Introduction

Thank you for selecting the Mitsubishi numerical control unit. This instruction manual describes the handling and caution points for using this AC servo/spindle. Incorrect handling may lead to unforeseen accidents, so always read this instruction manual thoroughly to ensure correct usage.

Make sure that this instruction manual is delivered to the end user. Always store this manual in a safe place.

In order to confirm if all function specifications described in this manual are applicable, refer to the specifications for each CNC.

Notes on Reading This Manual

(1) Since the description of this specification manual deals with NC in general, for the specifications of individual machine tools, refer to the manuals issued by the respective machine manufacturers. The "restrictions" and "available functions" described in the manuals issued by the machine manufacturers have precedence to those in this manual.

(2) This manual describes as many special operations as possible, but it should be kept in mind that items not mentioned in this manual cannot be performed.
Precautions for safety

Please read this manual and auxiliary documents before starting installation, operation, maintenance or inspection to ensure correct usage. Thoroughly understand the device, safety information and precautions before starting operation. The safety precautions in this instruction manual are ranked as "WARNING" and "CAUTION".

- **DANGER**: When there is a potential risk of fatal or serious injuries if handling is mistaken.

- **WARNING**: When a dangerous situation, or fatal or serious injuries may occur if handling is mistaken.

- **CAUTION**: When a dangerous situation may occur if handling is mistaken leading to medium or minor injuries, or physical damage.

Note that some items described as "CAUTION" may lead to major results depending on the situation. In any case, important information that must be observed is described.
The signs indicating prohibited and mandatory matters are explained below.

Indicates a prohibited matter. For example, "Fire Prohibited" is indicated as.

Indicates a mandatory matter. For example, grounding is indicated as.

The meaning of each pictorial sign is as follows.

<table>
<thead>
<tr>
<th>CAUTION</th>
<th>CAUTION rotated object</th>
<th>CAUTION HOT</th>
<th>Danger Electric shock risk</th>
<th>Danger explosive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prohibited</td>
<td>Disassembly is prohibited</td>
<td>KEEP FIRE AWAY</td>
<td>General instruction</td>
<td>Earth ground</td>
</tr>
</tbody>
</table>

After reading this specifications and instructions manual, store it where the user can access it easily for reference.

The numeric control unit is configured of the control unit, operation board, servo drive unit, spindle drive unit, power supply, servomotor and spindle motor, etc.

In this section "Precautions for safety", the following items are generically called the "motor".
  - Servomotor
  - Linear servomotor
  - Spindle motor

In this section "Precautions for safety", the following items are generically called the "unit".
  - Servo drive unit
  - Spindle drive unit
  - Power supply unit
  - Scale interface unit
  - Magnetic pole detection unit

Important matters that should be understood for operation of this machine are indicated as a POINT in this manual.
1. Electric shock prevention

- Do not open the front cover while the power is ON or during operation. Failure to observe this could lead to electric shocks.
- Do not operate the unit with the front cover removed. The high voltage terminals and charged sections will be exposed, and can cause electric shocks.
- Do not remove the front cover and connector even when the power is OFF unless carrying out wiring work or periodic inspections. The inside of the units is charged, and can cause electric shocks.
- Since the high voltage is supplied to the main circuit connector while the power is ON or during operation, do not touch the main circuit connector with an adjustment screwdriver or the pen tip. Failure to observe this could lead to electric shocks.
- Wait at least 15 minutes after turning the power OFF, confirm that the CHARGE lamp has gone out, and check the voltage between P and N terminals with a tester, etc., before starting wiring, maintenance or inspections. Failure to observe this could lead to electric shocks.
- Ground the unit and motor. For the motor, ground it via the drive unit.
- Wiring, maintenance and inspection work must be done by a qualified technician.
- Wire the servo drive unit and servomotor after installation. Failure to observe this could lead to electric shocks.
- Do not touch the switches with wet hands. Failure to observe this could lead to electric shocks.
- Do not damage, apply forcible stress, place heavy items on the cables or get them caught. Failure to observe this could lead to electric shocks.
- After assembling the built-in IPM spindle motor, if the rotor is rotated by hand etc., voltage occurs between the terminals of lead. Take care not to get electric shocks.
2. Injury prevention

⚠️ When handling a motor, perform operations in safe clothing.

⚠️ In the system where the optical communication with CNC is executed, do not see directly the light generated from CN1A/CN1B connector of drive unit or the end of cable. When the light gets into eye, you may feel something is wrong for eye.

(The light source of optical communication corresponds to class1 defined in JISC6802 or IEC60825-1.)

⚠️ The linear servomotor, direct-drive motor and built-in IPM spindle motor uses permanent magnets in the rotor, so observe the following precautions.

(1)Handling

• The linear servomotor, direct-drive motor and built-in IPM spindle motor could adversely affect medical electronics such as pacemakers, etc., therefore, do not approach the rotor.
• Do not place magnetic materials as iron.
• When a magnetic material as iron is placed, take safety measure not to pinch fingers or hands due to the magnetic attraction force.
• Remove metal items such as watch, piercing jewelry, necklace, etc.
• Do not place portable items that could malfunction or fail due to the influence of the magnetic force.
• When the rotor is not securely fixed to the machine or device, do not leave it unattended but store it in the package properly.

(2)Transportation and storage

• Correctly store the rotor in the package to transport and store.
• During transportation and storage, draw people’s attention by applying a notice saying "Strong magnet-Handle with care" to the package or storage shelf.
• Do not use a damaged package.

(3)Installation

• Take special care not to pinch fingers, etc., when installing (and unpacking) the linear servomotor.
1. Fire prevention

⚠️ Install the units, motors and regenerative resistor on non-combustible material. Direct installation on combustible material or near combustible materials could lead to fires.

⚠️ Always install a circuit protector and contactor on the servo drive unit power input as explained in this manual. Refer to this manual and select the correct circuit protector and contactor. An incorrect selection could result in fire.

⚠️ Shut off the power on the unit side if a fault occurs in the units. Fires could be caused if a large current continues to flow.

⚠️ When using a regenerative resistor, provide a sequence that shuts off the power with the regenerative resistor's error signal. The regenerative resistor could abnormally overheat and cause a fire due to a fault in the regenerative transistor, etc.

⚠️ The battery unit could heat up, ignite or rupture if submerged in water, or if the poles are incorrectly wired.

⚠️ Cut off the main circuit power with the contactor when an alarm or emergency stop occurs.

2. Injury prevention

⚠️ Do not apply a voltage other than that specified in this manual, on each terminal. Failure to observe this item could lead to ruptures or damage, etc.

⚠️ Do not mistake the terminal connections. Failure to observe this item could lead to ruptures or damage, etc.

⚠️ Do not mistake the polarity (+, -). Failure to observe this item could lead to ruptures or damage, etc.

⚠️ Do not touch the radiation fin on unit back face, regenerative resistor or motor, etc., or place parts (cables, etc.) while the power is turned ON or immediately after turning the power OFF. These parts may reach high temperatures, and can cause burns or part damage.

⚠️ Structure the cooling fan on the unit back face, etc., etc so that it cannot be touched after installation. Touching the cooling fan during operation could lead to injuries.

⚠️ Take care not to suck hair, clothes, etc. into the cooling fan.

⚠️ CAUTION
3. Various precautions

Observe the following precautions. Incorrect handling of the unit could lead to faults, injuries and electric shocks, etc.

(1) Transportation and installation

⚠ Correctly transport the product according to its weight.

⚠ Use the motor’s hanging bolts only when transporting the motor. Do not transport the machine when the motor is installed on the machine.

⚠ Do not stack the products above the tolerable number.

⚠ Follow this manual and install the unit or motor in a place where the weight can be borne.

⚠ Do not get on top of or place heavy objects on the unit.

⚠ Do not hold the cables, axis or detector when transporting the motor.

⚠ Do not hold the connected wires or cables when transporting the units.

⚠ Do not hold the front cover when transporting the unit. The unit could drop.

⚠ Always observe the installation directions of the units or motors.

⚠ Secure the specified distance between the units and control panel, or between the servo drive unit and other devices.

⚠ Do not install or run a unit or motor that is damaged or missing parts.

⚠ Do not block the intake or exhaust ports of the motor provided with a cooling fan.

⚠ Do not let foreign objects enter the units or motors. In particular, if conductive objects such as screws or metal chips, etc., or combustible materials such as oil enter, rupture or breakage could occur.

⚠ Provide adequate protection using a material such as connector for conduit to prevent screws, metallic detritus, water and other conductive matter or oil and other combustible matter from entering the motor through the power line lead-out port.

⚠ The units, motors and detectors are precision devices, so do not drop them or apply strong impacts to them.
⚠️ Store and use the units under the following environment conditions.

<table>
<thead>
<tr>
<th>Environment</th>
<th>Unit</th>
<th>Motor</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ambient temperature</strong></td>
<td>Operation: 0 to 55°C (with no freezing), Storage / Transportation: -15°C to 70°C (with no freezing)</td>
<td>Operation: 0 to 40°C (with no freezing), Storage: -15°C to 70°C (Note2) (with no freezing)</td>
</tr>
<tr>
<td><strong>Ambient humidity</strong></td>
<td>Operation: 90%RH or less (with no condensation) Storage / Transportation: 90%RH or less (with no condensation)</td>
<td>Operation: 80%RH or less (with no condensation), Storage: 90%RH or less (with no condensation)</td>
</tr>
<tr>
<td><strong>Atmosphere</strong></td>
<td>Indoors (no direct sunlight) With no corrosive gas, inflammable gas, oil mist, dust or conductive fine particles</td>
<td></td>
</tr>
<tr>
<td><strong>Altitude</strong></td>
<td>Operation/Storage: 1000 meters or less above sea level, Transportation: 13000 meters or less above sea level</td>
<td>Operation: 1000 meters or less above sea level, Storage: 10000 meters or less above sea level</td>
</tr>
</tbody>
</table>

(Note 1) For details, confirm each unit or motor specifications in addition.

(Note 2) -15°C to 55°C for linear servomotor.

⚠️ When disinfectants or insecticides must be used to treat wood packaging materials, always use methods other than fumigation (for example, apply heat treatment at the minimum wood core temperature of 56 °C for a minimum duration of 30 minutes (ISPM No. 15 (2009))). If products such as units are directly fumigated or packed with fumigated wooden materials, halogen substances (including fluorine, chlorine, bromine and iodine) contained in fumes may contribute to the erosion of the capacitors. When exporting the products, make sure to comply with the laws and regulations of each country.

⚠️ Do not use the products in conjunction with any components that contain halogenated flame retardants (bromine, etc). Failure to observe this may cause the erosion of the capacitors.

⚠️ Securely fix the servomotor to the machine. Insufficient fixing could lead to the servomotor slipping off during operation.

⚠️ Always install the servomotor with reduction gear in the designated direction. Failure to do so could lead to oil leaks.

⚠️ Structure the rotary sections of the motor so that it can never be touched during operation. Install a cover, etc., on the shaft.

⚠️ When installing a coupling to a servomotor shaft end, do not apply an impact by hammering, etc. The detector could be damaged.

⚠️ Do not apply a load exceeding the tolerable load onto the servomotor shaft. The shaft could break.

⚠️ Store the motor in the package box.

⚠️ When inserting the shaft into the built-in IPM spindle motor, do not heat the rotor higher than 130°C. The magnet could be demagnetized, and the specifications characteristics will not be ensured.

⚠️ Always use a nonmagnetic tool (explosion-proof beryllium copper alloy safety tool: NGK Insulators, etc.) when installing the linear servomotor.

⚠️ Always provide a mechanical stopper on the end of the linear servomotor’s travel path.

⚠️ If the unit has been stored for a long time, always check the operation before starting actual operation. Please contact the Service Center, Service Station, Sales Office or dealer.
(2) Wiring

- Correctly and securely perform the wiring. Failure to do so could lead to abnormal operation of the motor.
- Do not install a condensing capacitor, surge absorber or radio noise filter on the output side of the drive unit.
- Correctly connect the output side of the drive unit (terminals U, V, W). Failure to do so could lead to abnormal operation of the motor.
- When using a power regenerative power supply unit, always install an AC reactor for each power supply unit.
- In the main circuit power supply side of the unit, always install an appropriate circuit protector or contactor for each unit. Circuit protector or contactor cannot be shared by several units.
- Always connect the motor to the drive unit's output terminals (U, V, W).
- Do not directly connect a commercial power supply to the servomotor. Failure to observe this could result in a fault.
- When using an inductive load such as a relay, always connect a diode as a noise measure parallel to the load.
- When using a capacitance load such as a lamp, always connect a protective resistor as a noise measure serial to the load.
- Do not reverse the direction of a diode which connects to a DC relay for the control output signals such as contractor and motor brake output, etc. to suppress a surge. Connecting it backwards could cause the drive unit to malfunction so that signals are not output, and emergency stop and other safety circuits are inoperable.
- Do not connect/disconnect the cables connected between the units while the power is ON.
- Securely tighten the cable connector fixing screw or fixing mechanism. An insecure fixing could cause the cable to fall off while the power is ON.
- When using a shielded cable instructed in the instruction manual, always ground the cable with a cable clamp, etc.
- Always separate the signals wires from the drive wire and power line.
- Use wires and cables that have a wire diameter, heat resistance and flexibility that conforms to the system.

