main Circuit/Control Circuit and Motor Power Supply Connector

The main circuit/control circuit and motor power supply connector consist of main circuit power supply terminals and control power supply terminals.
For 2kW or greater servo amplifiers, screw terminals are formed as the main circuit power supply input terminals, control circuit power supply input terminals, and motor connection terminals. Tighten the terminals securely with the tightening torque from 1.0 to 1.2 N·m.

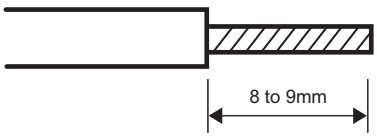
| | |
|---|---|
| *NOTICE* | **Follow these instructions when wiring the main circuit/control circuit and motor power supply connector of the servo amplifier.**<br>**• Do not turn on the servo amplifier until wiring is completed, including the main circuit/ control circuit and motor power supply connector.**<br>**• Remove the main circuit/control circuit and motor power supply connector from the servo amplifier to connect wiring.**<br>**• Insert one wire into each of the wire insertion ports of the main circuit/control circuit and motor power supply connector.**<br>**• When inserting a wire, be careful that the frayed core wire does not touch (short-circuit) nearby wires.**<br>**• For servo amplifiers above 2kW, be sure to tighten all the screw terminals (including the terminals not connected) according to the specified tightening torque.** |

### ■ Wiring procedure

**1 Remove the main circuit/control circuit and motor power supply connector from the servo amplifier.**

**2 Strip the end of the wire used for connection.**

Refer to "Wire Size", Page 4-6 for the size of the wire to be used.

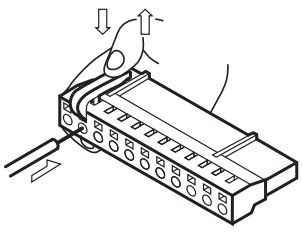



**3 Use a tool to open the wire insertion port of the power supply connector.**

To open the port, use one of the following two methods:

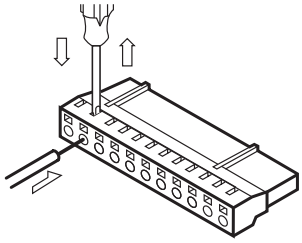
• **To use a spring opener supplied with the servo amplifier:**

Reference A spring opener from Tyco Electronics AMP (1981045-1) can also be used.



• **To use a commercially available flathead screwdriver:**

Insert a commercially available flathead screwdriver (tip width: 3.0 to 3.5 mm) into the port and open it.
* Do not insert too far. Otherwise, this may cause damage to the connector.



**4 Insert the core wire into the wire insertion port.**

After the core wire is inserted, pull out the connector lever or screwdriver and confirm that the wire is securely connected.

**5 Repeat the steps above to connect all necessary wires.**

**6 Connect to the servo amplifier.**



## Wiring the Power Supply of Main/Control Circuit

Wiring the power supply of main/control circuit is described as follows.
For internal circuit of the servo amplifier, see "A-2 Internal Block Diagram", Page A-19.

### ■ 3-phase 200 VAC

For wiring example, see "4-2 Standard Wiring Diagram", Page 4-4.

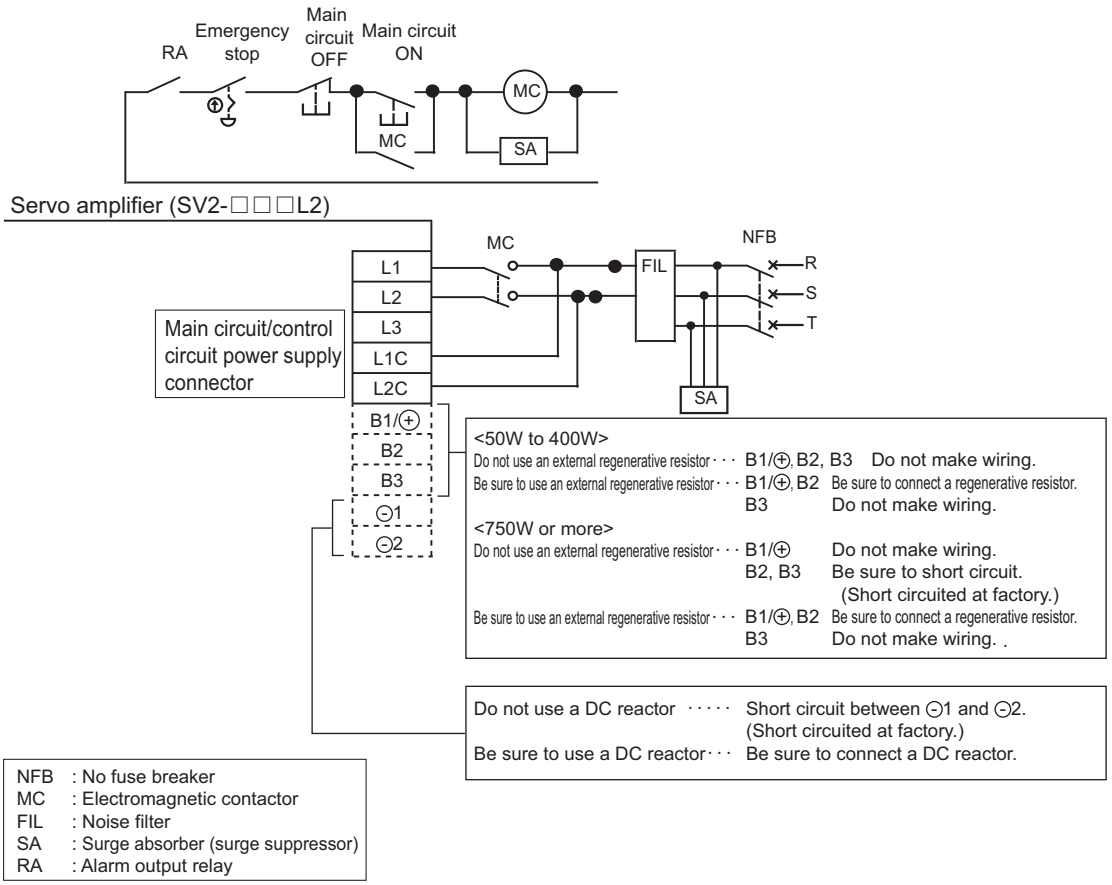
### ■ 1-phase 200 VAC

To wire L1/L2 when 1-phase 200 VAC is used.

**Point**

- **Do not connect to L3 when using a single-phase 200 VAC power supply. Be sure to change "*3PH/1PH power supply" (OTH_20) to "single phase". "Main circuit open phase" alarm (F10) will occur when "three-phase" is set.**
- **When 1-phase 200 VAC is used, Torque ─ rotation Speed Characteristic of servo motor may not be able to meet the characteristics of 3-phase power input. For details, See "2-4 Servo Motor Specifications", Page 2-11.**

Wiring example is as follows.




| NOTICE | **If you wire the terminals marked with "Not used", the servo amplifier may be damaged. Be sure to never wire such terminals.** |
|---|---|

## ■ DC power supply

B1/⊕ and ⊖2 terminals become the input terminals of DC power supply when DC power supply is used.
For the parameter setting when DC power supply is used, see "5-1 Main Circuit/Control Circuit Power Supply Setting", Page 5-2.

| Terminal | Name | Functions and ratings |
|---|---|---|
| B1/⊕ | Positive terminal of main circuit | 270 VDC to 324 VDC (-15% to +10%) |
| ⊖2 | Negative terminal of main circuit | 0 VDC |
| L1C, L2C | Power terminal of control circuit | 270 VDC to 324 VDC (-15% to +10%) |

**Important**

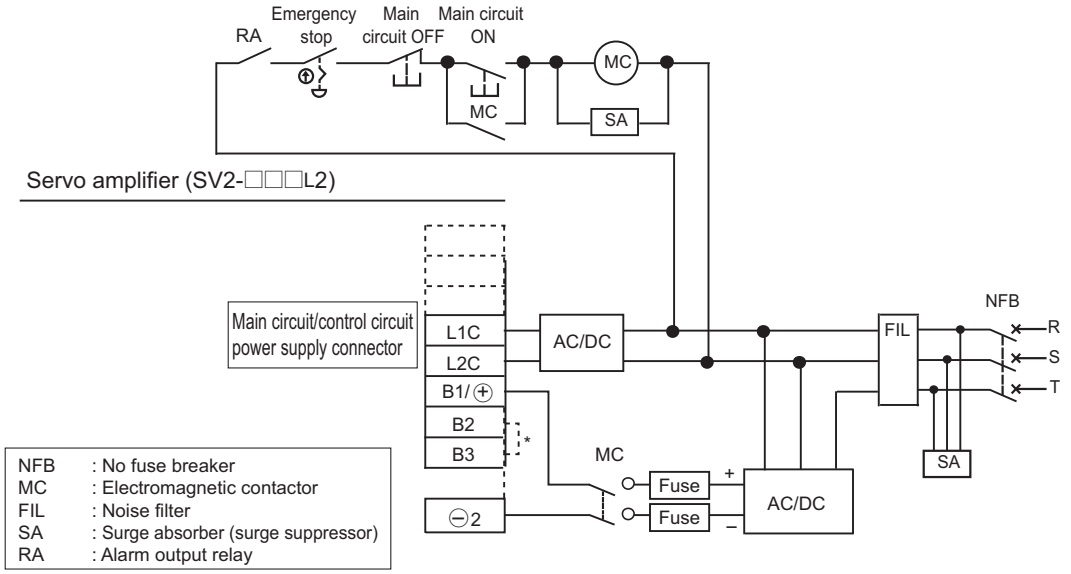
- **Be sure to connect fuses for DC power input.**
- **In DC power input mode, "Main circuit wiring error" alarm (330) will occur when AC power is input from L1, L2 or L3 terminals.**
- **When DC power is used for SV2 series, discharging will consume a lot of time after powering main circuit power OFF. In this case, there is still high voltage inside servo amplifier, take care to avoid being electrocuted.**
- **When DC power input is used, because there is no reverse protection circuit inside, do no connect reversely. Otherwise this may result in failure or damage.**
- **For servo amplifiers with the built-in regenerative resistor (SV2-075L2 or later), do not supply DC power to the main circuit when "*AC/DC power supply (OTH_19)" is set to "AC". Otherwise, this may cause malfunction. When making changes to the settings, be sure not to apply a voltage to the main circuit power supply.**

**Point**

**Because regeneration is unavailable for DC power inputs, be sure to apply regeneration processing at the power supply side.**

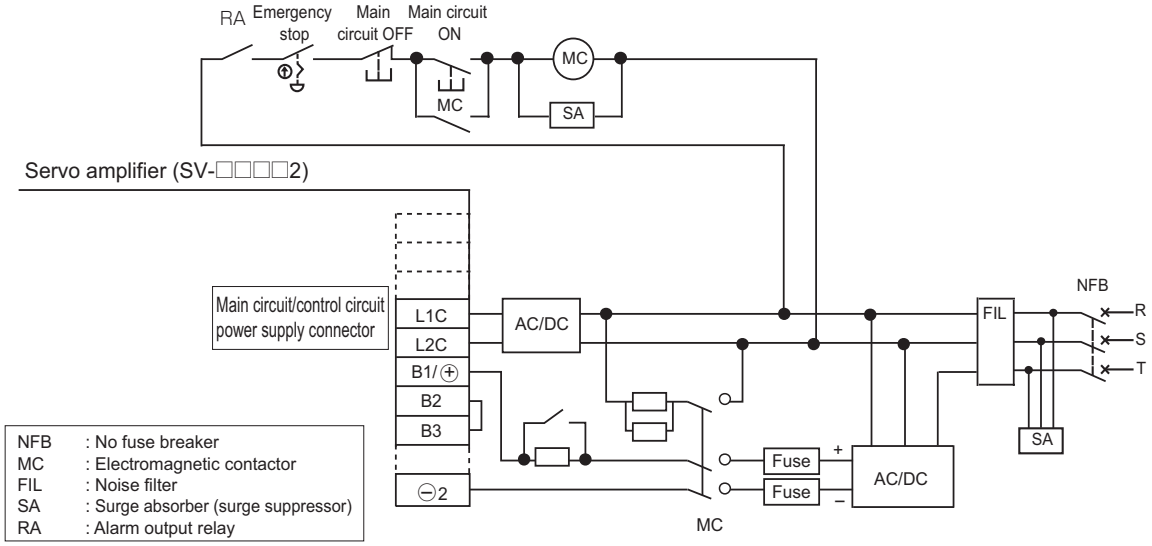
Wiring example is as follows.

- **SV2-005L2/010L2/020L2/040L2/075L2/100L2/150L2/200L2/300L2**




*1 For SV2-075L2/100L2/150L2/200L2/300L2, short-circuit between B2 and B3.
For SV2-005L2/010L2/020L2/040L2, no short-circuits.

- **SV2-500L2**




## ■ Circuit breaker and fuse when using a DC power supply

Use a circuit breaker and fuse to protect the power supply line. These cut off the circuit in the case of overcurrent. Select products based on the table below.
(Note) The current capacity and inrush current in the table below are for reference only.

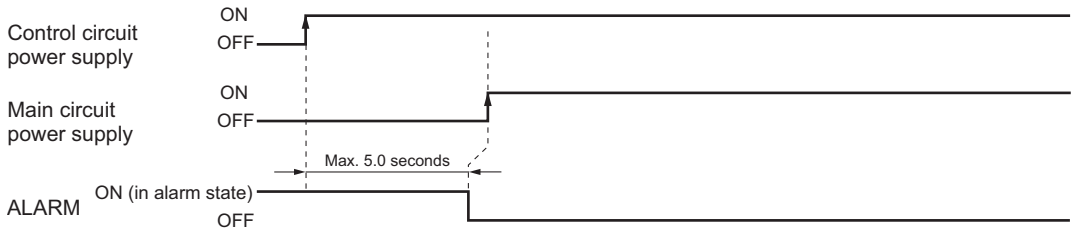
| Main circuit power source | Servo amplifier model SV2- | Power supply capacity [kVA] per servo amplifier*1 | Current capacity | | Incoming current | | External fuse | |
|---|---|---|---|---|---|---|---|---|
| | | | Main circuit [Arms]*1 | Control power [Arms] | Main circuit [A0-p] | Control power [A0-p] | Rated current [A] | Rated voltage [Vdc] |
| 270 VDC | 005L2 | 0.2 | 0.5 | 0.2 | 34 | 34 | 16 | 400 |
| | 010L2 | 0.3 | 1.0 | | | | | |
| | 020L2 | 0.5 | 1.5 | | | | | |
| | 040L2 | 1.0 | 3.0 | | | | 20 | |
| | 075L2 | 1.6 | 4.9 | | | | 40 | |
| | 100L2 | 2.3 | 6.9 | | | | | |
| | 150L2 | 3.2 | 11 | | | | | |
| | 200L2 | 4.0 | 14 | 0.25 | | | 63 | |
| | 300L2 | 5.9 | 20 | | | | | |
| | 500L2 | 7.5 | 34 | 0.3 | 68*2 (External 5 Ω) | | 100 | |

*1 These are the reference values at the rated load.

*2 To use SV2-500L2 with a DC power supply, connect the anti-surge circuit externally so the power on/off sequence is executed as recommended by us.
Otherwise, the equipment may be damaged.
Refer to 🕮 "Power On Sequence", Page 4-11 for further information on the power on/off sequence.

## Power On Sequence

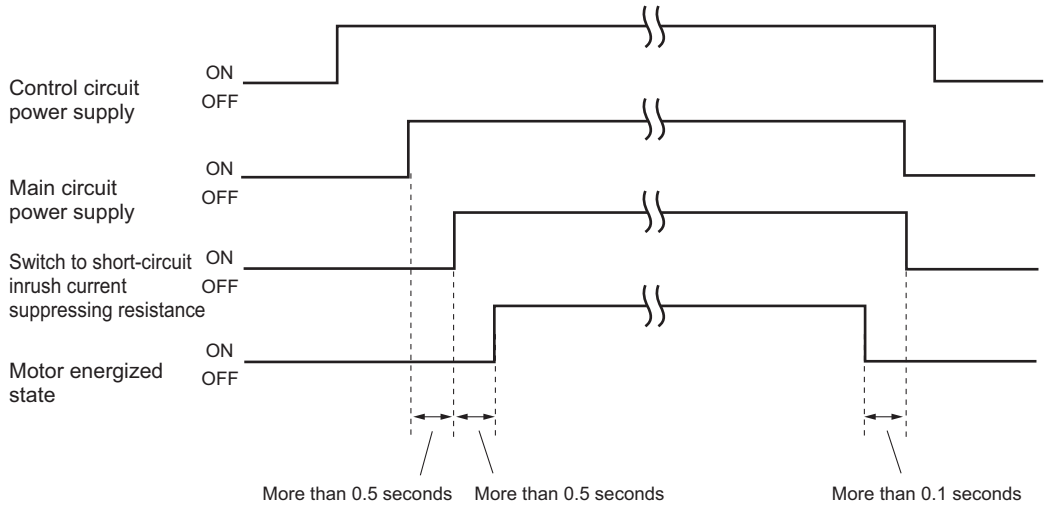
When powering on the control circuit, the "alarm (ALARM)" signal is output for up to 5 seconds.
Wait at least 5 seconds after the control circuit has been powered on and the "alarm (ALARM)" signal has been turned off before powering on the main circuit.




▶ Important

**Turn on the main circuit and the control circuit simultaneously, or turn on the control circuit first, then the main circuit.**
**When turning off the power turn off the main circuit first, then the control circuit.**

- **Power on SV2-500L2 in the following power on sequence when using a DC power supply.**




▶ Important

- **Once the "alarm (ALARM)" signal is output, design so that the main circuit is powered off.**
- **Power supply specifications of the components should correspond with those of the input power source.**
- **Wait at least 1 second after powering off before repowering.**

This section describes how to wire motor power cables, encoder cables and electromagnetic brake and how to prepare cables.

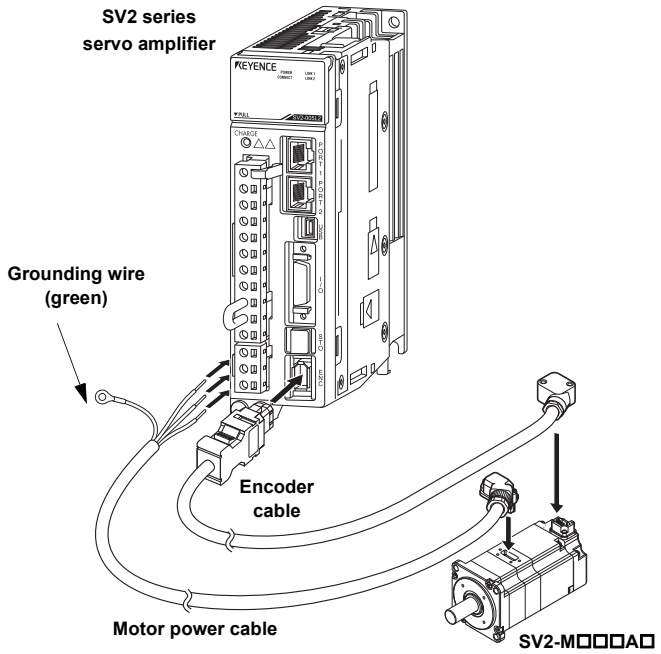
## Connecting Servo Amplifier and Servo Motor

### ■ Overview

Servo amplifier and servo motor can be connected with encoder cables and motor power cables.

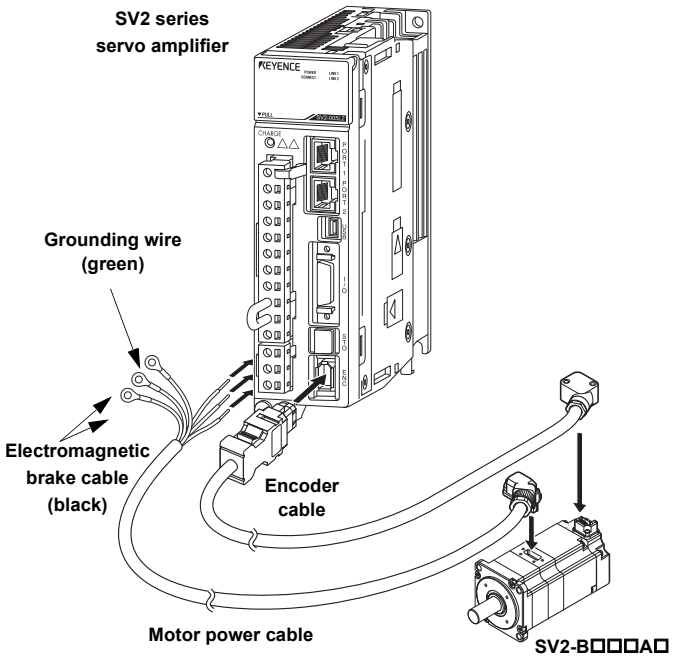
#### ● Standard motor

When standard motor is used, please connect servo amplifier and servo motor as the following diagram.




#### ● Electromagnetic brake motor

When motor with electromagnetic brake is used, please connect servo amplifier and servo motor as the following diagram.




**Point**

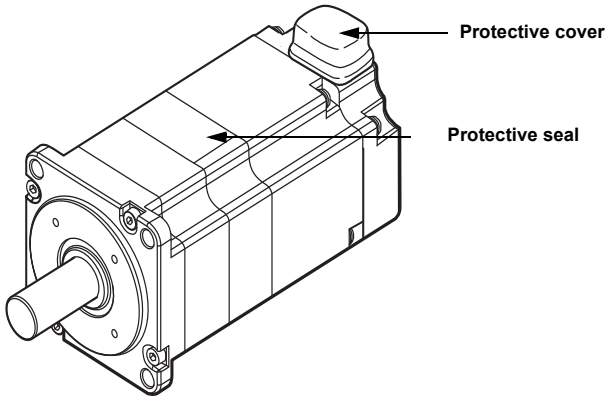
- **Connect the earth cable to the servo amplifier ground terminal.**
- **When using SV2-□100A□/□150A□/□200A□/□300A□/□500A□ motors, the servo motor connectors vary in shape.**
- **When using SV2-B100A□/B150A□/B200A□/B300A□/B500A□ motors, an additional electromagnetic brake cable is required.**

## ■ Wiring servo motor

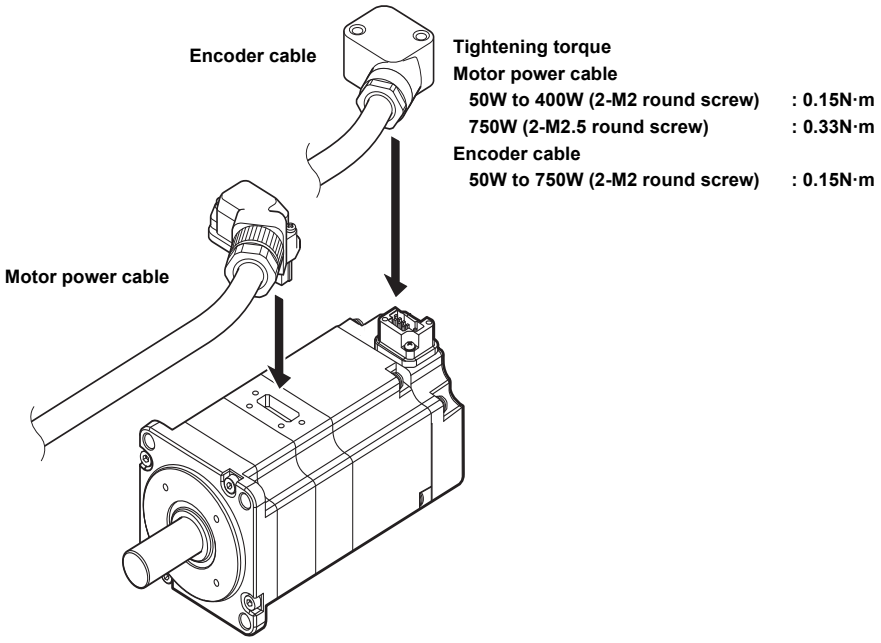
For wiring of encoder cables and motor power cables, please follow the sequence of servo motor → servo amplifier.

### ● Wiring procedures for encoder cable and motor power cable

**1 Remove the protective seal and cover on the servo motor.**




**2 Install based on the sequence of motor power cable and encoder cable.**




**Tightening torque**
**Motor power cable**
**50W to 400W (2-M2 round screw) : 0.15N·m**
**750W (2-M2.5 round screw) : 0.33N·m**
**Encoder cable**
**50W to 750W (2-M2 round screw) : 0.15N·m**

▶ Important

- **Be sure to install based on the sequence of motor power cables and encoder cables. If encoder cables are first connected, this may lead to encoder damage because of the potential relative to FG.**
- **Do not remove the rubber gasket. In addition, be sure to avoid movement of the rubber gasket during installation. If installation is not correct, it may not be able to meet the requirements of protective structures.**
- **The shape of connectors used for SV2-□100A□/□150A□/□200A□/□300A□/□500A□ servo motors are different. Connectors of various cables should be tightened firmly.**

## ● Precautions on connector

For connector, be sure to notice the followings.

- When connecting the connectors, connection part should be checked whether there are garbage or metal coupon or other foreign matters.
- Be sure to check whether there is wiring error when wiring.
- Be sure to avoid the connector part being pressed when wiring.
- Do not exert strong impact to connectors. Because the material is resin, it may be damaged.
- Be sure to hold the servo motor to move it when moving servo motor with connected cables. When the cables are held, there may be stresses on the cables, which may damage the connector or break the cable.

## ● Precautions on cable

SV2 series can be wired with standard cables and flexible cable.
Overbending or tension should be avoided on cable itself or cable leads. Recommended cable bending radius R is as follows.

- **Standard cable**

Recommended bend radius R for fixed cable areas
Motor power cable
50W to 400W: >= R15
750W: >= R20
1kW to 5kW: More than 3 times the cable outer diameter
Electromagnetic brake power cable
1kW to 5kW: >= R15
Encoder cable
Full capacity: >= R15
* Can not be used for bending purpose

- **Flexible cable**

Recommended cable bending R of bending radius part : >= R90
Bending lifetime : >= 10 million times

Recommended cable bending radius R of fixed part
Motor power cable
50W to 400W: >= R15
750W: >= R20
Encoder cable
Full capacity: >= R15

## ● Wiring flexible cables

Please notice the followings.

- **Torsion of cables**
  Cable surface should be checked whether there is torsion phenomenon, so as to ensure wiring in the status that cables are straight. Cable torsion may cause cables break.

- **Cable length**
  When cables are too short, tension at the fixed position will increase; or when cables are too long, they may be relaxed, which may lead to cable break. Proper length of cables should be used.

- **Fix of cables**
  Movable part of the cables should not be fixed, or be fixed with the minimum limit. Otherwise concentrated stress at the fixed position may cause the cable break.
  At the same time, stresses at the connector position of servo motor and servo amplifier should be avoided.
  It may damage the cables.

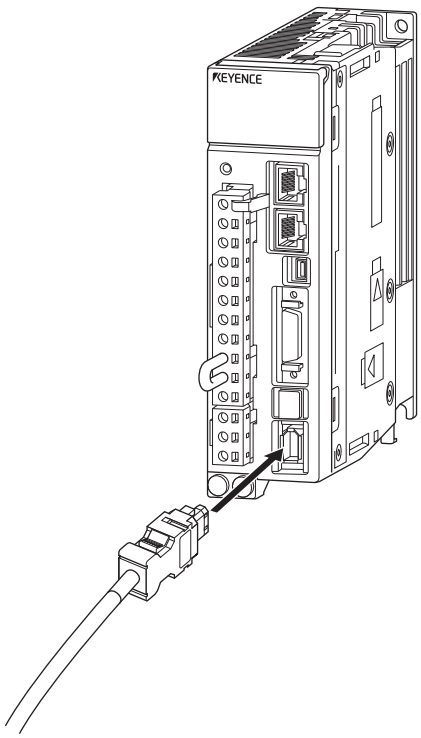
- **Distance from other cables**
  Be sure to leave enough distance from other cables when wiring, or baffles must be used to prevent interferences among cables. Interferences among cables may limit the movement of cables, and may cause cable breaks.

## ■ Wiring servo amplifiers

To connect the cables to servo amplifiers after wiring of servo motor finished.

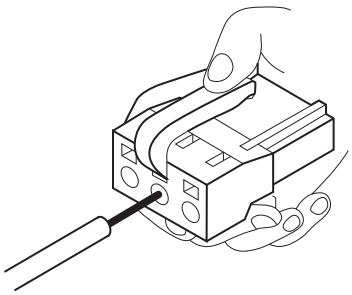
### ● Wiring procedures of encoder cable

Insert the servo amplifier side of the encoder cable into the encoder connector of the servo amplifier.




### ● Wiring procedures of motor power cables

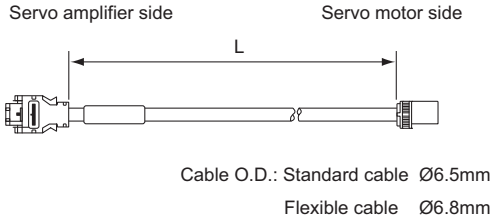
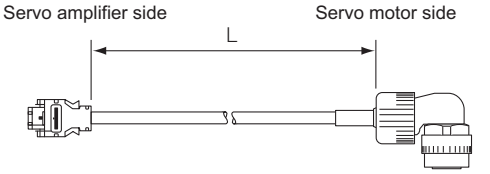
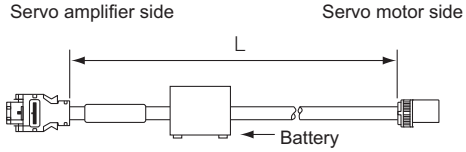
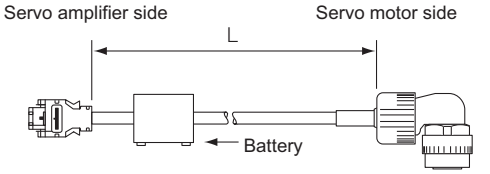
Same as wiring of motor power connector cables, "Wiring the Main Circuit/Control Circuit and Motor Power Supply Connector", Page 4-7.



## Encoder Cable

### ■ Model and shape

Model and shape of encoder cable are as follows.

| Name | Length (L) | Model | | Shape |
|---|---|---|---|---|
| | | Standard cable | Flexible cable | |
| Encoder cable (for 50W to 750W) | 3m | SV2-E3 | SV2-E3G |  Cable O.D.: Standard cable Ø6.5mm<br>Flexible cable Ø6.8mm |
| | 5m | SV2-E5 | SV2-E5G | |
| | 10m | SV2-E10 | SV2-E10G | |
| | 20m | SV2-E20 | SV2-E20G | |
| Encoder cable (for 1kW to 5kW) | 3m | SV-E3A | - |  Cable O.D.: Ø6.5mm |
| | 5m | SV-E5A | - | |
| | 10m | SV-E10A | - | |
| | 20m | SV-E20A | - | |
| Encoder cable with the battery (for 50W to 750W) | 3m | SV2-BE3 | SV2-BE3G |  Cable O.D.: Standard cable Ø6.5mm<br>Flexible cable Ø6.8mm |
| | 5m | SV2-BE5 | SV2-BE5G | |
| | 10m | SV2-BE10 | SV2-BE10G | |
| | 20m | SV2-BE20 | SV2-BE20G | |
| Encoder cable with the battery (for 1kW to 5kW) | 3m | SV2-BE3A | - |  Cable O.D.: Ø6.5mm |
| | 5m | SV2-BE5A | - | |
| | 10m | SV2-BE10A | - | |
| | 20m | SV2-BE20A | - | |

## Motor Power Cable

For use of motor power cables, please abide by the followings.

**Important**

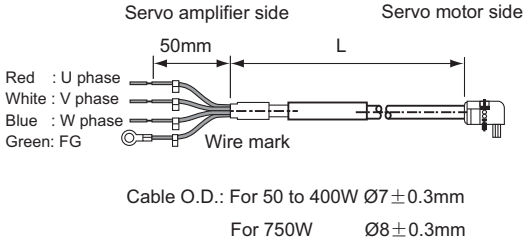
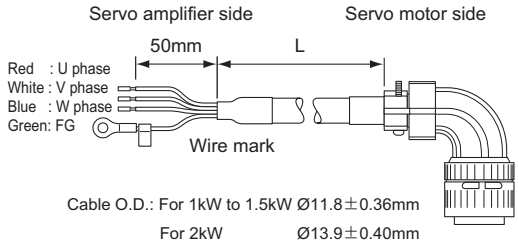
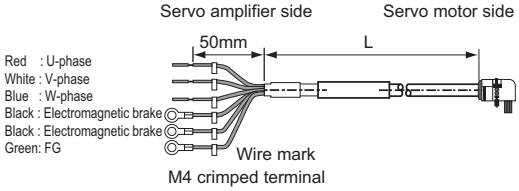
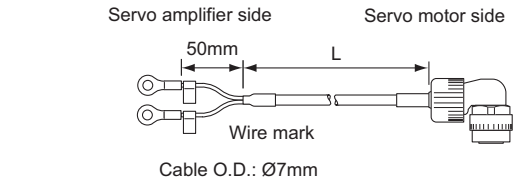
- **Servo motors must be connected to grounding, otherwise it may cause electrocution. For grounding method, see "4-10 Remedying Noise and High Harmonics", Page 4-43.**
- **In order to prevent the danger from movement of movable part of servo amplifiers when the power is OFF, which is caused by the dead weight of movable part of servo amplifiers or external forces on them, motor with electromagnetic brake can be used sometimes. When motor with electromagnetic brake is used, see "Electromagnetic Brake", Page 4-18.**

**Point**

**The wiring between servo motor and servo amplifier must be connected correctly according to terminal name (U, V, W). Otherwise the servo motor will be abnormal.**

## ■ Model

Model and shape of motor power cable are as follows.

| Name | Applicable capacity of servo amplifier | Length (L) | Model | | Shape |
|---|---|---|---|---|---|
| | | | Standard cable | Flexible cable | |
| Motor power cable (without electromagnetic brake) | 50W 100W | 3m | SV2-C3A | SV2-C3AG |  |
| | | 5m | SV2-C5A | SV2-C5AG | |
| | | 10m | SV2-C10A | SV2-C10AG | |
| | | 20m | SV2-C20A | SV2-C20AG | |
| | 200W 400W | 3m | SV2-C3B | SV2-C3BG | |
| | | 5m | SV2-C5B | SV2-C5BG | |
| | | 10m | SV2-C10B | SV2-C10BG | |
| | | 20m | SV2-C20B | SV2-C20BG | |
| | 750W | 3m | SV2-C3C | SV2-C3CG | |
| | | 5m | SV2-C5C | SV2-C5CG | |
| | | 10m | SV2-C10C | SV2-C10CG | |
| | | 20m | SV2-C20C | SV2-C20CG | |
| | 1kW 1.5kW | 3m | SV-C3D | - |  |
| | | 5m | SV-C5D | - | |
| | | 10m | SV-C10D | - | |
| | | 20m | SV-C20D | - | |
| | 2kW | 3m | SV-C3E | - | |
| | | 5m | SV-C5E | - | |
| | | 10m | SV-C10E | - | |
| | | 20m | SV-C20E | - | |
| | 3kW 5kW | 3m | SV-C3F | - | |
| | | 5m | SV-C5F | - | |
| | | 10m | SV-C10F | - | |
| | | 20m | SV-C20F | - | |
| Motor power cable (with electromagnetic brake) | 50W 100W | 3m | SV2-D3A | SV2-D3AG |  |
| | | 5m | SV2-D5A | SV2-D5AG | |
| | | 10m | SV2-D10A | SV2-D10AG | |
| | | 20m | SV2-D20A | SV2-D20AG | |
| | 200W 400W | 3m | SV2-D3B | SV2-D3BG | |
| | | 5m | SV2-D5B | SV2-D5BG | |
| | | 10m | SV2-D10B | SV2-D10BG | |
| | | 20m | SV2-D20B | SV2-D20BG | |
| | 750W | 3m | SV2-D3C | SV2-D3CG | |
| | | 5m | SV2-D5C | SV2-D5CG | |
| | | 10m | SV2-D10C | SV2-D10CG | |
| | | 20m | SV2-D20C | SV2-D20CG | |
| Electromagnetic brake power cable | 1kW 1.5kW 2kW 3kW 5kW | 3m | SV-D3D | - |  |
| | | 5m | SV-D5D | - | |
| | | 10m | SV-D10D | - | |
| | | 20m | SV-D20D | - | |



Cable O.D.: For 50 to 400W Ø7±0.3mm
For 750W Ø8±0.3mm



Cable O.D.: For 1kW to 1.5kW Ø11.8±0.36mm
For 2kW Ø13.9±0.40mm
For 3kW to 5kW Ø19.3±0.46mm
*For types ending with "E" or "F", round terminals are attached to all U-, V-, and W-phases.



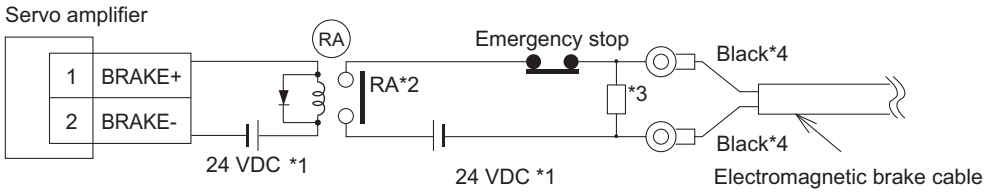
Cable O.D.: For 50 to 400W Ø7±0.3mm
For 750W Ø8±0.3mm



Cable O.D.: Ø7mm

## Electromagnetic Brake

When the power of servo amplifier is OFF, an electromagnetic brake should be used to prevent the movement of movable part of machines because of the dead weight of movable part of servo amplifiers or external forces on them.




*1 Power supply for electromagnetic brake can't be used for control I/O.

*2 Back electromotive force is generated at electromagnetic brake ON/OFF, so relay contacts must be used.

*3 In order to suppress the surge voltage occurred at electromagnetic brake ON/OFF, varistor or diode must be connected.
If varistor or diode is connected, please pay attention to the braking delay for electromagnetic brake.
"5-5 Electromagnetic Brake Setting", Page 5-25

*4 For electromagnetic brake cables for 750W or less. Otherwise it is black and white independent on the polarity.

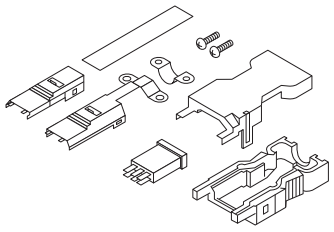
## How to Prepare Cables

Servo amplifier and servo motor cables can be prepared with optional connector set .
Connector set is divided according to capacity of servo amplifiers as follows.

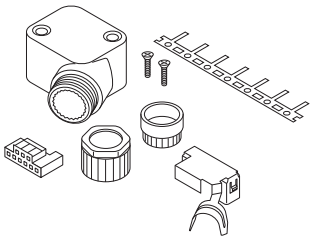
| | | |
|---|---|---|
| 50W to 100W | Encoder and motor power connector set SV-CN1 | |
| 200W to 400W | Encoder and motor power connector set SV-CN2 | |
| 750W | Encoder and motor power connector set SV-CN3 | |
| 1kW to 2kW | Encoder connector set | OP-87066 (angle), OP-87065 (straight) |
| | Motor power connector set | OP-87064 (angle), OP-87063 (straight) |
| | Electromagnetic brake connector set | OP-87068 (angle), OP-87067 (straight) |
| 3kW to 5kW | Encoder connector set | OP-87066 (angle), OP-87065 (straight) |
| | Motor power connector set | OP-87071 (angle), OP-87070 (straight) |
| | Electromagnetic brake connector set | OP-87068 (angle), OP-87067 (straight) |

Connector set consists of the following accessories. Be sure to check if these accessories are complete.

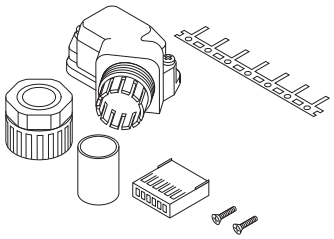
- **Encoder and motor power connector set (50W to 750W)**



(1) Encoder connector (Servo amplifier side)



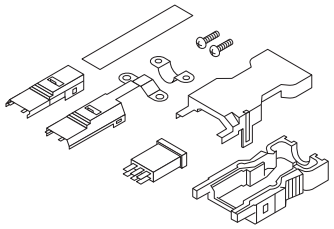
(2) Encoder connector (Servo motor side)



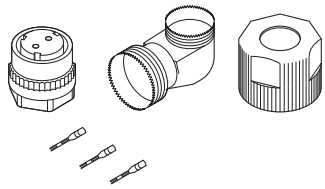
(3) Motor power connector*

* Shape and number of contacts depends on the capacity of servo amplifier.

- **Encoder connector set (1kW to 5kW)**

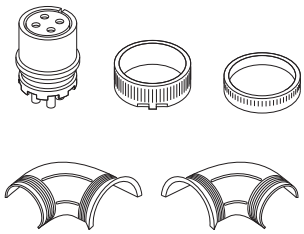


(4) Encoder connector
(Servo amplifier side)



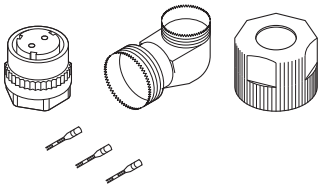
(5) Encoder connector
(Servo motor side)

- **Motor power connector set (1kW to 5kW)**



(6) Motor power connector

- **Electromagnetic brake connector set (1kW to 5kW)**



(7) Electromagnetic brake connector

## ■ Encoder cable (50W to 750W)

### ● Components and specifications

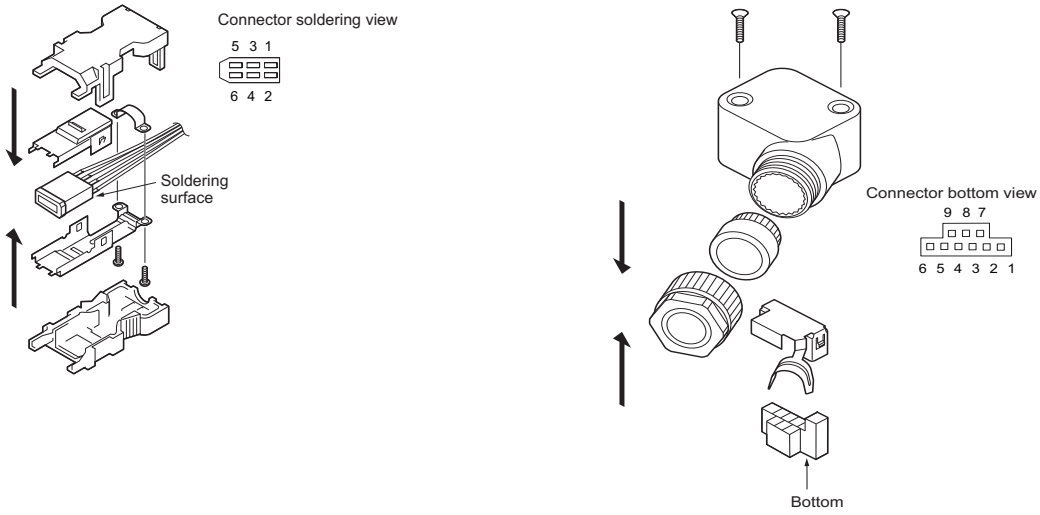
| Encoder connector | | Servo amplifier side (Fig. (1)) | Servo motor side (Fig. (2)) |
|---|---|---|---|
| Vendor | | Molex Ltd. | |
| Model | | 55100-0670 (welding) | 504678-0070 (crimping)*1 |
| Supported wire size | | AWG#28 to #16 | AWG#26 to #22 |
| Supported wire O.D. | | – | ϕ 6.3 to 7.7mm |
| User's Manual | | PS-54280 | AS-504682 |
| | | | CS-56161 |
| Crimping tool | Hand tool | Unnecessary for welding | 57175-5000 |
| | Applicator | | 57175-3000 |

*1 For 504678-0070, the contacts are not included in the packaging; if necessary, be sure to use the 56161-8081 made by Japan molex Co.,Ltd. (sold by reel).

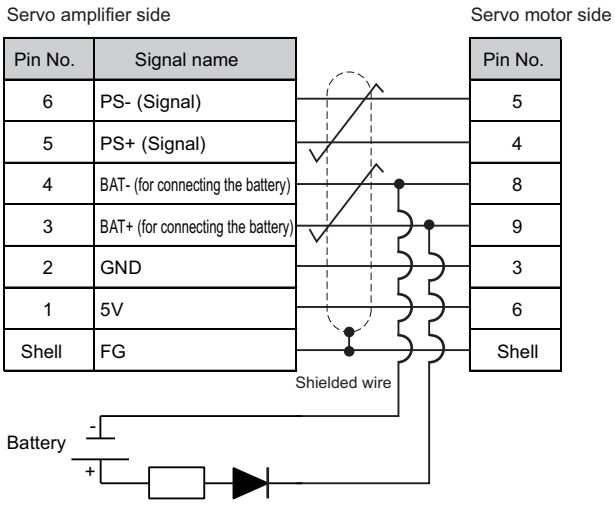
### ● How to wire

The connector at servo amplifier side is soldered when wiring, while the connector at servo motor side is crimped with crimping tool.

**Servo amplifier side (Fig. (1)) Servo motor side (Fig. (2))**




### ● Wiring diagram



**Point**

**When wiring the battery in the encoder cable, please pay attention to the following items.**
- **Please connect the diode for back flow prevention near the battery.**
- **Connect a 22Ω protection resistor**
- **Please set the voltage between the BAT+ and BAT- in the range of 2.9V to 4.5V.**
- **The BAT+/BAT- of the encoder connector and the BAT+/BAT of I/O connector is conducted within the servo amplifier.**

## ■ Motor power cable (50W to 750W)

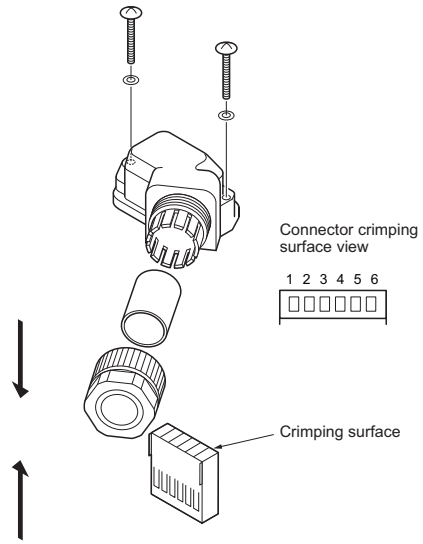
### ● Components and specifications

| Motor power connector (Fig. (3)) | | For 50W/100W | For 200W/400W | For 750W | |
|---|---|---|---|---|---|
| Vendor | | J.S.T. Mfg Co., Ltd | | | |
| User's Manual | | JFA Connector J-1700 | JFA Connector J-2700 | JFA Connector J-3700 | |
| Used components | Socket | J17S-06FMH-7KL-M-CF | J27S-06FMH-7KL-M-CF | J37S-06FMH-8KL-M-CF | |
| | Contact | SJ1F-01GF-P0.8 | SJ2F-01GF-P1.0 | SJ3F-41GF-P1.8 (For power terminal) | SJ3F-01GF-P1.8 (For electromagnetic brake terminal) |
| Supported wire size | | AWG#20 (for power terminals) AWG#24 to #20 (For electromagnetic brake terminal) | AWG#20 (for power terminals) AWG#24 to #20 (For electromagnetic brake terminal) | AWG#16 | AWG#24 to #20 |
| Supported wire O.D. | | ϕ 7±0.3mm | ϕ 7±0.3mm | ϕ 8±0.3mm | |
| Crimping tool | Hand tool | YRS-8841 | YRS-8861 | YRF-880 | YRF-881 |
| | Applicator | APLMK SJ1F/M01-08 | APLMK SJ2F/M01-08 | APLMK SF3F/M41-20 | APLMK SF3F/M01-20 |

### ● How to wire

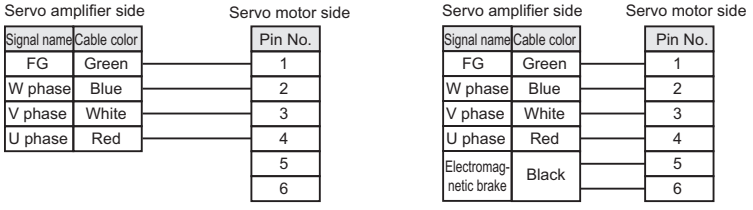
The wires at servo amplifier side adopts barbed wires, while the connector at servo motor side is crimped with crimping tool.

**Servo motor side**




### ● Wiring diagram

**Standard motorElectromagnetic brake motor**



## ■ Encoder cable (1kW to 5kW)

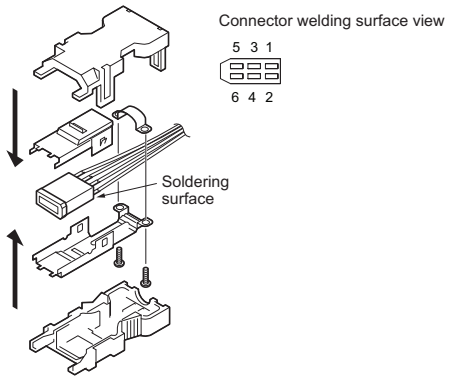
### ● Components and specifications

| Encoder connector | | Servo amplifier side (Fig. (4)) | Servo motor side (Fig. (5)) |
|---|---|---|---|
| Vendor | | Molex Ltd. | DDK Ltd. |
| Used components | Connector kit | 55100-0670 (welding) | CM10-AP10S-M-D (angle) (welding)<br>CM10-SP10S-M-D (straight) (welding) |
| | Contact | - | CM10-#22SC(S1)-100 |
| Supported wire size | | AWG #16 MAX (pin No.1,2,5,6)<br>AWG #22 MAX (pin No.3,4) | AWG #20 MAX |
| Supported wire O.D. | | ϕ 6.2 to 7.2mm | ϕ 6.0 to 9.0mm |
| User's Manual | | PS-54280 | TC-610 (angle)<br>TC-609 (straight) |

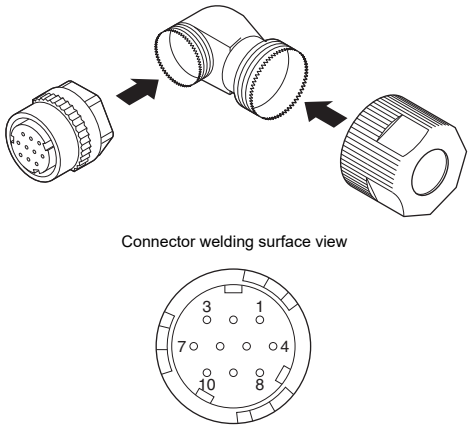
### ● How to wire

Solder the wires at both the servo amplifier and the servo motor sides.

Servo amplifier side (Fig.(4))




Servo motor side (Fig.(5))



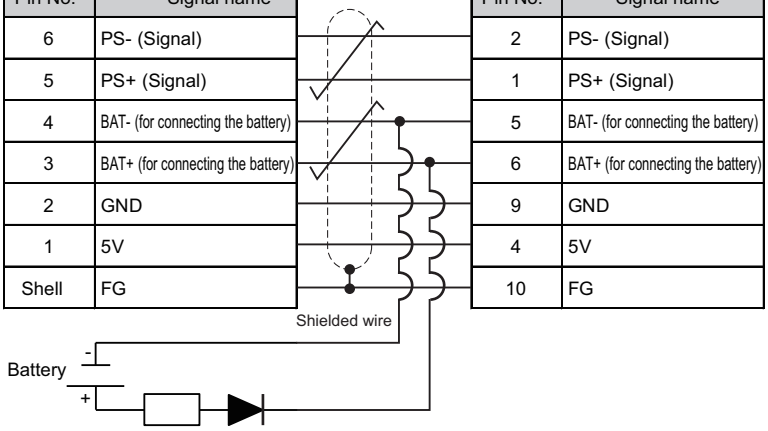

### ● Wiring diagram

Servo amplifier side

| Pin No. | Signal name |
|---|---|
| 6 | PS- (Signal) |
| 5 | PS+ (Signal) |
| 4 | BAT- (for connecting the battery) |
| 3 | BAT+ (for connecting the battery) |
| 2 | GND |
| 1 | 5V |
| Shell | FG |

Servo motor side

| Pin No. | Signal name |
|---|---|
| 2 | PS- (Signal) |
| 1 | PS+ (Signal) |
| 5 | BAT- (for connecting the battery) |
| 6 | BAT+ (for connecting the battery) |
| 9 | GND |
| 4 | 5V |
| 10 | FG |




**Point**

**Be careful of the following when wiring the encoder cable to a battery.**

- **Connect a diode that prevents backflow near the battery.**
- **Connect a 22Ω protective resistor.**
- **Make sure the voltage between BAT+ and BAT- is between 2.9 V and 4.5 V.**
- **The BAT+/BAT- of the encoder connector and the BAT+/BAT- of the I/O connector conduct electricity inside the servo amplifier.**

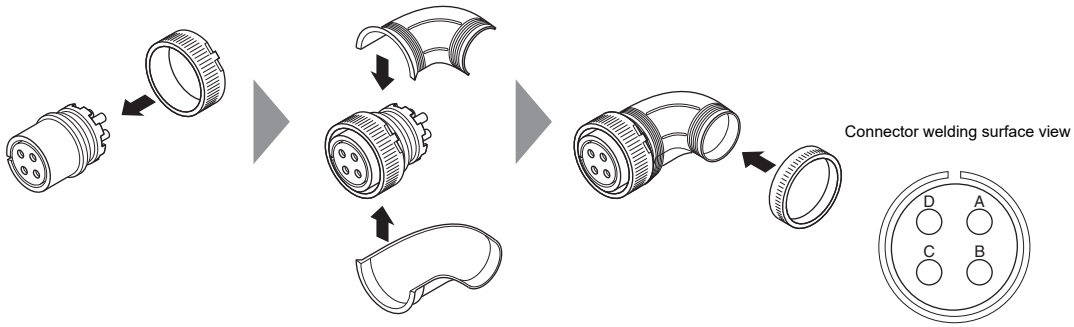
## ■ Motor power cable (1kW to 5kW)

### ● Components and specifications

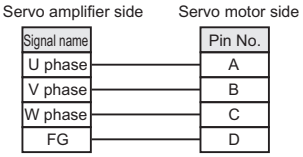
| Motor power connector | | For 1kW/1.5kW/2kW (Fig. (6)) | For 3kW/5kW |
|---|---|---|---|
| Vendor | | Japan Aviation Electronics Industry Ltd. | Japan Aviation Electronics Industry Ltd. |
| Used components | Plug | N/MS3108B18-10S (angle) (welding)<br>N/MS3106B18-10S (straight) (welding) | N/MS3108B22-22S (angle) (welding)<br>N/MS3106B22-22S (straight) (welding) |
| | Cable clamp | N/MS3057-10A | N/MS3057-12A |
| Supported wire size | | AWG #12 MAX | AWG #8 MAX |
| Internal rubber brushing I.D. | | ϕ 14.3mm | ϕ 15.9mm |

### ● How to wire

The wires at servo amplifier side adopts barbed wires, while the connector at servo motor side is soldered.




### ● Wiring diagram



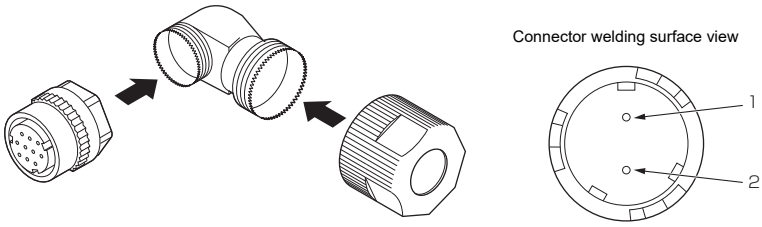
## ■ Electromagnetic brake power cable (1kW to 5kW)

### ● Components and specifications

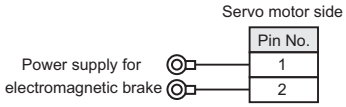
| Electromagnetic brake connector | | Servo motor side (Fig. (7)) |
|---|---|---|
| Vendor | | DDK Ltd. |
| Used components | Connector kit | CM10-AP2S-M-D (angle) (welding)<br>CM10-SP2S-M-D (straight) (welding) |
| | Contact | CM10-#22SC(S2)-100 |
| Supported wire size | | AWG #16 MAX |
| Supported wire O.D. | | $\phi$ 6.0 to 9.0mm |
| User's Manual | | TC-610 (angle)<br>TC-609 (straight) |

### ● How to wire

For wiring method at servo motor side, see "Encoder Cable", Page 4-16.
For wiring electromagnetic brake, see "Electromagnetic Brake", Page 4-18.



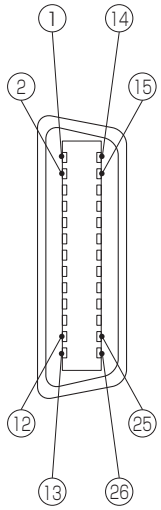

### ● Wiring diagram



# 4-5 Wiring I/O Signals

This section describes how to wire I/O connectors.
For assignment and polarity setting of I/O signal, see "5-3 I/O Signal Setting", Page 5-18.

## I/O Connector Pin Alignment




**SV2 main unit Illustration, view from outside**

| Pin No. | Direc-tion | Terminal name | | | Name |
|---|---|---|---|---|---|
| | | Position | Speed | Torque | |
| 1 | Output | OUT1+ (BRAKE+)*1 | | | Electromagnetic brake timing |
| 2 | Output | OUT1- (BRAKE-)*1 | | | |
| 3 | Output | ALARM+ | | | Alarm |
| 4 | Output | ALARM- | | | |
| 5 | Input | V+ | | | Analog feedback input |
| 6 | - | COM | | | Input common |
| 7 | Input | IN1 (LSP)*1 | | | Positive limit switch |
| 8 | Input | IN2 (LSN)*1 | | | Negative limit switch |
| 9 | Input | IN3 (PTL)*1 | | | Positive torque limit selection |
| 10 | Input | IN4 (EXT1)*1 | | | External latch signal 1 |
| 11 | Input | IN5 (EXT2)*1 | | | External latch signal 2 |
| 12 | Input | IN6 (EXT3)*1 | | | External latch signal 3 |
| 13 | Input | IN7 (NTL)*1 | | | Negative torque limit selection |
| 14 | - | BAT+ | | | Absolute value encoder battery |
| 15 | - | BAT- | | | |
| 16 | - | SG(V-) | | | Signal ground |
| 17 | Output | A+ | | | Encoder pulse A-phase+ |
| 18 | Output | A- | | | Encoder pulse A-phase- |
| 19 | Output | B+ | | | Encoder pulse B-phase+ |
| 20 | Output | B- | | | Encoder pulse B-phase- |
| 21 | Output | Z+ | | | Encoder pulse Z phase+ |
| 22 | Output | Z- | | | Encoder pulse Z-phase- |
| 23 | Output | OUT2+ (RDY+)*1 | | | Operation ready |
| 24 | Output | OUT2- (RDY-)*1 | | | |
| 25 | Output | OUT3+ (WARN+)*1 | | | Warning |
| 26 | Output | OUT3- (WARN-)*1 | | | |

*1 The I/O signal alignment can be changed. Signals in parentheses are default alignments.
"5-3 I/O Signal Setting", Page 5-18

## Names and Functions of I/O Terminals

Ex-factory pin assignment of I/O connector are as follows.
The following table and circuit reference diagram are available for wiring.

### ■ Input terminals

| Terminal name | Name | Functional description | Connector pin No. (default state) and reference circuit diagram | | Supported control mode | | |
|---|---|---|---|---|---|---|---|
| | | | Terminal | Circuit | Position | Speed | Torque |
| FSTOP | Forced termination | A warning occurs when turned off, bringing the servo motor to a stop. | -*1 | - | Yes | Yes | Yes |
| LSP | Positive limit switch | Bring the servo motor to a stop when turned off. Can move to the reverse rotation side. | 7 | DI-1 | Yes | Yes | Yes |
| LSN | Negative limit switch | Bring the servo motor to a stop when turned off. Can move to the forward rotation side. | 8 | DI-1 | Yes | Yes | Yes |
| PTL | Positive torque limit selection | Select forward rotation torque control from parameter settings. | 9 | DI-1 | Yes | Yes | Yes |
| NTL | Negative torque limit selection | Select reverse rotation torque control from parameter settings. | 13 | DI-1 | Yes | Yes | Yes |
| EXT1 | External latch signal 1 | Latch the feedback position once the signal is input. | 10 | DI-2 | Yes | Yes | Yes |
| EXT2 | External latch signal 2 | | 11 | DI-2 | Yes | Yes | Yes |
| EXT3 | External latch signal 3 | | 12 | DI-2 | Yes | Yes | Yes |
| DEC | Origin return deceleration switch | When turned off, decelerated to the origin return creep speed. | -*1 | - | Yes | Yes | Yes |
| COM | Input common | A common terminal for input. | 6 | DI-1 | Yes | Yes | Yes |
| V+ | Analog feedback input | Input analog feedback detection using an analog voltage. | 5 | AI | Yes | Yes | Yes |
| SG(V-) | Signal ground | A signal ground inside the servo amplifier. | 16 | AI | Yes | Yes | Yes |

*1 Can be used for I/O signal alignment.

## ■ Output terminals

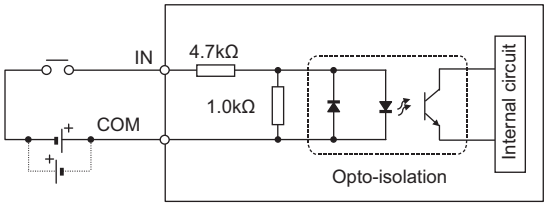
| Terminal name | Name | Functional description | Connector pin No. (default state) and reference circuit diagram | | Supported control mode | | |
|---|---|---|---|---|---|---|---|
| | | | Terminal | Circuit | Position | Speed | Torque |
| ALARM | Alarm | OFF when internal servo amplifier alarm occurs.*2 | 3, 4 | DO-1 | Yes | Yes | Yes |
| WARN | Warning | ON when internal servo amplifier warning occurs. | 25, 26 | DO-1 | Yes | Yes | Yes |
| INPOS | Inposition | ON when the absolute value of position deviation is within "INPOS range" (POS_03). | -*1 | - | Yes | - | - |
| VCMP | Speed match | ON when feedback speed is within "Speed match range" (VEL_03). | | | - | Yes | - |
| TLM | Torque limit in progress | ON during torque limit process. | -*1 | - | Yes | Yes | - |
| VLM | Speed limit in progress | ON during speed limit process. | | | - | - | Yes |
| RDY | Operation ready complete | ON when operation is ready after inputting servo ON signals. | 23, 24 | DO-1 | Yes | Yes | Yes |
| ZSP | Zero speed detection | ON when feedback speed of motor is less than "Zero speed detection range" (VEL_05). | -*1 | - | Yes | Yes | Yes |
| NEAR | Positioning approaching | ON when the absolute value of position deviation is within "NEAR range" (POS_05). | -*1 | - | Yes | - | - |
| BRAKE | Electromagnetic brake timing | To control the electromagnetic brake of a motor when motor with electromagnetic brake is used. | 1, 2 | DO-1 | Yes | Yes | Yes |
| A+ | Encoder pulse A-phase | To output the pulse set for "*Encoder division output pulse" (SYS_02) in differential line driver mode. | 17 | DO-E | Yes | Yes | Yes |
| A– | | | 18 | | Yes | Yes | Yes |
| B+ | Encoder pulse B-phase | | 19 | DO-E | Yes | Yes | Yes |
| B– | | | 20 | | Yes | Yes | Yes |
| Z+ | Encoder pulse Z-phase | To output the Z-phase of encoder output pulse in differential line driver mode. | 21 | DO-E | Yes | Yes | Yes |
| Z– | | | 22 | | Yes | Yes | Yes |

*1 The terminal can be used with I/O signal assignment.

*2 Alarm can be output up to 5 seconds when control circuit is powered ON.

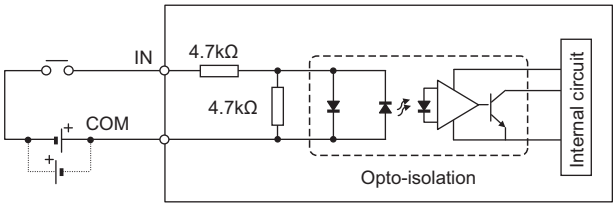
## Specification and Wiring of I/O Terminals

### ■ Common input (DI-1)



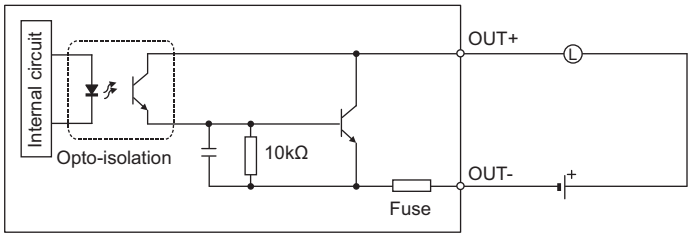

| Item | Specification |
|---|---|
| Max. input voltage | 28.8 VDC |
| Rated input voltage | 24 VDC (3.7mA) |
| Min. ON voltage | 19 VDC |
| Max. OFF current | 0.3mA |
| Common mode | Common |

### ■ 2-Wire high-speed input (DI-2)



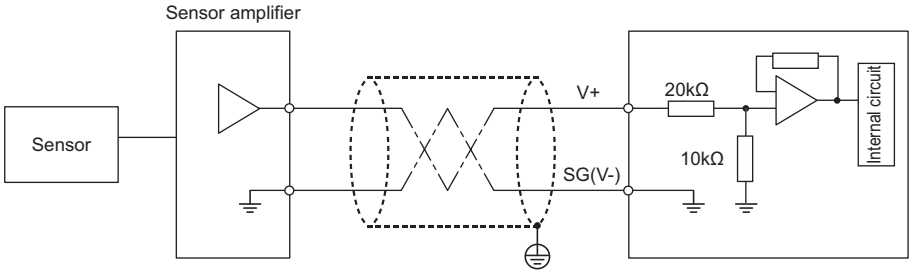

| Item | Specification |
|---|---|
| Max. input voltage | 28.8 VDC |
| Rated input voltage | 24 VDC (4.5mA) |
| Min. ON voltage | 19 VDC |
| Max. OFF current | 0.6mA |
| Common mode | Common |

### ■ Common output (DO-1)




| Item | Specification |
|---|---|
| Output mode | Open collector output |
| Rated load | 30 VDC (50mA) |
| Leak current at OFF | 0.1mA |
| Residual voltage at ON | Less than 1.5 VDC |
| Common mode | Independent |

## ■ Analog feedback input (AI)



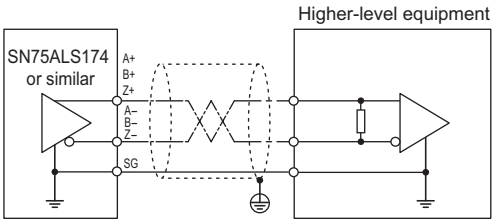

| Item | Specification |
|---|---|
| Input level | ±12V |
| Accuracy | ±1% of F.S. |
| Resolution | ±12 bits |
| Input impedance | 30kΩ |

**Point**

**Take the following measures against noise to prevent induction noise:**

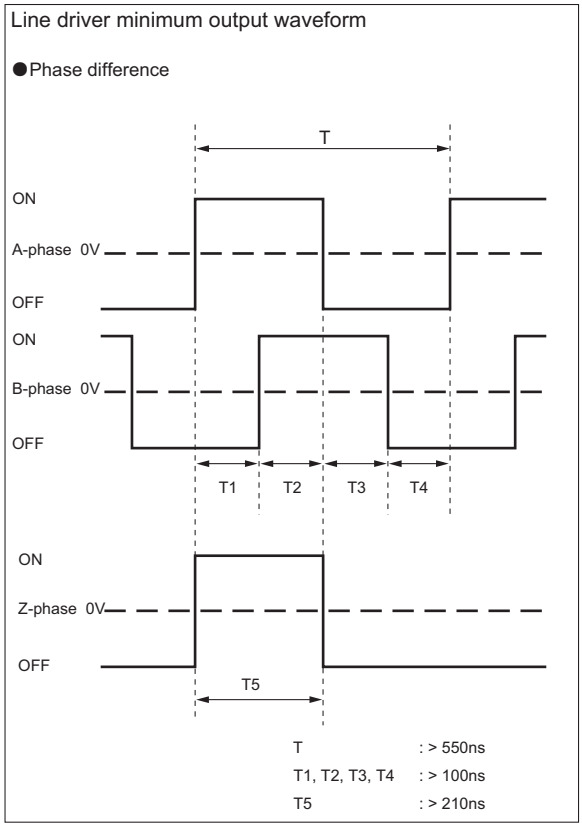
- **Set up "Analog input filter" (AFB_07).**
- **Use a twisted pair cable.**
- **Connect so the distance is the minimum distance.**
- **Install ferrite cores.**

## ■ Encoder output (DO-E)




| Item | Specification |
|---|---|
| Output mode | Differential line driver output |
| Output voltage | SN75ALS174 or similar |
| Common mode | Independent (non-isolation) |
| Output frequency | Phase difference: 1.6Mpps (Quadruplicated frequency : 6.4MHz) |

**<Minimum output waveform>**



## I/O Connector

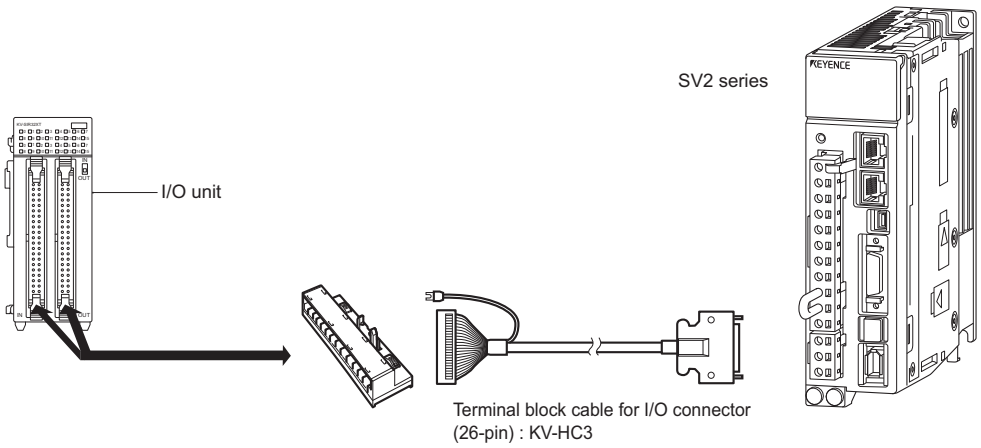
To input or output servo amplifier external signal.

**Point**

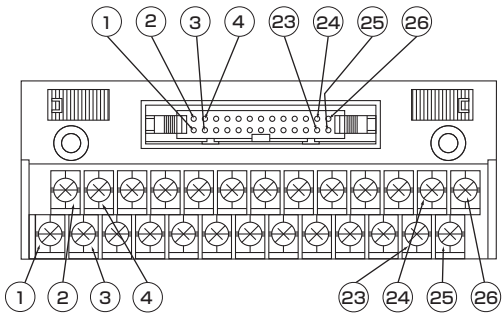
- **For I/O cables, please use twisted cables and multi-core shielded twisted cables.**
- **The length of I/O cable should not exceed 3m.**
- **When noise exists, the shielded twisted I/O cable should be connected to grounding.**
- **Wiring should be made as short as possible, and distance between power line and I/O cable should be kept above 30cm.**

### ■ Terminal block cable for I/O connector

Both ends of the terminal block cable for I/O connector (KV-HC□) are connectors. They can be connected to the terminal blocks of servo amplifier and I/O connector.




#### ● Terminal assignment



### ● Terminal block label (Attached with I/O connector terminal block)

Common

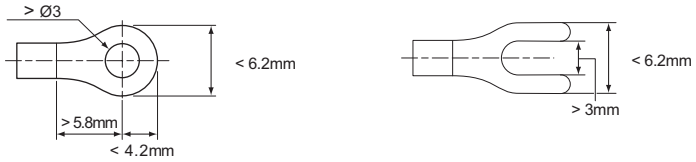
| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2<br>BRAKE- | 4<br>ALARM- | 6<br>COM | 8<br>LSN | 10<br>EXT1 | 12<br>EXT3 | 14<br>BAT+ | 16<br>SG(V-) | 18<br>A− | 20<br>B− | 22<br>Z− | 24<br>RDY- | 26<br>WARN- | |
| 1<br>BRAKE+ | 3<br>ALARM+ | 5<br>V+ | 7<br>LSP | 9<br>PTL | 11<br>EXT2 | 13<br>NTL | 15<br>BAT- | 17<br>A+ | 19<br>B+ | 21<br>Z+ | 23<br>RDY+ | 25<br>WARN+ | | |

To be filled by user

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2 | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 | 26 | |
| 1 | 3 | 5 | 7 | 9 | 11 | 13 | 15 | 17 | 19 | 21 | 23 | 25 | | |

### ● Available crimped terminal

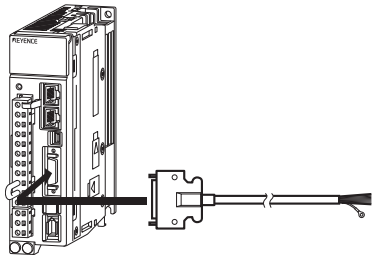
When crimped terminals are used for wiring of screw terminals of I/O connector terminal block, please use terminals with the following sizes.



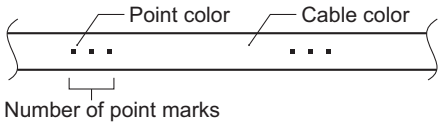

## ■ I/O connector cable

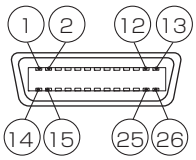
I/O connector cables at the servo amplifier side are connectors and the other side are barbed wires. You can connect servo amplifiers with I/O connector cables, and connect sensors with barbed wires.

**Servo amplifier**



**(26-pin): OP-84402 (1m), OP-84403 (3m)**



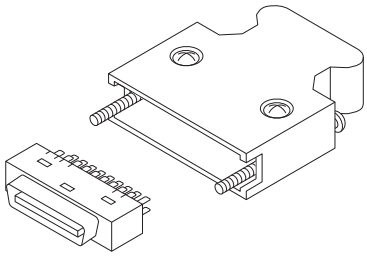




Cable view
connector side

| Pin No. | Cable color | Point | |
|---|---|---|---|
| | | Color | Number of marks |
| 1 | Orange | Red | 1 |
| 2 | Orange | Black | 1 |
| 3 | Gray | Red | 1 |
| 4 | Gray | Black | 1 |
| 5 | White | Red | 1 |
| 6 | White | Black | 1 |
| 7 | Yellow | Red | 1 |
| 8 | Yellow | Black | 1 |
| 9 | Pink | Red | 1 |
| 10 | Pink | Black | 1 |
| 11 | Orange | Red | 2 |
| 12 | Orange | Black | 2 |
| 13 | Gray | Red | 2 |
| 14 | Gray | Black | 2 |
| 15 | White | Red | 2 |
| 16 | White | Black | 2 |
| 17 | Yellow | Red | 2 |
| 18 | Yellow | Black | 2 |
| 19 | Pink | Red | 2 |
| 20 | Pink | Black | 2 |
| 21 | Orange | Red | 3 |
| 22 | Orange | Black | 3 |
| 23 | Gray | Red | 3 |
| 24 | Gray | Black | 3 |
| 25 | White | Red | 3 |
| 26 | White | Black | 3 |

## ■ I/O connector

Used to prepare I/O connector cables.



**(26-pin): OP-84407**
**Connector : 10126-3000PE (3M)**
**Case (shell) : 10326-52A0-008 (3M)**

# 4-6 Wiring Regenerative Resistor

This section describes the specification and connection of regenerative resistors.

## Regenerative Resistors Specifications

The specifications of built-in regenerative resistor (750W to 5kW) and external regenerative resistor are as follows.

### ■ Built-in regenerative resistor (750W to 5kw)

| Model of servo amplifier | Built-in regenerative resistors | | Regenerative power [W] |
|---|---|---|---|
| | Resistance value [Ω] | Capacity [W] | |
| SV2-075L2<br>SV2-100L2 | 40 | 40 | 8 |
| SV2-150L2 | 20 | 60 | 10 |
| SV2-200L2<br>SV2-300L2 | 12 | 60 | 16 |
| SV2-500L2 | 8 | 180 | 36 |

### ■ External regenerative resistors

| Model | Applicable capacity of servo amplifier | Resistance value [Ω] | Rated capacity [W] | Ambient temperature [°C] | Storage temperature [°C] | Thermostat | |
|---|---|---|---|---|---|---|---|
| | | | | | | Max. contact rating | Contact mode |
| OP-84399 | 50W to 1kW | 50±5% | 220*1 | –30 to +80 | –40 to +100 | 115 VAC / 22A<br>277 VAC / 8A<br>16 VDC / 20A | N.C. (Normal Closed: B contact) |
| OP-87073 | 1.5kW*2 | 20±5% | | | | | |

*1 Rated capacity refers to the value at environment temperature of 70°C. However, for natural air cooling please use the capacity of up to 20%.

*2 2kW to 5kW can also be used depending on operational conditions.

## How to Connect Regenerative Resistors

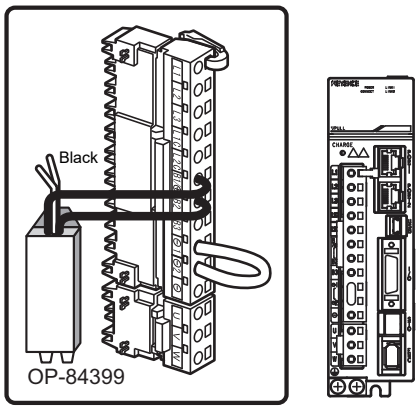
Connection of regenerative resistor is described as follows. For how to select regenerative resistor, see "5-4 Regenerative Resistor Setting", Page 5-20.

| WARNING | **Wiring of regenerative resistors must be correct. Otherwise this may lead to machine damage and fire.** |
|---|---|

Regenerative resistors can be connected as follows.

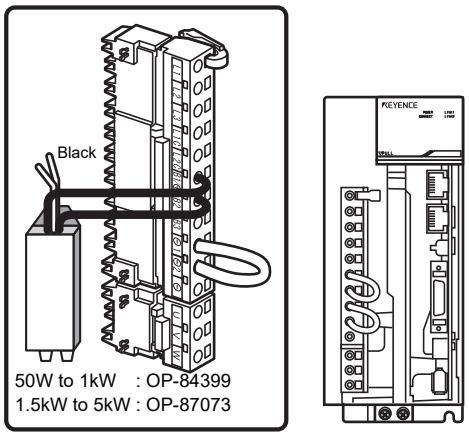
### ■ Connecting regenerative resistor with SV2-005L2, SV2-010L2, SV2-020L2 or SV2-040L2

The regenerative resistor can be connected to B1/⊕ and B2 terminals independent on the polarity.



## ■ Connecting regenerative resistor with SV2-075L2, SV2-100L2, SV2-150L2, SV2-200L2, SV2-300L2, SV2-500L2

Remove the wires connecting B2 and B3 terminals, and then wire the regenerative resistor to B1/⊕ and B2 terminals.
The regenerative resistor can be connected to B1/⊕ and B2 terminals independent on the polarity.
Be sure to remove the wires connecting B2 and B3 terminals and then wire.

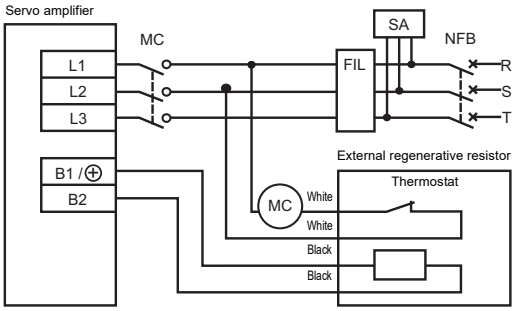



**Point** **When using SV2-200L2/SV2-300L2/SV2-500L2, screw terminals are provided. Tighten the terminals securely with the tightening torque from 1.0 to 1.2 N·m.**

## ■ Wiring example of thermostat

When regenerative resistors are used, be sure to use thermostat, and make the sequence control program for stopping the servo motor when thermostat output is enabled.

- Thermostat specifications
  Maximum contact rating
  115 VAC / 22A
  277 VAC / 8A
  16 VDC / 20A
- Wiring example



# 4-7 Wiring Analog Monitor

This section describes how to wire the analog monitor.

## Analog Monitor Specifications

Specifications of analog monitor are as follows.

| Item | Specification | Remark |
|---|---|---|
| Number of chs | 2ch | |
| Output range | –10V to +10V | Linear valid range is within ±8V. |
| Resolution | 16 bits | |
| Conversion precision | ±20mV | Standard value |
| Max. permissible load current | ±10mA | |
| Conversion speed | 1.2ms | Standard value |

### ■ Analog monitor cable (OP-84408)

| Terminal No. | Terminal name | Function name | Cable color | Functional description |
|---|---|---|---|---|
| 1 | VTG | Analog monitor 2 | Red | Used for monitoring values set in "Analog monitor 2" (OTH_12). |
| 2 | TMON | Analog monitor 1 | White | Used for monitoring values set in "Analog monitor 1" (OTH_11). |
| 3 | SG | - | Black | Signal ground |
| 4 | SG | - | Black | Signal ground |

Wire size : AWG#24 UL-Style No.1007 * Be sure to use the same cable color as in the table.
Socket : DF11-4DS-2C (HIROSE)
Contact : DF11-2428SCF (HIROSE)

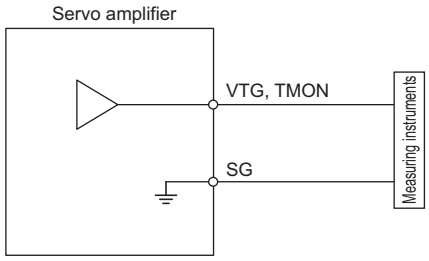
## Connecting the Analog Monitor Connector

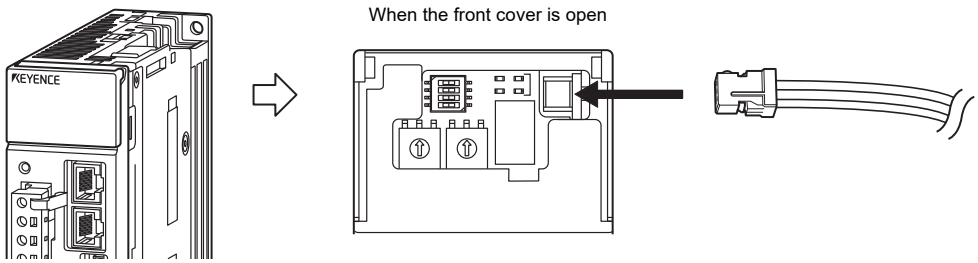
Open the front cover on the top of the main unit and then connect the analog monitor cable (OP-84408) to the main unit, to allow analog monitor signals to be monitored. Refer to "5-6 Analog Monitor Setting", Page 5-28 for analog monitor settings and monitor signals.

### ● Connecting with servo amplifier

Open the front cover on the top of the servo amplifier and connect analog monitor cable (OP-84408) to the servo amplifier.

### ● Connecting with measuring instruments



# 4-8 Safety Function Wiring

This section describes wiring to the safety device.

## Safety Function Specifications

### ■ Safety function circuit specifications

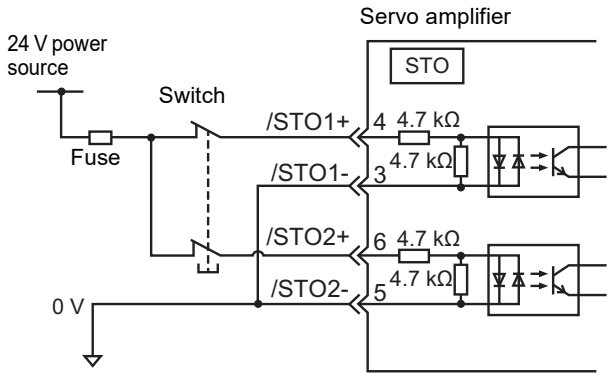
| Type | Signal Name | Status | Description |
|---|---|---|---|
| Input | /STO1 | ON (closed) | STO does not function (normal operation) |
| | | OFF (open) | STO functions (motor current shut-off request) |
| | /STO2 | ON (closed) | STO does not function (normal operation) |
| | | OFF (open) | STO functions (motor current shut-off request) |
| Output | EDM | ON | The STO1 signal and STO2 signal are both operating normally |
| | | OFF | The STO1 signal, the STO2 signal, or both signals are not operating normally |

**Important**

- **The STO terminal can be wired to from either the sink or source output, but from a safety standpoint we recommend making it a 0 V common and wiring from the source output.**
- **EDM output is source output.**
- **For the external device monitor (EDM), see "8-3 External device monitor (EDM)", Page 8-9.**

## Safety Function Terminal Specifications and Wiring

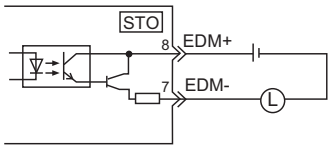
### ■ STO input




| Item | Specifications | Remarks |
|---|---|---|
| Input voltage | 24 VDC ±20% | - |
| Input rated voltage | 24 VDC (5 mA) | - |
| Maximum delay time | 8 ms | Time from when STO1/STO2 turn OFF until STO functions |

## ■ EDM output

Servo amplifier

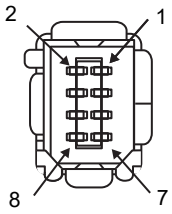



Electrical characteristics of the output signal (EDM signal)

| Item | Specifications | Remarks |
|---|---|---|
| Output form | Photocoupler-insulated output | - |
| Maximum allowable voltage | 30 VDC | - |
| Maximum allowable current | 50 mA DC | - |
| Residual voltage at ON | 1.5 VDC max. | - |
| Maximum delay time | 8 ms | Time to convert EDM after STO1 and STO2 convert |

## ■ Safety connector pin assignment

This section shows the assignment of the safety connector.




The outer appearance when viewed from the front of the servo amplifier

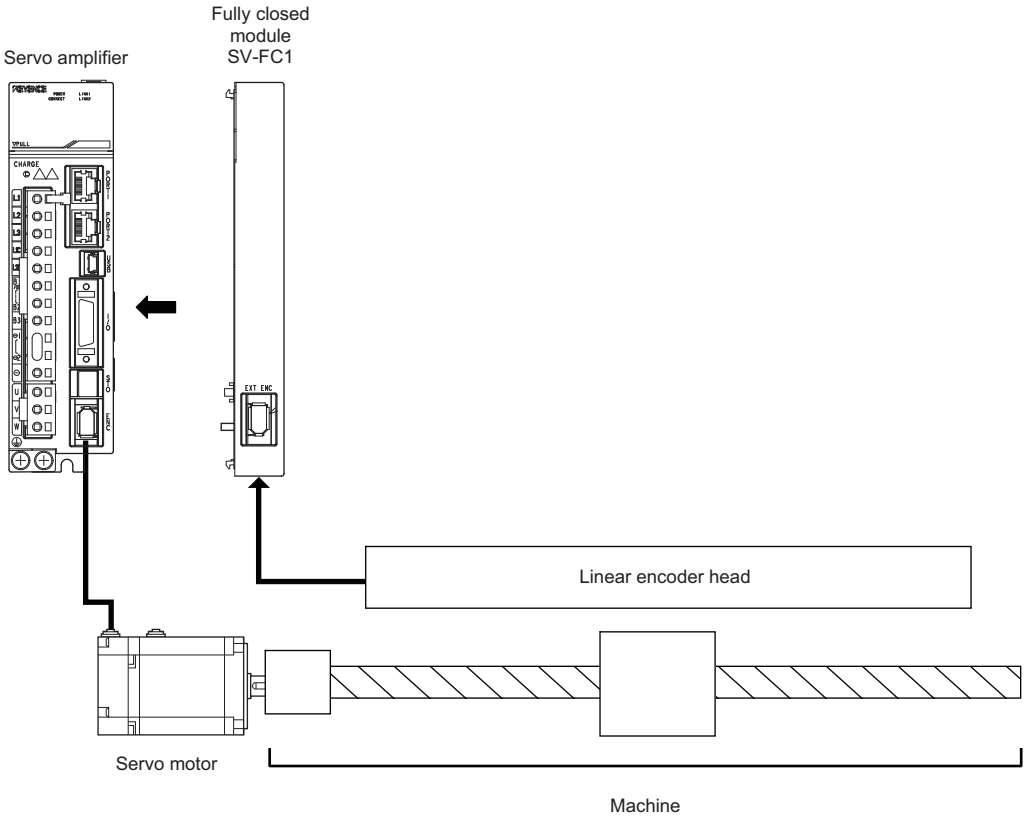
| Pin No. | Signal Name | Cable color | Marking color |
|---|---|---|---|
| 1 | Not connected | - | - |
| 2 | Not connected | - | - |
| 3 | /STO1- | White | Black |
| 4 | /STO1+ | White | Red |
| 5 | /STO2- | Grey | Black |
| 6 | /STO2+ | Grey | Red |
| 7 | EDM- | Orange | Black |
| 8 | EDM+ | Orange | Red |

# 4-9 Connecting an External Encoder

This section describes how to connect an external encoder.

## Overview

Connect the servo amplifier and an external encoder using the fully closed module (SV-FC1) as shown in the illustration below.

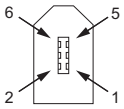



## Fully Closed Module (SV-FC1) Specifications

### ■ Specifications

| Item | | Specifications |
|---|---|---|
| Interface | | Yaskawa serial interface |
| Feedback | | Fully closed control serial communication |
| Input voltage | | Equivalent to an EIA standard RS485 compliant differential line receiver |
| Output voltage | | Equivalent to an EIA standard RS485 compliant differential line driver |
| Power output | Voltage | 5V±5% (4.75V to 5.25V) |
| | Current | Maximum 300mA |
| Communication speed | | 4 Mbps |
| Communication cycle | | 62.5 µs |

## ■ Pin alignment



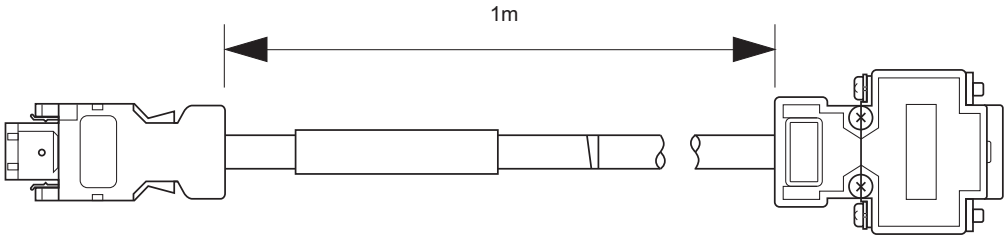

External view when seen from the front of the servo amplifier.

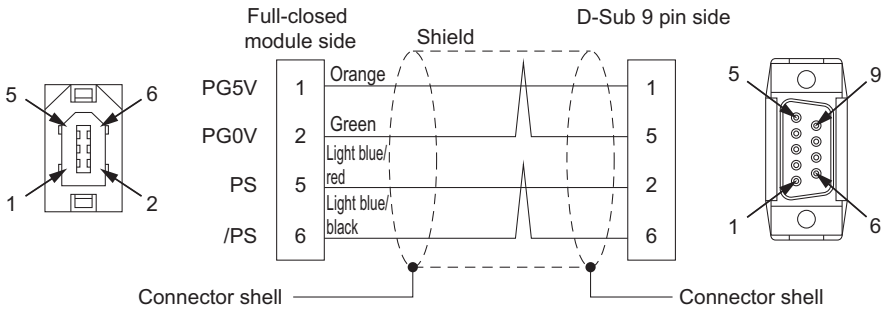
| Pin No. | Signal name |
|---|---|
| 1 | PG5V |
| 2 | PG0V |
| 3 | - |
| 4 | - |
| 5 | PS |
| 6 | /PS |



The connection used when connecting a full-closed module and linear encoder changes depending on the type of linear encoder.
For details on the connection, refer to the instruction manual for the device you will use.
The optional linear encoder connection cable (SV-LN1) is provided to connect a D-sub 9 pin to an external encoder connector.

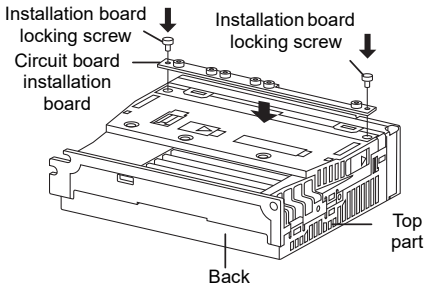
- **Linear encoder connection cable (SV-LN1)**



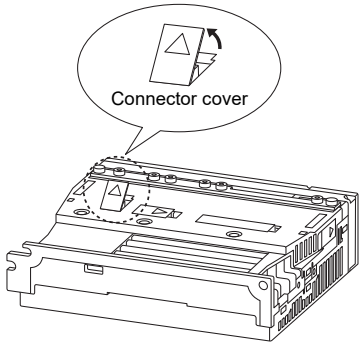



## Installing the Fully Closed Module

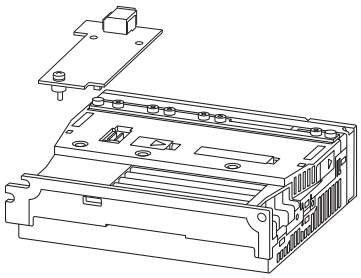
**1** **Align the circuit board installation board with the groove in the servo amplifier, and secure it with the installation board locking screws.**
(Tightening torque: 0.14 N·m)



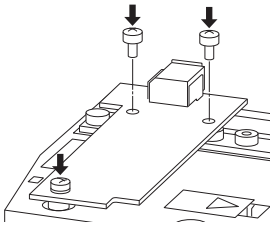

**2** **Remove the connector cover on the side of the servo amplifier.**



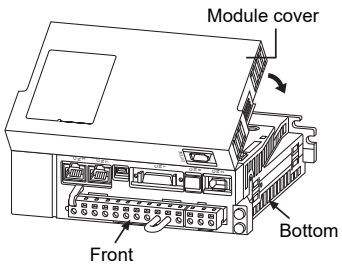

**3** **Firmly insert the circuit board connector into the servo amplifier connector.**



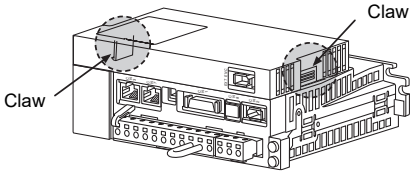
**4** **Secure the circuit board with screws.**
(Tightening torque: 0.14 N·m)



**5** **Install the module cover from the front so that the circuit board can be seen from the opening of the cover.**



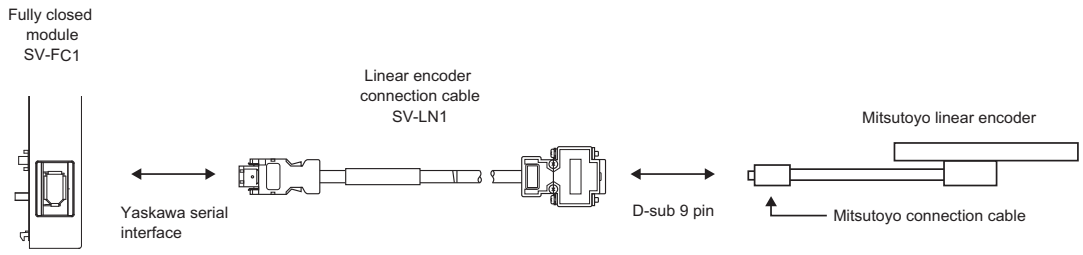

**6** **Push the left and right claws of the module cover inwards to secure the module to the servo amplifier.**



## Connection Example

### ■ When connecting the Mitsutoyo linear encoder

Connect using the linear encoder connection cable (SV-LN1).




Reference When connecting any other type than the above, connect it using the Yaskawa serial interface. Contact encoder manufacturers for the type of cable to be used.

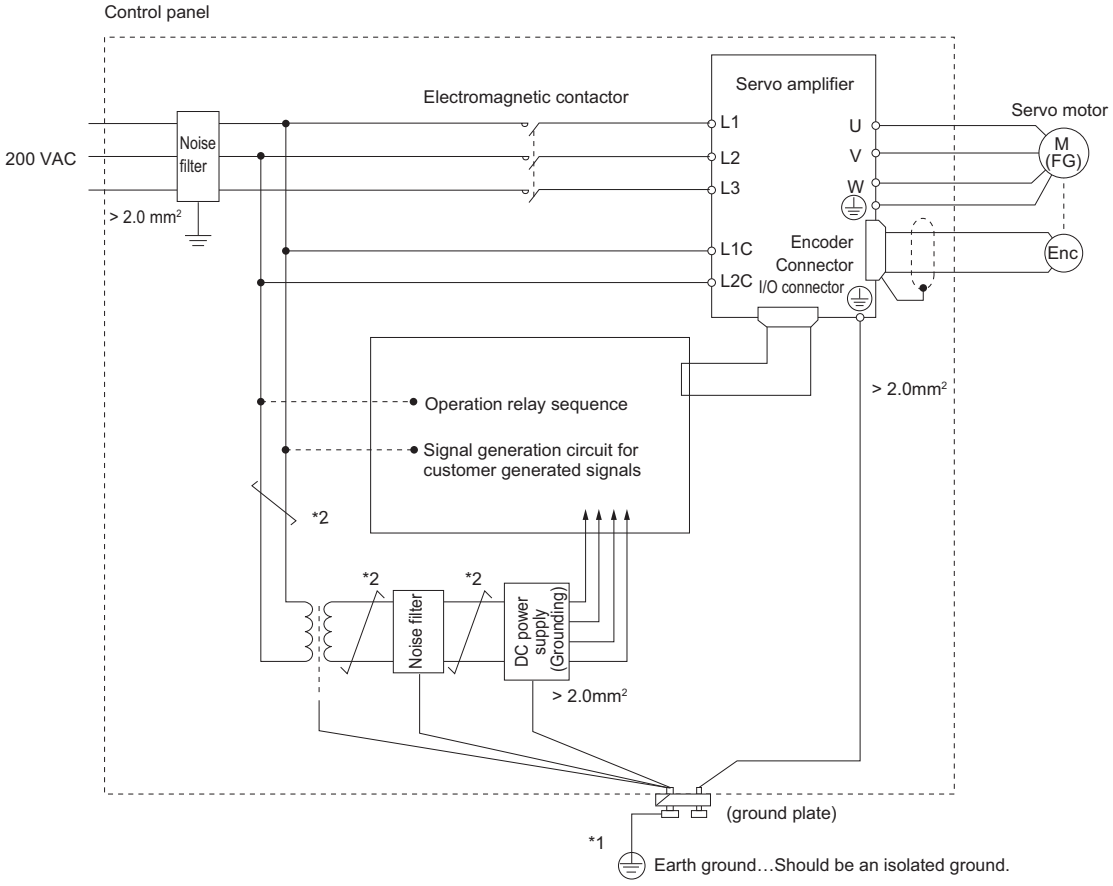
## Remedyting Noises

According to the different conditions of surround wiring or equipment installation, servo amplifiers may be affected by noises. Be sure to use the following countermeasures to prevent noises if necessary.

- Input command equipments and noise filters should be installed as near the servo amplifier as possible.
- Coils of relays, solenoids, electromagnetic contactors must use anti-surge countermeasures.
- Main/control circuit power cables and I/O cables should be wired with a spacing of above 30cm. The two cables can not be inserted into one duct or bundled together.
- It should be separated from power supply of welding machine, electric discharge machine and other noise sources. Even in conditions that power is separated, when there is high frequency generator nearby, be sure to connect noise filter at the input side of main/control circuit power cables.
- Be sure to use proper grounding.

### ■ Noise filter

Be sure to connect noise filter at proper position in order to avoid the influence of noise on servo amplifiers. About wiring method when noise filter is used, please refer to the following example.



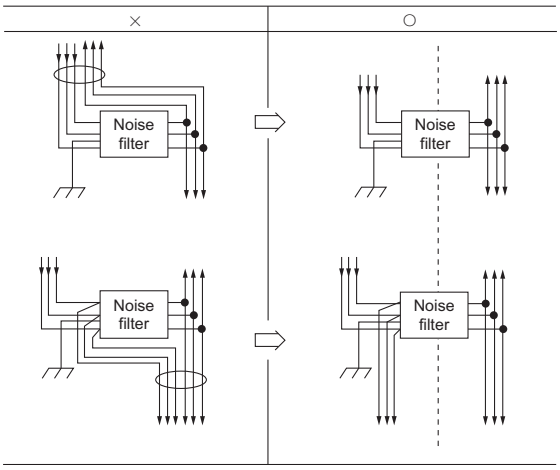

*1 Be sure to use flat braided copper conductor (> 2.0mm$^2$ ) for FG.

*2 Be sure to use twisted-pair cable for wiring.

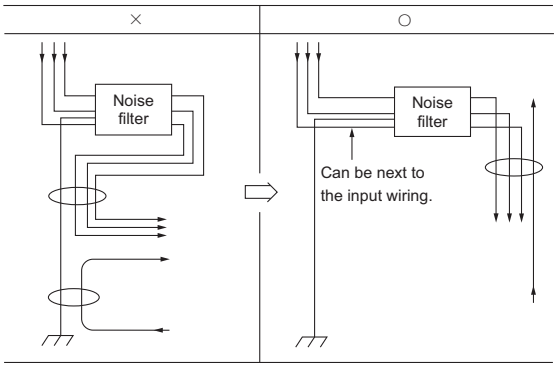
### ● Precautions on noise filter installation and wiring

Be sure to abide by the following precautions on noise filter installation and wiring.

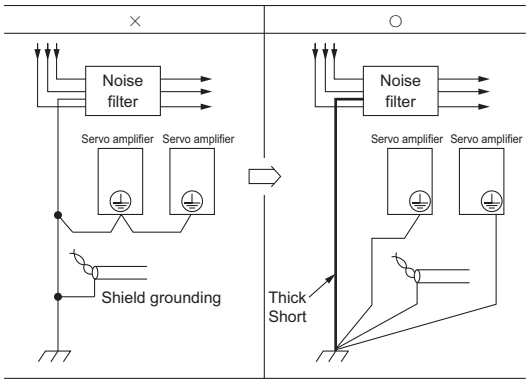
**1 Wiring of I/O should be separated. The two cables can not be inserted into one duct or bundled together.**



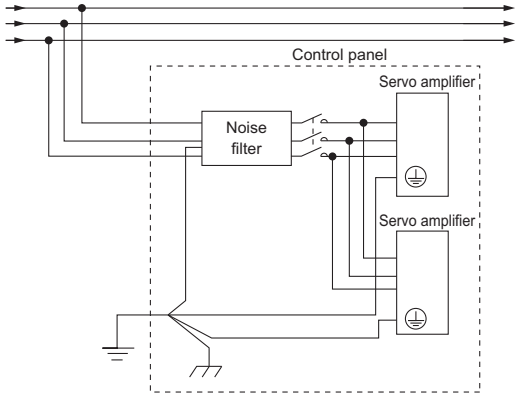

**2 Grounding wire of noise filter should be far from output wire. In addition, do not insert the grounding wire and output wire of noise filter or other signal lines into one duct or bundle them together.**




**3 Grounding wire of noise filter should be connected to grounding block separately.**




**4 When there is noise filter inside control panel, be sure to connect the grounding wire of noise filter and grounding wires of other equipments in the control panel to the grounding block of the control panel, and then process grounding.**




## ■ Grounding

In order to prevent false operations because of noises, be sure to use proper grounding.

### ● Grounding of motor frame

When servo motor is installed on machines, switching noise current may flow through the servo amplifier. In order to prevent the influence, be sure to connect the frame terminal (FG) of servo motor to the grounding terminal of servo amplifier.
In addition, the grounding terminal of servo amplifier must be connected to grounding.

### ● I/O cable

When noise is added to an I/O cable, ground the GND of that I/O cable at a single point. When the wires of the motor main circuit are stored within the metallic control panel, ground the control panel and its connection box at a single point.

## Surge Suppressor

A surge suppressor is a component that absorbs lightning surge to prevent malfunction or destruction of the electronic circuits.
The recommended surge suppressor models for the servo amplifier are as follows.

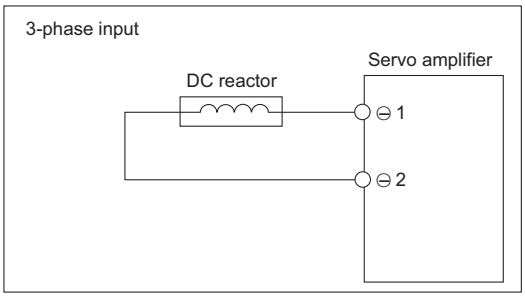
| Main circuit power supply | Model | Manufacturer |
|---|---|---|
| 3-phase 200 VAC | LT-C32G801WS | Soshin Electric Co., Ltd. |
| Single-phase 200 VAC | LT-C12G801WS | |

## Electromagnetic Contactor

When AC power sequence control program connected to servo amplifiers is constructed from outside, electromagnetic contactor should be used.
For electromagnetic contactor selection, see "2-3 Servo Amplifier Specifications", Page 2-6.

## Remedying High Harmonics

A DC reactor can be connected as part of the measures against high harmonics.
Connection method is as follows.




Refer to the table below to select the desired DC reactor.

| Main circuit power supply | Model of servo amplifier | Inductance [mH] | Rated current [A] |
|---|---|---|---|
| 3-phase 200 VAC | SV2-005L2 | 2 | 4.8 |
| | SV2-010L2 | | |
| | SV2-020L2 | | |
| | SV2-040L2 | | |
| | SV2-075L2 | | |
| | SV2-100L2 | | |
| | SV2-150L2 | 1.5 | 8.8 |
| | SV2-200L2 | | |
| | SV2-300L2 | 1 | 14 |
| | SV2-500L2 | 0.47 | 26.8 |
| Single-phase 200 VAC | SV2-005L2 | 40 | 0.85 |
| | SV2-010L2 | | |
| | SV2-020L2 | 20 | 1.65 |
| | SV2-040L2 | 10 | 3.3 |
| | SV2-075L2 | 4 | 5.3 |

**MEMO**

# 5

# PARAMETER SETTINGS

This chapter describes the servo parameter and I/O settings.

# 5-1 Main Circuit/Control Circuit Power Supply Setting

This section describes settings of main circuit/control circuit power supply.
For wiring of main circuit/control circuit power supply, see "4-3 Connecting the Main Circuit/Control Circuit Power Cables", Page 4-6.

## Main/Control Circuit Power Supply Setting

You can set up power type according to actually used power supply.

| Parameter type | Category | Level | Parameter name | Setting range | Setting unit | Default | Enable timing |
|---|---|---|---|---|---|---|---|
| OTH_19 | Other | Special | *AC/DC power supply | 0 : AC<br>1 : DC | - | 0 | After power is ON again |
| OTH_20 | Other | Special | *3PH/1PH power supply | 0 : Three phase<br>1 : Single phase | - | 0 | |

Point

- **If the input power type (AC/DC) is different from the OTH_19 setting, then "Main circuit wiring error" alarm (330) will occur.**
- **In the case of 200 VAC power input, "Main circuit open phase" alarm (F10) will occur when OTH_20 is set to "Three phase".**

## Operation at Instantaneous Powercut

When main circuit power supply of the servo amplifier is OFF due to instantaneous powercut, an excitation duration of servo motor can be set via parameters.

| Parameter type | Category | Level | Parameter name | Setting range | Setting unit | Default | Enable timing |
|---|---|---|---|---|---|---|---|
| OTH_24 | Other | Special | Instantaneous powercut hold time | 20 to 50000 | ms | 20 | After changing |

When main circuit power supply is OFF, an instantaneous powercut will be detected, and if the time from power OFF to ON is smaller than the set value of OTH_24, the servo amplifier will continue to operate; if it is larger than set value, then it will be OFF.

Point

- **The hold time for the control circuit of the servo amplifier is about 100 ms. Should the control circuit power supply become uncontrollable during an instantaneous power cut and behave exactly the same way as in a normal power-off state, the OTH_24 setting will have no effect.**
- **Hold time of the main circuit power depends upon outuput of the servo amplifier. When load of the servo motor is large, and "Main circuit under voltage" alarm (410) occurs during instantaneous powercut, the setting of OTH_24 will be disabled.**

## Torque Limit at Main Circuit Voltage Drop

After voltage of the main circuit voltage drops, the "Main circuit under voltage warning" (971) will be detected, and the output current will be suppressed through limiting the torque. Even if supply voltage drops, operation will continue and will not stop due to the alarm.
The servo amplifier is compliant to the SEMI F47 standards required by semiconductor manufacturing equipment. Combining with the functions available for Instantaneous powercut hold time (OTH_24) can prevent a stop invoked by an alarm and continue with the operation when momentary power failure occurs.

The torque when main circuit voltage drops can be limited through a higher-level equipment or servo amplifier.

- **Through a higher-level equipment**
  Higher-level equipment will limit torque when it receives "Main circuit under voltage warning" (971). It will release torque limit when it receives release signal of "Main circuit under voltage warning" (971).

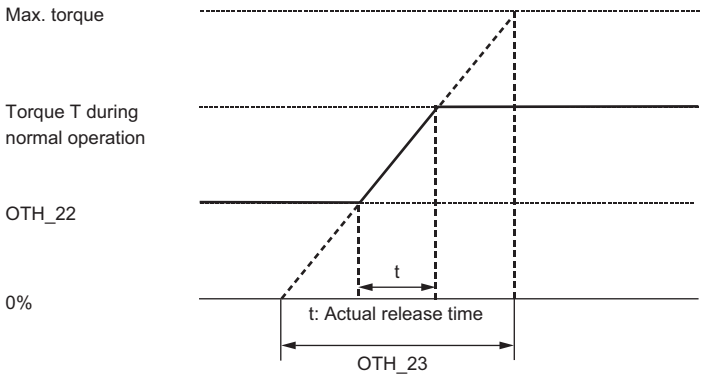
- **Through a servo amplifier**
  The servo amplifier will limit torque inside the servo amplifier when it receives the "Main circuit under voltage warning" (971). It will release torque limit according to the "Rel time for trq lim at vol drop" (OTH_23) when it receives release signal of "Main circuit under voltage warning" (971).

Torque limit can be set through parameters when main circuit voltage drops.

| Parameter type | Category | Level | Parameter name | Setting range | Setting unit | Default | Enable timing |
|---|---|---|---|---|---|---|---|
| OTH_21 | Other | Special | *Main circuit voltage drop | 0 : Not detect<br>1 : Warning<br>2 : Warning and torque limit | - | 0 | After power is ON again |
| OTH_22 | | | Trq lim at main circuit vol drop | 0 to 100 | % | 50 | After changing |
| OTH_23 | | | Rel time for trq lim at vol drop | 0 to 1000 | ms | 100 | |
| OTH_24 | | | Instantaneous powercut hold time | 20 to 50000 | ms | 20 | |

**Point**

- **Set a smaller value to OTH_22 than the torque applied during normal operation. A power cut is gradually cleared according to the OTH_23 setting once torque control has been lifted.**
- **Set OTH_23 to 1000ms to be compliant to the SEMI F47 standards.**




$$t = \frac{T - OTH\_22}{T_{MAX}} \times OTH\_23$$



▶ Important

- **The servo amplifier supports the voltages and instantaneous power cuts that are within the range defined by the SEMI F47 standards. Note, however, that it needs to be backed up by an uninterrupted power supply (UPS) in case of voltages and instantaneous power cuts that are out of range.**
- **Set the torque limit used for the host controller and/or servo amplifier so a torque is output that exceeds the acceleration torque when a command is received after the main control power has been restored.**
- **Do not limit the torque below the holding torque for the vertical axis.**
- **This function is intended to limit the torque to within the servo amplifier capabilities during power outage and does not support every load or operating condition. Be sure to observe the behavior of the actual device before setting the parameters.**
- **When "Instantaneous powercut hold time" (OTH_24) is set, it takes longer until the motor is powered off after powering off the mains. Use the Servo OFF (SV_OFF) command to power off the motor immediately.**

This section describes the parameters for each function.

## Limit Switch Settings

Set up the forward and reversal limit switches.
Refer to "4-5 Wiring I/O Signals", Page 4-25 for wiring the "Forward limit switch (LSP)" and "Reversal limit switch (LSN)" inputs and also to "5-3 I/O Signal Setting", Page 5-18 for signal alignment and polarity settings.

**Important**

- **In case of linear drivers, be sure to connect limit switches to prevent damage to the servo amplifier.**
- **Use the "N.C. (Normal Closed: B contact)" as much as possible to prevent the limit switch contacts from getting oxidized.**

### ■ Limit switch stop mode

| Parameter type | Category | Level | Parameter name | Setting range | Setting unit | Default | Enable timing |
|---|---|---|---|---|---|---|---|
| ALM_05 | Alarm | Extend | *Limit switch stop mode | 0: Same setting as Servo OFF<br>1: Servo lock after decel stop by setting trq<br>2: Free after decel stop by setting trq<br>3: Servo lock after decel stop by setting time<br>4: Free after decel stop by setting time | - | 1 | After power is ON again |

**Point**

- **When combing the servo amplifier with KV-XH16ML/XH04ML, set the limit switch stop mode to "1: Servo lock after decel stop by setting trq" or "3: Servo lock after decel stop by setting time". Otherwise, the servo amplifier cannot work properly.**
- **When the ALM_05 and ALM_01 values are set to "0" respectively, the switches become free after a dynamic braking stop.**
- **When the ALM_05 value is set to "1 to 2", the servo amplifier is decelerated and then brought to a stop according to the settings specified for "Common stop torque" (ALM_06).**
- **When the ALM_05 value is set to "3 to 4", the servo amplifier is decelerated and then brought to a stop according to the settings specified for "Common decelerate stop time" (ALM_07).**
- **When torque control is being applied, the ALM_05 setting takes no effect. The servo amplifier is brought to a stop according to "Servo OFF and G1 alarm stop mode" (ALM_01).**

### ■ Torque limit when the limit switches are on

| Parameter type | Category | Level | Parameter name | Setting range | Setting unit | Default | Enable timing |
|---|---|---|---|---|---|---|---|
| ALM_06 | Alarm | Extend | Common stop torque | 0 to 800 | % | 800 | After changing |

**Point**

- **The unit is the percentage of the rated torque.**
- **Even when a value is set that exceeds the maximum torque value of the servo motor, the maximum torque value of the servo motor is the upper limit.**
- **When the limit switches are turned on, the normal torque limit value is disabled. The servo amplifier is brought to a stop at zero speed (stop by command speed 0), while being controlled by ALM_06. Due to this, at the default value (800%), the servo amplifier is brought to a stop at zero speed (stop by command speed 0) by the maximum torque.**

### ■ Speed limit when the limit switches are on

| Parameter type | Category | Level | Parameter name | Setting range | Setting unit | Default | Enable timing |
|---|---|---|---|---|---|---|---|
| ALM_07 | Alarm | Extend | Common decelerate stop time | 0 to 10000 | ms | 0 | After changing |

**Point**

- **"Common decelerate stop time" (ALM_07) sets the time to stop from the maximum motor speed.**
- **When the limit switches are turned on, the normal speed limit value is disabled. The servo amplifier is decelerated and then brought to a stop within the time controlled by ALM_07. Due to this, at the default value (0ms), the servo amplifier is brought to a stop at zero speed (stop by command speed 0).**

## Motor Stop Mode Settings when the Servo Is Off, an Alarm Occurs, or a Forced Stop Is Activated

Set the motor stop mode settings when the servo is off, an alarm occurs, or a forced stop is activated.
Refer to "4-5 Wiring I/O Signals", Page 4-25 for wiring the "forced stop (FSTOP)" input and also refer to "5-3 I/O Signal Setting", Page 5-18 for signal alignment and polarity settings.

**Important**

- **Dynamic braking is the function for emergency stops. When the servo amplifier is powered on/off, powered on when the servo is on, or stopped, the dynamic brake circuit is operated very often, causing the internal elements to degrade.**
- **When the main circuit (L1, L2, L3) or the control circuit (L1C, L2C) is powered off, the servo amplifier is brought to a stop in the following manner, regardless of the parameter settings specified for "*Servo OFF or G1 alarm stop mode" (ALM_01) and "*G2 alarm stop mode" (ALM_02).**
  **The main circuit is powered off (all models) . . . . . Dynamic braking stop**
  **The control circuit is powered off (all models except for SV2-500L2) . . . . . Dynamic braking stop**
  **(SV2-500L2) . . . . . Free run stop**
- **If the servo amplifier needs to be stopped in free run mode instead of dynamic braking when the main circuit (L1, L2, L3) or the control circuit (L1C, L2C) is powered off, break servo motor wiring (U, V, W) to program the sequence externally.**

**Reference**

Alarms are categorized into two types: G1 and G2. You can set up the method to stop alarms based on their respective types when they occur.
Refer to "A-5 List of Alarm/Warning Messages", Page A-25 for how alarms are categorized into either of the types.

### ■ Motor stop mode when the servo is off and a G1 alarm occurs

| Parameter type | Category | Level | Parameter name | Setting range | Setting unit | Default | Enable timing |
|---|---|---|---|---|---|---|---|
| ALM_01 | Alarm | Extend | *Servo OFF or G1 alarm stop mode | 0: Dynamic brake<br>1: Dynamic brake and free<br>2: Free | - | 0 | After power is ON again |

**Reference**

Dynamic braking is one of the modes to bring the servo motor to an emergency stop. The dynamic brake circuit is integrated into the servo amplifier, bringing the servo motor to an emergency stop by shorting the electric circuit.

## ■ Motor stop mode when a G2 alarm occurs

| Parameter type | Category | Level | Parameter name | Setting range | Setting unit | Default | Enable timing |
|---|---|---|---|---|---|---|---|
| ALM_02 | Alarm | Extend | *G2 alarm stop mode | 0: Stop by command speed 0<br>1: Same setting as Servo OFF<br>2: Follow the setting of G2 alarm stop mode (ext.) | - | 1 | After power is ON again |
| ALM_03 | Alarm | Extend | *G2 alarm stop mode (ext.) | 0: Same setting as Servo OFF<br>1: Same setting as Servo OFF after decel stop by setting trq<br>2: Free after decel stop by setting trq<br>3: Same setting as Servo OFF after decel stop by setting time<br>4: Free after decel stop by setting time | - | 1 | After power is ON again |

**Point**

- **When combing the servo amplifier with KV-XH16ML/XH04ML, set the ALM_02 value to "1". Otherwise, the servo amplifier cannot work properly.**
- **When torque control is being applied, the ALM_02 and ALM_03 settings take no effect. The servo amplifier is brought to a stop according to "*Servo OFF and G1 alarm stop mode" (ALM_01).**
- **ALM_03 is only effective when the ALM_02 value to "2".**
- **When the ALM_03 value is set to "1 to 2", the servo amplifier is decelerated and then brought to a stop according to the settings specified for "Common stop torque" (ALM_06).**
- **When the ALM_03 value is set to "3 to 4", the servo amplifier is decelerated and then brought to a stop according to the settings specified for "Common decelerate stop time" (ALM_07).**

## ■ Motor stop mode when a forced stop is activated

| Parameter type | Category | Level | Parameter name | Setting range | Setting unit | Default | Enable timing |
|---|---|---|---|---|---|---|---|
| ALM_04 | Alarm | Extend | *FSTOP stop mode | 0: Same setting as Servo OFF<br>1: Same setting as Servo OFF after decel stop by setting trq<br>2: Free after decel stop by setting trq<br>3: Same setting as Servo OFF after decel stop by setting time<br>4: Free after decel stop by setting time | - | 1 | After power is ON again |

**Point**

- **When torque control is being applied, the ALM_04 setting takes no effect. The servo amplifier is brought to a stop according to "*Servo OFF and G1 alarm stop mode" (ALM_01).**
- **When the ALM_04 value is set to "1 to 2", the servo amplifier is decelerated and then brought to a stop according to the settings specified for "Common stop torque" (ALM_06).**
- **When the ALM_04 value is set to "3 to 4", the servo amplifier is decelerated and then brought to a stop according to the settings specified for "Common decelerate stop time" (ALM_07).**
- **When combing the servo amplifier with KV-XH16ML/XH04ML, set the ALM_04 value to "0 to 2". Otherwise, the servo amplifier cannot work properly.**

## Rotation Direction Setting

Change the rotational direction of the servo motor based on the command received.

Rotation direction can be set through a parameter.

| Parameter type | Category | Level | Parameter name | Setting range | Setting unit | Default | Enable timing |
|---|---|---|---|---|---|---|---|
| SYS_05 | Position | Basic | *Motor rotate direction | 0: CCW<br>1: CW | - | 0 | After power is ON again |

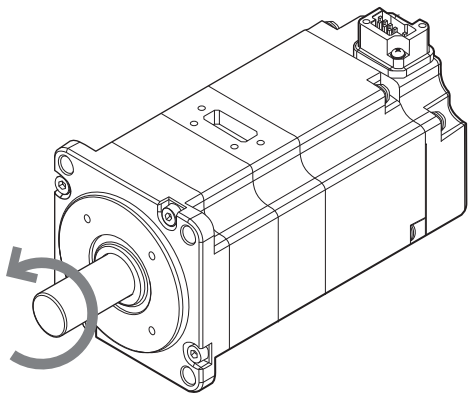


**Point**

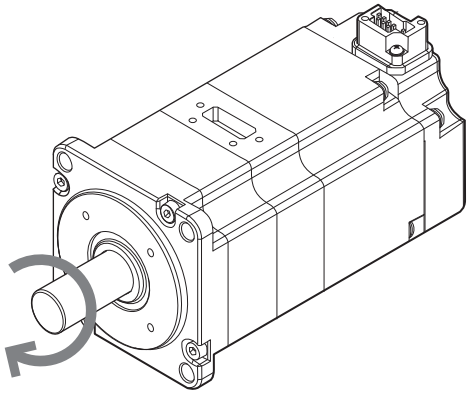
- **When combing the servo amplifier with KV-XH16ML/XH04ML, set the rotational direction to "CCW". Otherwise, the servo amplifier cannot work properly.**
- **When the command value of higher-level equipment is fixed, only rotation direction will be change according to the setting of SYS_05. Encoder pulse output or analog monitor signal, etc. will not change.**

**Reference**

- **CCW : Rotation of motor shaft counter-clockwise seen from the motor shaft end is called "CCW".**



- **CW : Rotation of motor shaft clockwise seen from the motor shaft end is called "CW".**



## Encoder Pulse Output Setting

Encoder pulse output is the function used by a servo motor to output a set pulse every revolution from the "Encoder pulse A-phase (A+/A–)", "Encoder pulse B-phase (B+/B–)" and "Encoder pulse Z-phase (Z+/Z–)" terminals.
For specification and wiring of each terminal, see "4-5 Wiring I/O Signals", Page 4-25.

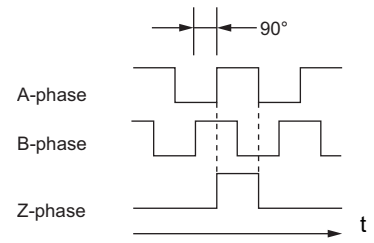
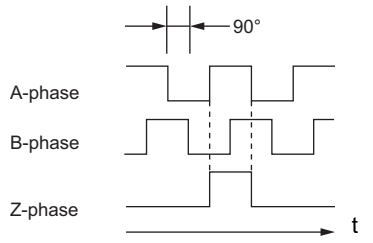
### ■ Signal

Encoder pulse output can output pulses of different status through the following output terminals. Output pulses are shown below.

| Signal | Category | Description |
|---|---|---|
| A+/A– | Encoder pulse A-phase | The output pulses per motor rotation based on encoder indexing pulses. |
| B+/B– | Encoder pulse B-phase | |
| Z+/Z– | Encoder pulse Z-phase | The pulse output by the motor every rotation. |

### ■ Output pulse phase

A pulse with B-phase leading 90° will be output in CCW direction; a pulse with A-phase leading 90° will be ouput in CW.

| CCW (B-phase leading 90°) | CW (A-phase leading 90°) |
|---|---|
|  |  |



▶ Important **Immediately after powering on the mains, restarting the servo amplifier, and performing the CONFIG command, the Z-phase may not be output properly unless the motor makes at least two rotations in advance. If the motor is unable to make two rotations, operate the motor at 600min$^{-1}$ or less.**

Point **The Z-phase pulse width varies according to "Encoder division output pulse" (SYS_02) and becomes the same with that of the A-phase.**

### ■ Output pulse setting

Set up the number of encoder division output pulses per motor rotation.

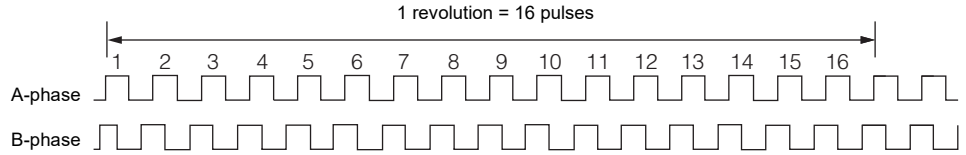
| Parameter type | Category | Level | Parameter name | Setting range | Setting unit | Default (factory setting) | Enable timing |
|---|---|---|---|---|---|---|---|
| SYS_02 | System | Basic | *Encoder division output pulse | 16 to 1048576 | PLS/Rev | 2048 | After power is ON again |

The unit varies according to the number of pulses to be output. If the conditions are not met, the "*encoder division output pulse error" alarm (041) is generated.

| Encoder division output pulse (SYS_02) | Setting unit (PLS/Rev) | Upper limit of motor speed at this setting ($min^{-1}$) |
|---|---|---|
| 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 |
| 262176 to 524288 | 32 | 187 |
| 524352 to 1048576 | 64 | 93 |



Example When "*Encoder division output pulse" (SYS_02) is set to 16 (16 pulses per rotation), the A-phase and B-phase will be output as follows.




**Point**

- **The encoder pulse output frequency upper limit is 1.6Mpps (2-phase and 4-multiplication, 6.4MHz equivalent). The number of motor rotations increases for a larger value. When the value exceeds 1.6Mpps, the "Encoder division output pulse overspeed" alarm (511) is generated.**
- **When not using the absolute position system, perform an origin return after the motor has made at least one rotation, and then count the output pulses. The output pulses may be shifted.**

## Zero Speed Detection Setting

When feedback speed of a servo motor is lower than set value of zero speed detection range, a "Zero speed detection (ZSP)" signal will be output.

For wiring of the "Zero speed detection (ZSP)" signal, see "4-5 Wiring I/O Signals", Page 4-25.

| Parameter type | Category | Level | Parameter name | Setting range | Setting unit | Default | Enable timing |
|---|---|---|---|---|---|---|---|
| VEL_05 | Speed | Extend | Zero speed detection range | 1 to 10000 | $min^{-1}$ | 20 | After changing |

Zero speed detection range has a 5 $min^{-1}$ lag. When feedback speed is above "Zero speed detection range + 5 $min^{-1}$", output will be OFF.

**Point**

**Even if the set value exceeds max. speed of the servo motor, max. speed of the servo motor will also be used as the upper limit value.**

## Torque Limit Setting

To input the internal torque limit value or the torque limit value based on MECHATROLINK-III communication command into the servo amplifier, and limit servo motor torque according to the specified torque.

### ■ Switching torque limit mode

Torque limit is divided into three types: "Internal torque limit (basic)", "Internal torque limit (extend)" and "Torque limit based on MECHATROLINK-III communication command".
Torque limit mode can be set through parameters.

| Parameter type | Category | Level | Parameter name | Setting range | Setting unit | Default | Enable timing |
|---|---|---|---|---|---|---|---|
| TRQ_05 | Torque | Basic | *Torque limit method | 0: Only TrqLim1 is valid<br>1: TrqLim2 is valid (P/NTL)<br>2: TLIM is valid<br>3: TLIM is valid (P/NTL)<br>4: TrqLim2 & TLIM are valid (P/NTL) | - | 2 | After power is ON again |

"Internal torque limit (basic)" will always be enabled in all modes, and "Internal torque limit (extend)" and "TLIM" will be enabled/disabled as follows according to the above parameter setings.

Setting
0. . . . . "Only TrqLim1 is valid" is only enabled.
1. . . . . "Only TrqLim1 is valid" is enabled.
Enable or disable "P-torque limit 2" using the "Forward torque limit selection (PTL)" and "Reversal torque limit selection (NTL)" inputs.
2. . . . . "Only TrqLim1 is valid" and "TLIM" inputs are enabled.
3 . . . . . "Only TrqLim1 is valid" is enabled.
Enable or disable "TLIM" using the "Forward torque limit selection (PTL)" and "Reversal torque limit selection (NTL)" inputs. TLIM is applied as the absolute value only in the direction set for PTL and NTL.
4. . . . . "Only TrqLim1 is valid" is enabled.
Enable or disable "P-torque limit 2" and "TLIM" using the "Forward torque limit selection (PTL)" and "Reversal torque limit selection (NTL)" inputs.

**Point**

- **When combing the servo amplifier with KV-XH16ML/XH04ML, set the torque control method to "TLIM is valid".**
- **When more than one torque control method is enabled simultaneously, control the torque using the minimum effective torque limit.**
- **When the "TLIM" using the "Forward torque limit selection (PTL)" and "Reversal torque limit selection (NTL)" inputs are not assigned to the I/O terminals, the "TLIM" using the "Forward torque limit selection (PTL)" and "Reversal torque limit selection (NTL)" inputs are always disabled.**
- **The input of "forward rotation side torque limit selection (PTL)" and "reversal torque side torque limit selection (NTL)" is the logical sum of the input terminal PTL, NTL and the P_CL, N_CL of servo command output signal field (WVCMD_IO).**
- **The TLIM value is applied to the forward/reverse directions as the absolute value.**
- **Even when a value is set that exceeds the maximum torque value of the servo motor, the maximum torque value of the servo motor is the upper limit.**
- **When running the servo in trial mode (Z phase search, servo JOG operation) while controlling the speed and torque, TLIM is disabled.**
- **The TRQ_05 setting has no effect when the limit switch input is active. The torque is controlled using the "*Limit switch stop mode" (ALM_05) and "Common stop torque" (ALM_06) settings.**

### ● Torque control using TLIM

The torque is controlled using the MECHATROLINK-III command data field (TLIM).
For details, refer to "A-6 MECHATROLINK-III Communication Commands", Page A-36 and the host controller user manual.

### ● Torque limit based on parameters

To set an internal torque limit value through a parameter.

| Parameter type | Category | Level | Parameter name | Setting range | Setting unit | Default | Enable timing |
|---|---|---|---|---|---|---|---|
| TRQ_01 | Torque | Basic | P-torque limit 1 | 0 to 800 | % | 800 | After changing |
| TRQ_02 | | | N-torque limit 1 | 0 to 800 | % | 800 | |
| TRQ_06 | | Extend | P-torque limit 2 | 0 to 800 | % | 100 | |
| TRQ_07 | | | N-torque limit 2 | 0 to 800 | % | 100 | |



## Motor Overload Detection Level Setting

To set up how to detect overload alarm/overload warning that will occur when a continuous load over rated value is applied to the servo motor.

### ■ Motor overload alarm

When a load that exceeds the rated value is applied to the servo motor, detect the "Overload (Peak)" alarm (710) and "Overload (Continuous)" alarm (720) to bring the servo motor to a stop, in order to prevent the heating of the servo motor or destruction of the machine.
When changing the "*Base cur at detecting overload" setting, the current to detect the "Overload (Continuous)" alarm (720) can also be changed.
When the servo motor discharge is not sufficient, the overload alarm can be detected early to prevent the heating of the motor.
"*Base cur at detecting overload" is set by the corresponding parameter.

| Parameter type | Category | Level | Parameter name | Setting range | Setting unit | Default | Enable timing |
|---|---|---|---|---|---|---|---|
| ALM_12 | Alarm | Extend | *Base cur at detecting overload | 10 to 100 | % | 100 | After power is ON again |

**Point** **When powering off the mains while the "Overload (Peak)" alarm (710) and "Overload (Continuous)" alarm (720) are generated, the "Overload warning" (910) is generated the next time the servo amplifier is powered on.**

### ■ Motor overload warning

When changing the "Overload warning" setting, the time to detect an overload warning can also be changed.
"Overload warning" is set by the corresponding parameter.

| Parameter type | Category | Level | Parameter name | Setting range | Setting unit | Default | Enable timing |
|---|---|---|---|---|---|---|---|
| ALM_11 | Alarm | Extend | Overload warning | 1 to 100 | % | 20 | After changing |

## Electronic Gear Setting (Position Control Mode)

A position command from the higher-level equipment will be sent to the servo motor after being converted through a electronic gear ratio.

▶ Important **When combing the servo amplifier with KV-XH16ML/XH04ML, set the electronic gear to the default value of "4/1" normally, or to "1/1" only when using the fully closed control function.**

To set up electronic gear through parameter.

| Parameter type | Category | Level | Parameter name | Setting range | Setting unit | Default | Enable timing |
|---|---|---|---|---|---|---|---|
| POS_01 | Position | Basic | *Electronic gear numerator | 1 to 1073741824 | - | 4 | After power is ON again |
| POS_02 | | | *Electronic gear denominator | 1 to 1073741824 | | 1 | |

Point **Be sure to set the electronic gear within the range of 0.001 ≤ electronic gear ratio (POS_01/ POS_02) ≤ 64000. The "*Parameter setting error 0" alarm (040) will occur when it exceeds the setting range.**

## Inposition Signal (INPOS) Setting (Position Control Mode)

If absolute value of the difference between the pulse command from the higher-level equipment and movement of the servo motor (position deviation pulse) is smaller than the set value, then a "Inposition (INPOS)" signal will be output.

### ■ INPOS range

The SV2 series can set a INPOS range according to position deviation range of the "Inposition (INPOS)" output. The INPOS range can be set through a parameter.

| Parameter type | Category | Level | Parameter name | Setting range | Setting unit | Default | Enable timing |
|---|---|---|---|---|---|---|---|
| POS_03 | Position | Basic | INPOS range | 0 to 1073741824 | CMD_PLS/ ENC_PLS | 25 | After changing |

Point
- **The seting unit is "CMD_PLS", which is a command pulse unit set through the electronic gear (POS_01/POS_02).**
- **If the set value is too large, and the position deviation during low speed operation becomes smaller, then it will always be in the inposition signal output status. Be sure to set a proper range.**

### ■ INPOS/NEAR unit

Number of pulses set in the INPOS/NEAR range can be set to a command pulse unit of the higher-level equipment or an encoder pulse (feedback pulse) unit of the servo motor. Pulse type can be set through a parameter.

| Parameter type | Category | Level | Parameter name | Setting range | Setting unit | Default | Enable timing |
|---|---|---|---|---|---|---|---|
| POS_06 | Position | Special | *INPOS, NEAR unit | 0: CMD_PLS<br>1: ENC_PLS | - | 0 | After power is ON again |

### ■ INPOS output timing

The "Inposition (INPOS)" output will always be ON when the position deviation is always small according to size of the INPOS range. During command pulse input, if the "Inposition (INPOS)" output is OFF, then "Inposition (INPOS)" output timing will be changed. Timing can be set through a parameter.

| Parameter type | Category | Level | Parameter name | Setting range | Setting unit | Default | Enable timing |
|---|---|---|---|---|---|---|---|
| POS_04 | Position | Extend | *INPOS output timing | 0: PosDeviation =< INPOS range<br>1: PosDev =< INPOS & cmd after flt=0<br>2: PosDev =< INPOS & cmd=0 | - | 0 | After power is ON again |



## Positioning Approximation (NEAR) Signal (Position Control Mode)

If absolute value of the difference between the pulse command from the higher-level equipment and movement of the servo motor (position deviation pulse) is smaller than the set value, then a "Positioning approximation (NEAR)" signal will be output.

### ■ NEAR range

The SV2 series cam set a NEAR range according to the position deviation range of "Positioning approximation (NEAR)" output. NEAR range can be set through a parameter.

| Parameter type | Category | Level | Parameter name | Setting range | Setting unit | Default | Enable timing |
|---|---|---|---|---|---|---|---|
| POS_05 | Position | Extend | NEAR range | 0 to 1073741824 | CMD_PLS/ ENC_PLS | 25 | After changing |

**Point** **When combing the servo amplifier with KV-XH16ML/XH04ML, set POS_05 to "25" normally.**

### ■ INPOS/NEAR unit

The number of pulses set in the INPOS/NEAR range can be set to a command pulse unit of the higher-level equipment or an encoder pulse (feedback pulse) unit of the servo motor. Pulse type can be set through a parameter.
"Inposition Signal (INPOS) Setting (Position Control Mode)", Page 5-13

## Deviation Excessive Alarm/Warning Setting (Position Control Mode)

If absolute value of the difference between the pulse command from the higher-level equipment and movement of the servo motor (position deviation pulse) is larger than the set value, then an alarm will occur and the "Alarm (ALARM)" will be ON; or a warning will occur, and the "Warning (WARN)" output will be ON.
When the motor behaves differently from what the command orders, setting "Deviation excessive alarm level" (ALM_10) to an appropriate value allows an error to be detected, bringing the motor to a stop. The position deviation is the difference between the position command value and the actual position and is calculated using the following formula.

$$\text{Position deviation} = \frac{\text{Motor speed [min}^{-1}\text{]}}{60} \times \frac{10 \times \text{Encoder resolution (22bit)}}{\text{"Position control gain" (TUN_04)}} \times \frac{\text{"*Electronic gear denominator" (POS_02)}}{\text{"*Electronic gear numerator" (POS_01)}}$$

### ■ Deviation excessive alarm

Set the deviation excessive alarm level to a value that is calculated by multiplying the value calculated using the above formula by values between 1.2 and 2.

| Parameter type | Category | Level | Parameter name | Setting range | Setting unit | Default | Enable timing |
|---|---|---|---|---|---|---|---|
| ALM_10 | Alarm | Extend | Deviation excessive alarm level | 1 to 1073741823 | CMD_PLS | 5242880 | After changing |

### ■ Deviation excessive warning

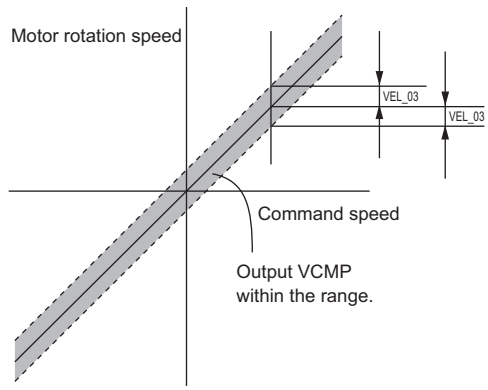
If a warning is detected before a deviation excessive alarm occurs, then adjust the motor load and command to prevent motor stop.
Proportion of a deviation excessive alarm level can be set through a parameter.

| Parameter type | Category | Level | Parameter name | Setting range | Setting unit | Default | Enable timing |
|---|---|---|---|---|---|---|---|
| ALM_09 | Alarm | Extend | Deviation excessive waring level | 10 to 100 | % | 100 | After changing |

## Speed Match Signal (Speed Control Mode)

If difference between the servo motor speed and the command speed is smaller than the "Speed match range" (VEL_03), then the "Speed match (VCMP)" signal will be output.
Detection width of the speed match signal can be set through a parameter.

| Parameter type | Category | Level | Parameter name | Setting range | Setting unit | Default | Enable timing |
|---|---|---|---|---|---|---|---|
| VEL_03 | Speed | Basic | Speed match range | 0 to 100 | $min^{-1}$ | 10 | After changing |




## Maximum Motor Speed Settings

When the servo motor speed exceeds the set value, the "Overspeed" alarm (510) can be detected to bring the servo motor to a stop, in order to prevent the destruction of the machine.
The maximum motor speed function is set using the following function.

| Parameter type | Category | Level | Parameter name | Setting range | Setting unit | Default | Enable timing |
|---|---|---|---|---|---|---|---|
| VEL_06 | Speed | Extend | *Maximum motor speed | 0 to 65535 | $min^{-1}$ | 10000 | After power is ON again |

**Point** **Even if the set value exceeds max. speed of the servo motor, the max. speed will also be used as the upper limit.**

## Speed Limit Setting (Torque Control Mode)

During speed limit, the internal speed limit value or the speed limit value based on MECHATROLINK-III communication command will be input to the servo amplifier, and speed of the servo motor will be limited according to the specified speed.

### ■ Speed limit method setting

Speed limit can be realized through a parameter set value or through VLIM.

#### ● Speed limit based on VLIM

Speed will be limited through the data area of MECHATROLINK-III communication command (VLIM).
For details, see "A-6 MECHATROLINK-III Communication Commands", Page A-36 and user's manual of the host equipment.

#### ● Speed limit based on parameters

Motor speed limit value can be set through a parameter. During torque control, the set value of speed limit will always be enabled.

| Parameter type | Category | Level | Parameter name | Setting range | Setting unit | Default | Enable timing |
|---|---|---|---|---|---|---|---|
| VEL_04 | Speed | Basic | Speed limit during torque control | 0 to 10000 | $min^{-1}$ | 10000 | After changing |

**Point** **When more than one speed control method is enabled simultaneously, control the speed using the minimum effective speed limit.**

## The setting related to the acceleration/deceleration rate of the speeding reference (speed control mode)

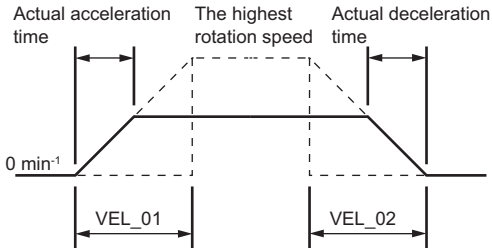
You can set the acceleration/deceleration rate for the speeding reference.
Set the time to accelerate from when the servo motor is stopping to the highest rotation speed[*1], and the time from the highest rotation speed to when the servo motor stops, it functions by the acceleration/deceleration rate during that time.

*1 The highest rotation speed varies depending on the capability of servo motor.
50 to 750W: 6000 $min^{-1}$
1.0k to 5.0kW: 3000 $min^{-1}$

| Parameter type | Category | Level | Parameter name | Setting range | Setting unit | Default | Enable timing |
|---|---|---|---|---|---|---|---|
| VEL_01 | Speed | Basic | Speed control acceleration time | 0 to 10000 | ms | 0 | After changing |
| VEL_02 | | | Speed control deceleration time | 0 to 10000 | ms | 0 | |

- **Setting example**

The example when using in the following environment
Servo motor: SV2-□100A□
The highest rotation speed: 3000 $min^{-1}$
"Speed reference acceleration time"(VEL_01):100 ms
Acceleration rate: 3000 $min^{-1}$ / 100 ms = 30 $min^{-1}$/ms
If starting from when the servo motor is stopping by the speed control at 600 $min^{-1}$ speed reference,
it is accelerated by 600 $min^{-1}$ / 30 $min^{-1}$/ms = 20 ms.




## The setting related to the acceleration/deceleration rate of the torque reference (torque control mode)

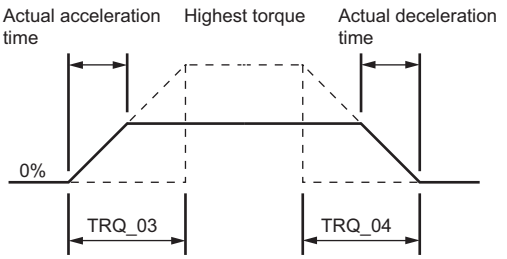
You can set the acceleration/deceleration rate for the torque reference.
Set the time to accelerate from torque reference = 0 to the highest torque[*1], and the time from the highest torque to when the torque stops, it functions by the acceleration/deceleration rate during that time.

*1 The highest torque is the ratio against the rated value of the instant highest torque.
(Example) When 50W, 0.557 N·m / 0.159 N·m = 350%

| Parameter type | Category | Level | Parameter name | Setting range | Setting unit | Default | Enable timing |
|---|---|---|---|---|---|---|---|
| VEL_03 | Torque | Basic | Torque command acceleration time | 0 to 10000 | ms | 0 | After changing |
| VEL_04 | | | Torque command deceleration time | 0 to 10000 | ms | 0 | |

- **Setting example**

The example when using in the following environment
The highest torque: 350%
"Torque reference acceleration time" (TRQ_03): 700 ms
Acceleration rate: 350% / 700 ms = 0.5 %/ms
When the torque reference is changed from 0 % to 60 %
it is accelerated by 60 % / 0.5 %/ms = 120 ms.



## I/O Signal Assignment and Polarity Setting

The I/O terminals are assigned their respective functions in advance. Some terminals can be assigned a different function, or their polarities can be changed. Functions are assigned and polarities are set using their corresponding parameters.

**Point**

- **Same function cannot be assigned to several input terminals. When a duplicate setting exists, the "*Parameter setting error 0" alarm (040) will occur.**
- **Same function can be assigned to several output terminals.**
- **I/O signal assignment/polarity can be set through a parameter. To enable a setting, be sure to make power ON again or restart the servo amplifier.**
- **It is strongly recommended that the input polarity of the "Forced stop (FSTOP)" signal be set to "N.C." for safety reasons.**
- **It is strongly recommended that the input polarity of "Forward limit switch (LSP)" and "Reversal limit switch (LSN)" be set to "N.C." for safety reasons.**



### ■ Input signal

#### ● Signal assignment

The following input signals can be assigned to pins "No.7 to 13". Signals are assigned using their corresponding parameters.

| Signal name | Pin No. | Parameter type | Setting range | Default | Enable timing |
|---|---|---|---|---|---|
| IN1 | 7 | IO_01 | 0 to 3, 7 to 9 | 1 | After power is ON again |
| IN2 | 8 | IO_02 | | 2 | |
| IN3 | 9 | IO_03 | | 7 | |
| IN4 | 10 | IO_04 | 0 to 9 | 4 | |
| IN5 | 11 | IO_05 | | 5 | |
| IN6 | 12 | IO_06 | | 6 | |
| IN7 | 13 | IO_07 | 0 to 3, 7 to 9 | 8 | |

The input signals that can be set and corresponding set value are shown below.
For input signals, see "4-5 Wiring I/O Signals", Page 4-25.

| Set value | Assigned function | | |
|---|---|---|---|
| | Position control | Speed control | Torque control |
| 0 | – | | |
| 1 | LSP | | |
| 2 | LSN | | |
| 3 | DEC | | |
| 4 | EXT1 | | |
| 5 | EXT2 | | |
| 6 | EXT3 | | |
| 7 | PTL | | |
| 8 | NTL | | |
| 9 | FSTOP | | |

**Point**

**When assigning the values "4 to 6" (EXT1 to EXT3) to terminals other than IN4 to IN6, those signals will not work.**
**Do not assign "4 to 6" to any terminals other than IO_04 to IO_06.**

### ● Polarity setting

Polarity of N.O./N.C. of the assigned signals can be changed. Polarity can be set through a parameter.

| Signal name | Pin No. | Parameter type | Setting range | Default | Enable timing |
|---|---|---|---|---|---|
| IN1 | 7 | IO_08 | 0: N.O.<br>1: N.C. | 1 | After power is ON again |
| IN2 | 8 | IO_09 | | 1 | |
| IN3 | 9 | IO_10 | | 0 | |
| IN4 | 10 | IO_11 | | 0 | |
| IN5 | 11 | IO_12 | | 0 | |
| IN6 | 12 | IO_13 | | 0 | |
| IN7 | 13 | IO_14 | | 0 | |

### ● Input time constant settings

When assigning functions other than EXT1 to EXT3, the input time constants can be changed. Input time constants are set using their corresponding parameters.
The input time constants for the signals that are assigned functions "EXT 1" to "EXT 3" will be 0.

| Signal name | Pin No. | Parameter type | Setting range | Default | Enable timing |
|---|---|---|---|---|---|
| IN1 | 7 | IO_15 | 0: 250 µs<br>1: 500 µs<br>2: 1 ms<br>3: 2.5 ms<br>4: 5 ms<br>5: 10 ms | 0 | After power is ON again |
| IN2 | 8 | IO_16 | | 0 | |
| IN3 | 9 | IO_17 | | 0 | |
| IN4 | 10 | IO_18 | | 0 | |
| IN5 | 11 | IO_19 | | 0 | |
| IN6 | 12 | IO_20 | | 0 | |
| IN7 | 13 | IO_21 | | 0 | |

## ■ Output signal

### ● Signal assignment

The following output signals can be assigned to pins No."1, 2", "23, 24", and "25, 26". Signals are assigned using their corresponding parameters.

| Signal name | Pin No. | Parameter type | Setting range | Default | Enable timing |
|---|---|---|---|---|---|
| OUT1 | 1, 2 | IO_22 | 0 to 7 | 3 | After power is ON again |
| OUT2 | 23, 24 | IO_23 | | 1 | |
| OUT3 | 25, 26 | IO_24 | | 5 | |

The output signals that can be set and corresponding set value are shown below.
For output signals, see "4-5 Wiring I/O Signals", Page 4-25.

| Set value | Assigned function | | |
|---|---|---|---|
| | Position control | Speed control | Torque control |
| 0 | - | | |
| 1 | RDY | | |
| 2 | INPOS | VCMP | - |
| 3 | BRAKE | | |
| 4 | TLM | TLM | VLM |
| 5 | WARN | | |
| 6 | ZSP | | |
| 7 | NEAR | - | - |

### ● Polarity setting

Polarity of N.O./N.C. of the assigned signals can be changed. Polarity can be set through a parameter.

| Signal name | Pin No. | Parameter type | Setting range | Default | Enable timing |
|---|---|---|---|---|---|
| OUT1 | 1, 2 | IO_25 | 0: N.O.<br>1: N.C. | 0 | After power is ON again |
| OUT2 | 23, 24 | IO_26 | | 0 | |
| OUT3 | 25, 26 | IO_27 | | 0 | |

# 5-4 Regenerative Resistor Setting

## Overview

When the servo motor is in regenerative status, the generated regenerative power will be absorbed by charging of the smoothing capacitor in the servo amplifier. If the regenerative power exceeds the charging capacity, be sure to use an external regenerative resistor.
Although servo amplifier of larger than 750W has a built-in regenerative resistor, an external regenerative resistor should be used if it is necessary to perform operation that may produce a regenerative power beyond its regenerative capacity.

The following are examples of servo motor in regenerative status.

- Deceleration period when acceleration/deceleration operation is performed
- Continuous moving down operation of a vertical axis
- An operation in which the servo motor is rotated continuously from load side (negative load)

▶ Important

- **Wrong wiring of regenerative resistor may lead to equipment damage or fire.**
- **Continuous operation cannot be performed in negative load status. In negative load status, the servo amplifier will be in a continuous regenerative braking status. Regenerative energy from load may exceeds the allowable range, causing damage to the servo amplifier.**

For wiring of regenerative resistor, see "4-6 Wiring Regenerative Resistor", Page 4-34.

## How to Select a Regenerative Resistor

Whether a regenerative resistor is needed or not can be determined through the following steps.

**1 Use a capacity selection software to determine whether a regenerative resistor is needed. ***

Generally, it is unnecessary to connect a regenerative resistor.

* When capacity selection software is not used, see "How to Select an External Regenerative Resistor", Page 5-21 to calculate the capacity of the regenerative resistor needed.

**2 When a regenerative resistor must be used, a regenerative resistor as an option (OP-84399/OP-87073) should be used.**

When regenerative capacity of the optional regenerative resistor is insufficient, a regenerative resistor can be provided by the customer.

## Regenerative Resistor Setting

### ■ Regenerative resistor capacity setting

When an external regenerative resistor is connected, be sure to set "Regenerative resistor capacity" (SYS_03) and "Regenerative resistor value" (SYS_04).

| Parameter type | Category | Level | Parameter name | Setting range | Setting unit | Default | Enable timing |
|---|---|---|---|---|---|---|---|
| SYS_03 | System | Basic | Regenerative resistor capacity | 0 to Servo amplifier capacity | 10W* | 0 | After changing |
| SYS_04 | System | Basic | Regenerative resistor value | 0 to 65535 | 10mΩ* | 0 | After changing |

* It is a unit when handling parameters from the ladder program. When setting with KV STUDIO (Software), set in multiples of 10 (in W and mΩ), including "0" at the ones place.

Setting of the regenerative resistor capacity should match the value of allowable capacity of the connected external regenerative resistor. The setting value will vary with the cooling status of the external regenerative resistor. Please use the following target value as a reference for calculation.

- In the case of natural air cooling: set a value below 20% of the regenerative resistor capacity (W)
- In the case of forcedl air cooling: set a value below 50% of the regenerative resistor capacity (W)

* For example, when the regenerative resistor option (OP-84399/OP-87073) is used according to natural air cooling, rated capacity is 220W × 20% = 44W, and you need set "4" (10W) in SYS_03 after rounding the ones place. Set "50000" (mΩ) in case of OP-84399 (50Ω) and "2000" (10mΩ) in case of OP-87073 (20Ω) to SYS_04. When setting with KV STUDIO (Software), set "40" (W) for regenerative resistance capacity and "20000" (mΩ) for regenerative resistance value.

**Important**

- **When a regenerative resistor other than OP-84399/OP-87073 is used, an external regenerative resistor with a thermostat is recommended to ensure safety.**
- **If you set SYS_03 to 0 when an external regenerative resistor is connected, it is possibe that the "Regenerative overload" alarm (320) cannot be detected. When it cannot be detected normally, personal injury or fire may result. Therefore, be sure to set it to a proper value.**

**Point**

**The default of "Regenerative resistor capacity" (SYS_03) and "Regenerative resistor value" (SYS_04) is 0, which is the value when no regenerative resistor is connected (for SV2-075L2/100L2/150L2/200L2/300L2/500L2, built-in regenerative resistors only). When setting "Regenerative resistor capacity" (SYS_03) or "Regenerative resistor value" (SYS_04) to other than 0 with no external regenerative resistor connected, the "Regenerative error" alarm (300) is generated.**



## How to Select an External Regenerative Resistor

When a regenerative resistor other than the external regenerative resistor option (OP-84399/OP-87073) is used, capacity of the regenerative resistor can be determined through the following steps.
For specification of the regenerative resistor, be sure to check ratings of the regenerative resistor before use.

### ■ Determine whether an external regenerative resistor is needed based on simple calculation

When driving a servo motor on a horizontal axis, you can use the following simple formula to determine whether an external regenerative resistor is required.

#### ● When the servo amplifier does not have a built-in regenerative resistor (below 400W)

The energy that can be handled by the capacitor is shown below.

| Servo amplifier type | Regenerative energy that can be handled [J] | Note |
|---|---|---|
| SV2-005L2 | 24.2 | The value when the main circuit input voltage is 200 VAC. |
| SV2-010L2 | | |
| SV2-020L2 | | |
| SV2-040L2 | 31.7 | |

When rotating energy of the servo motor and load exceeds the value in the table, please connect an external regenerative resistor. Rotating energy Es of the servo motor and load can be calculated using the following formula.

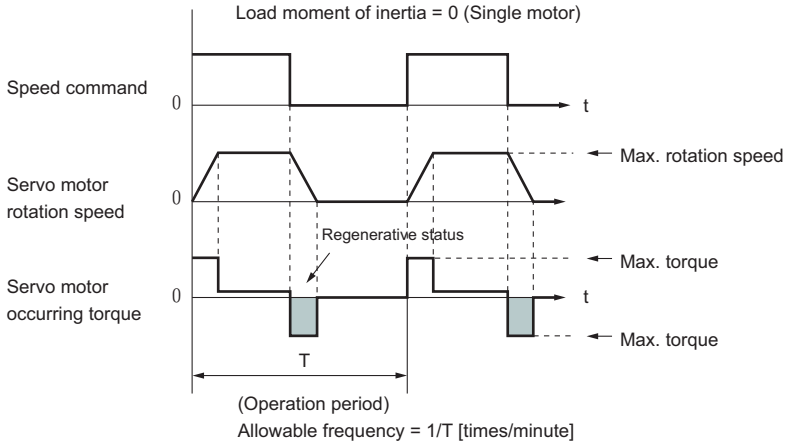
$$E_S = J \times n_M^2 / 182 \ [J]$$

$E_S$ : Energy
$J$ : ( = $J_M$+$J_L$) [kg·m$^2$]
$J_M$ : Rotor inertia moment of servo motor [kg·m$^2$]
$J_L$ : Ratio of load inertia moment converted based on motor axis [kg·m$^2$]
$n_M$ : Operating speed of servo motor [min$^{-1}$]

### ● When the servo amplifier has a built-in regenerative resistor (750W or more)

When the rotational speed ($min^{-1}$) is alternately accelerating and decelerating in the sequence of 0 → the maximum rotational speed → 0, the acceptable intervals are as follows. Estimate the intervals for the actual operating rotational speed and load inertia moment to determine whether to require an external regenerative resistor.

| Servo amplifier type | Acceptable intervals for regenerative operation [times/minute] |
|---|---|
| SV2-075L2 | 15 |
| SV2-100L2 | 6.9 |
| SV2-150L2 | 6.1 |
| SV2-200L2 | 7.4 |
| SV2-300L2 | 9.5 |
| SV2-500L2 | 6.4 |




Operation condition for regenerative allowable frequency calculation

Permissible frequency of regenerative operation can be calculated using the following formula.

**Permissible frequency = permissible frequency of individual servo motor/(1+n) × (max. speed/used speed)$^2$ [times/minute]**

n : ( = $J_L$ / $J_M$) [kg·m$^2$]
$J_M$ : Rotor inertia moment of servo motor [kg·m$^2$]
$J_L$ : Ratio of load inertia moment converted base on motor axis [kg·m$^2$]

## ■ Calculate required capacity of regenerative resistor based on regenerative energy

When operation of acceleration → deceleration in the operation period shown below is perfomred, capacity of the regenerative resistor can be calculated as follows.

| Step | Calculating item | Symbol | Formula for calculation |
|---|---|---|---|
| 1 | Calculate the rotating energy of servo system | $E_S$ | $E_S = J \times n_M^2 / 182$ |
| 2 | Calculate consumption energy lost in load system during deceleration | $E_L$ | $E_L = (\pi/ 60)\ n_M \times T_L \times t_D$ |
| 3 | Calculate the energy loss of servo motor winding resistance | $E_M$ | (Value calculated from the chart for energy loss of the servo motor winding resistance) × $t_D$ |
| 4 | Calculate the energy that can be absorbed by servo amplifier | $E_C$ | The value calculated from the chart for the energy that can be absorbed by the servo amplifier |
| 5 | Calculate the energy consumed by regenerative resistor | $E_K$ | $E_K = E_S - (E_L + E_M + E_C)$ |
| 6 | Calculate the required capacity (W) of regenerative resistor | $W_K$ | $W_K = E_K / (0.2 \times T)$ |

* "0.2" in the formula for $W_K$ is the value when load ratio of the regenerative resistor is 20%.

Unit for each symbol is shown as follows.

$E_S$ to $E_K$ : Engery, Joule [J]
$W_K$ : Required capacity of regenerative resistor [W]
J : (= $J_M$+$J_L$) [kg·$m^2$]
$n_M$ : Speed of servo motor [$min^{-1}$]
$T_L$ : Load torque [N·m]
$t_D$ : Deceleration stop time [s]
T : Cycle operation period of servo motor [s]

In the above calculation, if the value of $W_K$ does not exceed the power that can be handled by built-in regenerative resistor of the servo amplifier, an external regenerative resistor is not required. If it exceeds the power that can be handled by built-in regenerative resistor of the servo amplifier, please connect an external regenerative resistor with a corresponding capacity calculated through the above calculation.

In addition, when loss of the load system in Step 2 is unknown, please calculate again assuming that $E_L$=0.

For operation period in continuous regenerative status, you should first add the following items to the above calculation steps, then calculate the required capacity of regenerative resistor.

- Energy during operation period in continuous regenerative status : $E_G$ [J]
- Energy consumed by regenerative resistor : $E_K = E_S - (E_L + E_M + E_C) + E_G$
- Required capacity of regenerative resistor : $W_K = E_K / (0.2 \times T)$

Where $E_G = (2\pi/60) \times n_{MG} \times T_G \times t_G$

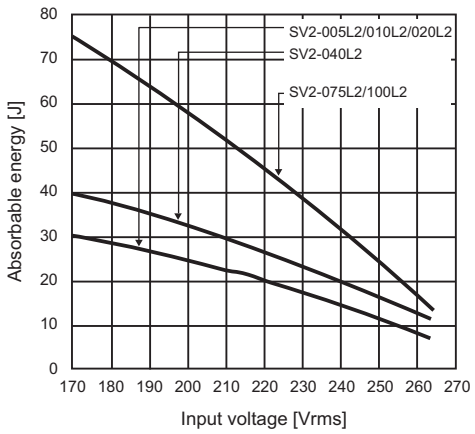
$T_G$ : Torque of servo motor during operation period in continuous regenerative status [N·m]
$n_{MG}$ : Speed of servo motor during operation [$min^{-1}$], same as above
$t_G$ : Operation time [s], same as above

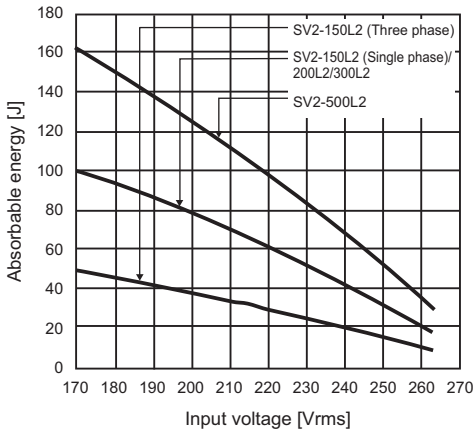
**Point**

- **Please select an external regenerative resistor within the following range of sizes.**
  **SV2-075L2/100L2 : 40Ω or more**
  **SV2-150L2 : 20Ω or more**
  **SV2-200L2/300L2 : 12Ω or more**
  **SV2-500L2 : 8Ω or more**
  **For the external regenerative resistors of below 20Ω, it is recommended to use the power type cement resistors made by Iwaki Musen (RH type).**
- **If value of the regenerative resistor capacity is too large, then time for consuming the regenerative energy will be longer. If the regenerative energy cannot be consumed completely during the operation period, the "Regenerative overload" alarm (320) may occur. Be sure to use a regenerative resistor with a smaller resistance value as much as possible.**

## ● Energy that can be absorbed by servo amplifier

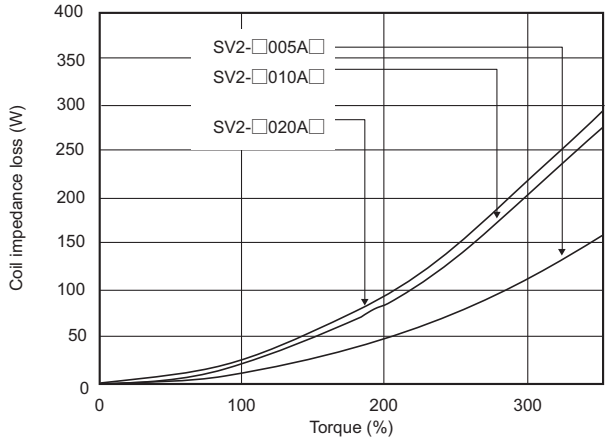
The energy that can be absorbed by the capacitor in the servo amplifier is shown below.

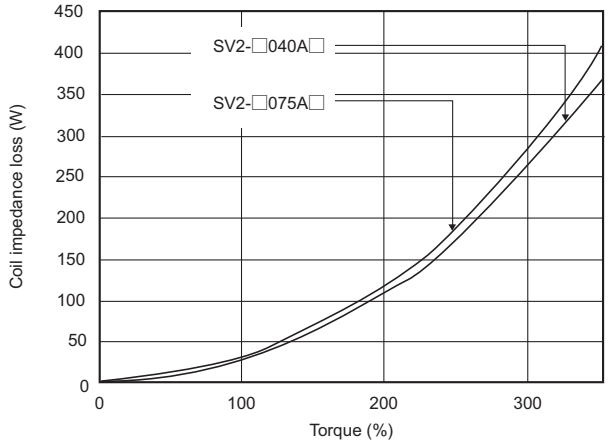


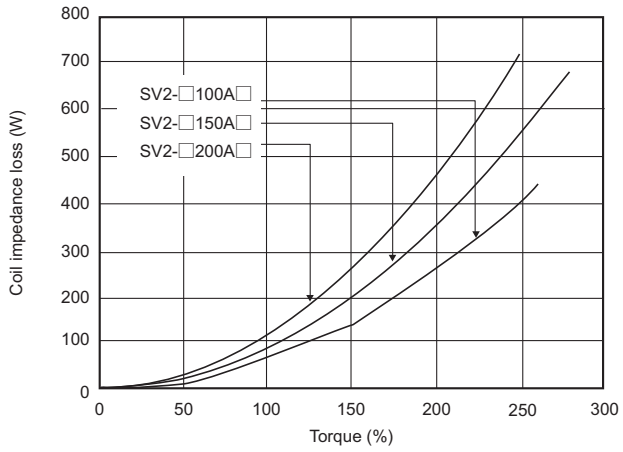



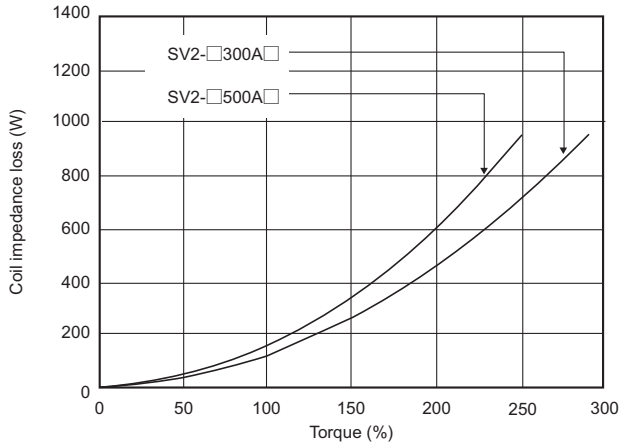
- **Winding resistance loss of servo motor**

Relationship between torque of servo motor and winding resistance loss is shown below.



# 5-5 Electromagnetic Brake Setting

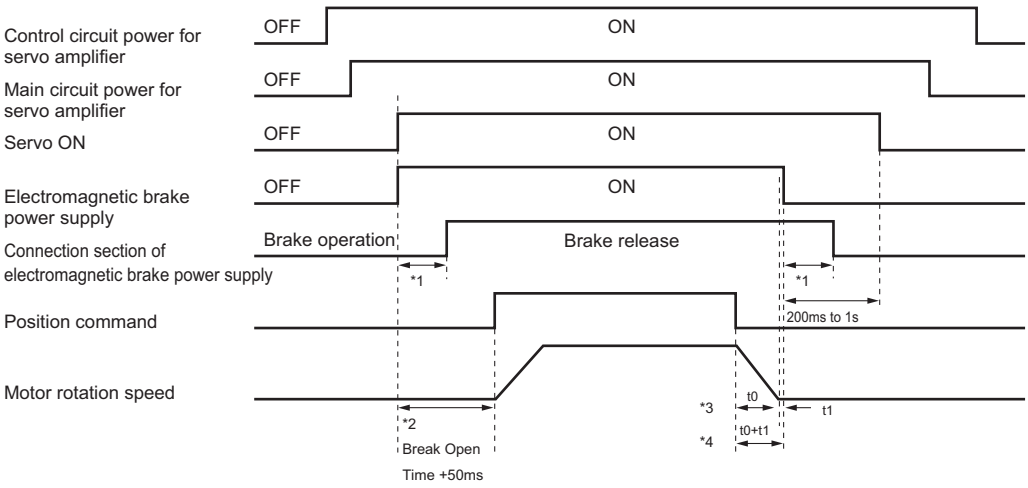
Electromagnetic brake is used to prevent movable parts of the machine from moving due to its own weight or an external force when power of the servo amplifier power is OFF.
It is built in the servo motor with an electromagnetic brake.

For wiring of the electromagnetic brake, see "4-4 Wiring Servo Motor", Page 4-12.

**Important** **The electromagnetic brake is a brake especially used for holding, and it should not be used for braking purpose. It can only be used to hold stop status of the servo motor.**

## Sequence Control Program for Brake Operation

The electromagnetic brake has operational delays. Be sure to stick to the sequence patterns as indicated in the illustration below.




*1 Delay time of brake operation depends on model type. "Brake operation delay time", Page 5-26
*2 Set the brake release time so it equals to the time from powering on the brake power to entering a command plus an additional 50ms or longer.
*3 t0 represents the stop time of motor.
*4 Be sure to set brake power to OFF after the motor stops. Usually it is set to (t0+t1): about 1 to 2s.

**Point** **The "Electromagnetic brake timing (BRAKE)" output is set to ON when the limit switch input is active.**

### ■ Brake operation delay time

A delay time will exist from the moment a brake signal is sent to the moment the actual operation of the brake is performed. An example of brake operation delay time is shown below.

| Servo motor type | Brake release time [ms] | Brake operation time [ms] |
|---|---|---|
| SV2-B005A□ | 60 | 100 |
| SV2-B010A□ | | |
| SV2-B020A□ | | |
| SV2-B040A□ | | |
| SV2-B075A□ | 80 | 100 |
| SV2-B100A□ | 100 | 80 |
| SV2-B150A□ | | |
| SV2-B200A□ | | |
| SV2-B300A□ | 170 | 100 |
| SV2-B500A□ | | |

**Point** **The above operation delay time is only an example. Be sure to evaluate it through actual motor type.**

### ■ How to calculate motor stop time

#### ● To calculate based on SI unit system

$$t_0 = \frac{(J_M + J_L) \times N_M}{(T_P + T_L)} \times \frac{2\pi}{60} \text{ (s)}$$

JM : Rotor moment of inertia ($kg \cdot m^2$)
$J_L$ : Load moment of inertia ($kg \cdot m^2$)
$N_M$ : Motor speed [$min^{-1}$]
$T_P$ : Motor deceleration torque (N·m)
$T_L$ : Load torque [N·m]

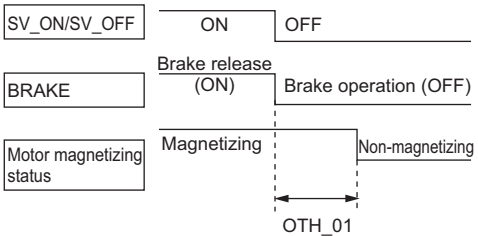
## Brake Timing Output Setting

Excitation of servo motor or output timing of the "Electromagnetic brake timing (BRAKE)" signal can be adjusted through parameter setting.

### ■ Electromagnetic brake operation when servo motor stops

When the servo motor is stop, the "Electromagnetic brake timing (BRAKE)" output will be ON when the servo OFF (SV_OFF:32H) command is input.
Through setting "Brake cmd - SVOFF delay time" (OTH_01), you can change the timing until the servo motor changes to a non-excitation status after the servo OFF (SV_OFF:32H) command is input (="Electromagnetic brake timing (BRAKE)" output is OFF).
If movable parts of of the machine may move due to its own weight or external force (such as vertical axis), the servo motor can be changed to a non-excitation status to prevent the machine from moving.

| Parameter Type | Category | Level | Parameter name | Setting range | Setting unit | Default | Enable timing |
|---|---|---|---|---|---|---|---|
| OTH_01 | Other | Extend | Brake cmd - SVOFF delay time | 0 to 50 | 10ms | 0 | After changing |



**Important** **OTH_01 can be used to set timing of servo motor stop. During servo motor operation, setting of "Brake cmd output speed level" (OTH_02) and "Waiting time for brake signal" (OTH_03) will be followed.**

## ■ Electromagnetic brake operation when servo motor rotates

After an alarm occurs during servo motor rotation, the servo motor will perform stop operation, and the "Electromagnetic brake timing (BRAKE)" output will be OFF.
After "Brake cmd output speed level" (OTH_02) and "Waiting time for brake signal" (OTH_03) are set, timing of the "Electromagnetic brake timing (BRAKE)" output can be set.

| Parameter Type | Category | Level | Parameter name | Setting range | Setting unit | Default | Enable timing |
|---|---|---|---|---|---|---|---|
| OTH_02 | Other | Extend | Brake cmd output speed level | 0 to 10000 | $min^{-1}$ | 100 | After changing |
| OTH_03 | | | Waiting time for brake signal | 10 to 100 | 10ms | 50 | |

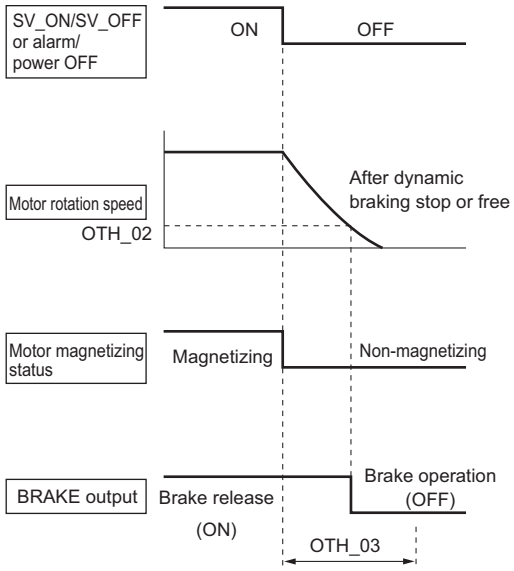
**Point** **Even if the set value exceeds max. speed of the servo motor, the max. speed will still be the upper limit.**

**Important** **When "*G2 alarm stop mode" (ALM_02) is set to "Stop by command speed 0" in case of a G2 alarm, the motor is brought to a stop by Command 0, and then the electromagnetic brake is activated according to OTH_01.**

### ● Condition for electromagnetic brake operation when servo motor rotates

When any of the following conditions is satisfied, the brake willl operate.

- After the motor is OFF, the motor speed is below the set value of OTH_02.
- In case the time set for OTH_03 has elapsed after powering off the motor.



# 5-6 Analog Monitor Setting

The analog monitor connector allows the feedback speed, internal command torque, etc. to be monitored using the analog voltage.
Refer to "4-7 Wiring Analog Monitor", Page 4-36 for analog monitor connector specifications and wiring.

Set signals to be output from the analog monitor connector using the corresponding parameters.

| Parameter type | Category | Level | Parameter name | Setting range | Setting unit | Default | Enable timing |
|---|---|---|---|---|---|---|---|
| OTH_11 | Other | Special | Analog monitor 1 | 00H: Feedback speed<br>01H: Internal command speed<br>02H: Internal command torque<br>03H: Position deviation<br>04H: Position amplifier deviation<br>05H: Position command speed<br>06H: Active gain number<br>07H: Pulse output completion signal<br>08H: INPOS signal<br>09H: Speed feedforward<br>0AH: Torque feedforward<br>0DH: External encoder speed<br>10H: Main circuit DC voltage<br>30H: Analog feedback command torque<br>31H: Analog feedback detection torque<br>32H: Analog feedback output torque<br>33H: Analog feedback torque deviation | - | 2 | After changing |
| OTH_12 | | | Analog monitor 2 | | | 0 | |

**Point**

- **After powering on the control circuit, approximately 10V may be output from the analog monitor connector for up to 200ms.**
- **The analog monitor output will output data for monitoring. Do not use it for control.**

## List of Signals to be Monitored

The signals that can be monitored by the analog monitor and corresponding units are shown below.
For values that can be monitored, see "A-3 Control Block Diagram", Page A-22.

| Monitoring signal | Unit |
|---|---|
| Feedback speed | 1V/1000min$^{-1}$ |
| Internal command speed | 1V/1000min$^{-1}$ |
| Internal command torque | 1V/100% (rated torque) |
| Position deviation | 0.05V/CMD_PLS |
| Position amplifier deviation | 0.05V/ENC_PLS |
| Position command speed | 1V/1000min$^{-1}$ |
| Active gain number | When Gain 1 is enabled: 1V; when Gain 2 is enabled: 2V |
| Pulse output completion signal | 5V for pulse output complete; 0V for pulse output not complete |
| INPOS signal | 5V for positioning complete; 0V for positioning not complete |
| Speed feedforward | 1V/1000min$^{-1}$ |
| Torque feedforward | 1V/100% (rated torque) |
| External encoder speed | 1V/1000min$^{-1}$ (motor shaft conversion value) |
| Main circuit DC voltage | 1V/Main circuit voltage 100 VDC |
| Analog feedback command torque | 1V/100% (rated torque) |
| Analog feedback detection torque | 1V/100% (rated torque) |
| Analog feedback output torque | 1V/100% (rated torque) |
| Analog feedback torque deviation | 1V/100% (rated torque) |

## Output Data Adjustment

Data output from the analog monitor connector can be adjusted as follows. Adjustments can be made for Analog monitor 1 and Analog monitor 2 respectively.

- **Analog monitor 1 output**

Analog monitor 1 output =(-1) × (value of "Analog monitor 1" × "Analog monitor 1 magnification" + "Analog monitor 1 offset voltage")
(OTH_11) (OTH_15) (OTH_13)

- **Analog monitor 2 output**

Analog monitor 2 output = (-1) × (value of "Analog monitor 2" × "Analog monitor 2 magnification" + "Analog monitor 2 offset voltage")
(OTH_12) (OTH_16) (OTH_14)

Analog monitor offset voltage and analog monitor magnification can be set through a parameter.

| Parameter type | Category | Level | Parameter name | Setting range | Setting unit | Default | Enable timing |
|---|---|---|---|---|---|---|---|
| OTH_13 | Other | Special | Analog monitor 1 offset voltage | −10000 to 10000 | 0.1V | 0 | After changing |
| OTH_14 | | | Analog monitor 2 offset voltage | −10000 to 10000 | 0.1V | 0 | |
| OTH_15 | | | Analog monitor 1 magnification | −10000 to 10000 | 0.01 × | 100 | |
| OTH_16 | | | Analog monitor 2 magnification | −10000 to 10000 | 0.01 × | 100 | |

**MEMO**

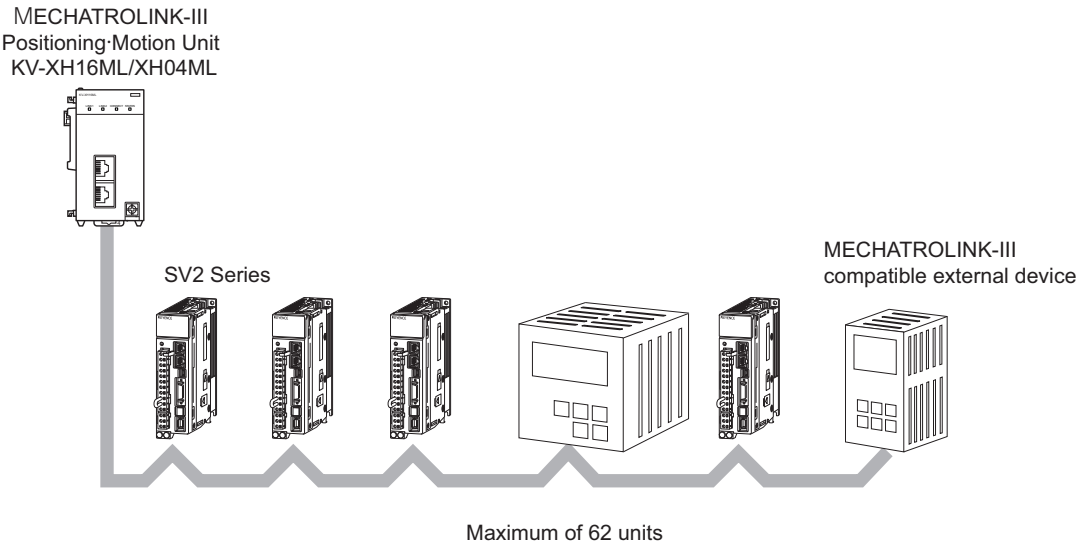
# 6

# CONFIGURATION AND OPERATION OF MECHATROLINK-III

Here, we will explain about the configuration of MECHATROLINK-III. Please use as a reference together with "chapter 5 PARAMETER SETTINGS".

## What is MECHATROLINK-III

MECHATROLINK-III is a motion field network which can control and servomotors, I/Os and inverters, and stepping motors.




### • Communication Specifications

The MECHATROLINK communication specification of SV2-□□L2 is as follows.

| Item | | Specifications |
|---|---|---|
| MECHATROLINK communication | Communication protocol | MECHATROLINK-III |
| | Station address | 03H to EFH (Max. No. of connectable slave stations: 62)<br>(Configure with rotary switch) |
| | Transmission rate | 100 Mbps |
| | Transmission cycle | 125 µs, 250 µs, 500 µs, 750 µs, 1 ms to 4 ms (multiple of 0.5 ms) |
| | No. of bytes transmitted | 32 bytes/station, 48 bytes/station (configure with dipswitch) |
| | Transmission medium, cable | Category 5e compliant STP cross cable |
| | Operation specification | Position control, speed control, and torque control ny MECHATROLINK communication. |
| | Command input | MECHATROLINK-III communication command<br>(Sequence, motion, data configuration/<br>reference, monitoring, adjustments, etc) |

### • Wiring

When connecting SV2-□□L2, MECHATROLINK-III compatible controllers, or MECHATROLINK-III compatible equiptment, please be sure to wire according to the following instructions.

Inter-station cable length: 0.2 m to 50 m

* Please wind 2 turns of ferrite core (OP-84409) on the 2 sides if more than 30m

For wiring methods and precautions related to wiring, please refer to the manual for the above equiptment.

## Connection with KV-XH16ML/XH04ML

If the SV2 series is connected with KV-XH16ML/XH04ML, the start-up man-hours can be reduced greatly due to the affinity shown below.

- It can be operated without being conscious of the MECHATROLINK-III communication commands.
- Because communication and monitoring with the servo amp is possible while the PLC and PC are connected with the communication cable, plugging the cable in and out is not necessary.
- The parameter can be managed collectively with KV-XH16ML/XH04ML.
- The MECHATROLINK selection monitoring can be used to select and monitor the necessary parameter from 40 types of parameter.

For details on KV-XH16ML/XH04ML usage instructions and function, please refer to the "KV-XH16ML/XH04ML User's Manual".

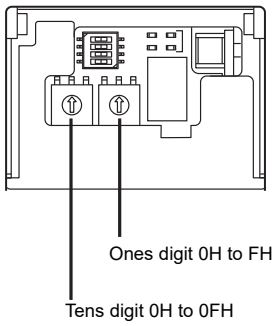
## MECHATROLINK-III configurations

In case of operating the servomotor with MECHATROLINK-III, communication configuration of the servo amp MECHATROLINK-III will be necessary.

### • Station address configuration

Configure servo amp station address with rotary switch.
The station address assigned to the servo amp is 03H to EFH. It is configured to 41H in the default value.

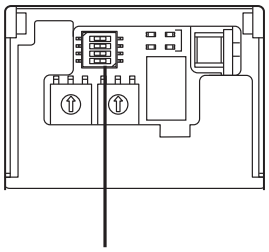
When the front cover is open



## • Configuration of No. of bytes transmitted

Configure the No. of bytes transmitted by MECHATROLINK-III with dipswitch.
The switch number is 1, 2, 3, 4 from the top, and the right side is ON.

When the front cover is open



OFF ⟷ ON
Configuration of No. of bytes transmitted





| Switch number | Item | Settings | | | Default value |
|---|---|---|---|---|---|
| | | 1 | 2 | Setting value | |
| 1, 2 | No. of bytes transmitted | OFF | OFF | System reservation (Do not configure) | 1: OFF<br>2: ON<br>(48 bytes) |
| | | ON | OFF | 32 bytes | |
| | | OFF | ON | 48 bytes | |
| | | ON | ON | System reservation (Do not configure) | |
| 3 | System reservation (Do not configure) | | | | OFF |
| 4 | System reservation (Do not configure) | | | | OFF |

**Point** **In case of using KV-XH16ML/XH04ML together, configure the transmission byte number to 48 bytes likes the default value. It will not function correctly if changed.**

# 6-3 Operation

For operation, please refer to the manual for the above equiptment.
The method of operation will change depending on the above equiptment.

## In the case of KV-XH16ML/XH04ML

In case of connecting with KV-XH16ML/XH04ML, it can be operated without being conscious of the MECHATROLINK-III communication commands.
For details on operation, please refer to the "KV-XH16ML/XH04ML User's Manual".

Point

**Please refer to "A-1 Parameter List", Page A-2 if changing from the default value. In the case of using together with KV-XH16ML/XH04ML, if part of the parameter is changed, it will not function correctly.**

**MEMO**

# 7

# TUNING

This chapter describes tuning for servo motor and other applications.