(3) Trial operation and adjustment

- Check and adjust each program and parameter before starting operation. Failure to do so could lead to unforeseen operation of the machine.
- Do not make remarkable adjustments and changes of parameter as the operation could become unstable.
- The usable motor and unit combination is predetermined. Always check the combinations and parameters before starting trial operation.
- The linear servomotor does not have a stopping device such as magnetic brakes. Install a stopping device on the machine side.
(4) **Usage methods**

- In abnormal state, install an external emergency stop circuit so that the operation can be stopped and power shut off immediately.
- Turn the power OFF immediately if smoke, abnormal noise or odors are generated from the unit or motor.
- Do not disassemble or repair this product.
- Never make modifications.
- When an alarm occurs, the machine will start suddenly if an alarm reset (RST) is carried out while an operation start signal (ST) is being input. Always confirm that the operation signal is OFF before carrying out an alarm reset. Failure to do so could lead to accidents or injuries.
- Reduce magnetic damage by installing a noise filter. The electronic devices used near the unit could be affected by magnetic noise. Install a line noise filter, etc., if there is a risk of magnetic noise.
- Use the unit, motor and regenerative resistor with the designated combination. Failure to do so could lead to fires or trouble.
- The brake (magnetic brake) of the servomotor are for holding, and must not be used for normal braking.
- There may be cases when holding is not possible due to the magnetic brake's life, the machine construction (when ball screw and servomotor are coupled via a timing belt, etc.) or the magnetic brake's failure. Install a stop device to ensure safety on the machine side.
- After changing the programs/parameters or after maintenance and inspection, always test the operation before starting actual operation.
- Do not enter the movable range of the machine during automatic operation. Never place body parts near or touch the spindle during rotation.
- Follow the power supply specification conditions given in each specification for the power (input voltage, input frequency, tolerable sudden power failure time, etc.).
- Set all bits to "0" if they are indicated as not used or empty in the explanation on the bits.
- Do not use the dynamic brakes except during the emergency stop. Continued use of the dynamic brakes could result in brake damage.
- If a circuit protector for the main circuit power supply is shared by several units, the circuit protector may not activate when a short-circuit fault occurs in a small capacity unit. This is dangerous, so never share the circuit protector.
- Mitsubishi spindle motor is dedicated to machine tools. Do not use for other purposes.

(5) **Troubleshooting**

- If a hazardous situation is predicted during power failure or product trouble, use a servomotor with magnetic brakes or install an external brake mechanism.
- Use a double circuit configuration that allows the operation circuit for the magnetic brakes to be operated even by the external emergency stop signal.
- Always turn the main circuit power of the motor OFF when an alarm occurs.
- If an alarm occurs, remove the cause, and secure the safety before resetting the alarm.
(6) Maintenance, inspection and part replacement

⚠ Always backup the programs and parameters before starting maintenance or inspections.
⚠ The capacity of the electrolytic capacitor will drop over time due to self-discharging, etc. To prevent secondary disasters due to failures, replacing this part every five years when used under a normal environment is recommended. Contact the Service Center, Service Station, Sales Office or dealer for repairs or part replacement.
⚠ Do not perform a megger test (insulation resistance measurement) during inspections.
⚠ If the battery low warning is issued, back up the machining programs, tool data and parameters with an input/output unit, and then replace the battery.
⚠ Do not short circuit, charge, overheat, incinerate or disassemble the battery.
⚠ For after-purchase servicing of the built-in motor, only the servicing parts for MITSUBISHI detector can be supplied. For the motor body, prepare the spare parts at the machine manufacturers.
⚠ For maintenance, part replacement, and services in case of failures in the built-in motor (including the detector), take necessary actions at the machine manufacturers. For spindle drive unit, Mitsubishi can offer the after-purchase servicing as with the general spindle drive unit.

(7) Disposal

⚠ Take the batteries and backlights for LCD, etc., off from the controller, drive unit and motor, and dispose of them as general industrial wastes.
⚠ Do not disassemble the unit or motor.
⚠ Dispose of the battery according to local laws.
⚠ Always return the secondary side (magnet side) of the linear servomotor to the Service Center or Service Station.
⚠ When incinerating optical communication cable, hydrogen fluoride gas or hydrogen chloride gas which is corrosive and harmful may be generated. For disposal of optical communication cable, request for specialized industrial waste disposal services that has incineration facility for disposing hydrogen fluoride gas or hydrogen chloride gas.

(8) Transportation

⚠ The unit and motor are precision parts and must be handled carefully.
⚠ According to a United Nations Advisory, the battery unit and battery must be transported according to the rules set forth by the International Civil Aviation Organization (ICAO), International Air Transportation Association (IATA), International Maritime Organization (IMO), and United States Department of Transportation (DOT), etc.

(9) General precautions

The drawings given in this manual show the covers and safety partitions, etc., removed to provide a clearer explanation. Always return the covers or partitions to their respective places before starting operation, and always follow the instructions given in this manual.
Treatment of waste

The following two laws will apply when disposing of this product. Considerations must be made to each law. The following laws are in effect in Japan. Thus, when using this product overseas, the local laws will have a priority. If necessary, indicate or notify these laws to the final user of the product.

(1) Requirements for "Law for Promotion of Effective Utilization of Resources"
   (a) Recycle as much of this product as possible when finished with use.
   (b) When recycling, often parts are sorted into steel scraps and electric parts, etc., and sold to scrap contractors. Mitsubishi recommends sorting the product and selling the members to appropriate contractors.

(2) Requirements for "Law for Treatment of Waste and Cleaning"
   (a) Mitsubishi recommends recycling and selling the product when no longer needed according to item (1) above. The user should make an effort to reduce waste in this manner.
   (b) When disposing a product that cannot be resold, it shall be treated as a waste product.
   (c) The treatment of industrial waste must be commissioned to a licensed industrial waste treatment contractor, and appropriate measures, including a manifest control, must be taken.
   (d) Batteries correspond to "primary batteries", and must be disposed of according to local disposal laws.
Disposal

(Note) This symbol mark is for EU countries only.
This symbol mark is according to the directive 2006/66/EC Article 20 Information for end-users and Annex II.

Your MITSUBISHI ELECTRIC product is designed and manufactured with high quality materials and components which can be recycled and/or reused.
This symbol means that batteries and accumulators, at their end-of-life, should be disposed of separately from your household waste.
If a chemical symbol is printed beneath the symbol shown above, this chemical symbol means that the battery or accumulator contains a heavy metal at a certain concentration. This will be indicated as follows:
Hg: mercury (0,0005%), Cd: cadmium (0,002%), Pb: lead (0,004%)
In the European Union there are separate collection systems for used batteries and accumulators.
Please, dispose of batteries and accumulators correctly at your local community waste collection/recycling centre.

Please, help us to conserve the environment we live in!
Trademarks

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Other company and product names that appear in this manual are trademarks or registered trademarks of the respective companies.
Handling of our product

(English)
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.
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<th>MDS-DH2-CV</th>
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<th>MDS-DJ-SP built-in converter</th>
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(Note 1) For the multiaxis drive unit, a control by each axis is not available. It is required to turn the servo of all axes OFF in the drive unit in order to enable a motor brake output.
## Spindle specifications

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<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>2-6 Smooth High Gain control (SHG control)</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>2-7 High-speed synchronous tapping control (OMR-DD control)</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>2-8 Dual feedback control</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>2-10 OMR-FF control</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>2-11 Control loop gain changeover</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>2-12 Spindle output stabilizing control</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>2-13 High-response spindle acceleration/deceleration function</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>3 Compensation control function</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3-1 Jitter compensation</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>3-2 Notch filter</td>
<td>Variable frequency: 4 Fixed frequency: 1</td>
<td>Variable frequency: 4 Fixed frequency: 1</td>
<td>Variable frequency: 4 Fixed frequency: 1</td>
<td>Variable frequency: 4 Fixed frequency: 1</td>
<td>Variable frequency: 4 Fixed frequency: 1</td>
</tr>
<tr>
<td>3-3 Adaptive tracking-type notch filter</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>3-4 Overshooting compensation</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>3-6 Lost motion compensation type 2</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>3-9 Spindle motor temperature compensation function</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>4 Protection function</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4-1 Deceleration control at emergency stop</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>4-3 Earth fault detection</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>4-5 SLS (Safety Limited Speed) function</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>4-6 Fan stop detection</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>4-9 STO (Safe Torque Off) function</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>5 Sequence functions</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5-4 Specified speed output</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>-</td>
</tr>
<tr>
<td>5-5 Quick READY ON sequence</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>6 Diagnosis functions</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6-1 Monitor output function</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>6-2 Machine resonance frequency display function</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>6-3 Machine inertia display function</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>6-4 Motor temperature display function</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>6-5 Load monitor output function</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>6-6 Open loop control function</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
</tbody>
</table>
Installation
1-1 Installation of servomotor

1. Do not hold the cables, axis or detector when transporting the motor. Failure to observe this could lead to faults or injuries.

2. Securely fix the motor to the machine. Insufficient fixing could lead to the motor deviating during operation. Failure to observe this could lead to injuries.

3. When coupling to a servomotor shaft end, do not apply an impact by hammering, etc. The detector could be damaged.

4. Never touch the rotary sections of the motor during operations. Install a cover, etc., on the shaft.

5. Do not apply a load exceeding the tolerable load onto the servomotor shaft. The shaft could break. Failure to observe this could lead to injuries.

6. Do not connect or disconnect any of the connectors while the power is ON.

1-1-1 Environmental conditions

<table>
<thead>
<tr>
<th>Environment</th>
<th>Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambient temperature</td>
<td>0° C to +40° C (with no freezing)</td>
</tr>
<tr>
<td>Ambient humidity</td>
<td>80% RH or less (with no dew condensation)</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>-15° C to +70° C (with no freezing)</td>
</tr>
<tr>
<td>Storage humidity</td>
<td>90% RH or less (with no dew condensation)</td>
</tr>
<tr>
<td>Atmosphere</td>
<td>Indoors (no direct sunlight)</td>
</tr>
<tr>
<td></td>
<td>No corrosive gas, inflammable gas, oil mist or dust</td>
</tr>
<tr>
<td>Altitude</td>
<td>Operation / storage: 1000m or less above sea level</td>
</tr>
<tr>
<td></td>
<td>Transportation: 10000m or less above sea level</td>
</tr>
</tbody>
</table>

1-1-2 Quakeproof level

<table>
<thead>
<tr>
<th>Motor type</th>
<th>Acceleration direction</th>
<th>Acceleration direction</th>
<th>Direction at right angle to axis (Y)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HF54, 104, 154, 224, 223</td>
<td>Axis direction (X)</td>
<td>24.5m/s² (2.5G) or less</td>
<td>24.5m/s² (2.5G) or less</td>
</tr>
<tr>
<td>HF204, 303, 302, 354, 453</td>
<td>24.5m/s² (2.5G) or less</td>
<td>29.4m/s² (3G) or less</td>
<td></td>
</tr>
</tbody>
</table>

The vibration conditions are as shown below.
1-1-3 Cautions for mounting load (prevention of impact on shaft)

[1] When using the servomotor with key way, use the screw hole at the end of the shaft to mount the pulley onto the shaft. To install, first place the double-end stud into the shaft screw holes, contact the coupling end surface against the washer, and press in as if tightening with a nut. When the shaft does not have a key way, use a frictional coupling, etc.

[2] When removing the pulley, use a pulley remover, and make sure not to apply an impact on the shaft.

[3] Install a protective cover on the rotary sections such as the pulley installed on the shaft to ensure safety.


1-1-4 Installation direction

[1] There are no restrictions on the installation direction. Installation in any direction is possible, but as a standard the motor is installed so that the motor power line and detector cable cannon plugs (lead-in wires) face downward. Installation in the standard direction is effective against dripping. Measure to prevent oil and water must be taken when not installing in the standard direction. When the motor is not installed in the standard direction, refer to section "Oil/water standards" and take the appropriate measures.

The brake plates may make a sliding sound when a servomotor with magnetic brake is installed with the shaft facing upward, but this is not a fault.
1-1-5 Shaft characteristics

There is a limit to the load that can be applied on the motor shaft. Make sure that the load applied on the radial direction and thrust direction, when mounted on the machine, is below the tolerable values given below. These loads may affect the motor output torque, so consider them when designing the machine.

<table>
<thead>
<tr>
<th>Servomotor</th>
<th>Tolerable radial load</th>
<th>Tolerable thrust load</th>
</tr>
</thead>
<tbody>
<tr>
<td>HF54T, 104T, 154T, 224T, 223T (Taper shaft)</td>
<td>392N (L=58)</td>
<td>490N</td>
</tr>
<tr>
<td>HF54S, 104S, 154S, 224S, 223S (Straight shaft)</td>
<td>980N (L=55)</td>
<td>490N</td>
</tr>
<tr>
<td>HF204S, 303S, 302S, 354S, 453S (Straight shaft)</td>
<td>2058N (L=79)</td>
<td>980N</td>
</tr>
</tbody>
</table>

(Note 1) The tolerable radial load and thrust load in the above table are values applied when each motor is used independently.

(Note 2) The symbol L in the table refers to the value of L below.

![Diagram of motor shaft loads]

L: Length from flange installation surface to center of load mass [mm]

1. Use a flexible coupling when connecting with a ball screw, etc., and keep the shaft core deviation to below the tolerable radial load of the shaft.

2. When directly installing the gear on the motor shaft, the radial load increases as the diameter of the gear decreases. This should be carefully considered when designing the machine.

**CAUTION!**

3. When directly installing the pulley on the motor shaft, carefully consider so that the radial load (double the tension) generated from the timing belt tension is less than the values shown in the table above.

4. In machines where thrust loads such as a worm gear are applied, carefully consider providing separate bearings, etc., on the machine side so that loads exceeding the tolerable thrust loads are not applied to the motor.

1-1-6 Machine accuracy

Machine accuracy of the servo motor’s output shaft and around the installation part is as below.

(Excluding special products)

<table>
<thead>
<tr>
<th>Accuracy</th>
<th>Measurement point</th>
<th>Flange size [mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Less than 100 SQ.</td>
</tr>
<tr>
<td>Run-out of the flange surface to the output shaft</td>
<td>a</td>
<td>0.05mm</td>
</tr>
<tr>
<td>Run-out of the flange surface’s fitting outer diameter</td>
<td>b</td>
<td>0.04mm</td>
</tr>
<tr>
<td>Run-out of the output shaft end</td>
<td>c</td>
<td>0.02mm</td>
</tr>
</tbody>
</table>

![Diagram of machine accuracy measurements]
1-1-7 Coupling with the load

There are several ways to couple the motor shaft and machine, such as direct coupling with flexible coupling or rigid coupling, gear connection, timing belt connection, etc. Summarized comparison is as follows.

<table>
<thead>
<tr>
<th>Coupling Type</th>
<th>Noise</th>
<th>Lubrication</th>
<th>Backlash</th>
<th>Rigidity</th>
<th>Reliability in coupling</th>
<th>Life</th>
<th>Torque Increased at Deceleration</th>
<th>Degree of Freedom in Motor Installation</th>
<th>Cautions in Motor Installation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct coupling with flexible coupling</td>
<td>◯</td>
<td>◯</td>
<td>◯</td>
<td>◯</td>
<td>◯</td>
<td>◯</td>
<td>×</td>
<td>△</td>
<td>Shaft core deviation (In the case of single)</td>
</tr>
<tr>
<td>Direct coupling with rigid coupling</td>
<td>◯</td>
<td>◯</td>
<td>◯</td>
<td>◯</td>
<td>◯</td>
<td>◯</td>
<td>×</td>
<td>×</td>
<td>Shaft core deviation Angle deviation</td>
</tr>
<tr>
<td>Gear</td>
<td>×</td>
<td>×</td>
<td>△</td>
<td>△</td>
<td>△</td>
<td>△</td>
<td>△</td>
<td>△</td>
<td>Backlash too small Pitch diameter too small</td>
</tr>
<tr>
<td>Timing belt</td>
<td>△</td>
<td>◯</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>◯</td>
<td>◯</td>
<td>Belt stretched too much Pitch diameter too small</td>
</tr>
</tbody>
</table>

**CAUTION**
If the cautions in motor installation in the above table are not observed, the motor will have a broken shaft, or the bearing will have a shorter life. Carry out design and installation adjustment so that the load on the motor shaft will be below the tolerable loads mentioned in "Shaft characteristics".

(1) **Direct coupling - Flexible coupling**
When coupling the load directly, a flexible coupling is recommended. The benefits of a flexible coupling are as below.
(a) Shaft’s angle deviation and core deviation can be absorbed to some extent, so adjustment in motor installation is easier.
However, in the case of single, shaft core deviation cannot be allowed, so it is required to design and adjust so that the shaft cores of the motor and ball screw align. Check the specification of the coupling to use. If the shaft core deviation exceeds the coupling's tolerable level, the motor will have a broken shaft, or the bearing will have a shorter life. Thus, in order to simplify the installation adjustment, use a double flexible coupling.

(b) Less looseness produces less vibration and less noise at the coupling part.
On the other hand, if assembling is loose, lower rigidity may be caused. When using a coupling with lower rigidity, the accuracy in centering the core doesn’t have to be high, however, it is undesirable for servo. In order to fully utilize the servo’s efficiency to ensure the maximum durability of the equipments, it is required to use a highly rigid coupling, and to fully align the shaft cores in the initial installation. It is also required to select the optimum flexible coupling according to the working conditions, and use it correctly according to the manufacturer's specification manual.

**Example of direct coupling with load**

![Example of direct coupling with load](image)
(2) Direct coupling - Rigid coupling
A rigid coupling has benefits such as high rigidity, and relatively lower price. However, shaft core deviation and angle deviation of the motor shaft and ball screw are not allowed, so full attention is required in installing the rigid coupling. Shaft core deviation is desired to be 0.01mm or less. If enough accuracy cannot be ensured, the motor will have a broken shaft, or the bearing will have a shorter life.
In addition, note that a rigid coupling is not acceptable for HF-KP Series servo motors.

Also note that the motor side ball screw bearing must be locked so that to avoid the thrust load on the motor shaft due to expansion and contraction of the ball screw.

(3) Gear connection
Gear's accuracy and backlash amount greatly affect on the machine’s positioning accuracy and noise during operation.
Thus, according to the machine’s specification, appropriately select the accuracy and backlash amount.
In gear connection, it is required to take measures against oil to enter the motor.

1-1-8 Oil / water standards
(1) The motor protective format uses the IP type, which complies with IEC Standard.
However, these Standards are short-term performance specifications. They do not guarantee continuous environmental protection characteristics. Measures such as covers, etc., must be taken if there is any possibility that oil or water will fall on the motor, and the motor will be constantly wet and permeated by water. Note that the motor’s IP-type is not indicated as corrosion-resistant.
(2) When a gear box is installed on the servomotor, make sure that the oil level height from the center of the shaft is higher than the values given below. Open a breathing hole on the gear box so that the inner pressure does not rise.

<table>
<thead>
<tr>
<th>Servomotor</th>
<th>Oil level (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HF54, 104, 154, 224, 223</td>
<td>22.5</td>
</tr>
<tr>
<td>HF204, 303, 302, 354, 453</td>
<td>30</td>
</tr>
</tbody>
</table>

(3) When installing the servomotor horizontally, set the power cable and detector cable to face downward. When installing vertically or on an inclination, provide a cable trap.

1. The servomotors, including those having IP67 specifications, do not have a completely waterproof (oil-proof) structure. Do not allow oil or water to constantly contact the motor, enter the motor, or accumulate on the motor. Oil can also enter the motor through cutting chip accumulation, so be careful of this also.

2. When the motor is installed facing upwards, take measures on the machine side so that gear oil, etc., does not flow onto the motor shaft.

(4) Do not use the unit with the cable submerged in oil or water.
(Refer to following drawing.)
(5) Make sure that oil and water do not flow along the cable into the motor or detector. (Refer to right drawing.)

(6) When installing on the top of the shaft end, make sure that oil from the gear box, etc., does not enter the servomotor. The servomotor does not have a waterproof structure.

1-1-9 Installation of servo motor

Mount the servo motor on a flange which has the following size or produces an equivalent or higher heat dissipation effect:

<table>
<thead>
<tr>
<th>Flange size (mm)</th>
<th>Servomotor capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>150 × 150 × 6</td>
<td>100W</td>
</tr>
<tr>
<td>250 × 250 × 6</td>
<td>200 to 400W</td>
</tr>
<tr>
<td>250 × 250 × 12</td>
<td>0.5 to 1.5kW</td>
</tr>
<tr>
<td>300 × 300 × 20</td>
<td>2.0 to 7.0kW</td>
</tr>
<tr>
<td>800 × 800 × 35</td>
<td>9.0 to 11.0kW</td>
</tr>
</tbody>
</table>
1-1-10 Cable stress

[1] Sufficiently consider the cable clamping method so that bending stress and the stress from the cable's own weight is not applied on the cable connection part.

[2] In applications where the servomotor moves, make sure that excessive stress is not applied on the cable. If the detector cable and servomotor wiring are stored in a cable bear and the servomotor moves, make sure that the cable bending part is within the range of the optional detector cable.

Fix the detector cable and power cable enclosed with the servomotor.

[3] Make sure that the cable sheathes will not be cut by sharp cutting chips, worn or stepped on by workers or vehicles.

The bending life of the detector cable is as shown below. Regard this with a slight allowance. If the servomotor/spindle motor is installed on a machine that moves, make the bending radius as large as possible.

![Detector cable bending life graph](image)

Detector cable bending life
(Material of Mitsubishi optional detector cable: A14B2343)

(Note) The values in this graph are calculated values and are not guaranteed.
1-2 Installation of spindle motor

1. Do not hold the cables, axis or detector when transporting the motor. Failure to observe this could lead to faults or injuries.

2. Securely fix the motor to the machine. Insufficient fixing could lead to the motor deviating during operation. Failure to observe this could lead to injuries.

3. When coupling to a servomotor shaft end, do not apply an impact by hammering, etc. The detector could be damaged.

4. Never touch the rotary sections of the motor during operations. Install a cover, etc., on the shaft.

5. Do not apply a load exceeding the tolerable load onto the servomotor shaft. The shaft could break. Failure to observe this could lead to injuries.

6. Do not connect or disconnect any of the connectors while the power is ON.

7. When coupling the motor directly with the spindle, perform the adequate centering and parallel correcting with the axis to be coupled. The vibration of the motor should be 4.9m/s² (0.5G) or less after balancing the spindle unit.

8. Perform a running-in before operating the machine.

1-2-1 Environmental conditions

<table>
<thead>
<tr>
<th>Environment</th>
<th>Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambient</td>
<td>temperature</td>
</tr>
<tr>
<td>Ambient</td>
<td>0°C to +40°C (with no freezing)</td>
</tr>
<tr>
<td>Ambient</td>
<td>humidity</td>
</tr>
<tr>
<td>Ambient</td>
<td>90%RH or less (with no dew condensation)</td>
</tr>
<tr>
<td>Storage</td>
<td>temperature</td>
</tr>
<tr>
<td>Storage</td>
<td>-20°C to +65°C (with no freezing)</td>
</tr>
<tr>
<td>Storage</td>
<td>humidity</td>
</tr>
<tr>
<td>Storage</td>
<td>90%RH or less (with no dew condensation)</td>
</tr>
<tr>
<td>Atmosphere</td>
<td>Indoors (Where unit is not subject to direct sunlight)</td>
</tr>
<tr>
<td>Atmosphere</td>
<td>No corrosive gases, flammable gases, oil mist or dust</td>
</tr>
<tr>
<td>Atmosphere</td>
<td>Operation/storage: 1000m or less above sea level</td>
</tr>
<tr>
<td>Atmosphere</td>
<td>Transportation: 10000m or less above sea level</td>
</tr>
<tr>
<td>Vibration</td>
<td>X:29.4m/s² (3G) Y:29.4m/s² (3G)</td>
</tr>
</tbody>
</table>

(Note) Refer to each spindle motor specifications for details on the spindle motor vibration class.

1-2-2 Cautions for mounting fittings

[1] When a spindle motor is driven at a high speed, slight unbalance generated on the rotor causes increase of the whirling load on the rotor. Thus rotational vibration occurs, which may result in abnormal sound, shorter bearing life and/or damages (fretting or flaking). Therefore, minimize the unbalance of rotational objects including the gear, pulley, coupling, rotary joint for coolant, etc. that are attached on the motor shaft.

[2] Key-less shaft is considered as standard in order to simplify balancing procedure of such as gear, pulley, coupling and rotary joint for coolant. We recommend you to choose a gear, pulley and coupling that have a fully symmetric shape, and arrange screw holes on their end faces at short and equal intervals in the circumferential direction.

[3] Use a fastener such as a shaft lock element to fix those fittings to the motor shaft.

[4] When you attach fittings to the motor shaft, be careful not to apply excessive impact by striking with a hammer, etc. This causes a high incidence of the shaft distortion and bearing damage, resulting in abnormal vibration, sound or shorter bearing life.
1-2-3 Shaft characteristics

There is a limit to the load that can be applied on the motor shaft. Make sure that the load applied on the radial direction, when mounted on the machine, is below the tolerable values given below. These loads may affect the motor output torque, so consider them when designing the machine.