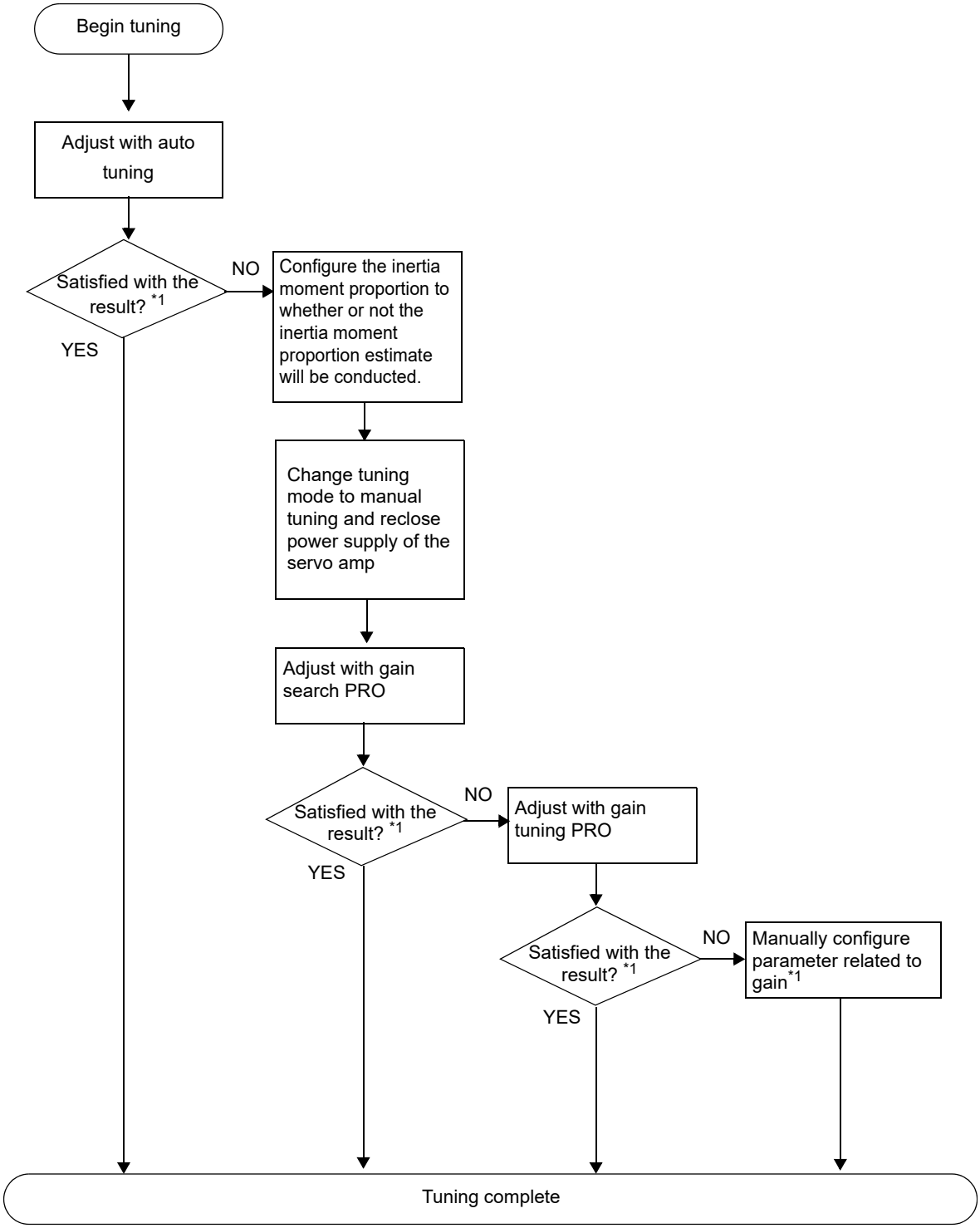
## Overview for tuning function

Gain adjustment in accordance with the characteristics of the machines are necessary for controlling machines with the SV2 series appropriately.
The SV2 series is made so that gain adjustment according to the characteristics of the machine is possible by using functions such as auto-tuning, gain search PRO, and gain tuning PRO.
Here we will explain the overview of tuning functions that can be performed with the SV2 series.

| Function | | Overview | Supported control mode | | |
|---|---|---|---|---|---|
| | | | Position | Speed | Torque |
| Auto-tuning | | The servo amp will automatically adjust the responsiveness so the responces will stay constant.<br>When mechanical resonance occurs, the notch filter will be automatically configured up to the second level by the notch filter automatic adjustment function, mitigating the impact of the mechanical resonance.<br>It can be adjusted in the easiest way, since the tuning is completed with only the configuration for auto tuning responsiveness. | Yes | Yes | - |
| Inertia moment proportion estimate | | It is a function which operates the servomotor automatically (alternating between clockwise and counter-clockwise rotation) and estimates the load inertia moment proportion (the ratio of the inertia moment of the load towards the rotor inertia). The more accurate the inertia moment proportion, the higher the accuracy of the various tuning functions. | Yes | Yes | Yes |
| Gain search PRO | Without host command | The servo amp measures the machine characteristics, and automatically conducts the gain adjustment.<br>Gain search PRO has two adjustment methods, "no host command" which automatically adjusts the gain by automatically operating (alternating between clockwise and counter-clockwise rotation) the servomotor within the configuration boudaries, and "host command" which automatically adjusts the gain in accordance with the above positioning/command from the motion unit.<br>Finer adjustments than auto tuning can be made in accordance with the characteristic of the machine. | Yes | - | - |
| | With host command | | Yes | Yes | - |
| Gain tuning PRO | Responsiveness level adjustment | It is a tuning function which conducts the most appropriate gain configuration by operating the servomotor with commands from the above positioning/motion unit, while manually changing the responsiveness level, stability level, or both.<br>Adjustment may take relatively long since it requires manual level adjustment and confirmation of the adjustment results, but it will allow for finer adjustments in accordance with the characteristics of the machine. | Yes | - | - |
| | Stability level adjustment | | Yes | Yes | Yes |
| Vibration suppression control | | It is a function which suppresses the continuous 100 to 1000Hz vibrations that occur when gain is taken up. | Yes | Yes | - |
| Vibration suppression | | It is a function which suppresses the transient low-frequency 1 to 100Hz vibrations that occur from things such as the machine stand vibrating. | Yes | Yes | - |
| Mechanical analyzer | | It is a function which measures the frequency characteristics of the machine.<br>It can also estimate the notch filter from the measured frequency characteristics.<br>Machine vibrations can be suppressed by configuring the estimated notch filter. | Yes | Yes | - |

## Tuning procedure

The tuning procedure will be shown in the following flowchart.




*1 If vibrations occur, the frequency characteristics of the machine can be measured using the mechanical analyzer, so machine vibrations can be suppressed by configuring the notch filter.

"7-6 Mechanical analyzer", Page 7-21

## Tuning method

Execute the "Tuning" from the SV2 series setting software/KV-XH setting tool.

- **For SV2 series setting software**

  Please refer to the "12-12 Tuning", Page 12-22 for the operation method of SV2 series setting software.

- **For KV-XH setting tool**

  Please refer to the manual below for control methods with the KV-XH configuration tool.

  "KV-XH16ML/XH04ML User's Manual"

## To conduct tuning safely

When conducting tuning, there is a possibility that the servomotor will function in unanticipated ways. For this reason, please conduct tuning under conditions with the consideration of utmost safety.

- Please do not come in contact with the rotating part when the servomotor is rotating, or when servo is on.
- Please operate in a condition where emergency termination is possible.
- Please limit the range of operation for the machine by taking measures such as placing a limit switch.

## Conditions for using the tuning function

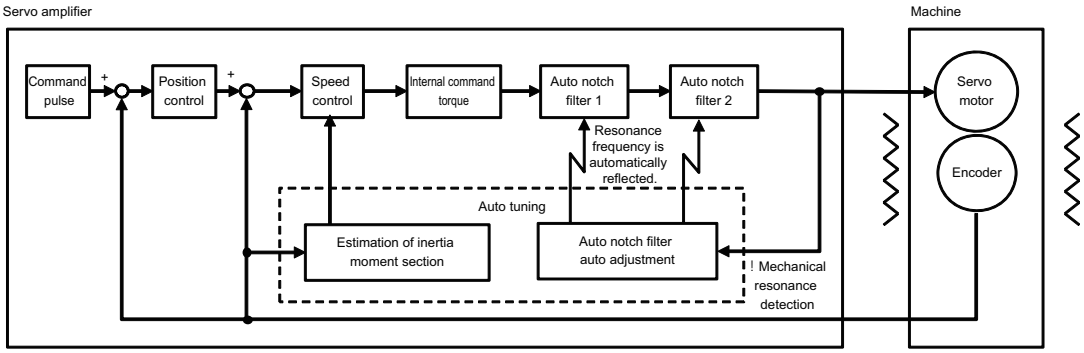
Each function of tuning can be conducted in the conditions shown below.

| Function | | Conditions for use |
|---|---|---|
| Auto-tuning | | • It is in auto-tuning mode<br>• It is in position control mode or speed control mode<br>• Motorless test operation is not in use |
| Inertia moment proportion estimate | | • Servo is off<br>• It is in position control mode or speed control mode<br>• Motorless test operation is not in use<br>• Automatic gain swith is configured to "do not use"<br>• There are no alarms or warnings<br>• It is not in limit switch condition<br>• Displacement distance is configured to over x0.5 servomotor axis rotations.<br>• Second gain is not being used<br>• It is not in STO condition<br>• It is not in force termination condition |
| Gain search PRO | Without host command | • It is in manual-tuning mode<br>• Servo is off<br>• It is in position control mode or speed control mode<br>• Motorless test operation is not in use<br>• Automatic gain swith is configured to "do not use"<br>• There are no alarms or warnings<br>• It is not in limit switch condition<br>• Displacement distance is configured to over x0.5 servomotor axis rotations.<br>• Second gain is not being used<br>• It is not in STO condition<br>• It is not in force termination condition |
| | With host command | • It is in manual-tuning mode<br>• It is in position control mode<br>• Motorless test operation is not in use<br>• Automatic gain swith is configured to "do not use"<br>• There are no alarms or warnings<br>• It is not in limit switch condition<br>• Servo is on<br>• Second gain is not being used |
| Gain tuning PRO | | • Tuning mode is manual<br>• Motorless test operation is not in use<br>• In speed control mode and torque control mode, only stability (L) and stability (H) are usable |
| Mechanical analyzer | | • Servo is off<br>• It is in position control mode or speed control mode<br>• Motorless test operation is not in use<br>• Automatic gain swith is configured to "do not use"<br>• There are no alarms or warnings<br>• It is not in limit switch condition<br>• Displacement distance is configured to over x0.5 servomotor axis rotations.<br>• Second gain is not being used<br>• It is not in STO condition<br>• It is not in force termination condition |

# 7-2 Auto-tuning

## What is auto-tuning

Auto-tuning is a function that ensures stable responsiveness just by automatically adjusting with easy controls, regardless of the characteristics of machinery or differences in load.
When mechanical resonance occurs, the notch filter will be automatically configured up to the second level by the notch filter automatic adjustment function, mitigating the impact of the mechanical resonance just by turning servo on or changing the tuning responsiveness.
Auto-tuning is valid in position control mode or speed control mode. It will be invalid in torque control mode.




## Parameters changed with auto-tuning

When auto-tuning is conducted, the parameters shown below will be changed.

- "Speed gain" (TUN_05)
- "Speed integration time constant" (TUN_06)
- "Position gain" (TUN_04)
- "Torque command LPF" (TUN_07)
- "Automatic notch filter 1" (TUN_24)
- "Automatic notch filter 2" (TUN_25)

## To conduct auto-tuning safely

When conducting changes in auto-tuning responsiveness, there is a possibility that the servomotor will function in unanticipated ways. For this reason, please conduct under conditions with the consideration of utmost safety.

- Please do not come in contact with the rotating part when the servomotor is rotating, or when servo is on.
- Please operate in a condition where emergency termination is possible.
- Please limit the range of operation for the machine by taking measures such as placing a limit switch.
- If auto-tuning is conducted when the load inertia moment proportion of the servomotor is above the allowed level, the machine can vibrate, so please pay attention to the operation state.

## Before conducting auto-tuning

Auto-tuning can be conducted when all of the conditions shown below are met.

- It is in auto-tuning mode
- It is in position control mode or speed control mode
- Motorless test operation is not in use

## Control procedure

Please conduct tuning with the procedure shown below.

1. Configure "tuning mode" to "auto-tuning".

* Reclosing power supply of rebooting servo amp will be necessary when changing from "manual tuning" to "auto-tuning".

↓

2. Adjust to the appropriate "auto-tuning responsiveness" settings by operating the servomotor with commands from above equiptment and servo trial run function, while changing the settings of "auto-tuning responsiveness".

* Please change the "auto-tuning responsiveness" settings gradually, from a small value to a larger value. Once the settings are changed, please run the servomotor while confirming the operation of the machine.

↓

3. In cases where machines become vibrational or the machine emits resonant sounds, the setting value of the "auto-tuning responsiveness" is too high, so change it to a lower value.

↓

4. When responsiveness is unsatisfactory, please run gain search PRO after configuring the load inertia moment proportion.
   Below are the two methods of configuring the load inertia moment proportion.
   - Estimate the load inertia moment proportion using the "inertia moment proportion estimate"
   - Manually configure "load inertia moment proportion" (TUN_08) parameter

## Control method

Execute the "Auto Tuning" from the SV2 series setting software/KV-XH setting tool.

- **For SV2 series setting software**

Please refer to the "Auto Tuning", Page 12-22 for the operation method of SV2 series setting software.

- **For KV-XH setting tool**

Please refer to the manual below for control methods with the KV-XH configuration tool.
"KV-XH16ML/XH04ML User's Manual"

## About auto tuning response setting

Auto-tuning responsiveness is a parameter for configuring gain related parameters, together with the rigidity of the machine. The guidelines for configurations according to the machinery used are as shown below.

| Auto tuning response setting | Machine rigidity | Examples of suitable machinery |
|---|---|---|
| 0 to 4 | Low | Machinery driven by chains and V belts |
| 5 to 8 | Around the middle | Machinery driven by timing belts and others |
| 9 to 12 | High | Machinery driven by ball screws and others |
| 13 to 15 | Exceptionally high | Rigid direct drives such as gears and cam shafts |

Also, pros and cons of large and small auto-tuning responsiveness configurations are as shown below.

| Auto tuning response setting | Advantage | Disadvantage |
|---|---|---|
| Small | • The machine tends not to get vibrational | • Servomotor responce to commands becomes slower<br>• Positiomimg stabilization takes longer |
| Large | • Servomotor responce to commands becomes faster<br>• Positiomimg stabilization takes less time | • The machine tends to get vibrational |



## Auto-tuning point

When adjustment cannot be done properly with auto-tuning, please check the following items.

- If applying to a load exceeding the allowed load inertia moment proportion, please adjust by changing the auto-tuning load level configuration to "high load" However, when in actual use, use within the specification range of the allowed load inertia moment proportion of the servomotor.
- The auto-tuning notch filter automatic adjustment function operates using the settings for "automatic notch filter 1" (TUN_24) and "automatic notch filter 2" (TUN_25). For this reason, if the load or machinery is changed after changing "automatic notch filter 1 automatic adjustment" (TUN_21) or "automatic notch filter 2 automatic adjustment" (TUN_22) to "do not automatically adjust", the mechanical resonance will not be mitigated. When the load or machinery is changed, please configure to "automatic notch filter 1 automatic adjustment" (TUN_21) and "automatic notch filter 2 automatic adjustment" (TUN_22) to "automatically adjust".
- A sound can come from the servomotor when the notch filter automatic adjustment operates, but it is not an abnormality.
- The "tuning excess vibration" alarm(521) can activate when the motor vibrates greatly. Cases like this should be addressed in ways such as lowering the setting value of "auto-tuning responsiveness", or changing the configurations of the "auto-tuning load level" (TUN_03).

## Parameters related to auto-tuning

There are some parameters which require configuring auto-tuning is used.
The various parameters are as shown below.

### ■ Auto-tuning responsiveness

Auto-tuning responsiveness will be configured in accordance with the rigidity of the machine.

| Parameter type | Category | Level | Parameter name | Setting range | Setting Unit | Default | Enable timing |
|---|---|---|---|---|---|---|---|
| TUN_02 | Tuning | Basics | Auto-tuning responsiveness | 0 to 15 | - | 5 | After changing |

### ■ Tuning mode

Configure to auto-tuning.

| Parameter type | Category | Level | Parameter name | Setting range | Setting Unit | Default | Enable timing |
|---|---|---|---|---|---|---|---|
| TUN_01 | Tuning | Basics | *Tuning mode | 0: Manual-tuning<br>1: Auto-tuning | - | 1 | After power is ON again |

### ■ Auto-tuning load level

By changing the configuration when the inertia moment of the load being applied is large, auto-tuning can be done more appropriately. If the load inertia moment proportion exceeds the allowed load inertia moment proportion of the servomotor, please change to "2: high load". However, when in actual use, use within the specification range of the allowed load inertia moment proportion of the servomotor.

| Parameter type | Category | Level | Parameter name | Setting range | Setting Unit | Default | Enable timing |
|---|---|---|---|---|---|---|---|
| TUN_03 | Tuning | Basics | Auto-tuning load level | 1: Low load<br>2: High load | - | 1 | After changing |

* For the allowed load inertia moment proportion of the servomotor, please refer to "2-4 Servo Motor Specifications", Page 2-11.

## ■ Notch filter automatic adjustment

Configure the auto-tuning notch filter automatic adjustment function operates to valid/invalid.
In general, please configure to "1: adjust automatically".

| Parameter type | Category | Level | Parameter name | Setting range | Setting Unit | Default | Enable timing |
|---|---|---|---|---|---|---|---|
| TUN_21 | Tuning | Extend | Automatic notch filter 1 automatic adjustment | 0: Do not adjust automatically<br>1: Adjust automatically | - | 1 | After changing |
| TUN_22 | Tuning | Extend | Automatic notch filter 2 automatic adjustment | 0: Do not adjust automatically<br>1: Adjust automatically | - | 1 | After changing |

By the automatic adjustment function of the notch filter, the parameters shown below will be changed.
Since it will be changed automatically, it is not normally necessary to configure.

- "Automatic notch-filter 1" (TUN_24)
- "Automatic notch-filter 2" (TUN_25)
- "Automatic notch filter 1 frequency" (TUN_31)
- "Automatic notch filter 1Q value" (TUN_32)
- "Automatic notch filter 1 depth" (TUN_33)
- "Automatic notch filter 2 frequency" (TUN_34)
- "Automatic notch filter 2Q value" (TUN_35)
- "Automatic notch filter 2 depth" (TUN_36)

For details regarding notch filter, please refer to "About notch filter configurations", Page 7-26.

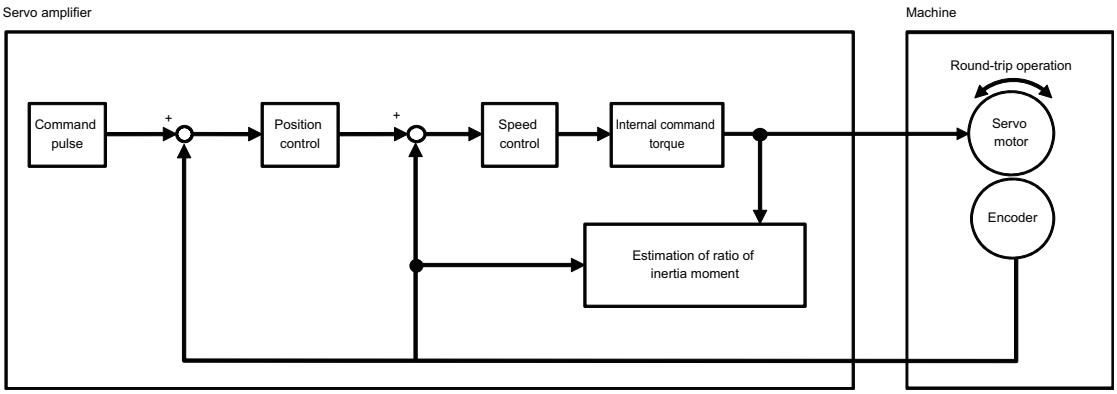
**Point**

**To make the notch filter automatic adjustment function valid, configure "automatic notch filter 1" (TUN_24) and "automatic notch filter 2" (TUN_25) to "0: do not use". When the notch-filter is automatically adjusted, the "Automatic notch-filter 1" (TUN_24) and "Automatic notch-filter 2" (TUN_25) is automatically changed to "1: In use".**

# 7-3 Inertia moment proportion estimate

## What is inertia moment proportion estimate

It is a function in which the servo amp automatically alternates between clockwise and counter-clockwise rotation, and estimates the load inertia moment proportion (the ratio of the inertia moment of the load against the rotor load inertia moment) in accordance with the configured operation conditions. The load inertia moment proportion must be accurately configured to conduct appropriate gain adjustments and control, in cases such as operating with manual tuning such as gain search PRO, or operating with analog feedback control.




In the inertia moment proportion estimate the servomotor will operate automatically with the specifications shown below.

| Item | Specifications |
|---|---|
| Maximum rotation speed | 200 to 1000 $min^{-1}$ |
| Maximum acceleration torque | Servomotor rated torque |
| Displacement distance | Servomotor axis x 0.5 to 3 rotations (-3145000 to -525000, 525000 to 3145000 command pulse*)<br>(Possible to configure in units of 1000 command pulses, default value is servomotor axis x3 rotations) |

* Though it is possible to configure up to 99990000 command pulses, the displacement distance when conducting inertia moment proportion estimate will be servomotor axis x3 rotations, even if configured to over 31450000 command pulses (servomotor axis x3 rotations).
The above is true for when the electronic gear configuration is 4/1. The configuration is anything other than 4/1, the number of servomotor axis rotations will change depending on the electronic gear configuration. Even if the electronic gear is configured to anything other than 4/1, the displacement distance will be a maximum of servomotor axis x3 rotations.

## Parameters changed with inertia moment proportion estimate

When the inertia moment proportion estimate is conducted, the "load inertia moment proportion" (TUN_08) changes.

| Parameter type | Category | Level | Parameter name | Setting range | Setting Unit | Default |
|---|---|---|---|---|---|---|
| TUN_08 | Tuning | Extend | Load inertia moment proportion | 0 to 20000 | % | After changing |

Point **Please use below the allowed load inertia moment proportion of the servomotor.**

Reference The "load inertia moment proportion" (TUN_08) can be manually configured without conducting inertia moment proportion estimate.

## To conduct inertia moment proportion estimate safely

When conducting changes in inertia moment proportion estimate, there is a possibility that the servomotor will function in unanticipated ways.
For this reason, please conduct under conditions with the consideration of utmost safety.

- Please do not come in contact with the rotating part when the servomotor is rotating.
- Please operate after confirming that whether there is enough range of motion.
- Please operate in a condition where emergency termination is possible.
- Please limit the range of motion for the machine by taking measures such as placing a limit switch.
- After conducting inertia moment proportion estimate, be sure to conduct power supply reclosing of the servo amp or slave equiptment reboot.
  Since in inertia moment proportion estimate the servomotor operates automatically, it will terminate at a position different from the command position of the above positioning/motion unit. For this reason, the "post internal command operation servo on" alarm (0B0) will occur when servo is turned on.
- After conducting inertia moment proportion estimate, be sure to confirm the termination position of the machine.
  Since in inertia moment proportion estimate the servomotor operates automatically, it will terminate at a position different from the command position of the above positioning/motion unit. Please operate in a state where the position of the above positioning/motion unit command position and the servomotor are equal, by conducting origin return.



## Before conducting inertia moment proportion estimate

Inertia moment proportion estimate can be conducted when all of the conditions shown below are met.

- Servo is off
- It is in position control mode or speed control mode
- Motorless test operation is not in use
- Automatic gain swith is configured to "do not use"
- There are no alarms or warnings
- It is not in limit switch condition
- Displacement distance is configured to over x0.5 servomotor axis rotations.
- Second gain is not being used
- It is not in STO condition
- It is not in force termination condition

## Control method

Execute the "inertia moment ratio estimation" from the SV2 series setting software/KV-XH setting tool.

### ● For SV2 series setting software

Please refer to the "Estimation of Ratio of Inertia Moment", Page 12-28 for the operation method of SV2 series setting software.

### ● For KV-XH setting tool

Please refer to the manual below for control methods with the KV-XH configuration tool.
"KV-XH16ML/XH04ML User's Manual"

## Important points of inertia moment proportion estimate

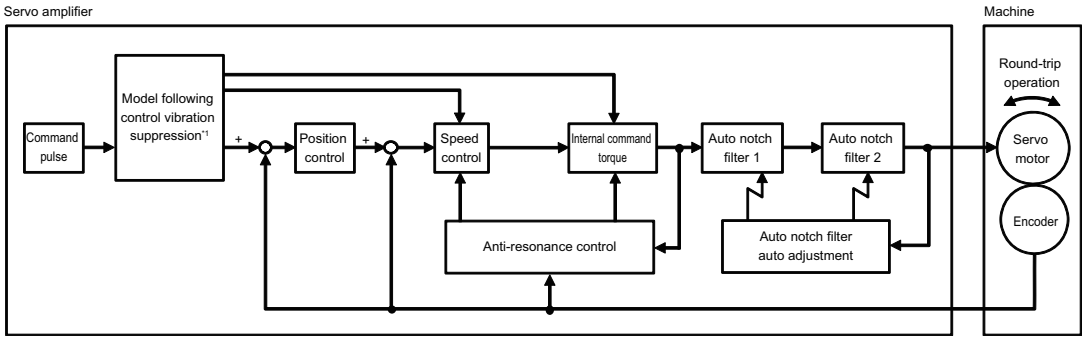
When inertia moment proportion estimate cannot be completed, please check the following items.

- Please conduct inertia moment proportion estimate in a condition where machine is not vibrating. If begun when vibrations are occuring, the estimate will fail.
- While the maximum rotation speed operates at the servomotor rated rotation speed x2/3 and the maximum acceleration torque operates with the rated torque of the servomotor, the operations while conducting inertia moment proportion estimate change depending on the configurations of the inertia moment proportion (servo parameter) at the time when inertia moment proportion estimate begins, and parameters related to gain. if estimate fails, check these parameter configurations and configure them to appropriate values.
- The torque command value of the inertia moment proportion estimate in progress will be limited by a configured limited torque limit value. if estimate fails, please check if these torque limit values are appropriate.
- When the inertia moment proportion is above 10000% (100 times) or the load of the inertia moment shifts, there is a chance of failiure while estimating.

# 7-4 Gain search PRO

## What is gain search PRO

The servo amp measures the machine characteristics, and automatically conducts the gain adjustment.
Finer adjustments than auto-tuning can be made in accordance with the characteristic of the machine.
Gain search PRO has two adjustment methods, "without host command" which automatically adjusts the gain by automatically operating (alternating between clockwise and counter-clockwise rotation) the servomotor within the configuration boudaries, and "with host command" which automatically adjusts the gain in accordance with the above positioning/command from the motion unit.
In cases where operating after adjusting with the normal method of "without host command" does not produce satisfactory results, please adjust further with "with host command".




*1 Adjust model following and vibration suppression only when the tuning type is Middle or High.
In the gain search PRO (without host command), the servomotor will operate automatically with the specifications shown below.

| Item | Specifications |
|---|---|
| Maximum rotation speed | Servomotor rated rotation speed x2/3 |
| Maximum acceleration torque | Servomotor rated torque |
| Displacement distance | Servomotor axis x0.5 to 9.5 rotations (-9999000 to -525000, 525000 to 9999000 command pulse*)<br>(Possible to configure in units of 1000 command pulses, default value is servomotor axis x3 rotations) |

* The above is true for when the electronic gear configuration is 4/1. The configuration is anything other than 4/1, the number of servomotor axis rotations will change depending on the electronic gear configuration.

Gain search PRO (without host command) in positioning control mode and speed control mode, and gain search PRO (with host command) are valid in positioning control mode.

## Parameters changed with gain search PRO

When gain search PRO is conducted, the parameters shown below will be changed.

- "Position gain" (TUN_04)
- "Speed gain" (TUN_05)
- "Speed integration time constant" (TUN_06)
- "Torque command LPF" (TUN_07)
- "Automatic notch filter 1" (TUN_24)
- "Automatic notch filter 2" (TUN_25)
- "Automatic notch filter 1 frequency" (TUN_31)
- "Automatic notch filter 1Q value"(TUN_32)
- "Automatic notch filter 2 frequency" (TUN_34)
- "Automatic notch filter 2Q value" (TUN_35)
- "Vibration suppression control" (TUN_73)
- "Vibration suppression control frequency" (TUN_75)
- "Vibration suppression control dumping gain 1" (TUN_77)
- "Model following" (TUN_57)*1
- "Model following gain" (TUN_59)*1
- "Model following gain amendment" (TUN_60)*1
- "Clockwise rotation side model following bias" (TUN_61)*1
- "Counter-clockwise rotation side model following bias" (TUN_62)*1
- "Model following feed forward" (TUN_66)*1
- "Model following speed feed forward compensation" (TUN_63)*1
- "Vibration suppression" (TUN_67)*1
- "First level vibration suppression frequency A" (TUN_69)*1
- "First level vibration suppression frequency B" (TUN_70)*1
- "Friction compensation" (TUN_51)
- "Friction compensation gain" (TUN_52)
- "Friction compensation coefficient" (TUN_54)
- "Friction compensation gain amendment" (TUN_56)

*1 Only if conducted with tuning type "Middle" or "High"

## About configurations of tuning types and filter types

With gain search PRO, tuning can be conducted in accordance with application and machinery by configuring the tuning type and filter type parameters. The guidelines for configurations according to the application and machinery used are as shown below.

| Parameter | Settings | Examples of suitable machinery and application |
|---|---|---|
| Tuning type | Low | Adjust with an emphasis on stability. |
| | Middle | Adjust with an emphasis on responsiveness. Suppress overshoot more than High. Can be selected only when in positioning control mode. (Default value) |
| | High | Adjust with an emphasis on responsiveness. Can be selected only when in positioning control mode. |
| Filter type | Belt | Suitable for machinery with relatively low rigidity driven by time belts. |
| | Ball screw | Suitable for machinery with relatively high rigidity driven by ball screws. (Default value) |
| | Rigid | Suitable for directly driven rigid bodies such as gears and camshafts. |

## To conduct gain search PRO safely

When conducting changes in gain search PRO (without host command), there is a possibility that the servomotor will function in unanticipated ways.
For this reason, please conduct under conditions with the consideration of utmost safety.

- Please do not come in contact with the rotating part when the servomotor is rotating.
- Please operate after confirming that whether there is enough range of motion.
- Please operate in a condition where emergency termination is possible.
- Please limit the range of motion for the machine by taking measures such as placing a limit switch.
- After conducting gain search PRO (no host command), please make sure to reclose the servo amp power supply. Since in gain search PRO (no host command) the servomotor operates automatically, it will terminate at a position different from the command position of the above positioning/motion unit. For this reason, the "post internal command operation servo on" alarm (0B0) will occur when servo is turned on.
- After conducting gain search PRO (no host command), please make sure to confirm machine termination position. Since in gain search PRO (no host command) the servomotor operates automatically, it will terminate at a position different from the command position of the above positioning/motion unit. Please operate in a state where the position of the above positioning/motion unit command position and the servomotor are equal, by conducting origin return.

## Before conducting gain search PRO

Gain search PRO can be conducted when all of the conditions shown below are met.

- **In case of no host commands**
  - It is in manual-tuning mode
  - Servo is off
  - It is in position control mode or speed control mode
  - Motorless test operation is not in use
  - Automatic gain swith is configured to "do not use"
  - There are no alarms or warnings
  - It is not in limit switch condition
  - Displacement distance is configured to over x0.5 servomotor axis rotations.
  - Second gain is not being used
  - It is not in STO condition
  - It is not in force termination condition
- **In case there are host commands**
  - It is in manual-tuning mode
  - It is in position control mode
  - Motorless test operation is not in use
  - Automatic gain swith is configured to "do not use"
  - There are no alarms or warnings
  - It is not in limit switch condition
  - Servo is on
  - Second gain is not being used



## Control method

Before conducting gain search PRO, conduct "inertia moment proportion estimate" and switch "tuning mode" (TUN_01) to "0: manual tuning".

"7-3 Inertia moment proportion estimate", Page 7-11
"Tuning mode", Page 7-9

Execute the "Gain search PRO" from the SV2 series setting software/KV-XH setting tool.

- **For SV2 series setting software**

Please refer to the "Gain Search PRO", Page 12-23 for the operation method of SV2 series setting software.

- **For KV-XH setting tool**

Please refer to the manual below for control methods with the KV-XH configuration tool.

"KV-XH16ML/XH04ML User's Manual"

## Important points of gain search PRO

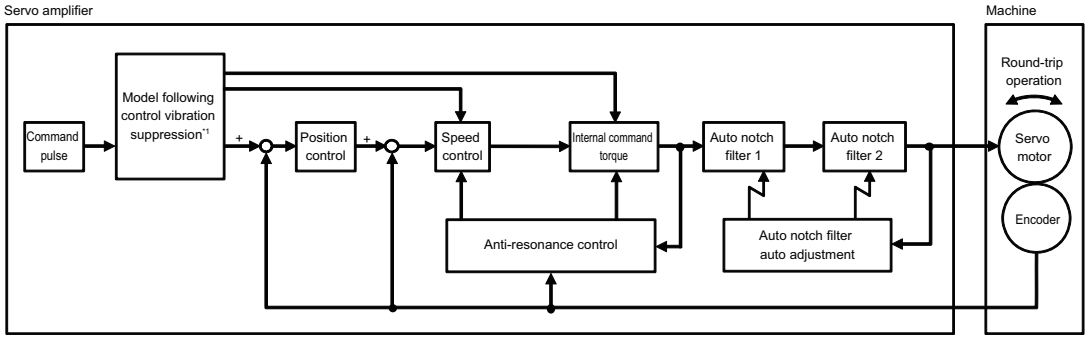
When gain search PRO cannot be completed, please check the following items.

- Please conduct gain search PRO in a state where machine is not vibrating. If begun when vibrations are occuring, the adjustment will fail.
- Please begin use after either conducting auto-tuning in advance and configuring to appropriate speed gain, or ignoring the speed gain configured at the beginning and use the default value.
- If the load inertia moment proportion is not configured correctly, the appropriate adjustments will not be made. Please begin after configuring the appropriate inertia moment proportion by conducting the inertia moment proportion estimate before beginning gain search PRO.
- When conducting gain search PRO again after changing the state of machinery and load after conducting gain search PRO, please change the following parameter to the default value.
  If gain search PRO is begun without making these changes, there can be problems making the optimum adjustments, leading to some cases of machines vibrating.
  - Vibration suppression control: Do not use
  - Automatic notch filter 1: Do not use
  - Automatic notch filter 2: Do not use
  - Friction compensation: Do not use
  - Vibration suppression: Do not use
- Since adjustments will be made referring to "INPOS range" (POS_04), configure the electronic gear and INPOS range to the value that will be used during actual operation if operating in positioning control. If operating with speed control, please configure each to the default value.
- There are cases where gain can decrease if estimating is conducted multiple times consecutively. Please set the "Start the tuning using the initial value" to valid, and start the tuning.

# 7-5 Gain tuning PRO

## What is gain tuning PRO

It is a tuning function which conducts the most appropriate gain configuration by operating the servomotor with commands from the above positioning/motion unit, while manually changing the responsiveness level, stability level, or both. Adjustment may take relatively long since it requires manual level adjustment and confirmation of the adjustment results, but it will allow for finer adjustments in accordance with the characteristics of the machine.




*1 Adjust model following and vibration suppression only when the tuning type is responsiveness (L), responsiveness (H).

Gain tuning PRO is valid in position control mode or speed control mode. It will be invalid in torque control mode.

## Parameters changed with gain tuning PRO

When gain tuning PRO is conducted, the parameters shown below will be changed.

- "Position gain" (TUN_04)
- "Speed gain" (TUN_05)
- "Speed integration time constant" (TUN_06)
- "Torque command LPF" (TUN_07)
- "Automatic notch filter 1" (TUN_24)
- "Automatic notch filter 2" (TUN_25)
- "Automatic notch filter 1 frequency" (TUN_31)
- "Automatic notch filter 1Q value" (TUN_32)
- "Automatic notch filter 2 frequency" (TUN_34)
- "Automatic notch filter 2Q value" (TUN_35)
- "Vibration suppression control" (TUN_73)
- "Vibration suppression control frequency" (TUN_75)
- "Vibration suppression control dumping gain 1" (TUN_77)
- "Model following" (TUN_57)*1
- "Model following gain" (TUN_59)*1
- "Model following gain amendment" (TUN_60)*1
- "Clockwise rotation side model following bias" (TUN_61)*1
- "Counter-clockwise rotation side model following bias" (TUN_62)*1
- "Model following feed forward" (TUN_66)*1
- "Model following speed feed forward compensation" (TUN_63)*1
- "Friction compensation" (TUN_51)
- "Friction compensation gain" (TUN_52)
- "Friction compensation coefficient" (TUN_54)
- "Friction compensation gain amendment" (TUN_56)
- "Vibration suppression" (TUN_67)*1
- "Vibration suppression automatic adjustment" (TUN_68)*1
- "The first stage vibration suppression frequency A" (TUN_69)*1
- "The first stage vibration suppression frequency B" (TUN_70)*1 (Default value)

*1 Only if conducted with tuning type "responsiveness (L)" or "responsiveness (H)"

## About configurations of tuning types and filter types

With gain tuning PRO, tuning can be conducted in accordance with application and machinery by configuring the tuning type and filter type parameters. The guidelines for configurations according to the application and machinery used are as shown below.

| Parameter | Settings | Examples of suitable machinery and application |
|---|---|---|
| Tuning type | Stability (L) | Adjust with an emphasis on stability. |
| | Stability (H) | Adjust with an emphasis on stability. Emphasize responsiveness rather than stability (L). |
| | Responsiveness (L) | Make adjustments with emphasis on responsiveness, using the internal model. Adjust so overshoot is suppressed more than responsiveness (H). *Can be used only when in positioning control mode. (Default value) |
| | Responsiveness (H) | Make adjustments with emphasis on responsiveness, using the internal model. *Can be used only when in positioning control mode. |
| Filter type | Belt | Suitable for machinery with relatively low rigidity driven by time belts. |
| | Ball screw | Suitable for machinery with relatively high rigidity driven by ball screws. (Default value) |
| | Rigid | Suitable for directly driven rigid bodies such as gears and camshafts. |

## About responsiveness level, stability level configurations

Gain tuning PRO makes micro-adjusts gain by configuring responsiveness level and stability level.

### ■ Responsiveness level configuration

Also, pros and cons of large and small level responsiveness configurations are as shown below.

| Response characteristic level | Advantage | Disadvantage |
|---|---|---|
| Small | • Hard for overshoot to occur<br>• The machine tends not to get vibrational | • Servomotor responce to commands becomes slower<br>• Positiomimg stabilization takes longer |
| Large | • Servomotor responce to commands becomes faster<br>• Positiomimg stabilization takes less time | • Easy for overshoot to occur<br>• The machine tends to get vibrational |

### ■ Stability level configuration

If the stability is small, machines tends to get vibrational. On the other hand, making it too much larger than the characteristic of the machine can make it vibrational. Configure to the appropriate value gradually from small to large, while checking the vibrations of the machine.

## Before conducting Gain tuning PRO

Gain tuning PRO can be conducted when all of the conditions shown below are met.

- Tuning mode is manual
- Motorless test operation is not in use
- In speed control mode and torque control mode, only stability (L) and stability (H) are usable

## Control method

Before conducting gain tuning PRO, conduct "inertia moment proportion estimate" and switch "*tuning mode" (TUN_01) to "0: manual tuning".

"7-3 Inertia moment proportion estimate", Page 7-11
"Tuning mode", Page 7-9

Execute the "Gain search PRO" from the SV2 series setting software/KV-XH setting tool.

#### ● For SV2 series setting software

Please refer to the "Gain Tuning PRO", Page 12-26 for the operation method of SV2 series setting software.

#### ● For KV-XH setting tool

Please refer to the manual below for control methods with the KV-XH configuration tool.

"KV-XH16ML/XH04ML User's Manual"

## Gain tuning PRO point

When conducting gain tuning PRO, please pay attention to the following.

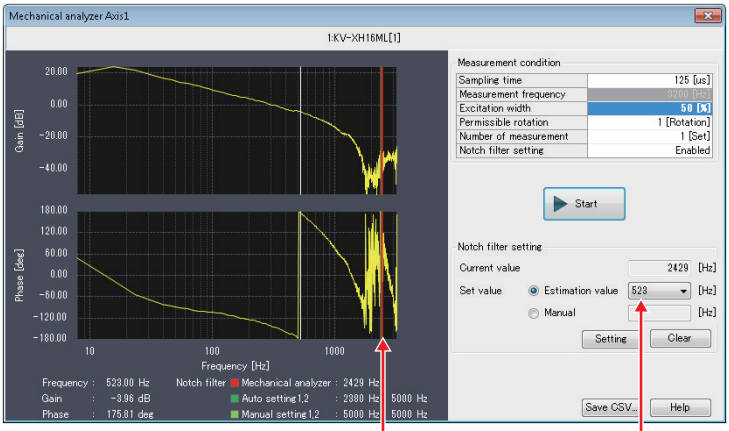
- Regarding adjustments of responsiveness level and stability level, adjust by adjusting the stability level gradually from a small value to a large value until there are no vibrations, and adjust the responsiveness level gradually to a large value.
- When low cycle vibrations occur, the use of the vibration suppression function may improve it.
  "Vibration suppression", Page 7-25
- Begin adjustments with the configured speed gain as a standard. Before beginning gain tuning PRO, perform auto tuning and gain search PRO, and set the speed gain appropriately.
- If the load inertia moment proportion is not configured correctly, the appropriate adjustments will not be made. Please begin after configuring the appropriate inertia moment proportion by conducting the inertia moment proportion estimate before beginning gain tuning PRO.
- After conducting gain tuning PRO, when beginning gain tuning PRO again after changing the state of machinery and load, please change the following parameter to the default value.

  If gain tuning PRO is begun without making these changes, there can be problems making the optimum adjustments, leading to some cases of machines vibrating.
  - Vibration suppression control: Do not use
  - Automatic notch filter 1: Do not use
  - Automatic notch filter 2: Do not use
  - Friction compensation: Do not use

## What is a mechanical analyzer

It is a function in which the servomotor automatically alternates between clockwise and counter-clockwise rotation and measures the frequency characteristic of the machine.
It can also estimate the notch filter from the measured frequency characteristics. Machine vibrations can be suppressed by configuring the estimated notch filter.

Measured frequency characteristics




Resonant frequency Estimated notch filter

In the mechanical analyzer, the servomotor will operate automatically with the description below, and measure the frequency characteristics.

| Item | Description |
|---|---|
| Sampling time | 125μs to 2500μs<br>It is cycle a which measures frequency characteristics.<br>High frequencies can be measured if sampling time is shortened.<br>Accuracy with low frequencies will be higher if sampling time is lengthened. |
| Measured frequencies | 160Hz to 3200Hz<br>The number of times the frequency characteristics are measured in 1 second. |
| Vibrational amplitude | 1 to 300% (rated torque)<br>Configure the operation torque for alternating operation.<br>The larger the operation torque is, the larger the amplitude becomes, resulting in improved measurement accuracy.<br>However, if made too large, the torque limit is reached and the measurement fails, or the "over-speed" alarm(510) and "*over-current" alarm(100) and others may go off. |
| Allowed number of rotations | 1 to 1000 rotations<br>When operating alternately, if the servomotor rotates more times than the configured number of rotations. The measurement will stop and the servomotor will terminate. |
| Number of times measured | 1 to 5 times<br>Configure the number of times measuring will be repeated.<br>The more times there are, the higher the measurement accuracy will be. |
| Notch filter configuration | Configure the validity/invalidity of the notch filter that was configured when operating alternately. |

**Point**

**The mechanical analyzer does not function normally when the full closed control is in use. Please set the "*external encoder" (FC_01) to "0: Not use" before execution.**

## Parameters changed with mechanical analyzer

The notch filter estimated with the mechanical analyzer will be reflected in the parameters shown below.

- "Notch filter for mechanical analyzer" (TUN_23)
- "Notch filter frequency for mechanical analyzer" (TUN_28)

For details regarding notch filter, please refer to "About notch filter configurations", Page 7-26.

## To conduct mechanical analyzer safely

When running the mechanical analyzer, there is a possibility that the servomotor will function in unanticipated ways. For this reason, please conduct under conditions with the consideration of utmost safety.

- Please do not come in contact with the rotating part when the servomotor is rotating.
- Please confirm that "allowed number of rotations" does not exceed the range of motion.
- Please operate in a condition where emergency termination is possible.
- Please limit the range of motion for the machine by taking measures such as placing a limit switch.
- After running mechanical analyzer, be sure to conduct power supply reclosing of the servo amp or slave equiptment reboot.

  Since with the mechanical analyzer the servomotor operates automatically, terminate in a different position from the command position of the above positioning/motion unit. For this reason, the "post internal command operation servo on" alarm (0B0) will occur when servo is turned on.
- After running mechanical analyzer, be sure to confirm the termination position of the machine.

  Since with the mechanical analyzer the servomotor operates automatically, terminate in a different position from the command position of the above positioning/motion unit. Please operate in a state where the position of the above positioning/motion unit command position and the servomotor are equal, by conducting origin return.
- If using when notch filter configurations are invalid, check that it is a system where it will not fall when servo is turned off.

## Before running mechanical analyzer

Mechanical analyzer can be run when all of the conditions shown below are met.

- Servo is off
- It is in position control mode or speed control mode
- Motorless test operation is not in use
- Automatic gain swith is configured to "do not use"
- There are no alarms or warnings
- It is not in limit switch condition
- Second gain is not being used
- It is not in STO condition
- It is not in force termination condition

## Control method

Execute the "Mechanical analyzer" from the SV2 series setting software/KV-XH setting tool.

### ● For SV2 series setting software

Please refer to the "Mechanical Analyzer", Page 12-30 for the operation method of SV2 series setting software.

### ● For KV-XH setting tool

Please refer to the manual below for control methods with the KV-XH configuration tool.

"KV-XH16ML/XH04ML User's Manual"

## Important points of mechanical analyzer

When mechanical analyzer cannot be completed, please check the following items.

- Please run mechanical analyzer in a state where machine is not vibrating. If begun when vibrations are occuring, the estimate will fail.
- Operation while mechanical analyzer is running will change depending on the inertia moment proportion (servo parameter) configurations and paramters related to gain. If measuring fails, please check these parameter configurations and configure them to appropriate values.
- The torque command value when mechanical analyzer is in progress will be limited by a configured torque limit value. If measuring fails, please check if these torque limit values are appropriate.

## Vibration suppression control

The vibration suppression control function is a function which suppresses the continuous 100 to 1000Hz vibrations that occur when gain is taken up.
It is invalid in auto-tuning mode and torque control.

### ■ In case of configuring automatically

Vibration suppression control will be configured automatically if the vibration is detected when conducting gain search PRO and gain tuning PRO.
The gain search PRO or the gain tuning PRO is executed according to the SV2 series setting software/KV-XH setting tool.

#### ● For SV2 series setting software

Please refer to the "Chapter 12 SV2 SERIES SETTING SOFTWARE", Page 12-1 for the operation method of SV2 series setting software.



#### ● For KV-XH setting tool

Please refer to the manual below for control methods with the KV-XH configuration tool.
"KV-XH16ML/XH04ML User's Manual"

### ■ In case of configuring manually

When the automatic adjustment results from gain search PRO and gain tuning PRO are unsatisfactory, adjust manually.

| Parameter type | Category | Level | Parameter name | Setting range | Setting Unit | Default | Enable timing |
|---|---|---|---|---|---|---|---|
| TUN_73 | Tuning | Special | Vibration suppression control | 0: Do not use<br>1: Use | - | 0 | After changing |
| TUN_75 | Tuning | Special | Vibration suppression control frequency | 10 to 20000 | 0.1Hz | 1000 | |
| TUN_77 | Tuning | Special | Vibration suppression control dumping gain 1 | 0 to 300 | % | 0 | |
| TUN_80 | Tuning | Special | Vibration suppression control dumping gain 2 | 0 to 1000 | % | 0 | |

#### ● Important points of vibration suppression control

When conducting vibration suppression control, please pay attention to the following.

- If the load inertia moment proportion is not configured correctly, the appropriate adjustments will not be made. Please begin after configuring the appropriate inertia moment proportion by conducting the inertia moment proportion estimate before beginning tuning.
- Configure "vibration suppression control frequency" (TUN_73) to "1: Use", and configure the frequency to be suppressed to "vibration suppression control frequency" (TUN_75), while checking the wave patterns of the return torque and position deviation using servo trace.
- The effect of vibration suppression can be heightened if "vibration suppression control dumping gain 1" (TUN_77) is enlarged, but the vibrations can become greater if it is enlarged too far. Enlarge the settings 10% at a time, with 0% to 200% as a guideline, while checking the vibration suppression effects. When results are unsatisfactory, please lower gain with gain tuning PRO.

#### ● In cases of suppressing multiple vibrations

After suppressing the vibrations using vibration suppression, there is a chance that different vibrations will occur with frequencies higher than the "vibration suppression control frequencies" (TUN_75).
In such cases, multiple vibrations can be suppressed by configuring "vibration suppression control dumping gain 2" (TUN_80) with the procedure shown below.

**1 Configure "vibration suppression control dumping gain 2" (TUN_80) to the same value as "vibration suppression control dumping gain 1" (TUN_77).**

**2 Elevate settings of "vibration suppression control dumping gain 2" (TUN_80) 10% at a time, while seeing the effects of vibration suppression.**
When results are unsatisfactory even after adjusting "vibration suppression control dumping gain 2" (TUN_80), please lower gain with gain tuning PRO.

## Vibration suppression

The vibration suppress function is a function which suppresses the transient low-frequency 1 to 100Hz vibrations that occur from things such as the machine stand vibrating.
If using in auto-tuning mode, configure "model following" (TUN_57) to "1: use" and configure the vibration suppression function manually.

### ■ In case of configuring automatically

Vibration suppression control will be configured automatically if the vibration is detected when conducting gain search PRO and gain tuning PRO.
In cases where the vibrations are too small to detect, please heighten the detection sensitivity by making the settings of "residual vibration detection range" (TUN_81) smaller. Adjust with each 10% as a guideline.

| Parameter type | Category | Level | Parameter name | Setting range | Setting Unit | Default | Enable timing |
|---|---|---|---|---|---|---|---|
| TUN_81 | Tuning | Special | Residual vibration detection range | 1 to 3000 | 0.1% | 400 | After changing |

The gain search PRO and the gain tuning PRO is executed according to the SV2 series setting software/KV-XH setting tool.

#### ● For SV2 series setting software

Please refer to the "Chapter 12 SV2 SERIES SETTING SOFTWARE", Page 12-1 for the operation method of SV2 series setting software.

#### ● For KV-XH setting tool

Please refer to the manual below for control methods with the KV-XH configuration tool.
"KV-XH16ML/XH04ML User's Manual"

### ■ In case of configuring manually

When the automatic adjustment results from gain search PRO and gain tuning PRO are unsatisfactory, adjust manually.

| Parameter type | Category | Level | Parameter name | Setting range | Setting Unit | Default | Enable timing |
|---|---|---|---|---|---|---|---|
| TUN_67 | Tuning | Special | Vibration suppression | 0: Do not use<br>1: Use (1 point)<br>2: Use (2 points) | - | 0 | After changing |
| TUN_69 | Tuning | Special | First level vibration suppression frequency A | 10 to 2500 | 0.1Hz | 500 | |
| TUN_70 | Tuning | Special | First level vibration suppression frequency B | 10 to 2500 | 0.1Hz | 700 | |
| TUN_71 | Tuning | Special | Second level vibration suppression frequency | 10 to 2000 | 0.1Hz | 800 | |

### ■ Important points of vibration suppression

When using the vibration suppression function, please pay attention to the following points.

- If the load inertia moment proportion is not configured correctly, the appropriate adjustments will not be made. Please begin after configuring the appropriate inertia moment proportion by conducting the inertia moment proportion estimate before beginning tuning.
- Configure "vibration suppression" (TUN_67) to "1: Use (1 point)", and configure the frequency to be suppressed to "first level vibration suppression frequency A" (TUN_69) and "first level vibration suppression frequency B" (TUN_70), while checking the wave patterns of the return torque and position deviation using servo trace. Configure "first level vibration suppression frequency A" (TUN_69) and "first level vibration suppression frequency B" (TUN_70) to the same frequency.
- In cases where a separate vibration exists, configure the vibration frequency to "second level vibration suppression frequency" (TUN_71).
- In cases where vibrations do not cease with automatically detected vibration frequencies, adjust to a value around the detected frequency manually, since it is possible that there is an error in the actual vibration frequency and detected frequency due to the transfer mechanism.

**Point**

**If there are no vibrations in the position deviation confirmable with servo trace, or the vibration frequency is outside the range of the detected frequency, frequency detection will not be conducted.**
**In such cases, measure the vibrations with sensors that can measure vibration frequencies, and configure to the vibration suppression frequency.**

## About notch filter configurations

In cases where results of notch filter configured with each tuning function are not satisfactory, adjust with the details parameter of the notch filter.
If manual notch filter 1/manual notch filter 2 are included, the notch filter can be configured to a maximum of 5 levels.
The parameters to be configured are as shown below.

Reference

- You can set the mechanical analyzer notch filter manually without using the mechanical analyzer.
- The automatic notch filter 1 and automatic notch filter 2 can be set manually without automatic adjustment. In that case, please set the "automatic notch filter 1 automatic adjustment" (TUN_21), "automatic notch filter 2 automatic adjustment" to "0: No automatic adjustment".

- Configuration the notch filter to be used to "1: Use".

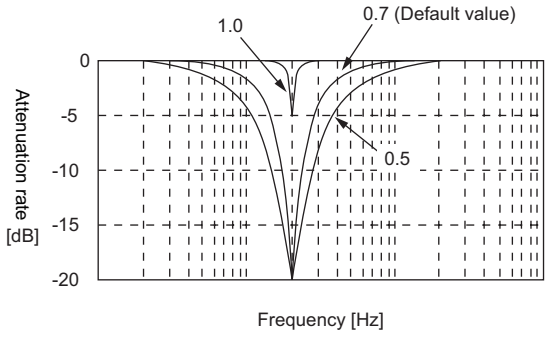
| Parameter type | Category | Level | Parameter name | Setting range | Setting Unit | Default | Enable timing |
|---|---|---|---|---|---|---|---|
| TUN_23 | Tuning | Extend | Notch filter for mechanical analyzer | 0: Do not use<br>1: Use | - | 0 | After changing |
| TUN_24 | Tuning | Extend | Automatic notch filter 1 | 0: Do not use<br>1: Use | - | 0 | |
| TUN_25 | Tuning | Extend | Automatic notch filter 2 | 0: Do not use<br>1: Use | - | 0 | |
| TUN_26 | Tuning | Special | Manual notch filter 1 | 0: Do not use<br>1: Use | - | 0 | |
| TUN_27 | Tuning | Special | Manual notch filter 2 | 0: Do not use<br>1: Use | - | 0 | |

- Configuration the frequency to be erased by notch filter.

The configurations of the notch filter will be configured by the 3 parameters "Notch filter frequency" "Notch filter Q value", and "Notch filter depth".

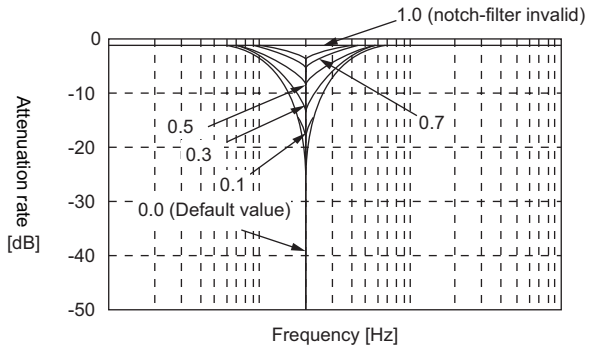
"Notch filter frequency": The center of the frequency to be erased.
"Notch filter Q value": The larger the Q value is, the more sharper the depression is, and the narrower the range of frequencies to delete.
"Notch filter depth": The smaller the depth value is, the deeper the depression is, and the higher the effect of the resonance suppression. However, if made too small, there is a chance that the vibrations will become greater.

**The notch-filter frequency characteristic based on different "notch-filter Q value"**




* The above image is the criterion and sometimes the actual characteristic varies.

**The notch-filter frequency characteristic based on different "notch-filter depth"**




* The notch-filter is invalid when setting the "notch-filter depth" to 1.0.

* The above image is the criterion and sometimes the actual characteristic varies.

| Parameter type | Category | Level | Parameter name | Setting range | Setting Unit | Default | Enable timing |
|---|---|---|---|---|---|---|---|
| TUN_28 | Tuning | Extend | Notch filter frequency for mechanical analyzer | 50 to 5000 | Hz | 5000 | After changing |
| TUN_29 | Tuning | Extend | Notch filter Q value for mechanical analyzer | 50 to 1000 | 0.01 | 70 | |
| TUN_30 | Tuning | Extend | Notch filter depth for mechanical analyzer | 0 to 1000 | 0.001 | 0 | |
| TUN_31 | Tuning | Extend | Automatic notch filter 1 frequency | 50 to 5000 | Hz | 5000 | |
| TUN_32 | Tuning | Extend | Automatic notch filter 1 Q value | 50 to 1000 | 0.01 | 70 | |
| TUN_33 | Tuning | Extend | Automatic notch filter 1 depth | 0 to 1000 | 0.001 | 0 | |
| TUN_34 | Tuning | Extend | Automatic notch filter 2 frequency | 50 to 5000 | Hz | 5000 | |
| TUN_35 | Tuning | Extend | Automatic notch filter 2 Q value | 50 to 1000 | 0.01 | 70 | |
| TUN_36 | Tuning | Extend | Automatic notch filter 2 depth | 0 to 1000 | 0.001 | 0 | |
| TUN_37 | Tuning | Special | Manual notch filter 1 frequency | 50 to 5000 | Hz | 5000 | |
| TUN_38 | Tuning | Special | Manual notch filter 1 Q value | 50 to 1000 | 0.01 | 70 | |
| TUN_39 | Tuning | Special | Manual notch filter 1 depth | 0 to 1000 | 0.001 | 0 | |
| TUN_40 | Tuning | Special | Manual notch filter 2 frequency | 50 to 5000 | Hz | 5000 | |
| TUN_41 | Tuning | Special | Manual notch filter 2 Q value | 50 to 1000 | 0.01 | 70 | |
| TUN_42 | Tuning | Special | Manual notch filter 2 depth | 0 to 1000 | 0.001 | 0 | |

**Point**

- **Please do not configure notch filter frequency to near the responce frequency of the speed loop. Please configure to a frequency of at least 4 times the speed gain (however, the inertia moment proportion must be configured correctly).**
  **If not configured correctly, there is a chance that vibrations will occur and damage the machine.**
- **Please make sure to change the notch filter frequency when the motor is terminated. If changed while operating, there is a chance that vibrations will occur.**

## About lowpass filter configurations

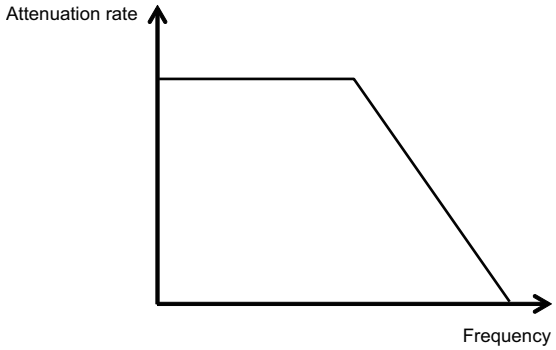
Adjust in cases where sudden vibrations occur due to disturbances. Suppress the shift of internal command torques over the configured frequency.

| Parameter type | Category | Level | Parameter name | Setting range | Setting Unit | Default | Enable timing |
|---|---|---|---|---|---|---|---|
| TUN_07 | Tuning | Extend | Torque command LPF | 0 to 65535 | 0.01ms | 132 | After changing |
| TUN_44 | Tuning | Special | Second torque command filter frequency | 100 to 5000*1 | Hz | 5000 | |
| TUN_45 | Tuning | Special | Q value of the second torque command filter | 50 to 100 | 0.01 | 50 | |

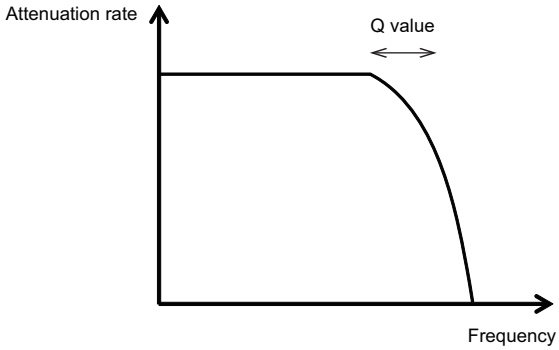
*1 When setting the "The second torque command frequency" (TUN_44) to 5000, the second torque filter will be invalid.



- **Torque command LPF**




- **Second torque command filter**



# 8

# SAFETY FUNCTION

This section describes details of the SV2 series safety functions.

# 8-1 Safety Function Outline

## Features of the Safety Function

**The servo amplifiers of the SV2 series have a built-in safety function that decrease the risk during the operation (protecting users from sudden movements of the moving parts, etc.), and make the machine safe. For example it is possible to use this function to prevent a sudden movement of the moving parts, especially when the user needs to open the guard and work in a dangerous area for the maintenance of the machine. For the safety features and the parameters of the safety function, please refer to the following.**

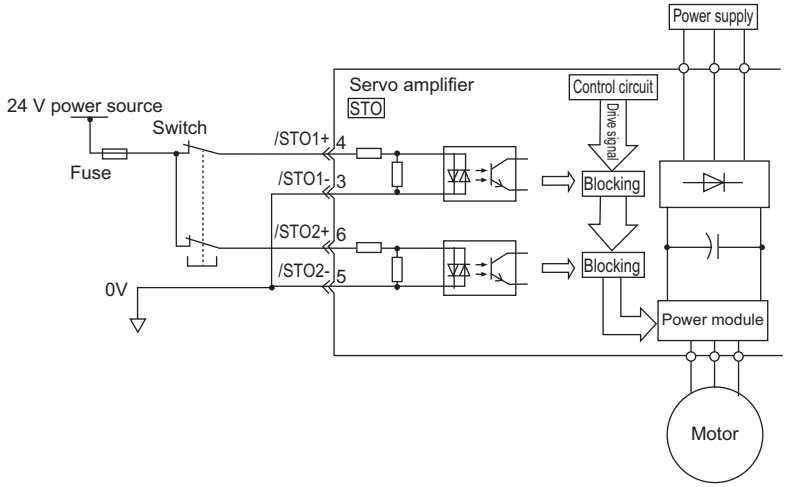
**"Precautions for Regulations and Standards"**

| | |
|---|---|
| WARNING | • **In order to confirm that the STO function meets the proper safety requirements, be sure to execute the risk assessment for the system. A wrong operation can result in personal injuries.**<br>• **Since the motor moves if there are external forces working (like the weight of the vertical axis) when the STO function is running, it is recommended to use separated mechanical brakes that meet the safety requirements of the system. A wrong operation can result in personal injuries.**<br>• **Since it can happen that the motor moves in an electric angle with a range inferior to 180° due to the malfunction of the servo amplifiers even when the STO function is running, it is recommended to use the machine only after confirming the absence of risks. A wrong operation can result in personal injuries.**<br>• **The braking signal of the dynamic brake is not a safety-related component. Please design the system in such a way to prevent the risks related to these malfunctions when the STO function is running. A wrong operation can result in personal injuries.**<br>• **Please connect to the safety function signal a device that meets the safety standards. A wrong operation can result in personal injuries.**<br>• **The STO function is not able to shut off the current flowing to the servo amplifiers, nor to create an electrical insulation. When repairing a servo amplifier, be sure to shut off the current flowing to the other servo amplifiers. Otherwise, this may cause electric shock.** |

# 8-2 Safe torque off (STO) function

## Features of the safe torque off (STO) function

**The safe torque function (STO function) is a safety function able to shut off the current flowing to the motor through an electric signal.**
**Inputting the signal in the STO terminal, it is possible to shut off the current flowing to the motor by controlling the driving signal to the power module that controls it.**
**Please see the connection example below.**




Reference
- Both STO signals operate in the same way and support duplicate signals. They can be used for error detection when used together with the EDM (External Device Monitoring) signal.
- The STO terminal can be wired to from either the sink or source output, but from a safety standpoint we recommend wiring from the source output.

## Risk assessment

**When using the STO function, be sure to run the risk assessment on the device and to confirm that it meets the standard safety level. For information on the standards, refer to the following.**
**"Safety Precautions"**

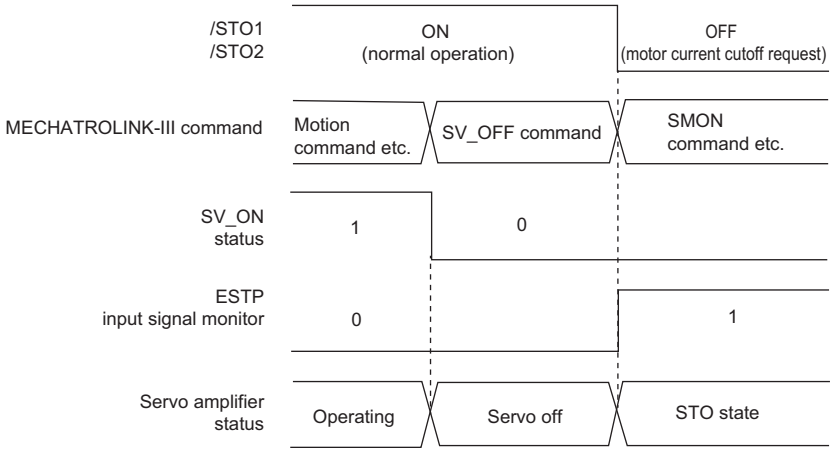
Reference In order to meet the safety standards PL e of EN ISO 13849-1 and SIL3 of IEC 61508, it is necessary to supervise the EDM signal with the host device. If the supervision of the EDM signal is not executed with the host device, then the safety levels will be PL c and SIL1.

**Since the following risks remain even when the STO function is running, it is strongly recommended to consider the safety when performing the risk assessment.**
- When an external force (like the weight of the vertical axis) is working, the motor can move. Please provide a separated mechanical braking device.
- Due to a malfunction of the servo amplifiers, it is possible that the motor moves in an electrical angle with a range inferior to 180° (mechanical angle 60°). Please confirm that no risky situation can happen even it the motor moves.
- The STO function is not able to shut off the current flowing to the servo amplifiers, nor to create an electrical insulation. When repairing the servo amplifiers, please provide a separated device to shut off the current flowing to the servo amplifiers.

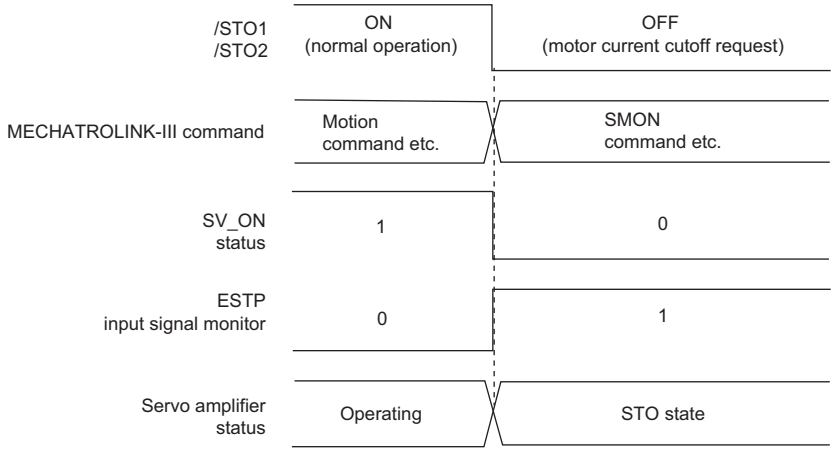
## Safe torque off State (STO State)

**The state of the servo amplifiers when the STO function has been run is as follows.**
**If the /STO1 or the /STO2 state is OFF, the servo amplifiers STO function will start, and the servo amplifiers will enter the safe torque off State (STO State).**

- If the STO function starts after the servo OFF (motor de-energized).




- If the STO function starts while the motor is powering up.

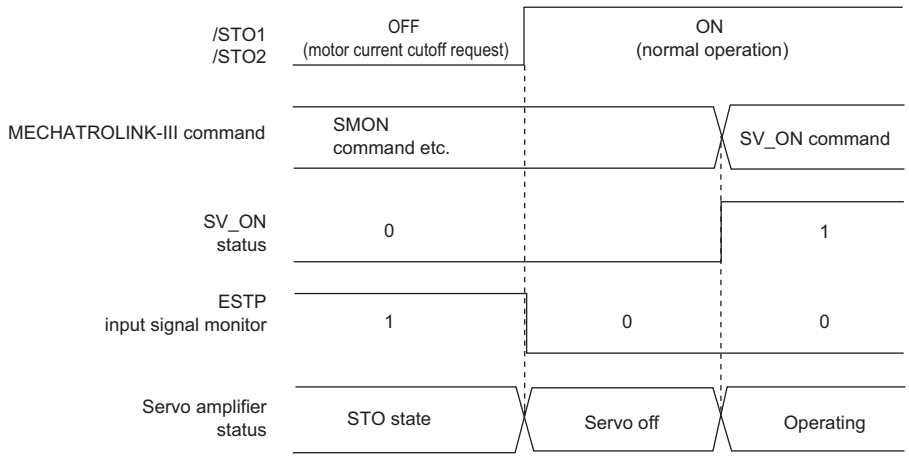



Reference

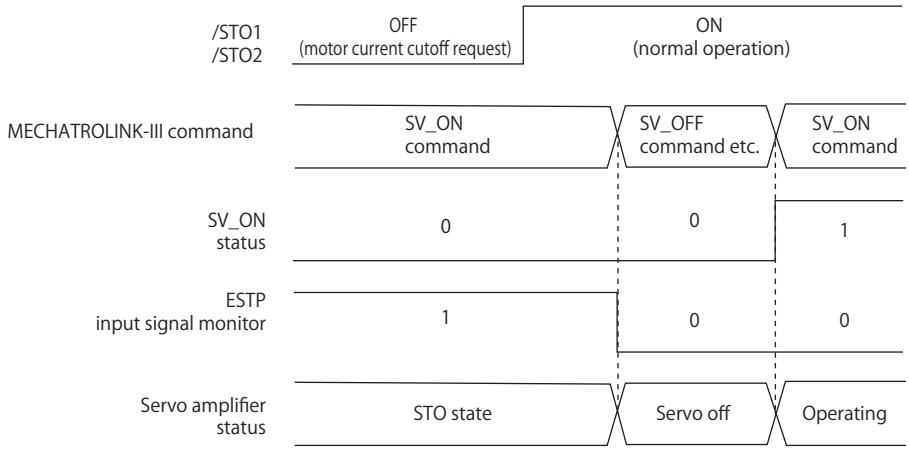
- If the B contact signal is input into each of the /STO1, /STO2 signal wires, ON/OFF shows the following status.
  ON: The contact (transistor/relay) is ON, and current flows through the signal wire
  OFF: The contact (transistor/relay) is OFF, and no current flows through the signal wire
- You can check if it is in STO state by seeing the ESTP status of the servo command input signal monitor (SVCMD_IO).
- When in STO state the "STO state warning (9D3)" is generated and the warning signal becomes ON.

## Methods for restoration from STO State

**Usually, after receiving the servo OFF (SV_OFF:32H) command and de-energizing the servo motor, the /STO1 and /STO2 signals become OFF and the machine enters the STO State. If /STO1, /STO2 are set to ON in this condition, the machine will change from the STO State to the Servo Off State, and it becomes possible to receive the Servo ON (SV_ON:31H) command.**




**If the Servo ON (SV_ON:31H) command is received in the /STO1, /STO2 signal OFF condition, the device will remain in the STO State even if the /STO1, /STO2 signal is set to ON.**
**Please receive the Servo ON (SV_ON:31H) command one more time after receiving the Servo OFF (SV_OFF:32H) command to set the Servo OFF State.**




Reference Even if you set the Servo OFF State by setting the main circuit power to OFF, it is impossible to exit the STO State until the Servo OFF (SV_OFF:32H) command is received.

## Related commands

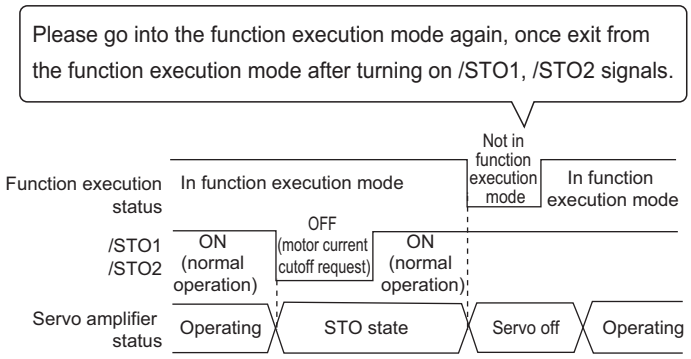
**If you change to the STO State when the following operation commands are in execution, there will be a command warning. The command warning will reset automatically if a receivable command is received. It is recommended to control the device to avoid it to enter the STO State during the execution of an operating command.**

| Target operating commands |
|---|
| Servo ON (SV_ON) |
| Interpolation (INTERPOLATE) |
| Positioning (POSING) |
| Constant speed feed (FEED) |
| Constant speed feed with position detection function (EX_FEED) |
| Positioning with external input (EX_POSING) |
| Return to origin (ZRET) |



## Operation without using host orders

**The STO function can operate even if only the SV2 series is used without receiving orders from the host. Nevertheless, if the STO function starts while the following functions are in execution, it is recommended to exit the function execution mode once, reenter again and restart the machine. The device will not restart just by setting to ON the /STO1, /STO2 signals.**

| Target functions | Methods for restoration from STO state |
|---|---|
| • Z-phase search<br>• Moment of inertia ratio calculation<br>• Gain search PRO (w/o higher-level command)<br>• Mechanical analyzer<br>• Servo JOG Operation<br>• Pattern Operation |  |

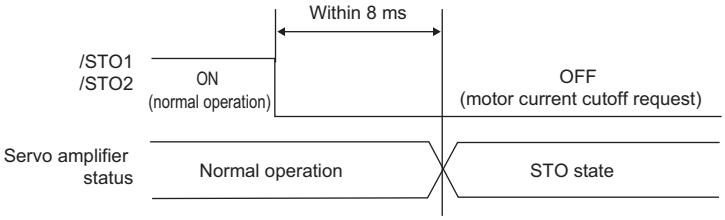
## Anomaly detection of the STO signal

**After setting to ON the /STO1 or the /STO2 signal, if the other signal is not set to ON within 10 seconds, the "*STO function signal input timing anomaly" alarm (EB1) will occur. In this way, a malfunction like the disconnection of the STO signal can be detected.**

| | |
|---|---|
| ⚠ CAUTION | **The "*STO function signal input timing anomaly" alarm (EB1) is not counted as a safety function.**<br>**To use the safety function in the whole device that the SV2 series is embedded in, make sure that there is no danger even if an alarm malfunctions.** |

## Specifications of the input signal (STO signal)

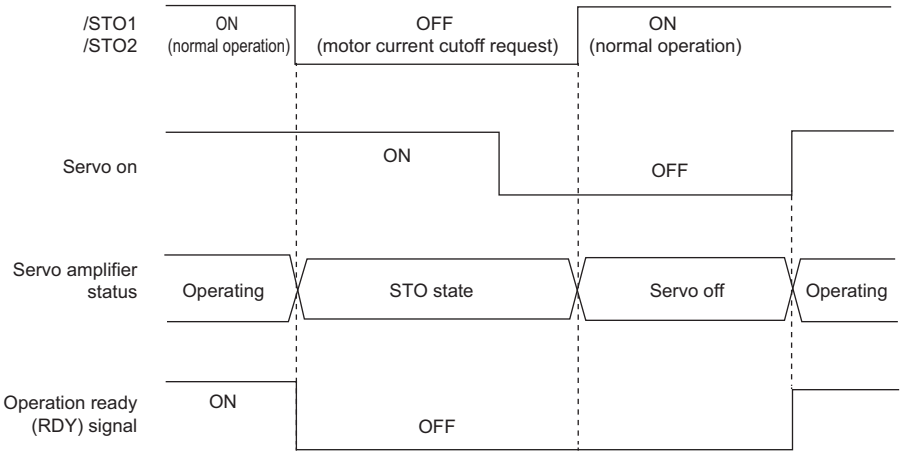
**If the STO function is requested because the 2 channel input signal /STO1, /STO2 are set to OFF, the current flowing to the motor is shut off within 8 ms.**




**Point** **If the /STO1, /STO2 OFF time is shorter the 0.5 ms, the OFF condition is not detected.**

## Operation ready (RDY) signal

**In the STO State the operation ready (RDY) output turns OFF as the servo on (SV_ON: 31H) command cannot be received. When both the /STO1 and /STO2 signals are ON and it is in servo on status, the operation ready (RDY) output turns ON. The following example shows the case in which the drive alarm does not occur with the main circuit power ON and the input performed by the sense ON (SENS_ON) command (when the absolute value encoder is used).**



## The electromagnetic brake timing (BRAKE) signal

**If the STO function starts with the /STO1 or /STO2 signal set to OFF, the electromagnetic brake timing (BRAKE) signal turns to OFF. In this case, since "Servo OFF delay time after electromagnetic brake order" (0TH_01) is disabled, during the time from when the electromagnetic brake timing (BRAKE) signal turns to OFF until the brake actually works, the machine may move because of an external force.**

| | |
|---|---|
| ⚠ CAUTION | • **The brake signal output has not been verified as a safety function. To use the safety function in the whole device that the SV2 series is embedded in, make sure that there is no danger even if the brake signal malfunctions.**<br>• **Please notice that the servo motor with brakes is just for repairing purpose, and therefore it cannot be used during the operation.** |

## How to stop the device

**If the STO function starts with the /STO1 or the /STO2 signal set to OFF, the servo motor will stop, according to the "*Stopping method during the servo OFF or G1 alarm" (ALM_01).**

| | |
|---|---|
| ⚠ CAUTION | **If the dynamic brake is set on Enabled (O: Dynamic brake, 1: Free after stopping dynamic brake), please pay attention to following.**<br>• **The dynamic brake has not been verified as a safety function. To use the safety function in the whole device that the SV2 series is embedded in, make sure that there is no danger even if the dynamic brake enters free run state without working. We recommend to control the device in such a way that it enters the STO State after it has stopped because of an order.**<br>• **If the STO function is used frequently, the internal components of the servo amplifiers may deteriorate when the dynamic brake is stopped. We recommend to control the device in such a way that it enters the STO State after it has stopped because of an order.** |

## Alarm (ALARM) signal

**The alarm (ALARM) signal is not output when in STO State.**

Reference When in STO state the "STO state warning (9D3)" is generated and the warning signal becomes ON. This cannot be cleared while in STO state. First leave STO state and then perform warning clear operation host device.

# 8-3 External device monitor (EDM)

**The external device monitor (EDM) is aimed to inspect the malfunctions of the STO function. Please connect it to the feedback of the safety unit.**

**Point** **In order to meet the PL e of EN ISO 13849-1 and the SIL3 of IEC 61508, it is necessary to supervise the EDM signal with the host device. If the supervision of the EDM signal is not executed with the host device, then the safety levels will be PL c and SIL1.**

### ■ Detection signal

**The relationship between the EDM and /STO1, /STO2 signal is as follows:**

| Signal Name | Logic | | | |
|---|---|---|---|---|
| | (1) | (2) | | (3) |
| /STO1 | ON | ON | OFF | OFF |
| /STO2 | ON | OFF | ON | OFF |
| EDM | OFF | OFF | OFF | ON |

**(1)(3) Normal operation is when the STO signals and EDM signal are reversed.**

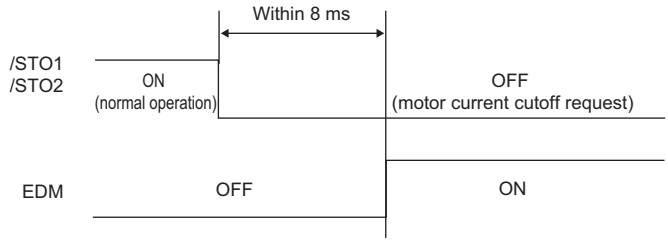
**(2) The duplicate /STO1 and /STO2 signals do not have the same status. This may be due to wire breakage or circuit malfunction.**

**The detection of the malfunctions of the EDM signal circuit is possible through the check of the four states of the EDM signal shown in the chart. It is possible to run the detection at the power-up if the check is allowed.**

| | |
|---|---|
| WARNING | **The EDM signal is not a safety output. Do not use it for anything other than monitoring malfunctions. To use the safety function in the whole device that the SV2 series is embedded in, make sure that there is no danger even if the EDM signal malfunctions.** |

## Specifications of the EDM output signal

**If the 2 channels input signals /STO1, /STO2 are set to OFF, the STO function is requested and, if the safety function is working normally, the EDM output signal will be set to ON within 8 ms.**



# 8-4 Example of use of the Safety Function

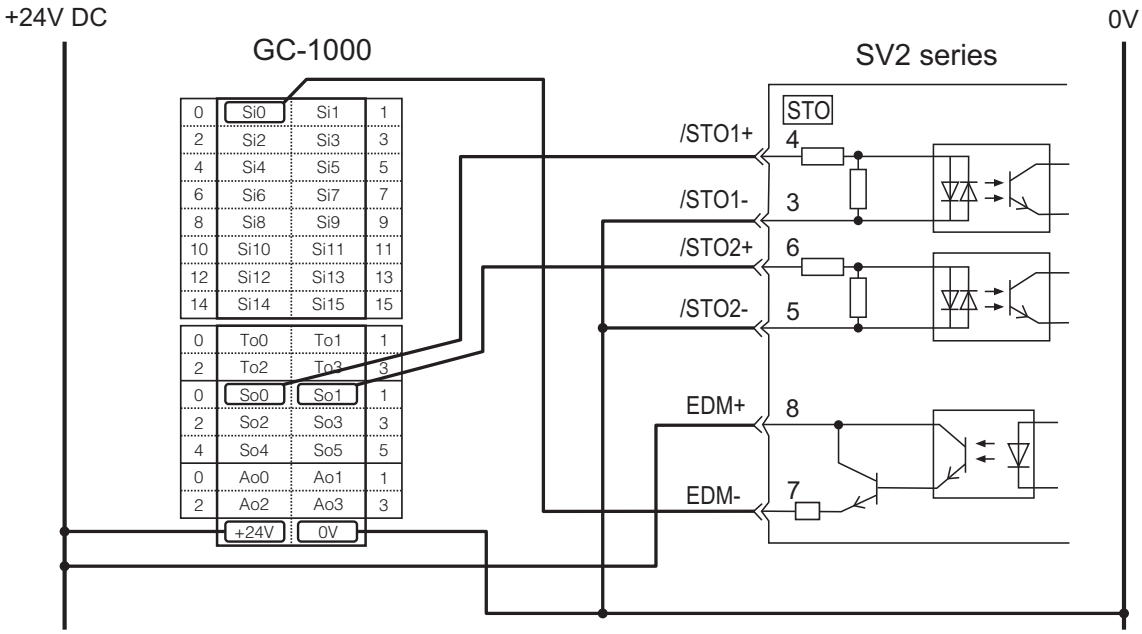
**Below are shown some examples of use of the safety function.**

## Example of connection

**Below is shown a connection example using Safety Controller GC-1000 manufactured by KEYENCE Ltd.**

**Setting of GC-1000**

So0 and So1 (S-OUT) setting: **Safety output x 2**
Si0 (EDM input) setting: **1 input**




**When the safety outputs (So0 and So1) of the GC-1000 are turned off, both the STO1 and STO2 signals are turned off, and the EDM signals are turned on. When the safety outputs (So0 and So1) are turned on, the STO1 and STO2 signals are both turned on and the EDM signals are turned off.**

Reference The EDM signal is used as source output. Please connect in such a way that the current direction is from EDM+ to EDM-.

## Methods to detect the malfunctions

**If such a malfunction occurs that the /STO1 or the /STO2 signal remains set to ON, since the EDM signal does not turn to ON, the guard cannot be reset if it is closed and, being impossible to start the device, the malfunction is detected.**
**In this case, since there is the possibility of an anomaly of an external device or of the disconnection/short circuit of the external wiring or a malfunction of the servo amplifier, it is recommended to check and to take a countermeasure.**

## Instructions for use

1. The safety light curtain detects an intruder.

2. The safety control unit set /STO1, /STO2 to OFF and the STO function is enabled. If the motor is running, please stop it following the stopping procedures for servo OFF. After the motor has stopped, stop the operation orders and the servo ON orders sent from the host.

3. Make the intruder leave the intrusion prohibited zone.

4. Turn the master reset ON after checking that the intruder has left.

5. The STO function is disabled.

6. Perform warning clear from host device.

7. Set to servo ON from host device.

# 8-5 Adequacy test for the safety function

**When starting up the device, in case of maintenance or exchange of the servo amplifiers, it is strongly recommended to do the following adequacy test for the STO function after the wiring. (We recommend to record the test result as a memo.)**

- When the /STO1, /STO2 signals are OFF, check that the indication on the 7SEG display is "A.9D3", and that the motor is not working.
- Control the ON/OFF status of the /STO1, /STO2 signals.
  If the signal ON/OFF status does not match with the display, the reason may be an anomaly of the external device, a disconnection/short circuit of the external wiring or a malfunction of the servo amplifier. Please find the reason and take a countermeasure.
- Check that the EDM signal is OFF during the normal operation by checking the feedback circuit input display of the connection device.

Reference It is possible to control the status of the /STO1, /STO2 signal through the servo trace of the SV2 series setting software/KV-XH setting tool.

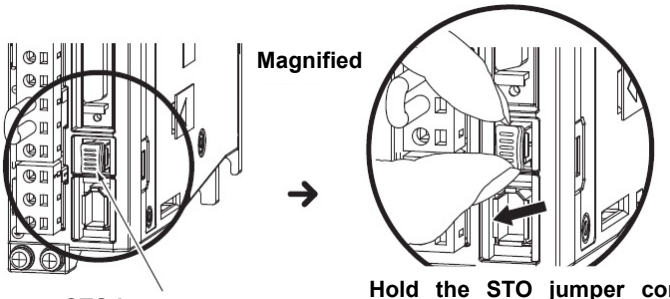
"Chapter 12 SV2 SERIES SETTING SOFTWARE", Page 12-1

"KV-XH16ML/XH04ML User's Manual"

# 8-6 Connection of the safety device

**Below are shown some examples of mounting of the safety device.**

**1 Remove the STO jumper connector of the STO connector (STO).**




**STO jumper connector**

**Hold the STO jumper connector with your fingers and remove it.**

**2 Connect the safety device to the STO connector (STO)**

Reference

- If the safety device is not connected, please leave the STO jumper connector mounted on the STO connector (STO). If the STO jumper connector is not mounted, the power is not fed to the motor and the motor torque cannot be output. In this case, the indication on the 7SEG display becomes "A.9D3".
- Use the following cable to connect a safety device.
  - SV-ST1 (1m)
  - SV-ST3 (3m)

  For the specification of the hard wiring, see "4-8 Safety Function Wiring", Page 4-37.

**MEMO**

# 9

# ABSOLUTE POSITION SYSTEM

This chapter describes how to use ABS encoder to keep absolute position and read absolute position data.

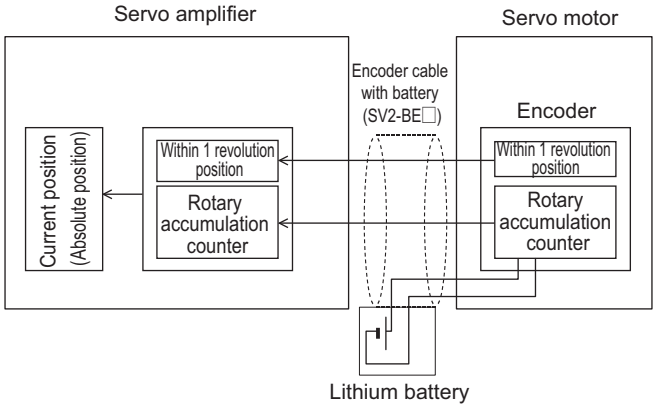
# 9-1 Overview and Specifications

This section describes overview and specifications of absolute position system and how to use.

## Overview

SV2 Series servo motor (SV2-□□□A□) consists of a detector that detects position within one revolution and rotary accumulation counter.

When using the absolute position system, current position of encoder can be kept by the lithium battery that the encoder cable with the battery (SV2-BE□) is built, even if power supply of control circuit is OFF.




**Point**

- **When absolute position system is not used, current coordinate will be reset once power is ON. Be sure to perform origin return first you start if required.**

## Specification

Specifications of absolute position system are listed in the following table.

| Item | Specification | Comments |
|---|---|---|
| Mode | Electronic/battery backup mode | - |
| Battery | Special Lithium battery | Replacement internal lithium battery (OP-88006) for encoder cable with battery (SV2-BE□) |
| Max. rotation range | –32768 to 32767 turns | - |
| Battery backup time | 3 years when off | The power is OFF and ambient temperature 20°C. |
| Recommended replacing time for battery | 3 years | It means the recommended replacing time for maintaining battery function whether power ON or OFF. |

## Steps to follow

The absolute position system is installed and set up with the following steps:

1. Mount encoder cable with battery (SV2-BE□).
   "9-2 Mounting Lithium Battery", Page 9-4

2. Set up the absolute position system.
   Change the parameter "*Absolute position system" (SYS_01) to "ABS", and restart power supply or slave apparatus.
   "9-3 Installation of Absolute Position System", Page 9-5

3. Alarm occurs.
   Due to unstable multi-turn data in the servo motor after power on, an "*Encoder backup need ABS setup" (810) alarm may occur.

4. Initialize multi-turn data.
   Set up ABS encoder and initialize multi-turn data of absolute position system.
   "9-3 Installation of Absolute Position System", Page 9-5

# 9-2 Mounting Lithium Battery

The following paragraph describes how to mount the lithium battery.

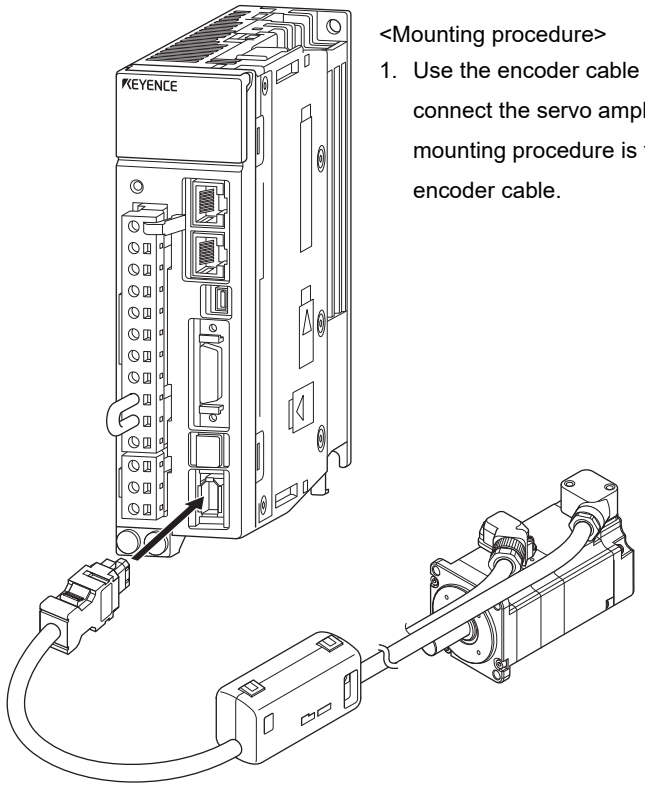
## Mounting the lithium battery

If the absolute position system is used, use the encoder cable with battery (SV2-BE□) to connect the servo amplifier with the servo motor. In this case, the normal encoder cable (SV2-E□) is not used.

▶ Important

- **Please mount and remove the encoder cable with battery (SV2-BE□) when at least 6 minutes have elapsed since the power has turned to OFF, and after confirming that the CHARGE display LED has turned to ON. Otherwise, this may cause electric shock.**

Since the encoder cable with battery (SV2-BE□) can send the current to the servo motor without passing through the servo amplifier, it can preserve the current position even if the servo amplifier is separated from the servo motor.




Encoder cable with battery <SV2-BE□>

<Mounting procedure>

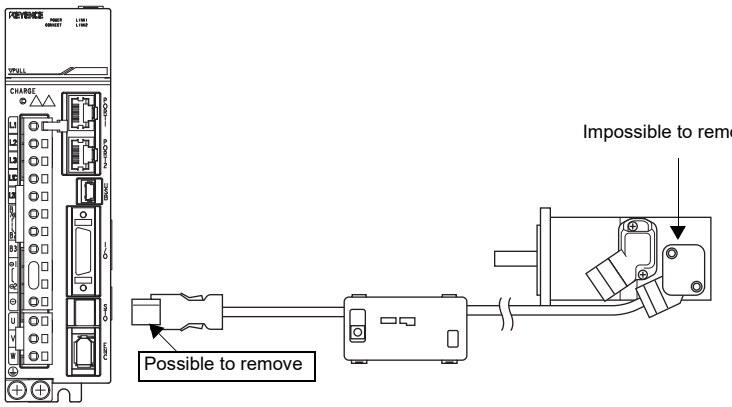
1. Use the encoder cable with battery (SV2-BE□) to connect the servo amplifier with the servo motor. The mounting procedure is the same as for a normal encoder cable.

### ● Separating the servo amplifier from the servo motor

If the encoder cable with battery is removed from the servo amplifier while it is still connected to the motor, it is possible to separate the servo amplifier from the servo motor without losing the current position.

Point

**If the encoder cable with battery (SV2-BE□) is removed from the servo motor, the servo motor current position will be lost.**



# 9-3 Installation of Absolute Position System

This chapter introduces parameter setting and ABS encoder setting when absolute position system is used.

## Parameter Setting

When absolute position system is used, "*Absolute position system" (SYS_01) is set to "ABS".

| Parameter type | Category | Level | Parameter name | Setting range | Setting unit | Default | Enable timing |
|---|---|---|---|---|---|---|---|
| SYS_01 | System | Basic | * Absolute position system | 0: ABS<br>1: INC<br>2: Singleturn ABS | - | 1 | When power is ON again |

Point **When the servo amplifier is used in combination with KV-XH16ML/XH04ML, please set "ABS" or "INC". If "Singleturn ABS" is set, then it is not possible to operate normally.**

## ABS Encoder Setting

Install the encoder cable with battery (SV2-BE□) and set up absolute position system parameters, then set up ABS encoder. After setting is ended, always restart the power supply.
ABS encoder should be set in the following conditions.

- When "*Encoder backup need ABS setup" alarm (810) occurs
- When "*Encoder error 0 need ABS setup" alarm (820) occurs
- To set multi-turn data of ABS encoder to 0

| NOTICE | **When absolute position system is used, if absolute encoder is set up, then multi-turn data will be changed, resulting in unexpected machine operations such as a dramatic rise of speed.** |
|---|---|

### ■ Control method

Execute the "Absolute encoder setup" from the SV2 series setting software/KV-XH setting tool.

#### ● For SV2 series setting software

Please refer to the "Absolute Encoder Setup", Page 12-34 for the operation method of SV2 series setting software.