<table>
<thead>
<tr>
<th>Spindle motor</th>
<th>Tolerable radial load</th>
</tr>
</thead>
<tbody>
<tr>
<td>SJ-VL11-10FZT, SJ-DL5.5/150-01Y</td>
<td>245N</td>
</tr>
<tr>
<td>SJ-V5.5-01ZT, SJ-V7.5-01ZT, SJ-V7.5-03ZT, SJ-V11-06ZT</td>
<td>980N</td>
</tr>
<tr>
<td>SJ-VL11-05FZT-S01, SJ-VL11-07ZT, SJ-D5.5/120-02</td>
<td>1470N</td>
</tr>
<tr>
<td>SJ-DJ5.5/100-01, SJ-DJ5.5/120-02, SJ-DL7.5/150-01T</td>
<td>1960N</td>
</tr>
<tr>
<td>SJ-D5.5/100-01, SJ-D5.5/120-01, SJ-DJ7.5/100-01, SJ-V11-08ZT</td>
<td>2940N</td>
</tr>
</tbody>
</table>

(Note) The load point is at the one-half of the shaft length.

⚠️ CAUTION ⚠️ Consider on the machine side so that the thrust loads are not applied to the spindle motor.

1-2-4 Machine accuracy

Machine accuracy of the spindle motor’s output shaft and around the installation part is as below. (Excluding special products)

<table>
<thead>
<tr>
<th>Accuracy</th>
<th>Measurement point</th>
<th>Frame No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Run-out of the flange surface to the output shaft</td>
<td>a</td>
<td>A71, B71, A90, B90, D90, A112, B112</td>
</tr>
<tr>
<td>Run-out of the flange surface’s fitting outer diameter</td>
<td>b</td>
<td>0.03mm</td>
</tr>
<tr>
<td>Run-out of the output shaft end</td>
<td>c</td>
<td>0.02mm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.01mm</td>
</tr>
</tbody>
</table>

(Note) Refer to Specifications Manual for the frame number of each spindle motor.

1-2-5 Coupling with the fittings

1. If the selection or tension of belt is incorrect, an excessive force is applied to the shaft end and bearings, which may result in shorter life or damages. We recommend you to adjust the dynamic balance (field balance) before fastening a belt.

2. When the load by the belt exceeds the tolerable radial load of the motor, reselect the motor or belt/pulley.

3. The position deviation in the axial direction between the motor pulley and spindle side pulley should be as small as possible and perform parallel correcting carefully.
### 1-2-6 Ambient environment

If you continue to use the spindle motor with dirt such as oil mist and dust adhered, its cooling performance degrades and the motor is unable to fully exercise its performance, which may cause the spindle motor overheat alarm. In some cases this may result in damage to the bearing or cooling fan. Use a filter, etc. to protect the motor from oil mist and dust.

### 1-2-7 Installation of spindle motor

Make sure that the spindle motor is installed so that the motor shaft points from downward to 90° as shown below. When installing upward more than 90°, contact your Mitsubishi Electric dealer.

The spindle motor whose motor power line and detection lead wires are connected with connectors, as a standard, should be installed with the connectors facing down. Installation in the standard direction is effective against dripping. Measure to prevent oil and water must be taken when not installing in the standard direction.

**CAUTION**

1. Rubber packing for waterproof is attached on the inner surface of the top cover of terminal block. After checking that the packing is installed, install the top cover.

2. When installing a motor on a flange, chamfer(C1) the part of flange that touches inside low part of the motor.

To yield good cooling performance, provide a space of at least 30mm between the cooling fan and wall. If the motor is covered by a structure and the air is not exchanged, its cooling performance degrades and the motor is unable to fully exercise its performance, which may cause the spindle motor overheat alarm. Do not use the spindle motor in an enclosed space with little ventilation.
1-2-8 Connection

1. When connecting the power line to the terminal block, tighten the screws with proper torque described in this section.

2. Make sure to connect the terminal to the terminal block. If running the motor with the terminal loosened, fires could be caused by motor overheat, and earth fault, short circuit and electric shocks could be caused by disconnection of the terminal.

3. To keep the insulation distance, always cover crimp terminals with insulation tubes when connecting crimp terminals at the end of the power line.

<table>
<thead>
<tr>
<th>Screw size</th>
<th>Proper torque [N•m]</th>
</tr>
</thead>
<tbody>
<tr>
<td>M4</td>
<td>2.0</td>
</tr>
<tr>
<td>M5</td>
<td>2.5</td>
</tr>
<tr>
<td>M6</td>
<td>3.0</td>
</tr>
<tr>
<td>M8</td>
<td>10.0</td>
</tr>
</tbody>
</table>

CAUTION
Connection method to a screwless terminal block for fan motor

(1) Lead-out length
   Strip the sheath of the cable in the range of 8 to 9mm with an appropriate tool.
   Applicable cable size: 0.08mm² to 2.5mm² (28AWG to 12AWG)

(2) Tool
   Use a flat-blade screwdriver whose blade edge size is 0.6×3.5mm for connecting.

(3) Work procedure
   (a) Insert the edge of screwdriver into the insertion point (small square hole) in a diagonal direction. When the spring touches the blade edge, push the screwdriver down to the position that hits a conductive plate, tilting it in the inside direction of terminal block. In this state, the spring is completely opened and the screwdriver is held to the terminal block. Make sure that the screwdriver is completely held, not to create difficulties in inserting the cable for the next procedure.
   (b) Check the stripped length of cable (8 to 9mm) and insert the cable end slowly along the outside of the insertion point (big square hole) as far as it will go, not to unravel wires. Make sure not to push thin cables too much.
   (c) Release the screwdriver while holding one hand against the inserted cable. The spring will be closed and the cable will be connected.
   (d) Gently pull the cable to make sure the connection. No need for a strong pull.

1. Connection of a cable is restricted to one to one spring.

2. For connecting a cable, both twisted wire and solid wire can be used as it is without termination after the sheath has been stripped. The cable attached with bar terminal can also be connected.

1-2-9 Cable stress

[1] Do not apply the bending stress and the stress from the cable's own weight on the cable connection part.
[2] Make sure that the cable sheathes will not be cut by sharp cutting chips, worn or stepped on by workers or vehicles.
1-3 Installation of the drive unit

1. Install the unit on noncombustible material. Direct installation on combustible material or near combustible materials may lead to fires.

2. Follow the instructions in this manual and install the unit while allowing for the unit mass.

3. Do not get on top of the units or motor, or place heavy objects on the unit. Failure to observe this could lead to injuries.

4. Always use the unit within the designated environment conditions.

5. Do not let conductive objects such as screws or metal chips, etc., or combustible materials such as oil enter the units.

6. Do not block the units intake and outtake ports. Doing so could lead to failure.

7. The units and servomotor are precision devices, so do not drop them or apply strong impacts to them.

8. Do not install or run units or servomotor that is damaged or missing parts.

9. When storing for a long time, please contact your dealer.

10. Always observe the installation directions. Failure to observe this could lead to faults.

11. Secure the specified distance between the units and panel, or between the units and other devices. Failure to observe this could lead to faults.

1-3-1 Environmental conditions

<table>
<thead>
<tr>
<th>Environment</th>
<th>Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambient temperature</td>
<td>0°C to +55°C (with no freezing)</td>
</tr>
<tr>
<td>Ambient humidity</td>
<td>90% RH or less (with no dew condensation)</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>-15°C to +70°C (with no freezing)</td>
</tr>
<tr>
<td>Storage humidity</td>
<td>90% RH or less (with no dew condensation)</td>
</tr>
<tr>
<td>Atmosphere</td>
<td>Indoors (no direct sunlight); no corrosive gas, inflammable gas, oil mist, dust or conductive fine particles</td>
</tr>
<tr>
<td>Altitude</td>
<td>Operation/storage: 1000m or less above sea level</td>
</tr>
<tr>
<td></td>
<td>Transportation: 13000m or less above sea level</td>
</tr>
<tr>
<td>Vibration</td>
<td>Operation/storage: 4.9m/s² (0.5G) or less</td>
</tr>
<tr>
<td></td>
<td>Transportation: 49m/s² (5G) or less</td>
</tr>
</tbody>
</table>

(Note) When installing the machine at 1,000m or more above sea level, the heat dissipation characteristics will drop as the altitude increases. The upper limit of the ambient temperature drops 1°C with every 100m increase in altitude. (The ambient temperature at an altitude of 2,000m is between 0 and 45°C.)
1-3-2 Installation direction and clearance

Wire each unit in consideration of the maintainability and the heat dissipation, as well as secure sufficient space for ventilation.

Installation clearance

1. The ambient temperature condition for the drive units is 55°C or less.

CAUTION

2. Because heat can easily accumulate in the upper portion of the units, give sufficient consideration to heat dissipation when designing the panel. If required, install a fan in the panel to agitate the heat in the upper portion of the units.

Refer to the instruction manual of each drive unit for details of the installation directions and the distance of the other units.
1-3-3 Prevention of entering of foreign matter

Treat the cabinet with the following items.

(1) Make sure that the cable inlet is dust and oil proof by using packing, etc.
(2) Make sure that the external air does not enter inside by using head radiating holes, etc.
(3) Close all clearances of the cabinet.
(4) Securely install door packing.
(5) If there is a rear cover, always apply packing.
(6) Oil will tend to accumulate on the top. Take special measures such as oil-proofing to the top so that oil does not enter the cabinet from the screw holds.
(7) After installing each unit, avoid machining in the periphery. If cutting chips, etc., stick onto the electronic parts, trouble may occur.
(8) When using the unit in an area with toxic gases or high levels of dust, protect the unit with air purging (system to blow clean air so that the panel's inner pressure is higher than the outer pressure).
1-3-4 Panel installation hole work drawings (Panel cut drawings)

Prepare a square hole to match the unit width.

[Image of panel installation hole work drawings]

**POINT** Attach packing around the square hole to provide a seal.

1-3-5 Heating value

The values for the servo drive unit apply at 50% of the stall output. The values for the spindle drive unit apply for the continuous rated output. The values for the multiple axes integrated drive unit include the AC reactor’s heating value.

<table>
<thead>
<tr>
<th>Multiple axes integrated drive unit</th>
<th>Heating value [W]</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Type MDS-DM2- Inside</td>
<td>Outside panel</td>
<td>panel</td>
</tr>
<tr>
<td>SPV3-10080 140</td>
<td>590</td>
<td></td>
</tr>
<tr>
<td>SPV3-16080 150</td>
<td>650</td>
<td></td>
</tr>
<tr>
<td>SPV3-20080 175</td>
<td>815</td>
<td></td>
</tr>
<tr>
<td>SPV3-200120 235</td>
<td>1025</td>
<td></td>
</tr>
<tr>
<td>SPHV3-20080 175</td>
<td>815</td>
<td></td>
</tr>
<tr>
<td>SPV2-10080 120</td>
<td>510</td>
<td></td>
</tr>
<tr>
<td>SPV2-16080 130</td>
<td>570</td>
<td></td>
</tr>
<tr>
<td>SPV2-20080 155</td>
<td>740</td>
<td></td>
</tr>
</tbody>
</table>

1. Design the panel’s heating value taking the actual axis operation (load rate) into consideration.

2. The heating values in the above tables are calculated with the following load rates.

**POINT**
1-3-6 Heat radiation countermeasures

(1) Heat radiation countermeasures in the control panel

In order to secure reliability and life, design the temperature in the panel so that the ambient temperature of each unit is 55°C or less.

If the heat accumulates at the top of the unit, etc., install a fan or heat exchanger so that the temperature in the panel remains constant.

Please refer to following method for heat radiation countermeasures.

Examples of mounting heat exchanger and temperature measurement positions (reference)
The following shows a calculation example for considering heat radiation countermeasures.

<Control panel outline dimension (assumption)>
When installing four units which have the heating value in the panel of 15W

Heat radiation area (A): When a bottom section contacts with a machine

A = 0.6 × 0.3 + 0.6 × 0.6 × 2 + 0.6 × 0.3 × 2 = 1.26 (m²)
   (Top face)    (Front/back face)   (Side face)

(Note) Actually, sections contacting other objects are excluded.

Heating value in panel (W): when installing four units which are 15W
W = 15 × 4 = 60 (W)

<Considering necessity of agitating fan>

1 Temperature standard
(1) Standard of temperature in panel (around each unit) T ≤ 55°C
(2) External peripheral temperature Ta = 0 to 45°C
(3) Internal temperature rise value DT = T - Ta (MAX) = 10°C

2 Cooling capacity of control panel (W1)
W1 = U x A x DT    DT = Internal temperature rise value (=10°C)
   U = 6W/m² • °C (with internal agitating fan)
   4W/m² • °C (without internal agitating fan)
   A = Effective heat radiation area (m²)
(1) With internal agitating fan W1 = 6 x 1.26 x 10 = 75.6 (W) > 60 (W)
(2) Without internal agitating fan W1 = 4 x 1.26 x 10 = 50.4 (W) < 60 (W) -- Internal fan is required.

Measure an actual internal temperature, and install a fan or heat exchanger which agitates the heat at the top of the unit if the temperature rise exceeds 10°C.
(2) **Heat radiation countermeasures outside the control panel**

Measure the temperature at 40mm from the tops of all units, and design the temperature rise so that it is 20°C or less against the ambient temperature.

If the temperature rise at the temperature measurement position exceeds 20°C, consider adding a fan.