#### ● For KV-XH setting tool

For operating method of KV-XH setting tool, see the manual below.
KV-XH16ML/XH04ML user's manual

# 9-4 Setting for Low Battery Voltage and Replacement of Lithium Battery

This section describes the handling of "ABS encoder battery alarm" (830) and "ABS encoder battery warning" (930) after absolute position system is set.

## Settings of Encoder Battery Alarm/Warning

Life of the lithium battery of the encoder cable with battery (SV2-BE□) is about 3 years when power off, ambient temperature is 20°C.

When lithium battery voltage drops to below 2.7V, "ABS encoder battery alarm" (830) or "ABS encoder battery warning" (930) will occur by setting "*Low battery voltage" (ALM_05).

Switching of alarm, warning may be set via parameter setting.

| Parameter type | Category | Parameter name | Setting range | Setting unit | Default | Enable timing |
|---|---|---|---|---|---|---|
| ALM_08 | Alarm | *Low battery voltage | 0: Alarm *1<br>1: Warning *2 | - | 0 | When power is ON agian |

*1 When "Alarm" is selected, after control circuit is ON and "Alarm (ALARM)" output is OFF, battery voltage will be monitored for only 15 seconds. After this, no monitoring is performed.

*2 When "Warning" is selected, after control circuit is ON, the battery voltage is always monitored.

## Replacing the lithium battery

Replace the lithium battery when the voltage is low and both the "encoder battery alarm" (830) and the "encoder battery warning" (930) occur.
Please replace the battery even if the former alarm warnings have not occurred but the recommended replacement time (3 years) has elapsed.
Please replace the lithium battery following the procedure below, replacing the lithium battery in use with the replacement lithium battery (OP-88006).

**Point**

- **Please replace the lithium battery when the control circuit power is ON. If the lithium battery is removed when the control circuit power is OFF, the current position will be lost.**
- **Please replace the lithium battery when the main circuit power is OFF, in order to avoid electrical shocks.**

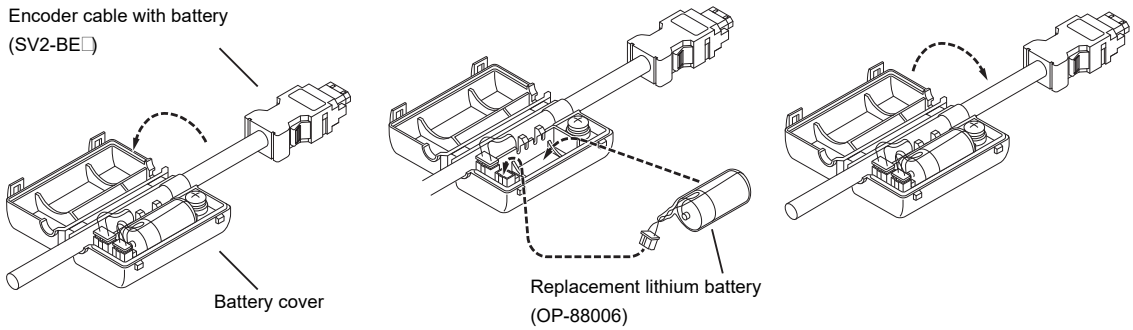
### ■ Replacing the lithium battery

When replacing the lithium battery of the encoder cable with battery (SV2-BE□), open the battery cover of the encoder cable with battery (SV2-BE□) and replace the inner lithium battery with the replacement lithium battery (OP-88006).

Open the battery cover of the encoder cable with battery (SV2-BE□).

Replace the lithium battery in use with the replacement lithium battery (OP-88006).

Close the battery cover.



# 9-5 Obtainment of the absolute position

## Obtaining procedure while connected with the KV-XH16ML/XH04ML

When using the KV-XH16ML/XH04ML, the absolute position of the servo motor is read out automatically to the buffer memory or to the data memory.
For details, see "KV-XH16ML/XH04ML Users Manual 'Chapter 6 - Axis control common function and setting'".

# 10

# FULLY CLOSED CONTROL

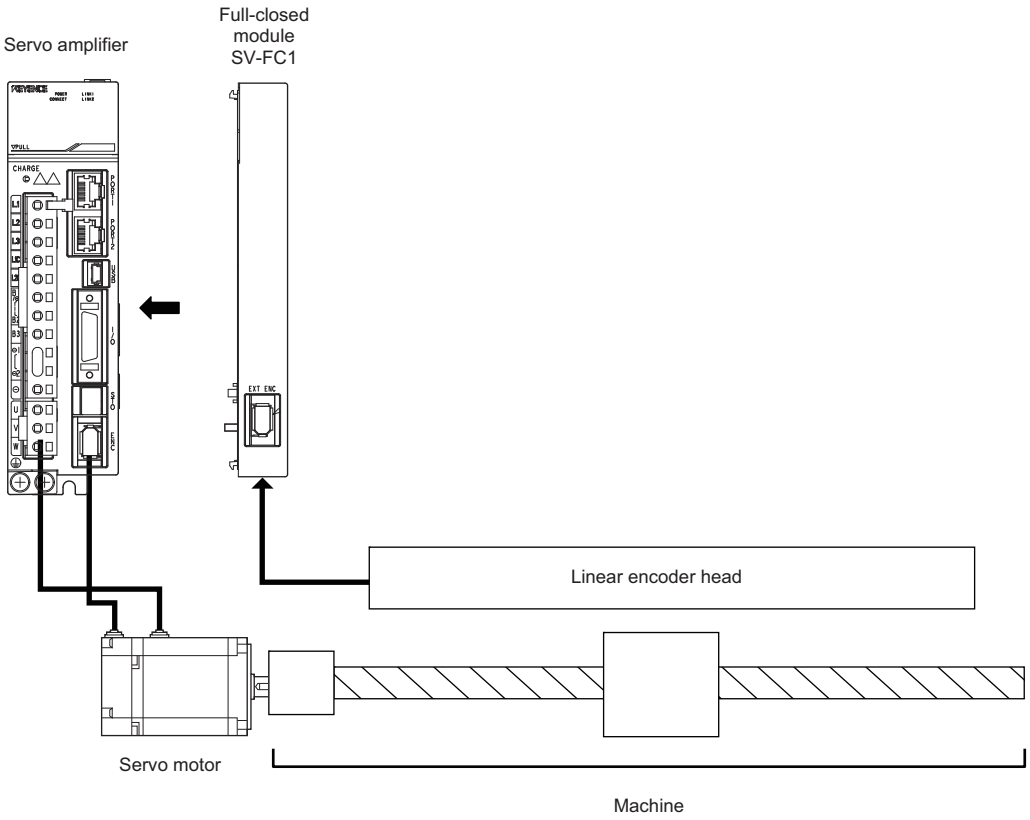
This chapter describes the details of the fully closed control.

# 10-1 Outline of the fully closed control

## Features of the fully closed control

The fully closed control is a function that feedbacks the servo amplifier by detecting the position of the controlled object through an external encoder installed in the system. It allows a high precision locating by feedbacking directly the actual position.

An example of system structure is shown below.




Reference Refer to "4-9 Connecting an External Encoder", Page 4-39 for information on connecting an external encoder.

# 10-2 Starting up procedure

In order to use the servo amplifier with the fully closed control, first check if the machine works correctly with the normal (semi-closed) control, based only on the encoder feedback from the servo motor. After that, change the setting and check if the machine works correctly with the fully closed control.
Below is the procedure to start up the fully closed control.

| Steps | Description | Operation | Parameters that need to be set | Command |
|---|---|---|---|---|
| 1 | Check the actions caused by the semi-closed control in unloaded condition.<br><Check items><br>Power circuit wiring<br>• Servo motor wiring<br>• Encoder wiring<br>• Input/output signal wiring with the host device<br>• Rotation direction, rotation speed and rotation quantity of the servo motor<br>• Brake safeguard operation | Semi-closed control in unloaded condition<br>To allow the correct operation with the (FC_01=0), set each parameter and check following points.<br>• Are there anomalies in the servo amplifier?<br>• Does the machine work normally in the JOG mode with only the servo motor?<br>• Does the Input/output signal ON/OFF work normally?<br>• Does the servo motor power up after the Servo ON (SV_ON) command has been sent from the host device?<br>• Does the servo motor work normally after the position command has been input from the host device? | • "*AC/DC current" (OTH_19)<br>• "*External encoder" (FC_01)<br>• "*Motor rotation direction" (SYS_05)<br>• "*Electronic gear (numerator)" (POS_01)<br>• "*Electronic gear (denominator)" (POS_02)<br>• Input/output signal setting (IO_01 to IO_27) | Servo amplifier or host device |
| 2 | When combining the machine with the servo motor, check the semi-closed control operation.<br><Check items><br>• Initial responsiveness of the combination with the machine<br>• Movement direction, movement distance, movement speed depending on the host device command | Mount the servo motor to machine. Execute the moment of inertia ratio calculation, and set the moment of inertia ratio to TUN_08. Then check if the movement direction, the movement distance and the movement speed are obeying the command sent from the host device. | "Load inertia moment ratio" (TUN_08) | Host device |
| 3 | Check the external device.<br><Check items><br>• Has the external encoder signal been taken correctly? | Set the fully closed control parameter and, without powering up the servo motor, move the machine by hand and check if the returning position monitored by the SV2 series setting software/KV-XH setting tool is the same as the movement distance of the machine. | • "*External encoder" (FC_01)<br>• "*Electronic gear (numerator)" (POS_01)<br>• "*Electronic gear (denominator)" (POS_02)<br>• "*External encoder division output resolution" (FC_05)<br>• "Alarm value indicating excessive deviation between the motor and the external encoder" (FC_06)<br>• "INPOS range" (POS_03)<br>• "Slip correction coefficient per motor rotation" (FC_07) | - |
| 4 | Perform the JOG run from the trial run of the SV2 series setting software/KV-XH setting tool.<br><Check items><br>• Is the absolute position detection system of the fully closed control working correctly? | Please perform the JOG run from the trial run of the SV2 series setting software/KV-XH setting tool and check if the movement distance is the same as the command value. When performing the JOG run, increase the speed little by little from low speed to operation speed. | - | Host device |
| 5 | Run the servo amplifier.<br><Check items><br>• Is the fully closed control (including the host device) working correctly? | Input the position command and check if the servo amplifier is working correctly. Increase the speed little by little from low speed to operation speed. | - | Host device |

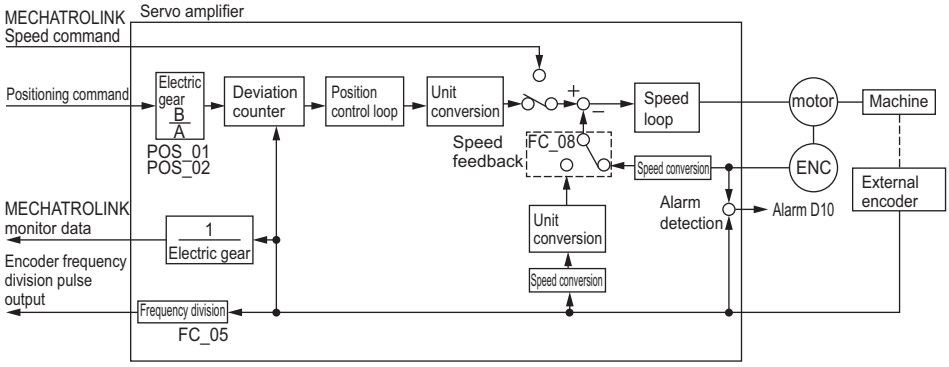
**Point**

**In order to adjust the gain, first perform it in semi-closed control state and then turn to full closed control.**
**If the operation is unstable due to oscillation when running the fully closed system, be sure to adjust it by decreasing the gain with the Gain tuning PRO.**

# 10-3 Setting of the fully closed control

## Control block diagram of the fully closed control

The control block diagram of the fully closed control is shown below.




## Fully closed control parameters

Here are described the parameters of the fully closed control.

10 FULLY CLOSED CONTROL

### ■ Setting of the motor rotate direction and of the machine movement direction

It sets the motor rotate direction and the machine movement direction. When using the fully closed control, it is necessary to set both the "*motor rotate direction" (SYS_05) and the "*external encoder" (FC_01).

| Parameters | | | FC_01 (*External encoder) | | | |
|---|---|---|---|---|---|---|
| | | | 1 : Use ((+) direction with motor CCW) | | 3 : Use ((-) direction with motor CCW) | |
| SYS_05 (*Motor rotation direction) | 0:CCW | Command direction | Normal rotation command | Reverse rotation command | Normal rotation command | Reverse rotation command |
| | | Motor rotation direction | CCW | CW | CCW | CW |
| | | External encoder | (+) direction movement | Reverse movement | Reverse movement | (+) direction movement |
| | 1:CW | Command direction | Normal rotation command | Reverse rotation command | Normal rotation command | Reverse rotation command |
| | | Motor rotation direction | CW | CCW | CW | CCW |
| | | External encoder | Reverse movement | (+) direction movement | (+) direction movement | Reverse movement |

**Point**

- Please reclose the power supply to reflect the setting change of the "* External encoder" (FC_01). It will not be reflected when restarting the slave devices by KV-XH setting tool or the SV2 series setting software.
- Despite the division pulse is set to "*Motor rotate direction" (SYS_05), the device proceeds to the B phase when receiving the normal rotation command.
- When using in combination with the servo amplifier and the KV-XH16ML/XH04ML, set the "*Motor rotate direction" (SYS_05) to "0:CCW". If the setting is changed, the machine stops working properly.
- Please set the "*External encoder" (FC_01) according to the following points.
  - Set SYS_05 = 0 (CCW), FC_01 = 1 ((+) direction with the motor CCW in use).
  - Turn the motor axis in the CCW direction by hand.
  - If the fully closed feedback pulse counter has counted up, set FC_01 = 1; if it has counted down, set FC_01 = 3.

## ■ Pitch number of the external encoder per 1 motor rotation

It sets the ratio of the external encoder distance resolution to the motor encoder distance to "*External encoder coordinate transformation numerator" (FC_02) and "*External encoder coordinate transformation denominator" (FC_03).

FC_02/FC_03 = External encoder distance resolution/Motor encoder distance resolution

* External encoder distance resolution = Scale pitch/Partitions number

* Motor encoder distance resolution = Movement distance per 1 rotation/Motor encoder resolution (22 bit)

| Parameter type | Category | Level | Parameter name | Setting range | Setting unit | Default | Enable timing |
|---|---|---|---|---|---|---|---|
| FC_02 | Fully closed | Extend | *External encoder coordinate transformation numerator | 1 to 1073741824 | - | 4194304 | When power is ON again |
| FC_03 | Fully closed | Extend | *External encoder coordinate transformation denominator | 1 to1073741824 | - | 50000 | |

### ● Setting example

The example refers to the following environment.

External encoder scale pitch: 20μm, partitions number 256

Ball screw lead: 5mm

Motor encoder resolution: 22bit

If the motor is directly connected,

FC_02 / FC_03 = (20μm/256) / (5mm /4194304)

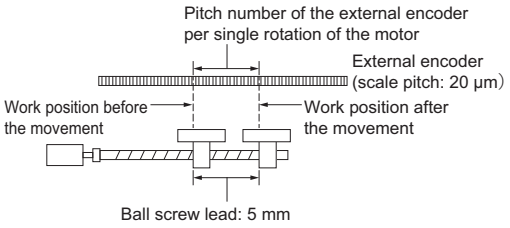
= 4194304 / (5mm × 256 / 20μm)

= 4194304 / 64000

Accordingly, set

FC_02 = 4194304

FC_03 = 64000




.

Reference This setting means that, if the command unit of the setting default value is PLS, the external encoder moves 50mm per 1 motor rotation.

Point **There are similar items when connecting KV-XH16ML/XH04ML and SV2, so this is a reference about the concept.**
**When using in connection to KV-XH16ML/XH04ML, with the command unit set to 1 mm, set the coordinate transformation numerator/denominator as follows.**
**Example) Linear scale: pitch 20μm, partitions number 256**
**The necessary pulse for a 1mm movement is 1×1000÷20×256 = 12800pls.**
**Accordingly, set coordinate transformation numerator = 1 and coordinate transformation denominator = 12800.**

## ■ Refer to the "KV-XH16ML/XH04ML User's Manual 6-5 Coordinate transformation" (Page 6-27)

## ■ Encoder division Z phase pulse output selection

Set if the Z phase pulse can be output only when using the incremental linear encoder which only output the Z phase pulse to only one direction in the external encoder, the external encoder is moving forward or when it is moving in both directions.

| Parameter type | Category | Level | Parameter name | Setting range | Setting unit | Default | Enable timing |
|---|---|---|---|---|---|---|---|
| FC_04 | Fully closed | Extend | *External encoder division Z phase pulse output | 0: Forward only<br>1: Forward and reverse | - | 1 | When power is ON again |

## ■ Encoder division pulse output (A/B/Z) signal setting

It sets the division resolution to "*External encoder division output resolution" (FC_05).
As setting value, input the A, B phase edge number.

| Parameter type | Category | Level | Parameter name | Setting range | Setting unit | Default | Enable timing |
|---|---|---|---|---|---|---|---|
| FC_05 | Fully closed | Extend | *External encoder division output resolution | 1 to 4096 | Edge/Scale pitch | 20 | When power is ON again |

### ● Setting example

The example refers to the following environment.

External encoder scale pitch: 20μm

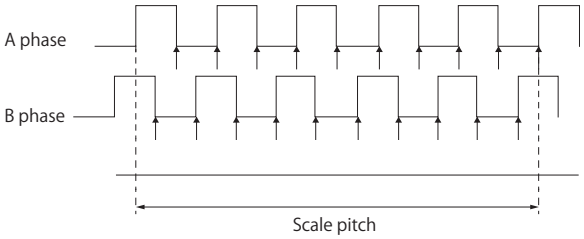
Ball screw lead: 30mm

Speed: 1600mm/s

If the output value is 1 pulse (value after the 4 edge evaluation) 1μm, FC_05=20.

If the output value is 1 pulse (after the 4 edge evaluation) 0,5μm, FC_05=40.

If the setting value is "20", the encoder division pulse output waveform is as follows.




"↑"represents the edge position. In this example, since the setting value is "20", "↑" represents 20 places.

**Point**

- **Since the upper limit of the encoder signal output frequency is 6.4 MHz (after the 4 edge evaluation), don't set a value that exceeds 6.4 MHz. If the setting value exceeds the upper limit, the "*Encoder division output pulse over speed" alarm (511) will occur.**
- **Example) If the value is set to "20", the speed is 1600 mm/s.**
  **$\frac{1600mm/s}{0.001mm}$ = 1600000 = 1.6 MHz**
  **Since 1.6 MHz < 6.4 MHz, this setting value can be used.**

## ■ Setting of the alarm value of excessive deviation between the motor and the external encoder

This setting detects the difference between the encoder feedback of the motor (position) and the external encoder feedback of the fully closed loop (load position). If the setting value is exceeded, the "Motor/External encoder deviation excess" alarm (D10) will occur.

| Parameter type | Category | Level | Parameter name | Setting range | Setting unit | Default | Enable timing |
|---|---|---|---|---|---|---|---|
| FC_06 | Fully closed | Extend | Motor-external encoder deviation excessive alarm level | 0 to 1073741824 | Command pulse | 1000 | After changing |

## ■ Setting of the slip correction coefficient per motor rotation

It sets the "Motor/External encoder deviation coefficient" per 1 motor rotation. It can be used for preventing the external encoder damage to go out of control and to detect the "sliding" of the belt mechanism.

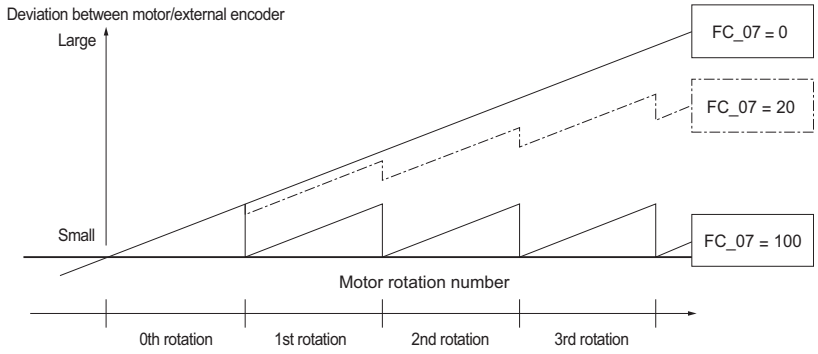
| Parameter type | Category | Level | Parameter name | Setting range | Setting unit | Default | Enable timing |
|---|---|---|---|---|---|---|---|
| FC_07 | Fully closed | Special | Slip correction coefficient per motor rotation | 0 to 100 | % | 0 | After changing |

### ● Setting example

Increase the value if the sliding rate and the torsion of the belt are big.

If the setting value is "0", the external encoder value is read as it is.

If the setting value is "20", the second rotation starts from the the motor 1st rotation deviation ×0.8.



**MEMO**

# 11

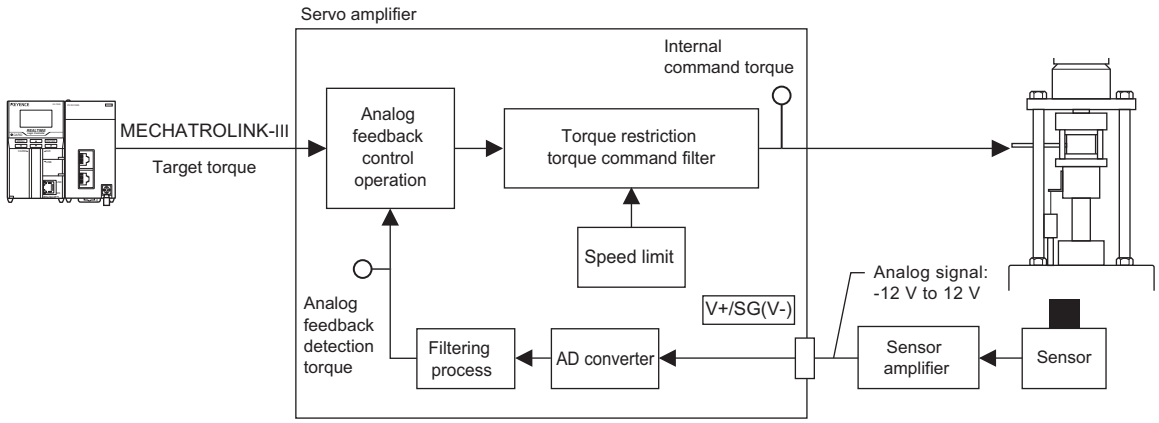
# ANALOG FEEDBACK CONTROL FUNCTIONS

This chapter describes the details of the analog feedback control functions.

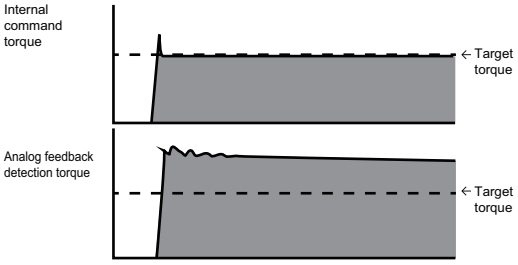
# 11-1 Overview of Analog feedback control

## What is Analog feedback control function

Analog feedback control is the functions to detect the torque or pressure that becomes the control object by the external sensor that is set at the mechanism of the control object to feedback to servo amplifier, and to control the detection value to become the target value. You can directly feed back the torque or pressure that actually becomes the control object, so high-speed and high-precision torque control can be performed easily.

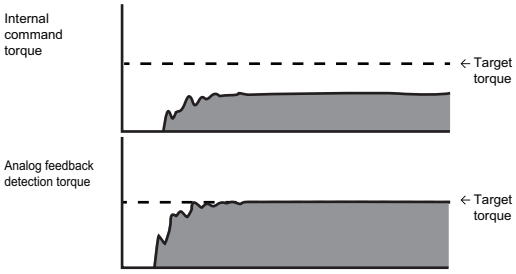



● **The case of torque control only**




Even if the internal command torque matches the torque command, the analog feedback detection torque may be out of alignment due to the influence of mechanical loss.

●**The case of analog feedback control**




Analog feedback detection torque controls the internal command torque to match the torque command.

### ■ Target torque setting

Set as follows according to control mode.
Servo amplifier controls internal command torque so that the analog feedback detection torque value becomes equal to the set torque command.

- Torque control: TQREF area of TRQCTRL command
- Speed control: TFF area of VELCTRL command

**Point**

**When connecting to KV-XH16ML/XH04ML, it can be specified easily as follows.**

- **Torque control: [Torque control torque command] in the buffer memory. It can be specified by the unit dedicated command, U_WRTTRQ.**
- **Speed control: [Speed control torque feedforward] in the buffer memory**

### ■ Acquisition of Analog feedback detection torque

If connected to KV-XH16ML/XH04ML, set "MECHATROLINK select monitor 1/2" (ML_51/ML_52) to "9: analog feedback detection torque", the analog feedback sensor input value can be stored the KV-XH16ML/XH04ML buffer memory. The stored value can be checked at the unit trace or the servo monitor in the SV2 series setting software/ KV-XH setting tool.


"Chapter 12 SV2 SERIES SETTING SOFTWARE", Page 12-1
"KV-XH16ML/XH04ML User's Manual"
"Monitor", Page 11-15
"Analog feedback input signals setting", Page 11-7

# 11-2 Start-up procedure

0. Efficient control mode setting (page 11-6)
   - AFB_01 *Analog feedback control
   - AFB_02 * Analog feedback efficient control

1. Analog feedback input signals setting (page 11-7)
   - AFB_05 Analog input gain
   - AFB_06 *Analog input polarity
   - AFB_07 Analog input filter
   - AFB_08 Analog input offset

2. Auto offset adjustment of Analog feedback input signal (page 11-7)

3. Control mode switching and Alarm detection condition setting (page 11-8)
   - AFB_09 Analog feedback ctrl enable change trq
   - AFB_10 Analog feedback ctrl disable change trq
   - AFB_11 Torque deviation excessive alarm level
   - AFB_12 Detection trq excessive warning level
   - AFB_13 Detection trq excessive warning time

4. Gain adjustment in the position control, and Ratio of load inertia moment setting "Chapter 7 TUNING"

5. Analog feedback control gain adjustment (page 11-10)

   For auto tuning:
   - AFB_03 *Tuning mode
   - AFB_04 Auto tuning response

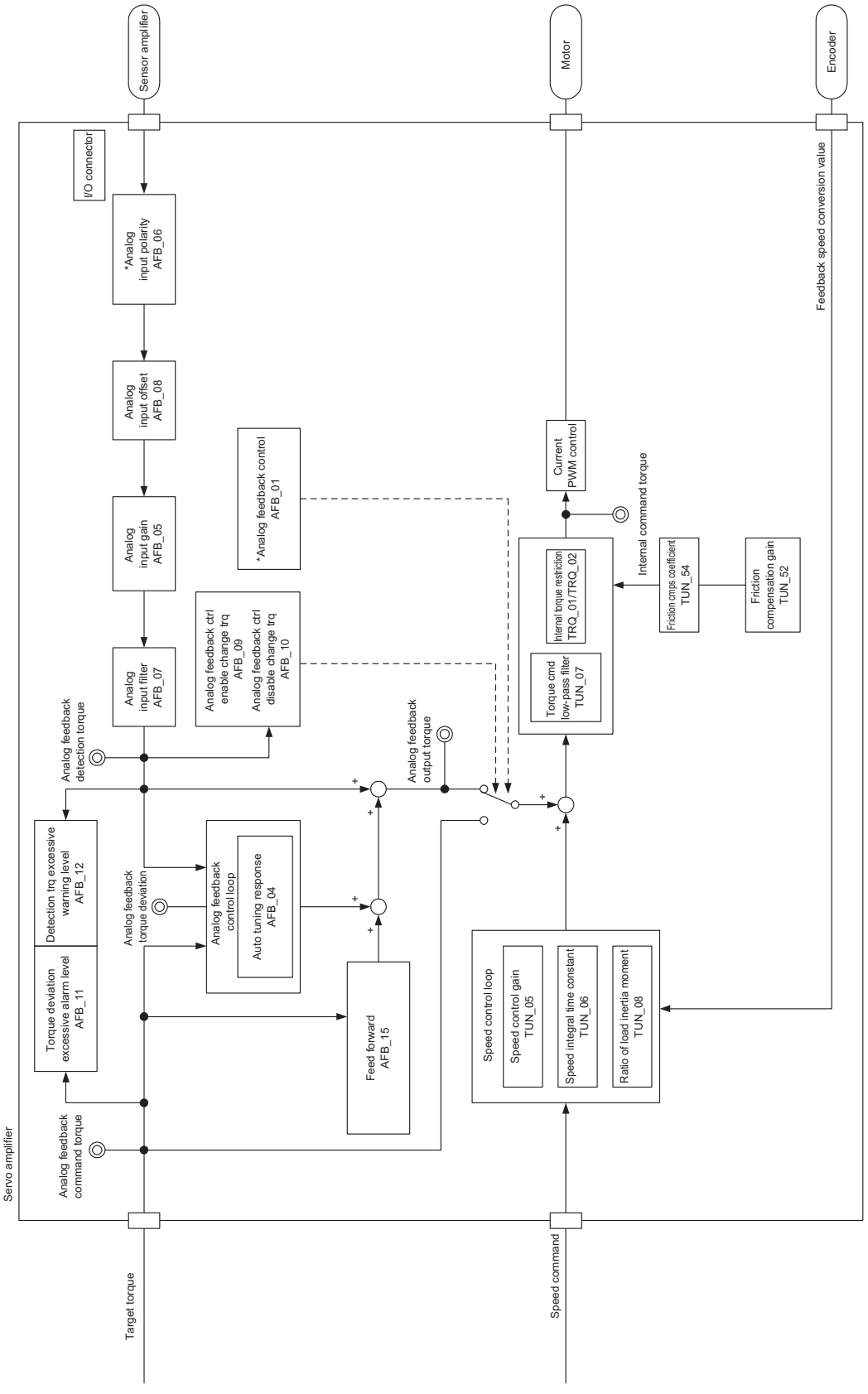
   For manual tuning:
   - AFB_14 Integral time constant
   - AFB_16 Derivative time
   - AFB_17 Differential filter multiplier
   - AFB_18 Proportional gain

   Common function:
   - AFB_15 Feed forward
   - AFB_19 Gravity compensation
   - AFB_20 Gravity compensation std level

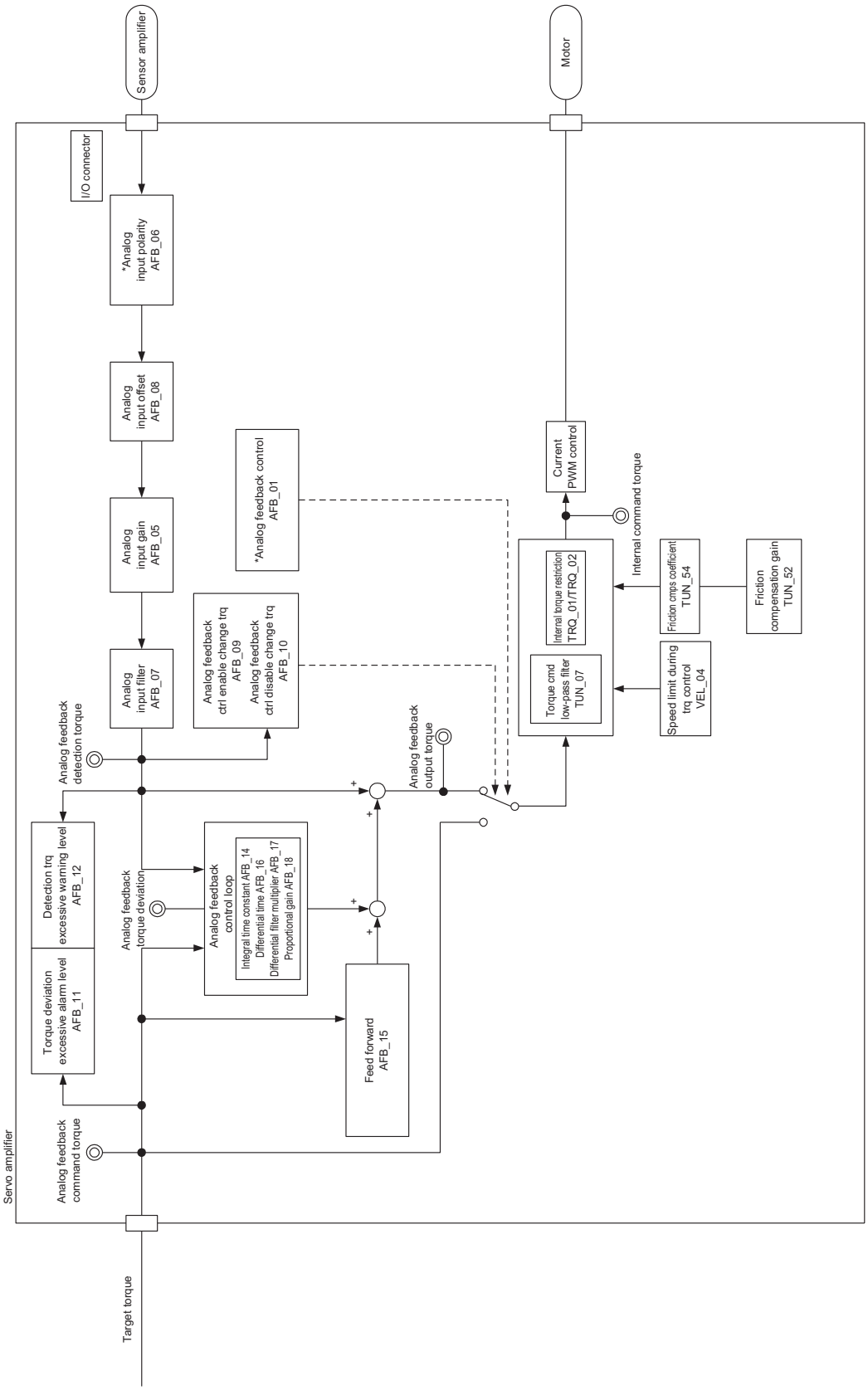
## Control block diagrams of analog feedback control functions

Control block diagrams of analog feedback control functions are as follows.

- **For auto tuning**



- **For manual tuning**



## Efficient control mode setting

### ■ Analog feedback control functions setting

If the analog feedback control function is used, set "*Analog feedback control" (AFB_01) to "1: Enable (Forward trq command)" or "2: Enable (Reverse trq command)" according to the command torque direction. Also, set the control mode that enables the analog feedback control to "*Analog feedback enable control mode" (AFB_02).

| Parameter type | Category | Parameter name | Setting range | Setting unit | Default | Enable timing |
|---|---|---|---|---|---|---|
| AFB_01 | Analog feedback | *Analog feedback control | 0: Not used<br>1: Enable (Forward trq command)<br>2: Enable (Reverse trq command) | - | 0 | When power is ON again |
| AFB_02 | Analog feedback | *Analog feedback enable control mode | 0: Enable at trq control<br>1: Enable at vel control*1<br>3: Enable at trq and vel control*1 | - | 0 | |

*1 When the speed control, it is enabled only in the case of "*Tuning mode" (AFB_03) = "1: Auto tuning".

#### ● For the shocking when switching the control mode

If the shocking occurs when switching the control mode, the shocking can be suppressed if the following conditions are met.

- Switch when the motor is stopping or the speed is low enough.
- The feedback speed and the command speed, or the feedback torque/command torque is consistent before and after the switch.
- When using as KV-XH16ML/XH04ML, "position control torque limit", "speed control torque limit", "torque control speed limit" for the buffer memory is set.
- The "speed command accelerate time" (VEL_01), "speed command decelerate time" (VEL_02) is set.
- The "speed limit during the torque control" (VEL_04) is set.
- Set the "* tuning mode"(TUN_01) to the "0: manual tuning" and use the gain search PRO to adjust.
- Set the "* tuning mode"(AFB_03) to the "0: manual tuning" and adjust the gain.

## Analog feedback input signals setting

### ■ Analog feedback sensor setting

Set "Analog input gain" (AFB_05) according to the output of the sensor amplifier.
This is a coefficient to convert the input voltage from the sensor to torque unit.

| Parameter type | Category | Parameter name | Setting range | Setting unit | Default | Enable timing |
|---|---|---|---|---|---|---|
| AFB_05 | Analog feedback | Analog input gain | 0 to 10000 | 0.01V/Rated torque | 0 | After changing |
| AFB_06 | Analog feedback | *Analog input polarity | 0:Not invert<br>1:Invert | - | 0 | When power is ON again |
| AFB_07 | Analog feedback | Analog input filter | 0 to 65535 | 0.01 ms | 100 | After changing |
| AFB_08 | Analog feedback | Analog input offset | -10000 to 10000 | 0.01%* | 0 | After changing |

* The setting unit is the ratio to the rated torque.

#### ● Setting example

The case to be used in the following environment is described as an example.
Servo motor: SV2-□100A□
Motor rated torque: 5.39 N•m
Ball screw lead:10mm
Sensor amplifier output: For 0 to 10,000 N, 0 to 10 V is output.
Pressure at the rated torque: 5.39 N•m × 2 × π × 1000 mm/10 mm ≈ 3386.5 N,
Pressure sensor amplifier output at the rated torque: 10 V × 3386.5 N/10000 N = 3.386 V,
Therefore, the setting value of "Analog input gain" (AFB_05) is 3.386 V ≈ 339 [0.01 V/ rated torque].
* The above example assumes that ball screw efficiency is η=1.

**Point**

- **If "*Analog feedback control" (AFB_01) is set to "2: Enable (Reverse trq command)" or the sensor input voltage is negative, please set "*Analog input polarity" (AFB_06) to "1: Invert".**
- **If the analog input noise is large, please set the low pass filter in "analog input filter" (AFB_07) as necessary.**
- **After auto offset adjustment of analog feedback input signal (page 11-7) is performed, please set "Analog input offset" (AFB_08) only in the case that the offset changing is necessary again.**

## Auto offset adjustment of Analog feedback input signal setting

Offset of Analog feedback input signal is automatically adjusted.

**Point**

**Please perform auto offset adjustment of analog feedback input signal in servo off state.**

### ■ Control method

Execute the "Analog feedback offset adjustment" from the SV2 series setting software/KV-XH setting tool.

#### ● For SV2 series setting software

Please refer to the "Analog Feedback Offset Adjustment", Page 12-36 for the operation method of SV2 series setting software.

#### ● For KV-XH setting tool

For operating method of KV-XH setting tool, see the manual below.
"KV-XH16ML/XH04ML User's Manual"

## Control mode switching and Alarm detection condition setting

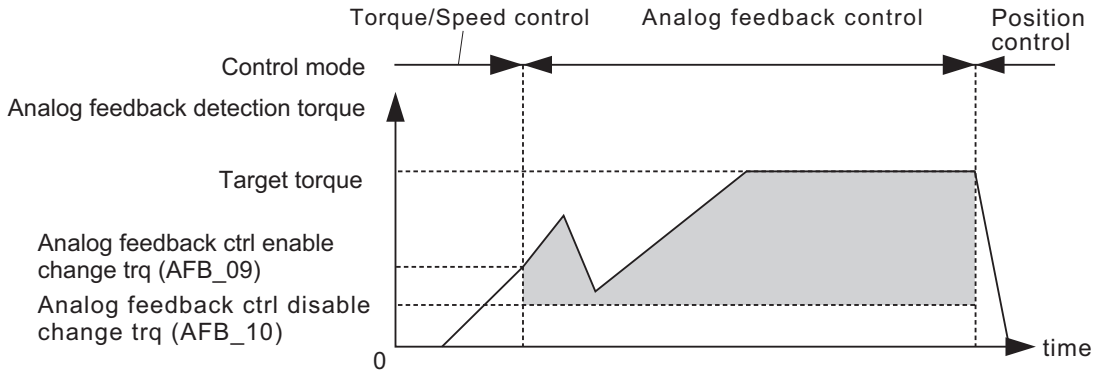
### ■ Setting of changing torque to the analog feedback control

For the method of changing to the analog feedback control, set in "Analog feedback ctrl enable change trq" (AFB_09) and "Analog feedback ctrl disable change trq" (AFB_10).

| Parameter type | Category | Parameter name | Setting range | Setting unit | Default | Enable timing |
|---|---|---|---|---|---|---|
| AFB_09 | Analog feedback | Analog feedback ctrl enable change trq | -10000 to 10000 | 0.01%* | 1000 | After changing |
| AFB_10 | Analog feedback | Analog feedback ctrl disable change trq | -10000 to 10000 | 0.01%* | 0 | |

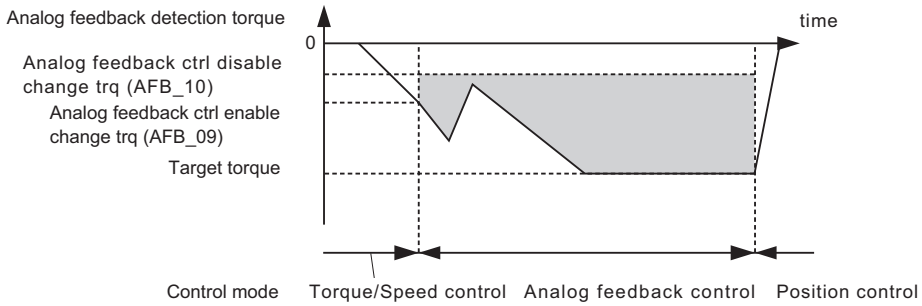
* The setting unit is the ratio to the rated torque.

The parts covered by gray in the diagram below is the enabled analog feedback control area.




**Point**

- **When using by connecting to KV-XH16ML/XH04ML, and setting [motor rotate direction] of the axis control setting to "negative rotation command in forward operation", the sign of the torque command direction that is input to the servo amplifier becomes opposite to the torque command value that is set in KV-XH16ML/XH04ML.**
- **When "analog feedback control" is performed in torque command of negative direction, even if the voltage to the analog feedback input is positive, set "Analog feedback control" (AFB_01) to "2: Enable (reverse trq command)", and "*Analog input polarity" (AFB_06) to "1: Invert". Also, set all of the following parameters in negative value.**
  - **Analog feedback ctrl enable change trq (AFB_09)**
  - **Analog feedback ctrl disable change trq (AFB_10)**
  - **Detection trq excessive warning level (AFB_12)**
  - **Gravity compensation std level (AFB_20)**




- **When the target torque is specified as 0, the analog feedback control is deactivated even if the analog feedback detection torque is bigger than the feedback control invalid switch torque.**
- **When the shocking occurs during the control mode switching, refer to the "For the shocking when switching the control mode", Page 11-6 to adjust the parameter.**

## ■ Excessive deviation alarm setting

If the difference between analog feedback command torque and analog feedback detection torque exceeds the setting value of "Torque deviation excessive alarm level" (AFB_11), "Analog feedback torque deviation excessive" alarm (D0A) will occur.
If AFB_11 = 800 is set, no errors are detected, and an alarm will not occur.

| Parameter type | Category | Parameter name | Setting range | Setting unit | Default | Enable timing |
|---|---|---|---|---|---|---|
| AFB_11 | Analog feedback | Torque deviation excessive alarm level | 0 to 800 | %* | 100 | After changing |

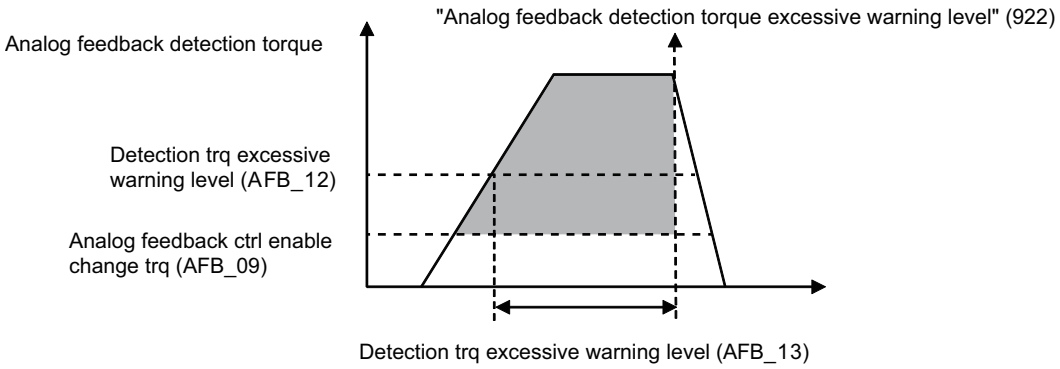
* The setting unit is the ratio to the rated torque.

## ■ Detection trq excessive warning setting

During the analog feedback control, if the torque that exceeds the setting value of "Detection trq excessive warning level" (AFB_12) is continuously detected in the setting time of "Detection trq excessive warning time" (AFB_13) "analog feedback detection torque excessive warning" (922) will occur and analog feedback control will be disabled.
If AFB_13 = 0 is set, a warning will occur immediately. If AFB_12 = 800 is set, no errors are detected, and a warning will not occur.

| Parameter type | Category | Parameter name | Setting range | Setting unit | Default | Enable timing |
|---|---|---|---|---|---|---|
| AFB_12 | Analog feedback | Detection trq excessive warning level | -800 to 800 | %* | 300 | After changing |
| AFB_13 | Analog feedback | Detection trq excessive warning time | 0 to 5000 | 0.1 ms | 0 | |

* The setting unit is the ratio to the rated torque.




**Point** **When the "analog feedback control"(AFB_01) is used as the "2: in use(reversal torque command)", please set the "detection torque " to a minus value.**

## Analog feedback control gain adjustment

### ■ Tuning method setting

Set the tuning method of the analog feedback control in "*Tuning mode" (AFB_03).

| Parameter type | Category | Parameter name | Setting range | Setting unit | Default | Enable timing |
|---|---|---|---|---|---|---|
| AFB_03 | Analog feedback | *Tuning mode | 0: Manual tuning<br>1: Auto tuning | - | 1 | When power is ON again |

The parameters used in gain adjustment is different by the setting of "*Tuning mode" (AFB_03).

**Point**

**When setting "*Tuning mode" (AFB_03) = "1: Auto tuning ", the setting value of "Speed limit at torque control"(VEL-04) and the value of data field (VLIM) for MECHATROLINK become invalid, and it runs at low speed with internally generated torque to bring the feedback speed close to zero. Therefore, after pushing start, stable control will be performed if stopping or operating at very low speed. If you want to increase the feedback speed for pushing operation and enable the setting value of "Speed restriction at torque control"(VEL_04) and the value of the data field (VLIM) of MECHATROLINK-III communication command, please set to "*Tuning mode" (AFB_03) = "0:Manual tuning".**
**When the "*analog feedback efficient control mode" (AFB_02) is used as "1" or "3", please set the "* tuning mode " (AFB_03) to "1:auto tuning".**

### ■ In the case of "*Tuning mode" (AFB_03) = "1: Auto tuning"

Adjust the following parameters.

| Parameter type | Category | Parameter name | Setting range | Setting unit | Default | Enable timing |
|---|---|---|---|---|---|---|
| AFB_04 | Analog feedback | Auto tuning response | 1 to 65535 | - | 100 | After changing |

**Point**

**In the case of "*Tuning mode" (AFB_03) = "0: Manual tuning", the above parameter will be disabled.**

#### ● Auto Tuning Response Setting

A specific mechanical rigidity is used for setting up gain related parameters.
Please adjust while checking the existence of response and vibration of servo motor.
The advantages and disadvantages for different setting are as follows:

| Auto tuning response setting | Advantage | Disadvantage |
|---|---|---|
| Small | • It is not easy for machine to vibrate | • Response of servo motor for command becomes slow<br>• Positioning adjustment time becomes longer. |
| Large | • Response of servo motor for command becomes fast<br>• Positioning adjustment time becomes shorter. | • It is easy for machine to vibrate |

**Point**

**If the results cannot satisfy, the adjustment may become easier by performing the following.**

- **Adjust "Speed integral time constant" (TUN_06) smaller within the range that does not affect the normal operation.**
- **Perform gain adjustment with gain search PRO in position control.**

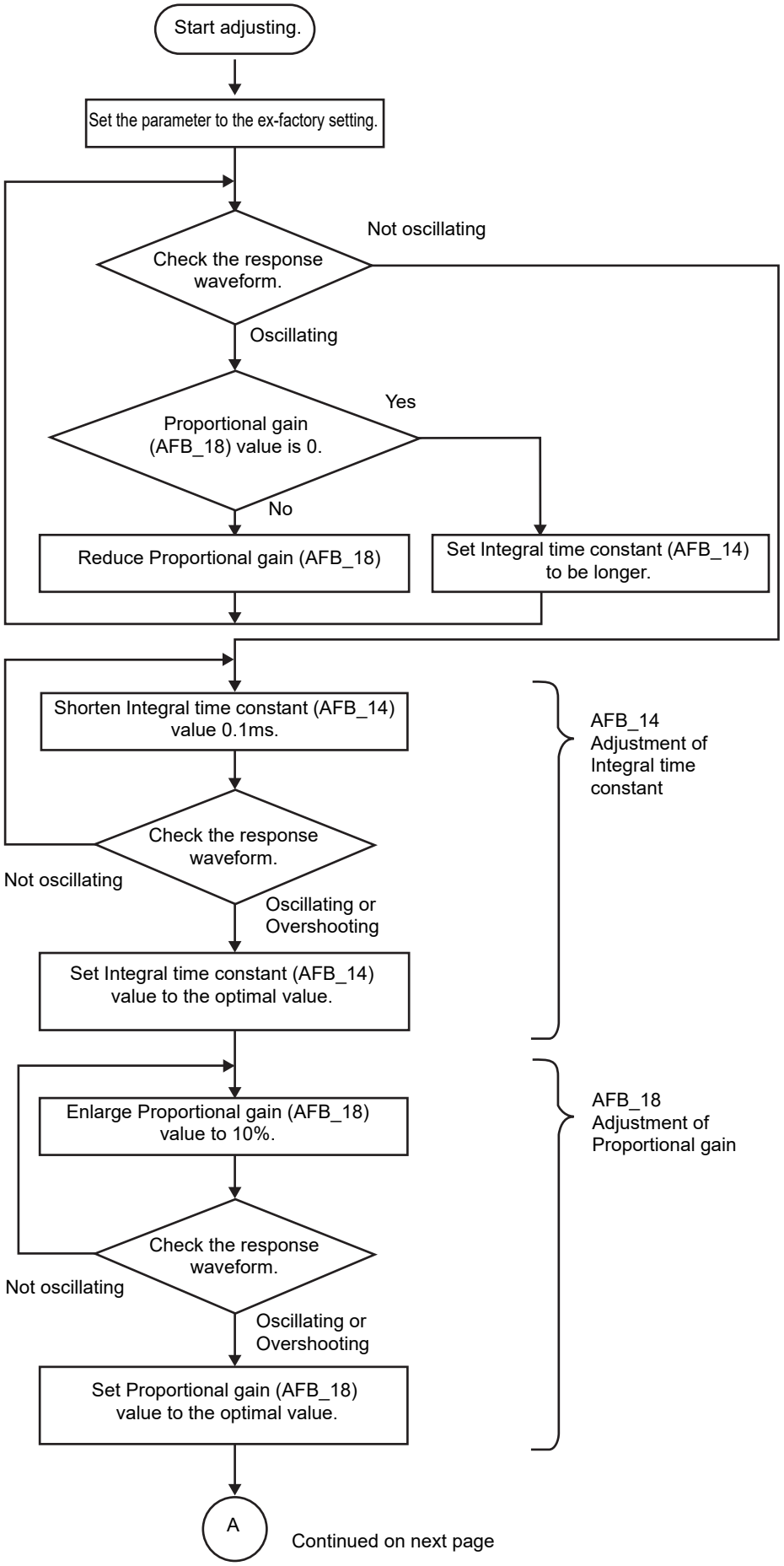
**If it still does not improve, adjust by setting "*Tuning mode" (AFB_03) to "0: Manual tuning".**

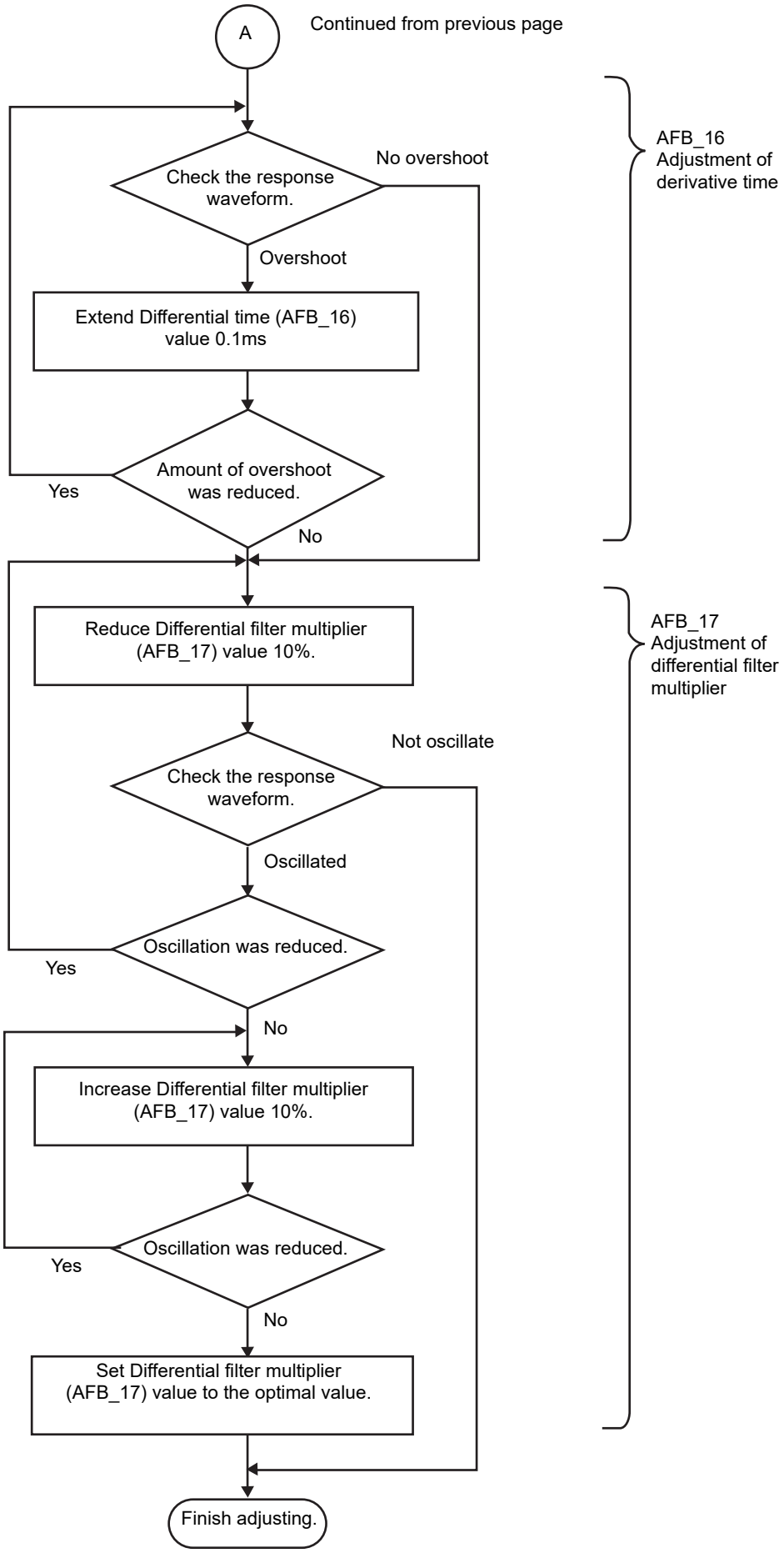
### ■ In the case of "*Tuning mode" (AFB_03) = "0: Manual tuning"

Adjust the following parameters.

| Parameter type | Category | Parameter name | Setting range | Setting unit | Default | Enable timing |
|---|---|---|---|---|---|---|
| AFB_14 | Analog feedback | Integral time constant | 0 to 51200 | 0.01 ms | 2000 | After changing |
| AFB_16 | Analog feedback | Derivative time | 0 to 51200 | 0.1 ms | 0 | |
| AFB_17 | Analog feedback | Differential filter multiplier | 0 to 10000 | % | 100 | |
| AFB_18 | Analog feedback | Proportional gain | 0 to 10000 | % | 100 | |

- **Flowchart of gain adjustment in manual tuning**




A
Continued from previous page
Check the response waveform.
No overshoot
Overshoot
Extend Differential time (AFB_16) value 0.1ms
Amount of overshoot was reduced.
Yes
No
AFB_16
Adjustment of derivative time
Reduce Differential filter multiplier (AFB_17) value 10%.
Check the response waveform.
Not oscillate
Oscillated
Oscillation was reduced.
Yes
No
Increase Differential filter multiplier (AFB_17) value 10%.
Oscillation was reduced.
Yes
No
Set Differential filter multiplier (AFB_17) value to the optimal value.
AFB_17
Adjustment of differential filter multiplier
Finish adjusting.

## ■ Feed forward setting

If feedforward compensation is performed, set "Feed forward" (AFB_15).

| Parameter type | Category | Parameter name | Setting range | Setting unit | Default | Enable timing |
|---|---|---|---|---|---|---|
| AFB_15 | Analog feedback | Feed forward | 0 to 1000 | % | 0 | After changing |

## ■ Gravity compensation setting

If it is necessary to compensate the influence of the weight of the moving parts in such as during vertical motion in the upside down orientation, set "Gravity compensation" (AFB_19) to "1: Enable". In the case of horizontal axis, set "Gravity compensation" (AFB_19) to "0: Disable".

| Parameter type | Category | Parameter name | Setting range | Setting unit | Default | Enable timing |
|---|---|---|---|---|---|---|
| AFB_19 | Analog feedback | Gravity compensation | 0: Disable<br>1 : Enable | - | 0 | After changing |
| AFB_20 | Analog feedback | Gravity compensation std level | -10000 to 10000 | 0.01%* | 0 | |

* The setting unit is the ratio to the rated torque.

Point **When the "Analog feedback control" (AFB_01) is used as "2: in use (reversal torque command)", please set the "gravity compensation" as a minus value.**

Important **Gravity compensation function needs to be used in the states that the output from the sensor is connected to servo amplifier and "analog feedback detection torque" can be normally checked.**

## Monitor

The operation states of analog feedback control can be checked from the following monitor functions.

### ■ Analog monitor

| OTH_11/OTH_12 Setting value | Signal Name | Output unit |
|---|---|---|
| 30H | Analog feedback Command torque | 1V/100% (Rated torque) |
| 31H | Analog feedback Detection torque | 1V/100% (Rated torque) |
| 32H | Analog feedback Output torque | 1V/100% (Rated torque) |
| 33H | Analog feedback Torque deviation | 1V/100% (Rated torque) |

"4-7 Wiring Analog Monitor", Page 4-36

### ■ MECHATROLINK select monitor

| ML_51/ML_52 Setting value | Name | Description |
|---|---|---|
| 8 | Analog feedback Command torque | 10000/100% (Rated torque) |
| 9 | Analog feedback Detection torque | 10000/100% (Rated torque) |
| 10 | Analog feedback Output torque | 10000/100% (Rated torque) |
| 11 | Analog feedback Torque deviation | 10000/100% (Rated torque) |
| 12 | Control mode | 0: Speed control, 1: Position control, 2: Torque control, 3: Analog feedback control |

### ■ Servo trace (word data)

| Traced item name | Output unit |
|---|---|
| Analog feedback command torque | 10000/100% (Rated torque) |
| Analog feedback detection torque | 10000/100% (Rated torque) |
| Analog feedback output torque | 10000/100% (Rated torque) |
| Analog feedback torque deviation | 10000/100% (Rated torque) |
| Control mode monitor | 0: Speed control, 1: Position control, 2: Torque control, 3: Analog feedback control |

### ■ Servo trace (bit data)

| Traced item name | Description |
|---|---|
| Analog feedback control switching monitor 0 (/AFB0) | 0: Position/speed control, 1: Torque/analog feedback control |
| Analog feedback control switching monitor 1 (/AFB1) | 0: Position/speed/torque control, 1: Analog feedback control |

**MEMO**

# 12

# SV2 SERIES SETTING SOFTWARE

This chapter describes SV2 series setting software.

# 12-1 SV2 series setting software Overview

This section describes information such as the operating environment, system configuration, features, and functions of “SV2 series setting software”.
Be sure to read this section before you start to use the product.

## Operating Environment and System Configuration

The following environment is required to operate SV2 series setting software.
Make sure that the system you are using meets the following conditions and is equipped with the required devices.

**Supported PC**

A PC installed with Windows 10, Windows 8, Windows 7, Windows Vista, or Windows XP and equipped with USB interface.

**CPU**

Windows 10/8/7/Vista:
A processor recommended by Microsoft Corporation
Windows XP:
Pentium 800 MHz or more
(Pentium 1 GHz or more recommended)

**Memory capacity**

Windows 10/8/7/Vista: Memory capacity recommended by Microsoft Corporation
Windows XP: Expanded memory 256 MB or more
(512 MB or more recommended)

**Applicable OS**

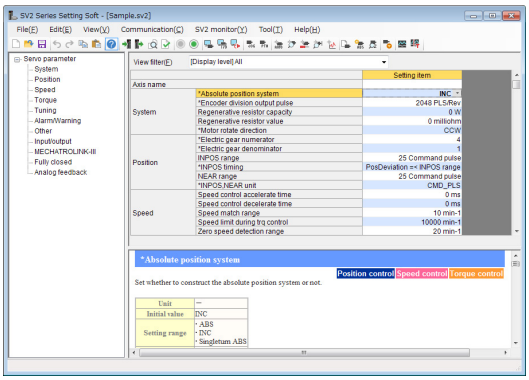
- Windows 10 / Windows 8 (including 8.1) / Windows 7 / Windows Vista (SP2 or later) / Windows XP (SP3 or later, excluding 64-bit versions)

**Free space available on hard disk**

100MB or more


## What is SV2 series setting software

The SV2 series setting software is the software which can connect the computer to the servo amplifier, and enables the SV2 series setting, monitoring and trial run. It is used when connecting to the MECHATROLINK-III corresponding controller except KV-XH16ML/XH04ML.



**Point**

**When using by connecting the SV2 series and KV-XH16ML/XH04ML, please transfer the setting data in the status that the SV2 series and KV-XH16ML/XH04ML communication is established. If the setting data is transferred in the status that the communication is not established, it is overwritten by the KV-XH16ML/XH04ML internal data at the timing that the communication to the KV-XH16ML/XH04ML is established.**

**Reference**

The setting data (*.sv2) created by the SV2 series setting software can be imported and used in KV-XH setting tool. For the operation method according to KV-XH setting tool, please refer to the following manual.
“KV-XH16ML/XH04ML User Manual”

## ■ Function of the SV2 series setting software

There are the following functions in the SV2 series setting software.

- **Creation and forward of SV2 independent setting data (*.sv2)**

Set the servo parameter and it can be transferred to the servo amplifier.

- **Monitor**

The operating status of the current position, input/output and the alarm can be monitored.
Hence, the data can also be monitored by the wave pattern using the servo trace function.

- **Trial run**

The operating in the independent SV2 series can be confirmed by the servo jog running/pattern running.

- **Tuning**

Many tuning functions such as auto-tuning, gain-search PRO. and gain-tuning PRO can be executed.

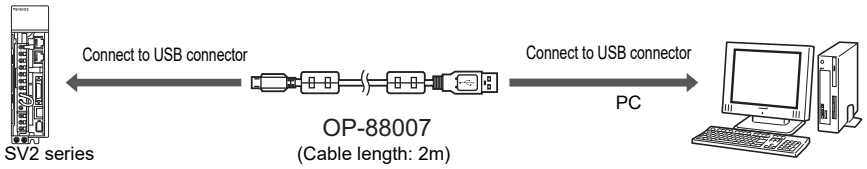
# Connection of Servo Amplifier

When setting parameters of SV2 Series Setting Software, using monitoring function for status inspection, SV2 series servo amplifier should be connected directly with USB port.

**Point** **When SV2 series are connected to PC for the first time, the USB driver must be installed on the PC in advance. (Generally, installation of SV2 Series Setting Software could be performed automatically.)**

## ■ Connecting to USB Port

Model of connecting cable: OP-88007




**Point** **Please use the dedicated cable (OP-88007). Otherwise, it will not function correctly.**

# 12-2 Installing Software/USB Driver

This section describes the installation of SV2 Series Setting Software and USB driver.

## Installing SV2 Series Setting Software

The following briefly describes how to install SV2 Series Setting Software on the hard disk of PC. Check the followings before you start to install it.

### ■ Free Space Available on Hard Disk

SV2 Series Setting Software can be installed on hard disk with at least 100 M bytes of free space. If there is not enough free space, clean up the hard disk.

### ■ Windows Environment and Installation Directory

SV2 Series Setting Software should be installed and operate on Windows.
Make sure that Windows 10/8/7/Vista/XP OS are installed and operating normally on the PC when you are using.

### ■ USB Port

When PC transfers parameters to SV2 series via USB port, USB port on the PC must be enabled when Monitor starts up. For details on how to setting, see the manual for the PC you are using.

## Precautions in Windows XP

### ■ Access Rights

To install SV2 Series Setting Software in default folder (C:\Program files\Keyence\SV2S\), please assign access rights as follows.

- For users of SV2 Series Setting Software, please assign "Power User" rights or higher.

## Precautions in Windows Vista

### ■ Access Rights

To install SV2 Series Setting Software in default folder (C:\Program files\Keyence\SV2S\), please assign access rights as follows.

- For users of SV2 Series Setting Software, please assign "Standard User" rights or higher.

## Installation

We will take following drive configuration as an example to describe how to install software on a PC. C: Hard drive

**1 Start Windows, and you can download the “SV2 series setting software” from our company's homepage "http://www.keyence.com.sg".**

**2 Double click the downloaded installer "Setup.exe" file to execute it.**

- The PC will start the installation program.
- Please install the software following the prompts.

Point **When installing in Windows Vista/XP, only the user with "Administrator" rights or higher can log in.**

## Uninstalling SV2 Series Setting Software

When SV2 Series Setting Software not used, it can be uninstalled.
Please use "Add/Delete applications" for uninstalling SV2 Series Setting Software through Windows control panel.

Point **When uninstalling from Windows Vista/XP, only the user with "Administrator" rights can log in.**

## Installing USB Driver

When connecting SV2 series with a PC, USB driver must be installed.
When installing SV2 Series Setting Software, USB driver can be automatically installed.

# 12-3 Precautions

This section describes the precautions to follow when using SV2 Series Setting Software.
Be sure to read carefully.

**Check PC setting**

Please check whether USB port is enabled or not before use.
If not set, error will occurs in communication during Monitor operation, and the Monitor cannot function correctly.
For details on how to setting, see the manual for the PC you are using.

**When in monitoring operation...**

When operating monitor, communication malfunction will occur if SV2 series is powered OFF or the connecting cable is pulled out. This abnormal operation is not allowed before exiting Monitor.

**Display resolution**

Please set the display resolution to 1024 X 768 pixels, High Color (16 bits) above and small fonts. Also, it will be comfortable to operate if setting a higher resolution. (1280 X 1024 pixels or higher recommended)

**Precautions when using USB**

For USB connection, it is allowed to directly connect with USB port on the PC without connecting via a USB hub.
Communication may be interrupted if electrical noise causes unstable communication.
If so, please re-insert the USB cable. If serious electrical noise causes unstable communication, please wrap the cable with electromagnetic shielding.

# 12-4 Basic Operation

This section describes common operation methods and screens of SV2 Series Setting Software, such as starting method, edit operation etc., as well as relevant matters to be understood before use.

## How to Start

The following describes how to start and exit software, and how to create a new file, read or save files.

### How to Start SV2 Series Setting Software

To start SV Series Setting Software.

**1 Select [Program] ▶ [SV2 Series Setting Software] ▶ [SV2 Series Setting Software] from [Start] menu in Windows.**

SV2 Series Setting Software starts up.

Please operate according to the following descriptions.

**When creating new setting data**

"New", page 12-11

**When opening existent setting data**

"Open Setting Data", page 12-11

**When reading setting data from servo amplifier**

"Read Unit", page 12-15

### Exit

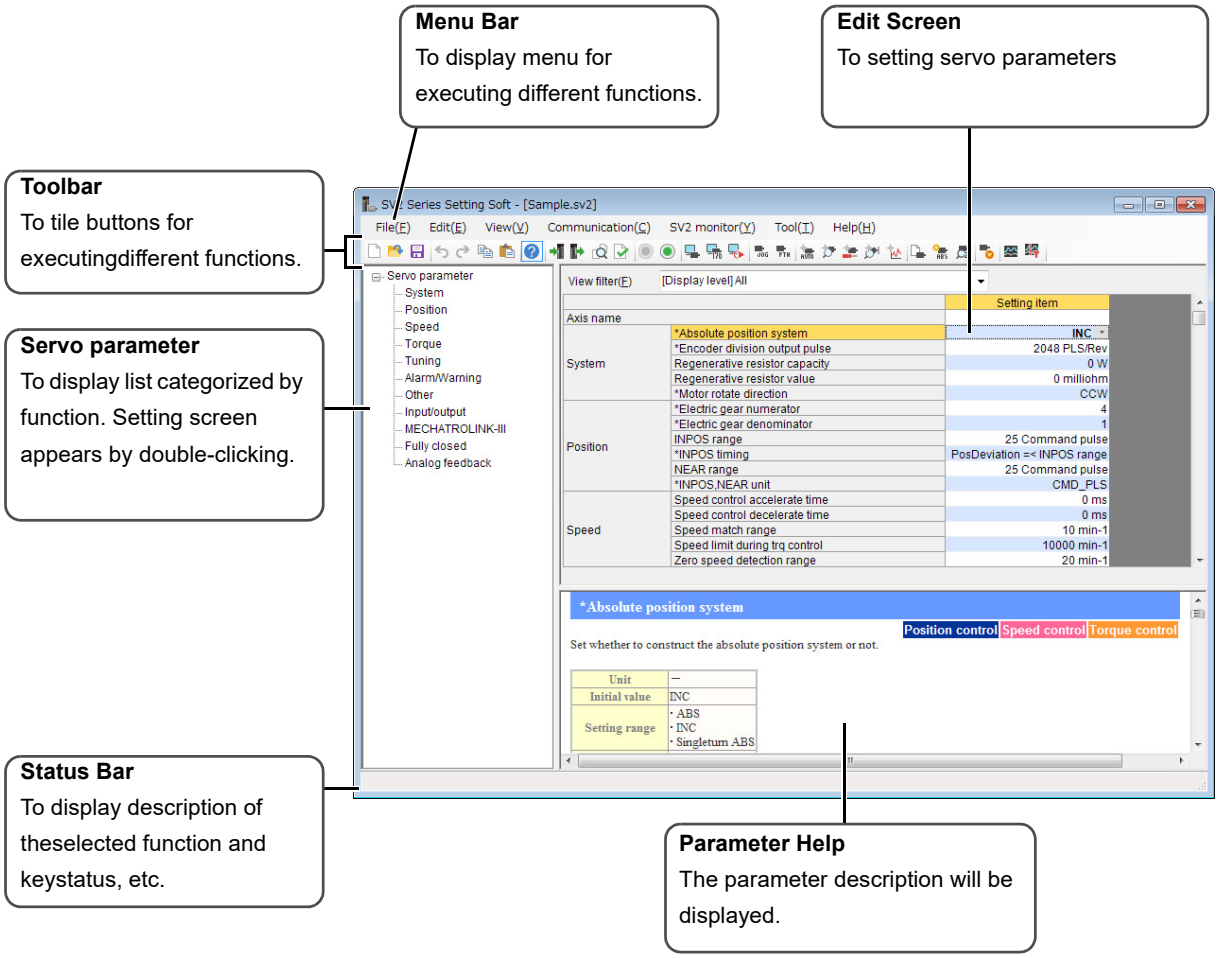
File(F) ▶ Exit(X) Alt + F4

**1 Select [File(F)] ▶ [Exit(X)] from the menu of SV2 Series Setting Software.**

Other procedures ✕ on the right end of the title bar of SV2 Series Setting Software to exit.

## Names and Functions of Components of Screen

The screen components of SV2 Series Setting Software is shown below.



## ■ Changing Column Width

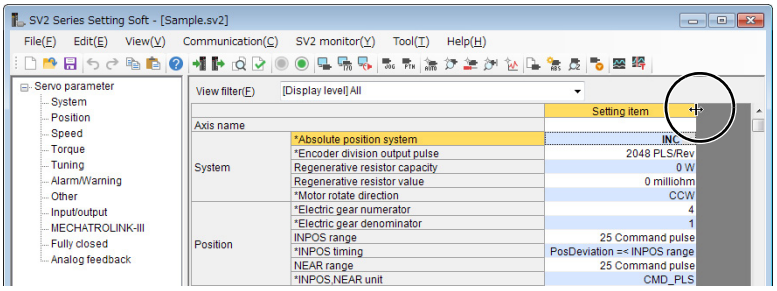
Column width/row height of a table cell can be changed freely. If comments can't be displayed in full, a larger column width will be helpful.

Column width/row height of a cell can be modified by using mouse on screen.

### ● Changing column width

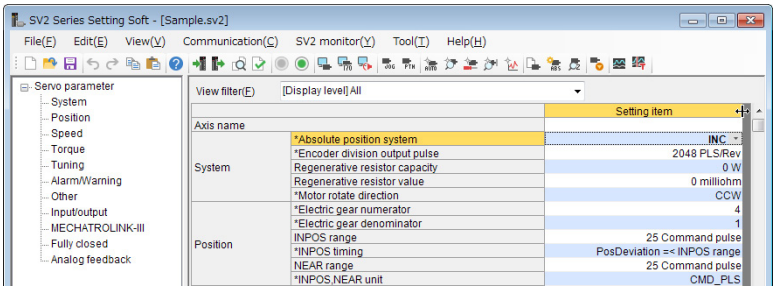
**1 Move the cursor to the grey sideline of the column that you want to change width.**

The cursor will become to ⇹.




**2 Drag the grid to both sides to the expected effect and release the mouse button.**

The column width is changed.



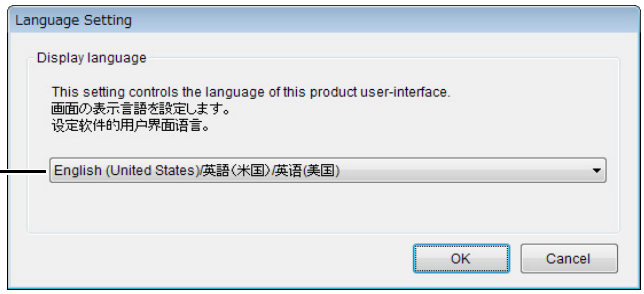

# Language setting

In the “SV2 series setting software”, the language can be used among Japanese, English and Chinese (simplified).

**1 Select [Tool (T)] ▶ [Language setting (S)] from the “SV2 series setting software” menu.**

The [Language setting] dialogue box is displayed.

Select the display language.




**Point** **The diaplay language switch can only be set in the status that the setting data is closed.**

# Help

SV2 Series Setting Software is attached with PDF manual.

If you don't understand the operation, you can select from the pull-down menu which is displayed by clicking the [Help (H)] from the menu bar.

# 12-5 File Management Overview

## File Structure

SV2 series setting could only be used for servo parameters.
Please use SV2 Series Setting Software for setting up and transferring these parameters.
The format of created file is as follows.

SV2 series setting data file: File name of setting data .sv2

**Point**

**When using by connecting the SV2 series and KV-XH16ML/XH04ML, please transfer the setting data in the status that the SV2 series and KV-XH16ML/XH04ML communication is established. If the setting data is transferred in the status that the communication is not established, it is overwritten by the KV-XH16ML/XH04ML internal data at the timing that the communication to the KV-XH16ML/XH04ML is established.**
**If you don't have KV-XH16ML/XH04ML, when creating the setting data file using "SV2 series setting software", you can use it by importing the SV2 series setting data file (.sv2) to KV-XH setting tool.**
**For the operation of "KV-XH setting tool", please refer to "KV-XH16ML/XH04ML user manual".**

# 12-6 File Menu

This section describes commands about the file operation.

## New

File(F) ▶ New(N)

To create a new setting data file.

**1 Select [File(F)] ▶ [New(N)] from the menu in order.**

Other procedures
- Click " " on the toolbar.
- Press Ctrl + N on the keyboard.

## Open Setting Data

File(F) ▶ Open(O)

To open the saved setting data file.

**1 Select [File(F)] ▶ [Open(O)] from the menu in order.**

"Open" dialogue box appears.

Other procedures
- Click " " on the toolbar.
- Press Ctrl + O on the keyboard.

**2 The choosed open file name in the project folder (directory) with saved readable file.**

## Close Setting Data

File(F) ▶ Close(C)

To close the setting data currently being edited.

**1 Select [File(F)] ▶ [Close(C)] from the menu in order.**

Close the setting data currently being edited.

## Save Setting Data

File(F) ▶ Save(S)

To save the setting data file currently being edited.

**1 Select [File(F)] ▶ [Save(S)] from the menu in order.**

Save the setting data file currently being edited.

Other procedures
- Click " " on the toolbar.
- Press Ctrl + S on the keyboard.

Reference

After newing and reading a setting data file from the servo amplifier, if saving operation is not performed, "Save as" dialogue box appears.

## Save Setting Data As

File(F) ▶ Save as(A)

To save the setting data file currently being edited with a new name.

**1 Select [File(F)] ▶ [Save as(A)] from the menu in order.**

"Save as" dialogue box appears.

**2 Specify the folder (directory) and file name to save the project, click "Save (S)".**

# 12-7 Edit Functions

This section describes commands about the edit functions.

## Undo/Redo

### Undo

Edit(E) ▶ Undo(U)

**1 Select [Edit(E)] ▶ [Undo(U)] from the menu in order.**

To cancel the previous operation to return to the previous status.

Other procedures
- Click " " on the toolbar.
- Press Ctrl + Z on the keyboard.
- Select "Undo(U)" from the right-click menu.

Reference — When it can not be undone, the button and menu item will be displayed in gray and unselectable.

### Redo

Edit(E) ▶ Redo(R)

**1 Select [Edit(E)] ▶ [Redo(R)] from the menu in order.**

To restore the operation canceled with [Undo(U)].

Other procedures
- Click " " on the toolbar.
- Press Ctrl + Y on the keyboard.
- Select "Redo(R)" from the right-click menu.

Reference — When it can not be restored, the button and menu item will be displayed in gray and unselectable.

## Copy/Paste

### Copy

Edit(E) ▶ Copy(C)

**1 Select [Edit(E)] ▶ [Copy(C)] from the menu in order.**

To copy the selected contents.

Other procedures
- Click " " on the toolbar.
- Press Ctrl + C on the keyboard.
- Select "Copy(C)" from the right-click menu.

Reference
- You may also copy several items and columns.
- When it can not be copied, the button and menu item will be displayed in gray and unselectable.

### Paste

Edit(E) ▶ Paste(P)

**1 Select [Edit(E)] ▶ [Paste(P)] from the menu in order.**

To paste the copied contents.

Other procedures
- Click " " on the toolbar.
- Press Ctrl + V on the keyboard.
- Select "Paste(P)" from the right-click menu.

Reference
When it can not be pasted, the button and menu item will be displayed in gray and unselectable.

## Reset settings

**1 In the status that the servo parameter setting items are selected, select the [Setting Initial(I)] from the menu displayed by right clicking.**

Initialize the selected setting items.

Other procedures
Press Del on keyboard.

# 12-8 View Functions

This section describes commands about the view functions.

## Display/hide the parameter help

Display(V) ▶ Parameter(H)

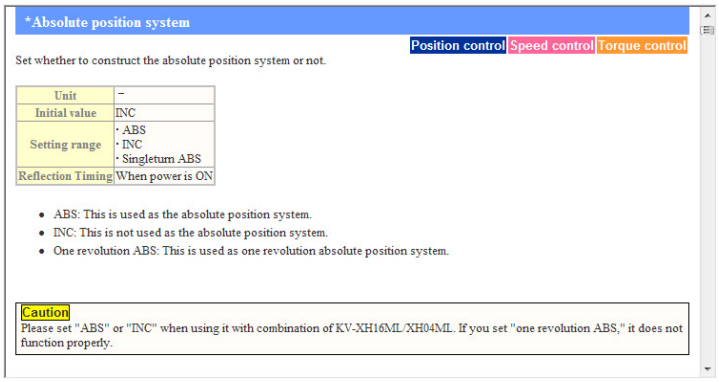
**1 Select [Display(V)] ▶ [Parameter Help(H)] from the menu in order.**

Switch between displaying/hiding parameter help.

Other procedures
- Click " " on the toolbar.
- Press Ctrl + Shift + H on the keyboard.

- **Parameter help**

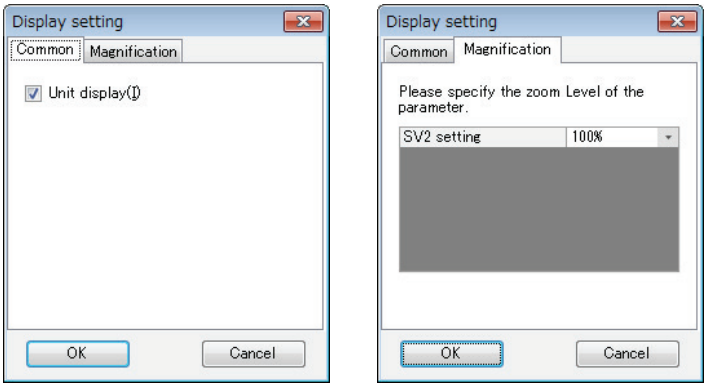
The description of the selected servo parameter is automatically displayed.




## Display setting

**1 Select the [Display Setting(W)] from the menu by right click on the screen.**

The [Display Setting] dialogue box is poped up.




Common ▶ Unit Didplay: Switch between displaying/hiding the unit in each setting item of the edition screen.
Magnification ▶ SV2 setting: The character size on the editing screen is set by 50 to 300%. (Initial value:100%)

# 12-9 Communication Functions

This section describes commands about the communication functions.

## Write Unit

Communication(C) ▶ Write unit(W)

To write setting data to SV2 series servo amplifier.

**1 Select [Communication(C)] ▶ [Write unit(W)] from the menu in order.**

Other procedures
- Click " " on the toolbar.
- Press F7 on the keyboard.

Point

- **When using by connecting the SV2 series and KV-XH16ML/XH04ML, please transfer the setting data in the status that the SV2 series and KV-XH16ML/XH04ML communication is established.**
- **If the setting data is transferred in the status that the communication is not established, it is overwritten by the KV-XH16ML/XH04ML internal data at the timing that the communication to the KV-XH16ML/XH04ML is established.**
- **If you want to connect the SV2 series to the computer, it is necessary to install a USB driver in the computer.**
- **When importing the <SV2 series setting software>, the USB driver is automatically installed.**

## Read Unit

Communication(C) ▶ Read unit(R)

To read setting data of SV2 series servo amplifier.

**1 Select [Communication(C)] ▶ [Read unit(R)] from the menu in order.**

Other procedures
- Click " " on the toolbar.
- Press F8 on the keyboard.

## Unit Verification

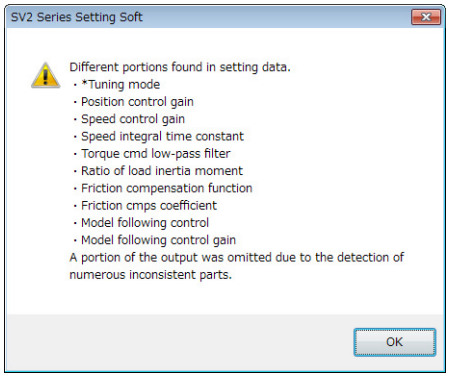
Communication(C) ▶ Unit verification(V)

Verify the “SV2 series” servo amplifier internal data and “SV2 series setting software” setting data.

**1 Select in menu one by one [Communication(C)] ▶ [Unit verification(V)] from the menu in order.**

Other procedures Click " " on the toolbar.

If the different contents is in the verification result, the corresponding setting item is displayed.




## Data Verification

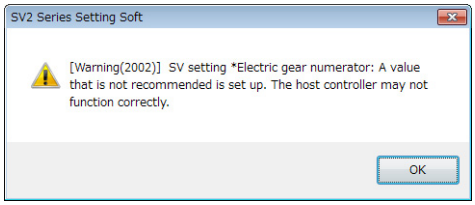
Communication(C) ▶ Data verification(X)

To verify consistency of the setting data.

**1 Select [Communication(C)] ▶ [Data verification(X)] from the menu in order.**

Other procedures
- Click " " on the toolbar.
- Press F6 on the keyboard.

If any problems about the setting data exist, the corresponding contents will be displayed.



This section describes commands about the monitors functions.

## Start/End Monitor

Set to the monitor status for updating the information of the monitor's each function. If the monitor is started successfully, "In monitoring" will be displayed in the status bar.

### Start Monitor

SV2 Monitor(Y) ▶ Start monitor(S)

**1 Select [SV2 Monitor(Y)] ▶ [Start monitor(S)] from the menu in order.**

Start monitor.

Other procedures
- Click " " (green) on the toolbar.
- Press F5 on the keyboard.

### Stop Monitor

SV2 Monitor(Y) ▶ Stop monitor(T)

**1 Select [SV Monitor(Y)] ▶ [Stop monitor(T)] from the menu in order.**

Stop monitor.

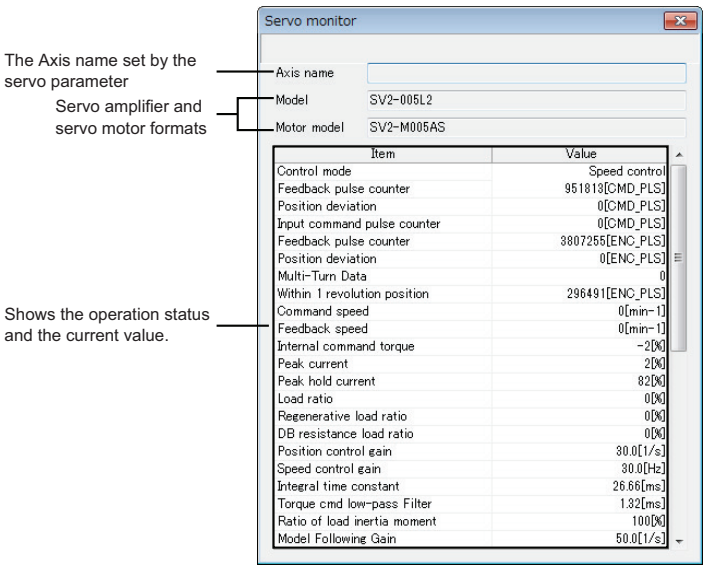
Other procedures
- Click " " (red) on the toolbar.
- Press Shift + F5 on the keyboard.

## Servo Monitor

SV2 Monitor(Y) ▶ Servo Monitor(V) ▶ Servo Monitor(V)

Other procedures
- Click " " on the toolbar.

You can monitor the operation status and internal data.

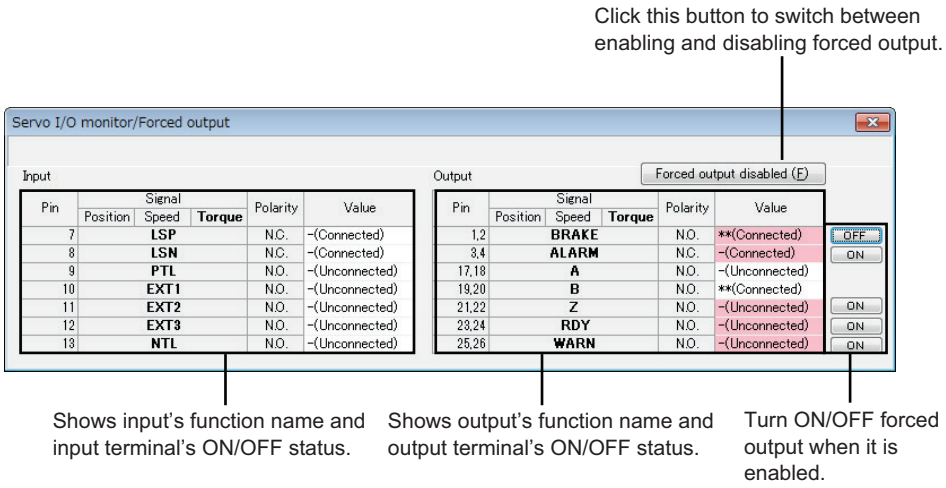


## Servo I/O Monitor (Forced Output)

SV2 Monitor(Y) ▶ Servo Monitor(V) ▶ Servo I/O Monitor(I)

Other procedures • Click " " on the toolbar.

You can monitor the I/O status.
By forcing (ON/OFF) the output terminal, you can check the output operation.

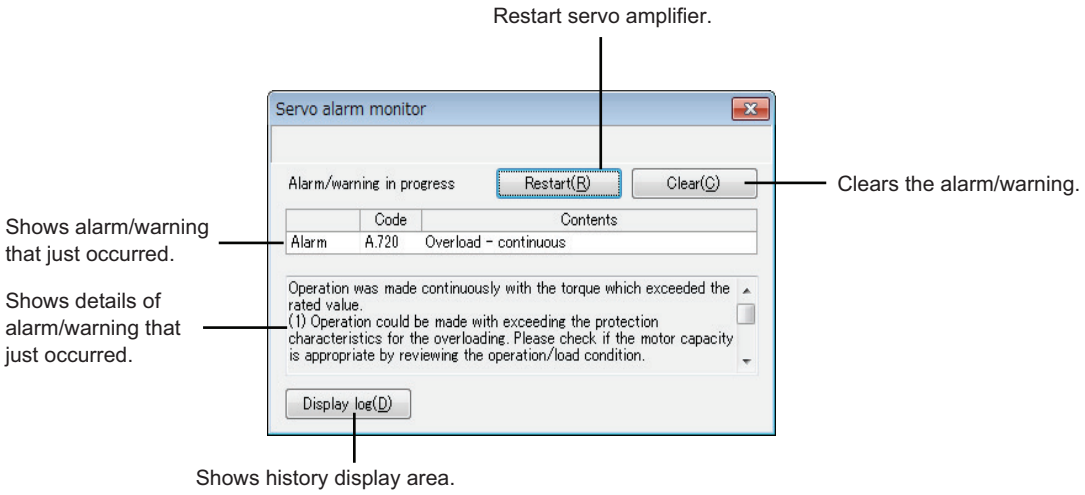



## Servo Alarm Monitor

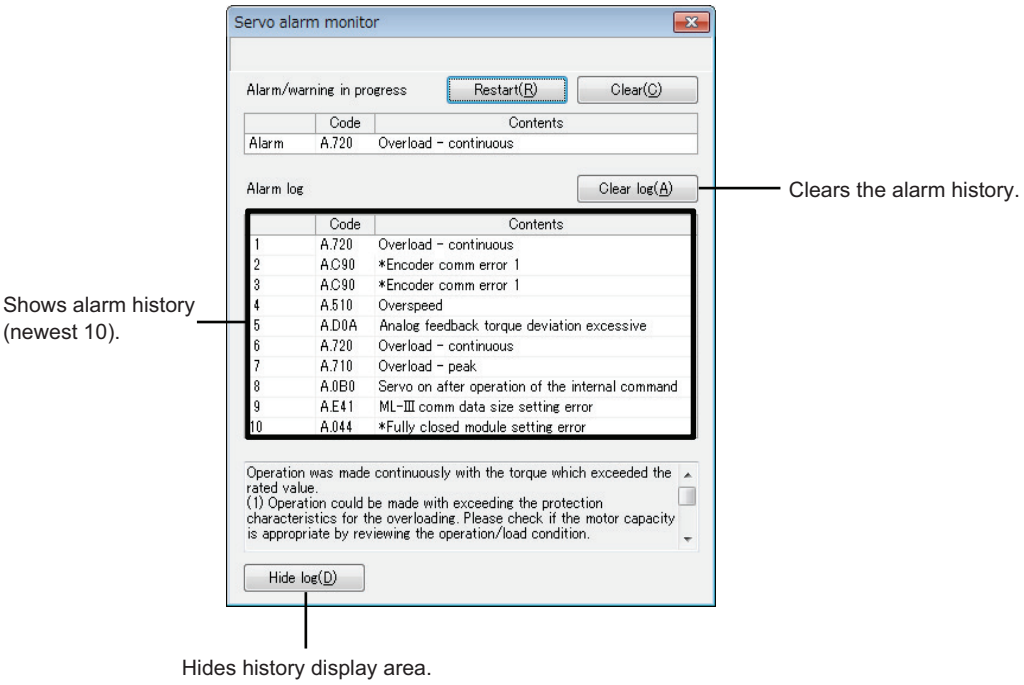
SV2 Monitor(Y) ▶ Servo Monitor(V) ▶ Servo Alarm Monitor(A)

Other procedures • Click " " on the toolbar.

You can monitor the alarm status.



- **Display history**



# 12-11 Servo Trial Run

This section describes commands about the Trial Run functions.

## Servo JOG Operation

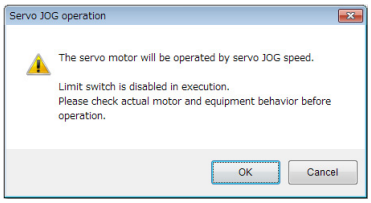
SV2 Monitor(Y) ▶ Servo trial run(C) ▶ Servo JOG operation(J)

The function that the JOG operation is executed in the single “SV2 series”.