The temperature of some units may rise locally, because air accumulates at a particular point. Therefore, take a temperature measurement in each unit. If a temperature at any point exceeds 20°C in the temperature measurements, take a heat radiation countermeasure such as adding fans.
1-4 Installation of the machine end detector
1-4-1 Spindle side ABZ pulse output detector (OSE-1024 Series)

To maintain the detector life and performance, a flexible coupling should be used to couple the spindle side detector and C-axis detector with the spindle.

![Diagram of detector and coupling installation accuracy]

**Recommended coupling**

<table>
<thead>
<tr>
<th></th>
<th>Recommendation 1</th>
<th>Recommendation 2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Manufacturer</strong></td>
<td>Tokushu Seiko</td>
<td>Eagle</td>
</tr>
<tr>
<td><strong>Model</strong></td>
<td>Model M1</td>
<td>FCS38A</td>
</tr>
<tr>
<td><strong>Resonance frequency</strong></td>
<td>1374Hz</td>
<td>3515Hz</td>
</tr>
<tr>
<td><strong>Position detection error</strong></td>
<td>$0.8 \times 10^{-3}$°</td>
<td>$1.2 \times 10^{-3}$°</td>
</tr>
<tr>
<td><strong>Tolerable speed</strong></td>
<td>20,000r/min</td>
<td>10,000r/min</td>
</tr>
<tr>
<td><strong>Mis-alignment</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Core deviation</td>
<td>0.7mm</td>
<td>0.16mm</td>
</tr>
<tr>
<td>Angle displacement</td>
<td>1.5°</td>
<td>1.5°</td>
</tr>
<tr>
<td><strong>Outline dimensions</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max. length</td>
<td>74.5mm</td>
<td>33mm</td>
</tr>
<tr>
<td>Max. diameter</td>
<td>$\phi$ 57mm</td>
<td>$\phi$ 38mm</td>
</tr>
</tbody>
</table>

⚠️ **CAUTION** Confirm that the gear ratio (pulley ratio) of the spindle end to the detector is 1:1.

Refer to the coupling catalog, etc., for details on the coupling.
1-4-2 Spindle side PLG serial output detector (TS5690, MU1606 Series)

(1) Part configuration
The detector is configured of a sensor and detection gear. The sensor and detection gear must be used in the designated combination.

These are precision parts, and require care when handling. Do not apply an excessive force on the sensor’s detection surface, as this could result in faults. Do not pull and apply a load on the lead wires. Make sure that foreign matters (iron chips, etc.) do not get on the sensor's detection surface or detection gears. If any foreign matter should get on these parts, carefully remove while taking care not to damage the parts. When handling the detection gears, take care not to damage or deform the teeth.

Spindle side PLG serial output detector TS5690 Series

(2) Installing the detection gears
[1] Install the detection gears so that the first gear's teeth side (Z phase) face the sensor's lead side.

[2] The detection gears and shaft or sleeve should be fixed with shrink fitting. Refer to the following table for the shrink fitting values. The detection gears should be heated evenly between 120 and 150°C using an electric furnace, etc.

Guideline for detection gear shrink fitting values

<table>
<thead>
<tr>
<th>Inner diameter (mm)</th>
<th>Shrink fitting (mm)</th>
<th>Inner diameter (mm)</th>
<th>Shrink fitting (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>φ 40</td>
<td>0.020 to 0.040</td>
<td>φ 140</td>
<td>0.050 to 0.085</td>
</tr>
<tr>
<td>φ 70</td>
<td>0.030 to 0.055</td>
<td>φ 160</td>
<td>0.060 to 0.090</td>
</tr>
<tr>
<td>φ 80</td>
<td>0.030 to 0.055</td>
<td>φ 215</td>
<td>0.080 to 0.110</td>
</tr>
<tr>
<td>φ 125</td>
<td>0.050 to 0.085</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

[3] Keep the run-out of the outer diameter, when the detection gears are installed on the shaft, to 0.02mm or less.

[4] To remove a detection gear fixed with shrink fitting, use the screw holes opened in the axial direction for pulling (two M5 screw holes or two M8 screw holes), or push the end with a jig. Carry out this work carefully. Applying excessive force when pulling out the gears could cause the inner diameter of the detection gears to deform.

[5] Before reusing detection gears which have been removed, always measure the inner diameter dimensions, and carefully check that the inner diameter is not deformed, and that the sufficient tightening amount can be secured. Do not reuse the detection gears if the inner diameter is deformed, or if any abnormality such as damage to the teeth is found.
(3) Installing the sensor section

[1] Prepare the notched fitting section at the machine side’s installation position to be of the specified dimensions in advance.

[2] With the sensor installation seat’s R section butted against the notched fitting section, fix the sensor installation seat with a mounting screw (M5 × 0.8 screws). A locking agent should be applied on the mounting screw before it is tightened.

[3] Fix the sensor with its R section butted against the notched fitting section so that the position relation between the detection gear and sensor is kept constant. This ensures favorable accuracy of the sensor installation.

[4] Keep the deviation of the sensor center and outer diameter center of the detection gear to ±0.25mm or less. If the center deviation cannot be directly measured, set so that the dimension from the sensor installing surface to the outer diameter edge of the detection gears is 22.5±0.25mm. (Some detection gears have thickness at the inner diameter section.)

[5] Make sure that force is not constantly applied on the sensor’s lead wires.

---

**POINT**

To install the sensor section, the notched fitting section on the machine side must have the specified dimensions. The sensor’s installation accuracy is assured by adjusting the outside dimensions of the notched fitting section.

---

**Shape of notched fitting section**

**Installing dimension of the sensor section**

<table>
<thead>
<tr>
<th>Sensor series type</th>
<th>Screw holes’ height from the rotation center (mm)</th>
<th>Notched fitting section’s outer diameter (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TS5690N6400</td>
<td>51.4</td>
<td>φ 72.0 +0.050 -0.010</td>
</tr>
<tr>
<td>TS5690N1200</td>
<td>77.0</td>
<td>φ 122.0 +0.025 -0.025</td>
</tr>
<tr>
<td>TS5690N2500</td>
<td>128.2</td>
<td>φ 223.6 +0.025 -0.025</td>
</tr>
</tbody>
</table>
(4) Installation accuracy diagnosis for spindle side PLG detector

**CAUTION**
Do not operate the spindle before performing this installation accuracy diagnosis.
If operated with an improperly installed spindle side PLG detector, the spindle motor may rotate at high speed. Always perform this diagnosis before normal operation.

[1] Outline
In this section, check if the installation polarity of spindle side PLG detector corresponds to the parameter setting, and the gap between the gear and the sensor is appropriate. In a full-closed loop control where the detector is also installed on the spindle side, it is controlled based on the feedback of the spindle side detector during the speed command operation (S command). Do not command a normal spindle operation before confirming the installation accuracy of the spindle side detector. Spindle side PLG detectors (TS5690 Series) have the specified gap from the gear by installing the sensor section on the machine-notched fitting section. Whether a signal is detected correctly or not can be confirmed using the servo diagnosis screen on NC while rotating the spindle motor in an open loop control.

[2] Confirmation of detector installation polarity
Open the drive monitor/spindle unit on the NC Diagnosis screen, and display "Machine position", "Motor end FB" and "FB error". Confirm that "Machine position" and "Motor end FB" are counted on the same polarity, and that "FB error" is not cumulated while rotating the spindle by hand. When the polarity of "Machine position" and "Motor end FB" is different and "FB error" is cumulated, change the setting of #13017/bit4(SP017/bit4). Set the spindle parameter so that the spindle system is in a full-closed loop control during this confirmation.
- #13019(SP019) Set the detector resolution of spindle side PLG detector correctly
- #13031(SP031) Set to full closed loop control (6200)

[3] Confirmation of detector installation accuracy
Whether the gap between the sensor section and the gear is ensured correctly or not can be confirmed using the servo diagnosis screen, [PLG diagn] on NC while rotating the spindle motor in an open loop control. Confirm it according to the following procedures.

1) Power ON the spindle drive unit and the NC.
2) Set the spindle parameter #13018/bit1 (SP018/bit1) to 1, and set to an open loop control.
3) Turn the NC power OFF and then ON again.
4) Rotate the spindle by inputting 100r/min command. Although this is the same as normal S command operation, neither the spindle side detector feedback nor the motor side detector feed back is used for the motor control on the spindle drive unit since the open loop control is set with the spindle parameter.
5) Switch to the [Servo Diagnosis] menu on the NC maintenance screen and change from [Spindle unit] to [PLG diagn]. When all the diagnosis signal bits are constantly at "0", the installation of PLG detector is normal. When the diagnosis signal bit is "1", the result of diagnosis is abnormal. Perform troubleshooting following "(4) Diagnosis and remedy" by reference to the error details and main cause.
6) Set the spindle parameter #13018/bit1 (SP018/bit1) to 0 again and finish the open loop control.

**CAUTION**
The spindle PLG diagnosis is only performed during the open loop control operation. Diagnosis screen is displayed even during the normal operation, however, the error detection ("1" display) will not be performed.
Installation diagnosis for spindle side PLG detector

Details of each diagnosis signal bit which is displayed as information for spindle PLG diagnosis are shown in the following table.

<table>
<thead>
<tr>
<th>Item</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Encoder Diagn L</td>
<td>Display the motor end PLG diagnosis signal bit 7 to 0.</td>
</tr>
<tr>
<td>Encoder Diagn H</td>
<td>Display the motor end PLG diagnosis signal bit F to 8.</td>
</tr>
<tr>
<td>Sub Encoder Diagn L</td>
<td>Display the machine end PLG diagnosis signal bit 7 to 0.</td>
</tr>
<tr>
<td>Sub Encoder Diagn H</td>
<td>Display the machine end PLG diagnosis signal bit F to 8.</td>
</tr>
</tbody>
</table>

When an error is detected with spindle PLG diagnosis → “1” is displayed on the corresponding diagnosis signal bit

Information for spindle PLG diagnosis (For details of each diagnosis signal bit, refer to the next page.)
When the diagnosis signal bit on [PLG diagn] is "1", check the installation of the PLG detector again.

When the waveform of spindle end PLG installation gap diagnosis is abnormal>
The gap between the sensor section and the gear may deviate from the specified value. Confirm that the sensor section is installed on the notched fitting section properly. Also confirm that the notched fitting section is machined properly based on the specified dimensions for each PLG detector.

When the waveform of spindle end PLG installation all errors diagnosis is abnormal>
The sensor section may deviate from the center of the gear. Confirm the installation of the sensor section and the gear.

1. When finely adjusting the sensor installation position, adjust after turning the power of the drive unit OFF.

2. "00000000" is also displayed in the following cases.
(1) When the spindle parameter #13018/bit1(SP018/bit1) is 0 (open loop disabled)
(2) When the spindle side PLG detector (TS5690 Series) is not connected

Set the machine side detector's installation polarity.
0: Forward polarity  1: Reverse polarity

This allows the operation in which no detector feedback signals are used.
It is used when adjusting the detector, etc.
0: Disable  1: Enable

Set the current command value for when the open loop control is enabled.
When "0" is set, the state will be the same as when "50" is set.
When not using, set to "0".
The open loop control is enabled when "SP018/bit1" is set to "1".

---Setting range---
0 to 999 (Short-time rated %)
1-4-3 Twin-head magnetic detector (MBA405W, MBE405W Series)

(1) Installing a magnetic drum
Install a flange on the shaft side and fix with screw in the axial direction by using the magnetic drum installation hole. Center the core with centering track so that the amplitude to the shaft rotation center is 15 μm or less to install the magnetic drum.

1. To avoid the interference with the sensor head, design the flange outer diameter \( \Phi_C \) so that it is equal to the magnetic drum outer diameter or less.

2. Fix the magnetic drum with screw on the shaft. (Do not fix with shrink fitting.)

3. Center the core with centering track. Do not perform by striking on the magnetizing part as it may result in damages.

4. Adherence of magnetic materials to the magnetizing part could lead to incorrect detections. Perform an air blow when the core alignment is completed.

---

<table>
<thead>
<tr>
<th>Type</th>
<th>Centering track outer diameter [mm]</th>
<th>Magnetic drum installation hole position [mm]</th>
<th>Installation screw</th>
<th>Recommended screw torque [N•m]</th>
</tr>
</thead>
<tbody>
<tr>
<td>MBA405W-BE082</td>
<td>( \Phi 98 )</td>
<td>8-( \Phi 3.4 ) through (evenly spaced around ( \Phi 90 ) circumference)</td>
<td>M3</td>
<td>0.61 to 0.83</td>
</tr>
<tr>
<td>MBE405W-BE082</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MBA405W-BF125</td>
<td>( \Phi 148.3 )</td>
<td>8-( \Phi 4.5 ) through (evenly spaced around ( \Phi 134 ) circumference)</td>
<td>M4</td>
<td>1.39 to 1.89</td>
</tr>
<tr>
<td>MBE405W-BF125</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MBA405W-BG160</td>
<td>( \Phi 198.6 )</td>
<td>8-( \Phi 4.5 ) through (evenly spaced around ( \Phi 170 ) circumference)</td>
<td>M5</td>
<td>2.75 to 3.63</td>
</tr>
<tr>
<td>MBE405W-BG160</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
(2) **Installing a installation ring**

Create a spigot-joint on machine side and fit the installation ring on the inner diameter of the spigot-joint to install the installation ring. Ensure the accuracy for the dimension of machine side spigot-joint as shown below so as not to degrade the detection accuracy.

Confirm the gap between the magnetic drum and the sensor head is secured by 0.29mm or more with clearance gauge etc. after the installation.

---

1. Do not contact to the magnetic drum when installing the installation ring as it may result in damages of magnetic drum or sensor head.

2. The sensor head is joined after adjusting the positional relationship with the installation ring beforehand, so do not remove the sensor head fixing screw.

3. Create a spigot-joint as close to the machine side and fit the installation ring on the spigot-joint to install. Do not center the core by striking on the installation ring outer diameter, etc.

4. Adherence of foreign materials to the element part of the sensor head (metallic thin film part) could lead to incorrect detections. Remove with an air blow when foreign materials are adhered so as not to damage them.
(3) For Z-phase signal detection
After turning the detector power ON, Z-phase signal is required to be detected by the main head (Z-phase signal position mark is required to pass the main head). For the device configuration which the magnetic drum cannot drive more than one rotation, install the detector so that Z-phase can pass the main head in the shaft stroke.

(4) For the rotation direction of the detector
Seeing a detector from the upper surface as shown below, when the magnetic drum rotates clockwise is the forward run. Confirm the rotation direction of the detector and motor by reference to each motor specifications.

(5) For MBA405W (absolute detector)
The initial setup operation is required after the operation is enabled for NC system to connect MBA405W to the servo drive unit. Refer to "4-2-2 Setting of machine side detector" for details.
The initial setup is required only for the first time after installing the detector to the machine.
1-5 Noise measures

Noise includes "propagation noise" generated from the relay, etc., and propagated along a cable causing the drive unit to malfunction, and "radiated noise" propagated through air from a peripheral device, etc., and causing the power supply unit or drive unit to malfunction.

Always implement these noise measures to prevent the peripheral devices and unit from malfunctioning. The measures differ according to the noise propagation path, so refer to the following explanation and take appropriate measures.

(1) General noise measures
   (a) Avoid laying the drive unit’s power line and signal wire in a parallel or bundled state. Always separate these wires. Use a twisted pair shielded wire for the detector cable and signal wires such as the communication cable connected with the NC unit, and accurately ground the devices.
   (b) Use one-point grounding for the drive unit and motor.
   (c) Accurately ground the AC reactor.

(2) Propagation noise measures
   Take the following measures when noise generating devices are installed and the drive unit could malfunction.
   (a) Install a surge killer on devices (magnetic contacts, relays, etc.) which generate high levels of noise.
   (b) Install a power line filter in the stage before the drive unit.
   (c) Install a ferrite core on the signal wire.
   (d) Ground the shield of the servo detector’s cable with a cable clamp.
   (e) Wire the spindle PLG detector cable away from other wires.

(3) Measures against radiated noise
   The types of propagation paths of the noise and the noise measures for each propagation path are shown below.
When devices such as instrument, receiver or sensor, which handle minute signals and are easily affected by noise, or the signal wire of these devices, are stored in the same panel as the drive units and the wiring is close, the device could malfunction due to airborne propagation of the noise. In this case, take the following measures.

(a) Install devices easily affected as far away from the drive units as possible.
(b) Lay devices easily affected as far away from the signal wire of the drive unit as possible.
(c) Avoid laying the signal wire and power line in a parallel or bundled state.
(d) Insert a line noise filter on the input/output wire or a radio filter on the input to suppress the noise radiated from the wires.
(e) Use a shield wire for the signal wire and power line, or place in separate metal ducts.

If the signal wire is laid in parallel to the power line, or if it is bundled with the power line, the noise could be propagated to the signal wire and cause malfunction because of the magnetic induction noise or static induction noise. In this case, take the following measures.

(a) Install devices easily affected as far away from the drive unit as possible.
(b) Lay devices easily affected as far away from the signal wire of the drive unit as possible.
(c) Avoid laying the signal wire and power line in a parallel or bundled state.
(d) Use a shield wire for the signal wire and power line, or place in separate metal ducts.

If the power supply for the peripheral devices is connected to the drive unit in the same system as the drive units, the noise generated from the power supply unit could back flow over the power line and cause the devices to malfunction. In this case, take the following measures.

(a) Install a radio filter on the drive unit's power line.
(b) Install a power filter on the drive unit's power line.

If a closed loop is created by the peripheral device and drive unit's grounding wire, a leakage current could flow and cause the device to malfunction. In this case, change the device grounding methods and the grounding place.
Wiring and Connection
1. Wiring work must be done by a qualified technician.

2. Wait at least 15 minutes after turning the power OFF and check the voltage with a tester, etc., before starting wiring. Failure to observe this could lead to electric shocks.

3. Securely ground the drive units and servo/spindle motor.

**WARNING**

4. Wire the drive units and servo/spindle motor after installation. Failure to observe this could lead to electric shocks.

5. Do not damage, apply forcible stress, place heavy items on the cables or get them caught. Failure to observe this could lead to electric shocks.

6. Always insulate the power terminal connection section. Failure to observe this could lead to electric shocks.

1. Correctly and securely perform the wiring. Failure to do so could result in runaway of the servo/spindle motor or injury.

2. Do not mistake the terminal connections.

3. Do not mistake the polarity (+, -). Failure to observe this item could lead to ruptures or damage, etc.

4. Do not mistake the direction of the diodes for the surge absorption installed on the DC relay for the motor brake and contactor (magnetic contactor) control. The signal might not be output when a failure occurs.

**CAUTION**

5. Electronic devices used near the drive units may receive magnetic obstruction. Reduce the effect of magnetic obstacles by installing a noise filter, etc.

6. Do not install a phase advancing capacitor, surge absorber or radio noise filter on the power line (U, V, W) of the servo/spindle motor.

7. Do not modify this unit.

8. If the connectors are connected incorrectly, faults could occur. Make sure that the connecting position and the connection are correct.

9. When grounding the motor, connect to the protective grounding terminal on the drive units, and ground from the other protective grounding terminal. (Use one-point grounding)
   Do not separately ground the connected motor and drive unit as noise could be generated.
2-1 Part system connection diagram

(Note 1) The total length of the optical communication cable from the NC must be within 30m and the minimum-bending radius within 80mm.

(Note 2) The connection method will differ according to the used motor.

(Note 3) Battery for the detector back up is built-in the drive unit. (An external battery is available as an option.)

(Note 4) The main circuit (◎), control circuit (○) and ground (●) are safely separated.

(Note 5) Connect the ground of the motor to the ground of the connected drive unit.
## 2-2 Main circuit terminal block/control circuit connector

### 2-2-1 Names and applications of main circuit terminal block signals and control circuit connectors

The following table shows the details for each terminal block signal.

<table>
<thead>
<tr>
<th>Name</th>
<th>Signal name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>L1 . L2 . L3</td>
<td>Main circuit power supply</td>
<td>Main circuit power supply input terminal&lt;br&gt;Connect a 3-phase 200 VAC (50 Hz) or 200 to 230 VAC (60 Hz) power supply.</td>
</tr>
<tr>
<td>L11 L21</td>
<td>Control circuit power supply</td>
<td>Control circuit power supply input terminal&lt;br&gt;Connect a single-phase 200 VAC (50 Hz) or 200 to 230 VAC (60 Hz) power supply</td>
</tr>
<tr>
<td>U . V . W</td>
<td>Motor output</td>
<td>Servo/spindle motor power output terminal&lt;br&gt;The servo/spindle motor power terminal (U, V, W) is connected.</td>
</tr>
<tr>
<td>LU . LV . LW</td>
<td>Motor output</td>
<td>Servo motor power output terminal (L-axis/M-axis/S-axis)&lt;br&gt;The servo/spindle motor power terminal (U, V, W) is connected.</td>
</tr>
<tr>
<td>MU . MV . MW</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SU . SV . SW</td>
<td></td>
<td></td>
</tr>
<tr>
<td>+</td>
<td>Protective grounding</td>
<td>Grounding terminal&lt;br&gt;The servomotor/spindle motor grounding terminal is connected and grounded.</td>
</tr>
<tr>
<td></td>
<td>(PE)</td>
<td></td>
</tr>
</tbody>
</table>

**CAUTION**

1. When sharing a circuit protector for several drive units, of a short-circuit fault occurs in a small capacity unit, the circuit protector could trip. This can be hazardous, so do not share the circuit protector.

2. Be sure to use the circuit protector of proper capacity for each drive unit.
2-2-2 Connector pin assignment

**CAUTION**

Do not apply a voltage other than that specified in Instruction Manual on each terminal. Failure to observe this item could lead to rupture or damage, etc.

(1) Main circuit terminal block and connector

<table>
<thead>
<tr>
<th>Terminal position</th>
<th>MDS-DM2-SPV3-10080 to 20080</th>
<th>MDS-DM2-SPHV3-20080</th>
<th>MDS-DM2-SPV2-10080 to 20080</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Terminal</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>[1] TE1</td>
<td>MDS-DM2-SPV3-10080 to 20080</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Terminal specification/Pin assignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>[2] CN31L</td>
</tr>
<tr>
<td>[3] CN31M</td>
</tr>
<tr>
<td>[4] CN31S</td>
</tr>
</tbody>
</table>

| [5] | L1 L2 L3 U V W P+ N- |

<table>
<thead>
<tr>
<th>Compatible unit</th>
<th>All of SPV Series</th>
</tr>
</thead>
<tbody>
<tr>
<td>Screw size</td>
<td>M5 x 12</td>
</tr>
<tr>
<td>Tightening torque</td>
<td>2.0Nm</td>
</tr>
</tbody>
</table>

| [1] | L1 L2 L3 U V W P+ N- |


<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>V</td>
<td>U</td>
</tr>
<tr>
<td>PE</td>
<td>W</td>
</tr>
</tbody>
</table>

Screw size: M5 x 8
Tightening torque: 2.0Nm

(Note) The illustrations of drive units are shown as an example. The connector and terminal block layout may differ according to the unit being used. Refer to each unit outline drawing for details.
### (2) Control circuit connector

<table>
<thead>
<tr>
<th>Terminal position</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>MDS-DM2-SPV3-10080 to 20080</td>
<td></td>
</tr>
<tr>
<td>MDS-DM2-SPHV3-20080</td>
<td></td>
</tr>
<tr>
<td>MDS-DM2-SPV2-10080 to 20080</td>
<td></td>
</tr>
</tbody>
</table>

#### Terminal position

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Connector specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>[1] VDD</td>
<td></td>
</tr>
<tr>
<td>[2] SG</td>
<td></td>
</tr>
<tr>
<td>[3] CN9A</td>
<td></td>
</tr>
<tr>
<td>[5] OPT1A</td>
<td></td>
</tr>
<tr>
<td>[6] CN2SP</td>
<td></td>
</tr>
<tr>
<td>[7] CN3SP</td>
<td></td>
</tr>
<tr>
<td>[8] CN2L</td>
<td></td>
</tr>
<tr>
<td>[9] CN2M</td>
<td></td>
</tr>
<tr>
<td>[10] CN2S</td>
<td></td>
</tr>
<tr>
<td>[12] CN3M</td>
<td></td>
</tr>
<tr>
<td>[13] CN3S</td>
<td></td>
</tr>
<tr>
<td>[14] CN5A</td>
<td></td>
</tr>
<tr>
<td>[15] CN5B</td>
<td></td>
</tr>
</tbody>
</table>

**Note:** The illustrations of drive units are shown as an example. The connector and terminal block layout may differ according to the unit being used. Refer to each unit outline drawing for details.
2-3 NC and drive unit connection

Connect the optical communication cables from the NC to the each drive unit so that they run in a straight line from the NC to the drive unit that is a final axis. And up to 16 axes can be connected per system.

Note that the number of connected axes is limited by the NC.

1. Connect the NC and the drive units by the optical communication cables. The distance between the NC and the final drive unit must be within 30m and the bending radius within 80mm.

**CAUTION**

2. A spindle drive unit that controls the high-speed synchronous tapping (OMR-DD control) has to be connected on the farther side from the NC than the optical servo drive to be combined.

Thus, if you use an MDS-DM2 unit for servo control of the high-speed synchronous tapping, combinable spindle drive is that of the MDS-DM2 unit only.

(1) When using only MDS-DM2-SPV Series

(2) When using the MDS-D2 unit together

For MDS-DM2-SPV Series, axis Nos. are fixed as follows.

1st axis : spindle
2nd axis : servo L axis
3rd axis : servo M axis
4th axis : servo axis (only MDS-DM2-SPV3)
2-4 Connecting with optical communication repeater unit

**CAUTION** Optical communication repeater unit cannot be used to connect between two servo drive units.

1) **Connection example**
   Connect the control unit to OPT1IN and the drive unit to OPT1OUT.