**1 Select [SV Monitor(Y)] ▶ [Servo trial run(C)] ▶ [Servo JOG operation(J)] from the menu in order.**

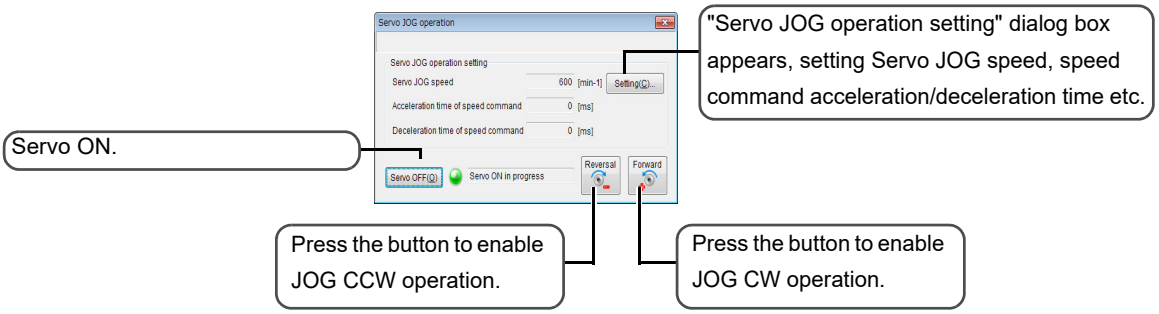
Other procedures • Click " " on the toolbar.

The dialog box on the right confirmation.



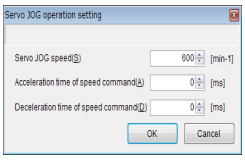

**Point** **When servo is ON, it cannot be used.**

"Servo JOG operation" dialog box appears.




**"Servo JOG operation setting" dialog box.**

For setting Servo JOG speed, speed command acceleration/deceleration time etc.




| NOTICE | **Please perfom Servo JOG operation on the basis of ensuring safe operating conditions.** |
|---|---|

Reference In "Servo JOG operation setting dialogue", if you change the operation condition, the change contents will be reflected in the following servo parameters.

- "Servo JOG speed" (OTH_04)
- "Speed command acceleration time" (VEL_01)
- "Speed command deceleration time" (VEL_02)

## Pattern Operation

SV2 Monitor(Y) ▶ Servo trial run(C) ▶ Pattern operation(P)

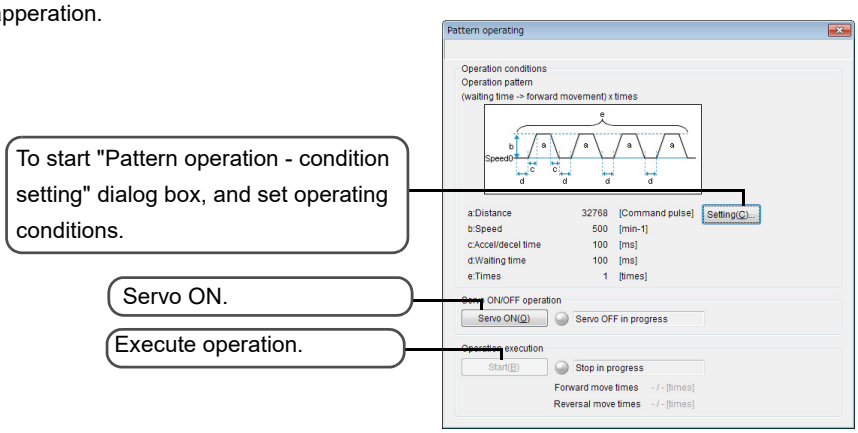
Only SV2 series can execute simple pattern operation function.

**1 Select [SV Monitor(Y)] ▶ [Servo trial run(C)] ▶ [Pattern operation(P)] from the menu in order.**

Other procedures • Click " " on the toolbar.

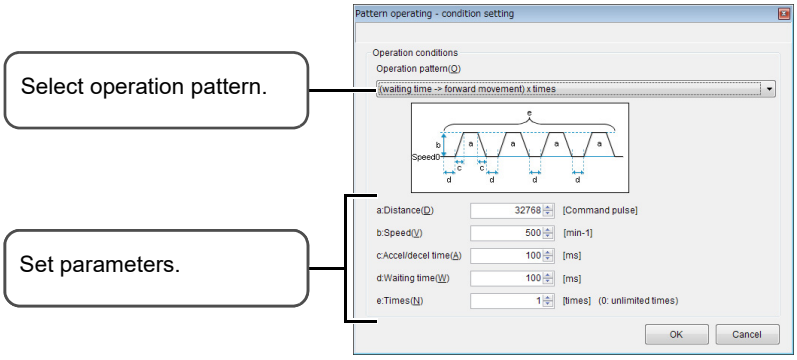
**Point** **When servo is ON, it cannot be used.**

"Pattern operation" dialog box apperation.




**"Pattern operation-Condition settings" dialog box.**

To setting operation conditions.




| *NOTICE* | **Please execute pattern operation on the basis of ensuring safe operating conditions.** |
|---|---|

Reference In "Pattern operation - condition setting" dialogue, if you change the operation condition, the change contents will be reflected in the following servo parameters.

- "Pattern operation" (OTH_05)
- "Pattern operation movement distance" (OTH_06)
- "Pattern operation speed" (OTH_07)
- "Pattern operation deceleration time" (OTH_08)
- "Pattern operation waiting time" (OTH_09)
- "Pattern operation movement times" (OTH_10)

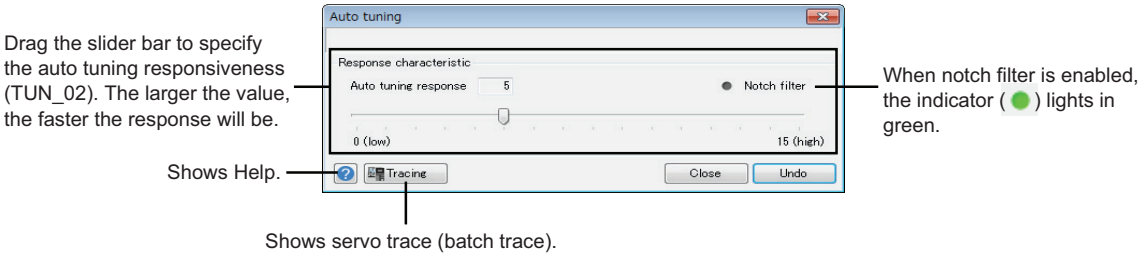
The tuning function is described.
Auto tuning, gain search PRO, gain tuning PRO, estimation of ratio of inertia moment and mechanical analyzer can only be executed in the monitoring status.

## Auto Tuning

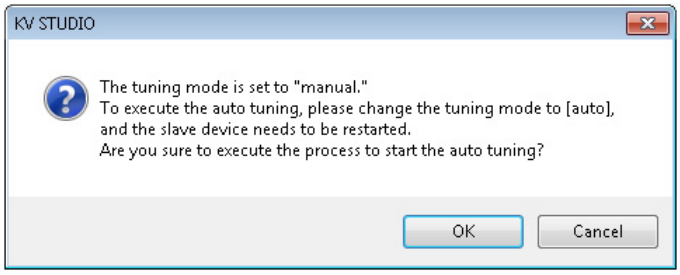
SV2 Monitor(Y) ▶ Tuning(N) ▶ Auto Tuning(A)

Other procedures • Click " " on the toolbar.

**1 When "*tuning mode" (TUN_01) is "1: Auto tuning", specify the auto tuning responsiveness.**




Reference Auto tuning cannot be executed when SV2 series ser is running in the manual tuning mode.
If you perform auto tuning when the "*tuning mode" (TUN_01) of SV2 series is setted to "0: Manual tuning", the following dialog box appears.




Clicking the "OK" button changes the "*tuning mode" (TUN_01) to "1: auto tuning", and then it starts in auto tuning mode.
Clicking the "Cancel" button cancels the operation to start in auto tuning mode (keep the "*tuning mode" (TUN_01) as "0: Manual tuning").

Reference For the details about the auto tuning, please refer to "7-2 Auto-tuning", page 7-6.

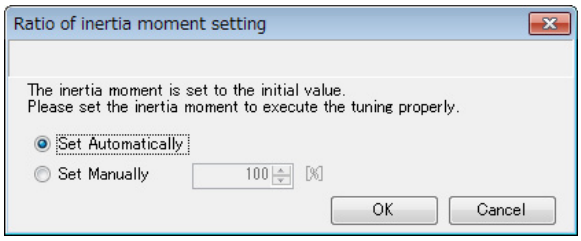
## Gain Search PRO

SV2 Monitor(Y) ▶ Tuning(N) ▶ Gain Search PRO(S)

Other procedures • Click " " on the toolbar.

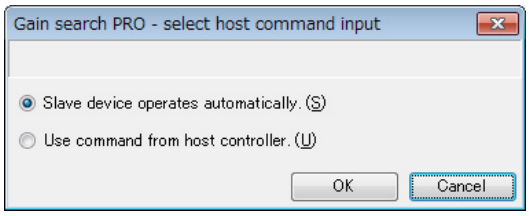
Use the specified condition to perform gain search and servo tuning.

**1 If "Loading inertia moment ratio" (TUN_08) is set to its default (100%), then display the "Ratio of inertia moment setting" dialog box.**

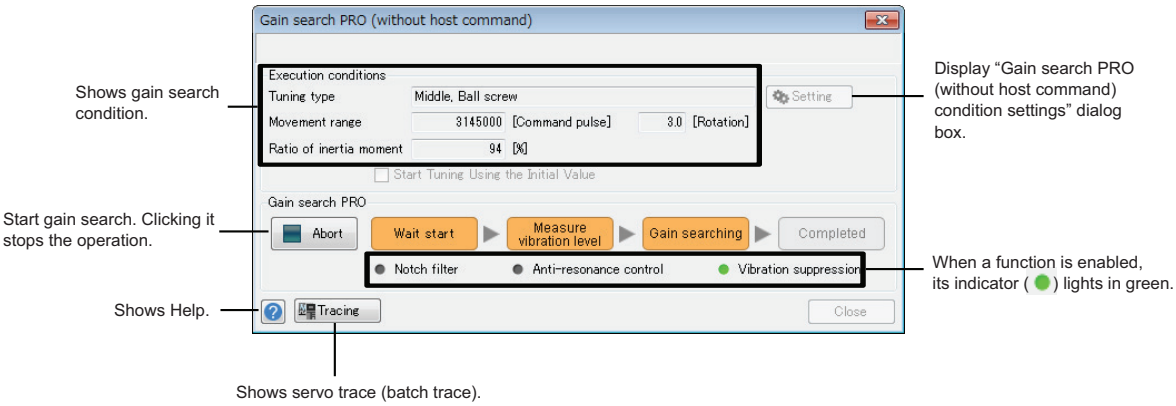



- Select "Auto Setting" and click the "OK" button. The "Ratio of inertia moment estimation" dialog box appears and the Ratio of inertia moment estimation is executed.
  When estimation of ratio of inertia moment is executed and servo amplifier restarts, "Gain search PRO - select host command input" dialog box appears.
- If you have selected "Manual Setting", enter ratio of inertia moment and click the "OK" button. The "Gain search PRO - select host command input" dialog box appears.

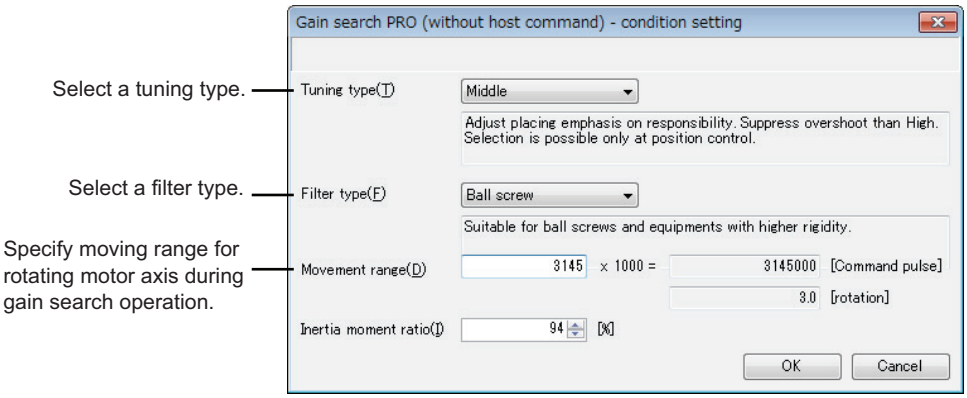
**2 Select either "Auto run slave apparatus" or "Use command from host controller". Then, click the "OK" button.**



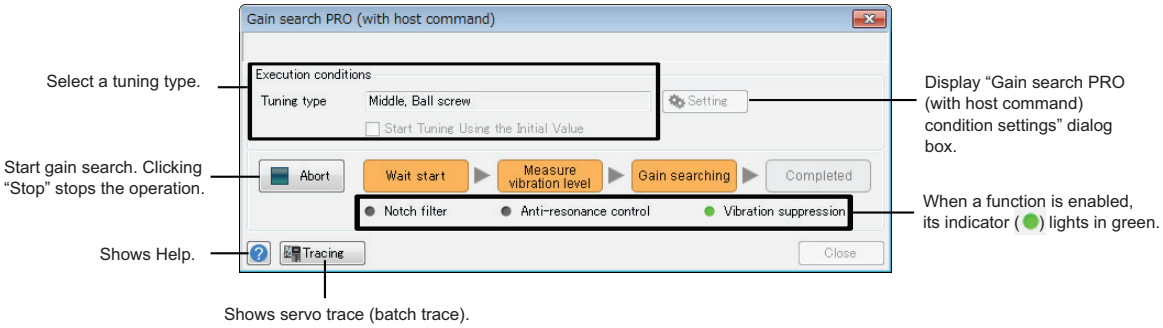

### ● If auto run slave apparatus is used



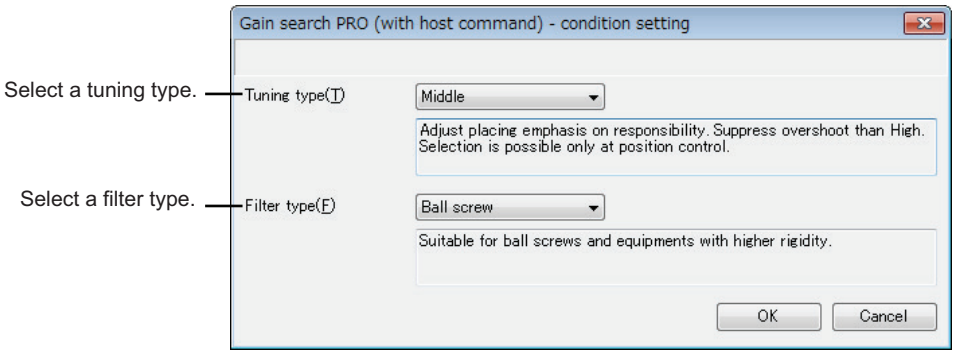
"Gain search PRO (without host command) condition settings" dialog box




- **If host controller instruction is used**

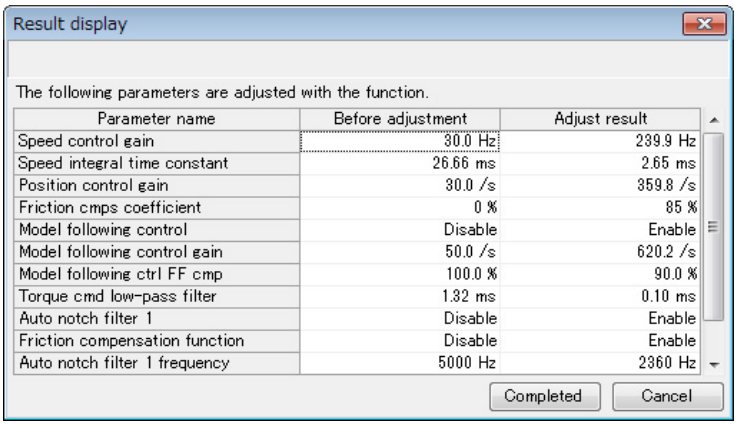



"Gain search PRO (with host command) condition settings" dialog box




**3 After gain search starts, if "Auto run servo amplifier" is selected, then auto run is executed within the moving range. If "Host controller instruction is used" is selected, enter instruction from the host controller and operate the servo until gain search is finished.**

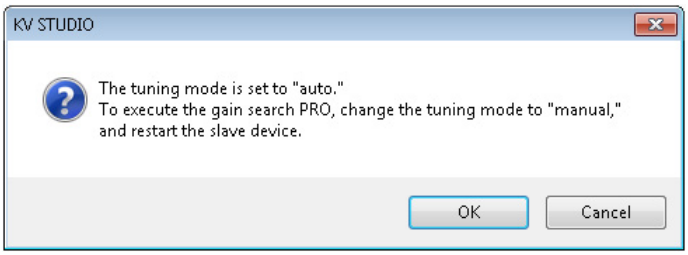
**4 When gain search is finished, the "Display result" dialog box appears.**




The gain search PRO execution result, adjusted parameter name, as well as the value before and after adjustment appear.

| | |
|---|---|
| *NOTICE* | Check that the operating environment is safe and then perform gain search PRO. |

Reference Gain search PRO cannot run when SV2 series is running in the auto tuning mode.
If you perform gain search PRO when the "*tuning mode" (TUN_01) of SV2 series is setted to "1: auto tuning", the following dialog box appears.




Clicking the "OK" button changes "*tuning mode" (TUN_01) to "0: Manual tuning", and then starts gain search PRO.
Clicking the "Cancel" button cancels the operation to start gain search PRO (keep the "*tuning mode" (TUN_01) as "1: Auto tuning").

Reference For the details about the gain search PRO, please refer to "7-4 Gain search PRO", page 7-14.

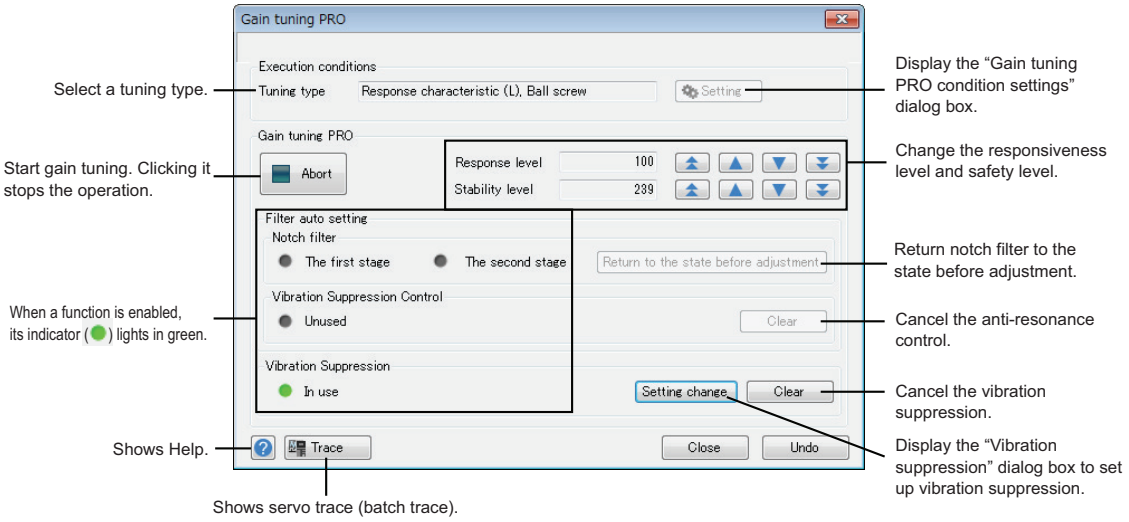
# Gain Tuning PRO

SV2 Monitor(Y) ▶ Tuning(N) ▶ Gain Tuning PRO(T)

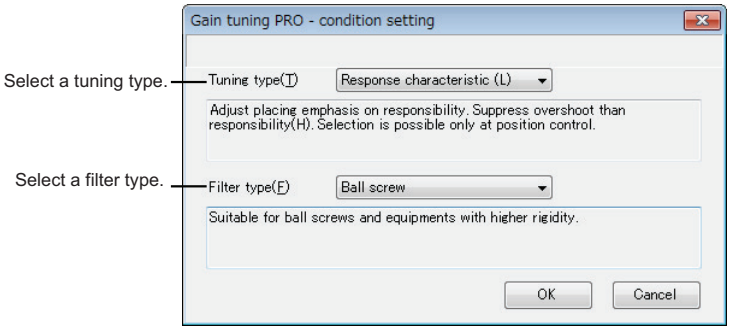
Other procedures • Click " " on the toolbar.

Finely adjust the responsiveness level and safety level to perform servo tuning.

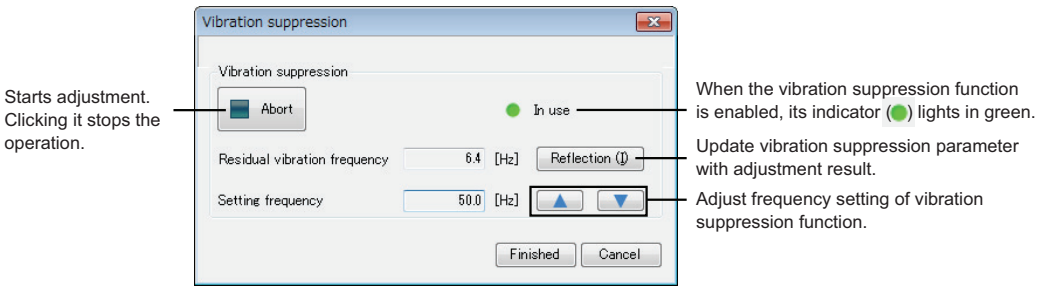
## 1 The "Gain tuning PRO" dialog box appears.




"Gain tuning PRO condition setting" dialog box

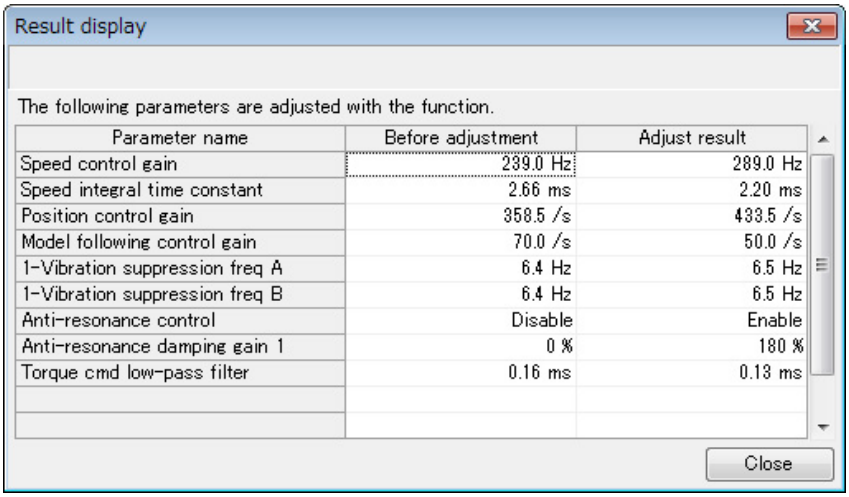



Vibration suppression dialog box



**2 After gain tuning starts, while performing the operation, adjust the responsiveness level and safety level. Then check the operation.**

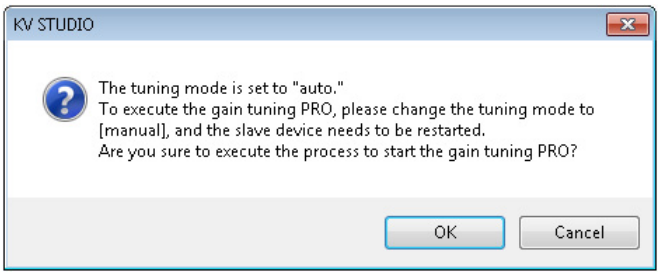
**When adjustment is completed, click "Close" button to display "Result display" dialog box.**




The gain tuning PRO execution result, adjusted parameter name, as well as the value before and after adjustment appear.

| | |
|---|---|
| *NOTICE* | Check that the operating environment is safe and then perform gain tuning PRO. |

Reference Gain tuning PRO cannot run when SV2 series is running in the auto tuning mode.
If you perform gain tuning PRO when the "*tuning mode" (TUN_01) of SV2 series is setted to "1: auto tuning", the following dialog box appears.




Clicking the "OK" button changes "* tuning mode" (TUN_01) to "0: Manual tuning", and then starts gain tuning PRO.
Clicking the "Cancel" button cancels the operation to start gain tuning PRO (keep the "*tuning mode" (TUN_01) as "1: Auto tuning").

Reference For the details about the gain tuning PRO, please refer to "7-5 Gain tuning PRO", page 7-18.

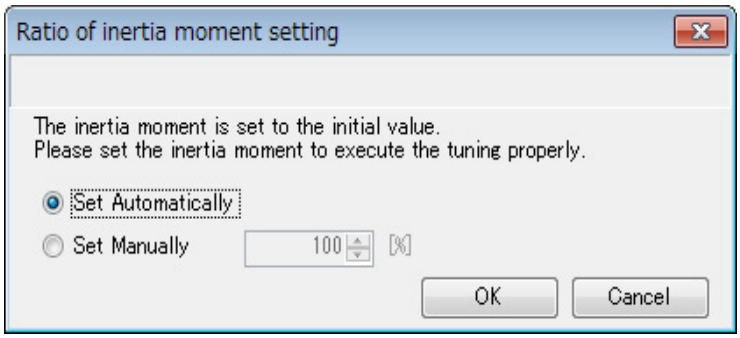
## Estimation of Ratio of Inertia Moment

SV2 Monitor(Y) ▶ Tuning(N) ▶ Estimation of Ratio of Inertia Moment(I)

Other procedures • Click " " on the toolbar.

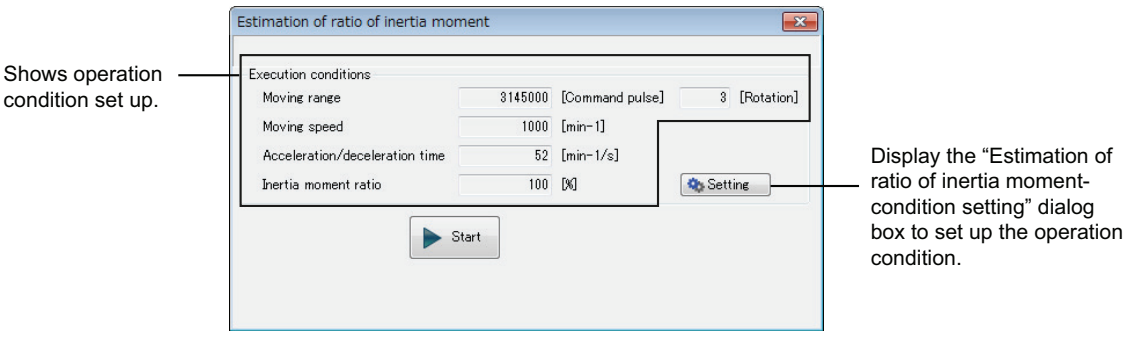
The servo motor operates automatically and ratio of load inertia moment is estimated.

**1 The "Ratio of inertia moment setting" dialog box appears.**

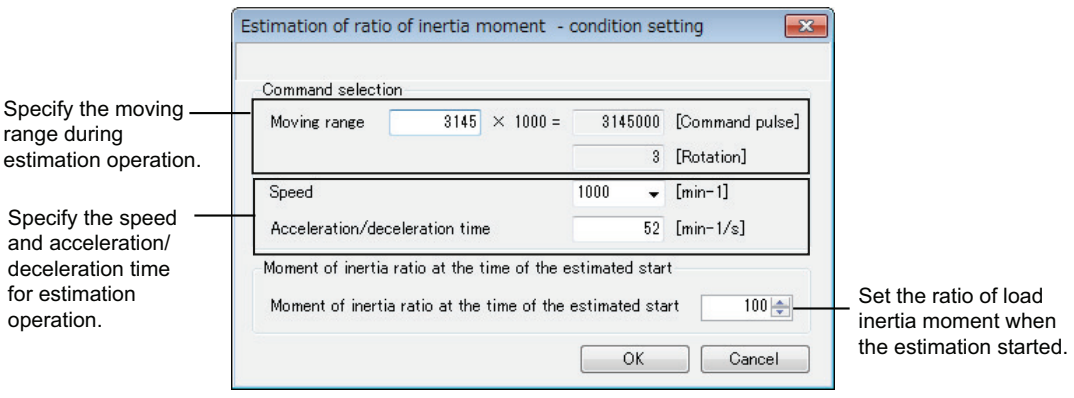



- Select "Auto Setting" and click the "OK" button. The "Ratio of inertia moment estimation" dialog box appears and the Ratio of inertia moment estimation is exeuted.
- If you have selected "Manual Setting", enter ratio of inertia moment and click the "OK" button. The setting value is reflected at "Ratio of load inertia moment" (TUN_08) of servo parameter settings.

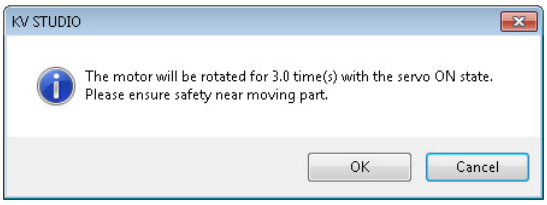
**2 The following dialog box appears. Click the "Start" button.**



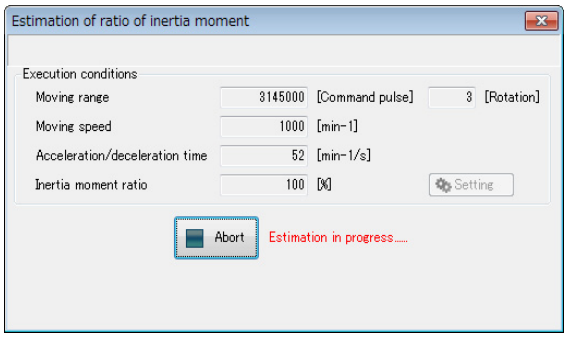

"Estimation of ratio of inertia moment - condition setting" dialog box



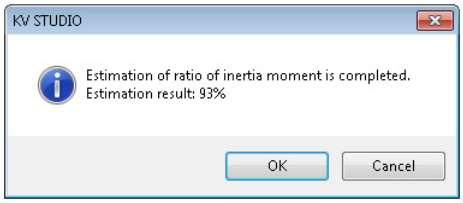
**3** **The following dialog box appears. Check the safety of the surrounding, and then click the "OK" button.**



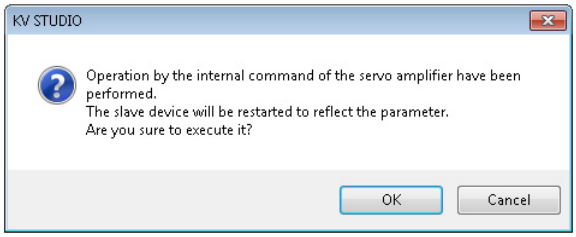

**4** **Auto run starts in the specified moving range.**




**5** **When estimation is finished, the following dialog box appears. "Estimation result" shows ratio of load inertia moment estimated in automatic operation. If you click the "OK" button, the estimated ratio of load inertia moment is reflected in the "loading inertia moment ratio" (TUN_08) of servo parameter.**




**6** **The following dialog box appears. Clicking the "OK" button restarts the slave apparatus. If you click the "Cancel" button, and the slave apparatus does not restart but end.**




| NOTICE | **Check that the operating environment is safe and then perform estimation of ratio of inertia moment.** |
|---|---|

Reference For the details about the inertia moment ratio estimation, please refer to "7-3 Inertia moment proportion estimate", page 7-11.

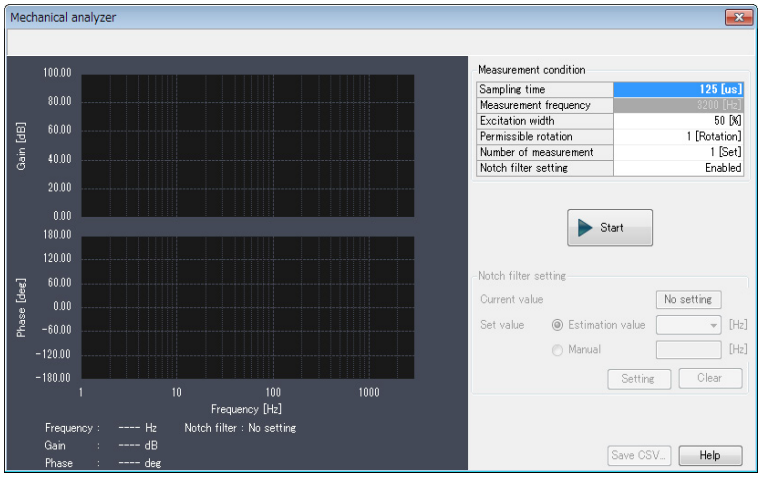
## Mechanical Analyzer

SV2 Monitor(Y) ▶ Tuning(N) ▶ Mechanical Analyzer(M)

Other procedures • Click " " on the toolbar.

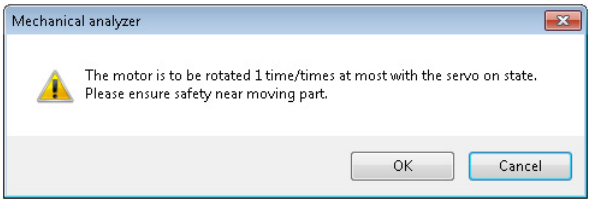
This section describes servo motor to run automatically, then measure/analyze the resonant frequency of the mechanism, and estimate and set up the mechanical analyzer notch filter.

**1 The "Mechanical analyzer" dialog box appears.**

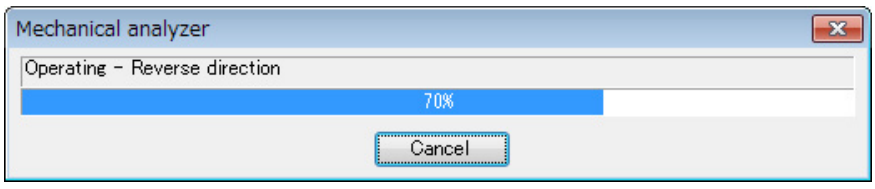



**Point** **The mechanical analyzer can start only when the servo is off. If the higher-level controller etc. has been used to turn the servo on, then turn it off before performing the operation.**

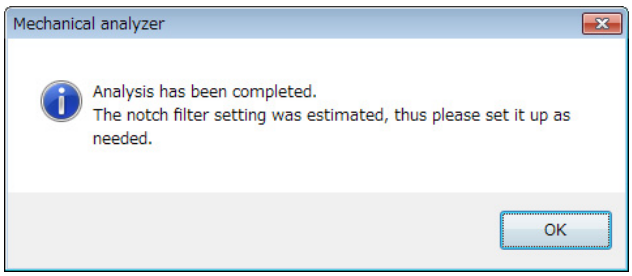
**2 Click the "Start" button. The following dialog box appears.**



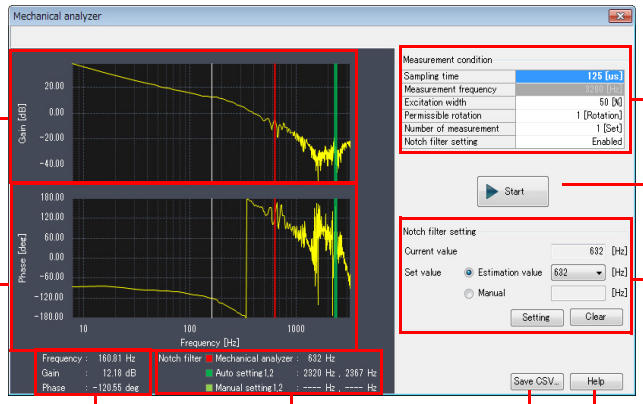

**3 Check the safety of the surrounding, and then click the "OK" button. Auto run starts.**




**4 When estimation is finished, the following dialog box appears. Click the "OK" button.**



## 5 Measurement result appears in the "Mechanical analyzer" dialog box.




Shows frequency - gain characteristics graph.

Shows frequency - phase characteristics graph.

Display and specify measurement condition.

Turn on servo and start mechanical analyzer.

Shows estimated value of notch filter measured by mechanical analyzer. The "mechanical analyzer notch filter frequency" (TUN_28) is reflected.

Shows measured value of the cursor (white line) position.

The setting contents of the configured notch filter is displayed.

Shows Help.

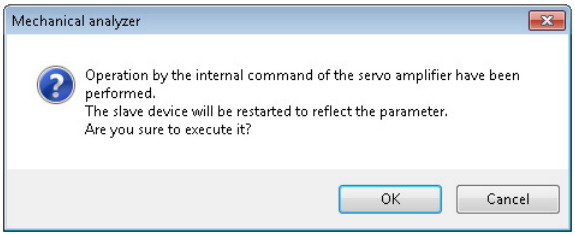
Save measurement to CSV file.

| Item | | Description |
|---|---|---|
| Graph display | White | For checking (shows measured value of cursor position at lower part of graph). |
| | Red | Shows mechanical analyzer notch filter frequency. |
| | Green | Shows automatic notch filter frequency. |
| | Yellow-green | Shows manual notch filter frequency. |
| Measurement condition | Sampling duration | Click the button. From the pull-down menu, select a sampling duration (125 to 2500µs).<br>A short sampling duration allows measurement up to high frequency area. On the contrary, a long sampling duration improves measurement accuracy of low frequency area. |
| | Amplitude | Specify the amplitude, in terms of percentage (1 to 300%) of rated torque, to drive the motor. |
| | Allowable number of rotations | Specify the upper limit (1 to 1000 rotations) of motor during measurement. |
| | Number of measurements | Specify the number of measurements to repeat (1 to 5). If it is set to 2 or more, then the average value is indicated in the measurement result. |
| | Notch filter setting*1 | Click the button. From the pull-down menu, select "Enable" or "Disable.<br>Enable (default): Enable notch filter in measurement operation. (Set it to "Enable" when using the vertical axis in operation.)<br>Disable: Disable notch filter in measurement operation.*2 |
| Start | | Start the motor automatically and take measurement. |
| Notch filter setting | Current value | Shows mechanical analyzer notch filter frequency set up currently. |
| | Setting value | Estimated values: frequency candidates based on notch filter frequencies obtained from measurement result and shown in the pull-down menu. (When you select a frequency from the pull-down menu, the white cursor moves to the position of the selected frequency.)<br>Manual: Manually enter mechanical analyzer notch filter frequency. |
| | [Settings] | If it is set to automatic, then the frequency selected from the pull-down menu is set as “Mechanical analyzer notch filter (TUN_28)” frequency. If it is set to manual, then the specified frequency is used. |
| | [Release] | Set “Mechanical analyzer notch filter” (TUN_23) to "0: Do no use". |
| Save to CSV | | Save measurement result to CSV file. Use this format if you want to use a spreadsheet to view the measurement result. |

*1 By setting the notch filter setting to "Enable", you can check the resonant frequency of mechanism that is not removed even when notch filter is applied. On the other hand, by setting the notch filter setting to "Disable", you can check the resonant frequency of mechanism when notch filter is not applied.

*2 If you perform the operation at the mechanism of vertical axis with the notch filter set to "Disable", falling due to gravity may happen. If you want to use mechanical analyzer at the vertical axis, then first set the notch filter to "Enable".

**6 When you close the "Mechanical analyzer" dialog box, the following dialog box appears. Clicking the "OK" button restarts the slave apparatus. Clicking the "Cancel" button ends the operation without restarting the slave apparatus.**




Reference For the details about the mechanical analyzer, please refer to "7-6 Mechanical analyzer", page 7-21.

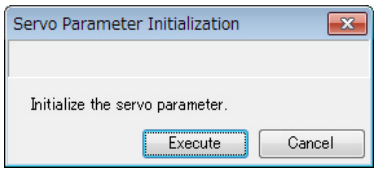
The setting initialization of the servo system etc. is performed.

## Initializing Servo Parameters

SV2 Monitor(Y) ▶ Initialize and adjust(O) ▶ Initializing Servo Parameters(P)

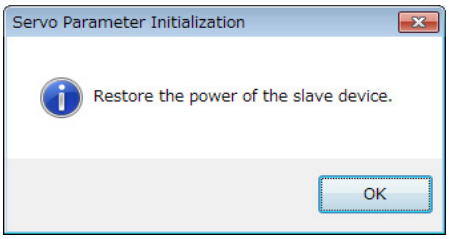
Other procedures • Click " " on the toolbar.

This function returns servo amplifier's parameters to their default values.

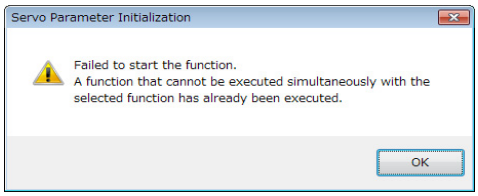



Click the "Execute" button.

If servo parameter initialization succeeds, the message shown on the right appears.
It is necessary to turn off an on servo amplifier.




If servo parameter initialization fails, the message shown on the right appears. If this happens, check the cause of problem described in the message and then try again.



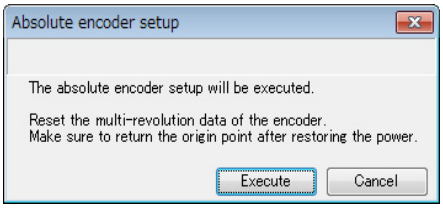

Reference After servo parameter initialization, you cannot turn on the servo.
After initializing servo parameters, be sure to always turn on the servo amplifier again.

## Absolute Encoder Setup

SV2 Monitor(Y) ▶ Initialize and adjust(O) ▶ Absolute Encoder Setup(E)

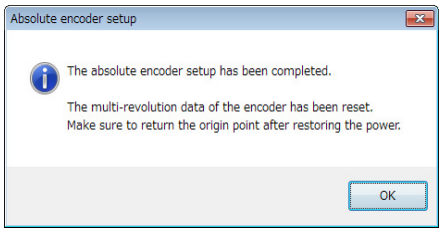
Other procedures • Click " " on the toolbar.

This function resets the current value of servo amplifier's absolute encoder to zero.

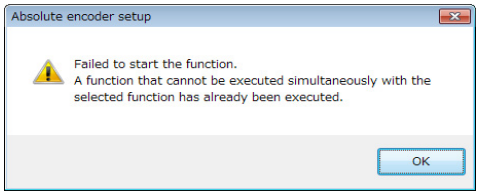



Click the "Execute" button.

If absolute encoder setup succeeds, the message shown on the right appears.
It is necessary to turn off and on servo amplifier.




If absolute encoder setup fails, the message shown on the right appears. If this happens, check the cause of problem described in the message and then try again.




| | |
|---|---|
| *NOTICE* | • **During use, whenever you perform absolute encoder setup, the cumulative number of rotations changes and unexpected device operation may happen. Thoroughly check the operating environment and then perform the operation.**<br>• **After absolute encoder setup is finished, be sure to always turn on the power again, and then perform origin return.** |

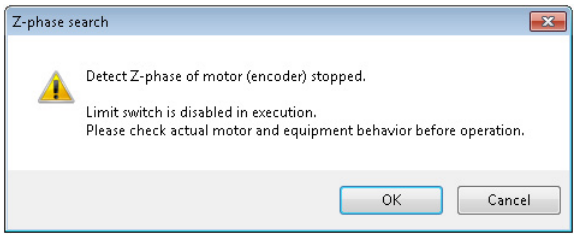
For details on absolute positioning system, refer to "Chapter 9 ABSOLUTE POSITION SYSTEM", page 9-1.

## Z-phase Search

SV2 Monitor(Y) ▶ Initialize and adjust(O) ▶ Z-phase Search(Z)

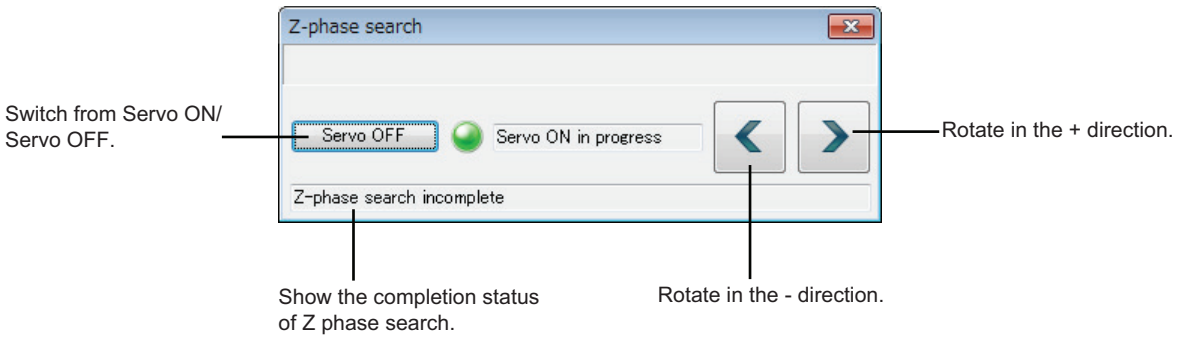
Other procedures • Click " " on the toolbar.

This function moves until the Z-phase of servo motor is found, and then move to the Z-phase.

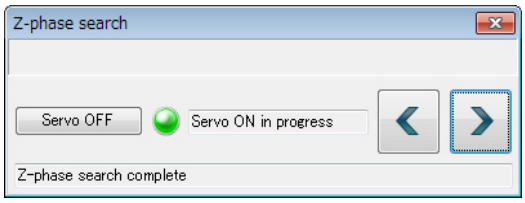



Click the "OK" button.

Reference If the servo is ON, Z-phase search cannot be executed. Turn off the servo and then perform this operation.




Click the "<" or ">" button to rotate the motor.

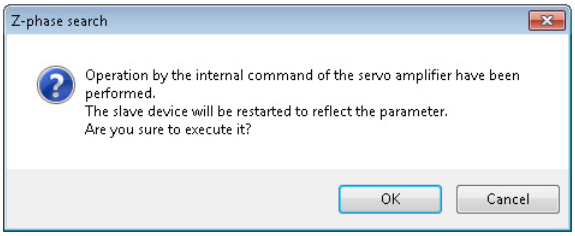



It stops at the position where Z-phase is detected. Then, clicking the "<" or ">" button does not rotate the motor.

| NOTICE | **Check that the operating environment is safe and then perform Z-phase search.** |
|---|---|

Reference Even if the servo is off by the ladder program, it can be turned on from Z-phase search.

When Z-phase search is finished, the following dialog box appears. Clicking the "OK" button restarts the slave apparatus.
Clicking the "Cancel" button ends the operation without restarting the slave apparatus.

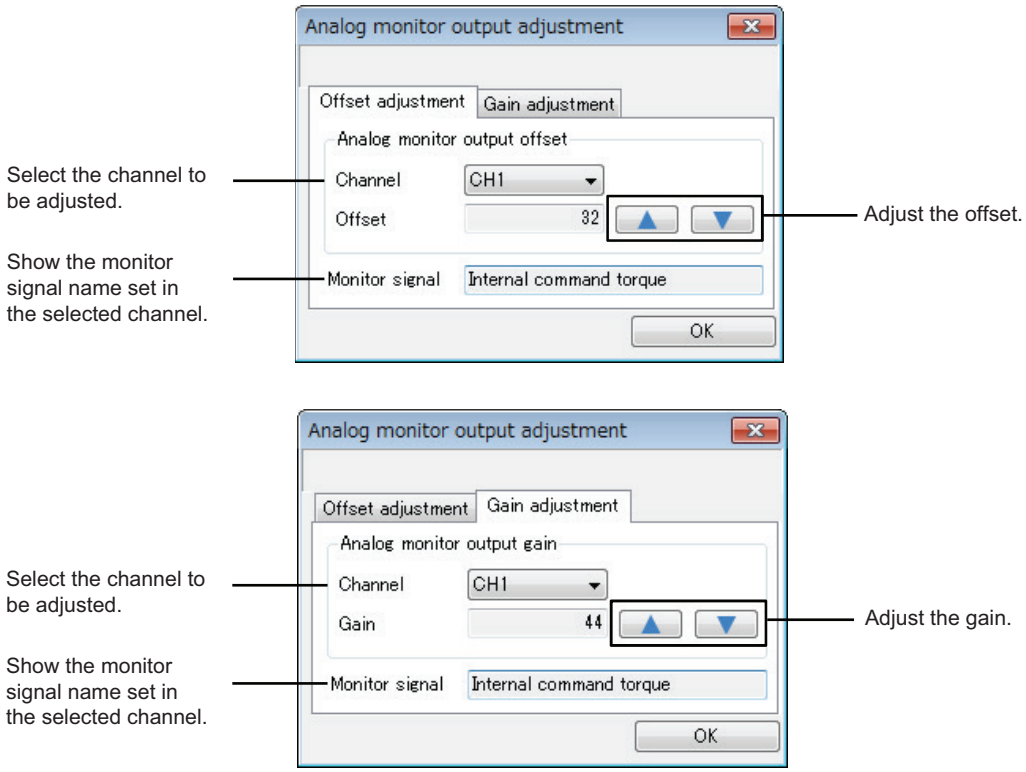


## Analog Monitor Output Adjustment

SV2 Monitor(Y) ▶ Initialize and adjust(O) ▶ Analog Monitor Output Adjustment(O)

This function performs analog monitor output offset and gain adjustment.

"Analog Monitor Output Adjustment" dialog box



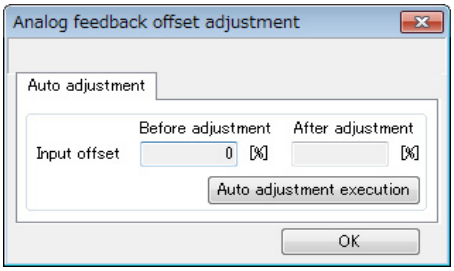

Clicking the "OK" button closes the "Analog Monitor Output Adjustment" dialog box and ends the operation.

## Analog Feedback Offset Adjustment

SV2 Monitor(Y) ▶ Initialize and adjust(O) ▶ Analog Feedback Offset Adjustment(C)

This function automatically adjusts the analog feedback input offset.

"Analog Feedback Offset Adjustment" dialog box




Clicking the "Automatic adjustment" button, perform the analog feedback input offset automatic adjustment, the result will be reflected in the "Analog input offset"(AFB_08).
Clicking the "OK" button closes the "Analog Feedback Offset Adjustment" dialog box and ends the operation.
For the details about the analog feedback control, please refer to "Chapter 11 ANALOG FEEDBACK CONTROL FUNCTIONS", page 11-1.

# 12-14 Slave Apparatus Restart

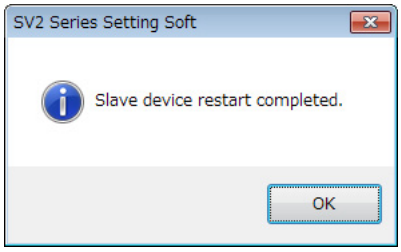
SV2 Monitor(Y) ▶ Slave apparatus restart(E)

Other procedures • Click " " on the toolbar.

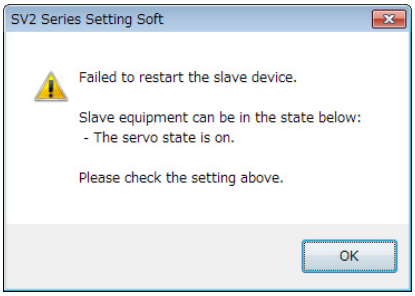
Restart servo amplifier.


Click the "Execute" button.

If restart succeeds, the message shown on the right appears.




If restart fails, the message shown on the right appears. If this happens, check the cause of problem described in the message and then try again.




Reference The software reset is used for the slave machine restart from the SV2 series setting software. If a warning appears, the restart may have failed, so check the reason.

# 12-15 Servo Trace (Real-time/Batch)

SV2 Monitor(Y) ▶ Servo Trace(R) ▶ Real-time trace(R)
SV2 Monitor(Y) ▶ Servo Trace(R) ▶ Batch trace(B)

Other procedures
- Real-time trace : Click " " on the toolbar.
- Batch trace : Click " " on the toolbar.

You can display graphically data.
There are two kinds of the batch trace in the servo trace, which are the real time trace reading out the data from the servo amplifier in each sampling cycle, and in each control cycle, the data is buffered in the servo amplifier, the batch trace reading out the data after the trigger condition is satisfied.

- **Servo trace (real-time)**

  This function performs sampling of data in an operating servo amplifier at real time, and then displays it as graph on the trace screen.

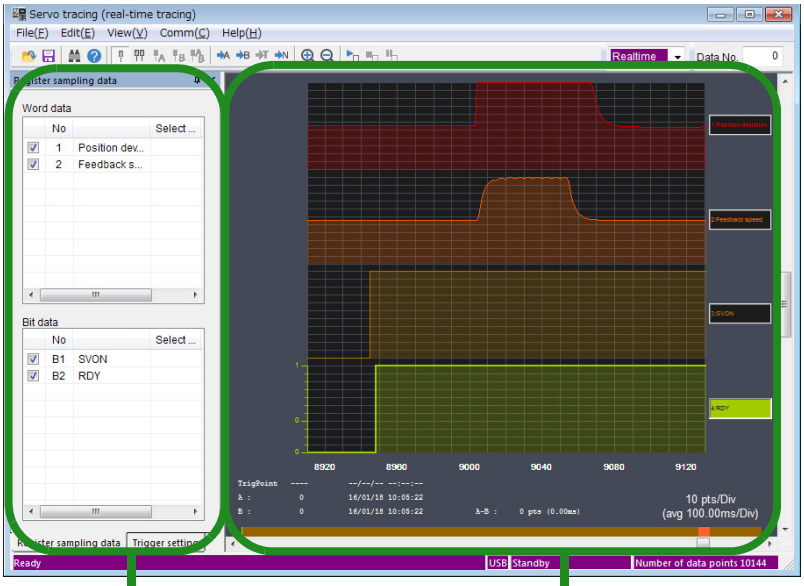
- **Servo trace (batch)**

  Data is buffered in the internal memory of the servo amplifier. When the specified condition is met, it is read by the PC. Trace can be executed without missing any data even in high-speed sampling period.

**Point**

**You cannot start multiple trace screens (servo trace (real-time), servo trace (batch)) at the same time.**

**Names and functions of parts of servo trace**




Sampling data registration/ trigger setting area

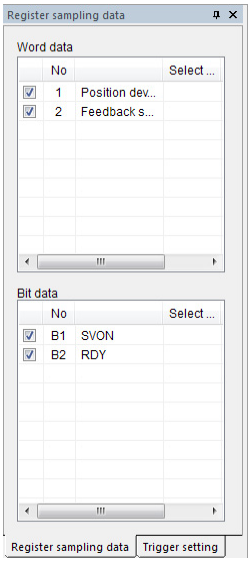
Time chart display area

## ● Sampling data registration/trigger settings data

Register data for sampling and set up triggers.

### Sampling data registration tab

Register data for sampling and specify whether to display waveform.

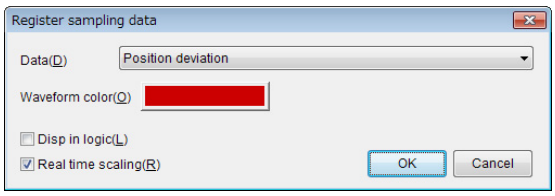



| Item | Description |
|---|---|
| (Checkbox) | Waveform of data with its checkbox selected appears. |
| No. | Shows registration number of data for monitoring. |
| (Data content) | Shows content of data for monitoring. |
| Selected value/current value | During a trace, "Current value" appears in the title cell and current value of each data also appear.<br>"*" appears when a bit data is ON, or "-" when it is OFF.<br>When trace stops, "Selected value" appears in the title cell and the value at the cursor display position also appears. |
| A-B | Shows the difference in values at cursor A and cursor B.<br>For bit data, "---" appears. |

### Sampling data registration/modification method

- Double-click a cell you want to register or edit.
- After selecting a cell for registration or editing, press the Enter key.
- Right-click a cell you want to register or edit. From the menu, select "Register/Edit(R)".

The following "Register sampling data" dialog box appears.




| Item | Function |
|---|---|
| Data | Click the ▼ button. From the pull-down menu, select data. |
| Waveform color | Clicking this button displays the "Color settings" dialog box. Select a color to use in time chart display area. |
| Display in logic format | Selecting ( ☑ ) this checkbox enables word data to be displayed in logic format. |
| Real-time scaling | Selecting ( ☑ ) this checkbox automatically adjusts the display range in real time according to the current value (word data only). |

**Point** **The maximum number of data that can be registered is two each for word data and bit data in servo trace (real-time), or three each for word data and bit data in servo trace (batch).**

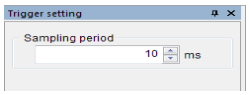
**Deleting a sampling data**

- After selecting a cell you want to delete, press the Delete key.
- Right-click a cell you want to delete. From the menu, select "Delete(D)".

**Trigger settings tab**

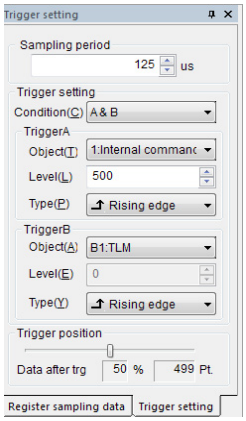
Use it to set up a trigger.

For servo trace (real-time)




| Item | Description |
|---|---|
| Sampling interval | Specify a sampling period (10 to 5000ms). |

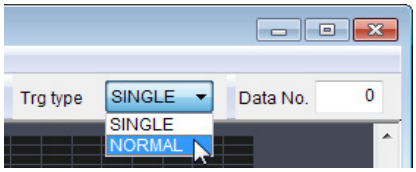
For Servo trace (batch)




| Item | | | Description |
|---|---|---|---|
| Sampling interval | | | Specify a sampling period (125 to 8191875µs). |
| Trigger settings | Condition | | Click the button. From the pull-down menu, select a trigger condition. |
| | Trigger A | Target | Click the button. From the pull-down menu, select a trigger target. |
| | | Level | Specify a trigger level. |
| | | Type | Click the button. From the pull-down menu, select a type. |
| | Trigger B | Target | Click the button. From the pull-down menu, select a trigger target. |
| | | Level | Specify a trigger level. |
| | | Type | Click the button. From the pull-down menu, select a type. |
| Trigger position | Data amount after trigger | | Specify amount of data to collect after a trigger occurs.<br>Specify a percentage of the 1000 points of entire data as after trigger data.<br>Move the slider to change data amount.<br>Moving it to the left increases the data amount, and moving it to the right reduces the amount.<br>Also, you can enter the data amount ratio (%) directly. |

**Trigger type settings**

You can select a mode for monitoring trigger.




- **Trigger type "SINGLE"**

When a trigger occurs, the specified amount of data is traced and then trace automatically stops.

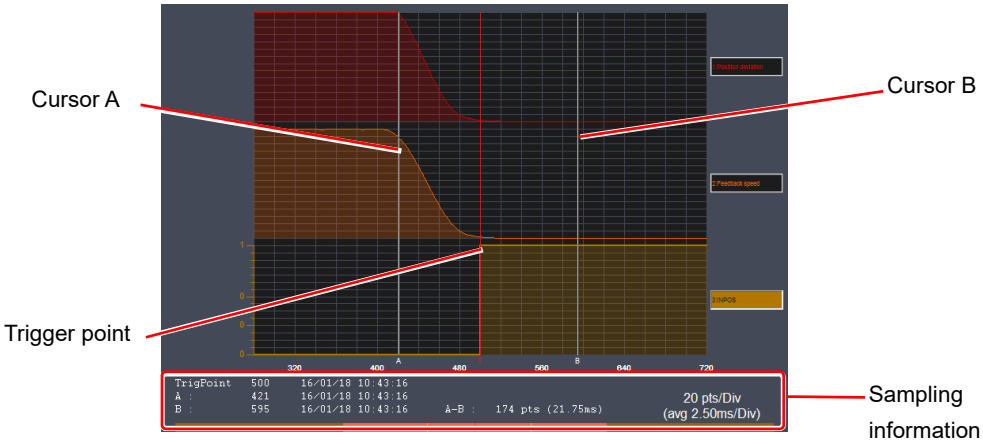
- **Trigger type "NORMAL"**

When a trigger occurs, the specified amount of data is traced and then trace automatically pauses.
When trace pauses, servo trace continues to monitor the servo amplifier while waiting for the next trigger.
When a trigger occurs again, the specified amount of data is traced and then trace pauses.
This state continues until trace is stopped.

"Stop trace", page 12-52

## ● Time chart display area

This area shows a variety of information including waveform of data for monitoring.




**Cursors A and B**

Use a cursor to check the value of the selected location, or use the two cursors to check timing, response delay, etc.

To move a cursor, use the mouse to drag it.

To fine tune the position of a cursor, use cursor keys on the keyboard.

**Trigger point**

When you apply a trigger and then perform sampling, the triggered point appears.

You can use "Sampling information" to check the absolute position of the triggered point or the trigger date and time.

**Sampling information display**

Shows information about the displayed time chart.

TrigPoint : Triggered position[*1], date and time

A : Cursor A position[*1], date and time

B : Cursor B position[*2], date and time

A-B : Distance between cursor A and cursor B, and time.

100pts/Div : Unit of currently displayed X grid[*2](sampling count/Div) and average time(ms/Div)

*1 For position, beginning of data is considered as 0.

*2 The unit changes as the time axis is expanded or reduced. (Default value: 100pts/Div)

## ■ "File(F)" menu

### ● Open file

Open servo trace data (SV trace file (*.str)).
From the menu, select "File(F)" ▶ "Open(O)" to open the "Open" dialog box and select an SV trace file.

Other procedures
- Ctrl + O
- 

Point

**Only servo trace data of the same type saved respectively in servo trace (real-time) and servo trace (batch) can be opened. Data of a different type (real-time or batch) cannot be opened.**

### ● Save

Save servo trace unit by overwriting existing one.
From the menu, select "File(F)" ▶ "Save(S)". If this is the first time you save it, then the "Save As" dialog box appears so that you can specify a file name to save the data.

Other procedures
- Ctrl + S
- 

### ● Save As

Save servo trace data by naming the file.
From the menu, select "File(F)" ▶ "Save As(A)". On the "Save As" dialog box, enter a file name and then click "Save".

### ● Save as CSV/TXT file

Save servo trace data as CSV or TXT file.
From the menu, select "File(F)" ▶ "Save As CSV/TXT(O)". On the "Save As" dialog box, enter a file name and then save.

### ● Exit servo trace

Exit servo trace
From the menu, select "File(F)" ▶ "Exit(X)". The "Servo trace" dialog box closes.

## ■ "Edit(E)" menu

### ● Find

Find single waveform sampled data.

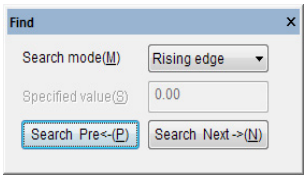
Activate a waveform graph you want to find, then from the menu, select "Edit(E)" ▶ "Find(F)". The "Find" dialog box opens.

Changing the waveform data you want to activate also changes the target for search.

Other procedures
- Ctrl + F
- 

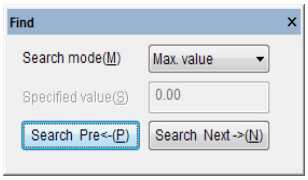
Reference Cursor A automatically moves to the location searched.

### ● If search target is a bit data




| Item | Description |
|---|---|
| Search mode | Select a search mode from the pull-down menu.<br>Rise: Search OFF→ON change point.<br>Fall: Search ON→OFF change point. |
| [Search previous←] | Search previous part (left side) from the point of cursor A. |
| [Search next→] | Search next part (right side) from the point of cursor A. |

### ● If search target is a word data



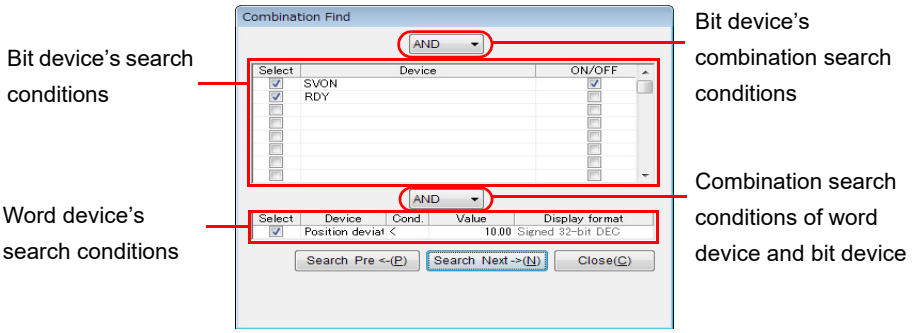

| Item | Description |
|---|---|
| Search mode | Select a search mode from the pull-down menu.<br>Maximum value: Find maximum value of data.<br>Minimum value: Find minimum value of data.<br>Extremely large value: Find extremely large value of data.<br>Extremely small value: Find extremely small value of data.<br>Specified value: Select it when searching for specified value. |
| Specified value | Input is possible only when you have selected "Specified value" as the search mode.<br>Enter a value for the search. |
| [Search previous←] | Search previous part (left side) from the point of cursor A. |
| [Search next→] | Search next part (right side) from the point of cursor A. |

## ● Combination search

Use combined conditions to find multiple sampled waveform data.

From the menu, select "Edit(E)" ▶ "Combination search(C)". The "Combination search" dialog box opens.

Reference Cursor A automatically moves to the location searched.




| Item | | Description |
|---|---|---|
| Bit device's combination search conditions | | Select condition of bit device combinations as specified in search conditions.<br>AND: Find point where all bit device search conditions are met.<br>OR: Find point when any one of bit device search conditions is met. |
| Bit device's search condition | Select | Devices with checkbox selected are searched. |
| | Device | Shows bit devices registered. |
| | ON/OFF | Specify status of bit device to search. |
| Combination search conditions of word device and bit device | | Select combination condition of bit device and word device as specified in search conditions.<br>AND: Find point where all of device search conditions and word device search conditions are met.<br>OR: Find point when any one of bit device search conditions or word device search conditions is met. |
| Word device's search conditions | Select | Devices with checkbox selected are searched. |
| | Device | Select a registered word device from the pull-down menu. |
| | Condition | Specify search condition for word device.<br>=: Find point where the device value is equal to the comparative value.<br>>: Find point where the device value is greater than the comparative value.<br><: Find point where the device value is smaller than the comparative value.<br><>: Find point where the device value is not equal to the comparative value. |
| | Value | Specify a value to compare with word device. |
| | Display format | Shows the display format of the registered device |
| [Search previous←] | | Search previous part (left side) from the point of cursor A. |
| [Search next→] | | Search next part (right side) from the point of cursor A. |
| [Close] | | The "Combination search" dialog box closes. |

## ■ Search next

Search next part (right side) from cursor A of active waveform graph.
If the "Search" dialog box appears, search using the conditions specified in the dialog box.
From the menu, select "Edit(E)" ▶ "Search next(N)" to start the search.

Other procedures • F3

## ■ Search previous

Search previous part (left side) from cursor A of active waveform graph.
If the "Search" dialog box appears, search using the conditions specified in the dialog box.
From the menu, select "Edit(E)" ▶ "Search previous(F)" to start the search.

Other procedures • Shift + F3

## ■ Jump to cursor A

From the menu, select "Edit(E)" ▶ "Jump(J)" ▶ "Cursor A(A)" to jump to cursor A.

Other procedures • Ctrl + A
• A

## ■ Jump to cursor B

From the menu, select "Edit(E)" ▶ "Jump(J)" ▶ "Cursor B(B)" to jump to cursor B.

Other procedures • Ctrl + B
• B

## ■ Jump to trigger position

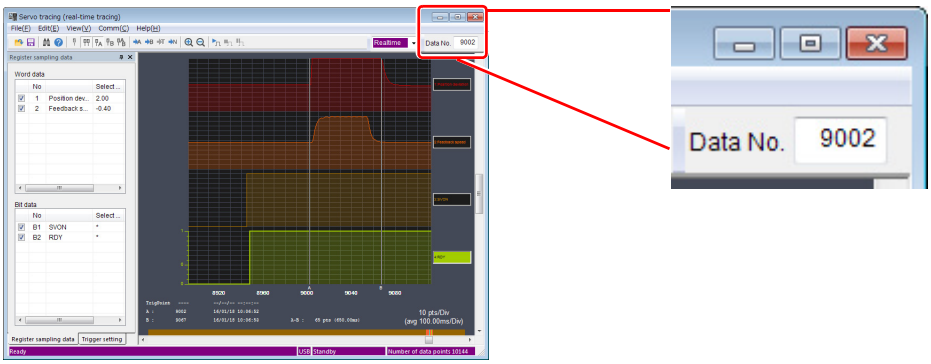
From the menu, select "Edit(E)" ▶ "Jump(J)" ▶ "Trigger position(T)" to jump to trigger position.

Other procedures • Ctrl + T
• T

## ■ Jump to specified data number

From the menu, select "Edit(E)" ▶ "Jump(J)" ▶ "Specify data number(N)" to jump to specified data number.
Use the "Data number" text box on the right side of the toolbar to enter a data number.

Other procedures • Ctrl + N
• N



## "View(V)" Menu

### ■ Sampling data registration list

From the menu, select "View(V)" ▶ "Sampling data registration(R)". The "Sampling data registration" tab appears in the sampling data registration/trigger setting area. Also, it is selected on the menu.
While the "Sampling data registration" tab appears, selecting "Sampling data registration(R)" hides the "Sampling data registration" tab and clears the selection on the menu.

### ■ Display trigger setting

From the menu, select "View(V)" ▶ "Trigger setting(G)". The "Trigger setting" tab appears in the sampling data registration/trigger setting area. Also, it is selected on the menu.
While the "Trigger setting" tab appears, selecting "Trigger setting(G)" hides the "Trigger setting" tab and clears the selection on the menu.

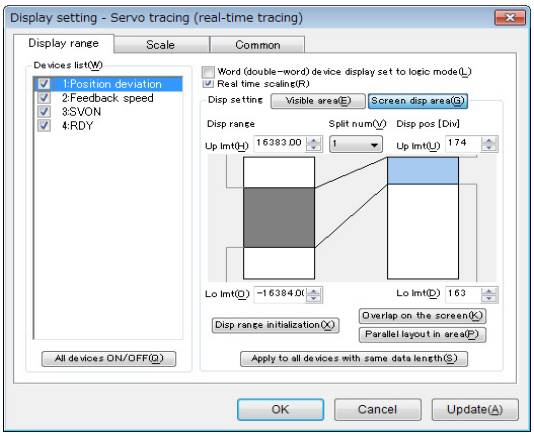
### ■ Display settings

From the menu, select "View(V)" ▶ "Display settings(S)". The "Display settings" dialog box appears.
Use it to specify display of unit trace.

Other procedures
- Right-click the display area of time chart. From the menu, select "Display settings(S)".
- Right-click a Sampling data name displayed in the right side of the time chart display area.

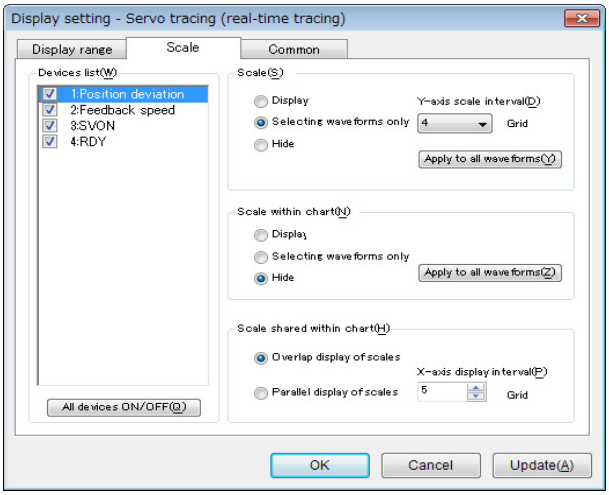
The display settings dialog box has three tabs: "Display range", "Scale", and "Common".

- **"Display range" tab**



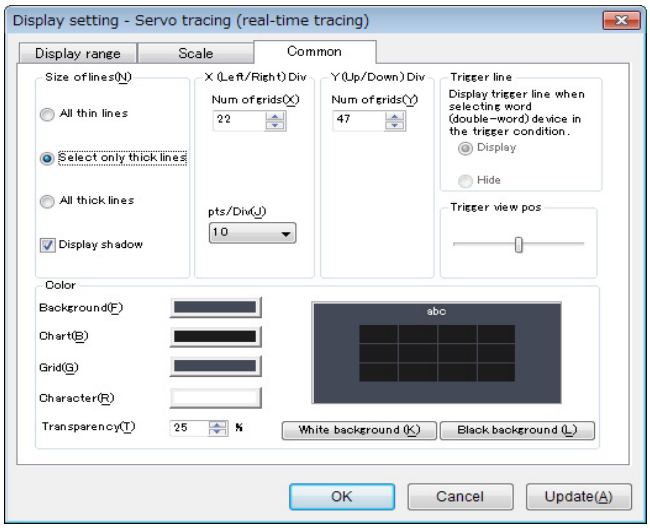

| Item | Description |
|---|---|
| Device list | Shows a list of registered devices. Waveform of devices with their checkbox selected appear. |
| [All devices ON/OFF] | Select or clear checkboxes of all devices. |
| Display word (double word) device in logic format | Selecting the checkbox displays the waveform in logic format.<br>When bit device is selected, this checkbox cannot be selected. |
| Real-time scaling | Selecting this checkbox automatically adjusts the display range in real time according to the current value (word device only). |
| Device display setting | Specify waveform display position in time chart display area. |
| [Display possible area] | Clicking this button sets the waveform display area to 0 to 100Div.<br>Legend display color:<br>White: Area where waveform of selected device is not displayed<br>Light blue: Area where waveform of selected device is not displayed on the screen<br>Blue: Area where waveform of selected device is displayed on the screen<br>Gray: Area where selected waveform out of the displayed portion on the screen is not displayed |
| [Screen display area] | Clicking this button sets the waveform display area to the range specified by "Y(↑↓)Div" on the "Common" tab.<br>Legend display color:<br><Display range><br>White: Area where waveform is not drawn<br>Gray: Area where waveform is drawn<br><Display position><br>White: Area where waveform of selected device is not displayed<br>Light blue: Area where waveform of selected device is displayed<br>Red: Division line |
| Display range | Specify the top and bottom of range of sampled data to display. |
| Number of divisions | If you set up a number of divisions, then a red division line appears in the legend.<br>Clicking a position in display automatically sets up the display position of waveform. |
| Display position | You can enter the top and bottom values to set up the display range.<br>The range for input is 0 to 100 Div and the top value must be greater than the bottom value. |
| [Initialize display range] | Return the top and bottom values of display position to their defaults. |
| [Stack within screen] | Clicking this button displays all waveforms stacked. |
| [Stack within area] | Clicking this button displays all waveforms side by side. |
| [Apply same data size to all devices] | Apply the same data size specified on the "Display range" tab to waveforms of all devices. |
| [OK] | Update the settings and close the "Display settings" dialog box. |
| [Cancel] | Cancel the settings and close the "Display settings" dialog box. |
| [Update] | Update the settings without closing the "Display settings" dialog box. |

- **[Scale] tab**




| Item | | Description |
|---|---|---|
| Scale | | Specify whether to display or hide the scale on the left side of waveform. |
| | Display | Always display the scale. |
| | Only when waveform is selected | Display scale only for waveform of selected device. |
| | Hide | Do not display the scale. |
| | Y-axis scale interval | Specify an interval between numbers displayed along the Y-axis. |
| | [Apply to all waveforms] | Clicking this button applies the "Scale" settings to all waveforms. |
| Scale within chart | | Specify scale to use inside the time chart. |
| | Display | Always display the scale. |
| | Only when waveform is selected | Display scale only for waveform of selected device. |
| | Hide | Do not display the scale. |
| | [Apply to all waveforms] | Clicking this button applies the "Scale within chart" settings to all waveforms. |
| Common scale within chart | | Specify display method and interval for stacked scales.<br>This is a common setting for scales in all time chart display areas. |
| | Display scales stacked | Display scale at the same relative position of all waveforms. When waveforms are stacked, the waveform of selected device appears at the top. (Specify display interval along the X-axis.) |
| | Display scales side by side | Display each grid by shifting its scale. |
| | Display interval along X-axis | Specify display interval of scale in chart. |
| [OK] | | Update the settings and close the "Display settings" dialog box. |
| [Cancel] | | Cancel the settings and close the "Display settings" dialog box. |
| [Update] | | Update the settings without closing the "Display settings" dialog box. |

- **"Common" tab**




| Item | | Description |
|---|---|---|
| Line thickness | | Specify thickness of line of waveform to display. |
| | All thin lines | Display all waveforms as thin lines. |
| | Thick line only for selected waveform | Use thick line only for waveform of selected device. |
| | All thick lines | Display all waveforms as thick lines. |
| | Display shadow | Display shadow at the area between the lower limit of display range and waveform. |
| X(←→)Div | | Specify the number of grids and unit of samplings using grids as unit, along the time axis (horizontal). |
| | Number of grids | Specify the number of grids to use for the time axis (horizontal) of waveform display.<br>Setting range: 10 to 100 |
| | pts/Div | Select the number of sampling for 1Div(1 grid).<br>You can also change it using "View" ▶ "Time scale zoom in" or "Time scale zoom out". |
| Y(↑↓)Div | | Specify the number of grids for the vertical axis. |
| | Number of grids | Specify the number of grids to use for the vertical direction of waveform display.<br>Setting range: 10 to 100 |
| Trigger line | | Perform display setting of trigger line of word device.<br>This is possible only when word device is set up at trigger. |
| | Show | Display trigger line. |
| | Hide | Hide trigger line. |
| Color | | Specify display color for non-waveform items. |
| | Background | Specify background color for area other than the waveform display area. |
| | Chart | Specify background color for inside of waveform display area. |
| | Grid | Specify color of grid in waveform display area. |
| | Text | Specify color of text in time chart display area. |
| | [White background mode] | Use white as background of waveform display area, and automatically set color for all waveforms. |
| | [Black background mode] | Use black as background of waveform display area, and automatically set color for all waveforms. |
| [OK] | | Update the settings and close the "Display settings" dialog box. |
| [Cancel] | | Cancel the settings and close the "Display settings" dialog box. |
| [Apply] | | Update the settings without closing the "Display settings" dialog box. |

## ■ Display waveforms stacked

From the menu, select "View(V)" ▶ "Display waveforms stacked(O)" to display waveforms of all sampling data stacked.

## ■ Display waveforms side by side

From the menu, select "View(V)" ▶ "Display waveforms side by side(L)" to display waveforms of all sampling data side by side in vertical direction.

## ■ Time scale zoom in

From the menu, select "View(V)" ▶ "Time scale zoom in(U)" to expand the time axis (horizontal) of the waveform display area.

Other procedures
- Alt + →
- 

## ■ Time scale zoom out

From the menu, select "View(V)" ▶ "Time scale zoom out(D)" to reduce the time axis (horizontal) of the waveform display area.

Other procedures
- Alt + ←
- 

## ■ Number of grids zoom in/out

Specify the number of grids in the vertical and horizontal directions of the waveform display area.

### ● Expand grids in vertical direction

From the menu, select "View(V)" ▶ "Number of grids zoom in/out(V)" ▶ "Vertical zoom in(T)" to expand grids (by reducing the number of grids) in the vertical direction of the waveform display area.

Other procedures
- Ctrl + ↑

### ● Reduce grids in vertical direction

From the menu, select "View(V)" ▶ "Number of grids zoom in/out(V)" ▶ "Vertical zoom out(B)" to reduce grids (by increasing the number of grids) in the vertical direction of the waveform display area.

Other procedures
- Ctrl + ↓

### ● Expand grids in horizontal direction

From the menu, select "View(V)" ▶ "Number of grids zoom in/out(V)" ▶ "Horizontal zoom in(R)" to expand grids (by reducing the number of grids) in the horizontal direction of the waveform display area.

Other procedures
- Ctrl + →

### ● Reduce grids in horizontal direction

From the menu, select "View(V)" ▶ "Number of grids zoom in/out(V)" ▶ "Horizontal zoom out(L)" to reduce grids (by increasing the number of grids) in the horizontal direction of the waveform display area.

Other procedures
- Ctrl + ←

## ■ Display range zoom in/out

Specify the display range of the selected waveform.

### ● Expand display range

From the menu, select "View(V)" ▶ "Display range zoom in/out(K)" ▶ "Display range zoom in(T)" to expand (by narrowing the display width) the display range of waveform.

Other procedures • Alt + ↑

### ● Reduce display range

From the menu, select "View(V)" ▶ "Display range zoom in/out(K)" ▶ "Display range zoom out(B)" to reduce (by widening the display width) the display range of waveform.

Other procedures • Alt + ↓

### ● Move display range up

From the menu, select "View(V)" ▶ "Display range zoom in/out(K)" ▶ "Display range up(U)" to move the display range up without changing the display range width of waveform.

Other procedures • Shift + ↑

### ● Move display range down

From the menu, select "View(V)" ▶ "Display range zoom in/out(K)" ▶ "Display range down(D)" to move the display range down without changing the display range width of waveform.

Other procedures • Shift + ↓

## ■ Automatic adjustment of display range

From the menu, select "View(V)" ▶ "Auto adjust display range(Q)" to optimize the display range of the selected sampling data to match the waveform.

Point **You can optimize just word sampling data.**

## ■ Display cursor

Display cursor at waveform display area.
By setting up a cursor at the waveform display area, you can display each cursor point's value and, date and time as well as distance between cursor A and cursor B, at the sampling information display area.

### ● Hide cursor

From the menu, select "View(V)" ▶ "Cursor(R)" ▶ "Hide cursor(N)" to hide the cursor.

Other procedures •

### ● Display cursor

From the menu, select "View(V)" ▶ "Cursor(R)" ▶ "Display cursor(V)" to display cursor A and B.

Other procedures •

- **Select cursor A**

  From the menu, select "View(V)" ▶ "Cursor(R)" ▶ "Select cursor A(A)" to select cursor A.

  Other procedures • 

- **Select cursor B**

  From the menu, select "View(V)" ▶ "Cursor(R)" ▶ "Select cursor B(B)" to select cursor B.

  Other procedures • 

- **Select cursors A&B.**

  From the menu, select "View(V)" ▶ "Cursor(R)" ▶ "Select cursors A&B(C)" to select cursors A and B.

  Other procedures • 

## "Communication(C)" Menu

### ■ Start trace

Start trace of registered sampling data.
From the menu, select "Communication(C)" ▶ "Start trace(S)" to start communication with PLC and trace of registered sampling data.

Other procedures • F5
• 

### ■ Stop trace

From the menu, select "Communication(C)" ▶ "Stop trace(E)" to stop the trace.

Other procedures • Shift + F5
• 

### ■ Pause trace

From the menu, select "Communication(C)" ▶ "Pause trace(I)" to suspend the trace. To resume trace, select "Pause trace(I)".

Other procedures • F6
• 

Point **The trace can be started when the SV2 series setting software is being monitored.**

## "Help(H)" Menu

### ■ Display user manual

From the menu, select "Help(H)" ▶ "User manual(H)" to display the PDF manual of servo trace.

Other procedures • F1

### ■ Display servo trace version information

From the menu, select "Help(H)" ▶ "Version information(A)" to display the "Version information" dialog box of servo trace.

**MEMO**

# APPENDIX

This section describes the parameter list, control block diagram, list of alarm/warning messages, MECHATROLINK-III communication commands and motorless test.

# A-1 Parameter List

For the SV2 series, the parameter displayed in the SV2 series setting software/KV-XH setting tool can be set by level. The following display levels are available:

- "Basic"
- "Basic + Extend"
- "All" (Basic + Extend + Special)

For the change of the display level according to the SV2 series setting software/KV-XH setting tool, please refer to the following manual.

"Chapter 12 SV2 SERIES SETTING SOFTWARE", Page 12-1
KV-XH16ML/XH04ML User's Manual

## ■ System-related parameters

| Parameter | Category | Parameter name*1 | Description | Set value: Contents [Unit] | Default | Mechatrolink Parameter No. | Control mode | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Position | Speed | Torque |
| SYS_01 | Basic | *Absolute position system*2 | Set up whether to configure the absolute position system or not. | 0: ABS<br>1: INC<br>2: 1 turn ABS | 1 | 002H (8 to 11 bits) | Yes | Yes | Yes |
| SYS_02 | Basic | *Encoder frequency division output pulse | Set up the number of encoder output pulses output by the servo amplifier when the servo motor rotates 1 turn. | 16 to 1048576 [PLS/Rev] | 2048 | 212H (2 words) | Yes | Yes | Yes |
| SYS_03 | Basic | Regenerative resistor capacity | Set up the capacity (W) of an external regenerative resistor. | 0 to amplifier capacity [10W] | 0 | 600H (1 word) | Yes | Yes | Yes |
| SYS_04 | Basic | Regenerative resistor value | Set up the resistance value (mΩ) of an external regenerative resistor. | 0 to 65535 [10mΩ] | 0 | 603H (1 word) | Yes | Yes | Yes |
| SYS_05 | Basic | *Motor rotation direction*3 | Set up the motor positive rotation direction. | 0: CCW<br>1: CW | 0 | 000H (0 to 3 bits) | Yes | Yes | Yes |

*1 For parameters marked with "*", the power needs to be restarted to reflect the changes made.
*2 When using with the KV-XH16ML/XH04ML, please use "0:ANS" or "1:INC". It will not function normally if changed.
*3 When used together with KV-XH16ML/XH04ML, use the series with the defaults. Otherwise, the unit cannot work properly.

## ■ Position-related parameters

| Parameter | Category | Parameter name*1 | Description | Set value: Contents [Unit] | Default | Mechatrolink Parameter No. | Control mode | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Position | Speed | Torque |
| POS_01 | Basic | *Electric gear numerator*2 | The position command (movement) is converted into an electric gear ratio (Electric gear numerator /Electric gear denominator) before operating the servo motor. | 1 to 1073741824 | 4 | 20EH (2 words) | Yes | - | - |
| POS_02 | Basic | *Electric gear denominator*2 | The position command (movement) is converted into an electric gear ratio (Electric gear numerator /Electric gear denominator) before operating the servo motor. | 1 to 1073741824 | 1 | 210H (2 words) | Yes | - | - |
| POS_03 | Basic | INPOS range | Output the INPOS signal when the absolute value of the position deviation is less than set value. | 0 to 1073741824 (CMD_PLS or ENC_PLS) | 25 | 522H (2 words) | Yes | - | - |
| POS_04 | Extend | *INPOS timing | Set up the time to output the INPOS signal. | 0: PosDeviation =< INPOS range<br>1: (PosDev =< INPOS) & cmd after flt=0<br>2: (PosDev =< INPOS) & cmd=0 | 0 | 207H (12 to 15 bits) | Yes | - | - |
| POS_05 | Extend | NEAR range | Output the NEAR signal when the absolute value of the position deviation is less than set value. | 0 to 1073741824 (CMD_PLS or ENC_PLS) | 25 | 524H (2 words) | Yes | - | - |
| POS_06 | Special | *INPOS,NEAR unit | Set up the unit of the INPOS range and NEAR range. | 0: CMD_PLS<br>1: ENC_PLS | 0 | 2D0H (0 to 3 bits) | Yes | - | - |

*1 For parameters marked with "*", the power needs to be restarted to reflect the changes made.
*2 When used together with KV-XH16ML/XH04ML, commonly "4/1"(initial value) is used, and please use "1/1" during full closed control. Otherwise, the unit cannot work properly.

## ■ Speed-related parameters

| Parameter | Category | Parameter name*1 | Description | Set value: Contents [Unit] | Default | Mechatrolink Parameter No. | Control mode | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Position | Speed | Torque |
| VEL_01 | Basic | Speed control accelerate time | Set up the acceleration time relative to the speed command. Set up the time required for the servo motor to reach the max speed from the stop status. | 0 to 10000 [ms] | 0 | 305H (1 word) | - | Yes | - |
| VEL_02 | Basic | Speed control decelerate time | Set up the deceleration time relative to the speed command. Set up the time required for the servo motor to reach the stop status from the max speed. | 0 to 10000 [ms] | 0 | 306H (1 word) | - | Yes | - |
| VEL_03 | Basic | Speed match range | Output the speed match (VCMP) signal when the absolute value of the difference between the motor speed and command speed is less than the set value. | 0 to 100 [$min^{-1}$] | 10 | 503H (1 word) | - | Yes | - |
| VEL_04 | Basic | Speed limit during trq control | Set up the speed limit during torque control. | 0 to 10000 [$min^{-1}$] | 10000 | 407H (1 word) | - | - | Yes |
| VEL_05 | Extend | Zero speed detection range | Output the ZSP signal when the motor speed is less than the set value. | 0 to 10000 [$min^{-1}$] | 20 | 502H (1 word) | Yes | Yes | Yes |
| VEL_06 | Extend | *Maximum motor speed | Set up the maximum motor speed. | 0 to 65535 [$min^{-1}$] | 10000 | 316H (1 word) | Yes | Yes | Yes |

*1 For parameters marked with "*", the power needs to be restarted to reflect the changes made.

## ■ Torque-related parameters

| Parameter | Category | Parameter name*1 | Description | Set value: Contents [Unit] | Default | Mechatrolink Parameter No. | Control mode | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Position | Speed | Torque |
| TRQ_01 | Basic | P-torque limit 1 | Set up the forward torque limit. | 0 to 800 [%] | 800 | 402H (1 word) | Yes | Yes | Yes |
| TRQ_02 | Basic | N-torque limit 1 | Set up the reversal torque limit. | 0 to 800 [%] | 800 | 403H (1 word) | Yes | Yes | Yes |
| TRQ_03 | Basic | Torque command accelerate time | Set up the acceleration time relative to the torque command. Set up the time required to reach the max. torque from torque command = 0. | 0 to 10000 [ms] | 0 | 4D0H (1 word) | - | - | Yes |
| TRQ_04 | Basic | Torque command decelerate time | Set up the deceleration time relative to the torque command. Set up the time required to reach torque command = 0 from the max. torque. | 0 to 10000 [ms] | 0 | 4D1H (1 word) | - | - | Yes |
| TRQ_05 | Basic | *Torque limit method*2 | Set up the method to limit torque. | 0: Only TrqLim1 is valid<br>1: TrqLim2 is valid (P/NTL)<br>2: TLIM is valid<br>3: TLIM is valid (P/NTL)<br>4: TrqLim2 & TLIM are valid (P/NTL) | 2 | 4D2H (0 to 3 bits) | Yes | Yes | Yes |
| TRQ_06 | Extend | P-torque limit 2 | Set the forward torque limit when the internal torque limit (expansion) is set to valid. | 0 to 800 [%] | 100 | 404H (1 word) | Yes | Yes | Yes |
| TRQ_07 | Extend | N-torque limit 2 | Set the reversal torque limit when the internal torque limit (expansion) is set to valid. | 0 to 800 [%] | 100 | 405H (1 word) | Yes | Yes | Yes |

*1 For parameters marked with "*", the power needs to be restarted to reflect the changes made.

*2 When used together with KV-XH16ML/XH04ML, normally use the series with the defaults.