   - **Electric cabinet**
   - **Relay box**
   - **Operation panel**

   Drive Units MDS-D2/DH2/DM2

   | 24VDC stabilized power supply |
   | ACIN |
   | F070 |
   | DCOUT |
   | FG |
   | Optical communication repeater unit |
   | DCIN |
   | CF01 |
   | DCOUT |
   | OPT1OUT |
   | OPT1IN |
   | FCU7-EX022 |
   | G380 |
   | OPT2OUT |
   | OPT2IN |
   | G380 |

   L1: Distance between the drive unit and the control unit.
   L2: Distance between the drive unit and the optical communication repeater unit. (The wire length of G380 cable)
   L3: Distance between the optical communication repeater unit and the control unit. (The wire length of G380 cable)

   **<Related items>**
   - Cable drawing "Cable: F070 Cable", "Cable: G380 Cable"
   - Connector pin assignment: "General Specifications: Optical Communication Repeater Unit" (DCIN connector, OPT1IN connector, OPT1OUT connector)
(2) **Power Supply Sequence**

The diagram below shows the timing of power ON/OFF of the drive unit 200VAC (400VAC), the optical communication repeater unit, and the control unit.

**[Power ON]**

Turn the power ON in the following order; drive unit -> optical communication repeater unit -> control unit.

If the control unit is powered ON before the optical communication repeater unit, the initial communication with the drive unit may fail and cause an alarm.

**[Power OFF]**

Turn the power OFF in the following order; control unit -> optical communication repeater unit -> drive unit.

Set aside more than 8ms the time difference between the power OFF of the control unit and the power OFF of the optical communication repeater unit.

If the optical communication repeater unit is powered OFF before the drive unit, or the time lag is less than 8ms, data acquisition from the drive unit may fail and cause an alarm.

![Diagram showing power supply sequence](image)

t1: Time lag between the power-ON of the drive unit and the optical communication repeater unit

t2: Time lag between the power-ON of the optical communication repeater unit and the control unit

t3: Time lag between the power-OFF of the optical communication repeater unit and the control unit
2-5 Motor and detector connection

2-5-1 Connection of the servomotor

(1) Connecting the HF54(B) / HF104(B) / HF154 / HF224 / HF223

- Detector connector: CN2L
- Motor magnetic brake wiring
- Power wire and grounding wire
- Brake connector

Optional cable: CNV2E (Refer to Appendix 1 for details on the cable treatment.)

Max. 30m
(2) Connecting the HF204(B) / HF354(B) / HF303 / HF453 / HF302

Motor and detector connection

Detector connector
CMV1-R10P

Motor magnetic brake wiring
(Refer to section "Wiring of the motor magnetic brake" for details.)

Brake connector
CMV1-R2P

These are 24VDC, and have no polarity.

Optional cable: CNV2E
(Refer to Appendix 1 for details on the cable treatment.)

Power wire and grounding wire
(Refer to Specification manual for details on selecting the wire.)

Power connector
CE05-2A22-22PD

Detector connector: CN2L

MDS-DM2-SPV Series
2-5-2 Connection of the full-closed loop system

Refer to the section "Connection of the servomotor" for details on connecting each motor type and wiring the power line or the motor magnetic brake.

(1) Connecting the ball screw side detector
Connect the ball screw side detector cable to CN3L(CN3M for M axis of dual-axis unit). Option battery is required for the absolute position system.

(2) Connecting the linear scale (For Mitsubishi serial signal output)
Mitsubishi serial signal output (including when SIN wave signal output is converted to Mitsubishi serial signal output with a scale manufacturer detector interface unit) can directly input to the drive unit.

(Note) The conversion unit of the scale manufacturer is included.
(3) Connecting the linear scale (for rectangular wave signal output)
Rectangular wave signal output (including when SIN wave signal output is converted to the rectangular wave signal output with a scale manufacturer detector interface unit) can directly input to the drive unit.

(4) Connecting the linear scale (for SIN wave signal output)
SIN wave signal output is converted to Mitsubishi serial signal output with the detector interface unit (MDS-B-HR). The distance-coded reference scale interface is also available.

![Diagram of Motor and Detector Connection](image-url)
2-5-3 Connection of the spindle motor

Refer to each motor specifications for details on the motor side connection destination, specifications and outline, and for the spindle PLG detector specifications.

(1) Connecting the motor built-in PLG

For a 3-phase cooling fan, when the phase sequence of the 3-phase power supply is connected reversely, its cooling capacity degrades due to the reversed rotation direction. Make sure the air blowoff direction. When the fan rotates reversely, reconnect BU and BW reversely, and then check the blowoff direction.
(2) Connecting the spindle side ABZ pulse output detector (OSE-1024-3-15-68, OSE-1024-3-15-68-8)

(Note) Confirm that the gear ratio (pulley ratio) of the spindle end to the detector is 1:1. Use a timing belt for connecting.

(3) Connecting the spindle side PLG serial output detector (TS5690 Series)
2-6 Connection of power supply

1. Make sure that the power supply voltage is within the specified range of each unit. Failure to observe this could lead to damage or faults.

2. For safety purposes, always install a circuit protector, and make sure that the circuit is cut off when an error occurs or during inspections.

3. The wire size will differ according to each drive unit capacity.

4. For safety purposes, always install a magnetic contactor (contactor) on the main circuit power supply input. Large rush currents will flow when the power is turned ON.

2-6-1 Power supply input connection

(1) When using only MDS-DM2-SPV Series

![Diagram of MDS-DM2-SPV Series power supply input connection]
2-6-2 Connecting the grounding cable

(1) Connecting the protective grounding (PE) and frame ground (FG)
Each unit has a terminal or mounting hole to connect PE (grounds) or FG.
Please connect an earth wire to the main ground of a cabinet or a machine frame at one point.
Ground each device according to the grounding conditions set forth by each country. (Typically, a Y-connection neutral point ground is used in Europe.)
- PE: Grounding to provide protection from electric shock, etc.
- FG: Grounding to stabilize the operation of the devices, etc. (Suppress noise)

Do not connect the grounding cable from each unit directly to the grounding plate. Noise from other units could result in malfunctions.

(2) Grounding cable size
Earth wire size should follow the following table.

<table>
<thead>
<tr>
<th>Type</th>
<th>Grounding cable size (Required grounding)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MDS-DM2-SPV Series Unit</td>
<td>Larger than thickness of wire connected to TET (L1/L2/L3) (PE)</td>
</tr>
<tr>
<td>D-AL (AC Reactor)</td>
<td>5.5 mm² (AWG10) or more (FG)</td>
</tr>
</tbody>
</table>
2-7 Wiring of the motor brake

2-7-1 Wiring of the motor magnetic brake

The magnetic brake of servomotors with a magnetic brake is controlled by the motor brake control connector (CN9B-8 pin) on the servo drive unit. The servo drive unit releases the brake when the motor is ON. (Servo ON means when torque is generated in the motor.)

(1) Motor brake control connector (CN9B) output circuit

As shown in the illustration below, an external power supply circuit is controlled by the DO output (8-10 pin) of CN9B through the relay. Install the diode in case of the inductive load.

![Diagram of motor brake control connector (CN9B) output circuit]

- Use a compact relay operated with rating of 24VDC, 50mA or less.
  <Example> OMROM: G6B type, MY type

<table>
<thead>
<tr>
<th>Output voltage</th>
<th>Output condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>24VDC</td>
<td>±5%</td>
</tr>
<tr>
<td>Tolerable output current</td>
<td>50mA or less</td>
</tr>
</tbody>
</table>

Use a compact relay operated with rating of 24VDC, 50mA or less.

- Always install a surge absorber near the motor's brake terminal to eliminate noise and protect the contacts.
- Do not drive the motor brake directly with CN9B output as the drive unit is damaged.
- When using brakes in multiple servo axes in a drive unit, apply parallel circuit for the output circuit of CN9B.
- For the 24V power supply used in the motor brake circuit, use the one separated from the 24 power supply for the control circuit.

**CAUTION**

To ensure safety in an emergency, make sure that the magnetic brakes are applied in sequence with the emergency stop switch.
(2) Motor brake release sequence

The motor brake control connector (CN9B-8 pin) releases the magnetic brake in the sequences in the following drawing when canceling the emergency stop. The brake is released after the start of the power ON to the servomotor.

If the power of the power supply unit has been charged by the servo parameter setting, the time to the Ready completion can be reduced.

**[#2217(PR)]** SV017 SPEC1 Servo specification 1

bit 2 : seqh Ready on sequence

0: Normal 1: High-speed

**[#13017(PR)]** SP017 SPEC1 Spindle specification 1

bit 2 : seqh READY ON sequence

0: Normal 1: High-speed

[1] When SV017 is set to bit2 = 0:

[2] When SV017 is set to bit2 = 1:

**Using the Quick READY ON sequence, set the parameter for all the axes including the spindle. Especially when it is not set for the power supply control axis, power supply will not work at high-speed sequence.**

**CAUTION**

When SV017/bit2=1, SP017/bit2=1 is set, for the model using an external dynamic brake, the Ready completion will be delayed by 10ms to ensure the external contactor operation time.
(3) Control during the servo OFF command

When a servo OFF command is input by an NC sequence input, the motor brake turns ON simultaneously when the motor ON is shut off. Note that the vertical axis drop prevention control is not validated, so a drop due to the brake operation lag occurs. When the servo OFF is canceled, a drop due to an uncontrolled state does not occur.

< Caution in use of MDS-DM2 Series >

It is required to input a servo OFF command to all axes in order to turn the brake ON with a motor brake control output of drive unit. Input the servo OFF command to an axis cannot turn the brake ON. Therefore, when performing a control to fix the position with the motor brake by the servo OFF command during the motor stop for PLC axis, use 1-axis drive unit.

During emergency stop, the servo OFF is applied to all axes at same time, so a brake control is not affected.

(4) Operation sequences when an emergency stop occurs

The motor brake control output operation when an emergency stop occurs differs according to the motor deceleration stop method. Refer to section “Settings for emergency stop” for details on the operation sequences for each stop method.
2-8 Peripheral control wiring

2-8-1 Input/output circuit wiring

CN9A/CN9B connector is equipped with 24V input/output circuit for the control of external devices and the control by an external signal.

Set the relevant parameters and use them with care for the wiring since some signals are changeover type, which can be switched over by parameters. Refer to the description of each function in relevant sections for details on the function specifications and settings.

<table>
<thead>
<tr>
<th>Input condition</th>
<th>Output condition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Switch ON</strong></td>
<td></td>
</tr>
<tr>
<td>18VDC to 25.2VDC</td>
<td><strong>Output voltage</strong></td>
</tr>
<tr>
<td>4.3mA or more</td>
<td>24VDC ± 5%</td>
</tr>
<tr>
<td></td>
<td><strong>Tolerable output current to</strong></td>
</tr>
<tr>
<td></td>
<td>50mA or less</td>
</tr>
<tr>
<td><strong>Switch OFF</strong></td>
<td></td>
</tr>
<tr>
<td>4VDC or less</td>
<td></td>
</tr>
<tr>
<td>2mA or less</td>
<td></td>
</tr>
</tbody>
</table>

For a switch or relay to be wired, use a switch or relay that satisfies the input/output (voltage, current) conditions.

<table>
<thead>
<tr>
<th>Interface name</th>
<th>Selection example</th>
</tr>
</thead>
</table>
| **For digital input signal**
  (CN9A/CN9B)   | Use a minute signal switch which is stably contacted and operated even with low voltage or current. |
|               | <Example> OMRON: G2A, G6B type, MY type, LY type |
| **For digital output signal**
  (CN9A/CN9B)   | Use a compact relay operated with rating of 24VDC, 50mA or less. |
|               | <Example> OMRON: G6B type, MY type |

(Note) Do not connect "(1)" or "(2)".