## ■ Tuning-related parameters

| Parameter | Category | Parameter name*1 | Description | Set value: Contents [Unit] | Default | Mechatrolink Parameter No. | Control mode | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Position | Speed | Torque |
| TUN_01 | Basic | *Tuning mode | Set up the method to adjust gain. | 0: Manual tuning<br>1: Auto tuning | 1 | 170H<br>(0 to 3 bits) | Yes | Yes | - |
| TUN_02 | Basic | Auto tuning response | Set up the proper value for mechanical system rigidity when using auto tuning. | 0 to15 | 5 | 170H<br>(8 to 11 bits) | Yes | Yes | - |
| TUN_03 | Basic | Auto tuning load level | Set up the ratio of load inertia moment level (size) of the mechanical system when using auto tuning. | 1: Low load<br>2: High load | 1 | 170H<br>(12 to 15 bits) | Yes | Yes | - |
| TUN_04 | Extend | Position control gain | Set up the gain of the position control loop. | 10 to 20000<br>[0.1/s] | 300 | 102H<br>(1 word) | Yes | - | - |
| TUN_05 | Extend | Speed control gain | Set up the gain of the speed control loop. | 10 to 20000<br>[0.1Hz] | 300 | 100H<br>(1 word) | Yes | Yes | - |
| TUN_06 | Extend | Speed integral time constant | Set up the integral time constant of the speed control loop. | 15 to 51200<br>[0.01ms] | 2666 | 101H<br>(1 word) | Yes | Yes | - |
| TUN_07 | Extend | Torque cmd low-pass filter | Set the time constant of the low-pass filter towards the torque command. | 0 to 65535<br>[0.01ms] | 100 | 401H<br>(1 word) | Yes | Yes | Yes |
| TUN_08 | Extend | Ratio of load inertia moment | Set up the ratio of load inertia moment relative to servo motor inertia moment. | 0 to 20000<br>[%] | 100 | 103H<br>(1 word) | Yes | Yes | Yes |
| TUN_09 | Extend | Feed forward gain | Set up the gain for feed forward compensation. | 0 to 100<br>[%] | 0 | 109H<br>(1 word) | Yes | - | - |
| TUN_10 | Extend | Feed forward low-pass filter | Set up the low-pass filter for feed forward compensation. | 0 to 6400<br>[0.01ms] | 0 | 10AH<br>(1 word) | Yes | - | - |
| TUN_11 | Extend | Position control gain 2 | Set up the gain of the position control loop. Enabled at Gain 2. | 10 to 20000<br>[0.1/s] | 400 | 106H<br>(1 word) | Yes | - | - |
| TUN_12 | Extend | Speed control gain 2 | Set up the gain of the speed control loop. Enabled at Gain 2. | 10 to 20000<br>[0.1Hz] | 400 | 104H<br>(1 word) | Yes | Yes | - |
| TUN_13 | Extend | Speed integral time constant 2 | Set up the integral time constant of the speed control loop. Enabled at Gain 2. | 15 to 51200<br>[0.01ms] | 2000 | 105H<br>(1 word) | Yes | Yes | - |
| TUN_14 | Extend | Torque cmd low-pass filter 2 | Set the constant of the low-pass filter towards the torque command. Enabled at Gain 2. | 0 to 65535<br>[0.01ms] | 100 | 412H<br>(1 word) | Yes | Yes | Yes |
| TUN_15 | Extend | Gain switching time 1 | Set up the switching time from Gain 1 to Gain 2. | 0 to 65535<br>[ms] | 0 | 131H<br>(1 word) | Yes | - | - |
| TUN_16 | Extend | Gain switching time 2 | Set up the switching time from Gain 2 to Gain 1. | 0 to 65535<br>[ms] | 0 | 132H<br>(1 word) | Yes | - | - |
| TUN_17 | Extend | Gain switching waiting time 1 | Set up the time until the gain begins to change after the condition has been established to switch from Gain 1 to Gain 2. | 0 to 65535<br>[ms] | 0 | 135H<br>(1 word) | Yes | - | - |
| TUN_18 | Extend | Gain switching waiting time 2 | Set up the time until the gain begins to change after the condition has been established to switch from Gain 2 to Gain 1. | 0 to 65535<br>[ms] | 0 | 136H<br>(1 word) | Yes | - | - |
| TUN_19 | Extend | Auto gain switch | Set up whether to use auto gain switch. | 0: Not used<br>1: Used | 0 | 139H<br>(0 to 3 bits) | Yes | - | - |
| TUN_20 | Extend | Auto gain switch condition | Set up the auto gain switch condition. | 0: INPOS is ON<br>1: INPOS is OFF<br>2: NEAR is ON<br>3: NEAR is OFF<br>4: Command pulse is OFF<br>5: Command pulse is ON | 0 | 139H<br>(4 to 7 bits) | Yes | - | - |
| TUN_21 | Extend | Auto notch filter 1 auto adjustment | Set up whether to use the auto adjustment function for the 1-notch filter when performing the tuning function. | 0: Disable<br>1: Enable | 1 | 460H<br>(8 to 11 bits) | Yes | Yes | Yes |
| TUN_22 | Extend | Auto notch filter 2 auto adjustment | Set up whether to use the auto adjustment function for the 2-notch filter when performing the tuning function. | 0: Disable<br>1: Enable | 1 | 466H<br>(0 to 3 bits) | Yes | Yes | Yes |
| TUN_23 | Extend | Mechanical analyzer notch filter | Set up whether to use the mechanical analyzer notch filter. | 0: Not used<br>1: Used | 0 | 408H<br>(0 to 3 bits) | Yes | Yes | Yes |
| TUN_24 | Extend | Auto notch filter 1 | Set up whether to use the auto notch filter 1. | 0: Not used<br>1: Used | 0 | 408H<br>(8 to 11 bits) | Yes | Yes | Yes |
| TUN_25 | Extend | Auto notch filter 2 | Set up whether to use the auto notch filter 2. | 0: Not used<br>1: Used | 0 | 416H<br>(0 to 3 bits) | Yes | Yes | Yes |
| TUN_26 | Special | Manual notch filter 1 | Set up whether to use the manual notch filter 1. | 0: Not used<br>1: Used | 0 | 416H<br>(4 to 7 bits) | Yes | Yes | Yes |
| TUN_27 | Special | Manual notch filter 2 | Set up whether to use the manual notch filter 2. | 0: Not used<br>1: Used | 0 | 416H<br>(8 to 11 bits) | Yes | Yes | Yes |

*1 For parameters marked with "*", the power needs to be restarted to reflect the changes made.

| Parameter | Category | Parameter name*1 | Description | Set value: Contents [Unit] | Default | Mechatrolink Parameter No. | Control mode | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Position | Speed | Torque |
| TUN_28 | Extend | Mechanical analyzer notch filter frequency | Set up the frequency for the mechanical analyzer notch filter. | 50 to 5000 [Hz] | 5000 | 409H (1 word) | Yes | Yes | Yes |
| TUN_29 | Extend | Mechanical analyzer notch filter Q value | Set up the Q value for the mechanical analyzer notch filter. | 50 to 1000 [0.01] | 70 | 40AH (1 word) | Yes | Yes | Yes |
| TUN_30 | Extend | Mechanical analyzer notch filter depth | Set up the depth for the mechanical analyzer notch filter. | 0 to 1000 [0.001] | 0 | 40BH (1 word) | Yes | Yes | Yes |
| TUN_31 | Extend | Auto notch filter 1 frequency | Set up the frequency for the auto notch filter 1. | 50 to 5000 [Hz] | 5000 | 40CH (1 word) | Yes | Yes | Yes |
| TUN_32 | Extend | Auto notch filter 1 Q value | Set up the Q value for the auto notch filter 1. | 50 to 1000 [0.01] | 70 | 40DH (1 word) | Yes | Yes | Yes |
| TUN_33 | Extend | Auto notch filter 1 depth | Set up the depth for the auto notch filter 1. | 0 to 1000 [0.001] | 0 | 40EH (1 word) | Yes | Yes | Yes |
| TUN_34 | Extend | Auto notch filter 2 frequency | Set up the frequency for the auto notch filter 2. | 50 to 5000 [Hz] | 5000 | 417H (1 word) | Yes | Yes | Yes |
| TUN_35 | Extend | Auto notch filter 2 Q value | Set up the Q value for the auto notch filter 2. | 50 to 1000 [0.01] | 70 | 418H (1 word) | Yes | Yes | Yes |
| TUN_36 | Extend | Auto notch filter 2 depth | Set up the depth for the auto notch filter 2. | 0 to 1000 [0.001] | 0 | 419H (1 word) | Yes | Yes | Yes |
| TUN_37 | Special | Manual notch filter 1 frequency | Set up the frequency for the manual notch filter 1. | 50 to 5000 [Hz] | 5000 | 41AH (1 word) | Yes | Yes | Yes |
| TUN_38 | Special | Manual notch filter 1 Q value | Set up the Q value for the manual notch filter 1. | 50 to 1000 [0.01] | 70 | 41BH (1 word) | Yes | Yes | Yes |
| TUN_39 | Special | Manual notch filter 1 depth | Set up the depth for the manual notch filter 1. | 0 to 1000 [0.001] | 0 | 41CH (1 word) | Yes | Yes | Yes |
| TUN_40 | Special | Manual notch filter 2 frequency | Set up the frequency for the manual notch filter 2. | 50 to 5000 [Hz] | 5000 | 41DH (1 word) | Yes | Yes | Yes |
| TUN_41 | Special | Manual notch filter 2 Q value | Set up the Q value for the manual notch filter 2. | 50 to 1000 [0.01] | 70 | 41EH (1 word) | Yes | Yes | Yes |
| TUN_42 | Special | Manual notch filter 2 depth | Set up the depth for the manual notch filter 2. | 0 to 1000 [0.001] | 0 | 41FH (1 word) | Yes | Yes | Yes |
| TUN_43 | Special | Position integral time constant | Set up the integral time constant of the position control loop. Normally, this does not need to be set. | 0 to 50000 [0.1ms] | 0 | 11FH (1 word) | Yes | - | - |
| TUN_44 | Special | Secondary torque command Filter frequency | Set up the frequency for the secondary torque command. Normally, this does not need to be set. | 100 to 5000 [Hz] | 5000 | 40FH (1 word) | Yes | Yes | Yes |
| TUN_45 | Special | Secondary torque command filter Q value | Set up the Q value for the secondary torque command filter. Normally, this does not need to be set. | 50 to 100 [0.01] | 50 | 410H (1 word) | Yes | Yes | Yes |
| TUN_46 | Special | Auto proportion control switch | Set up the condition to automatically switch to proportional control. Normally, this does not need to be set. | 0: Internal command torque<br>1: Internal command speed<br>2: Acceleration<br>3: Position deviation<br>4: Unavailable | 4 | 10BH (0 to 3 bits) | Yes | Yes | - |
| TUN_47 | Special | P change command torque | Set up the internal command torque value to automatically switch to proportional control. Normally, this does not need to be set. | 0 to 800 [%] | 200 | 10CH (1 word) | Yes | Yes | - |
| TUN_48 | Special | P change command speed | Set up the internal command torque speed to automatically switch to proportional control. Normally, this does not need to be set. | 0 to 10000 [$min^{-1}$] | 0 | 10DH (1 word) | Yes | Yes | - |
| TUN_49 | Special | P change Acceleration | Set up the acceleration to automatically switch to proportional control. Normally, this does not need to be set. | 0 to 30000 [$min^{-1}$/s] | 0 | 10EH (1 word) | Yes | Yes | - |
| TUN_50 | Special | P change position deviation | Set up the position deviation value to automatically switch to proportional control. Normally, this does not need to be set. | 0 to 10000 [CMD_PLS] | 0 | 10FH (1 word) | Yes | Yes | - |
| TUN_51 | Special | Friction compensation function | Set up whether to use the friction compensation function. Normally, this does not need to be set. | 0: Not used<br>1: Used | 0 | 408H (12 to 15 bits) | Yes | Yes | - |
| TUN_52 | Special | Friction compensation gain | Set up the friction compensation gain. Normally, this does not need to be set. | 10 to 1000 [%] | 100 | 121H (1 word) | Yes | Yes | - |
| TUN_53 | Special | Friction compensation gain 2 | Set up the friction compensation gain 2. Normally, this does not need to be set. | 10 to 1000 [%] | 100 | 122H (1 word) | Yes | Yes | - |
| TUN_54 | Special | Friction cmps coefficient | Set up the friction compensation coefficient. Normally, this does not need to be set. | 0 to 100 [%] | 0 | 123H (1 word) | Yes | Yes | - |
| TUN_55 | Special | Friction cmps freq correction | Set up the friction compensation frequency correction. Normally, this does not need to be set. | -10000 to 10000 [0.1Hz] | 0 | 124H (1 word) | Yes | Yes | - |

*1 For parameters marked with "*", the power needs to be restarted to reflect the changes made.

| Parameter | Category | Parameter name*1 | Description | Set value: Contents [Unit] | Default | Mechatrolink Parameter No. | Control mode | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Position | Speed | Torque |
| TUN_56 | Special | Friction cmps gain correction | Set up the friction compensation gain correction.<br>Normally, this does not need to be set. | 1 to 1000<br>[%] | 100 | 125H<br>(1 word) | Yes | Yes | - |
| TUN_57 | Special | Model following control | Set up whether to use the model following control function.<br>Normally, this does not need to be set. | 0: Not used<br>1: Used | 0 | 140H<br>(0 to 3 bits) | Yes | - | - |
| TUN_58 | Special | *Model following control type | Set up the model following control type.<br>Normally, this does not need to be set. | 0: Type 1<br>1: Type 2 | 1 | 14FH<br>(0 to 3 bits) | Yes | - | - |
| TUN_59 | Special | Model following control gain | Set up the model following control gain.<br>Normally, this does not need to be set. | 10 to 20000<br>[0.1/s] | 500 | 141H<br>(1 word) | Yes | - | - |
| TUN_60 | Special | Model follow ctrl gain correct | Set up the model following control gain correction.<br>Normally, this does not need to be set. | 500 to 2000<br>[0.1%] | 1000 | 142H<br>(1 word) | Yes | - | - |
| TUN_61 | Special | P-Model following control bias | Set up the forward model following control bias.<br>Normally, this does not need to be set. | 0 to 10000<br>[0.1%] | 1000 | 143H<br>(1 word) | Yes | - | - |
| TUN_62 | Special | N-Model following control bias | Set up the reversal model following control bias.<br>Normally, this does not need to be set. | 0 to 10000<br>[0.1%] | 1000 | 144H<br>(1 word) | Yes | - | - |
| TUN_63 | Special | Model following ctrl FF comp | Set up the model following control speed feed-forward compensation.<br>Normally, this does not need to be set. | 0 to 10000<br>[0.1%] | 1000 | 147H<br>(1 word) | Yes | - | - |
| TUN_64 | Special | Model following control gain 2 | Set up the model following control gain 2.<br>Normally, this does not need to be set. | 10 to 20000<br>[0.1/s] | 500 | 148H<br>(1 word) | Yes | - | - |
| TUN_65 | Special | Model follow ctrl gain correct 2 | Set up the model following control gain correction 2.<br>Normally, this does not need to be set. | 500 to 2000<br>[0.1%] | 1000 | 149H<br>(1 word) | Yes | - | - |
| TUN_66 | Special | Model following control FF | Set up whether to use model following control and speed/torque feed-forward together.<br>Normally, this does not need to be set. | 0: Not used<br>1: Used | 0 | 140H<br>(12 to 15 bits) | Yes | - | - |
| TUN_67 | Special | Vibration suppression | Set up the status of the vibration suppression function.<br>It is used to suppress the transient low-frequency 1 to 100Hz vibrations which occur after the operation. | 0: Not used<br>1: Enable (1 point)<br>2: Enable (2 point) | 0 | 140H<br>(4 to 7 bits) | Yes | - | - |
| TUN_68 | Special | Vibration suppression auto adj | Set up whether vibration suppression auto adjustment function is used or not when performing the tuning function. | 0: Disable<br>1: Enable | 1 | 140H<br>(8 to 11 bits) | Yes | - | - |
| TUN_69 | Special | 1-Vibration suppression freq A | Set up the 1-vibration suppression frequency.<br>It is no necessary to set when using the automatic adjustment function. | 10 to 2500<br>[0.1Hz] | 500 | 145H<br>(1 word) | Yes | - | - |
| TUN_70 | Special | 1-Vibration suppression freq B | Set up the 1-vibration suppression frequency.<br>It is no necessary to set when using the automatic adjustment function. | 10 to 2500<br>[0.1Hz] | 700 | 146H<br>(1 word) | Yes | - | - |
| TUN_71 | Special | 2-Vibration suppression freq | Set up the 2-vibration suppression frequency. | 10 to 2000<br>[0.1Hz] | 800 | 14AH<br>(1 word) | Yes | - | - |
| TUN_72 | Special | 2-Vibration suppression correct | Set up the 2-vibration suppression correction. | 10 to 1000<br>[%] | 100 | 14BH<br>(1 word) | Yes | - | - |
| TUN_73 | Special | Anti-resonance control | Set up the status of the anti-resonance control function.<br>It is used when the continuous 100~1000Hz vibrations that occur when gain is taken up is suppressed. | 0: Not used<br>1: Used | 0 | 160H<br>(0 to 3 bits) | Yes | Yes | - |
| TUN_74 | Special | Anti-res control adjustment | Set up whether anti-resonance control adjustment function is used or not when performing the tuning function. | 0: Disable<br>1: Enable | 1 | 160H<br>(4 to 7 bits) | Yes | Yes | - |
| TUN_75 | Special | Anti-resonance frequency | Set up the anti-resonance frequency.<br>It is no necessary to set when using the automatic adjustment function. | 10 to 20000<br>[0.1Hz] | 1000 | 161H<br>(1 word) | Yes | Yes | - |
| TUN_76 | Special | Anti-resonance gain correction | Set up the intensity for the anti-resonance control function.<br>Normally, this does not need to be set. | 1 to 1000<br>[%] | 100 | 162H<br>(1 word) | Yes | Yes | - |
| TUN_77 | Special | Anti-resonance damping gain 1 | Set up the intensity for the anti-resonance control function.<br>It is no necessary to set when using the automatic adjustment function. | 0 to 300<br>[%] | 0 | 163H<br>(1 word) | Yes | Yes | - |
| TUN_78 | Special | Anti-res filter time constA cmp | Set up the filter time constant for the anti-resonance control function.<br>Normally, this does not need to be set. | -1000 to 1000<br>[0.01ms] | 0 | 164H<br>(1 word) | Yes | Yes | - |
| TUN_79 | Special | Anti-res filter time constB cmp | Set up the filter time constant for the anti-resonance control function.<br>Normally, this does not need to be set. | -1000 to 1000<br>[0.01ms] | 0 | 165H<br>(1 word) | Yes | Yes | - |
| TUN_80 | Special | Anti-resonance damping gain 2 | When the anti-resonance control function is applied, it is used especially when the vibration occurs by other high frequency. | 0 to 1000<br>[%] | 0 | 166H<br>(1 word) | Yes | Yes | - |

*1 For parameters marked with "*", the power needs to be restarted to reflect the changes made.

| Parameter | Category | Parameter name*1 | Description | Set value: Contents [Unit] | Default | Mechatrolink Parameter No. | Control mode | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Position | Speed | Torque |
| TUN_81 | Special | Remained vibration detect width | If the vibration is small, the vibration detection sensivitity of the anti-resonance control function will be adjusted. | 1 to 3000 [0.1%] | 400 | 560H (1 word) | Yes | Yes | - |
| TUN_82 | Special | Overshoot detection level | Set up the allowable overshoot when performing the tuning function with the ratio relative to the INPOS range. Normally, this does not need to be set. | 0 to 100 [%] | 100 | 561H (1 word) | Yes | Yes | Yes |
| TUN_83 | Special | *I-P control | The control method of the speed control loop is set based on the PI control and I-P control. Normally, this does not need to be set. | 0: PI<br>1: I-P | 0 | 10BH (4 to 7 bits) | Yes | Yes | - |
| TUN_84 | Special | *Speed control mode | Set up the speed control mode for the host controller when controlling the speed. Normally, this does not need to be set. | 0: Speed control<br>1: Pos control at host controller | 0 | 170H (4 to 7 bits) | - | Yes | - |

*1 For parameters marked with "*", the power needs to be restarted to reflect the changes made.

## ■ Alarm-related parameters

| Parameter | Category | Parameter name*1 | Description | Set value: Contents [Unit] | Default | Mechatrolink Parameter No. | Control mode | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Position | Speed | Torque |
| ALM_01 | Extend | *Servo OFF and G1 alarm stop mode | Set up the stop mode when the servo is OFF and the G1 alarm occurs as well as the status after performing a stop. | 0: Dynamic brake<br>1: Free after dynamic brake stop<br>2: Free | 0 | 001H (0 to 3 bits) | Yes | Yes | Yes |
| ALM_02 | Extend | *G2 alarm stop method*2 | Set up the stop mode when the G2 alarm occurs. | 0: Stop by command speed 0<br>1: Same setting as Servo OFF<br>2: Follow the setting of G2 alarm stop mode (ext.) | 1 | 00BH (4 to 7 bits) | Yes | Yes | - |
| ALM_03 | Extend | *G2 alarm stop mode (ext.) | Set up the stop mode when the G2 alarm occurs. This is enabled only when "*G2 alarm stop mode" is set to "2: Follow the setting of G2 alarm stop mode (ext.)". | 0: Same setting as Servo OFF<br>1: Same setting as Servo OFF after decel stop by setting trq<br>2: Free after decel stop by setting trq<br>3: Same setting as Servo OFF after decel stop by setting time<br>4: Free after decel stop by setting time | 1 | 00AH (0 to 3 bits) | Yes | Yes | - |
| ALM_04 | Extend | *FSTOP stop mode*3 | Set up the stop mode when Forced stop is set to ON. | 0: Same setting as Servo OFF<br>1: Same setting as Servo OFF after decel stop by setting trq<br>2: Free after decel stop by setting trq<br>3: Same setting as Servo OFF after decel stop by setting time<br>4: Free after decel stop by setting time | 1 | 00AH (4 to 7 bits) | Yes | Yes | - |
| ALM_05 | Extend | *Limit switch stop mode*4 | Set up the stop mode when the limit switch is set to ON. | 0: Same setting as Servo OFF<br>1: Servo lock after decel stop by setting trq<br>2: Free after decel stop by setting trq<br>3: Servo lock after decel stop by setting time<br>4: Free after decel stop by setting time | 1 | 001H (4 to 7 bits) | Yes | Yes | - |
| ALM_06 | Extend | Common stop torque | Set up the torque value when the G2 alarm occurs, or Forced stop/ the limit switch is set to ON. | 0 to 800 [%] | 800 | 406H (1 word) | Yes | Yes | - |
| ALM_07 | Extend | Common decelerate stop time | Set up the deceleration stop time when the G2 alarm occurs, or Forced stop/ the limit switch is set to ON. | 0 to 10000 [ms] | 0 | 30AH (1 word) | Yes | Yes | - |
| ALM_08 | Extend | *Low battery voltage | Set up how an alarming/warning occurs when the battery voltage is low. | 0: Alarm<br>1: Warning | 0 | 008H (0 to 3 bits) | Yes | Yes | Yes |

*1 For parameters marked with "*", the power needs to be restarted to reflect the changes made.
*2 When using with KV-XH16ML/XH04ML, please use the initial value. It will not function normally if changed.
*3 When using with KV-XH16ML/XH04ML, please use any value of "0~2". It will not function normally if changed.
*4 When using with KV-XH16ML/XH04ML, please use "1"or "3". It will not function normally if changed.

| Parameter | Category | Parameter name*1 | Description | Set value: Contents [Unit] | Default | Mechatrolink Parameter No. | Control mode | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Position | Speed | Torque |
| ALM_09 | Extend | Deviation excessive waring level | Set up the set value to detect the "position deviation excessive warning (900)" with the ratio relative to the "deviation excessive alarm level". | 10 to 100 [%] | 100 | 51EH (1 word) | Yes | - | - |
| ALM_10 | Extend | Deviation excessive alarm level | The "position deviation excessive alarm (D00)" occurs when the absolute value of the position deviation is more than the set value. | 1 to 1073741823 [CMD_PLS] | 5242880 | 520H (2 words) | Yes | - | - |
| ALM_11 | Extend | Overload warning | Set up the ratio for the tine to detect an overload warning relative to the tine to detect an overload alarm. | 1 to 100 [%] | 20 | 52BH (1 word) | Yes | Yes | Yes |
| ALM_12 | Extend | *Base cur at detecting overload | Set up the detection level for the "overload (maximum continuous load) alarm (720)". | 10 to 100 [%] | 100 | 52CH (1 word) | Yes | Yes | Yes |
| ALM_13 | Special | *Warning detection | Set up whether to use the warning detection function. | 0: Detect<br>1: Not detect | 0 | 008H (8 to 11 bits) | Yes | Yes | Yes |
| ALM_14 | Special | Dev excessive alm level at SVON | When the position deviation is more than the set value with Servo ON, the "excessive position deviation at servo ON 1 (D01)" alarm occurs. | 1 to 1073741823 [CMD_PLS] | 5242880 | 526H (2 words) | Yes | - | - |
| ALM_15 | Special | Dev excessive warn level at SVON | Set up the ratio relative to the set value to detect the deviation excessive alarm at servo ON. | 10 to 100 [%] | 100 | 528H (1 word) | Yes | - | - |
| ALM_16 | Special | Speed limit at servo ON | Control the speed using the set value when the position deviation exists with Servo ON. | 0 to 10000 [$min^{-1}$] | 10000 | 529H (1 word) | Yes | - | - |

*1 For parameters marked with "*", the power needs to be restarted to reflect the changes made.

## ■ Other parameters

| Parameter | Category | Parameter name*1 | Description | Set value: Contents [Unit] | Default | Mechatrolink Parameter No. | Control mode | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Position | Speed | Torque |
| OTH_01 | Extend | Brake cmd - SVOFF delay time | Set up the time until the motor is powered off status after outputting the electromagnetic brake command (brake operation) while the servo motor is being stopped. | 0 to 50 [10ms] | 0 | 506H (1 word) | Yes | Yes | Yes |
| OTH_02 | Extend | Brake cmd output speed level | Set up the speed to output the electromagnetic brake command when the servo becomes OFF while the servo motor is rotating. | 0 to 10000 [$min^{-1}$] | 100 | 507H (1 word) | Yes | Yes | Yes |
| OTH_03 | Extend | Waiting time for brake signal | Set up the output delay speed for the electromagnetic brake command when the servo becomes OFF while the servo motor is rotating. | 10 to 100 [10ms] | 50 | 508H (1 word) | Yes | Yes | Yes |
| OTH_04 | Special | JOG operation speed | Set up the rotational speed when operating servo JOG. | 0 to 10000 [$min^{-1}$] | 500 | 304 (1 word) | Yes | Yes | Yes |
| OTH_05 | Special | Pattern operation | Set the operation pattern of the pattern operation. | 0: (Waiting time→ forward movement) × movement times<br>1: (Waiting time → reversal movement) × movement times<br>2: (Waiting time → forward movement) × movement times → (waiting time → reversal movement) × movement times<br>3: (Waiting time → reversal movement) × movement times → (waiting time → forward movement) × movement times<br>4: (Waiting time → forward movement → waiting time → reversal movement) × movement times<br>5: (Waiting time → reversal movement → waiting time → forwardmovement) × movement times | 0 | 530H (0 to 3 bits) | Yes | Yes | Yes |

*1 For parameters marked with "*", the power needs to be restarted to reflect the changes made.

| Parameter | Category | Parameter name*1 | Description | Set value: Contents [Unit] | Default | Mechatrolink Parameter No. | Control mode | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Position | Speed | Torque |
| OTH_06 | Special | Pattern operation movement diatance | Set the pattern operation movement diatance | 1 to 1073741824 [Command pulse] | 32768 | 531H (1word) | Yes | Yes | Yes |
| OTH_07 | Special | Pattern operation speed | Set the pattern operation speed. | 1 to 10000 [$min^{-1}$] | 500 | 533H (1word) | Yes | Yes | Yes |
| OTH_08 | Special | Pattern operation acceleration/ deceleration time | Set the pattern operation acceleration/deceleration time. | 2 to 10000 [ms] | 100 | 534H (1word) | Yes | Yes | Yes |
| OTH_09 | Special | Pattern operation waiting time | Set the pattern operationwaiting time. | 0 to 10000 [ms] | 100 | 535H (1word) | Yes | Yes | Yes |
| OTH_10 | Special | Pattern operation movement times | Set the pattern operation movement times. | 0 to 1000 [Times] | 1 | 536H (1word) | Yes | Yes | Yes |
| OTH_11 | Special | Analog monitor 1 | Set up the signal to monitor using Analog monitor 1. | 00H: Feedback speed<br>01H: Internal command speed<br>02H: Internal command torque<br>03H: Position deviation<br>04H: Position amplifier deviation<br>05H: Position command speed<br>06H: Active gain number<br>07H: Pulse output completion signal<br>08H: INPOS signal<br>09H: Speed feedforward<br>0AH: Torque feedforward<br>0DH: External encoder speed<br>10H: Main circuit DC voltage<br>30H: Analog feedback command torque<br>31H: Analog feedback detection torque<br>32H: Analog feedback output torque<br>33H: Analog feedback torque deviation | 2 | 006H (0 to 7 bits) | Yes | Yes | Yes |
| OTH_12 | Special | Analog monitor 2 | Set up the signal to monitor using Analog monitor 2. | | 0 | 007H (0 to 7 bits) | Yes | Yes | Yes |
| OTH_13 | Special | Analog monitor 1 offset voltage | Set up the offset voltage for analog monitor 1. | -10000 to 10000 [0.1V] | 0 | 550H (1 word) | Yes | Yes | Yes |
| OTH_14 | Special | Analog monitor 2 offset voltage | Set up the offset voltage for analog monitor 2. | -10000 to 10000 [0.1V] | 0 | 551H (1 word) | Yes | Yes | Yes |
| OTH_15 | Special | Analog monitor magnification 1 | Set up the magnification for analog monitor 1. | -10000 to 10000 [0.01 times] | 100 | 552H (1 word) | Yes | Yes | Yes |
| OTH_16 | Special | Analog monitor magnification 2 | Set up the magnification for analog monitor 2. | -10000 to 10000 [0.01 times] | 100 | 553H (1 word) | Yes | Yes | Yes |
| OTH_17 | Special | *Motor less test | Set up whether to use the motor less test function.<br>Allow you to check the respective behaviors of the host controller and peripherals by simulating the motor operation inside the servo amplifier without connecting the motor. | 0: Not used<br>1: Used | 0 | 00CH (0 to 3 bits) | Yes | Yes | Yes |
| OTH_18 | Special | *Motor less encoder type | Set up the encoder type to be used for the motor less test function. | 0: INC<br>1: ABS | 0 | 00CH (8 to 11 bits) | Yes | Yes | Yes |
| OTH_19 | Special | *AC/DC power supply | Set up the type of input power source (AC or DC power supply). | 0: AC<br>1: DC | 0 | 001H (8 to 11 bits) | Yes | Yes | Yes |
| OTH_20 | Special | *3PH/1PH power supply | Set up the type of input power source (single phase or three phase) for the main circuit power supply. | 0: Three phase<br>1: Single phase | 0 | 00BH (8 to 11 bits) | Yes | Yes | Yes |
| OTH_21 | Special | *Main circuit voltage drop | Set up whether to detect the "main circuit supply voltage low warning (971)" when the main circuit power supply voltage drops. | 0: Not detect<br>1: Warning<br>2: Warning and torque limit | 0 | 008H (4 to 7 bits) | Yes | Yes | Yes |
| OTH_22 | Special | Trq lim at main circuit vol drop | Set up the torque limit when the main circuit power supply voltage drops. | 0 to 100 [%] | 50 | 424H (1 word) | Yes | Yes | Yes |
| OTH_23 | Special | Rel time for trq lim at vol drop | Set up the time to lift the torque limit when the main circuit power supply voltage drops. | 0 to 1000 [ms] | 100 | 425H (1 word) | Yes | Yes | Yes |
| OTH_24 | Special | Instantaneous powercut hold time | Set up the instantaneous power cut-off time to enable continuous operation when an instantaneous power cut-off occurs with the main circuit power supply | 20 to 50000 [ms] | 20 | 509H (1 word) | Yes | Yes | Yes |
| OTH_25 | Special | Power consumption update cycle | Set up the unit time for the power usage monitor. | 1 [Second] | 1 | 55AH (1 word) | Yes | Yes | Yes |

*1 For parameters marked with "*", the power needs to be restarted to reflect the changes made.

## ■ I/O-related parameters

| Parameter | Category | Parameter name*1 | Description | Set value: Contents [Unit] | Default | Mechatrolink Parameter No. | Control mode | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Position | Speed | Torque |
| IO_01 | Extend | *Input1 assignment | Set up the function of the input terminal (IN1) (No.7 pin) of the I/O connector. | 0: None<br>1: LSP<br>2: LSN<br>3: DEC<br>7: PTL<br>8: NTL<br>9: FSTOP | 1 | 5E6H (1 word) | Yes | Yes | Yes |
| IO_02 | Extend | *Input2 assignment | Set up the function of the input terminal (IN2) (No.8 pin) of the I/O connector. | | 2 | 5E7H (1 word) | Yes | Yes | Yes |
| IO_03 | Extend | *Input3 assignment | Set up the function of the input terminal (IN3) (No.9 pin) of the I/O connector. | | 7 | 5E8H (1 word) | Yes | Yes | Yes |
| IO_04 | Extend | *Input4 assignment | Set up the function of the input terminal (IN4) (No.10 pin) of the I/O connector. | 0: None<br>1: LSP<br>2: LSN<br>3: DEC<br>4: EXT1<br>5: EXT2<br>6: EXT3<br>7: PTL<br>8: NTL<br>9: FSTOP | 4 | 5E9H (1 word) | Yes | Yes | Yes |
| IO_05 | Extend | *Input5 assignment | Set up the function of the input terminal (IN5) (No.11 pin) of the I/O connector. | | 5 | 5EAH (1 word) | Yes | Yes | Yes |
| IO_06 | Extend | *Input6 assignment | Set up the function of the input terminal (IN6) (No.12 pin) of the I/O connector. | | 6 | 5EBH (1 word) | Yes | Yes | Yes |
| IO_07 | Extend | *Input7 assignment | Set up the function of the input terminal (IN7) (No.13 pin) of the I/O connector. | 0: None<br>1: LSP<br>2: LSN<br>3: DEC<br>7: PTL<br>8: NTL<br>9: FSTOP | 8 | 5ECH (1 word) | Yes | Yes | Yes |
| IO_08 | Extend | *Input1 polarity | Set up the polarity of the input terminal (IN1) (No.7 pin) of the I/O connector. | 0: N.O.<br>1: N.C. | 1 | 5EDH (4 to 7 bits) | Yes | Yes | Yes |
| IO_09 | Extend | *Input2 polarity | Set up the polarity of the input terminal (IN2) (No.8 pin) of the I/O connector. | | 1 | 5EDH (8 to 11 bits) | Yes | Yes | Yes |
| IO_10 | Extend | *Input3 polarity | Set up the polarity of the input terminal (IN3) (No.9 pin) of the I/O connector. | | 0 | 5EDH (12 to 15 bits) | Yes | Yes | Yes |
| IO_11 | Extend | *Input4 polarity | Set up the polarity of the input terminal (IN4) (No.10 pin) of the I/O connector. | | 0 | 5EEH (0 to 3 bits) | Yes | Yes | Yes |
| IO_12 | Extend | *Input5 polarity | Set up the polarity of the input terminal (IN5) (No.11 pin) of the I/O connector. | | 0 | 5EEH (4 to 7 bits) | Yes | Yes | Yes |
| IO_13 | Extend | *Input6 polarity | Set up the polarity of the input terminal (IN6) (No.12 pin) of the I/O connector. | | 0 | 5EEH (8 to 11 bits) | Yes | Yes | Yes |
| IO_14 | Extend | *Input7 polarity | Set up the polarity of the input terminal (IN7) (No.13 pin) of the I/O connector. | | 0 | 5EEH (12 to 15 bits) | Yes | Yes | Yes |
| IO_15 | Extend | *Input1 circuit time constant | Set up the input time constant of the input terminal (IN1) (No.7 pin) of the I/O connector. | 0: 250 µs<br>1: 500 µs<br>2: 1 ms<br>3: 2.5 ms<br>4: 5 ms<br>5: 10 ms | 0 | 5F3H (4 to 7 bits) | Yes | Yes | Yes |
| IO_16 | Extend | *Input2 circuit time constant | Set up the input time constant of the input terminal (IN2) (No.8 pin) of the I/O connector. | | 0 | 5F3H (8 to 11 bits) | Yes | Yes | Yes |
| IO_17 | Extend | *Input3 circuit time constant | Set up the input time constant of the input terminal (IN3) (No.9 pin) of the I/O connector. | | 0 | 5F3H (12 to 15 bits) | Yes | Yes | Yes |
| IO_18 | Extend | *Input4 circuit time constant | Set up the input time constant of the input terminal (IN4) (No.10 pin) of the I/O connector. | | 0 | 5F4H (0 to 3 bits) | Yes | Yes | Yes |
| IO_19 | Extend | *Input5 circuit time constant | Set up the input time constant of the input terminal (IN5) (No.11 pin) of the I/O connector. | | 0 | 5F4H (4 to 7 bits) | Yes | Yes | Yes |
| IO_20 | Extend | *Input6 circuit time constant | Set up the input time constant of the input terminal (IN6) (No.12 pin) of the I/O connector. | | 0 | 5F4H (8 to 11 bits) | Yes | Yes | Yes |
| IO_21 | Extend | *Input7 circuit time constant | Set up the input time constant of the input terminal (IN7) (No.13 pin) of the I/O connector. | | 0 | 5F4H (12 to 15 bits) | Yes | Yes | Yes |
| IO_22 | Extend | *Output1 assignment | Set up the function of the output terminal (OUT1) (No.1 pin) of the I/O connector. | 0: None<br>1: RDY<br>2: INPOS/VCMP<br>3: BRAKE<br>4: TLM/VLM<br>5: WARN<br>6: ZSP<br>7: NEAR | 3 | 5EFH (1 word) | Yes | Yes | Yes |
| IO_23 | Extend | *Output2 assignment | Set up the function of the output terminal (OUT2) (No.23 pin) of the I/O connector. | | 1 | 5F0H (1 word) | Yes | Yes | Yes |
| IO_24 | Extend | *Output3 assignment | Set up the function of the output terminal (OUT3) (No.25 pin) of the I/O connector. | | 5 | 5F1H (1 word) | Yes | Yes | Yes |
| IO_25 | Extend | *Output1 polarity | Set up the polarity of the output terminal (OUT1) (No.1 pin) of the I/O connector. | 0: N.O.<br>1: N.C. | 0 | 5F2H (0 to 3 bits) | Yes | Yes | Yes |
| IO_26 | Extend | *Output2 polarity | Set up the polarity of the output terminal (OUT2) (No.23 pin) of the I/O connector. | 0: N.O.<br>1: N.C. | 0 | 5F2H (4 to 7 bits) | Yes | Yes | Yes |
| IO_27 | Extend | *Output3 polarity | Set up the polarity of the output terminal (OUT3) (No.25 pin) of the I/O connector. | 0: N.O.<br>1: N.C. | 0 | 5F2H (8 to 11 bits) | Yes | Yes | Yes |

*1 For parameters marked with "*", the power needs to be restarted to reflect the changes made.

## ■ MECHATROLINK-III-related parameters

| Parameter | Category | Parameter name*1 | Description | Set value: Contents [Unit] | Default | Mechatrolink Parameter No. |
|---|---|---|---|---|---|---|
| ML_01 | Special | Software limit*2 | Set up whether to use the function of the software limit function. | 0: Enabled<br>1: P-Software limit invalid<br>2: N-Software limit invalid<br>3: Disabled | 3 | 801H<br>(0 to 3 bits) |
| ML_02 | Special | Software limit check | Set up whether to perform software limit check when inputting the target position command via POSING or INTERPOLATE. | 0: Disable<br>1: Enable | 0 | 801H<br>(8 to 11 bits) |
| ML_03 | Special | Origin range | Set up the origin coordinate range. | 0 to 250<br>[CMD_PLS] | 10 | 803H<br>(1 word) |
| ML_04 | Special | P-Software limit | Set the positive direction side soft limit. | $-2^{30}+1$ to $2^{30}-1$<br>[CMD_PLS] | 1073741823 | 804H<br>(2 words) |
| ML_05 | Special | N-Software limit | Set the negative direction side soft limit. | $-2^{30}+1$ to $2^{30}-1$<br>[CMD_PLS] | -1073741823 | 806H<br>(2 words) |
| ML_06 | Special | ABS encoder origin coordinate offset | Set up the offset value for both the encoder position and feedback position (APOS) when using the absolute encoder. | $-2^{30}+1$ to $2^{30}-1$<br>[CMD_PLS] | 0 | 808H<br>(2 words) |
| ML_07 | Special | 1st acceleration rate 1 | Set up the 1st acceleration rate 1 when performing the POSING, EX_POSING, FEED, ZRET and/or HOLD command. | 1 to 65535<br>[10000 CMD_PLS/$s^2$] | 100 | 80AH<br>(1 word) |
| ML_08 | Special | 2nd acceleration rate 1 | Set up the 2nd acceleration rate 1 when performing the POSING, EX_POSING, FEED, ZRET and/or HOLD command. | 1 to 65535<br>[10000 CMD_PLS/$s^2$] | 100 | 80BH<br>(1 word) |
| ML_09 | Special | Acceleration rate switch speed 1 | Set up the speed to switch between [1st acceleration rate 1] and [2nd acceleration rate 1]. | 0 to 65535<br>[100 CMD_PLS/$s^2$] | 0 | 80CH<br>(1 word) |
| ML_10 | Special | 1st deceleration rate 1 | Set up the 1st deceleration rate 1 when performing the POSING, EX_POSING, FEED, ZRET and/or HOLD command. | 1 to 65535<br>[10000 CMD_PLS/$s^2$] | 100 | 80DH<br>(1 word) |
| ML_11 | Special | 2nd deceleration rate 1 | Set up the 2nd deceleration rate 1 when performing the POSING, EX_POSING, FEED, ZRET and/or HOLD command. | 1 to 65535<br>[10000 CMD_PLS/$s^2$] | 100 | 80EH<br>(1 word) |
| ML_12 | Special | Deceleration rate switch speed 1 | Set up the speed to switch between [1st deceleration rate 1] and [2nd deceleration rate 1]. | 0 to 65535<br>[100 CMD_PLS/$s^2$] | 0 | 80FH<br>(1 word) |
| ML_13 | Special | Acceleration/ deceleration bias | Set up the bias speed for the acceleration/ deceleration filter used by the exponential function. | 0 to 65535<br>[100 CMD_PLS/$s^2$] | 0 | 810H<br>(1 word) |
| ML_14 | Special | Accel/decel time constant | Set up the time constant for the acceleration/ deceleration filter used by the exponential function. | 0 to 5100<br>[0.1ms] | 0 | 811H<br>(1 word) |
| ML_15 | Special | Movement average time | Set up the movement average time for the movement average filter. | 0 to 5100<br>[0.1ms] | 0 | 812H<br>(1 word) |
| ML_16 | Special | Distance after latch | Set up the distance moved after inputting the latch signal. | $-2^{30}+1$ to $2^{30}-1$<br>[CMD_PLS] | 100 | 814H<br>(2 words) |
| ML_17 | Special | Origin creep speed 1 | Set up the creep speed during return to origin after inputting the signal for the origin return deceleration switch (DEC). | 0 to 65535<br>[100 CMD_PLS/$s^2$] | 50 | 817H<br>(1 word) |
| ML_18 | Special | Origin creep speed 1 (ext.) | Set up the creep speed during return to origin after inputting the signal for the origin return deceleration switch (DEC).<br>This is enabled only when "Origin creep speed 1"is set to "0". | 0 to 20971520<br>[100 CMD_PLS/$s^2$] | 0 | 842H<br>(2 words) |
| ML_19 | Special | Origin creep speed 2 | Set up the creep speed during return to origin after inputting the latch signal. | 0 to 65535<br>[100 CMD_PLS/$s^2$] | 5 | 818H<br>(1 word) |
| ML_20 | Special | Origin creep speed 2 (ext.) | Set up the creep speed during return to origin after inputting the latch signal.<br>This is enabled only when "Origin creep speed 2" is set to "0". | 0 to 20971520<br>[100 CMD_PLS/$s^2$] | 0 | 844H<br>(2 words) |
| ML_21 | Special | Origin distance after latch*3 | Set up the distance moved during return to origin after inputting the latch signal. | $-2^{30}+1$ to $2^{30}-1$<br>[CMD_PLS] | 0 | 819H<br>(2 words) |
| ML_22 | Special | P-Latching allowable area*2 | Set up the forward latch ready area. | $-2^{31}$ to $2^{31}-1$<br>[CMD_PLS] | 0 | 820H<br>(2 words) |
| ML_23 | Special | N-Latching allowable area*2 | Set up the reversal latch ready area. | $-2^{31}$ to $2^{31}-1$<br>[CMD_PLS] | 0 | 822H<br>(2 words) |
| ML_24 | Special | Stop deceleration rate 1 | Set up the deceleration rate 1 when performing the HOLD and/or SV_OFF command. | 1 to 65535<br>[10000 CMD_PLS/$s^2$] | 100 | 827H<br>(1 word) |
| ML_25 | Special | *Accel/decel rate*3 | Select the 1st and 2nd acceleration/ deceleration rates. | 0: 1 is valid<br>1: 2 is valid | 0 | 833H<br>(0 to 3 bits) |
| ML_26 | Special | 1st acceleration rate 2 | Set up the 1st acceleration rate 2 when performing the POSING, EX_POSING, FEED, ZRET and/or HOLD command. | 1 to 20971520<br>[10000 CMD_PLS/$s^2$] | 100 | 834H<br>(2 words) |

*1 For parameters marked with "*", the power needs to be restarted to reflect the changes made.
*2 When used together with KV-XH16ML/XH04ML, use the series with the defaults. Otherwise, the unit cannot work properly.
*3 When used together with KV-XH16ML/XH04ML, normally use the series with the defaults.

| Parameter | Category | Parameter name*1 | Description | Set value: Contents [Unit] | Default | Mechatrolink Parameter No. |
|---|---|---|---|---|---|---|
| ML_27 | Special | 2nd acceleration rate 2 | Set up the 2nd acceleration rate 2 when performing the POSING, EX_POSING, FEED, ZRET and/or HOLD command. | 1 to 20971520 [10000 CMD_PLS/s$^2$] | 100 | 836H (2 words) |
| ML_28 | Special | Acceleration rate change speed 2 | Set up the speed to switch between [1st acceleration rate 2] and [2nd acceleration rate 2]. | 0 to 2097152000 [CMD_PLS/s] | 0 | 838H (2 words) |
| ML_29 | Special | 1st deceleration rate 2 | Set up the 1st deceleration rate 2 when performing the POSING, EX_POSING, FEED, ZRET and/or HOLD command. | 1 to 20971520 [10000 CMD_PLS/s$^2$] | 100 | 83AH (2 words) |
| ML_30 | Special | 2nd deceleration rate 2 | Set up the 2nd deceleration rate 2 when performing the POSING, EX_POSING, FEED, ZRET and/or HOLD command. | 1 to 20971520 [10000 CMD_PLS/s$^2$] | 100 | 83CH (2 words) |
| ML_31 | Special | Deceleration rate switch speed 2 | Set up the speed to switch between [1st deceleration rate 2] and [2nd deceleration rate 2]. | 0 to 2097152000 [CMD_PLS/s] | 0 | 83EH (2 words) |
| ML_32 | Special | Stop deceleration rate 2 | Set up the deceleration rate 2 when performing the HOLD and/or SV_OFF command. | 1 to 20971520 [10000 CMD_PLS/s$^2$] | 100 | 840H (2 words) |
| ML_33 | Special | Latch signal number | Set up the number of signals to be latched by a series of latch operations. | 0 to 8 | 0 | 850H (1 word) |
| ML_34 | Special | Continuous latch count | Set up the number of latch operation cycles. | 0 to 255 | 0 | 851H (1 word) |
| ML_35 | Special | Latch signal 1 | Set up the latch signal 1. | 0: Z-phase<br>1: EXT1<br>2: EXT2<br>3: EXT3 | 0 | 852H (0 to 3 bits) |
| ML_36 | Special | Latch signal 2 | Set up the latch signal 2. | | 0 | 852H (4 to 7 bits) |
| ML_37 | Special | Latch signal 3 | Set up the latch signal 3. | | 0 | 852H (8 to 11 bits) |
| ML_38 | Special | Latch signal 4 | Set up the latch signal 4. | | 0 | 852H (12 to 15 bits) |
| ML_39 | Special | Latch signal 5 | Set up the latch signal 5. | | 0 | 853H (0 to 3 bits) |
| ML_40 | Special | Latch signal 6 | Set up the latch signal 6. | | 0 | 853H (4 to 7 bits) |
| ML_41 | Special | Latch signal 7 | Set up the latch signal 7. | | 0 | 853H (8 to 11 bits) |
| ML_42 | Special | Latch signal 8 | Set up the latch signal 8. | | 0 | 853H (12 to 15 bits) |
| ML_43 | Special | IO_STS1 monitor signal | Set up the signal to be monitored by bit 24 of the IO monitor field. | 0: None<br>2: IN1<br>3: IN2<br>4: IN3<br>5: IN4<br>6: IN5<br>7: IN6<br>8: IN7<br>9: OUT1<br>10: OUT2<br>11: OUT3 | 2 | 860H (0 to 3 bits) |
| ML_44 | Special | IO_STS2 monitor signal | Set up the signal to be monitored by bit 25 of the IO monitor field. | | 3 | 860H (4 to 7 bits) |
| ML_45 | Special | IO_STS3 monitor signal | Set up the signal to be monitored by bit 26 of the IO monitor field. | | 4 | 860H (8 to 11 bits) |
| ML_46 | Special | IO_STS4 monitor signal | Set up the signal to be monitored by bit 27 of the IO monitor field. | | 5 | 860H (12 to 15 bits) |
| ML_47 | Special | IO_STS5 monitor signal | Set up the signal to be monitored by bit 28 of the IO monitor field. | | 6 | 861H (0 to 3 bits) |
| ML_48 | Special | IO_STS6 monitor signal | Set up the signal to be monitored by bit 29 of the IO monitor field. | | 7 | 861H (4 to 7 bits) |
| ML_49 | Special | IO_STS7 monitor signal | Set up the signal to be monitored by bit 30 of the IO monitor field. | | 8 | 861H (8 to 11 bits) |
| ML_50 | Special | IO_STS8 monitor signal | Set up the signal to be monitored by bit 31 of the IO monitor field. | | 0 | 861H (12 to 15 bits) |

*1 For parameters marked with "*", the power needs to be restarted to reflect the changes made.

| Parameter | Category | Parameter name*1 | Description | Set value: Contents [Unit] | Default | Mechatrolink Parameter No. |
|---|---|---|---|---|---|---|
| ML_51 | Special | MECHATROLINK select monitor 1*4 | Set up the items to be monitored by the fixed monitor field 1 (CPRM_SEL_MON1). | 0: Feedback position (APOS)<br>1: Command position (CPOS)<br>2: Position deviation (PERR)<br>3: Latch position 1 (LPOS1)<br>4: Latch position 2 (LPOS2)<br>5: Feedback speed (FSPD)<br>6: Internal command speed (CSPD)<br>7: Internal command torque (TRQ)<br>8: Analog feedback command torque<br>9: Analog feedback detection torque<br>10: Analog feedback output torque<br>11: Analog feedback torque deviation<br>12: Control mode<br>13: Alarm code (ALARM)<br>14: Feedback pulse counter (Lower)<br>15: Feedback pulse counter (Upper)<br>16: Fully closed feedback pulse counter (Lower)<br>17: Fully closed feedback pulse counter (Upper)<br>18: Within 1 revolution position<br>19: Speed limit (SPD_LIM)<br>20: Torque limit (TRQ_LIM)<br>21: Initial multiturn data<br>22: Initial within 1 revolution position<br>23: Initial feedback position (INIT_PGPOS) (Lower)<br>24: Initial feedback position (INIT_PGPOS) (Upper)<br>25: Operation status (SV_STAT)<br>26: Input signal monitor<br>27: Output signal monitor<br>28: Load ratio<br>29: Regenerative load ratio<br>30: DB resistance load ratio<br>31: Power consumption<br>32: Power consumption<br>33: Cumulative power consumption<br>34: Last value of LPOS 1<br>35: Internal command position (MPOS)<br>36: Target position (TPOS)<br>37: Internal command position (IPOS)<br>38: Command position offset (POS_OFFSET)<br>39: Target speed (TSPD) | 1 | 8FEH (1 word) |
| ML_52 | Special | MECHATROLINK select monitor 2*4 | Set up the items to be monitored by the fixed monitor field 2 (CPRM_SEL_MON2). | | 0 | 8FFH (1 word) |

*1 For parameters marked with "*", the power needs to be restarted to reflect the changes made.
*4 If you don't use the SV2 series setting software/KV-XH setting tool, when changing the "MECHATROLINK selection monitor 1(ML_51)", "MECHATROLINK selection monitor 2"(ML_52) from the program, please also change "CPRM_SEL_MON1", " CPRM_SEL_MON2", "Common monitor 1(CPRM_SEL_MON)", "Option monitor 2(CPRM_SEL_MON)".

| Parameter | Category | Parameter name*1 | Description | Set value: Contents [Unit] | Default | Mechatrolink Parameter No. |
|---|---|---|---|---|---|---|
| - | - | CPRM_SEL_MON1*5 | Fixed monitor field 1<br>Set the monitor items by (CPRM_SEL_MON1). | 0H: Returning position (APOS)<br>1H: Command position (CPOS)<br>2H: Position deviation (PERR)<br>3H: Latch position 1 (LPOS1)<br>4H: Latch position 2 (LPOS2)<br>5H: Returning speed (FSPD)<br>6H: Command speed (CSPD)<br>7H: Internal command torque (TRQ)<br>8H: Alarm code (ALARM)<br>9H: Command code (MPOS)<br>CH: Common monitor 1 (CMN1)<br>DH: Common monitor 2 (CMN2)<br>EH: Option monitor 1 (OMN1)<br>FH: Option monitor 2 (OMN2) | 1H | 84CH<br>(1 word) |
| - | - | CPRM_SEL_MON2*5 | Fixed monitor field 2<br>Set the monitor items by (CPRM_SEL_MON1). | | 0H | 84DH<br>(1 word) |
| - | - | Common monitor 1 (CPRM_SEL_MON)*5 | When CPRM_SEL_MON1/CPRM_SEL_MON2 is set to [CH: common monitor 1 (CMN1)], set the items which is monitored by the fixed monitor field (CPRM_SEL_MON1)/fixed monitor field 2 (CPRM_SEL_MON2). | 0: Target position (TPOS)<br>1: Internal command position (IPOS)<br>2: Command position offset (POS_OFFSET)<br>3: Target speed (TSPD)<br>4: Speed limit (SPD_LIM)<br>5: Torque limit (TRQ_LIM)<br>6: Operation status (SV_STAT)<br>8: Initial returning position (INIT_PGPOS) (lower position)<br>9: Initial returning position (INIT_PGPOS) (upper position) | 0 | 84EH<br>(1 word) |
| - | - | Common monitor 2 (CPRM_SEL_MON)*5 | When CPRM_SEL_MON1/CPRM_SEL_MON2 is set to [DH: common monitor 2 (CMN2)], set the items which is monitored by the fixed monitor field (CPRM_SEL_MON1)/fixed monitor field 2 (CPRM_SEL_MON2). | | 0 | 84FH<br>(1 word) |

*5 When setting the "[MECHATROLINK selection monitor 1] (ML_51)", "MECHATROLINK selection monitor 2" (ML_52) from the SV2 series setting software/KV-XH setting tool, it can be automatically set.
When changing the "[MECHATROLINK selection monitor 1] (ML_51)", "MECHATROLINK selection monitor 2" (ML_52) from the program, please change in all.
When using with KV-XH16ML/XH04ML, you can use the "parameter 1 point reading/writing" function to change.

| Parameter | Category | Parameter name*1 | Description | Set value: Contents [Unit] | Default | Mechatrolink Parameter No. |
|---|---|---|---|---|---|---|
| - | - | Option monitor 1 (CPRM_SEL_MON)*5 | When CPRM_SEL_MON1/CPRM_SEL_MON2 is set to [EH: option monitor 1 (OMN1)], set the items which is monitored by the fixed monitor field (CPRM_SEL_MON1)/fixed monitor field 2 (CPRM_SEL_MON2). | 000AH: Returning pulse counter (lower position)<br>000BH: Returning pulse counter (Upper position)<br>000CH: Full closed returning pulse counter (lower position)<br>000DH: Full closed returning pulse counter (upper position)<br>0013H: Position within one rotation<br>0015H: Input signal monitor<br>0016H: Output signal monitor<br>0019H: Load rate<br>001AH: Regenerative load rate<br>001BH: DB resistance load rate<br>0023H: Initial multiple rotationdata<br>0024H: Initial single rotation position<br>0046H: Electricity consumption<br>0047H: Electricity consumption amount<br>0048H: Accumulated electricity consumption<br>0050H: Analog feedback detection torque<br>0052H: Control mode<br>0053H: Analog feedback command torque<br>0054H: Analog feedback output torque<br>0055H: Analog feedback torque deviation<br>0080H:Latch position 1 (LPOS1) previous value<br>0081H: Latch position 2 (LPOS2) previous value<br>0084H: Continuous latch status | 000AH | 824H (1 word) |
| - | - | Option monitor 2 (CPRM_SEL_MON)*5 | When CPRM_SEL_MON1/CPRM_SEL_MON2 is set to [FH: option monitor 2 (OMN2)], set the items which is monitored by the fixed monitor field (CPRM_SEL_MON1)/fixed monitor field 2 (CPRM_SEL_MON2). | | 000AH | 825H (1 word) |

*5 When setting the "[MECHATROLINK selection monitor 1] (ML_51)", "MECHATROLINK selection monitor 2" (ML_52) from the SV2 series setting software/KV-XH setting tool, it can be automatically set.
When changing the "[MECHATROLINK selection monitor 1] (ML_51)", "MECHATROLINK selection monitor 2" (ML_52) from the program, please change in all.
When using with KV-XH16ML/XH04ML, you can use the "parameter 1 point reading/writing" function to change.

| Parameter | Category | Parameter name*1 | Description | Set value: Contents [Unit] | Default | Mechatrolink Parameter No. |
|---|---|---|---|---|---|---|
| ML_53 | Special | MECHATROLINK comm check mask | Set up whether to mask MECHATROLINK communication alarms. | 0: No mask<br>1: Ignore MLcom error(A.E60)<br>2: Ignore WDT error(A.E50)<br>3: Ignore both communication malfunction(A.E60) and WDT error(A.E50) | 0 | 800H<br>(0 to 3 bits) |
| ML_54 | Special | Warning check mask | Set up whether to mask warnings. | 0H: No mask<br>1H: Ignore data setting warning(A.94*)<br>2H: Ignore command warning(A.95*)<br>3H: Ignore A.94*,A.95*<br>4H: Ignore communication warning(A.96*)<br>5H: Ignore A.94*,A.96*<br>6H: Ignore A.95*,A.96*<br>7H: Ignore A.94*,A.95*, A.96*<br>8H: Ignore command warning(A.97A, A.97B)<br>9H: Ignore A.94*,A.97A, A.97B<br>AH: Ignore A.95*, A.97A,A.97B<br>BH: Ignore A.94*,A.95*, A.97A,A.97B<br>CH: A.96*,A.97A, A.97B<br>DH: Ignore A.94*,A.96*, A.97A,A.97B<br>EH: Ignore A.95*,A.96*, A.97A,A.97B<br>FH: Ignore A.94*,A.95*, A.96*,A.97A, A.97B | 4 | 800H<br>(4 to 7 bits) |
| ML_55 | Special | Automatic warning clear | Set up whether to use automatic warning clear for MECHATROLINK commands. | 0: Not used<br>1: Used | 1 | 800H<br>(12 to 15 bits) |
| ML_56 | Special | SVOFF wait time | Set the waiting time until servo OFF after performing the SV_OFF command while the motor is rotating. | 0 to 65535<br>[10ms] | 0 | 829H<br>(1 word) |
| ML_57 | Special | Communication error brake signal | Set up the status of the electromagnetic brake when a MECHATROLINK communication error occurs. | 0: Depend on command<br>1: Always enable | 0 | 884H<br>(0 to 3 bits) |
| ML_58 | Special | *Speed unit*3*6 | Set up the unit to specify the speed with the motion command. | 0: CMD_PLS/s<br>1: CMD_PLS/min<br>2: Percentage (%) of rated speed<br>3: $min^{-1}$<br>4: Max. motor speed/ 40000000H | 0 | 8F0H<br>(1 word) |
| ML_59 | Special | *Speed base unit*3*6 | Set up the unit exponent to specify the speed with the motion command. | -3: 0.001<br>-2: 0.01<br>-1: 0.1<br>0: 1<br>1: 10<br>2: 100<br>3: 1000 | 0 | 8F1H<br>(1 word) |
| ML_60 | Special | *Position unit | Set up the unit to specify the position with the motion command. | 0: CMD_PLS | 0 | 8F2H<br>(1 word) |
| ML_61 | Special | *Position base unit | Set up the unit exponent to specify the position with the motion command. | 0: 1 | 0 | 8F3H<br>(1 word) |
| ML_62 | Special | *Acceleration unit*3 | Set up the unit to specify acceleration/ deceleration with the motion command. | 0: CMD_PLS/$s^2$ | 0 | 8F4H<br>(1 word) |

*1 For parameters marked with "*", the power needs to be restarted to reflect the changes made.
*3 When used together with KV-XH16ML/XH04ML, normally use the series with the defaults.
*6 When the "*speed unit" (ML_58) is set to "2: % against the rated speed" or "3: min-1", please set the "* speed basic unit" (ML_59) to "-3:0.001" to "0:1". It will not function normally if changed.

| Parameter | Category | Parameter name*1 | Description | Set value: Contents [Unit] | Default | Mechatrolink Parameter No. |
|---|---|---|---|---|---|---|
| ML_63 | Special | *Acceleration base unit*3 | Set up the unit exponent to specify acceleration/deceleration with the motion command. | 4: 10000<br>5: 100000<br>6: 1000000 | 4 | 8F5H<br>(1 word) |
| ML_64 | Special | *Torque unit*3*7 | Set up the unit exponent to specify the torque with the motion command. | 1: Percentage (%) of rated torque<br>2: Max. motor torque/ 40000000H | 1 | 8F6H<br>(1 word) |
| ML_65 | Special | *Torque base unit*3*7 | Set up the unit to specify the torque with the motion command. | -5: 0.00001<br>-4: 0.0001<br>-3: 0.001<br>-2: 0.01<br>-1: 0.1<br>0: 1 | -2 | 8F7H<br>(1 word) |

*1 For parameters marked with "*", the power needs to be restarted to reflect the changes made.
*3 When used together with KV-XH16ML/XH04ML, normally use the series with the defaults.
*7 If the "* torque unit" (ML_64) was set to "2:Maximum torque/40000000H", please set the "* Torque basic unit" (ML_65) to "0:1". It will not function normally if changed.

## ■ Fully closed control-related parameters

| Parameter | Category | Parameter name*1 | Description | Set value: Contents [Unit] | Default | Mechatrolink Parameter No. |
|---|---|---|---|---|---|---|
| FC_01 | Extend | *External encoder | Set up the method to use the external encoder for fully closed control. | 0: Not used<br>1: Forward direction for motor CCW<br>3: Reverse direction for motor CCW | 0 | 002H<br>(12 to 15 bits) |
| FC_02 | Extend | *External encoder coordinate transformation (numerator) | Set up the proportion of external encoder distance resolution and motor encoder distance resolution.<br>Numerator/denominator=external encoder distance resolution/motor encoder distance resolution | 1 to 1073741824 | 4194304 | 284H<br>(2 words) |
| FC_03 | Extend | *External encoder coordinate transformation (denominator) | Set up the proportion of external encoder distance resolution and motor encoder distance resolution.<br>Numerator/denominator=external encoder distance resolution/motor encoder distance resolution | 1 to 1073741824 | 50000 | 286H<br>(2 words) |
| FC_04 | Extend | *External encoder Z phase pulse output | Set up only when an incremental linear encoder is used that outputs Z-phase only in one direction. | 0: Forward only<br>1: Forward and reverse | 1 | 081H<br>(0 to 3 bits) |
| FC_05 | Extend | *External encoder division output resolution | Set up the number of encoder division output pulses per scale pitch of the external encoder. | 1 to 4096<br>[Edge/Scale pitch] | 20 | 281H<br>(1 word) |
| FC_06 | Special | Motor-external encoder deviation excessive alarm level | Set up to detect the difference between the feedback position of the motor encoder and the feedback position (load position) of the external encoder.<br>The "motor-external encoder deviation excessive alarm" (D10) occurs when exceeding the set value. | 0 to 1073741824<br>[CMD_PLS] | 1000 | 51BH<br>(2 words) |
| FC_07 | Special | Slip correction coefficient per motor rotation | Set up the "motor-external encoder deviation coefficient" per motor rotation.<br>Used to control detection of the "motor-external encoder deviation excessive alarm" (D10) due to belt slippage, etc. | 0 to 100<br>[%] | 0 | 52AH<br>(1 word) |
| FC_08 | Special | *Fully closed control speed feedback | Select the encoder to be used for speed feedback.<br>Normally, select the motor encoder. | 0: Motor encoder<br>1: External encoder | 0 | 22AH<br>(12 to 15 bits) |

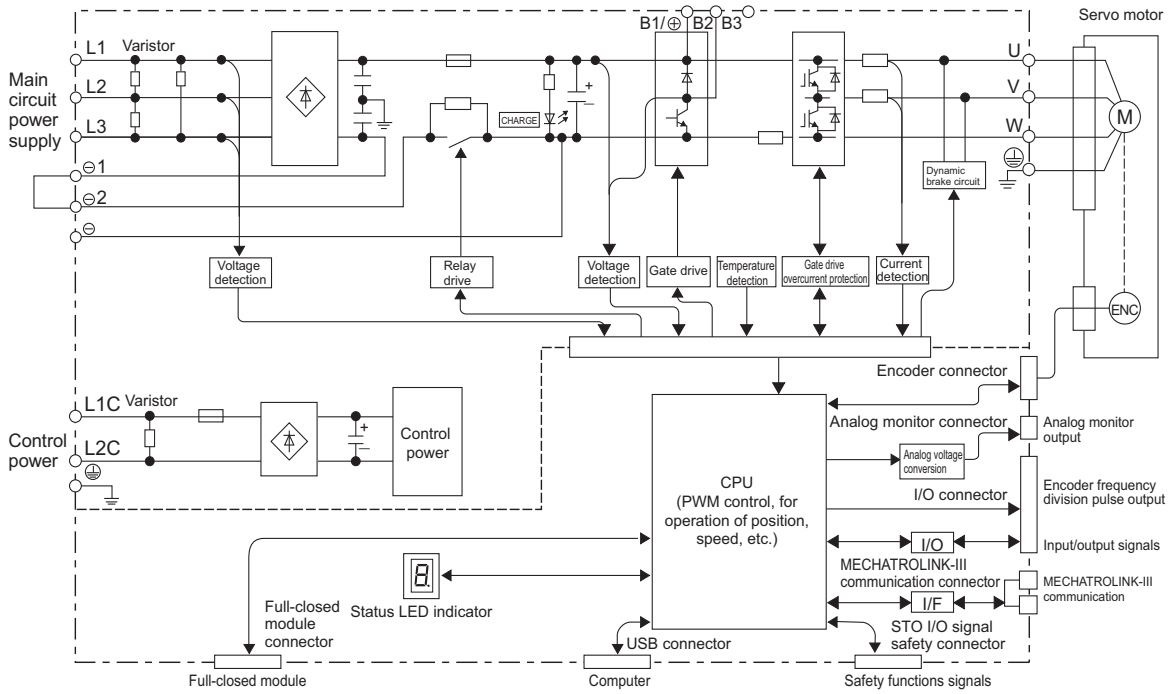
*1 For parameters marked with "*", the power needs to be restarted to reflect the changes made.

## ■ Analog feedback-related parameters

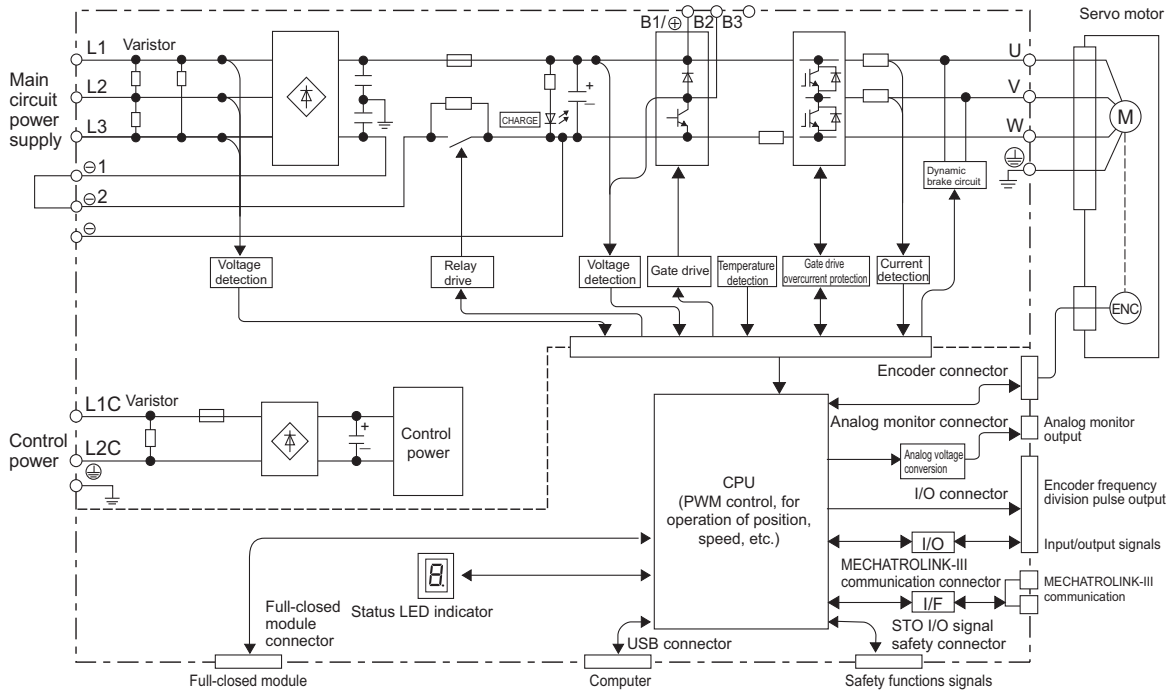
| Parameter | Category | Parameter name*1 | Description | Set value: Contents [Unit] | Default | Mechatrolink Parameter No. |
|---|---|---|---|---|---|---|
| AFB_01 | Extend | *Analog feedback control | Set up whether to use the analog feedback control function and also set up the torque command direction. | 0: Not used<br>1: Used (Forward trq command)<br>2: Used (Reverse trq command) | 0 | 440H<br>(0 to 3 bits) |
| AFB_02 | Extend | *Analog feedback enable control mode | Set up the control mode to enable the analog feedback control function. | 0: Enable at trq control<br>1: Enable at vel control<br>3: Enable at trq and vel control | 1 | 458H<br>(8 to 11 bits) |
| AFB_03 | Extend | *Tuning mode | Set up the method to adjust the gain when using analog feedback control. | 0: Manual tuning<br>1: Auto tuning | 1 | 458H<br>(4 to 7 bits) |
| AFB_04 | Extend | Auto tuning response | Set up the proper value for mechanical system rigidity and requested responses when using auto tuning. | 1 to 65535 | 10 | 4A0H<br>(1 word) |
| AFB_05 | Extend | Analog input gain | Set up the gain for sensor input when using analog feedback control. | 0 to 10000<br>[0.01V/Rated torque] | 0 | 449H<br>(1 word) |
| AFB_06 | Extend | *Analog input polarity | Set up whether to invert the polarity for sensor input when using analog feedback control. | 0: Not invert<br>1: Invert | 0 | 440H<br>(4 to 7 bits) |
| AFB_07 | Extend | Analog input filter | Set up the low-pass filter for sensor input when using analog feedback control. | 0 to 65535<br>[0.01ms] | 100 | 44AH<br>(1 word) |
| AFB_08 | Extend | Analog input offset | Set up the offset in percentage to the rated torque for sensor input when using analog feedback control. | -10000 to 10000<br>[0.01%] | 0 | 448H<br>(1 word) |
| AFB_09 | Extend | Analog feedback ctrl enable change trq | Set up the sensor input level in percentage to the rated torque to enable analog feedback control. | -10000 to 10000<br>[0.01%] | 1000 | 44CH<br>(1 word) |
| AFB_10 | Extend | Analog feedback ctrl disable change trq | Set up the sensor input level in percentage to the rated torque to disable analog feedback control. | -10000 to 10000<br>[0.01%] | 0 | 45AH<br>(1 word) |
| AFB_11 | Extend | Torque deviation excessive alarm level | Set up the set value to detect the "analog feedback torque deviation excessive" (D0A) in percentage to the rated torque to disable analog feedback control. | 0 to 800<br>[%] | 100 | 447H<br>(1 word) |
| AFB_12 | Extend | Detection trq excessive warning level | Set up the set value in percentage to the rated torque to disable analog feedback control and detect the "analog feedback torque deviation excessive warning" (922). | -800 to 800<br>[%] | 300 | 44DH<br>(1 word) |
| AFB_13 | Extend | Detection trq excessive warning time | Set up the time until the "analog feedback torque deviation excessive warning" (922) is detected when the analog feedback detection torque is more than the set value. | 0 to 5000<br>[0.1ms] | 0 | 44EH<br>(1 word) |
| AFB_14 | Special | Integral time constant | Set up the integral time for the analog feedback control loop. | 0 to 51200<br>[0.01ms] | 2000 | 442H<br>(1 word) |
| AFB_15 | Special | Feed forward | Set up feed forward for the analog feedback control loop. | 0 to 1000<br>[%] | 0 | 444H<br>(1 word) |
| AFB_16 | Special | Differential time | Set up the differential time for the analog feedback control loop. | 0 to 51200<br>[0.1ms] | 0 | 450H<br>(1 word) |
| AFB_17 | Special | Differential filter multiplier | Set up the low-pass filter placed before the differential compensator for the analog feedback control loop, in multiplication to the differential time. | 0 to 10000<br>[%] | 100 | 451H<br>(1 word) |
| AFB_18 | Special | Proportional gain | Set up the proportional gain for the analog feedback control loop. | 0 to 10000<br>[%] | 100 | 452H<br>(1 word) |
| AFB_19 | Special | Gravity compensation | Set up whether to use the gravity compensation function when using analog feedback control. Automatically compensate for gravity when affected by gravity of the vertical axis, etc. | 0: Not used<br>1: Used | 0 | 440H<br>(12 to 15 bits) |
| AFB_20 | Special | Gravity compensation std level | Set up the standard level in percentage to the rated torque to apply the gravity compensation function when using analog feedback control. | -10000 to 10000<br>[0.01%] | 0 | 459H<br>(1 word) |

*1 For parameters marked with "*", the power needs to be restarted to reflect the changes made.

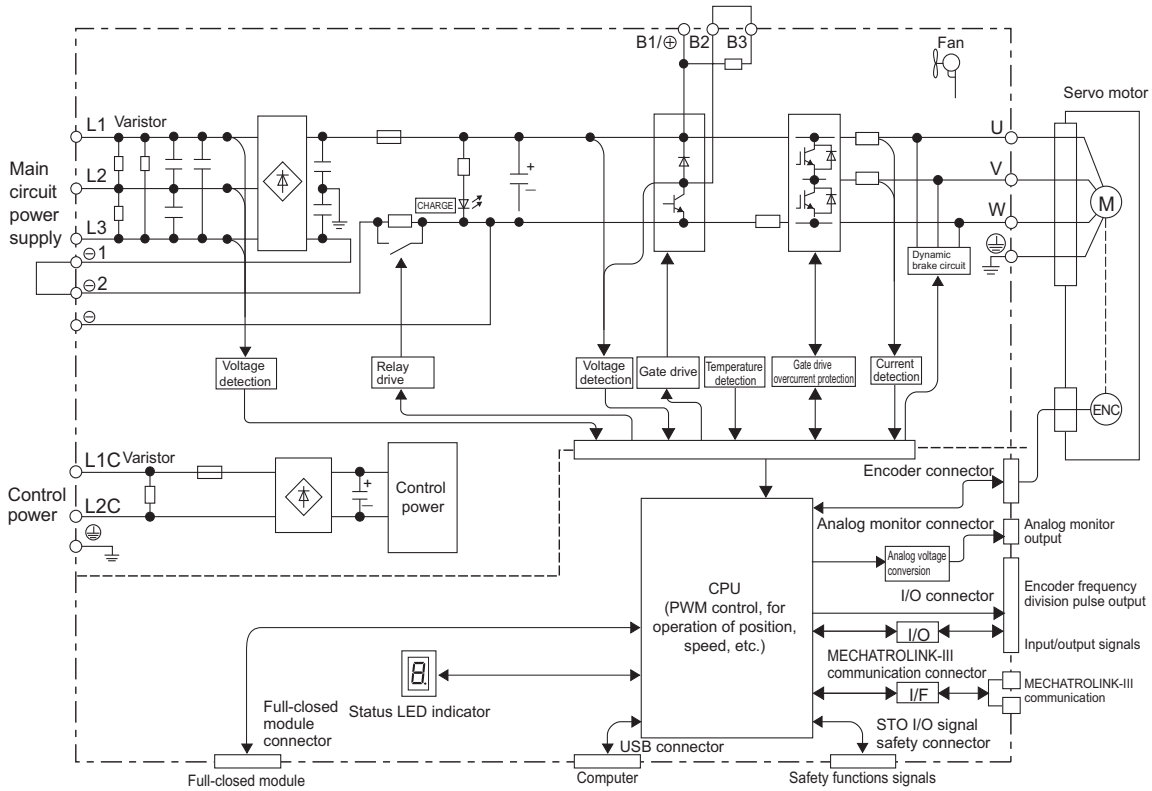
## ■ SV2-005L2/010L2/020L2



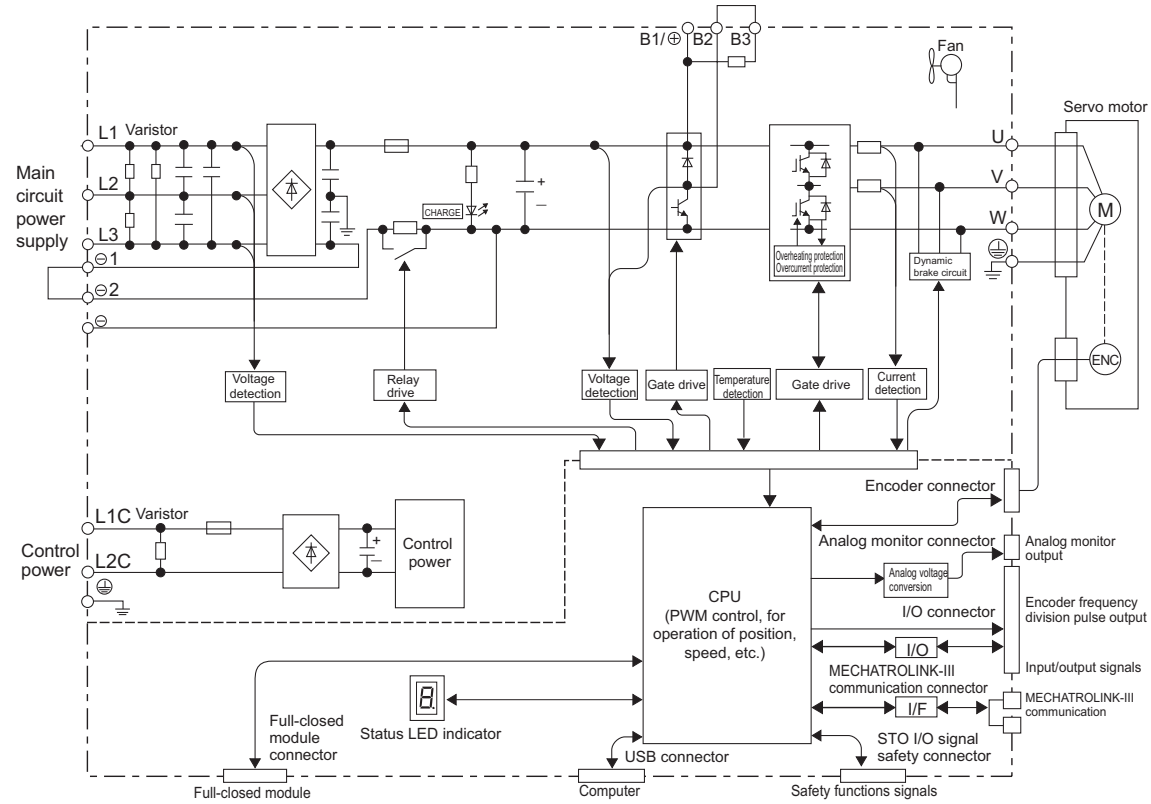

## ■ SV2-040L2



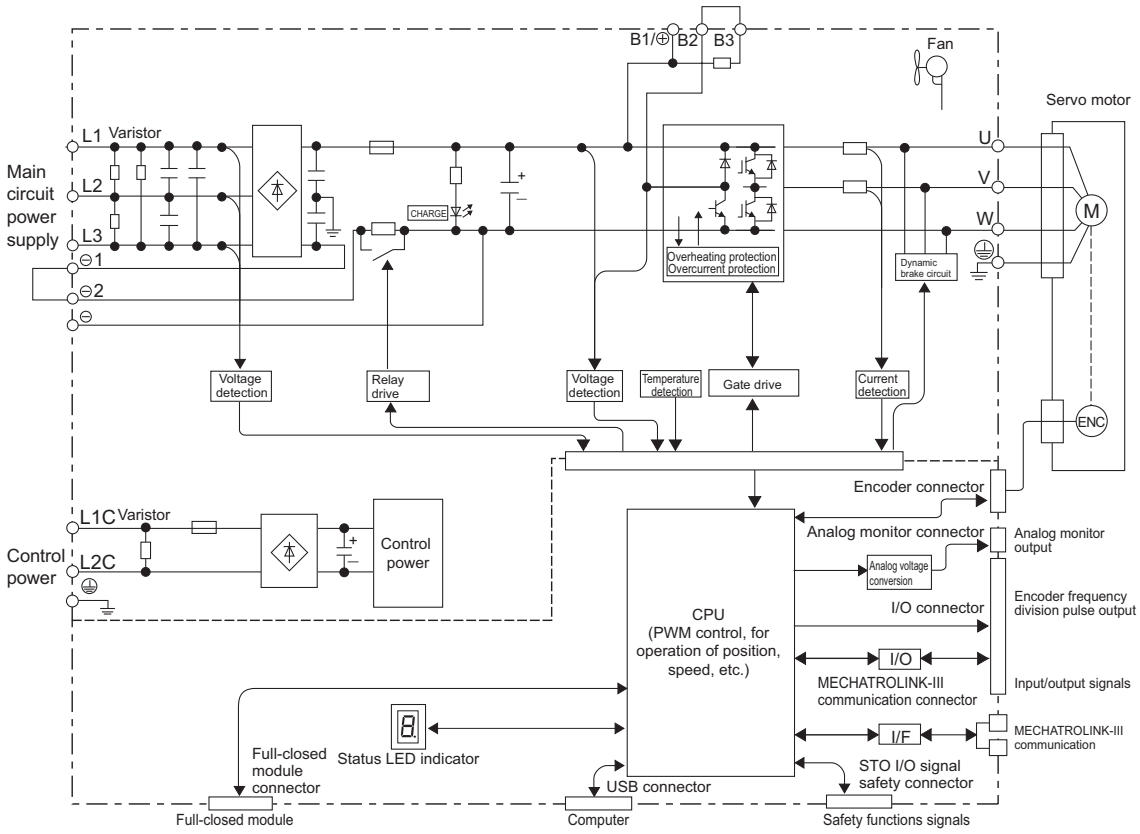
## ■ SV2-075L2/100L2



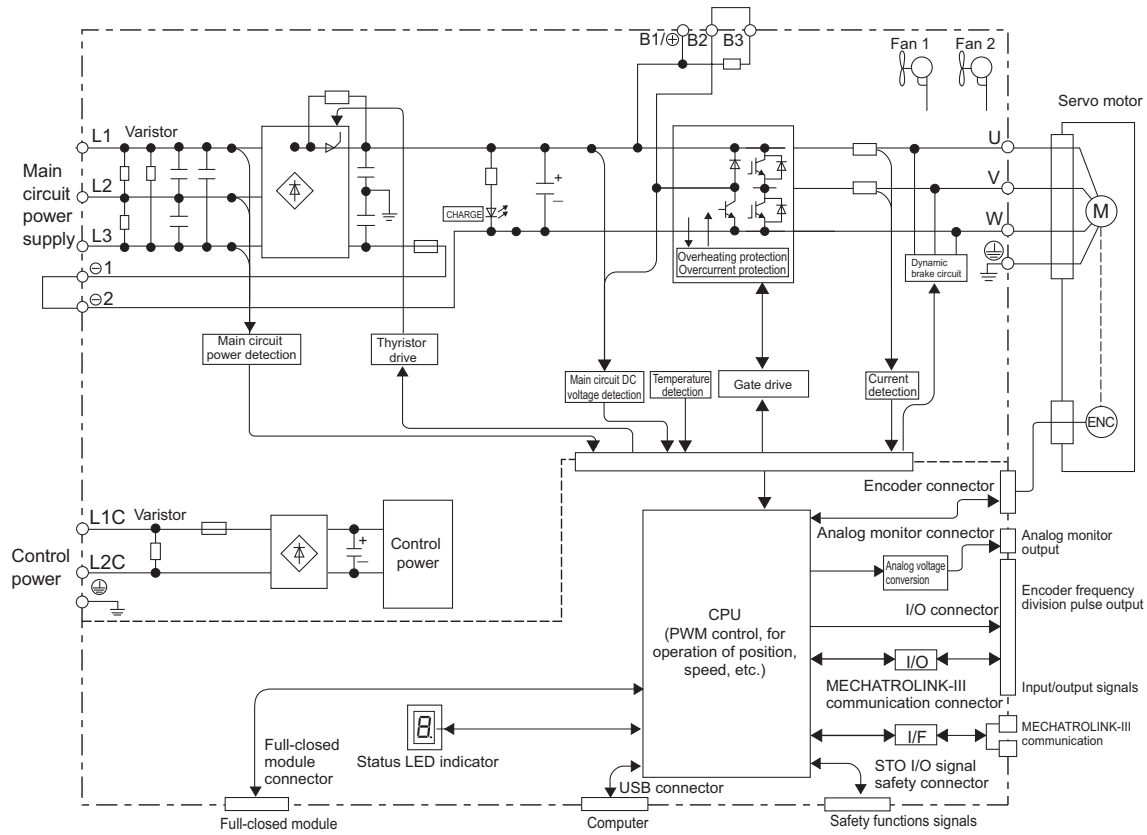

## ■ SV2-150L2

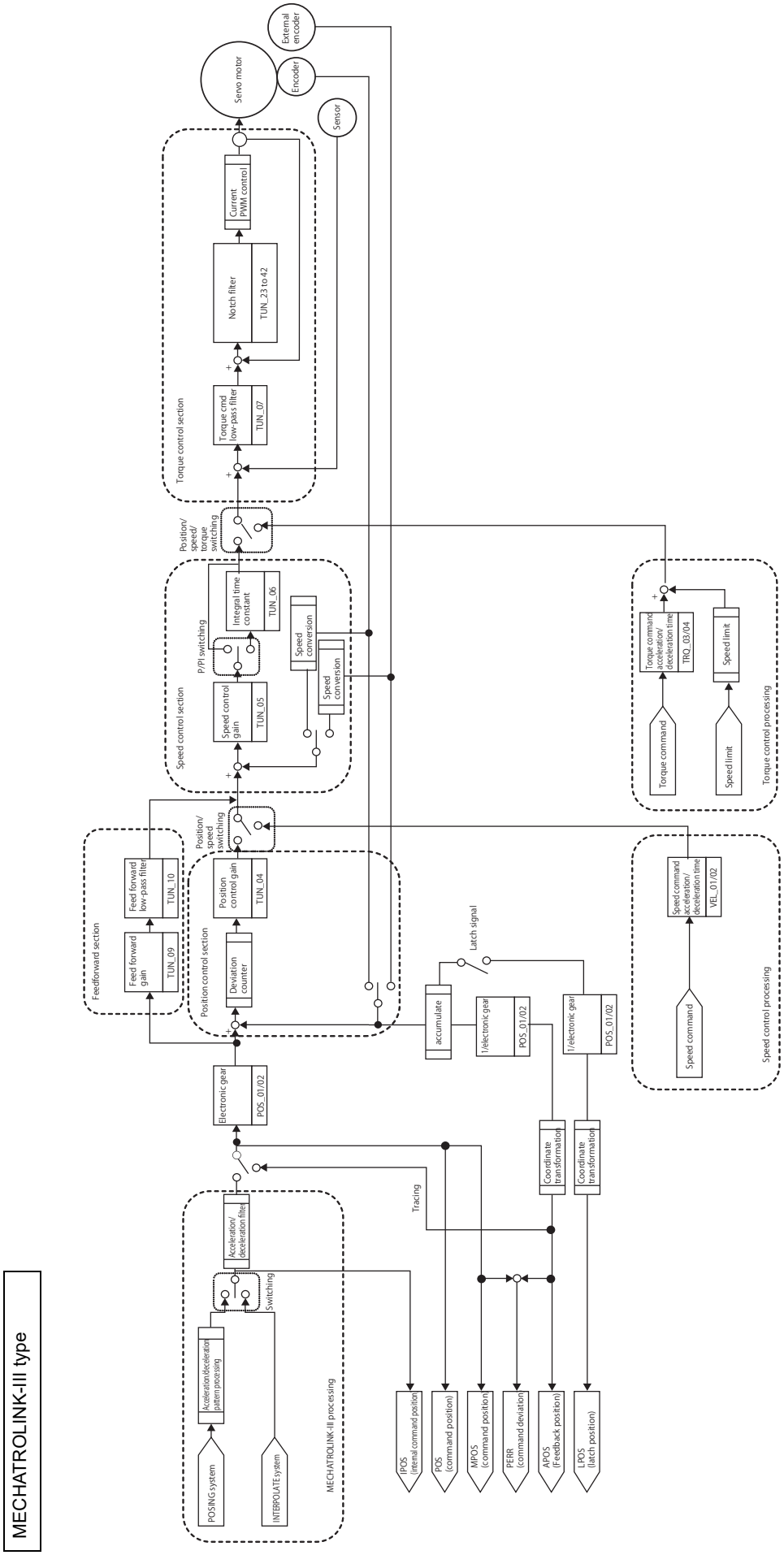


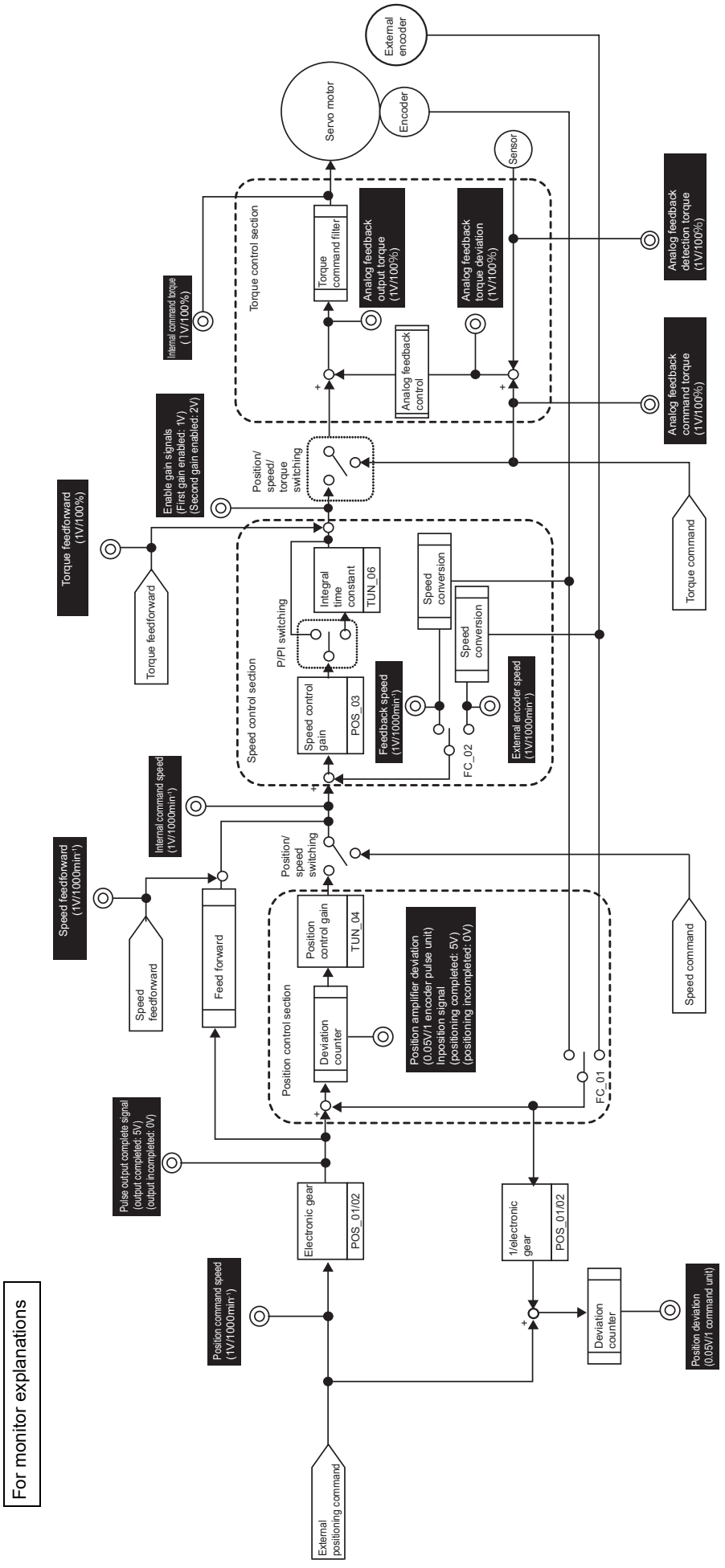
## ■ SV2-200L2/300L2




## ■ SV2-500L2




MECHATROLINK-III type
Servo motor
External encoder
Encoder
Sensor
Current (PWM control)
Notch filter
TUN_23 to 42
Torque cmd low-pass filter
TUN_07
Torque control section
Position/ speed/ torque switching
Integral time constant
TUN_06
P/PI switching
Speed conversion
Speed conversion
Speed control gain
TUN_05
Speed control section
Torque command acceleration/ deceleration time
TRQ_03/04
Speed limit
Torque command
Speed limit
Torque control processing
Position/ speed switching
Feed forward low-pass filter
TUN_10
Feed forward gain
TUN_09
Feedforward section
Position control gain
TUN_04
Deviation counter
Position control section
Latch signal
accumulate
1/electronic gear
POS_01/02
1/electronic gear
POS_01/02
Speed command acceleration/ deceleration time
VEL_01/02
Speed command
Speed control processing
Electronic gear
POS_01/02
Coordinate transformation
Coordinate transformation
Tracing
Acceleration/ deceleration filter
Switching
Acceleration/deceleration pattern processing
POSING system
INTERPOLATE system
MECHATROLINK-III processing
IPOS (internal command position)
POS (command position)
MPOS (command position)
PERR (command deviation)
APOS (Feedback position)
LPOS (latch position)

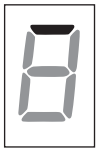

For monitor explanations
External positioning command
Position command speed (1V/1000min⁻¹)
Pulse output complete signal (output completed: 5V) (output incompleted: 0V)
Electronic gear
POS_01/02
1/electronic gear
POS_01/02
Deviation counter
Position deviation (0.05V/1 command unit)
Position control section
Deviation counter
Position control gain
TUN_04
Feed forward
Position amplifier deviation (0.05V/1 encoder pulse unit)
Inposition signal (positioning completed: 5V) (positioning incompleted: 0V)
FC_01
Position/ speed switching
Speed feedforward (1V/1000min⁻¹)
Speed feedforward
Internal command speed (1V/1000min⁻¹)
Speed control section
Speed control gain
POS_03
P/PI switching
Integral time constant
TUN_06
Feedback speed (1V/1000min⁻¹)
Speed conversion
Speed conversion
FC_02
External encoder speed (1V/1000min⁻¹)
Torque feedforward (1V/100%)
Torque feedforward
Enable gain signals (First gain enabled: 1V) (Second gain enabled: 2V)
Position/ speed/ torque switching
Torque control section
Torque command filter
Analog feedback control
Internal command torque (1V/100%)
Analog feedback output torque (1V/100%)
Analog feedback torque deviation (1V/100%)
Analog feedback detection torque (1V/100%)
Analog feedback command torque (1V/100%)
Torque command
Speed command
Servo motor
Encoder
Sensor
External encoder

# A-4 How to Check the Panel Display

You can check the servo amplifier status on the panel display.
When an alarm/warning occurs, the corresponding alarm/warning number is displayed.

## How to check the status

You can check status displays as follows.

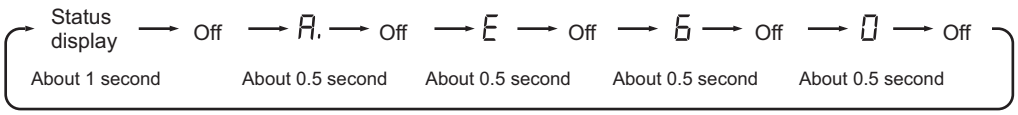
| Display | Description |
|---|---|
|  | **MOVE**<br>Lights when the servo motor speed is more than "Zero speed detection range" (VEL_05) and goes out when the speed is less than the default value. |
|  | **SVOFF**<br>Lights when the servo is off.<br>Goes out when the servo is on. |

| Display | Description |
|---|---|
|  | **CMD**<br>Lights when inputting a command. |
|  | **CTRL PWR**<br>Lights when the control power source is on. |

## How to check alarm/warning displays

The number corresponding to the alarm/warning that is occurring is displayed one character at a time as follows.

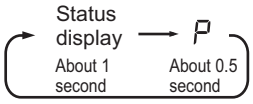
Example: When the alarm "E60" occurs



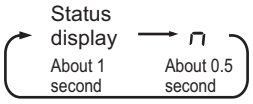

## Displays while detecting the limit switch

The following status displays are shown while detecting the limit switch.

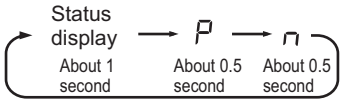
Forward limit switch (LSP)




Reversal limit switch (LSN)




In the case that both forward/ reverse sides are detected.




A
APPENDIX

## ■ List of Alarm Messages

### ● How to check the table

- An alarm code is represented by 3-digit hexadecimal number.
- Alarms marked with "*" ahead at the beginning of their names require repowering the control circuit to clear. They cannot be cleared with the CONFIG command.
- Alarms are categorized into two types: G1 and G2. You can set up the method to stop alarms based on their respective types when they occur.
  Refer to "5-1 Main Circuit/Control Circuit Power Supply Setting", Page 5-2 for further information on the stop method.

| Alarm code | Alarm name*1 | Contents of alarms and corrective actions | Stop method*2 |
|---|---|---|---|
| 020 | *Parameter error 0 | An error occurred with the internal parameters for the servo amplifier.<br>(1) An instantaneous voltage drop of the control circuit power supply, or the power supply of control circuit blocked while writing parameters. Check the control circuit voltage, and then perform "servo parameter initialization".<br>(2) Possible malfunction due to noise. Keep the series away from the noise source such as electromagnetic switches while in use.<br>Please contact our nearest sales office if the problem persists even after checking the above and repowering the control circuit. | G1 |
| 021 | *Parameter error 1 | An error occurred with the internal parameters for the servo amplifier.<br>Please contact our nearest sales office if the problem persists even after repowering the control circuit. | G1 |
| 022 | *Parameter error 2 | An error occurred with the internal parameters for the servo amplifier.<br>An instantaneous voltage drop of the control circuit power supply, or the power supply of control circuit blocked while writing parameters. Check the control circuit voltage, and then perform "servo parameter initialization".<br>Please contact our nearest sales office if the problem persists even after checking the above and repowering the control circuit. | G1 |
| 024 | *System alarm 5 | An error occurs with the internal program of the servo amplifier.<br>Please contact our nearest sales office if the problem persists even after repowering the control circuit. | G1 |
| 025 | *System alarm 6 | An error occurs with the internal program of the servo amplifier.<br>Please contact our nearest sales office if the problem persists even after repowering the control circuit. | G1 |
| 030 | An main circuit detection section error | An error occurred with th main circuit detection data.<br>Please contact our nearest sales office if the problem persists even after repowering the control circuit. | G1 |
| 040 | *Parameter setting error 0 | An error occurred with the parameter setting range.<br>(1) The electronic gear ratio is now possibly out of the acceptable range. Check if the following conditions are met: 0.001≤ (*electronic gear (numerator) [POS_02]/ *electronic gear (denominator); [POS_03]) ≤ 4000.<br>(2) The same function may have been assigned to more than one input, or EXIT 1 through 3 may have been assigned to anything other than IN4 through 6. Check the input signal assignment settings.<br>(3) The changed parameter is now possibly out of the acceptable setting range. Check the setting range for the parameter that has been changed.<br>(4) A possible mismatch between the servo amplifier and servo motor. Check their respective models.<br>Please contact our nearest sales office if the problem persists even after checking the above and repowering the control circuit. | G1 |
| 041 | *Encoder division output pulse error | The set value for Encoder division output pulse [SYS_02] resulted in an error.<br>Check the setting range and if the setting conditions are met. | G1 |
| 042 | *Parameter setting error 1 | An error occurred with the parameter setting. Check if the following conditions are met:<br>For Estimation of ratio of inertia moment or Gain search PRO (without host command):<br>(1) For the inertia moment ratio estimation, or the gain search PRO (No superior command)<br>A) Motor rated speed [min-1]*(1/3)*(222)/(6*(105)) > *Electronic gear(numerator) [POS_02]/*Electronic gear (denominator) [POS_03]<br>B) Motor highest speed [min-1]*(222)/(3.66*(1012)) < *Electronic gear(numerator) [POS_02]/*Electronic gear (denominator) [POS_03]<br>(2) During pattern operation<br>A) "Pattern operation speed" [min-1]*(222)/(6*(105)) > *Electronic gear(numerator) [POS_02]/*Electronic gear (denominator) [POS_03]<br>B) Motor highest speed [min-1]*(222)/(3.66*(1012)) < *Electronic gear(numerator) [POS_02]/*Electronic gear (denominator) [POS_03] | G1 |

*1 Alarms marked with "*" require repowering the control circuit.
*2 Refer to "5-2 Function Setting", Page 5-5 for further information on the stop method.
*3 The maximum rotational speed is the maximum rotational speed based on motor performance or the value of "*Maximum motor speed" (VEL_06), whichever is lower.

| Alarm code | Alarm name*1 | Contents of alarms and corrective actions | Stop method*2 |
|---|---|---|---|
| 044 | *Fully closed module setting error | Fully closed module was unable to be recognized.<br>(1) A possible poor connection to the fully closed module. Check the installation.<br>(2) In case of not using the fully closed module, set "*External encoder" (FC_01) to "0: Do not use".<br>Please contact our nearest sales office if the problem persists even after checking the above and repowering the control circuit. | G1 |
| 04A | *Parameter setting error 2 | An error occurred with the parameter setting range.<br>(1) When 4-bit parameter was written into the bank as a bank member, two members in succession may have not been registered correctly. Check the number of bytes is fixed for that bank.<br>(2) The total data amount in the bank may have exceeded 64 ("*Parameter banks" × "*Parameter bank members" > 64). Set the total data amount in the bank to less than 64.<br>(3) The reserved parameter value is incorrect. Perform Servo Parameter Initialization. | G1 |
| 050 | Motor combination error 2 | A mismatch between the servo amplifier and servo motor. Check the servo amplifier and servo motor used.<br>Please contact our nearest sales office if the problem persists even after checking the above and repowering the control circuit. | G1 |
| 051 | *Motor combination error 1 | An unidentifiable servo motor was connected to the servo amplifier. Check the servo amplifier and servo motor used.<br>Please contact our nearest sales office if the problem persists even after checking the above and repowering the control circuit. | G1 |
| 0B0 | Servo on after internal command operation | The servo ON command is input from the superior device after you execute the function which servo ON and the mandatory output is executed by the servo amplifier internal command.<br>Please reclose the control circuit power supply after the execution of the following functions.<br>• Z-phase search<br>• Gain search PRO (No superior command)<br>• Mechanical analyzer<br>• Pattern operation<br>• Inertia moment ratio estimation<br>• Mandatory output<br>• Servo JOG operation | G1 |
| 100 | *Overcurrent | An overcurrent was detected in a power transistor.<br>(1) Incorrect wiring, a poor contact, a short circuit, or a ground fault is possible with the main circuit power cable or motor power cable. Check the wiring.<br>(2) Incorrect wiring, a poor contact, overcapacity in regenerative processing, or a too small regenerative resistance value is possible with the regenerative resistor. Check the wiring, resistor value, and load of the regenerative resistor.<br>(3) The dynamic brake may be used frequently. Reconsider the selection, operating conditions, and mechanical system of the servo amplifier to decrease usage frequency.<br>(4) Possible malfunction due to noise. Keep the series away from the noise source such as electromagnetic switches while in use. | G1 |
| 101 | *Motor overcurrent | A current exceeding the acceptable current ran through the motor.<br>(1) The following can be considered with the motor cable connection. Check the following:<br>• A poor contact<br>• Incorrect wiring<br>• An internal short circuit or a ground fault<br>(2) Possible malfunction due to noise. Take action against noise by wiring FG properly, etc.<br>(3) The servo motor may be being stopped, or a high load may have been applied to the servo motor during low-speed operation. Reduce the load or reconsider the operating conditions.<br>Please contact our nearest sales office if the problem persists even after checking the above and repowering the control circuit. | G1 |
| 300 | Regenerative error | A error related to regenerative processing occurred.<br>(1) Regenerative resistor capacity [SYS_03] is possibly set to a value other than "0" for a servo amplifier with no internal regenerative resistor and no external regenerative resistor attached. Check the set value.<br>(2) The jumper between power terminals B2 and B3 may be disconnected in a servo amplifier with the internal regenerative resistor. Check the wiring.<br>(3) Incorrect wiring or a broken wire is possible with the regenerative resistor. Check the wiring.<br>Check the above, and then repower the control circuit without powering on the main circuit. | G1 |

*1 Alarms marked with "*" require repowering the control circuit.
*2 Refer to 📖 "5-2 Function Setting", Page 5-5 for further information on the stop method.
*3 The maximum rotational speed is the maximum rotational speed based on motor performance or the value of "*Maximum motor speed" (VEL_06), whichever is lower.

| Alarm code | Alarm name*1 | Contents of alarms and corrective actions | Stop method*2 |
|---|---|---|---|
| 320 | Regenerative overload | Regenerative overload was detected.<br>(1) Regenerative power possibly exceeds the acceptable range. Reconsider the load, operating conditions, and the value set for Regenerative resistor capacity [SYS_03].<br>(2) The main circuit power supply voltage possibly exceeds the range defined in the specifications. Check the input voltage.<br>Please contact our nearest sales office if the problem persists even after checking the above and repowering the control circuit.<br>After an alarm went off, the alarm detection level will be reduced to 50% of the normal level only the next time the control circuit is powered on. | G2 |
| 330 | Main circuit wiring error | A wiring error was detected with the main circuit.<br>(1) Wires of either an internal or external regenerative circuit may have been broken with the main circuit power supply voltage high inside the servo amplifier. Check the resistance value and wiring of the regenerative resistor.<br>(2) The input power source type (AC/DC) possibly varies from the value set for the AC/DC power supply [OTH_19] . Check the power source type and the set value correspond to each other.<br>(3) Regenerative resistor capacity [SYS_03] is possibly set to a value other than "0" for a servo amplifier with no external regenerative resistor attached. Check the set value. | G1 |
| 400 | Main circuit overvoltage | An overvoltage was detected with the main circuit power supply in the servo amplifier.<br>(1) The main circuit power supply voltage is possibly unexceptionally high. Check if the power supply voltage is unstable or within the range defined in the specifications. Install a surge absorber or a similar device in case of possible lightning effects.<br>(2) The external regenerative resistor resistance value is possibly too high. Check the operating conditions and load and reconsider the regenerative resistance value.<br>(3) The ratio of load inertia moment possibly exceeds the range defined in the specifications. Check the load value and operating conditions.<br>Please contact our nearest sales office if the problem persists even after checking the above and repowering the control circuit. | G1 |
| 410 | Main circuit under voltage | An undervoltage was detected with the main circuit power supply in the servo amplifier.<br>(1) The main circuit power supply voltage possibly falls short of a predetermined level. Check if the power supply voltage is unstable or within the range defined in the specifications.<br>(2) The instantaneous power failure possibly falls short of a predetermined level. Check the main circuit power supply and change Instantaneous powercut hold time [OTH_24] to a smaller value if it was changed.<br>(3) The fuse inside the servo amplifier may have been melted down. Repair or replace the servo amplifier first, and then connect it to the AC/DC reactor.<br>Please contact our nearest sales office if the problem persists even after checking the above and repowering the control circuit. | G2 |
| 510 | Overspeed | The motor speed exceeded the maximum rotational speed(*3).<br>(1) Incorrect wiring is possible with the U-phase, V-phase, and W-phase between the servo amplifier and servo motor. Check the wiring.<br>(2) An overshooting is possibly too high. Reconsider the command input value, acceleration/deceleration conditions, gain, etc. | G1 |
| 511 | Encoder division output pulse overspeed | The encoder division output pulse exceeded the highest frequency 1.6 Mpps (6.4 MHz after 4 multiplications).<br>Reconsider the value set for Encoder division output pulse [SYS_02] and motor rotational speed. | G1 |
| 521 | Vibration alarm at tuning | Strong vibrations were detected while performing the tuning function.<br>• While performing auto-tuning: Make the value set for the load level bigger or that for the response characteristic smaller.<br>• Others: Perform corrective actions that correspond to the procedures to perform each function. | G1 |
| 710 | Overload (Instantaneous maximum load) | The series was operated from a few seconds up to several dozen seconds at a torque exceeding the rated value.<br>(1) Operation that exceeded the overload protection characteristic may have been performed. Reconsider the operating and load conditions and check if the motor capacity is appropriate.<br>(2) Incorrect wiring or a poor connection is possible with the motor and encoder cables. Check if there are problems with the wiring.<br>(3) The load may have become excessive during operation as the motor did not operate due to mechanical reasons. Check the mechanical systems.<br>Please contact our nearest sales office if the problem persists even after checking the above and repowering the control circuit.<br>After an alarm went off, the alarm detection level will be reduced to 50% of the normal level only the next time the control circuit is powered on. | G2 |

*1 Alarms marked with "*" require repowering the control circuit.
*2 Refer to "5-2 Function Setting", Page 5-5 for further information on the stop method.
*3 The maximum rotational speed is the maximum rotational speed based on motor performance or the value of "*Maximum motor speed" (VEL_06), whichever is lower.

| Alarm code | Alarm name*1 | Contents of alarms and corrective actions | Stop method*2 |
|---|---|---|---|
| 720 | Overload<br>(Overload (Continuous)) | The series was operated continuously at a torque exceeding the rated value.<br>(1) Operation that exceeded the overload protection characteristic may have been performed. Reconsider the operating and load conditions and check if the motor capacity is appropriate.<br>(2) Incorrect wiring or a poor connection is possible with the motor and encoder cables.<br>(3) The load may have become excessive during operation as the motor did not operate due to mechanical reasons. Check the mechanical systems.<br>Please contact our nearest sales office if the problem persists even after checking the above and repowering the control circuit.<br>After an alarm went off, the alarm detection level will be reduced to 50% of the normal level only the next time the control circuit is powered on. | G1 |
| 730 | Dynamic brake overload | An overload was detected in dynamic brake resistance.<br>The rotational energy when the dynamic brake is brought to a stop may have exceeded the acceptable value, or the motor is possibly being driven by an external force. Reconsider the operating conditions by lowering the command speed, making the load inertia moment smaller, decreasing the frequency of stopping the dynamic brake, etc.<br>Please contact our nearest sales office if the problem persists even after checking the above and repowering the control circuit.<br>After an alarm went off, the alarm detection level will be reduced to 50% of the normal level only the next time the control circuit is powered on. | G1 |
| 740 | Surge current overload | The acceptable frequency for surge current resistance when the main circuit is powered on/off was exceeded.<br>Decrease the frequency of powering the main circuit ON/OFF. | G1 |
| 7A1 | Internal overheat 0 | The temperature inside the servo amplifier exceeded the acceptable temperature.<br>(1) Ambient temperature is possibly high. Set the ambient temperature around the servo amplifier to within the default value.<br>(2) The load is possibly excessive, or operation may be exceeding the regenerative processing capacity. Reconsider the load and operating conditions.<br>(3) The overload alarm may have been repeatedly reset by powering off to continue with operation. Reconsider the method to reset the alarm.<br>(4) The condition of the servo amplifier installation may not be appropriate. Check the installation criteria such as the direction in which the servo amplifier is installed, etc.<br>Please contact our nearest sales office if the problem persists even after checking the above and repowering the control circuit. | G2 |
| 7A2 | Internal overheat 1 | | G2 |
| 7A3 | *Internal temperature detection section error | An error occurred with the internal temperature detection circuit in the servo amplifier.<br>Please contact our nearest sales office if the problem persists even after repowering the control circuit. | G2 |
| 7AB | Built-in fan stopped | The built-in fan inside the servo amplifier stopped.<br>Check if there is any foreign material inside and remove it if there is any.<br>Please contact our nearest sales office if the problem persists even after checking the above and repowering the control circuit. | G1 |
| 810 | *Encoder backup alarm | The encoder power became low and the position data was cleared.<br>(1) Perform the "absolute encoder setup" when powering on the absolute encoder for the first time.<br>(2) The battery voltage is possibly low, or the battery may have been removed once. Check if the battery has been replaced or power is properly supplied to the encoder, and then perform the "absolute encoder setup".<br>Please contact our nearest sales office if the problem persists even after checking the above and repowering the control circuit. | G1 |
| 820 | *Encoder error 0 | An error occurred with the internal parameters for the encoder.<br>Perform the "absolute encoder setup".<br>Please contact our nearest sales office if the problem persists even after checking the above and repowering the control circuit. | G1 |
| 830 | Encoder battery alarm | An error was detected while checking the battery voltage when powering on the control circuit.<br>(1) The absolute encoder battery voltage may have been lowered to less than 2.7V. Replace the battery.<br>(2) The battery may not be properly connected. Check the wiring. | G1 |
| 840 | *Encoder error 1 | An error occurred with the internal parameters for the encoder.<br>A possible encoder malfunction due to noise. Keep the series away from the noise source such as electromagnetic switches while in use.<br>Please contact our nearest sales office if the problem persists even after checking the above and repowering the control circuit. | G1 |
| 850 | *Encoder overspeed | Motor rotations were detected when powering on the control circuit.<br>The servo motor may be rotating at more than 200min$^{-1}$ when powering on the control circuit. Check the servo amplifier speed when powering on the control circuit.<br>Please contact our nearest sales office if the problem persists even after checking the above and repowering the control circuit. | G1 |

*1 Alarms marked with "*" require repowering the control circuit.
*2 Refer to 📖 "5-2 Function Setting", Page 5-5 for further information on the stop method.
*3 The maximum rotational speed is the maximum rotational speed based on motor performance or the value of "*Maximum motor speed" (VEL_06), whichever is lower.

| Alarm code | Alarm name*1 | Contents of alarms and corrective actions | Stop method*2 |
|---|---|---|---|
| 860 | *Encoder overheat | An overheat was detected inside the encoder.<br>(1) The ambient temperature around the servo motor is possibly high. Reconsider the cooling conditions and check that ambient temperature is less than 40°C (or 60°C when used at the derated value).<br>(2) The motor is possibly overheated due to the load conditions being too high. Check the operating conditions and load.<br>Please contact our nearest sales office if the problem persists even after checking the above and repowering the control circuit. | G1 |
| 8A0 | External encoder error 0 | Failed to acquire the origin position of the absolute value external encoder.<br>(1) The motor may be operating when trying to acquire the origin position. Ensure that the motor does not operate when acquiring the origin position.<br>(2) The external encoder may be defective. Check the external encoder. | G1 |
| 8A1 | External encoder error 1 | An error was detected with the external encoder.<br>The external encoder may be defective. Check the external encoder. | G1 |
| 8A2 | External encoder error 2 | An error was detected with the external encoder.<br>The external encoder may be defective. Check the external encoder. | G1 |
| 8A3 | External encoder error 3 | An error was detected with the external encoder.<br>The external encoder may be defective. Check the external encoder. | G1 |
| 8A5 | External encoder error 4 | An overspeed error was detected from the external encoder.<br>The external encoder may have operated at a speed exceeding its maximum speed. Check the external encoder specifications, and then reconsider the operating conditions. | G1 |
| 8A6 | External encoder error 5 | An overheat error was detected from the external encoder.<br>The external encoder may be defective. Check the external encoder. | G1 |
| B33 | *Current detected error | An error occurred with the current detection circuit.<br>(1) Possible malfunction due to noise. Keep the series away from the noise source such as electromagnetic switches while in use.<br>(2) The servo motor power cable may be disconnected. Check the wiring.<br>Please contact our nearest sales office if the problem persists even after checking the above and repowering the control circuit. | G1 |
| B6A | *MECHATROLINK comm. ASIC error 0 | An error occurred with the MECHATROLINK communication ASIC.<br>Possible malfunction due to noise. Keep the series away from the noise source such as electromagnetic switches while in use.<br>Please contact our nearest sales office if the problem persists even after checking the above and repowering the control circuit. | G1 |
| B6B | *MECHATROLINK comm. ASIC error 1 | | G2 |
| BF0 | *System alarm 0 | An error occurs with the internal program of the servo amplifier.<br>Possible malfunction due to noise. Keep the series away from the noise source such as electromagnetic switches while in use.<br>Please contact our nearest sales office if the problem persists even after checking the above and repowering the control circuit. | G1 |
| BF1 | *System alarm 1 | | G1 |
| BF2 | *System alarm 2 | | G1 |
| BF3 | *System alarm 3 | | G1 |
| BF4 | *System alarm 4 | | G1 |
| C10 | Overrun detected | An overrun was detected with the servo motor.<br>The wiring order of the U-phase, V-phase, and W-phase of the motor may be incorrect. Check the wiring.<br>Please contact our nearest sales office if the problem persists even after checking the above and repowering the control circuit. | G1 |
| C80 | *Encoder comm error 0 | An error occurred with internal data of the encoder.<br>Possible malfunction due to noise. Keep the series away from the noise source such as electromagnetic switches while in use.<br>Please contact our nearest sales office if the problem persists even after checking the above and repowering the control circuit. | G1 |

*1 Alarms marked with "*" require repowering the control circuit.
*2 Refer to "5-2 Function Setting", Page 5-5 for further information on the stop method.
*3 The maximum rotational speed is the maximum rotational speed based on motor performance or the value of "*Maximum motor speed" (VEL_06), whichever is lower.

| Alarm code | Alarm name*1 | Contents of alarms and corrective actions | Stop method*2 |
|---|---|---|---|
| C90 | *Encoder comm error 1 | A communication error occurred between the encoder and servo amplifier.<br>(1) The following can be considered with encoder wiring. Check the following:<br>• The connector is disconnected, or a poor contact is observed.<br>• Incorrect wiring<br>• The encoder cable is too long or too thin.<br>(2) Possible malfunction due to noise. Keep the series away from the noise source such as electromagnetic switches while in use.<br>Please contact our nearest sales office if the problem persists even after checking the above and repowering the control circuit. | G1 |
| C91 | *Encoder comm error 2 | A communication error occurred between the encoder and servo amplifier.<br>Possible malfunction due to noise. Possibilities include but are not limited to: The encoder cable is bound with the high current line, or the FG electrical potential has moved. Check how the encoder cable is connected and ground the device.<br>Please contact our nearest sales office if the problem persists even after checking the above and repowering the control circuit. | G1 |
| C92 | *Encoder comm error 3 | A communication error occurred between the encoder and servo amplifier.<br>(1) Possible malfunction due to noise. Keep the series away from the noise source such as electromagnetic switches while in use.<br>(2) Excessive vibrations may have been transferred to the encoder. Try to reduce the vibration of the mechanical systems.<br>Please contact our nearest sales office if the problem persists even after checking the above and repowering the control circuit. | G1 |
| CA0 | *Encoder comm error 4 | An error occurred with the internal parameters for the encoder.<br>Possible malfunction due to noise. Keep the series away from the noise source such as electromagnetic switches while in use.<br>Please contact our nearest sales office if the problem persists even after checking the above and repowering the control circuit. | G1 |
| CB0 | *Encoder comm error 5 | A communication error occurred between the encoder and servo amplifier.<br>(1) The following can be considered with encoder wiring. Check the following:<br>• The connector is disconnected, or a poor contact is observed.<br>• The encoder cable is too long or too thin.<br>• Incorrect wiring<br>(2) Possible malfunction due to noise. Keep the series away from the noise source such as electromagnetic switches while in use.<br>(3) Excessive vibrations may have been transferred to the encoder. Try to reduce the vibration of the mechanical systems.<br>Please contact our nearest sales office if the problem persists even after checking the above and repowering the control circuit. | G1 |
| CC0 | *Encoder comm error 6 | An error occurred with internal data of the encoder.<br>Possible malfunction due to noise. Keep the series away from the noise source such as electromagnetic switches while in use.<br>Please contact our nearest sales office if the problem persists even after checking the above and repowering the control circuit. | G1 |
| CF1 | *Fully closed module comm. error 0 | A communication error occurred between the fully closed module and external encoder.<br>(1) The following can be considered with external encoder wiring. Check the following:<br>• The connector is disconnected, or a poor contact is observed.<br>• Incorrect wiring<br>• The encoder cable is too long or too thin.<br>(2) Possible malfunction due to noise. Keep the series away from the noise source such as electromagnetic switches while in use.<br>Please contact our nearest sales office if the problem persists even after checking the above and repowering the control circuit. | G1 |
| CF2 | *Fully closed module comm. error 1 | | G1 |

*1 Alarms marked with "*" require repowering the control circuit.
*2 Refer to 📖 "5-2 Function Setting", Page 5-5 for further information on the stop method.
*3 The maximum rotational speed is the maximum rotational speed based on motor performance or the value of "*Maximum motor speed" (VEL_06), whichever is lower.

| Alarm code | Alarm name*1 | Contents of alarms and corrective actions | Stop method*2 |
|---|---|---|---|
| D00 | Excessive position deviation | Position deviation exceeded the deviation excessive alarm level [ALM_10].<br>(1) The command frequency and its resulting deviation is possibly too high. Reconsider the respective values set for the input frequency, acceleration/ deceleration time, gain, and electronic gear ratio.<br>(2) The load inertia is possibly too high. Reconsider the load and motor capacity.<br>(3) The electromagnetic brake may not have been released. Check the electromagnetic brake.<br>(4) The motor is possibly mechanically locked, or a possible mechanical clash. Check the mechanical systems.<br>(5) Incorrect wiring is possible with the U-phase, V-phase, and W-phase between the servo amplifier and motor. Check the wiring.<br>(6) The motor may have been driven by an external force (such as gravity) when it was brought to a stop. Check the state of the motor when brought to a stop.<br>(7) The value set for the deviation excessive alarm level [ALM_10] is possibly too small as compared to the operating conditions. Reconsider the set value. | G1 |
| D01 | Excessive position deviation at servo on 1 | Position deviation with Servo ON exceeded the dev excessive alm level at SVON [ALM_14].<br>The motor may have operated during Servo OFF without clearing the position deviation pulse, and the servo may have been turned ON with the position deviation pulse accumulated in excess amounts. Clear the position deviation pulse during Servo OFF, or reconsider the value set for the dev excessive alm level at SVON [ALM_14]. | G1 |
| D02 | Excessive position deviation at servo on 2 | Position deviation exceeded the deviation excessive alarm level [ALM_10].<br>The servo may have been turned ON with the position deviation pulse accumulated during Servo OFF, and the command pulse may have been input while operating at the speed limit at servo ON [ALM_16], exceeding the deviation excessive alarm level [ALM_10]. Set the correct value for the deviation excessive alarm level [ALM_10] or speed limit at servo ON [ALM_16]. | G2 |
| D0A | Analog feedback excessive torque deviation | Analog feedback torque deviation exceeded the "torque deviation excessive alarm level" (AFB_11).<br>(1) Analog input may not be properly input. Check the wiring and sensor behavior.<br>(2) The setting for "Analog input gain" (AFB_05) may not be properly configured. Reconsider the set value. | G1 |
| D10 | Excessive motor-external encoder deviation | The difference between the motor encoder feedback position and the external encoder feedback position (load position) exceeded the "motor-external encoder deviation excessive alarm level" (FC_06).<br>(1) The motor rotational direction is possibly reverse to the external encoder installation direction. Reverse the installation direction or the direction set for "external encoder" (FC_01).<br>(2) There may be problems with the load such as the motor and stage, or with the mechanical connection by the external encoder. Check the connections and readjust the mechanical connection. In case of slipping belts, etc., properly set up "slip correction coefficient per motor rotation" (FC_07).<br>(3) The "*external encoder coordinate transformation" (FC_02,FC_03) setting may not be appropriate. Check the set value. | G2 |
| E40 | ML-III transform cycle setting error | A synchronization error occurred during MECHATROLINK-III communication.<br>The MECHATROLINK-III transform cycle setting is possibly incorrect. Check the value set for the transform cycle. | G2 |
| E41 | ML-III communication data size setting error | The communication data size possibly varies between the host controller and servo amplifier.<br>Check the master communication data size and the value set for the servo amplifier (dip switch). | G2 |
| E42 | *ML-III station address setting error | An error was found with the station address setting.<br>(1) The station address is possibly set to a value that is out of range. Check if the value for the station address (rotary switch) is in the range between 03H and EFH.<br>(2) A device using the same address is possibly present on the communication network. Check device station addresses on the communication network to ensure that no duplicate addresses. | G2 |
| E50 | ML-III sync error | A synchronization error occurred during MECHATROLINK-III communication.<br>(1) Check if WDT data has been updated correctly on the host controller.<br>(2) Take correction action against noise. (Check communication cable wiring and grounding. Or, attach ferrite core(s) to the communication cable, etc.)<br>Please contact our nearest sales office if the problem persists even after checking the above and repowering the control circuit.<br>ML-III sync error (E50) is not saved in the alarm history. | G2 |

*1 Alarms marked with "*" require repowering the control circuit.
*2 Refer to 📖 "5-2 Function Setting", Page 5-5 for further information on the stop method.
*3 The maximum rotational speed is the maximum rotational speed based on motor performance or the value of "*Maximum motor speed" (VEL_06), whichever is lower.

| Alarm code | Alarm name*1 | Contents of alarms and corrective actions | Stop method*2 |
|---|---|---|---|
| E51 | ML-III sync failed | Synchronous communications failed to start.<br>Check if WDT data has been updated correctly on the host controller.<br>Please contact our nearest sales office if the problem persists even after checking the above and repowering the control circuit. | G2 |
| E60 | ML-III comm error - receive error | Communication errors occurred in succession during MECHATROLINK-III communication. Reconsider the following:<br>(1) Perform MECHATROLINK-III cable wiring and install the terminator properly.<br>(2) Take correction action against noise. (Check communication cable wiring and grounding. Or, attach ferrite core(s) to the communication cable, etc.)<br>ML-III comm error (E60) is not saved in the alarm history. | G2 |
| E61 | ML-III transform cycle error - sync interval error | A transform cycle error occurred during MECHATROLINK-III communication.<br>Check the cause that led to changes in the transform cycle of the host controller.<br>Please contact our nearest sales office if the problem persists even after checking the above and repowering the control circuit. | G2 |
| E63 | ML-III sync frame not received | An error occurred during synchronous communication.<br>(1) Perform MECHATROLINK-III cable wiring and install the terminator properly.<br>(2) Take correction action against noise. (Check communication cable wiring and grounding. Or, attach ferrite core(s) to the communication cable, etc.)<br>Please contact our nearest sales office if the problem persists even after checking the above and repowering the control circuit.<br>ML-III sync frame not received (E63) is not saved in the alarm history. | G2 |
| EB1 | *STO function signal input timing error | There is a time difference of 10 seconds between STO1 input and STO2 input until they are activated.<br>Check the time difference between input signals and set the output circuit and device properly.<br>Please contact our nearest sales office if the problem persists even after checking the above and repowering the control circuit. | G1 |
| EC8 | *Gate drive error 1 | The servo amplifier is possibly defective. Please contact our nearest sales office if the problem persists even after repowering the control circuit. | G1 |
| EC9 | *Gate drive error 2 | | G1 |
| ED1 | Command execute timeout | A timeout error occurred with the MECHATROLINK-III command. Check if the SV_ON, SENS_ON command is performed while the motor is rotating. | G2 |
| F10 | Main circuit open phase | One of the L1, L2, and L3 phase voltages remained low for more than a second with the main circuit powered on.<br>(1) The value set for "*3PH/1PH power supply" (OTH_20) may vary from the power source type (three phase/single phase) actually being input. Check the set value and input power source type.<br>(2) Three phase power supply wiring may be defective, or the three phase power supply may be unbalanced. Check if there are no balance problems between the three phase power supply wiring and power supply. | G2 |
| F50 | Motor power supply cable broken | The motor power supply cable was found disconnected.<br>The following can be considered with the motor cable connection. Check the following:<br>• Disconnected<br>• A poor contact<br>• Incorrect wiring<br>Please contact our nearest sales office if the problem persists even after checking the above and repowering the control circuit. | G1 |

*1 Alarms marked with "*" require repowering the control circuit.
*2 Refer to 🕮 "5-2 Function Setting", Page 5-5 for further information on the stop method.
*3 The maximum rotational speed is the maximum rotational speed based on motor performance or the value of "*Maximum motor speed" (VEL_06), whichever is lower.

## ■ List of Warning Messages

| Alarm code | Warning name | Contents of alarms and corrective actions |
|---|---|---|
| 900 | Excessive warning | The position deviation pulse exceeded the deviation excessive alarm level [ALM_10]× (deviation excessive waring level [ALM_09]/100).<br>(1) The command frequency and its resulting deviation is possibly too high. Reconsider the respective values set for the input frequency, acceleration/deceleration time, gain, and electronic gear ratio.<br>(2) The load inertia is possibly too high. Reconsider the load and motor capacity.<br>(3) The electromagnetic brake may not have been released. Check the electromagnetic brake.<br>(4) The motor is possibly mechanically locked, or a possible mechanical clash. Check the mechanical systems.<br>(5) Incorrect wiring is possible with the U-phase, V-phase, and W-phase between the servo amplifier and motor. Check the wiring.<br>(6) The motor may have been driven by an external force (such as gravity) when it was brought to a stop. Check the state of the motor when brought to a stop.<br>(7) The values set for the deviation excessive alarm level [ALM_10] and deviation excessive waring level [ALM_09] are possibly too small as compared to the operating conditions. Reconsider the set value. |
| 901 | Excessive warning at servo on | The position deviation exceeded the deviation excessive alarm level [ALM_14]× (dev excessive alm level at SVON [ALM_15]/100).<br>The motor may have operated during Servo OFF when the setting is configured so the position deviation pulse is not cleared. Clear the position deviation pulse during Servo OFF, or set the deviation excessive alarm level [ALM_14] and dev excessive alm level at SVON [ALM_15] to appropriate values. |
| 910 | Overload warning | The operating load exceeded the overload warning level [ALM_11].<br>(1) Operation that exceeded the specified overload warning level may have been performed. Reconsider the operating and load conditions and check if the motor capacity is appropriate.<br>(2) Incorrect wiring or a poor connection is possible with the motor and encoder cables. Check if there are problems with the wiring.<br>(3) The load may have become excessive during operation as the motor did not operate due to mechanical reasons. Check the mechanical systems. |
| 911 | Vibration excessive waring | Unexceptional motor speed-related vibrations were detected.<br>(1) The operating conditions and tuning may not be appropriate. Reconsider the setting by lowering the motor speed or "speed control gain" (TUN_05).<br>(2) The actual ratio of inertia moment is possibly smaller or larger than the set value. Correct the "ratio of load inertia moment" (TUN_08) by setting the appropriate value. |
| 912 | Internal overheat warning 0 | The temperature inside the servo amplifier exceeded the acceptable temperature.<br>(1) Ambient temperature is possibly high. Set the ambient temperature around the servo amplifier to within the default value.<br>(2) The load is possibly excessive, or operation may be exceeding the regenerative processing capacity. Reconsider the load and operating conditions.<br>(3) The overload alarm may have been repeatedly reset by powering off to continue with operation. Reconsider the method to reset the alarm.<br>(4) The condition of the servo amplifier installation may not be appropriate. Check the installation criteria such as the direction in which the servo amplifier is installed, etc.<br>Please contact our nearest sales office if the problem persists even after checking the above and repowering the control circuit. |
| 913 | Internal overheat warning 1 | |
| 920 | Regenerative overload warning | The operating load exceeded the regenerative warning level.<br>(1) Regenerative power possibly exceeds 50% of the regenerative warning level. Reconsider the load, operating conditions, and the value set for Regenerative resistor capacity [SYS_13].<br>(2) The main circuit power supply voltage possibly exceeds the range defined in the specifications. Check the input voltage. |
| 921 | Dynamic brake overload warning | An overload was detected in dynamic brake resistance.<br>The rotational energy when the dynamic brake is brought to a stop may have exceeded the acceptable value, or the motor is possibly being driven by an external force.<br>Reconsider the operating conditions by lowering the command speed, making the load inertia moment smaller, decreasing the frequency of stopping the dynamic brake, etc. |
| 922 | Analog feedback detection torque excessive warming | The analog feedback detection torque exceeded the "detection trq excessive warning level" (AFB_12) and passed "detection trq excessive warning time" (AFB_13).<br>(1) Analog input may not be properly input. Check the wiring and sensor behavior.<br>(2) The setting for "Analog input gain" (AFB_05) may not be properly configured. Reconsider the set value. |
| 923 | Built-in fan stop warning | The built-in fan inside the servo amplifier stopped.<br>Check if there is any foreign material inside the fan.<br>Please contact our nearest sales office if the problem persists even after checking the above and repowering the control circuit. |

| Alarm code | Warning name | Contents of alarms and corrective actions |
|---|---|---|
| 930 | ABS encoder battery warning | An error was detected while checking the battery voltage.<br>(1) The absolute encoder battery voltage may have been lowered to less than 2.7V. Replace the battery.<br>(2) The battery may not be properly connected. Check the wiring.<br>Please contact our nearest sales office if the problem persists even after checking the above and repowering the control circuit. |
| 94A | Data setting warning 1 (constant number) *1 | A parameter was set that cannot be used for the MECHATROLINK-III communication command.<br>Set up an appropriate parameter. |
| 94B | Data setting warning 2 (out of range)*1 | A value that is out of range was set for MECHATROLINK-III communication command data.<br>Set up data within the configurable range. |
| 94C | Data setting warning 3 (calculate error)*1 | The calculated result for the set value returned an error.<br>Set up data within the configurable range. |
| 94D | Data setting warning 4 (parameter size)*1 | The parameter size set for the MECHATROLINK-III communication command is not correct.<br>Configure the proper parameter size. |
| 95A | Command warning 1 (out of condition)*1 | A command was sent although its conditions were incomplete.<br>Check the execution conditions for each command and send the commands under complete conditions. |
| 95B | Command warning 2 (not supported)*1 | An unsupported command was received.<br>Do not send an unsupported command. |
| 95E | Command warning 5 (sub command not allowed)*1 | The sending conditions for sub command are not complete.<br>Send the sub commands once the conditions are complete. |
| 95F | Command warning 6 (undefined)*1 | An undefined command was received.<br>Do not send an undefined command. |
| 960 | ML-III comm warning | Communication errors occurred in succession during MECHATROLINK-III communication. Reconsider the following:<br>(1) Perform MECHATROLINK-III cable wiring and install the terminator properly.<br>(2) Take correction action against noise (check communication cable connections and grounding). Or, attach ferrite core(s) to the communication cable, etc.)<br>Please contact our nearest sales office if the problem persists even after checking the above and repowering the control circuit. |
| 971 | Main circuit under voltage warning | An undervoltage was detected with the main circuit power supply in the servo amplifier.<br>(1) The main circuit power supply voltage possibly falls short of a predetermined level. Check if the power supply voltage is unstable or within the range defined in the specifications.<br>(2) The instantaneous power failure possibly falls short of a predetermined level. Check the power supply voltage and change Instantaneous powercut hold time [OTH_24] to a smaller value if it was changed.<br>(3) The fuse inside the servo amplifier may have been melted down. Repair or replace the servo amplifier first, and then connect it to the AC/DC reactor.<br>Please contact our nearest sales office if the problem persists even after checking the above and repowering the control circuit. |
| 97A | Command warning 7 phase error*1 | A command was sent that cannot be performed in the present communication phase.<br>Reconsider the setting so the conditions to send commands from the host controller are complete. |
| 97B | Out of range data clamp*1 | A value that is out of range was set for command data.<br>Reconsider the setting so the conditions to send command data from the host controller are complete. |
| 9D1 | Master station error warning | An error occurred at the MECHATROLINK-III master station.<br>Check the state of the master station. |

*1 The warning will be automatically cancelled when receiving the MECHATROLINK-III command normally.

| Alarm code | Warning name | Contents of alarms and corrective actions |
|---|---|---|
| 9D2 | Servo on condition fail warning | The Servo ON command was sent from the host controller when Servo ON was not possible.<br>(1) An alarm is possibly occurring. Check the state of the alarm.<br>(2) The main circuit power supply is possibly turned off. Check the main circuit power supply voltage.<br>(3) A possible STO state. Check the state of the /STO1 and /STO2 terminals.<br>(4) A possible forced stop state. When Forced stop (FSTOP) is assigned to the input terminal, check the state of the Forced stop assigned input terminal.<br>(5) When "*Absolute position system" (SYS_01) is set to either "0:ABS" or "2:1 turn ABS", the SV_ON command was possibly received without receiving the SENS_ON command. Check the set value and host controller command sequence.<br>(6) The Servo ON command is possibly input after the Servo ON or performing the function to force output by the internal command. Repower the control circuit after performing the following functions.<br>• Z-phase search<br>• Gain search PRO (No superior command)<br>• Mechanical analyzer<br>• Pattern operation<br>• Inertia moment ratio estimation<br>• Mandatory output<br>• Servo JOG operation |
| 9D3 | STO state warning | A STO state was detected.<br>Do a safety check and follow the instructions as described in "Methods for restoration from STO State", Page 8-5 to restore the settings. |
| 9D4 | Forced termination warning | A forced stop was detected. Check the forced stop input signal. |

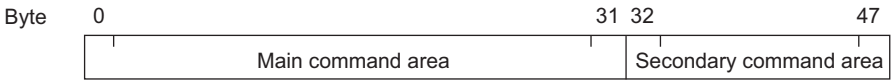
## Overview

### Overview of MECHATROLINK-III communication commands

SV2 Series can also use MECHATROLINK-III communication commands to send operating commands to the servo motor, in addition to the methods provided in Chapter 6.

#### ■ Frame structure

When 48 bytes are set for the number of transmission bytes in the communication settings, the command frame structure is as follows.




0 to 31: Used for main commands. The set value varies across the commands. Refer to the list of commands for further information.

32 to 47: Used for sub commands. A limited number of combinations is supported for main and sub commands.

When 32 bytes are set for the number of transmission bytes in the communication settings, the command frame is comprised only of main commands.

#### ■ Data entry format

For MECHATROLINK-III communication, response frame data is entered in reverse order (Little Endian).

Received data

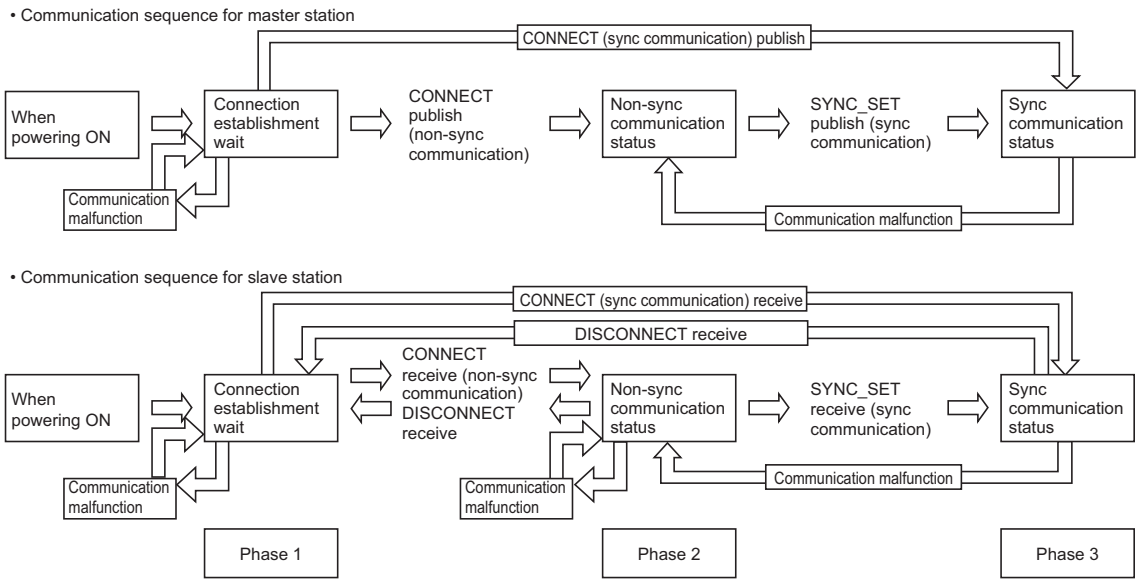
1234ABCDH

Input data

| | 1st byte | | 2nd byte | | 3rd byte | | 4th byte | |
|---|---|---|---|---|---|---|---|---|
| | Upper | Lower | Upper | Lower | Upper | Lower | Upper | Lower |
| HEX | CH | DH | AH | BH | 3H | 4H | 1H | 2H |

#### ■ Communication sequence for master/slave stations

The status of master stations and slave stations transitions as follows when these stations communicate with each other.



## ■ Phase

MECHATROLINK-III communication has three phases.

| Phase | Status |
|---|---|
| Phase 1 | The power is turned on, ready for a connection to be established. |
| Phase 2 | The connection is now established, ready for asynchronous communication. |
| Phase 3 | The connection is now established, ready for synchronous communication. |

## ■ Terminology

Transmission cycle . . . . . A transmission cycle for MAC (Media Access Control Layer). A physical transmission cycle to send out data to the transmission path.

Communication cycle . . . A communication cycle in the application layer. Set to integer multiples of the transmission cycle.

Type of synchronization

Synchronous . . . . . A type of command to issue commands and receive responses in each communication cycle.
Receive responses for issued commands in the next communication cycle.
Update and check the WDT (Watchdog Timer) value in the frame in each communication cycle.

Asynchronous . . . . . A type of command to issue commands and receive responses asynchronously with regard to the communication cycle.
Responses for issued commands are not necessarily received in the next communication cycle.
The WDT (Watchdog Timer) value in the frame is not checked.

Communication mode

Asynchronous . . . . . Send and receive commands/responses in each communication cycle.

Synchronous . . . . . Asynchronously with regard to the communication cycle, issue commands in an event-driven manner. Note that commands/responses are sent and received synchronously with regard to the communication cycle.

## List of MECHATROLINK-III communication commands

MECHATROLINK-III communication commands are divided into main commands and sub commands. The list of commands is as follows.

### ■ List of main commands

| Command | Command code | Descriptions | SV2 series supported | See page |
|---|---|---|---|---|
| NOP | 00H | No operation performed. | Yes | A-53 |
| PRM_RD | 01H | Read parameters. | - | - |
| PRM_WR | 02H | Save parameters. | - | - |
| ID_RD | 03H | Read the servo motor ID. | Yes | A-54 |
| CONFIG | 04H | Enable the configured parameter. | Yes | A-57 |
| ALM_RD | 05H | Read the state of the alarm/warning that is occurring and the alarm history. | Yes | A-60 |
| ALM_CLR | 06H | Clear the state of the alarm/warning that is occurring and the alarm history. | Yes | A-60 |
| SYNC_SET | 0DH | Start synchronous communication. | Yes | A-61 |
| CONNECT | 0EH | Establish a connection. | Yes | A-55 |
| DISCONNECT | 0FH | Disconnect a connection. | Yes | A-54 |
| PPRM_RD | 1BH | Read parameters from flash ROM. | - | - |
| PPRM_WR | 1CH | Save parameters to flash ROM. | - | - |
| MEM_RD | 1DH | Read parameters from memory. | Yes | A-73 |
| MEM_WR | 1EH | Save parameters to memory. | Yes | A-74 |
| POS_SET | 20H | Set up the coordinates. | Yes | A-61 |
| BRK_ON | 21H | Activate the electromagnetic brake. | Yes | A-72 |
| BRK_OFF | 22H | Release the electromagnetic brake. | Yes | A-72 |
| SENS_ON | 23H | Acquire position data by powering on the encoder. | Yes | A-58 |
| SENS_OFF | 24H | Power off the encoder. | Yes | A-58 |
| SMON | 30H | Monitor the state of the servo amplifier. | Yes | A-59 |
| SV_ON | 31H | Set the servo motor to Servo On State. | Yes | A-59 |
| SV_OFF | 32H | Set the servo motor to Servo Off State. | Yes | A-59 |
| INTERPOLATE | 34H | Perform the interpolation. | Yes | A-63 |
| POSING | 35H | The target position (TPOS) is set relative to the target speed (TSPD). | Yes | A-63 |
| FEED | 36H | Feed at the target speed (TSPD). | Yes | A-65 |
| EX_FEED | 37H | Feed at the specified speed (TSPD). When the latch signal is input while performing this command, positioning is performed from the latch signal input position to a position, to which the parameter-specified moved distance after inputting the latch signal is added. | Yes | A-66 |
| EX_POSING | 39H | The target position (TPOS) is set relative to the target speed (TSPD). When the latch signal is input while performing this command, positioning is performed from the latch signal input position to a position, to which the parameter-specified moved distance after inputting the latch signal is added. | Yes | A-67 |
| ZRET | 3AH | Perform an origin return. | Yes | A-68 |
| VELCTRL | 3CH | Control the speed. | Yes | A-70 |
| TRQCTRL | 3DH | Control the torque. | Yes | A-71 |
| SVPRM_RD | 40H | Read servo parameters. | Yes | A-56 |
| SVPRM_WR | 41H | Save servo parameters. | Yes | A-56 |

### ■ List of sub commands

| Command | Command code | Descriptions | SV2 series supported | See page |
|---|---|---|---|---|
| NOP | 00H | No operation performed. | Yes | A-76 |
| ALM_RD | 05H | Read the state of the alarm/warning that is occurring and the alarm history. | Yes | A-76 |
| ALM_CLR | 06H | Clear the state of the alarm/warning that is occurring and the alarm history. | Yes | A-76 |
| MEM_RD | 1DH | Read parameters from memory. | Yes | A-76 |
| MEM_WR | 1EH | Save parameters to memory. | Yes | A-76 |
| SMON | 30H | Monitor the state of the servo amplifier. | Yes | A-77 |
| SVPRM_RD | 40H | Read servo parameters. | Yes | A-77 |
| SVPRM_WR | 41H | Save servo parameters. | Yes | A-77 |

### ■ List of main commands and corresponding sub commands

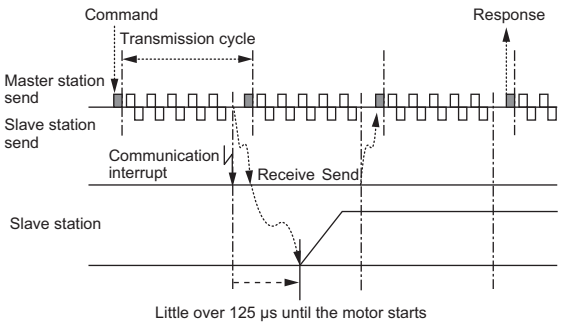
Sub commands are enabled only for specific main commands. The list of main commands and corresponding sub commands is as follows.

| Command | Command code | Sub commands | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | NOP | ALM_RD | ALM_CLR | MEM_RD | MEM_WR | SMON | SVPRM_RD | SVPRM_WR |
| NOP | 00H | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| ID_RD | 03H | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| CONFIG | 04H | Yes | No | No | No | No | Yes | No | No |
| ALM_RD | 05H | Yes | No | No | No | No | Yes | No | No |
| ALM_CLR | 06H | Yes | No | No | No | No | Yes | No | No |
| SYNC_SET | 0DH | Yes | No | No | No | No | Yes | No | No |
| CONNECT | 0EH | Yes | No | No | No | No | No | No | No |
| DISCONNECT | 0FH | Yes | No | No | No | No | No | No | No |
| MEM_RD | 1DH | Yes | No | No | No | No | Yes | No | No |
| MEM_WR | 1EH | Yes | No | No | No | No | Yes | No | No |
| POS_SET | 20H | Yes | No | No | No | No | Yes | No | No |
| BRK_ON | 21H | Yes | No | No | No | No | Yes | No | No |
| BRK_OFF | 22H | Yes | No | No | No | No | Yes | No | No |
| SENS_ON | 23H | Yes | No | No | No | No | Yes | No | No |
| SENS_OFF | 24H | Yes | No | No | No | No | Yes | No | No |
| SMON | 30H | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| SV_ON | 31H | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| SV_OFF | 32H | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| INTERPOLATE | 34H | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| POSING | 35H | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| FEED | 36H | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| EX_FEED | 37H | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| EX_POSING | 39H | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| ZRET | 3AH | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| VELCTRL | 3CH | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| TRQCTRL | 3DH | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| SVPRM_RD | 40H | Yes | No | No | No | No | Yes | No | No |
| SVPRM_WR | 41H | Yes | No | No | No | No | Yes | No | No |

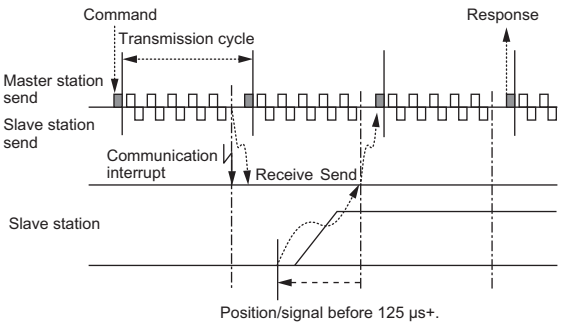
## Command/response timing chart

When the master station is sending a command to the slave station, the timing for the slave station to perform the command and for the master station to input monitoring data is as follows. The timing is consistent regardless of whether it is the communication cycle or transmission cycle.

- **Timing to perform commands**




- **Timing to input monitoring data**



## Flow of operation

## Operating method

Before starting communication, follow the procedures provided in "6-2 SV2 Series Setting", Page 6-3 to check the communication settings and communication status.
In case of operating using the MECHATROLINK-III communication commands, two types of operating methods are available: the controller based parameter management method and the servo amplifier based parameter management method. To manage parameters using the controller, you do not need to reassign parameters to the servo amplifier even after the servo amplifier has been replaced.
The flow of operation for each method is as follows.

### ■ Operating sequence when managing parameters using the controller

| Steps | Command | Command code | Steps |
|---|---|---|---|
| 1 | - | - | Power on the main and control circuits. |
| 2 | NOP | 00H | Check if servo amplifier initialization is completed. |
| 3 | DISCONNECT*1 | 0FH | Disconnect the last connection. |
| 4 | CONNECT | 0EH | Establish a connection and start counting the watchdog timer. |
| 5 | ID_RD | 03H | Read the servo motor ID. |
| 6 | SVPRM_RD | 40H | Read the configuration information such as servo motor parameters. |
| 7 | SVPRM_WR | 41H | Write parameters necessary for the servo motor. |
| 8 | CONFIG | 04H | Enable the parameter configured for the servo motor. |
| 9 | SENS_ON | 23H | Acquire position data by powering on the encoder. |
| 10 | SV_ON | 31H | Set the servo motor to Servo On State. Perform operation. |
| 11 | POSING, INTERPOLATE, etc. | | Start operation. |
| 12 | SV_OFF | 32H | Set the servo motor to Servo Off State. |
| 13 | DISCONNECT | 0FH | Disconnect a communication connection. |
| 14 | - | - | Power off the main and control circuits. |

*1 In case the connection was not disconnected successfully, send the CONNECT command after sending the DISCONNECT command in more than 2 communication cycles.

### ■ Operating sequence when managing parameters using the servo amplifier

#### ● During setup

| Steps | Command | Command code | Steps |
|---|---|---|---|
| 1 | - | - | Power on the main and control circuits. |
| 2 | DISCONNECT*1 | 0FH | Disconnect the last connection. |
| 3 | CONNECT | 0EH | Establish a connection and start counting the watchdog timer. |
| 4 | ID_RD | 03H | Read the servo motor ID. |
| 5 | SVPRM_RD | 40H | Read the configuration information such as servo motor parameters. |
| 6 | SVPRM_WR | 41H | Write parameters necessary for the servo motor to flash ROM. |
| 7 | DISCONNECT | 0FH | Disconnect a communication connection. |
| 8 | - | - | Power off the main and control circuits. |

*1 In case the connection was not disconnected successfully, send the CONNECT command after sending the DISCONNECT command in more than 2 communication cycles.

### ● During normal operation

| Steps | Command | Command code | Steps |
|---|---|---|---|
| 1 | - | - | Power on the main and control circuits. |
| 2 | DISCONNECT*1 | 0FH | Disconnect the last connection. |
| 3 | CONNECT | 0EH | Establish a connection and start counting the watchdog timer. |
| 4 | ID_RD | 03H | Read the servo motor ID. |
| 5 | SVPRM_RD | 40H | Read the configuration information such as servo motor parameters. |
| 6 | SENS_ON | 23H | Acquire position data by powering on the encoder. |
| 7 | SV_ON | 31H | Set the servo motor to Servo On State. |
| 8 | POSING, INTERPOLATE, etc. | | Perform operation. |
| 9 | SV_OFF | 32H | Set the servo motor to Servo Off State. |
| 10 | DISCONNECT | 0FH | Disconnect a communication connection. |
| 11 | - | - | Power off the main and control circuits. |

*1 In case the connection was not disconnected successfully, send the CONNECT command after sending the DISCONNECT command in more than 2 communication cycles.

## ■ Other operating sequences

Special sequences using MECHATROLINK-III communication commands are as follows.

### ● During Servo ON

SV2 Series controls operation using MECHATROLINK-III communication commands sent from the host controller only during Servo ON.

During Servo OFF, positioning is controlled by the servo amplifier (follow-up processing) so the command pulse equals to the feedback pulse.

To send MECHATROLINK-III communication commands properly, you need to perform SMON after Servo ON was enabled, check the state of the servo monitor and send the appropriate position command.

To enable Servo ON, check that the SVCMD_IO field read by SMON is M_RDY=1 and send the SV_ON command.

### ● During limit switch stop mode

Once the limit switch signal has been input, the servo amplifier brings the motor to a stop using the method set for "*Limit switch stop mode" (ALM_05).

When stopped, the limit switch signal needs to be cleared using the following method.

**Step 1**

Monitor the limit switch signal (LSP/LSN) and send the following commands once the limit switch signal has been input.

- **Interpolation command**
  Stop updating the interpolation position without making changes to the interpolation command. Or, send the SMON command.
- **Commands other than the interpolation command**
  Send CMD_CANCEL=1.

**Step 2**

Using the DEN = 1 (pulse output completion) signal in the SVCMD_IO field, check that the servo amplifier has been brought to a stop by the limit switch. Also, by monitoring the ZSPD=1 (zero speed) in the SVCMD_IO field, the stop of the motor can be detected reliably. Keep the command in step 1 until the DEN and ZSPD signals are ready.

**Step 3**

Use move commands (POSING, INTERPOLATE, etc.) to perform limit release processing (move back in the reverse direction). Use the command to read the present position, respecify the appropriate command pulse, and then issue a command.

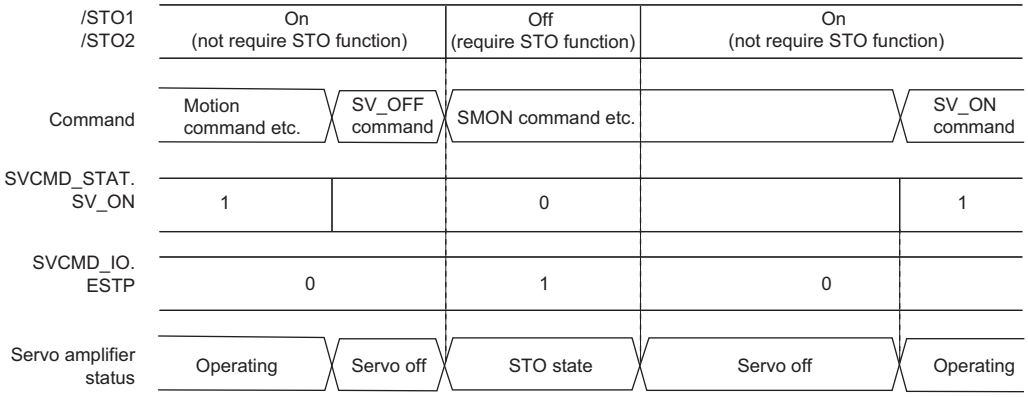
- **During emergency stops( with the main circuit turned OFF)**

  Detect SV_ON or PON=0 of response data from the SVCMD_IO field, and then send the SV_OFF command.
  Use the SMON command, etc., during emergency stops to monitor the state of the servo amplifier.

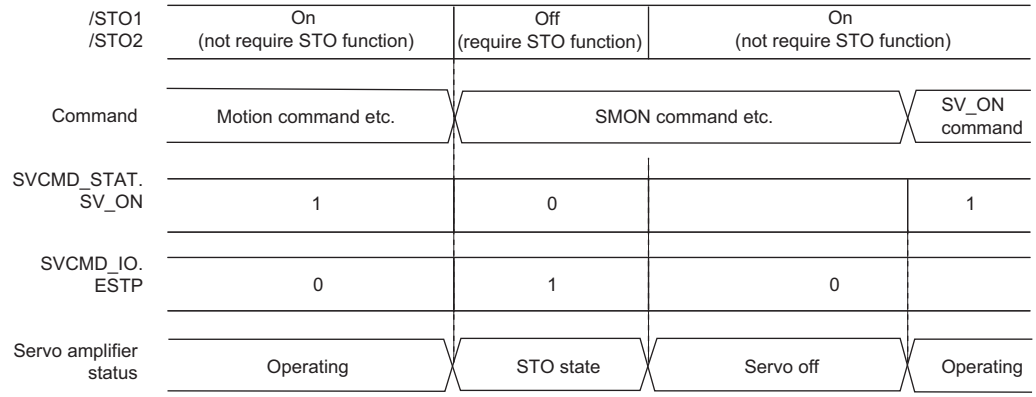
- **During safety signal inputs**

  Once safety signals have been input, the servo amplifier forcibly shuts off the power to the motor and brings it to a stop using the method set for "*Servo OFF or G1 alarm stop mode" (ALM_01).
  "How to stop the device", Page 8-8

  - **When the STO signal is input after motor power shut-off**




  - **When the STO signal is input while the motor is powered on**




Monitor the state of the STO input signal or the ESTP signal (STO) in the servo command input signal monitoring field (SVCMD_IO). If a forced stop is detected, use the SV_OFF command, etc., to bring the motor to a stop.

Once the motor has been brought to a stop, use the following method to restore the settings.

**Step 1**
Clear the /STO1 or /STO2 signal.
At this point, the motor is still in the STO state.

**Step 2**
Issue the SV_OFF command to enter into the Servo Off state.

**Step 3**
Restore the controller and system settings.

**Step 4**
Issue the SV_ON command to enter into the Servo On state.

**Step 5**

Complete operation preparations after Servo ON.

**Step 6**

Start operation.

**Point**

- **If entered into the STO state while sending the SV_ON command, clear the /STO1 or /STO2 signal. Then send commands other than SV_ON such as SV_OFF, and send the SV_ON command again. This restores the normal operation state.**
- **If entered into the STO state while performing SV_ON, INTERPOLATE, POSING, FEED, EX_FEED, EX_POSING, ZRET commands, SV2 Series enters into the Servo Off state, setting off a command warning.**

### ● When an alarm occurs

When D_ALM = 1 or COMM_ALM≧8 is detected from the CMD_STAT field of response data, issue the SV_OFF command. You can check the activation state using the ALM_RD command.

The alarm activation state can be cleared by resolving the alarm cause and issuing the ALM_CLR command. Note that if an alarm occurs that requires repowering, it cannot be cleared.

### ● When a communication-related alarm occurs

Issue the ALM_CLR command to clear the alarm.

### ● When a warning occurs

When D_WAR = 1 or COMM_ALM = 1 to 7 is detected, SV2 Series does not enter into the Servo Off state only with a warning.

Check the alarm code generated using the ALM_RD command to resolve the warning cause.

The warning state can be cleared by issuing the ALM_CLR command or ALM_CLR bit of command control (CMD_CTRL).

### ● When a command error occurs

When CMD_ALM ≠ 0 is detected, the alarm is automatically cleared the next time a successful command is received. Monitor the CMD_ALM state in each communication cycle from the host controller.

## Setting the origin position at start-up

### ■ Incremental encoder

When using the servo motor in incremental mode, an origin return needs to be performed when repowering.

Once an origin return has been performed and the origin has been confirmed, set up the command coordinates.

Two types of methods are available to set up the command coordinates.

### ● Setting up the command coordinates using the ZRET command

The master station (controller) uses the ZRET command to perform an origin return and then set up the command coordinates.

### ● Setting up the command coordinates using the POS_SET command

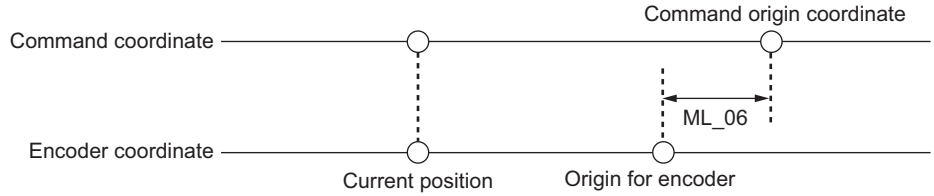
The controller uses the POS_SET command to set up the command coordinates of the slave station.

1: Position the coordinates at the reference position.
2: By setting POS_SET_MODE.POS_SEL=3, POS_SET_MODE.REFE=1, POS_DATA as the reference position, issue the POS_SET command.

Once the coordinates have been set up, ZPOINT and Software limit are enabled.

### ■ Absolute encoder

When using the servo motor in absolute mode, read the absolute position data from the absolute encoder using the SENS_ON command, and then set up the command coordinates of the servo amplifier. The command coordinates are set up by the absolute encoder detecting the position and "Absolute encoder origin offset" (ML_06).




Present position (command coordinates) = Present position (encoder coordinates) + ML_06

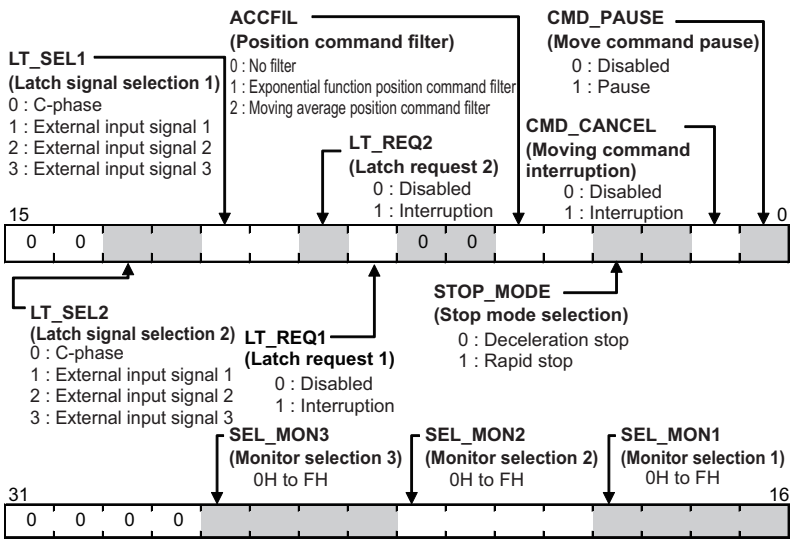
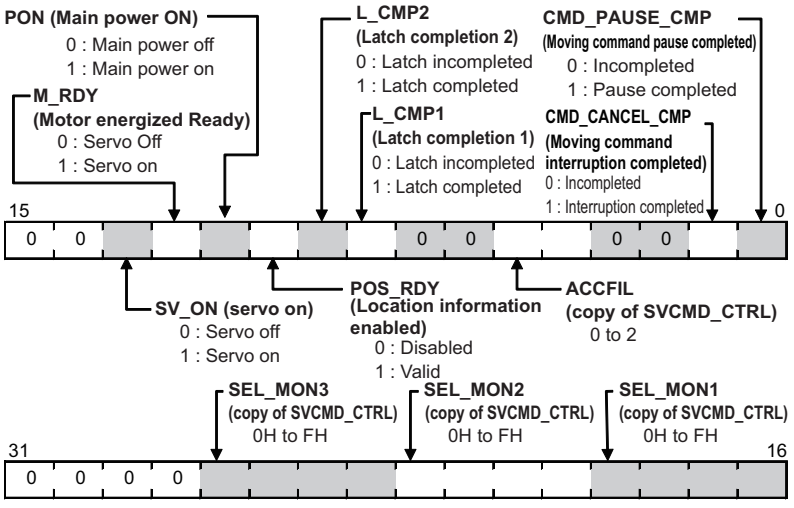
## List of data fields

### ■ Data fields related to main commands

| Data field | Data length | Data |
|---|---|---|
| WDT (Watchdog timer) | 1 byte | SN (RSN copy of RWDT) 0H to FH; MN (+1 each communication cycle) 0H to FH; 7 … 0 |
| RWDT (Watchdog timer) | 1 byte | RSN (+1 each communication cycle) 0H to FH; RMN (MN copy of WDT) 0H to FH; 7 … 0 |
| CMD_CTRL (Command control) | 2 bytes | CMD_ID (command ID) 0 to 3 Arbitrary value; 15 … 0; 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0; ALM_CLR (Alarm clear) 0 : Alarm/warning Clear invalid 1 : Alarm/warning Clear execution |
| CMD_STAT (Command status) | 2 bytes | RCMD_ID (copy of CMD_ID) 0 to 3; D_ALM (alarm) 0 : None 1 : Occurring; CMD_ALM (Command abnormal state) 0H to FH; CMDRDY (command ready) 0 : Failed to accept command 1 : Command acceptable; 15 … 0; 0 0; COMM_ALM (communication abnormal state) 0H to FH; ALM_CLR_CMP (Alarm clear completed) 0 : Clear incomplete 1 : Clear completed; D_WAR (warning) 0 : None 1 : Occurring |

| CMD_ALM | | Description |
|---|---|---|
| Normal | 0H | Normal |
| Warning | 1H | Out of range |
| Alarm | 8H | An unsupported command received |
| | 9H | Out of range |
| | AH | A command execution condition error |
| | BH | A sub command combination error |
| | DH | A phase error |

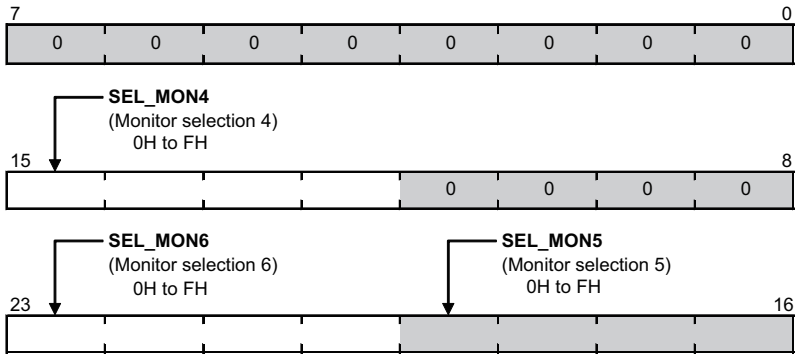
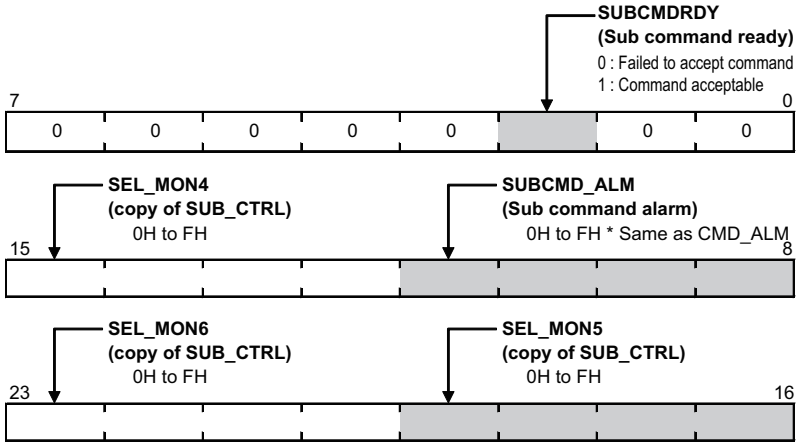
| COMM_ALM | | Description |
|---|---|---|
| Normal | 0H | Normal |
| Warning | 1H | An FCS error |
| | 2H | Command data not received |
| | 3H | Synchronous frame not received |
| Alarm | 8H | An FCS error |
| | 9H | Command data not received |
| | AH | Synchronous frame not received |
| | BH | The synchronous interval error |
| | DH | A WDT error |

| Data field | Data length | Data |
|---|---|---|
| SVCMD_CTRL (Servo command control) | 4 bytes |  |
| SVCMD_STAT (Servo command status) | 4 bytes |  |

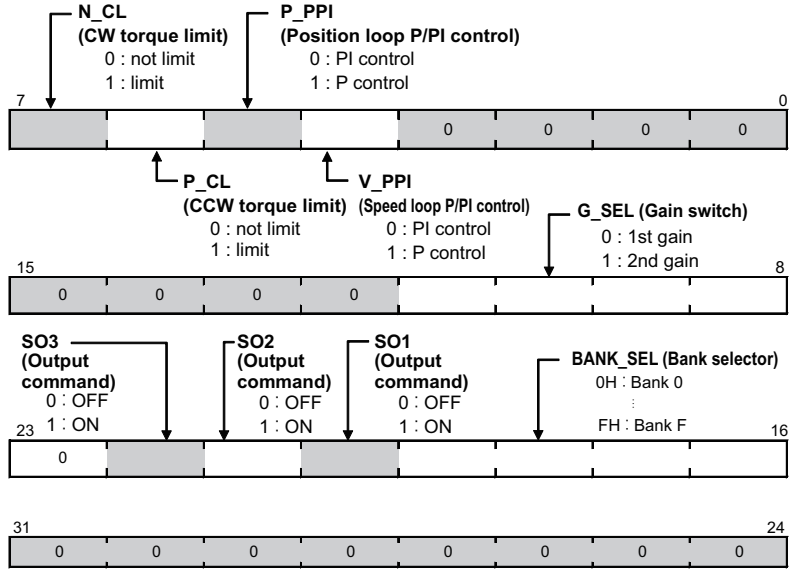
Setting the following values to SEL_MON1/2/3/4/5/6 allows changing data to be saved to monitors 1/2/3/4/5/6. Data that can be configured and units of saved values are as follows.

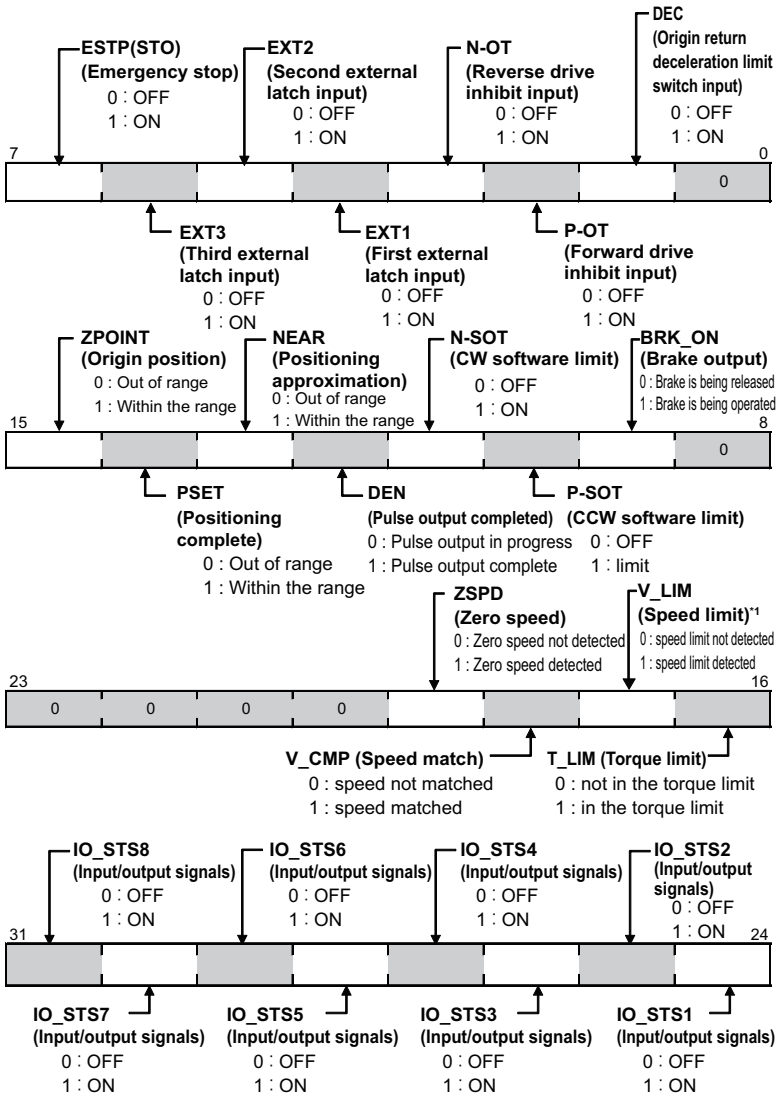
| SEL_MON1/2/3/4/5/6 | Signal name | Data to be saved to monitors 1/2/3/4/5/6 | Remarks |
|---|---|---|---|
| 0H | APOS | Feedback position | Command unit |
| 1H | CPOS | Command position | Command unit |
| 2H | PEER | Position deviation | Command unit |
| 3H | LPOS1 | Feedback latch position 1 | Command unit |
| 4H | LPOS2 | Feedback latch position 2 | Command unit |
| 5H | FSPD | Feedback speed | Following the machine parameter (8F0H) "*Speed unit" the machine parameter (8F1H) "*Speed basic unit" |
| 6H | CSPD | Command speed | Following the machine parameter (8F0H) "*Speed unit" the machine parameter (8F1H) "*Speed basic unit" |
| 7H | TRQ | Torque command | Following the machine parameter (8F6H) "*Torgue unit" the machine parameter (8F7H) "*Torgue basic unit" |
| 8H | ALARM | Alarm information details | - |
| 9H | MPOS | Command position of the position control loop | Command unit |
| AH | - | - | - |
| BH | - | - | - |
| CH | CMN1 | Common monitor 1 | Monitor the parameter set for the machine parameter (84EH) "Common monitor 1 (CPRM_SEL_MON)". |
| DH | CMN2 | Common monitor 2 | Monitor the parameter set for the machine parameter (84FH) "Common monitor 2 (CPRM_SEL_MON)". |
| EH | OMN1 | Option monitor 1 | Monitor the parameter set for the machine parameter (824H) "Option monitor 1 (CPRM_SEL_MON)". |
| FH | OMN2 | Option monitor 2 | Monitor the parameter set for the machine parameter (825H) "Option monitor 2 (CPRM_SEL_MON)". |

## ■ Data fields related to sub commands

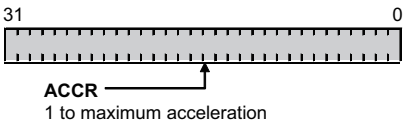
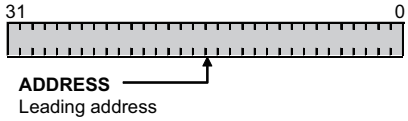
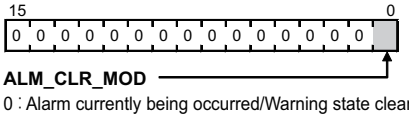
| Data field | Data length | Data |
|---|---|---|
| SUB_CTRL<br>(Sub command control) | 3 bytes |  |
| SUB_CTRL<br>(Sub command status) | 3 bytes |  |

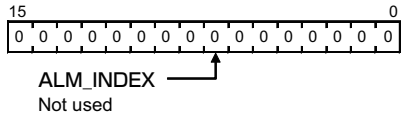
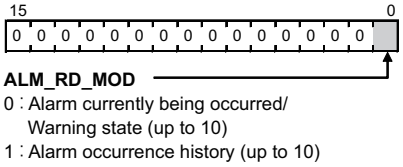
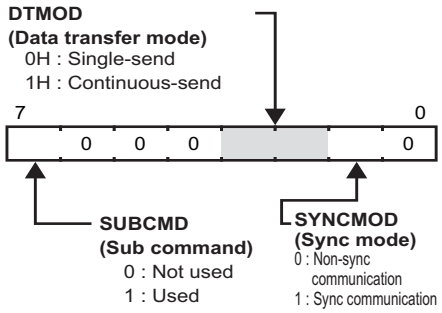
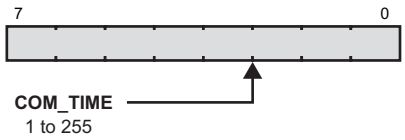
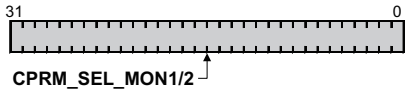
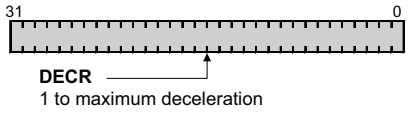
## ■ Data fields related to I/O monitoring

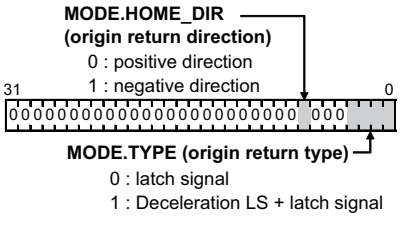
| Data field | Data length | Data |
|---|---|---|
| SVCMD_IO<br>(Output signal)<br>*Command side | 4 bytes |  |

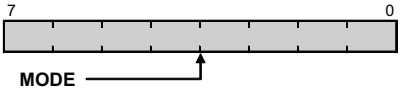
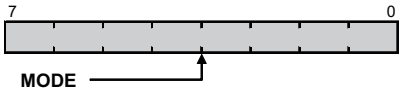
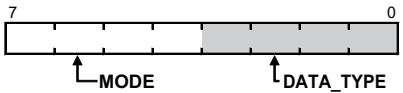
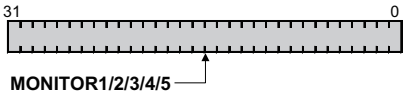
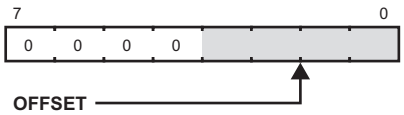
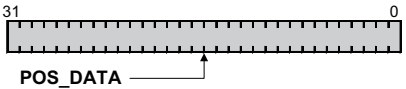
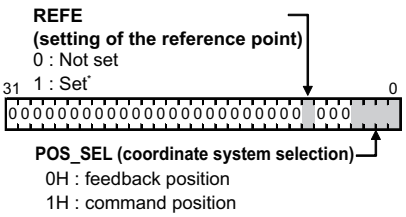
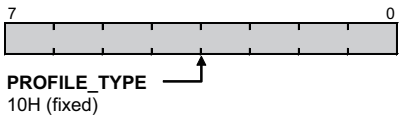
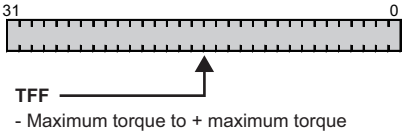
| Data field | Data length | Data |
|---|---|---|
| SVCMD_IO<br>(Input signal)<br>*Response side | 4 bytes |  <br>*1 Set to On when outputting the torque to an upper torque command for controlling the speed.<br>In case of a large difference in torque before and after switching from speed control to torque control, this may be set to On even when the feedback speed has not reached the speed limit. |

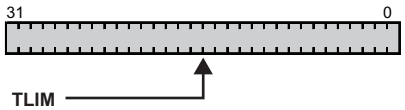
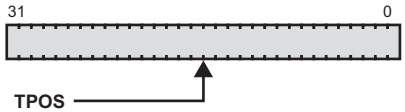
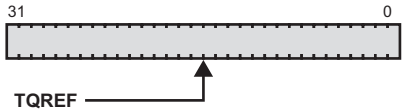
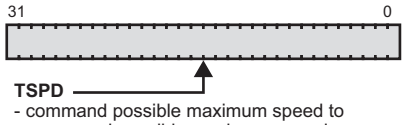
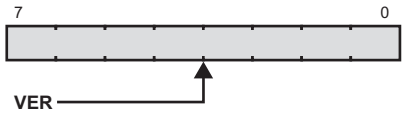
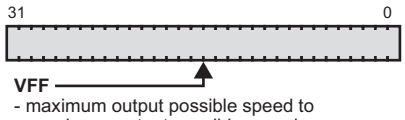
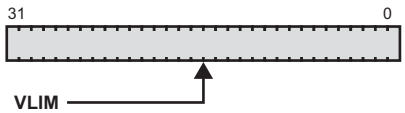
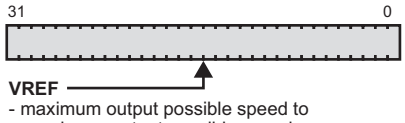
## ■ Other data fields

| Data field | Data length | Data | Remarks |
|---|---|---|---|
| ACCR<br>(Acceleration) | 4 bytes |  | - |
| ADDRESS<br>(Address) | 4 bytes |  | - |
| ALM_CLR_MOD<br>(Alarm to be cleared) | 2 bytes |  | - |

<table>
<tr><th>Data field</th><th>Data length</th><th>Data</th><th>Remarks</th></tr>
<tr><td>ALM_DATA<br>(Alarm data)</td><td>24 bytes</td><td>
<table>
<tr><th>ALM_RD_MOD</th><th>Data to be saved to ALM_DATA</th></tr>
<tr><td>0H</td><td>Up to 10 latest alarms/warnings that are occurring are saved.</td></tr>
<tr><td>1H</td><td>Up to 10 most recent alarms/warnings that occurred before are saved.</td></tr>
</table>
</td><td></td></tr>
<tr><td>ALM_INDEX<br>(Alarm index)</td><td>2 bytes</td><td> 
</td><td>-</td></tr>
<tr><td>ALM_RD_MOD<br>(Alarm read method)</td><td>2 bytes</td><td> 
</td><td>-</td></tr>
<tr><td>COM_MOD<br>(Communication mode)</td><td>1 byte</td><td> 
</td><td>-</td></tr>
<tr><td>COM_TIME<br>(Communication cycle)</td><td>1 byte</td><td> 
</td><td>0.125 (ms) ≤ MECHATROLINK-III transmission cycle (ms) × COM_TIME ≤ 32 (ms)</td></tr>
<tr><td>CPRM_SEL_MON1/2<br>(Fixed monitoring field)</td><td>4 bytes</td><td> 
</td><td>The parameter which was set in the Machine Parameter (84CH) "(CPRM_SEL_MON 1)" and the Machine Parameter (84DH) "(CPRM_SEL_MON 2)" are stored.</td></tr>
<tr><td>DATA<br>(Read data)</td><td>4 bytes/<br>20 bytes</td><td>Data specified for MODE, DATA_TYPE, SIZE, ADDRESS</td><td>-</td></tr>
<tr><td>DECR<br>(Deceleration speed)</td><td>4 bytes</td><td> 
</td><td>-</td></tr>
</table>

<table>
<tr><th>Data field</th><th>Data length</th><th>Data</th><th>Remarks</th></tr>
<tr><td>ID<br>(Device information)</td><td>24 bytes</td><td rowspan="2"><table>
<tr><th>ID_CODE</th><th>ADDRESS</th><th>Data to be saved to ID</th></tr>
<tr><td>01H</td><td>0000 0004H</td><td>Vendor ID code</td></tr>
<tr><td>02H</td><td>0000 0008H</td><td>Device code</td></tr>
<tr><td>03H</td><td>0000 000CH</td><td>Device version</td></tr>
<tr><td>04H</td><td>0000 0010H</td><td>Machine Definition (MDI) file version</td></tr>
<tr><td>05H</td><td>0000 0014H</td><td>Advanced address settings</td></tr>
<tr><td>06H</td><td>0000 0034H to<br>0000 0018H</td><td>Serial number</td></tr>
<tr><td>10H</td><td>0000 0040H</td><td>Profile type 1 (primary)</td></tr>
<tr><td>11H</td><td>0000 0044H</td><td>Profile version 1 (primary)</td></tr>
<tr><td>12H</td><td>0000 0048H</td><td>Profile type 2</td></tr>
<tr><td>13H</td><td>0000 004CH</td><td>Profile version 2</td></tr>
<tr><td>14H</td><td>0000 0050H</td><td>Profile type 3</td></tr>
<tr><td>15H</td><td>0000 0054H</td><td>Profile version 3</td></tr>
<tr><td>16H</td><td>0000 0058H</td><td>Transmission cycle minimum limit [0.01µs]</td></tr>
<tr><td>17H</td><td>0000 005CH</td><td>Transmission cycle maximum limit [0.01µs]</td></tr>
<tr><td>18H</td><td>0000 0060H</td><td>Transmission cycle interval</td></tr>
<tr><td>19H</td><td>0000 0064H</td><td>Communication cycle minimum limit [0.01µs]</td></tr>
<tr><td>1AH</td><td>0000 0068H</td><td>Communication cycle maximum limit [0.01µs]</td></tr>
<tr><td>1BH</td><td>0000 006CH</td><td>No. of bytes transmitted</td></tr>
<tr><td>1CH</td><td>0000 0070H</td><td>No. of bytes transmitted (present set value)</td></tr>
<tr><td>1DH</td><td>0000 0080H</td><td>Profile type (present selected value)</td></tr>
<tr><td>20H</td><td>0000 0080H</td><td>For Communication mode</td></tr>
<tr><td>30H</td><td>0000 00DFH to<br>0000 00C0H</td><td>For the list of main commands</td></tr>
<tr><td>38H</td><td>0000 00FFH to<br>0000 00E0H</td><td>For the list of sub commands</td></tr>
<tr><td>40H</td><td>0000 011FH to<br>0000 0100H</td><td>For the list of common parameters</td></tr>
<tr><td>80H</td><td>0000 021FH to<br>0000 0200H</td><td>Main device 1 name</td></tr>
<tr><td>90H</td><td>0000 025FH to<br>0000 0240H</td><td>Sub device 1 name</td></tr>
<tr><td>98H</td><td>0000 0260H</td><td>Sub device 1 version</td></tr>
<tr><td>A0H</td><td>0000 029FH to<br>0000 0280H</td><td>Sub device 2 name</td></tr>
<tr><td>A8H</td><td>0000 02A0H</td><td>Sub device 2 version</td></tr>
<tr><td>B0H</td><td>0000 02DFH to<br>0000 02C0H</td><td>Sub device 3 name</td></tr>
<tr><td>B8H</td><td>0000 02E0H</td><td>Sub device 3 version</td></tr>
<tr><td>C0H</td><td>0000 031FH to<br>0000 0300H</td><td>Sub device 4 name</td></tr>
<tr><td>C8H</td><td>0000 0320H</td><td>Sub device 4 version</td></tr>
<tr><td>D0H</td><td>0000 035FH to<br>0000 0340H</td><td>Sub device 5 name</td></tr>
<tr><td>D8H</td><td>0000 0360H</td><td>Sub device 5 version</td></tr>
<tr><td>E0H</td><td>0000 039FH to<br>0000 0380H</td><td>Sub device 6 name</td></tr>
<tr><td>E8H</td><td>0000 03A0H</td><td>Sub device 6 version</td></tr>
</table></td><td></td></tr>
<tr><td>ID_CODE<br>(Device information selection)</td><td>1 byte</td><td></td><td></td></tr>
<tr><td>MODE<br>(Origin return method)<br>* For ZRET</td><td>4 bytes</td><td> 
</td><td>-</td></tr>
</table>

| Data field | Data length | Data | Remarks |
|---|---|---|---|
| MODE<br>(Servo parameter read mode)<br>* For SVPRM_RD | 1 byte |  <br>00H : common parameters (volatile memory area)<br>10H : device parameters (volatile memory area) | - |
| MODE<br>(Servo parameter write mode)<br>* For SVPRM_WR | 1 byte |  <br>00H : common parameters (volatile memory area)<br>01H : common parameter (non-volatile memory area)<br>10H : device parameters (volatile memory area)<br>11H : device parameters (non-volatile memory area) | - |
| MODE/DATA_TYPE<br>(Data type) | 1 byte |  <br>1 : volatile memory<br>2 : non-volatile memory<br>1: Byte type<br>2: Short type<br>3: Long type | - |
| MONITOR1/2/3/4/5<br>(Monitor) | 4 bytes |  | Data set to SEL_MON1/2/3/4/5 is saved. |
| NO. (Parameter number) | 2 bytes | Parameter number that is to be read/has been read | - |
| OFFSET<br>(Offset position) | 1 byte |  <br>0H to FH | - |
| PARAMETER<br>(Parameter) | 8 bytes/<br>16 bytes | Parameter that has been read | - |
| POS_DATA<br>(Value set for the coordinate system) | 4 bytes |  | Set the reference coordinates for the mechanical coordinate system when 0H: APOS (the feedback position for the mechanical coordinate system) is set for POS_SET_MOD.<br>In case of anything other than 0H: APOS, set 00000000H. |
| POS_SET_MOD<br>(Coordinate system setting method) | 4 bytes |  | ZPOINT (the origin position) and Software limit are enabled when REFE is set to "1: Enable". |
| PROFILE_TYPE<br>(Profile type) | 1 byte |  | - |
| SIZE<br>(Data size) | 1 byte/<br>2 bytes | Amount of data (Type specified for DATA_TYPE) | - |
| TFF<br>(Torque feedforward) | 4 bytes |  <br>- Maximum torque to + maximum torque | - |

| Data field | Data length | Data | Remarks |
|---|---|---|---|
| TLIM<br>(Torque limit value) | 4 bytes |  | - |
| TPOS<br>(Target coordinate) | 4 bytes |  | Distance moved: Less than 2147483647 |
| TQREF<br>(Torque command) | 4 bytes |  | - |
| TSPD<br>(Target speed) | 4 bytes |  | - |
| VER<br>(MECHATROLINK-III version) | 1 byte |  | - |
| VFF<br>(Speed feedforward) | 4 bytes |  | - |
| VLIM<br>(Speed limit value) | 4 bytes |  | - |
| VREF<br>(Speed command value) | 1 byte |  | - |

# Commands to be used prior to operation

## List of commands

MECHATROLINK-III communication commands that are used prior to operation after powered on are as follows.

| Command | Command code | Function name | Description | See page |
|---|---|---|---|---|
| NOP | 00H | Disabled | Disable servo amplifier communication. | A-53 |
| DISCONNECT | 0FH | Connection disconnection request | Disconnect the MECHATROLINK-III connection. | A-54 |
| CONNECT | 0EH | Connection establishment request | Establish the MECHATROLINK-III connection. | A-55 |
| ID_RD | 03H | Read ID | Check the device ID, etc. | A-54 |
| SVPRM_RD | 40H | Read servo parameters | Read servo parameters. | A-56 |
| SVPRM_WR | 41H | Write servo parameters | Write servo parameters. | A-56 |
| CONFIG | 04H | Device setup request | Enable the configured parameter. | A-57 |
| SENS_ON | 23H | Sensor ON | Acquire position data by powering on the encoder. | A-58 |
| SENS_OFF | 24H | Sensor OFF | Power off the encoder. | A-58 |
| SV_ON | 31H | Servo ON | Sets the servo to ON. | A-59 |
| SV_OFF | 32H | Servo OFF | Sets the servo to OFF. | A-59 |
| SMON | 30H | Status monitoring | Monitor the state of the servo amplifier. | A-59 |
| ALM_RD | 05H | Alarm/warning read | Read the alarm/warning and history that are occurring. | A-60 |
| ALM_CLR | 06H | Alarm/warning clear | Clear the alarm/warning and history that are occurring. | A-60 |
| SYNC_SET | 0DH | Synchronization establishment request | Start synchronous communication. | A-61 |
| POS_SET | 20H | Set coordinate system | Set up the coordinates. | A-61 |

## Disable (00H) [NOP]

Use the NOP command when powered on to monitor the state until servo amplifier initialization is completed.

| Byte | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Command | 00H | WDT | CMD_CTRL | | - | | | | | | | | | | | |
| Response | 00H | RWDT | CMD_STAT | | - | | | | | | | | | | | |

| Byte | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Command | - | | | | | | | | | | | | | | | |
| Response | - | | | | | | | | | | | | | | | |

Available phase : Phases 2 and 3
Command type : Asynchronous
Read cycle : Within the communication cycle
Sub command : Available

**Point** **The response is NOP until servo amplifier initialization is completed after powered on. During that time, CMDRDY=0.**

## Connection disconnection request (0FH) [DISCONNECT]

Disconnect the MECHATROLINK-III connection.

| Byte | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Command | 0FH | - | | | | | | | | | | | | | | |
| Response | 0FH | - | | | | | | | | | | | | | | |

| Byte | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Command | - | | | | | | | | | | | | | | | |
| Response | - | | | | | | | | | | | | | | | |

Available phase : All phases
Command type : Asynchronous
Read cycle : Over the communication cycle, less than 5 seconds
Sub command : N/A

**Point**

**Once the DISCONNECT command has been received, the following operations are performed.**

- **Enters Phase 1.**
- **Activate Servo OFF.**
- **The reference point setting is disabled.**
- **Position information is initialized.**
- **The brake signal is activated**
- **In the alarm state, alarms will not be cleared even if the communication is disconnected**
- **The configured parameters are written and saved into Flash ROM.**
- **When re-connecting MECHATROLINK-III, use the same procedure as when powering on to establish a connection.**

## Read ID (03H) [ID_RD]

Read the servo amplifier ID.

| Byte | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Command | 03H | WDT | CMD_CTRL | | ID_CODE | OFFSET | SIZE | | - | | | | | | | |
| Response | 03H | RWDT | CMD_STAT | | ID_CODE | OFFSET | SIZE | | - | | | | | | | |

| Byte | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Command | - | | | | | | | | | | | | | | | |
| Response | ID | | | | | | | | | | | | | | | |

Available phase : Phases 2 and 3
Command type : Asynchronous
Read cycle : Within the communication cycle
Sub command : Available

**Point**

**The following conditions result in a warning, ignoring commands.**

- **When a number that is out of range is set to DEVICE_CODE ("Data setting warning 2 (out of range)" warning (94B))**
- **When SIZE does not match ("Data setting warning 4 (parameter size)" warning (94D))**

## Connection establishment request (0EH) [CONNECT]

Establish the MECHATROLINK-III connection and set the communication mode to COM_MOD.

| Byte | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Command | 0EH | WDT | CMD_CTRL | | VER | COM_MOD | COM_TIM | PROFILE_TYPE | - | | | | | | | |
| Response | 0EH | RWDT | CMD_CTRL | | VER | COM_MOD | COM_TIM | PROFILE_TYPE | - | | | | | | | |

| Byte | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Command | - | | | | | | | | | | | | | | | |
| Response | - | | | | | | | | | | | | | | | |

Available phase : Phase 1

Command type : Asynchronous

Read cycle : Over the communication cycle, less than 5 seconds

Sub command : N/A

**Point**

**The following conditions result in a warning, ignoring commands.**

- **When COM_MOD is out of range**
- **When COM_TIM is out of range**
- **When performing the tuning, initialization/setting adjustment, forced output functions using the SV2 series setting software/KV-XH setting tool**

**The servo amplifier only accepts the CONNECT, DISCONNECT, NOP commands until the connection is established. When it receives other commands, the response is NOP.**

## Read servo parameters (40H) [SVPRM_RD]

Specify the servo parameter number, data size, and read mode to read the parameter.

| Byte | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Command | 40H | WDT | CMD_CTRL | | SVCMD_CTRL | | | | SVCMD_IO | | | | NO | | SIZE | MODE |
| Response | 40H | RWDT | CMD_STAT | | SVCMD_STAT | | | | SVCMD_IO | | | | NO | | SIZE | MODE |

| Byte | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Command | - | | | | | | | | | | | | | | | |
| Response | PARAMETER | | | | | | | | | | | | | | | |

Available phase : Phases 2 and 3
Command type : Asynchronous
Read cycle : Less than 200ms
Sub command : N/A

**Point**

**The following conditions result in a warning, setting PARAMETER to an undefined value.**
- **When NO is out of range: "Data setting warning 1 (constant number)" warning (94A)**
- **When MODE is out of range: "Data setting warning 2 (out of range)" warning (94B)**
- **When SIZE does not match ("Data setting warning 4 (parameter size)" (94D)**
- **When performing the tuning, initialization/setting adjustment, forced output functions using the SV2 series setting software/KV-XH setting tool : "Command warning 1 (out of condition)" warning (95A)**

## Write servo parameters (41H) [SVPRM_WR]

Specify the servo parameter number, data size, and write mode to write the parameter.

| Byte | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Command | 41H | WDT | CMD_CTRL | | SVCMD_CTRL | | | | SVCMD_IO | | | | NO | | SIZE | MODE |
| Response | 41H | RWDT | CMD_STAT | | SVCMD_STAT | | | | SVCMD_IO | | | | NO | | SIZE | MODE |

| Byte | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Command | PARAMETER | | | | | | | | | | | | | | | |
| Response | PARAMETER | | | | | | | | | | | | | | | |

Available phase : Phases 2 and 3
Command type : Asynchronous
Read cycle : Less than 200ms
Sub command : N/A

**Point**

- **Specify whether to write the RAM or Flash ROM space in write mode (MODE).**
- **To change the parameter that requires repowering, perform the SVPRM_WR command and then the CONFIG command to enable the written parameter.**
- **The following conditions result in a warning, ignoring commands.**
  - **When NO is out of range: "Data setting warning 1 (constant number)" warning (94A)**
  - **When MODE is out of range: "Data setting warning 2 (out of range)" warning (94B)**
  - **When SIZE is out of range: "Data setting warning 4 (parameter size)" warning (94D)**
  - **When performing the tuning, initialization/setting adjustment, forced output functions using the SV2 series setting software/KV-XH setting tool : "Command warning 1 (out of condition)" warning (95A)**

## Device setup request (04H) [CONFIG]

Enable the configured parameter.

| Byte | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Command | 04H | WDT | CMD_CTRL | | CONFIG_MOD | - | | | | | | | | | | |
| Response | 04H | RWDT | CMD_CTRL | | CONFIG_MOD | - | | | | | | | | | | |

| Byte | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Command | - | | | | | | | | | | | | | | | |
| Response | - | | | | | | | | | | | | | | | |

Available phase : Phases 2 and 3
Command type : Asynchronous
Read cycle : CONFIG_MOD
set to 1: Less than 5 seconds
set to 2: Less than 20 seconds
Sub command : N/A

**Point**

**When the sensor is ON, Sensor OFF is activated.**

**The following conditions result in a warning, ignoring commands.**

- **When servo ON**
- **When performing the tuning, initialization/setting adjustment, forced output functions using the SV2 series setting software/KV-XH setting tool**

**The following statuses change while performing a command.**

- **ALM (STATUS): The present status maintained, CMDRDY (STATUS): 0, other status (STATUS): Not specified**

**The following output signals change while performing a command.**

- **RDY signal: OFF, other signals: Not specified**

### ● Outputs and statuses while performing the CONFIG command

Output signals and statues changes as follows while performing the CONFIG command.

| Output signals and statuses | Before performing the CONFIG command | While performing the CONFIG command | After performing the CONFIG command |
|---|---|---|---|
| ALARM output | The present state maintained | The present state maintained | The present state maintained |
| RDY output | The present state maintained | OFF | When CONFIG_MOD=0, the present state maintained<br>When CONFIG_MOD=2, OFF |
| Other outputs | The present state maintained | Not specified | The present state maintained |
| ALARM status | The present state maintained | The present state maintained | The present state maintained |
| CMDRDY status | 1 | 0 | 1 |
| Other statues | The present state maintained | Not specified | The present state maintained |
| ALARM code | Alarm occurring | Alarm occurring | Alarm occurring |

## Sensor ON (23H) [SENS_ON]

Acquire absolute position data by powering on the encoder.

| Byte | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Command | 23H | WDT | CMD_CTRL | | SVCMD_CTRL | | | | SVCMD_IO | | | | - | | | |
| Response | 23H | RWDT | CMD_STAT | | SVCMD_STAT | | | | SVCMD_IO | | | | CPRM_SEL_MON1 | | | |

| Byte | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Command | - | | | | | | | | | | | | | | | |
| Response | CPRM_SEL_MON2 | | | | MONITOR1 | | | | MONITOR2 | | | | MONITOR3 | | | |

Available phase : Phases 2 and 3
Command type : Asynchronous
Read cycle : Less than 2 seconds
Sub command : N/A

**Point**

- **When the absolute encoder is in use, the reference point, origin position (ZPOINT) and software limit are enabled.**
- **After using the SENS_ON command, monitor position data and set up the host controller.**

## Sensor OFF (24H) [SENS_OFF]

Power off the encoder.

| Byte | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Command | 24H | WDT | CMD_CTRL | | SVCMD_CTRL | | | | SVCMD_IO | | | | - | | | |
| Response | 24H | RWDT | CMD_STAT | | SVCMD_STAT | | | | SVCMD_IO | | | | CPRM_SEL_MON1 | | | |

| Byte | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Command | - | | | | | | | | | | | | | | | |
| Response | CPRM_SEL_MON2 | | | | MONITOR1 | | | | MONITOR2 | | | | MONITOR3 | | | |

Available phase : Phases 2 and 3
Command type : Asynchronous
Read cycle : Less than 2 seconds
Sub command : N/A

**Point**

- **When the absolute encoder is in use, position data is not specified.**
- **The reference point, origin position (ZPOINT) and software limit are disabled.**
- **The following conditions result in a warning, ignoring commands.**
  - **Servo ON ("Command warning 1 (out of condition)" warning (95A))**

## Servo ON (31H) [SV_ON]

Put the servo motor to the excited state to make it ready for operation.

| Byte | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Command | 31H | WDT | CMD_CTRL | | SVCMD_CTRL | | | | SVCMD_IO | | | | - | | | |
| Response | 31H | RWDT | CMD_STAT | | SVCMD_STAT | | | | SVCMD_IO | | | | CPRM_SEL_MON1 | | | |

| Byte | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Command | - | | | | | | | | | | | | | | | |
| Response | CPRM_SEL_MON2 | | | | MONITOR1 | | | | MONITOR2 | | | | MONITOR3 | | | |

Available phase : Phases 2 and 3
Command type : Asynchronous
Read cycle : Normally 0.05 seconds, max. 10 seconds
Sub command : Available

Point

**The following conditions result in a warning, ignoring commands.**
- **Alarm occurring ("Command warning 1 (out of condition)" warning (95A))**
- **Main circuit power supply OFF ("Command warning 1 (out of condition)" warning (95A))**
- **When the absolute encoder is in use or SENS_ON is not complete yet**

**After using the SV_ON command, read the command position and set up the coordinate system of the host controller.**

## Servo OFF (32H) [SV_OFF]

Put the servo amplifier to the non-excited state.

| Byte | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Command | 32H | WDT | CMD_CTRL | | SVCMD_CTRL | | | | SVCMD_IO | | | | - | | | |
| Response | 32H | RWDT | CMD_STAT | | SVCMD_STAT | | | | SVCMD_IO | | | | CPRM_SEL_MON1 | | | |

| Byte | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Command | - | | | | | | | | | | | | | | | |
| Response | CPRM_SEL_MON2 | | | | MONITOR1 | | | | MONITOR2 | | | | MONITOR3 | | | |

Available phase : Phases 2 and 3
Command type : Asynchronous
Read cycle : The value set for "Brake cmd - SVOFF delay time" (OTH_01). Maximum 500 ms
Sub command : Available

Point

- **When "SVOFF wait time" (ML_56) is set to any other value than 0, the servo amplifier is decelerated and brought to a stop according to the parameter deceleration constant for a stop and then is powered off.**
- **When "SVOFF wait time" (ML_56) is set to 0, the servo amplifier is powered off immediately after receiving the SV_OFF command.**
- **Once the SV_OFF command has been received, the speed command, Speed feedforward, torque feedforward, and torque control activated by the position and speed control commands are all cancelled.**

## Status monitoring (30H) [SMON]

Check the state of the servo amplifier.

| Byte | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Command | 30H | WDT | CMD_CTRL | | SVCMD_CTRL | | | | SVCMD_IO | | | | - | | | |
| Response | 30H | RWDT | CMD_STAT | | SVCMD_STAT | | | | SVCMD_IO | | | | CPRM_SEL_MON1 | | | |

| Byte | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Command | - | | | | | | | | | | | | | | | |
| Response | CPRM_SEL_MON2 | | | | MONITOR1 | | | | MONITOR2 | | | | MONITOR3 | | | |

Available phase : Phases 2 and 3
Command type : Asynchronous
Read cycle : Communication cycle
Sub command : Available

## Alarm/warning read (05H) [ALM_RD]

Read the alarm/warning and history that are occurring with the servo amplifier.

| Byte | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Command | 05H | WDT | CMD_CTRL | | ALM_RD_MOD | | ALM_INDEX | | - | | | | | | | |
| Response | 05H | RWDT | CMD_STAT | | ALM_RD_MOD | | ALM_INDEX | | ALM_DATA | | | | | | | |

| Byte | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Command | - | | | | | | | | | | | | | | | |
| Response | ALM_DATA | | | | | | | | | | | | | | | |

Available phase : Phases 2 and 3
Command type : Asynchronous
Read cycle : ALM_RD_MOD
set to 0: Within the communication cycle
set to 1: Within 60 ms
Sub command : N/A

**Point**

**Warnings are not saved in the alarm history.**
**The following conditions result in a warning, ignoring commands.**
- **When ALM_RD_MOD is out of range: ("Data setting warning 2 (out of range)" warning (94B))**
- **When ALM_RD_MOD is 0 or 1, a 1-byte alarm code (upper two digits) is returned.**
- **When ALM_RD_MOD is 2 or 3, a 2-byte alarm code is returned.**

## Alarm/warning clear (06H) [ALM_CLR]

Clear the state of the alarm/warning and alarm history for the servo amplifier that is occurring.

| Byte | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Command | 06H | WDT | CMD_CTRL | | ALM_RD_MOD | | ALM_INDEX | | - | | | | | | | |
| Response | 06H | RWDT | CMD_STAT | | ALM_RD_MOD | | ALM_INDEX | | - | | | | | | | |

| Byte | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Command | - | | | | | | | | | | | | | | | |
| Response | - | | | | | | | | | | | | | | | |

Available phase : Phases 2 and 3
Command type : Asynchronous
Read cycle : ALM_CLR_MOD
set to 0: Less than 0.2 seconds
set to 1: Less than 2 seconds
Sub command : N/A

**Point**

**The following conditions result in a warning, ignoring commands.**
- **When performing the tuning, initialization/setting adjustment, forced output functions using the SV2 series setting software/KV-XH setting tool ("Command warning 1 (out of condition)" warning (95A))**
- **When ALM_RD_MOD is out of range: ("Data setting warning 2 (out of range)" warning (94B))**

## Synchronization establishment request (0DH) [SYNC_SET]

Start synchronous communication and transition from Phase 2 to Phase 3.

| Byte | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Command | 0DH | WDT | CMD_CTRL | | - | | | | | | | | | | | |
| Response | 0DH | RWDT | CMD_STAT | | - | | | | | | | | | | | |

| Byte | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Command | - | | | | | | | | | | | | | | | |
| Response | - | | | | | | | | | | | | | | | |

Available phase : Phase 2

Command type : Asynchronous

Read cycle : Over the communication cycle, less than 5 seconds

Sub command : N/A

**Point**

- **Changes in WDT (edges) allows establishing synchronization. Note that when "MECHATROLINK comm check disable" (ML_53) is set so WDT errors are ignored, the process is completed once this command has been received.**
- **When using SYNC_SET during Phase 3, the command is ignored, and the normal response is returned.**
- **When using SYNC_SET during Servo ON in Phase 2, Servo OFF is activated.**
- **When the following alarms occur, you need to send the SYNC_SET command to reestablish synchronous communication.**
  - **"ML-III sync error" alarm (E50)**
  - **"ML-III sync failed" alarm (E51)**
  - **"ML-III sync error (receive error)" alarm (E60)**
  - **"ML-III transform cycle error (sync interval error)" alarm (E61)**

## Coordinate system settings (20H) [POS_SET]

Set up the coordinate system.

| Byte | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Command | 20H | WDT | CMD_CTRL | | SVCMD_CTRL | | | | SVCMD_IO | | | | POS_SET_MOD | | | |
| Response | 20H | RWDT | CMD_STAT | | SVCMD_STAT | | | | SVCMD_IO | | | | POS_SET_MOD | | | |

| Byte | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Command | POS_DATA | | | | - | | | | | | | | | | | |
| Response | POS_DATA | | | | MONITOR1 | | | | MONITOR2 | | | | MONITOR3 | | | |

Available phase : Phases 2 and 3

Command type : Asynchronous

Read cycle : Within the communication cycle

Sub command : N/A

**Point**

**The following conditions result in a warning, ignoring commands.**

- **When a number that is out of range is set to POS_SET_MOD ("Data setting warning 2 (out of range)" warning (94B))**

# Operation-related commands

## List of operation-related commands

MECHATROLINK-III communication commands that are used during operation are as follows.

| Command | Command code | Function name | Description | See page |
|---|---|---|---|---|
| INTERPOLATE | 34H | Interpolation feed | Perform the interpolation. | A-63 |
| POSING | 35H | Positioning | The target position (TPOS) is set relative to the target speed (TSPD). | A-63 |
| FEED | 36H | Feed at fixed speed | Feed at the target speed (TSPD). | A-65 |
| EX_FEED | 37H | Feed external input at fixed speed | Feed at the specified speed (TSPD). When the latch signal is input while performing this command, positioning is performed from the latch signal input position to a position, to which the parameter-specified moved distance after inputting the latch signal is added. | A-66 |
| EX_POSING | 39H | External input positioning | The target position (TPOS) is set relative to the target speed (TSPD). When the latch signal is input while performing this command, positioning is performed from the latch signal input position to a position, to which the parameter-specified moved distance after inputting the latch signal is added. | A-67 |
| ZRET | 3AH | Origin return | Perform an origin return. | A-68 |
| VELCTRL | 3CH | Speed control | Control the speed. | A-70 |
| TRQCTRL | 3DH | Torque control | Control the torque. | A-71 |

## Interpolation feed (34H) [INTERPOLATE]

Perform the interpolation. Speed feedforward and torque feedforward can be activated at the same time.

| Byte | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Command | 34H | WDT | CMD_CTRL | | SVCMD_CTRL | | | | SVCMD_IO | | | | TPOS | | | |
| Response | 34H | RWDT | CMD_STAT | | SVCMD_STAT | | | | SVCMD_IO | | | | CPRM_SEL_MON1 | | | |

| Byte | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Command | VFF | | | | TFF | | | | - | | | | TLIM | | | |
| Response | CPRM_SEL_MON2 | | | | MONITOR1 | | | | MONITOR2 | | | | MONITOR3 | | | |

Available phase : Phase 3
Command type : Synchronous
Read cycle : Within the communication cycle
Sub command : Available

**Point**

- **The following conditions result in a warning, ignoring commands.**
  - **When performed in Phase 2: "Command warning 7 (phase error)" warning (97A)**
  - **When performed during Servo OFF: "Command warning 1 (out of condition)" warning (95A)**
  - **When the difference between the target position (TPOS) and present position (IPOS) exceeds the limit: "Data setting warning 2 (out of range)" warning (94B)**
  - **When writing a motor operation related command during execution: "Command warning 1 (out of condition)" warning (95A)**
- **The following conditions result in a warning, clamping to the boundary value.**
  - **When speed correction (VFF), torque correction (TFF), and torque limit value (TLIM) are out of setting range: "Out of data range clamp" (97 B)**

## Positioning (35H) [POSING]

The target position (TPOS) is set relative to the target coordinates (TPOS).

| Byte | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Command | 35H | WDT | CMD_CTRL | | SVCMD_CTRL | | | | SVCMD_IO | | | | TPOS | | | |
| Response | 35H | RWDT | CMD_STAT | | SVCMD_STAT | | | | SVCMD_IO | | | | CPRM_SEL_MON1 | | | |

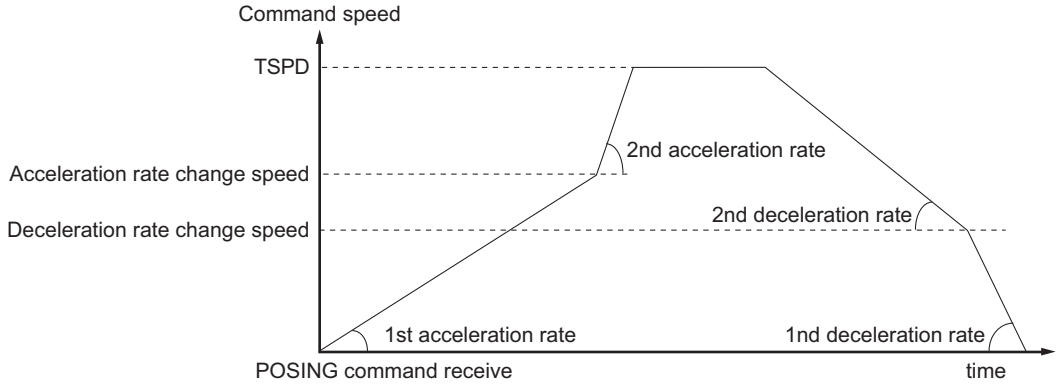
| Byte | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Command | TSPD | | | | ACCR | | | | DECR | | | | TLIM | | | |
| Response | CPRM_SEL_MON2 | | | | MONITOR1 | | | | MONITOR2 | | | | MONITOR3 | | | |

Available phase : Phases 2 and 3
Command type : Asynchronous
Read cycle : Within the communication cycle
Sub command : Available

**Point**

- **The target position and speed can be changed even while performing a command. Note that they cannot be changed while accelerating or decelerating.**
- **Using CMD_CANCEL=1 in the SVCMD_CTRL field, a command invoked shift can be cancelled.**
- **Using CMD_PAUSE=1 in the SVCMD_CTRL field, a command invoked shift can be suspended.**
- **The following conditions result in a warning, ignoring commands.**
  - **When performed during Servo OFF: "Command warning 1 (out of condition)" warning (95A)**
  - **When the target speed (TSPD), acceleration (ACCR), and deceleration (DECR) are out of range: "Data setting warning 2 (out of range)" warning (94B)**
  - **When writing a motor operation related command during execution: "Command warning 1 (out of condition)" warning (95A)**
- **The following conditions result in a warning, clamping to the boundary value.**
  - **When the torque limit value (TLIM) is out of range: "Out of range data clamp" (97B)**

Once the POSING command has been received, the following positioning can be set.




* When using the 2 phase acceleration/deceleration, set both acceleration and deceleration (ACCR, DECR) in a command to 0. Accelerate or decelerate using the parameter setting.

## ■ Related parameters

| Parameter | Category | Parameter overview | Set value/setting unit | Default | Enable timing |
|---|---|---|---|---|---|
| ML_07 | Special | 1st acceleration rate 1 | 1 to 65535 (10000 CMD_PLS/s$^2$) | 100 | After changing |
| ML_08 | Special | 2nd acceleration rate 1 | 1 to 65535 (10000 CMD_PLS/s$^2$) | 100 | |
| ML_09 | Special | Acceleration rate change speed 1 | 0 to 65535 (100 CMD_PLS/s) | 0 | |
| ML_10 | Special | 1st deceleration rate 1 | 1 to 65535 (10000 CMD_PLS/s$^2$) | 100 | |
| ML_11 | Special | 2nd deceleration rate 1 | 1 to 65535 (10000 CMD_PLS/s$^2$) | 100 | |
| ML_12 | Special | Deceleration rate change speed 1 | 0 to 65535 (100 CMD_PLS/s) | 0 | |
| ML_25 | Special | *Accel/decel rate | 0: 1 is valid<br>1: 2 is valid | 0 | After powered on |
| ML_26 | Special | 1st acceleration rate 2 | 1 to 20971520 (10000 CMD_PLS/s$^2$) | 100 | After changing |
| ML_27 | Special | 2nd acceleration rate 2 | 1 to 20971520 (10000 CMD_PLS/s$^2$) | 100 | |
| ML_28 | Special | Acceleration rate change speed 2 | 0 to 2097152000 (100 CMD_PLS/s) | 0 | |
| ML_29 | Special | 1st deceleration rate 2 | 1 to 20971520 (10000 CMD_PLS/s$^2$) | 100 | |
| ML_30 | Special | 2nd deceleration rate 2 | 1 to 20971520 (10000 CMD_PLS/s$^2$) | 100 | |
| ML_31 | Special | Deceleration rate change speed 2 | 0 to 2097152000 (100 CMD_PLS/s) | 0 | |

**Point**

- **When ML_25=0, use ML_07 to ML_12 parameter to accelerate/decelerate. When ML_25=1, use ML_26 to ML_31 parameter to accelerate/decelerate.**
- **When ML_07 to ML_12 and ML_26 to ML_31 remained set to the default, TSPD may not be accelerated, either.**

## Feed at rated speed (36H) [FEED]

Feed at the specified speed (TSPD).

| Byte | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Command | 36H | WDT | CMD_CTRL | | SVCMD_CTRL | | | | SVCMD_IO | | | | - | | | |
| Response | 36H | RWDT | CMD_STAT | | SVCMD_STAT | | | | SVCMD_IO | | | | CPRM_SEL_MON1 | | | |

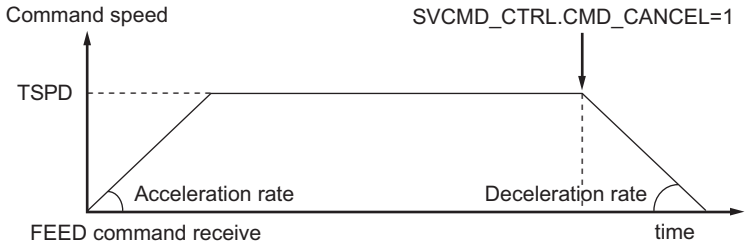
| Byte | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Command | TSPD | | | | ACCR | | | | DECR | | | | TLIM | | | |
| Response | CPRM_SEL_MON2 | | | | MONITOR1 | | | | MONITOR2 | | | | MONITOR3 | | | |

Available phase : Phases 2 and 3
Command type : Asynchronous
Read cycle : Within the communication cycle
Sub command : Available

**Point**

- **The target speed can be changed even while performing a command. Note that they cannot be changed while accelerating or decelerating.**
- **Using CMD_CANCEL=1 in the SVCMD_CTRL field, a command invoked shift can be cancelled.**
- **Using CMD_PAUSE=1 in the SVCMD_CTRL field, a command invoked shift can be suspended.**
- **The following conditions result in a warning, ignoring commands.**
  - **When performed during Servo OFF: "Command warning 1 (out of condition)" warning (95A)**
  - **When the target speed (TSPD), acceleration (ACCR), and deceleration (DECR) are out of range: "Data setting warning 2 (out of range)" warning (94B)**
  - **When writing a motor operation related command during execution: "Command warning 1 (out of condition)" warning (95A)**
- **The following conditions result in a warning, clamping to the boundary value.**
  - **When the torque limit value (TLIM) is out of range: "Out of range data clamp" (97B)**

Once the FEED command has been received, the following positioning can be set.




* You can use FEED command to execute the 2 phase acceleration/deceleration. The setting method is the same with the POSING command.

## Feed external input at fixed speed (37H) [EX_FEED]

Feed at the specified speed (TSPD). When the latch signal is input while performing this command, positioning is performed from the latch signal input position to a position, to which the parameter-specified moved distance after inputting the latch signal is added.

| Byte | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Command | 37H | WDT | CMD_CTRL | | SVCMD_CTRL | | | | SVCMD_IO | | | | - | | | |
| Response | 37H | RWDT | CMD_STAT | | SVCMD_STAT | | | | SVCMD_IO | | | | CPRM_SEL_MON1 | | | |

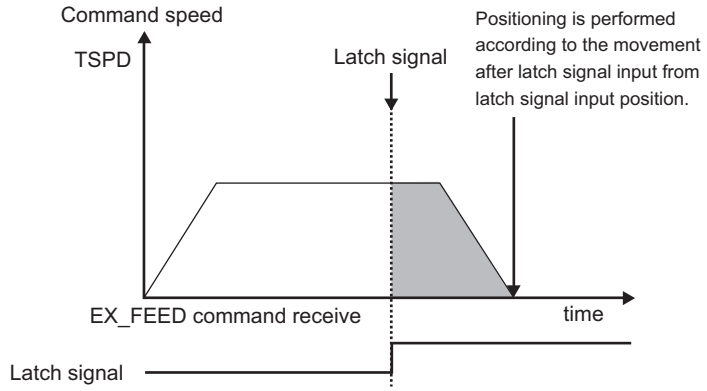
| Byte | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Command | TSPD | | | | ACCR | | | | DECR | | | | TLIM | | | |
| Response | CPRM_SEL_MON2 | | | | MONITOR1 | | | | MONITOR2 | | | | MONITOR3 | | | |

Available phase : Phases 2 and 3
Command type : Asynchronous
Read cycle : Within the communication cycle
Sub command : Available

**Point**

- **The target speed can be changed even while performing a command. Note that it cannot be changed while accelerating or decelerating, or after the latch signal has been input.**
- **Using CMD_CANCEL=1 in the SVCMD_CTRL field, a command invoked shift can be cancelled.**
- **Using CMD_PAUSE=1 in the SVCMD_CTRL field, a command invoked shift can be suspended.**
- **The following conditions result in a warning, ignoring commands.**
  - **When performed during Servo OFF: "Command warning 1 (out of condition)" warning (95A)**
  - **When the target speed (TSPD), acceleration (ACCR), and deceleration (DECR) are out of range: "Data setting warning 2 (out of range)" warning (94B)**
  - **When writing a motor operation related command during execution: "Command warning 1 (out of condition)" warning (95A)**
- **The following conditions result in a warning, clamping to the boundary value.**
  - **When the torque limit value (TLIM) is out of range: "Out of range data clamp" (97B)**

Once the EX_FEED command has been received, the following positioning can be set.




* You can use EX_FEED command to execute the 2 phase acceleration/deceleration. The setting method is the same with the POSING command.

* The parameter related to the latch signal is the same with the EX_POSING command.

## External input positioning (39H) [EX_POSING]

The target position (TPOS) is set relative to the target speed (TSPD). When the latch signal is input while performing this command, positioning is performed from the latch signal input position to a position, to which the parameter-specified moved distance after inputting the latch signal is added.

| Byte | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Command | 39H | WDT | CMD_CTRL | | SVCMD_CTRL | | | | SVCMD_IO | | | | TPOS | | | |
| Response | 39H | RWDT | CMD_STAT | | SVCMD_STAT | | | | SVCMD_IO | | | | CPRM_SEL_MON1 | | | |

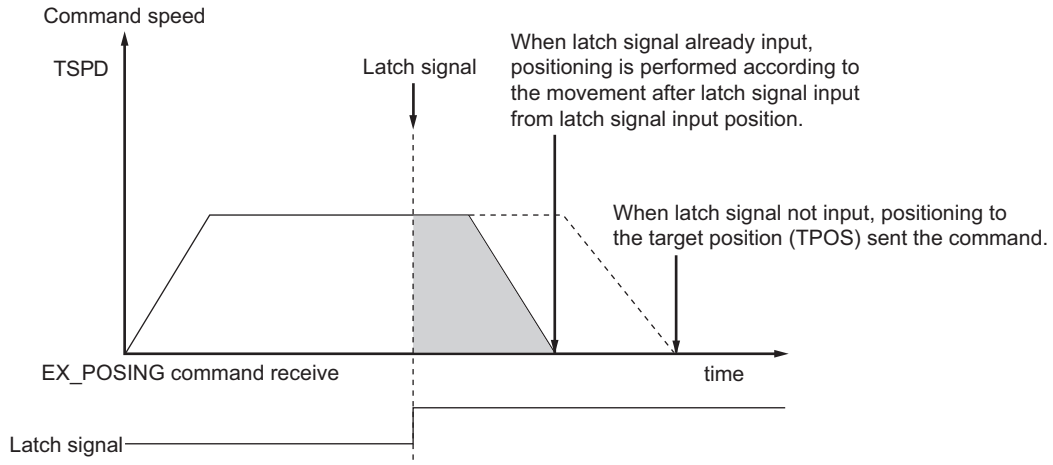
| Byte | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Command | TSPD | | | | ACCR | | | | DECR | | | | TLIM | | | |
| Response | CPRM_SEL_MON2 | | | | MONITOR1 | | | | MONITOR2 | | | | MONITOR3 | | | |

Available phase : Phases 2 and 3
Command type : Asynchronous
Read cycle : Within the communication cycle
Sub command : Available

**Point**

- **The target position and speed can be changed even while performing a command. Note that it cannot be changed while accelerating or decelerating, or after the latch signal has been input.**
- **Using CMD_CANCEL=1 in the SVCMD_CTRL field, a command invoked shift can be cancelled.**
- **Using CMD_PAUSE=1 in the SVCMD_CTRL field, a command invoked shift can be suspended.**
- **The following conditions result in a warning, ignoring commands.**
  - **When performed during Servo OFF: "Command warning 1 (out of condition)" warning (95A)**
  - **When the target speed (TSPD), acceleration (ACCR), and deceleration (DECR) are out of range: "Data setting warning 2 (out of range)" warning (94B)**
  - **When writing a motor operation related command during execution: "Command warning 1 (out of condition)" warning (95A)**
- **The following conditions result in a warning, clamping to the boundary value.**
  - **When the torque limit value (TLIM) is out of range: "Out of range data clamp" (97B)**

Once the EX_POSING command has been received, the following positioning can be set.




* You can use EX_POSING command to execute the 2 phase acceleration/deceleration. The setting method is the same with the POSING command.

### ■ Related parameters

| Parameter | Category | Parameter overview | Set value/setting unit | Default | Enable timing |
|---|---|---|---|---|---|
| ML_16 | Special | Distance after latch | $-2^{30}+1$ to $2^{30}-1$ (CMD_PLS) | 100 | After changing |
| ML_22 | Special | P-Latching allowable area | $-2^{31}$ to $2^{31}-1$ (CMD_PLS) | 0 | |
| ML_23 | Special | N-Latching allowable area | $-2^{31}$ to $2^{31}-1$ (CMD_PLS) | 0 | |

## Origin return (3AH) [ZRET]

Perform an origin return.

| Byte | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Command | 3AH | WDT | CMD_CTRL | | SVCMD_CTRL | | | | SVCMD_IO | | | | MODE | | | |
| Response | 3AH | RWDT | CMD_STAT | | SVCMD_STAT | | | | SVCMD_IO | | | | CPRM_SEL_MON1 | | | |

| Byte | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Command | TSPD | | | | ACCR | | | | DECR | | | | TLIM | | | |
| Response | CPRM_SEL_MON2 | | | | MONITOR1 | | | | MONITOR2 | | | | MONITOR3 | | | |

Available phase : Phases 2 and 3
Command type : Asynchronous
Read cycle : Within the communication cycle
Sub command : Available

**Point**

- **Using CMD_CANCEL=1 in the SVCMD_CTRL field, a command invoked shift can be cancelled.**
- **Using CMD_PAUSE=1 in the SVCMD_CTRL field, a command invoked shift can be suspended.**
- **The following conditions result in a warning, ignoring commands.**
  - **When performed during Servo OFF: "Command warning 1 (out of condition)" warning (95A)**
  - **When the target speed (TSPD), acceleration (ACCR), and deceleration (DECR) are out of range: "Data setting warning 2 (out of range)" warning (94B)**
  - **When writing a motor operation related command during execution: "Command warning 1 (out of condition)" warning (95A)**
- **The following conditions result in a warning, clamping to the boundary value.**
  - **When the torque limit value (TLIM) is out of range: "Out of range data clamp" (97B)**

## ■ Flow of an origin return

### ● When TYPE=1: deceleration LS + latch signal is set in the MODE field

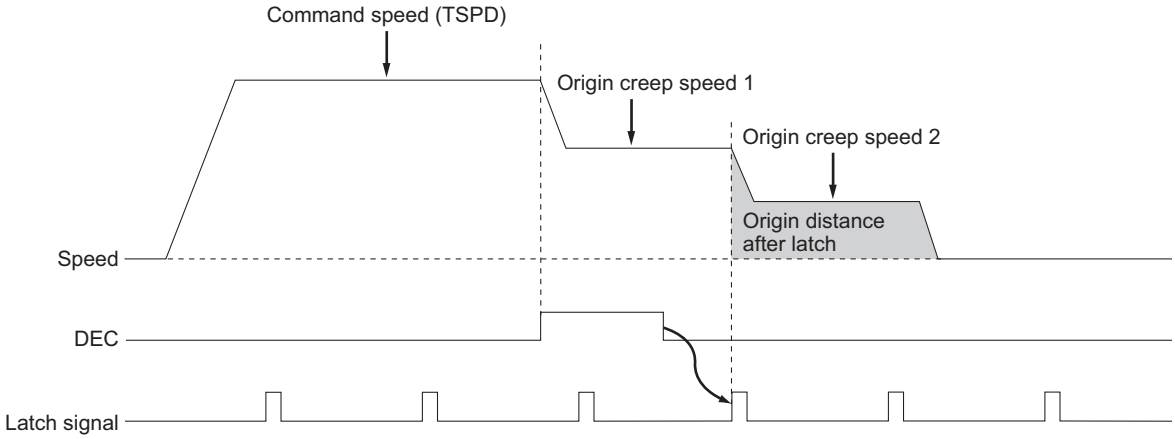
**1** **The origin moves in the direction specified by the HOME_DIR of the MODE field at the target speed (TSPD).**

**2** **With DEC=1, it is decelerated to "Origin creep speed 1" (ML_17).**

**3** **With DEC=0, it enters into latch operation.**

**4** **Once the latch signal has been input, it moves to the coordinates where "Origin distance after latch" (ML_21) is added to the latch signal input position at "Origin creep speed 2" (ML_19).**

**5** **When positioning is completed, set the coordinate system so its position is 0.**

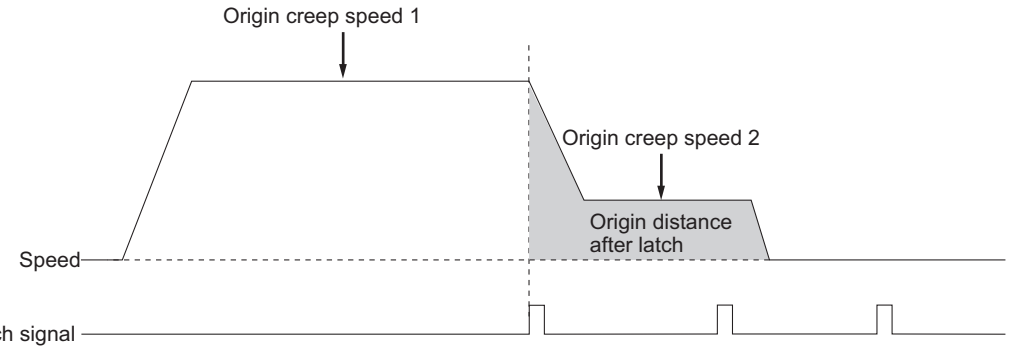



### ● When TYPE=0: latch signal is set in the MODE field

**1** **The origin moves in the direction specified by HOME_DIR in the MODE field at Original creep speed 1 (ML_17).**

**2** **Once the latch signal has been input, it moves to the coordinates where "Origin distance after latch" (ML_21) is added to the latch signal input position at "Origin creep speed 2" (ML_19).**

**3** **When positioning is completed, set the coordinate system so its position is 0.**




* You can use ZRET command to execute the 2 phase acceleration/deceleration. The setting method is the same with the POSING command.

### ■ Related parameters

| Parameter | Category | Parameter overview | Set value/setting unit | Default | Enable timing |
|---|---|---|---|---|---|
| ML_17 | Special | Origin creep speed 1 | 0 to 65535 (100 CMD_PLS/s) | 50 | After changing |
| ML_18 | Special | Origin creep speed 1 (expansion)*1 | 0 to 20971520 (100 CMD_PLS/s) | 0 | |
| ML_19 | Special | Origin creep speed 2 | 0 to 65535 (100 CMD_PLS/s) | 5 | |
| ML_20 | Special | Origin creep speed 2 (expansion)*2 | 0 to 20971520 (100 CMD_PLS/s) | 0 | |
| ML_21 | Special | Origin distance after latch | $-2^{30}+1$ to $2^{30}-1$ (CMD_PLS) | 0 | |
| ML_22 | Special | P-Latching allowable area | $-2^{31}$ to $2^{31}-1$ (CMD_PLS) | 0 | |
| ML_23 | Special | N-Latching allowable area | $-2^{31}$ to $2^{31}-1$ (CMD_PLS) | 0 | |

*1 Valid when "Original creep speed 1" (ML_17) is "0".

*2 Valid when "Original creep speed 2" (ML_19) is "0".

## Speed control (3CH) [VELCTRL]

Control the speed.

| Byte | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Command | 3CH | WDT | CMD_CTRL | | SVCMD_CTRL | | | | SVCMD_IO | | | | TFF | | | |
| Response | 3CH | RWDT | CMD_STAT | | SVCMD_STAT | | | | SVCMD_IO | | | | CPRM_SEL_MON1 | | | |

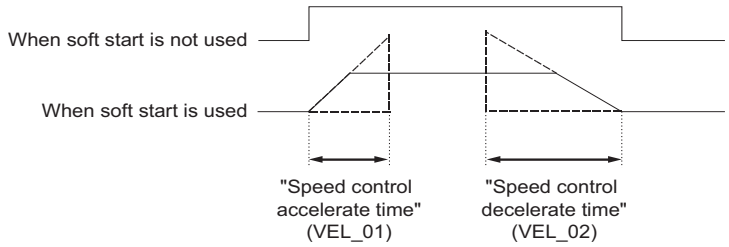
| Byte | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Command | VREF | | | | ACCR | | | | DECR | | | | TLIM | | | |
| Response | CPRM_SEL_MON2 | | | | MONITOR1 | | | | MONITOR2 | | | | MONITOR3 | | | |

Available phase : Phases 2 and 3
Command type : Asynchronous
Read cycle : Within the communication cycle
Sub command : Available

- **Soft start**

You can perform soft start using "Speed control accelerate time" (VEL_01) and "Speed control decelerate time" (VEL_02). Soft start is the function to automatically convert a certain level of acceleration/deceleration to a speed command to smoothly accelerate or decelerate the motor.

During acceleration or deceleration, their respective speed can be set.




Reference Acceleration/deceleration time can be set in the ACCR or DECR field.

### ■ Related parameters

| Parameter | Category | Parameter overview | Set value/setting unit | Default | Enable timing |
|---|---|---|---|---|---|
| VEL_01 | Basic | Speed control accelerate time | 0 to 10000 (ms) | 0 | After changing |
| VEL_02 | Basic | Speed control decelerate time | 0 to 10000 (ms) | 0 | |
| TRQ_02 | Basic | P-torque limit 1 | 0 to 800 (%) | 800 | After changing |
| TRQ_03 | Basic | N-torque limit 1 | 0 to 800 (%) | 800 | |
| TRQ_06 | Basic | *Torque limit method | 0: Only TrqLim1 is valid<br>1: TrqLim2 is valid (P/NTL)<br>2: TLIM is valid<br>3: TLIM is valid (P/NTL)<br>4: TrqLim2 & TLIM are valid (P/NTL) | 0 | After powered on |
| TRQ_07 | Extend | P-torque limit 2 | 0 to 800(%) | 100 | After changing |
| TRQ_08 | Extend | N-torque limit 2 | 0 to 800(%) | 100 | |

## Torque commands (3DH) [TRQCTRL]

Control the torque.

| Byte | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Command | 3DH | WDT | CMD_CTRL | | SVCMD_CTRL | | | | SVCMD_IO | | | | VLIM | | | |
| Response | 3DH | RWDT | CMD_STAT | | SVCMD_STAT | | | | SVCMD_IO | | | | CPRM_SEL_MON1 | | | |

| Byte | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Command | TQREF | | | | - | | | | | | | | | | | |
| Response | CPRM_SEL_MON2 | | | | MONITOR1 | | | | MONITOR2 | | | | MONITOR3 | | | |

Available phase : Phases 2 and 3
Command type : Asynchronous
Read cycle : Within the communication cycle
Sub command : Available

### ■ Related parameters

| Parameter | Category | Parameter overview | Set value/setting unit | Default | Enable timing |
|---|---|---|---|---|---|
| VEL_05 | Basic | Speed limit during trq control | 0 to 10000 ($min^{-1}$) | 10000 | After changing |
| TRQ_04 | Basic | Torque command accelerate time | 0 to 10000 (ms) | 0 | After changing |
| TRQ_05 | Basic | Torque command decelerate time | 0 to 10000 (ms) | 0 | |

## Other commands

This section discusses other MECHATROLINK-III communication commands.

### Brake operation request (21H) [BRK_ON]

Set the brake signal to off to activate the brake.

| Byte | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Command | 21H | WDT | CMD_CTRL | | SVCMD_CTRL | | | | SVCMD_IO | | | | - | | | |
| Response | 21H | RWDT | CMD_STAT | | SVCMD_STAT | | | | SVCMD_IO | | | | CPRM_SEL_MON1 | | | |

| Byte | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Command | - | | | | | | | | | | | | | | | |
| Response | CPRM_SEL_MON2 | | | | MONITOR1 | | | | MONITOR2 | | | | MONITOR3 | | | |

Available phase : Phases 2 and 3
Command type : Asynchronous
Read cycle : Within the communication cycle
Sub command : N/A

Point **The BRAKE signal is output within 2 ms after the BRK_ON command has been received. The BRK_ON command is effective only during Servo OFF.**

### Brake cancel request (22H) [BRK_OFF]

Bring the servo amplifier to a stop at the set position using the method specified by HOLD_MOD.

| Byte | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Command | 22H | WDT | CMD_CTRL | | SVCMD_CTRL | | | | SVCMD_IO | | | | - | | | |
| Response | 22H | RWDT | CMD_STAT | | SVCMD_STAT | | | | SVCMD_IO | | | | CPRM_SEL_MON1 | | | |

| Byte | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Command | - | | | | | | | | | | | | | | | |
| Response | CPRM_SEL_MON2 | | | | MONITOR1 | | | | MONITOR2 | | | | MONITOR3 | | | |

Available phase : Phases 2 and 3
Command type : Asynchronous
Read cycle : Within the communication cycle
Sub command : N/A

Point **The BRAKE signal is deactivated within 2 ms after the BRK_OFF command has been received.**

Important **When the BRK_ON or BRK_OFF command has been received during Servo ON, it will not be reflected in operation, but the BRAKE signal is activated. Due to this, an unexpected behavior is probable when receiving the SV_OFF command, ensure that you can always keep track of the state of the BRK_ON and BRK_OFF command.**

### ■ Related parameters

| Parameter | Category | Parameter overview | Set value/setting unit | Default | Enable timing |
|---|---|---|---|---|---|
| IO_52 | Extend | *Output1 assignment | 0: Unavailable<br>1: RDY<br>2: INPOS/VCMP<br>3: BRAKE<br>4: TLM/VLM<br>5: WARN<br>6: ZSP<br>7: NEAR | 3 | After powered on |
| IO_53 | | *Output2 assignment | | 1 | |
| IO_54 | | *Output3 assignment | | 5 | |

## Memory read (1DH) [MEM_RD]

Specify the initial address in the virtual memory space, data size, read mode, data type to read data.

| Byte | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Command | 1DH | WDT | CMD_CTRL | | - | MODE/DATA_TYPE | SIZE | | ADDRESS | | | | - | | | |
| Response | 1DH | RWDT | CMD_STAT | | - | MODE/DATA_TYPE | SIZE | | ADDRESS | | | | DATA | | | |

| Byte | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Command | - | | | | | | | | | | | | | | | |
| Response | DATA | | | | | | | | | | | | | | | |

Available phase : Phases 2 and 3
Command type : Asynchronous
Read cycle : Less than 200 ms
Sub command : N/A

**Point**

**The following conditions result in a warning, setting DATA to an undefined value.**

- **When ADDRESS is out of range: "Data setting warning 1 (constant number)" warning (94A)**
- **When MODE/DATA_TYPE is out of range: "Data setting warning 2 (out of range)" warning (94B)**
- **When SIZE is out of range: "Data setting warning 4 (parameter size)" warning (94D)**
- **When editing in the SV2 series setting software/KV-XH setting tool: "Command warning 1 (out of condition)" warning (95A)**

## Memory write (1EH) [MEM_WR]

Specify the initial address in the virtual memory space, data size, write mode, data type to write data.

| Byte | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Command | 1EH | WDT | CMD_CTRL | | - | MODE/DATA_TYPE | SIZE | | ADDRESS | | | | DATA | | | |
| Response | 1EH | RWDT | CMD_STAT | | - | MODE/DATA_TYPE | SIZE | | ADDRESS | | | | DATA | | | |

| Byte | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Command | DATA | | | | | | | | | | | | | | | |
| Response | DATA | | | | | | | | | | | | | | | |

Available phase : Phases 2 and 3
Command type : Asynchronous
Read cycle : Depends on processing
Sub command : N/A

**Point**

**The following conditions result in a warning, ignoring commands.**

- **When ADDRESS is out of range: "Data setting warning 1 (constant number)" warning (94A)**
- **When MODE/DATA_TYPE is out of range: "Data setting warning 2 (out of range)" warning (94B)**
- **When SIZE is out of range: "Data setting warning 4 (parameter size)" warning (94D)**
- **When editing in the SV2 series setting software/KV-XH setting tool: "Command warning 1 (out of condition)" warning (95A)**
- **When operating conditions for executable adjustment operation are not met: "Command warning 1 (out of condition)" warning (95A)**

### ■ Adjustment

#### ● Executable adjustment operation

| Adjustment operation | Request code | Execution preparation processing | Processing time | Execution conditions |
|---|---|---|---|---|
| Normal mode | 0000H | Unavailable | Less than 0.2s | None in particular |
| Parameter initialization | 1005H | Unavailable | Less than 20s | Parameter initialization cannot be performed during Servo ON.<br>After parameter initialization has been performed, repowering and restarting the servo amplifier are required. |
| Absolute encoder setup | 1008H | Available | Less than 5s | During Servo ON and when the incremental encoder is in use, absolute encoder setup is disabled.<br>After absolute encoder setup has been performed, repowering and restarting the servo amplifier are required. |
| Automatic offset adjustment for the motor current detection signal | 100EH | Unavailable | Less than 5s | Cannot be adjusted during Main circuit power supply OFF or Servo ON, or while the motor is rotating. |
| Multiturn limit setting | 1013H | Available | Less than 5s | After the multiturn limit setting has been performed, repowering and restarting the servo amplifier are required. |

- **Procedure to perform adjustment operation**

**1** **Send the following data to set up the request code to perform adjustment operation.**

Command=MEM_WR
ADDRESS=80004000H
MODE/DATA_TYPE=12H
SIZE=0001H
DATA=Request code (adjustment operation to be performed)
Check CMDRDY=1 to confirm completed operation. When an error occurs, perform step 4 to complete the operation.

**2** **Send the following data when execution preparation processing in the table is required.**

Command=MEM_WR
ADDRESS=80004002H
MODE/DATA_TYPE=12H
SIZE=0001H
DATA=0002H
Check CMDRDY=1 to confirm completed operation. When an error occurs, perform step 4 to complete the operation.

**3** **Send the following data to perform adjustment operation.**

Command=MEM_WR
ADDRESS=80004002H
MODE/DATA_TYPE=12H
SIZE=0001H
DATA=0001H
Check CMDRDY=1 to confirm completed operation. When an error occurs, perform step 4 to complete the operation.

**4** **Send the following data to finish adjustment operation.**

Command=MEM_WR
ADDRESS=80004000H
MODE/DATA_TYPE=12H
SIZE=0001H
DATA=0000H
Check CMDRDY=1 to confirm completed operation.

## Sub commands

Main commands include commands to use sub commands. Using sub commands allow you to send another command when receiving a specific main command to get a response.
Sub commands are set to 32 to 47 bytes of the MECHATROLINK-III communication commands. Responses are also saved to these 32 to 47 bytes.
Refer to "A-6 MECHATROLINK-III Communication Commands", Page A-36 for available combinations of main and sub commands.
The function of sub commands are the same as main commands. Refer to "A-7 Motorless Test", Page A-87 and " Operation-related commands", Page A-62 for further information.

### Disable (00H) [NOP]

These commands are invalid.

| Byte | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Command | 00H | SUB_CTRL | | | - | | | | | | | | | | | |
| Response | 00H | SUB_STAT | | | - | | | | | | | | | | | |

### Alarm/warning read (05H) [ALM_RD]

Read the alarm/warning state.

| Byte | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Command | 05H | SUB_CTRL | | | ALM_RD_MOD | | ALM_INDEX | | - | | | | | | | |
| Response | 05H | SUB_STAT | | | ALM_RD_MOD | | ALM_INDEX | | ALM_DATA | | | | | | | |

### Alarm/warning clear (06H) [ALM_CLR]

Clear the alarm/warning state.

| Byte | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Command | 06H | SUB_CTRL | | | ALM_RD_MOD | | - | | | | | | | | | |
| Response | 06H | SUB_STAT | | | ALM_RD_MOD | | - | | | | | | | | | |

### Memory read (1DH) [MEM_RD]

Specify the initial address in the virtual memory space, data size, read mode, data type to read data.

| Byte | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Command | 1DH | SUB_CTRL | | | - | MODE/DATA_TYPE | SIZE | | ADDRESS | | | | - | | | |
| Response | 1DH | SUB_STAT | | | - | MODE/DATA_TYPE | SIZE | | ADDRESS | | | | DATA | | | |

### Memory write (1EH) [MEM_WR]

Specify the initial address in the virtual memory space, data size, write mode, data type to write data.

| Byte | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Command | 1EH | SUB_CTRL | | | - | MODE/DATA_TYPE | SIZE | | ADDRESS | | | | DATA | |
| Response | 1EH | SUB_STAT | | | - | MODE/DATA_TYPE | SIZE | | ADDRESS | | | | DATA | |

## Status monitoring (30H) [SMON]

Monitor the state of the slave station.

| Byte | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Command | 30H | SUB_CTRL | | | - | | | | | | | | | | | |
| Response | 30H | SUB_STAT | | | MONITOR4 | | | | MONITOR5 | | | | MONITOR6 | | | |

## Read servo parameters (40H) [SVPRM_RD]

Specify the servo parameter number, data size, and read mode to read the parameter.

| Byte | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Command | 40H | SUB_CTRL | | | NO | | SIZE | MODE | - | | | | | | | |
| Response | 40H | SUB_STAT | | | NO | | SIZE | MODE | PARAMETER | | | | | | | |

## Write servo parameters (41H) [SVPRM_WR]

Specify the servo parameter number, data size, and write mode to write the parameter.

| Byte | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Command | 41H | SUB_CTRL | | | NO | | SIZE | MODE | PARAMETER | | | | | | | |
| Response | 41H | SUB_STAT | | | NO | | SIZE | MODE | PARAMETER | | | | | | | |

## List of common parameters

Common parameters for MECHATROLINK-III are as follows.

To refer to or set up common parameters, select [Common parameter] in servo parameter read (SVPRM_RD) or servo parameter write (SVPRM_WR) command mode.

| Common parameter No. Numbers in parentheses are bit numbers. | ADDRESS | Parameter name | Setting items | Unit | Default | Enabled Timing |
|---|---|---|---|---|---|---|
| 01H | 0001 0004H | Encoder type (Read Only) | 0: ABS<br>1: INC | - | 0 | After changing |
| 02H | 0001 0008H | Motor type (Read Only) | 0: Rotational<br>1: Linear | - | 0 | After changing |
| 03H | 0001 000CH | Semi-closed/ Fully closed (Read Only) | 0: Semi-closed<br>1: Fully closed | - | 0 | After changing |
| 04H | 0001 0010H | Rated rotation speed (Read Only) | 0 to FFFFFFFFH | $min^{-1}$ | 0 | After changing |
| 05H | 0001 0014H | Maximum output enable speed (Read Only) | 0 to FFFFFFFFH | $min^{-1}$ | 0 | After changing |
| 06H | 0001 0018H | Speed multiplier (Read Only) | -3FFFFFFFH to 3FFFFFFFH | - | 2 | After changing |
| 07H | 0001 001CH | Rated torque (Read Only) | 0 to FFFFFFFFH | N·m | 0 | After changing |
| 08H | 0001 0020H | Maximum output enable torque (Read Only) | 0 to FFFFFFFFH | N·m | 0 | After changing |
| 09H | 0001 0024H | Torque multiplier (Read Only) | -3FFFFFFFH to 3FFFFFFFH | - | -2 | After changing |
| 0AH | 0001 0028H | Resolution (Read Only) | 0 to FFFFFFFFH | ENC pulse/ Rev | 0 | After changing |
| 0BH | 0001 002CH | Reserve | 0 to 65536000 | nm | 0 | After powered on |
| 0CH | 0001 0030H | Reserve | 0 to FFFFFFFFH | PLS/ Pitch | 0 | After changing |
| 21H | 0001 0084H | *Electronic gear (numerator) | 1 to 1073741824 | - | 4 | After powered on |
| 22H | 0001 0088H | *Electronic gear (denominator) | 1 to 1073741824 | - | 1 | After powered on |
| 23H | 0001 008CH | Absolute encoder origin offset | $-2^{30}+1$ to $2^{30}-1$ | CMD_PLS | 0 | After SENS_ON |
| 24H | 0001 0090H | *Multiturn limit setting | 0 to 65535 | Rev | 65535 | After powered on |
| 25H (00) | 0001 0094H | *Forward limit switch (Read Only) | 0: Used<br>1: Not used | - | 0 | After powered on |
| 25H (01) | | *Reversal limit switch (Read Only) | 0: Used<br>1: Not used | - | 0 | After powered on |
| 25H (02) | | Reserve | - | - | 0 | After powered on |
| 25H (03) | | Reserve | - | - | 0 | After powered on |
| 25H (04) | | *P-Software limit (Read Only) | 0: Not used<br>1: Used | - | 0 | After powered on |
| 25H (05) | | *N-Software limit (Read Only) | 0: Not used<br>1: Used | - | 0 | After powered on |
| 25H (06) | | Reserve | - | - | 0 | After powered on |
| 25H (07 to 31) | | Reserve | - | - | 0 | After powered on |

| Common parameter No. Numbers in parentheses are bit numbers. | ADDRESS | Parameter name | Setting items | Unit | Default | Enabled Timing |
|---|---|---|---|---|---|---|
| 26H | 0001 0098H | P-Software limit | $-2^{30}+1$ to $2^{30}-1$ | CMD_PLS | 1073741823 | After changing |
| 27H | - | Reserve | - | - | 0 | After changing |
| 28H | 0001 00A0H | N-Software limit | $-2^{30}+1$ to $2^{30}-1$ | CMD_PLS | -1073741823 | After changing |
| 29H | - | Reserve | - | - | 0 | After changing |
| 41H | 0001 0104H | *Speed unit | 0: CMD_PLS/s<br>1: CMD_PLS/min<br>2: Percentage (%) of rated speed<br>3: $min^{-1}$<br>4: Max. motor speed/ 40000000H | - | 0 | After powered on |
| 42H | 0001 0108H | *Speed base unit | -3: 0.001<br>-2: 0.01<br>-1: 0.1<br>0: 1<br>1: 10<br>2: 100<br>3: 1000 | - | 0 | After powered on |
| 43H | 0001 010CH | *Position unit | 0: CMD_PLS | - | 0 | After powered on |
| 44H | 0001 0110H | *Position base unit | 0: 1 | - | 0 | After powered on |
| 45H | 0001 0114H | *Acceleration unit | 0: $CMD\_PLS/s^2$ | - | 0 | After powered on |
| 46H | 0001 0118H | *Acceleration base unit | 4: 10000<br>5: 100000<br>6: 1000000 | - | 4 | After powered on |
| 47H | 0001 011CH | *Torque unit | 1: Percentage (%) of rated torque<br>2: Max. motor torque/ 40000000H | - | 1 | After powered on |
| 48H | 0001 0120H | *Torque base unit | -5: 0.00001<br>-4: 0.0001<br>-3: 0.001<br>-2: 0.01<br>-1: 0.1<br>0: 1 | - | -2 | After powered on |

| Common parameter No. Numbers in parentheses are bit numbers. | ADDRESS | Parameter name | Setting items | Unit | Default | Enabled Timing |
|---|---|---|---|---|---|---|
| 49H (00) | 0001 0124H | CMD_PLS/s (Read Only) | 0: Disabled<br>1: Enabled | - | 1H | After changing |
| 49H (01) | | CMD_PLS/min (Read Only) | 0: Disabled<br>1: Enabled | - | 1H | After changing |
| 49H (02) | | Percentage (%) of rated speed (Read Only) | 0: Disabled<br>1: Enabled | - | 1H | After changing |
| 49H (03) | | $min^{-1}$ (Read Only) | 0: Disabled<br>1: Enabled | - | 1H | After changing |
| 49H (04) | | Max. motor speed/40000000H (Read Only) | 0: Disabled<br>1: Enabled | - | 1H | After changing |
| 49H (05 to 07) | | Reserve (Read Only) | - | - | 0H | After changing |
| 49H (08) | | CMD_PLS (Read Only) | 0: Disabled<br>1: Enabled | - | 1H | After changing |
| 49H (09 to 15) | | Reserve (Read Only) | - | - | 0H | After changing |
| 49H (16) | | CMD_PLS/$s^2$ (Read Only) | 0: Disabled<br>1: Enabled | - | 1H | After changing |
| 49H (17) | | Acceleration time up to rated speed (Read Only) | 0: Disabled<br>1: Enabled | - | 0H | After changing |
| 49H (18 to 23) | | Reserve (Read Only) | - | - | 0H | After changing |
| 49H (24) | | N·m (Read Only) | 0: Disabled<br>1: Enabled | - | 0H | After changing |
| 49H (25) | | Percentage (%) of rated torque (Read Only) | 0: Disabled<br>1: Enabled | - | 1H | After changing |
| 49H (26) | | Max. motor torque/40000000H (Read Only) | 0: Disabled<br>1: Enabled | - | 1H | After changing |
| 49H (27 to 31) | | Reserve (Read Only) | - | - | 0H | After changing |
| 61H | 0001 0184H | Speed control gain | 1000 to 2000000 | 0.001Hz | 30000 | After changing |
| 62H | 0001 0188H | Speed integral time constant | 150 to 512000 | μs | 26660 | After changing |
| 63H | 0001 018CH | Position control gain | 1000 to 2000000 | 0.001/s | 30000 | After changing |
| 64H | 0001 0190H | Feed forward gain | 0 to 100 | % | 0 | After changing |
| 65H | 0001 0194H | Position integral time constant | 0 to 5000000 | μs | 0 | After changing |
| 66H | 0001 0198H | INPOS range | 0 to 1073741824 | CMD_PLS | 25 | After changing |
| 67H | 0001 019CH | NEAR range | 0 to 1073741824 | CMD_PLS | 25 | After changing |
| 81H | 0001 0204H | Accel/decel time constant | 0 to 510000 | μs | 0 | After changing |
| 82H | 0001 0208H | Movement average time | 0 to 510000 | μs | 0 | After changing |
| 83H | 0001 020CH | Distance after latch | -1073741823 to 1073741823 | CMD_PLS | 100 | After changing |
| 84H | 0001 0210H | Origin creep speed 1 | 0 to 3FFFFFFFH | $0.001min^{-1}$ | 5000 [Command unit/s] conversion value | After changing |
| 85H | 0001 0214H | Origin creep speed 2 | 0 to 3FFFFFFFH | $0.001min^{-1}$ | 500 [Command unit/s] conversion value | After changing |

| Common parameter No. Numbers in parentheses are bit numbers. | ADDRESS | Parameter name | Setting items | Unit | Default | Enabled Timing |
|---|---|---|---|---|---|---|
| 86H | 0001 0218H | Origin distance after latch | -1073741823 to 1073741823 | CMD_PLS | 0 | After changing |
| 87H | 0001 021CH | CPRM_SEL_MON1 | 0H: Feedback position (APOS)<br>1H: Command position (CPOS)<br>2H: Position deviation (PERR)<br>3H: Latch position 1 (LPOS1)<br>4H: Latch position 2 (LPOS2)<br>5H: Feedback speed (FSPD)<br>6H: Command speed (CSPD)<br>7H: Internal command torque (TRQ)<br>8H: Alarm code (ALARM)<br>9H: Command position (MPOS)<br>AH: (Reserve 1)<br>BH: (Reserve 2)<br>CH: Common monitor 1 (CMN1)<br>DH: Common monitor 2 (CMN2)<br>EH: Option monitor 1 (OMN1)<br>FH: Option monitor 2 (OMN2) | - | 1 | After changing |
| 88H | 0001 0220H | CPRM_SEL_MON2 | 0H: Feedback position (APOS)<br>1H: Command position (CPOS)<br>2H: Position deviation (PERR)<br>3H: Latch position 1 (LPOS1)<br>4H: Latch position 2 (LPOS2)<br>5H: Feedback speed (FSPD)<br>6H: Command speed (CSPD)<br>7H: Internal command torque (TRQ)<br>8H: Alarm code (ALARM)<br>9H: Command position (MPOS)<br>AH: (Reserve 1)<br>BH: (Reserve 2)<br>CH: Common monitor 1 (CMN1)<br>DH: Common monitor 2 (CMN2)<br>EH: Option monitor 1 (OMN1)<br>FH: Option monitor 2 (OMN2) | - | 0 | After changing |

| Common parameter No. Numbers in parentheses are bit numbers. | ADDRESS | Parameter name | Setting items | Unit | Default | Enabled Timing |
|---|---|---|---|---|---|---|
| 89H | 0001 0224H | Common monitor 1 (CPRM_SEL_MON) | 0: Target position (TPOS)<br>1: Internal command position (IPOS)<br>2: Command position offset (POS_OFFSET)<br>3: Target speed (TSPD)<br>4: Speed limit (SPD_LIM)<br>5: Torque limit (TRQ_LIM)<br>6: Operation status (SV_STAT)<br>7: (Reserve 1)<br>8: Initial feedback position (INIT_PGPOS) (Lower)<br>9: Initial feedback position (INIT_PGPOS) (Upper) | - | 0 | After changing |
| 8AH | 0001 0228H | Common monitor 2 (CPRM_SEL_MON) | 0: Target position (TPOS)<br>1: Internal command position (IPOS)<br>2: Command position offset (POS_OFFSET)<br>3: Target speed (TSPD)<br>4: Speed limit (SPD_LIM)<br>5: Torque limit (TRQ_LIM)<br>6: Operation status (SV_STAT)<br>7: (Reserve 1)<br>8: Initial feedback position (INIT_PGPOS) (Lower)<br>9: Initial feedback position (INIT_PGPOS) (Upper) | - | 0 | After changing |
| 8BH | 0001 022CH | Origin range | 0 to 250 | CMD_PLS | 10 | After changing |
| 8CH | 0001 0230H | P-torque limit 2 | 0 to 800 | % | 100 | After changing |
| 8DH | 0001 0234H | N-torque limit 2 | 0 to 800 | % | 100 | After changing |
| 8EH | 0001 0238H | Zero speed detection range | 1000 to 10000000 | $0.001min^{-1}$ | 20000 | After changing |
| 8FH | 0001 023CH | Speed match range | 0 to 100000 | $0.001min^{-1}$ | 10000 | After changing |

| Common parameter No. Numbers in parentheses are bit numbers. | ADDRESS | Parameter name | Setting items | Unit | Default | Enabled Timing |
|---|---|---|---|---|---|---|
| 90H (00) | 0001 0240H | SVCMD_CTRL CMD_PAUSE (Read Only) | 0: Disabled<br>1: Enabled | - | 1H | After changing |
| 90H (01) | | SVCMD_CTRL CMD_CANCEL (Read Only) | 0: Disabled<br>1: Enabled | - | 1H | After changing |
| 90H (02,03) | | SVCMD_CTRL STOP_MODE (Read Only) | 0: Disabled<br>1: Enabled | - | 3H | After changing |
| 90H (04,05) | | SVCMD_CTRL ACCFIL (Read Only) | 0: Disabled<br>1: Enabled | - | 3H | After changing |
| 90H (06,07) | | Reserve (Read Only) | 0: Disabled<br>1: Enabled | - | 0H | After changing |
| 90H (08) | | SVCMD_CTRL LT_REQ1 (Read Only) | 0: Disabled<br>1: Enabled | - | 1H | After changing |
| 90H (09) | | SVCMD_CTRL LT_REQ2 (Read Only) | 0: Disabled<br>1: Enabled | - | 1H | After changing |
| 90H (10,11) | | SVCMD_CTRL LT_SEL1 (Read Only) | 0: Disabled<br>1: Enabled | - | 3H | After changing |
| 90H (12,13) | | SVCMD_CTRL LT_SEL2 (Read Only) | 0: Disabled<br>1: Enabled | - | 3H | After changing |
| 90H (14,15) | | Reserve (Read Only) | 0: Disabled<br>1: Enabled | - | 0H | After changing |
| 90H (16 to 19) | | SVCMD_CTRL SEL_MON1 (Read Only) | 0: Disabled<br>1: Enabled | - | FH | After changing |
| 90H (20 to 23) | | SVCMD_CTRL SEL_MON2 (Read Only) | 0: Disabled<br>1: Enabled | - | FH | After changing |
| 90H (24 to 27) | | SVCMD_CTRL SEL_MON3 (Read Only) | 0: Disabled<br>1: Enabled | - | FH | After changing |
| 90H (28 to 31) | | Reserve (Read Only) | 0: Disabled<br>1: Enabled | - | 0H | After changing |

| Common parameter No. Numbers in parentheses are bit numbers. | ADDRESS | Parameter name | Setting items | Unit | Default | Enabled Timing |
|---|---|---|---|---|---|---|
| 91H (00) | 0001 0244H | SVCMD_STAT CMD_PAUSE_CMP (Read Only) | 0: Disabled 1: Enabled | - | 1H | After changing |
| 91H (01) | | SVCMD_STAT CMD_CANCEL_CMP (Read Only) | 0: Disabled 1: Enabled | - | 1H | After changing |
| 91H (02,03) | | Reserve (Read Only) | 0: Disabled 1: Enabled | - | 0H | After changing |
| 91H (04,05) | | SVCMD_STAT ACCFIL (Read Only) | 0: Disabled 1: Enabled | - | 3H | After changing |
| 91H (06,07) | | Reserve (Read Only) | 0: Disabled 1: Enabled | - | 0H | After changing |
| 91H (08) | | SVCMD_STAT L_CMP1 (Read Only) | 0: Disabled 1: Enabled | - | 1H | After changing |
| 91H (09) | | SVCMD_STAT L_CMP2 (Read Only) | 0: Disabled 1: Enabled | - | 1H | After changing |
| 91H (10) | | SVCMD_STAT POS_RDY (Read Only) | 0: Disabled 1: Enabled | - | 1H | After changing |
| 91H (11) | | SVCMD_STAT PON (Read Only) | 0: Disabled 1: Enabled | - | 1H | After changing |
| 91H (12) | | SVCMD_STAT M_RDY (Read Only) | 0: Disabled 1: Enabled | - | 1H | After changing |
| 91H (13) | | SVCMD_STAT SV_ON (Read Only) | 0: Disabled 1: Enabled | - | 1H | After changing |
| 91H (14,15) | | Reserve (Read Only) | 0: Disabled 1: Enabled | - | 0H | After changing |
| 91H (16 to 19) | | SVCMD_STAT SEL_MON1 (Read Only) | 0: Disabled 1: Enabled | - | FH | After changing |
| 91H (20 to 23) | | SVCMD_STAT SEL_MON2 (Read Only) | 0: Disabled 1: Enabled | - | FH | After changing |
| 91H (24 to 27) | | SVCMD_STAT SEL_MON3 (Read Only) | 0: Disabled 1: Enabled | - | FH | After changing |
| 91H (28 to 31) | | Reserve (Read Only) | 0: Disabled 1: Enabled | - | 0H | After changing |

| Common parameter No. Numbers in parentheses are bit numbers. | ADDRESS | Parameter name | Setting items | Unit | Default | Enabled Timing |
|---|---|---|---|---|---|---|
| 92H (00 to 02) | 0001 0248H | Reserve (Read Only) | 0: Disabled<br>1: Enabled | - | 0H | After changing |
| 92H (03) | | Reserve (Read Only) | 0: Disabled<br>1: Enabled | - | 0H | After changing |
| 92H (04) | | SVCMD_IO V_PPI (Read Only) | 0: Disabled<br>1: Enabled | - | 1H | After changing |
| 92H (05) | | SVCMD_IO P_PPI (Read Only) | 0: Disabled<br>1: Enabled | - | 1H | After changing |
| 92H (06) | | SVCMD_IO P_CL (Read Only) | 0: Disabled<br>1: Enabled | - | 1H | After changing |
| 92H (07) | | SVCMD_IO N_CL (Read Only) | 0: Disabled<br>1: Enabled | - | 1H | After changing |
| 92H (08) | | SVCMD_IO G_SEL (Read Only) | 0: Disabled<br>1: Enabled | - | 1H | After changing |
| 92H (09 to 11) | | SVCMD_IO G_SEL (Read Only) | 0: Disabled<br>1: Enabled | - | 0H | After changing |
| 92H (12 to 15) | | Reserve (Read Only) | 0: Disabled<br>1: Enabled | - | 0H | After changing |
| 92H (16 to 19) | | SVCMD_IO BANK_SEL (Read Only) | 0: Disabled<br>1: Enabled | - | FH | After changing |
| 92H (20 to 22) | | SVCMD_IO SO1 to SO3 (Read Only) | 0: Disabled<br>1: Enabled | - | 7H | After changing |
| 92H (23) | | Reserve (Read Only) | 0: Disabled<br>1: Enabled | - | 0H | After changing |
| 92H (24 to 31) | | Reserve (Read Only) | 0: Disabled<br>1: Enabled | - | 0H | After changing |

| Common parameter No. Numbers in parentheses are bit numbers. | ADDRESS | Parameter name | Setting items | Unit | Default | Enabled Timing |
|---|---|---|---|---|---|---|
| 93H (00) | 0001 024CH | Reserve (Read Only) | 0: Disabled<br>1: Enabled | - | 0H | After changing |
| 93H (01) | | SVCMD_IO DEC (Read Only) | 0: Disabled<br>1: Enabled | - | 1H | After changing |
| 93H (02) | | SVCMD_IO P-OT (Read Only) | 0: Disabled<br>1: Enabled | - | 1H | After changing |
| 93H (03) | | SVCMD_IO N-OT (Read Only) | 0: Disabled<br>1: Enabled | - | 1H | After changing |
| 93H (04) | | SVCMD_IO EXT1 (Read Only) | 0: Disabled<br>1: Enabled | - | 1H | After changing |
| 93H (05) | | SVCMD_IO EXT2 (Read Only) | 0: Disabled<br>1: Enabled | - | 1H | After changing |
| 93H (06) | | SVCMD_IO EXT3 (Read Only) | 0: Disabled<br>1: Enabled | - | 1H | After changing |
| 93H (07) | | SVCMD_IO ESTP (Read Only) | 0: Disabled<br>1: Enabled | - | 1H | After changing |
| 93H (08) | | Reserve (Read Only) | 0: Disabled<br>1: Enabled | - | 0H | After changing |
| 93H (09) | | SVCMD_IO BRK_ON (Read Only) | 0: Disabled<br>1: Enabled | - | 1H | After changing |
| 93H (10) | | SVCMD_IO P-SOT (Read Only) | 0: Disabled<br>1: Enabled | - | 1H | After changing |
| 93H (11) | | SVCMD_IO N-SOT (Read Only) | 0: Disabled<br>1: Enabled | - | 1H | After changing |
| 93H (12) | | SVCMD_IO DEN (Read Only) | 0: Disabled<br>1: Enabled | - | 1H | After changing |
| 93H (13) | | SVCMD_IO NEAR (Read Only) | 0: Disabled<br>1: Enabled | - | 1H | After changing |
| 93H (14) | | SVCMD_IO PSET (Read Only) | 0: Disabled<br>1: Enabled | - | 1H | After changing |
| 93H (15) | | SVCMD_IO ZPOINT (Read Only) | 0: Disabled<br>1: Enabled | - | 1H | After changing |
| 93H (16) | | SVCMD_IO T_LIM (Read Only) | 0: Disabled<br>1: Enabled | - | 1H | After changing |
| 93H (17) | | SVCMD_IO V_LIM (Read Only) | 0: Disabled<br>1: Enabled | - | 1H | After changing |
| 93H (18) | | SVCMD_IO V_CMP (Read Only) | 0: Disabled<br>1: Enabled | - | 1H | After changing |
| 93H (19) | | SVCMD_IO ZSPD (Read Only) | 0: Disabled<br>1: Enabled | - | 1H | After changing |
| 93H (20 to 23) | | Reserve (Read Only) | 0: Disabled<br>1: Enabled | - | 0H | After changing |
| 93H (24 to 31) | | SVCMD_IO I0_STS1 to 8 (Read Only) | 0: Disabled<br>1: Enabled | - | FFH | After changing |

# A-7 Motorless Test

SV2 Series is capable of simulating servo motor operation without running it to check host controller and/or peripheral operation. This is usable when checking wiring, verifying parameters, and adjusting the system.
You cab perform a motorless test without connecting the servo motor.

**Point** **You cannot verify regenerative operation or dynamic braking in a motorless test.**

## ■ Parameter setting

The following parameters need to be set up when performing a motorless test.

| Parameter type | Category | Level | Parameter name | Setting Range | Setting Unit | Factory setting | Enable timing |
|---|---|---|---|---|---|---|---|
| OTH_17 | Other | Special | *Motorless test | 0: Not used<br>1: Used | - | 0 | After powered on |
| OTH_18 | | | *Motorless Encoder type*1 | 0: INC<br>1: ABS | - | 0 | |

*1 When the servo motor is actually connected, the encoder type of the connected servo motor takes precedence.

## Overview of the tracing function

### ■ Tracing function

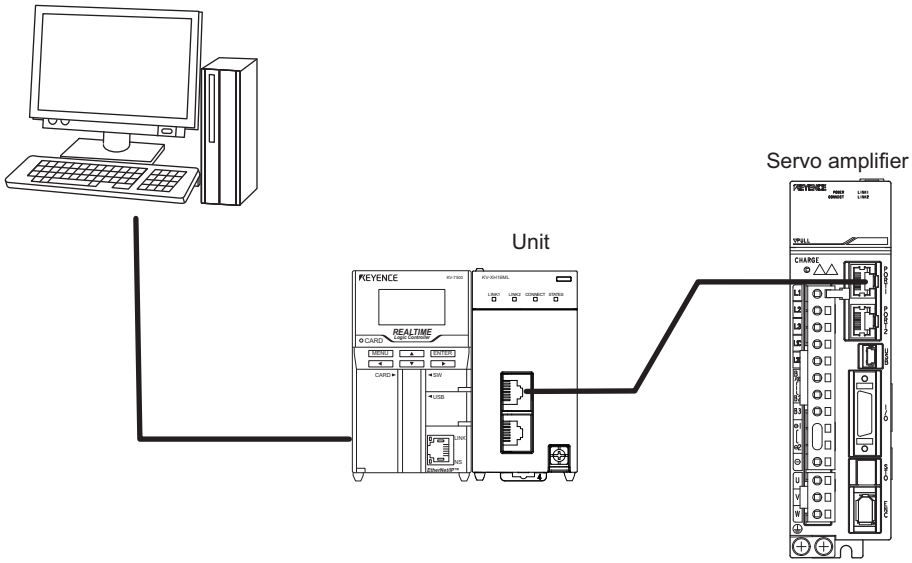
The tracing function is to import the state of the servo amplifier at any timing (trigger) by using SV2 Series in combination with KV-XH16ML/XH04ML. Two types of tracing are available: Real time to read data in each sampling cycle and batch to perform data buffering in each control cycle.

Acquired data can be graphically displayed on KV STUDIO as waveforms to allow easy debugging and tuning.

Refer to 🕮 KV-XH16ML/XH04ML User's Manual for further information on how to use the tracing function.

## Required system

This section discusses the system configuration for performing tracing.



# A-9 List of Monitoring Items

Units and update cycles that can be monitored by the analog monitoring and servo tracing functions available with SV2 Series are as follows.

| Monitor item | Update cycle | Functions that can be monitored | | |
|---|---|---|---|---|
| | | MECHATROLINK selected monitor | Analog monitor | Servo Tracing Function*1 |
| Feedback position (APOS) | Control cycle | Yes (CMD_PLS) | - | - |
| Command position (CPOS) | Control cycle | Yes (CMD_PLS) | - | - |
| Position deviation (PERR) | Control cycle | Yes (CMD_PLS) | Yes (0.05V/1 command unit) | Yes (CMD_PLS) |
| Position amplifier deviation | Control cycle | - | Yes (0.05V/1 Encoder pulse unit) | Yes (Encoder pulse) |
| Excessive motor-external encoder deviation | Control cycle | - | - | Yes (CMD_PLS) |
| Latch position 1 (LPOS1) | Control cycle | Yes (CMD_PLS) | - | - |
| Latch position 2 (LPOS2) | Control cycle | Yes (CMD_PLS) | - | - |
| Feedback speed (FSPD) | Control cycle | Yes (CMD_PLS/s) | Yes ($1V/1000min^{-1}$) | Yes ($min^{-1}$) |
| External encoder speed | Control cycle | - | Yes ($1V/1000min^{-1}$ (motor conversion value)) | Yes ($min^{-1}$) |
| Command speed (CSPD) | Control cycle | Yes (CMD_PLS/s) | - | - |
| Internal command speed | Control cycle | - | Yes ($1V/1000min^{-1}$) | Yes ($min^{-1}$) |
| Position command speed | Control cycle | - | Yes ($1V/1000min^{-1}$) | Yes ($min^{-1}$) |
| Internal command torque (TRQ) | Control cycle | Yes (0.01%) | Yes (1V/100%) | Yes (%) |
| Analog feedback command torque | Control cycle | Yes (0.01%) | Yes (1V/100%) | Yes (%) |
| Analog feedback detection torque | Control cycle | Yes (0.01%) | Yes (1V/100%) | Yes (%) |
| Analog feedback output torque | Control cycle | Yes (0.01%) | Yes (1V/100%) | Yes (%) |
| Analog feedback torque deviation | Control cycle | Yes (0.01%) | Yes (1V/100%) | Yes (%) |
| Speed feedforward | Control cycle | - | Yes ($1V/1000min^{-1}$) | Yes ($min^{-1}$) |
| Torque feedforward | Control cycle | - | Yes (1V/100%) | Yes (%) |
| Active gain number | Control cycle | - | Yes (1st gain: 1V, 2nd gain: 2V) | Yes (1st gain: 4096, 2nd gain: 8192) |
| Control mode | Control cycle | Yes (Speed control: 0, Position control: 1, Torque control: 2, Analog feedback control: 3) | - | Yes (Speed control: 0, Position control: 1, Torque control: 2, Analog feedback control: 3) |
| Alarm code (ALARM) | Control cycle | Yes (Alarm code) | - | - |
| Feedback pulse counter (Lower) | Control cycle | Yes (CMD_PLS) | - | - |
| Feedback pulse counter (Upper) | Control cycle | Yes (CMD_PLS) | - | - |
| Fully closed feedback pulse counter (Lower) | Control cycle | Yes (CMD_PLS) | - | - |
| Fully closed feedback pulse counter (Upper) | Control cycle | Yes (CMD_PLS) | - | - |
| Within 1 revolution position | Control cycle | Yes (Encoder pulse) | - | - |
| Speed limit (SPD_LIM) | Control cycle | Yes (CMD_PLS/s) | - | - |

*1 The servo tracing function can be accessed from the setting software/setting tool.

"Chapter 12 SV2 SERIES SETTING SOFTWARE", Page 12-1

KV-XH16ML/XH04ML User's Manual

| Monitor item | Update cycle | Functions that can be monitored | | |
|---|---|---|---|---|
| | | MECHATROLINK selected monitor | Analog monitor | Servo Tracing Function*1 |
| Torque limit (TRQ_LIM) | Control cycle | Yes (0.01%) | - | - |
| Initial multiturn data | Within 2 ms | Yes (Rev) | - | - |
| Initial within 1 revolution position | Within 2 ms | Yes (Encoder pulse) | - | - |
| Initial feedback position (INIT_PGPOS) (Lower) | Within 2 ms | Yes (CMD_PLS) | - | - |
| Initial feedback position (INIT_PGPOS) (Upper) | Within 2 ms | Yes (CMD_PLS) | - | - |
| Operation status (SV_STAT) | Control cycle | Yes (1st byte = Communication phase, 2nd byte = Control mode, 3rd byte = Reserve, 4th byte = Advanced signal monitor) | - | - |
| Input signal monitor | Control cycle | Yes (0 bit = Reserve, 1 to 7 bits = Input 1 to 7, 8 to 31 bits = Reserve) | - | Yes |
| Output signal monitor | Control cycle | Yes (0 bit = ALARM, 1 to 3 bits = Output 1 to 3, 4 to 31 bits = Reserve) | - | Yes |
| Pulse output completion signal | Control cycle | - | Yes (Pulse output complete: 5V, Pulse output incomplete: 0V) | - |
| INPOS signal | Control cycle | - | Yes (Positioning completion: 5V, Positioning incomplete: 0V) | - |
| Load ratio | 10 sec. | Yes (%) | - | - |
| Regenerative load ratio | 10 sec. | Yes (%) | - | - |
| DB resistance load ratio | 10 sec. | Yes (%) | - | - |
| Power consumption | 1 sec. | Yes (W) | - | - |
| Power consumption | 1 sec. | Yes (0.001Wh) | - | - |
| Cumulative power consumption | 1 sec. | Yes (Wh) | - | - |
| Main circuit DC voltage | Control cycle | - | Yes (1V/Main circuit voltage 100 VDC) | - |
| Last value of LPOS 1 | Control cycle | Yes (CMD_PLS) | - | - |
| Command position (MPOS) | Control cycle | Yes (CMD_PLS) | - | - |
| Target position (TPOS) | Control cycle | Yes (CMD_PLS) | - | - |
| Internal command position (IPOS) | Control cycle | Yes (CMD_PLS) | - | - |
| Command position offset (POS_OFFSET) | Control cycle | Yes (CMD_PLS) | - | - |
| Target speed (TSPD) | Control cycle | Yes (CMD_PLS/s) | - | - |

*1 The servo tracing function can be accessed from the setting software/setting tool.

"Chapter 12 SV2 SERIES SETTING SOFTWARE", Page 12-1

KV-XH16ML/XH04ML User's Manual

Refer to "A-3 Control Block Diagram", Page A-22 for the SV2 Series control block diagram.

# A-10 Index

This index of terms used in this manual is assigned by alphabet.

## symbol



## A



## B



## C



## D



## E



## F



## G

## H



## I



## L



## M



## N



## O

## P



## R



## S



## T



## V



## W

## Z

**MEMO**

# Revision History

| Printing Date | Version | Details of Revision |
|---|---|---|
| Mar 2016 | Second version | |
| July 2016 | Third version | |
| Aug 2016 | Fourth version | |
| Mar 2018 | Fifth version | |
| May 2022 | Revised 1st edition | |
| Feb 2023 | 2nd revision 1st edition | |

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## KEYENCE CORPORATION

1-3-14, Higashi-Nakajima, Higashi-Yodogawa-ku, Osaka, 533-8555, Japan PHONE: +81-6-6379-2211

www.keyence.com/glb

**AUSTRIA**
Phone: +43 (0)2236 378266 0

**BELGIUM**
Phone: +32 (0)15 281 222

**BRAZIL**
Phone: +55-11-3045-4011

**CANADA**
Phone: +1-905-366-7655

**CHINA**
Phone: +86-21-3357-1001

**CZECH REPUBLIC**
Phone: +420 220 184 700

**FRANCE**
Phone: +33 1 56 37 78 00

**GERMANY**
Phone: +49-6102-3689-0

**HONG KONG**
Phone: +852-3104-1010

**HUNGARY**
Phone: +36 1 802 7360

**INDIA**
Phone: +91-44-4963-0900

**INDONESIA**
Phone: +62-21-2966-0120

**ITALY**
Phone: +39-02-6688220

**KOREA**
Phone: +82-31-789-4300

**MALAYSIA**
Phone: +60-3-7883-2211

**MEXICO**
Phone: +52-55-8850-0100

**NETHERLANDS**
Phone: +31 (0)40 206 6100

**PHILIPPINES**
Phone: +63-(0)2-8981-5000

**POLAND**
Phone: +48 71 368 61 60

**ROMANIA**
Phone: +40 (0)269 232 808

**SINGAPORE**
Phone: +65-6392-1011

**SLOVAKIA**
Phone: +421 (0)2 5939 6461

**SLOVENIA**
Phone: +386 (0)1 4701 666

**SWITZERLAND**
Phone: +41 (0)43 455 77 30

**TAIWAN**
Phone: +886-2-2721-1080

**THAILAND**
Phone: +66-2-078-1090

**UK & IRELAND**
Phone: +44 (0)1908-696-900

**USA**
Phone: +1-201-930-0100

**VIETNAM**
Phone: +84-24-3772-5555


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