If a ground of the external 24V power is same as the 24V power in the drive unit, a fault or abnormal operation could occur.
## Wiring and Connection

### MITSUBISHI CNC

#### Servo input/output signal (CN9A,CN9B connector)

<table>
<thead>
<tr>
<th>Device name</th>
<th>Connector pin No.</th>
<th>Signal name</th>
<th>Signal changeover parameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Servo input</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MPI1</td>
<td>CN9B-13</td>
<td>SLS(Safely Limited Speed) function</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>door state signal</td>
<td></td>
</tr>
<tr>
<td>MPI2</td>
<td>CN9A-2</td>
<td>(Reservation)</td>
<td></td>
</tr>
<tr>
<td>MPI3</td>
<td>CN9A-3</td>
<td>(Reservation)</td>
<td></td>
</tr>
<tr>
<td>Servo output</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MPO1</td>
<td>CN9B-8</td>
<td>Motor brake control signal</td>
<td></td>
</tr>
<tr>
<td>MPO2</td>
<td>CN9A-8</td>
<td>Servo specified speed signal</td>
<td></td>
</tr>
<tr>
<td>MPO3</td>
<td>CN9A-18</td>
<td>(Reservation)</td>
<td></td>
</tr>
</tbody>
</table>

#### Spindle input/output signal (CN9A,CN9B connector)

<table>
<thead>
<tr>
<th>Device name</th>
<th>Connector pin No.</th>
<th>Signal name</th>
<th>Signal changeover parameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spindle input</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MPI1</td>
<td>CN9B-2</td>
<td>SLS(Safely Limited Speed) function</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>door state signal</td>
<td></td>
</tr>
<tr>
<td>MPI2</td>
<td>CN9A-13</td>
<td>(Reservation)</td>
<td></td>
</tr>
<tr>
<td>MPI3</td>
<td>CN9B-3</td>
<td>External emergency stop signal</td>
<td></td>
</tr>
<tr>
<td>Spindle output</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MPO1</td>
<td>CN9B-18</td>
<td>Coil changeover signal</td>
<td></td>
</tr>
<tr>
<td>MPO2</td>
<td>CN9B-16</td>
<td>Spindle specified speed signal</td>
<td></td>
</tr>
<tr>
<td>MPO3</td>
<td>CN9A-16</td>
<td>Contactor control signal</td>
<td></td>
</tr>
</tbody>
</table>

#### Input/output signal (CN9A,CN9B connector)

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>CN9A</th>
<th>CN9B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>-</td>
<td>Proximity switch, Safety (SP)</td>
</tr>
<tr>
<td>3</td>
<td>-</td>
<td>EXEMG</td>
</tr>
<tr>
<td>13</td>
<td>(Retract)</td>
<td>MPI1(Door), Safety(SV), BT-BOX</td>
</tr>
<tr>
<td>20</td>
<td>DICOM</td>
<td>DICOM</td>
</tr>
<tr>
<td>Output</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>SV specified speed</td>
<td>MBR</td>
</tr>
<tr>
<td>10</td>
<td>24G</td>
<td>24G</td>
</tr>
<tr>
<td>16</td>
<td>MC</td>
<td>SP specified speed</td>
</tr>
<tr>
<td>18</td>
<td>-</td>
<td>Coil changeover</td>
</tr>
</tbody>
</table>
2-8-2 Specified speed output

Specified speed output function turns the output signal ON when the machine-end speed is below the speed specified with the parameter. This function enables the safety door, etc., to be locked to secure the machine operator when the machine-end speed has exceeded the specified speed. This function can also be used for judging whether the current machine-end speed reaches the specified speed.

The specified speed output signal is output to the digital signal output 2 (MPO2). Refer to the next page for details, because the configuration of the parameters differs from the servo to spindle. For the 3-axis drive unit, it is required to set the parameter to all axes. The signal output turns ON when all axes satisfy the conditions (theoretical product output).

As for 3-axis drive unit, the output signal turns OFF when one of the axes exceed the specified speed, and it turns ON when all axes are within the specified speed.

For 3-axis drive unit

Specified speed signal output sequence
< Servo drive unit >

### [#2233] SV033 SSF2  Servo function 2

**bit D : rps Safely limited speed setting increment**

Change the setting units of the specified speed signal output speed (SV073) and safely limited speed (SV238).

0: mm/min  1: 100mm/min

### [#2273(PR)] SV073 FEEDout Specified speed output speed

Set the specified speed.

Also set SV082/bit9,8 to output digital signal.

---Setting range---

0 to 32767 (r/min)

However, when SV033/bitD=1, the setting range is from 0 to 32767(100mm/min).

### [#2282] SV082 SSF5  Servo function 5

**bit 9-8 : dos2 Digital signal output 2 selection**

00: Disable  01: Specified speed output

< Spindle drive unit >

### [#13018(PR)] SP018 SPEC2  Spindle specification 2

**bit 8 : spsu Command speed limit value**

0: 33,750 r/min  1: 135,000 r/min

### [#13030] SP030 SDT2  2nd speed detection setting value

Set the specified speed of the specified speed output.

When carrying out digital output of the specified speed output, set SP229/bitC to "1".

---Setting range---

0 to 32767 (r/min)

### [#13229] SP229 SFNC9  Spindle function 9

**bit C : sdt2 Specified speed output digital signal 2 output**

0: Normal  1: Enable
2-8-3 Spindle coil changeover

There are spindle motors capable of coil changeover control, which enables favorable characteristics to be attained from low speeds to high speeds by changing two types of coils.

(1) Coil changeover control

The speed at which to change the coils is detected by the spindle drive according to the value set with spindle parameter SP028. This is conveyed to the NC with a speed detection (SD) signal. The NC judges the other conditions (coil fixed, etc.), and issue a coil changeover command to the spindle drive with the L coil selection command (LCS).

To prevent the contactor from varying, the hysteresis set with SP029 is applied on the speed when changing from the low-speed coil to the high-speed coil and the high-speed coil to the low-speed coil.

![Spindle motor coil changeover control diagram](image)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Setting Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>SP028</td>
<td>SDTS Speed detection set value</td>
<td>10 to 32767 (r/min)</td>
</tr>
<tr>
<td>SP029</td>
<td>SDTR Speed detection reset width</td>
<td>10 to 1000 (r/min)</td>
</tr>
</tbody>
</table>
(2) Protective functions

[1] **Gate shutoff after a winding changeover**
When the L-coil selection command (LCS) is used to perform low-speed winding -> high-speed winding switching, or vice-versa, the gate is shut off during contactor operation time in order to protect the spindle drive unit's main circuit. The gate shutoff time is determined by the "Coil changeover gate cutoff timer" (SP114) setting. The standard time setting should be used, as a shorter time can cause contactor burn damage. (Refer to "Spindle control output 5" Coil changing (bit 6) for details.)

**[#13114] SP114 MKT Coil changeover gate cutoff timer**
Set the time required to cut off the gate when turning OFF/ON the coil switch contactor.
The value should be longer than the coil switch contactor's OFF/ON time.
The standard setting is "150".

---Setting range---
0 to 3500 (ms)

[2] **Current limit after coil changeover**
Following a coil changeover, the current is limited (SP116) for the period specified by the current limit timer (SP115) in order to stabilize control. Because position loop control (synchronous tap, C-axis control, etc.) that occurs immediately after a coil changeover will result in unstable control, be sure that position commands specified by the sequence is input after the current limit is cancelled.

**[#13115] SP115 MKT2 Coil changeover current limit timer**
Set the time required to limit the current immediately after the coil switch contactor ON/OFF is completed and the gate is turned ON.
The standard setting is "250".

---Setting range---
0 to 3500 (ms)

**[#13116] SP116 MKIL Coil changeover current limit value**
Set the time required to limit the current immediately after the coil switch contactor ON/OFF is completed and the gate is turned ON.
The standard setting is "120".

---Setting range---
0 to 999 (Short-time rated %)
(3) Wiring

The illustration below shows the 2 types of changeover that occur after a coil changeover, (a) \( \text{star} - \Delta \) (delta) changeover, and (b) \( \text{star} - \text{star} \) changeover. As shown in (c), one of the contactors (MC1 or MC2) is turned ON and the other is turned OFF at all of the coil changeover control circuits.

(a) \( \text{star} - \Delta \) (delta) changeover circuit

![Diagram of the \( \text{star} - \Delta \) (delta) changeover circuit]

- MC1: Contactor to connect low-speed coil (\( \text{star} \)-connection)
- MC2: Contactor to connect high-speed coil (\( \Delta \)-connection)

**Coil changeover circuit**

(Wiring of motor coil)

- Spindle drive unit
- MC1: Contactor to connect low-speed coil (\( \text{star} \)-connection)
- MC2: Contactor to connect high-speed coil (\( \Delta \)-connection)

<Wire the terminals according to the signs (U, V, W, X, Y, Z) of the spindle motor for the coil changeover.>

**POINT**

Wire it according to each 6 terminal’s sign (U, V, W, X, Y, Z) of spindle motor for the coil changeover.
(b) \( \star \text{-} \star \) changeover circuit

Coil changeover circuit

Wire it according to each 6 terminal's sign (U1, V1, W1, U2, V2, W2) of spindle motor for the coil changeover.

(c) Coil changeover control circuit (common)

Coil changeover relay control circuit
2-8-4 Proximity switch orientation

(1) Electrical specifications
Use a proximity switch which satisfies the following specifications.

<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output method</td>
<td>DC double wire system / three wire system</td>
</tr>
<tr>
<td>Power supply voltage</td>
<td>24V DC</td>
</tr>
<tr>
<td>Response frequency</td>
<td>400Hz or more</td>
</tr>
<tr>
<td>Load current</td>
<td>14mA or more</td>
</tr>
<tr>
<td>Residual voltage</td>
<td>4V or less</td>
</tr>
<tr>
<td>Leakage current</td>
<td>1mA or less</td>
</tr>
</tbody>
</table>

(2) Connection with drive unit

(a) When DICOM is connected to 24V

< Connection details: For proximity switch of two wire system >

(b) When DICOM is connected to 24G

< Connection details: For proximity switch of three wire system >

1. Supply the 24VDC power externally.

⚠️ CAUTION 2. Install a proximity switch at the spot that rotates in the ratio of 1:1 to the spindle.

3. Set the spindle parameter to the pulley ratio for belt drive or to the gear ratio for gear drive.
### Detection signal polarity

The table below is the polarities of the detections signals. According to the polarity, select the enable edge of the signals with the spindle parameter (SP225/bit5).

<table>
<thead>
<tr>
<th>Sensor operation</th>
<th>Enable detection</th>
<th>Drive unit input signal polarity (CN9B MPI2)</th>
<th>Enable selection (SP225/bit5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal open (NO)</td>
<td>Rising part</td>
<td>Detection of enable</td>
<td>Falling edge (0)</td>
</tr>
<tr>
<td>Normal close (NC)</td>
<td>Falling part</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal open (NO)</td>
<td>Rising part</td>
<td>Detection of enable</td>
<td>Rising edge (1)</td>
</tr>
<tr>
<td>Normal close (NC)</td>
<td>Falling part</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Parameter setting

When using the proximity switch, set the following parameters to the spindle to be used.

When the proximity switch detection is enabled, the rotation direction of the orientation follows Z-phase detection direction (#3106/bit0), and the rotation speed follows Z-phase detection speed (#3109).

#### 【#3106】 zrn_typ Zero point return specifications

Select the zero point return specification.

- **bit F : Spindle zero point detection with contactless switch**
  - 0: Normal
  - 1: Enable spindle zero point detection using proximity switch

- **bit E : Control mode selection in orientation**
  - Select non-interpolation mode when vibration occurs since the gain is high during the orientation.
  - 0: Interpolation mode (Use the interpolation mode gain "SP002".)
  - 1: Non-interpolation mode (Use the non-interpolation mode gain "SP001")

- **bit D-B:**
  - Not used. Set to "0".

- **bit A-9 : Spindle/C axis zero point return direction**
  - bitA,9=
    - 00: Short-cut
    - 01: Forward run
    - 10: Reverse run

- **bit 8 : Designate zero point return**
  - 0: Automatically return to zero point simultaneously with C-axis changeover
  - 1: Separate operations are required for zero point return

- **bit 7 : Synchronous tapping command polarity**
  - 0: Forward direction
  - 1: Reverse direction (The standard setting when spindle and motor are directly coupled)

- **bit 6-5 : Synchronous tapping zero point return direction**
  - bit 6,5=
    - 00: Short-cut
    - 01: Forward run
    - 10: Reverse run

---

【2 Wiring and Connection】
### 2-8 Peripheral control wiring

#### bit 4: Designate zero point return/deceleration stop in synchronous tapping

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Automatically return to zero point before synchronous tapping is started (tapping phase alignment)</td>
</tr>
<tr>
<td>1</td>
<td>Not return to zero point and immediately synchronous tapping is started</td>
</tr>
</tbody>
</table>

#### bit 3:

Not used. Set to "0".

#### bit 2-1: Orientation direction

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>00</td>
<td>Short-cut</td>
</tr>
<tr>
<td>01</td>
<td>Forward run</td>
</tr>
<tr>
<td>10</td>
<td>Reverse run</td>
</tr>
</tbody>
</table>

#### bit 0: Z phase detection direction

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Forward direction</td>
</tr>
<tr>
<td>1</td>
<td>Reverse direction</td>
</tr>
</tbody>
</table>

---

### [#3108] ori_sft Position shift amount for orientation

The orientation stop position can be moved with this parameter setting although normally the position is Z-phase position. During multi-point orientation control, the stop position is determined by the total value of this parameter and the position data for multi-point orientation of PLC input.

---Setting range---

-35999 to 35999 (0.01°)

### [#3109] zdetspd Z phase detection speed

For the first S command after power is turned ON, the spindle rotates at the speed of setting value for this parameter. When "#3106/bitF = 1" (Spindle zero point proximity switch detection enabled), also proximity switch is detected.

(Note) When spindle zero point return proximity switch detection is enabled, the rotation direction of the orientation/zero point return (synchronous tapping, spindle/C axis, etc.) will follow Z phase detection direction. And the speed will follow Z phase detection speed (In order to prevent the influences of the delayed detection of the signal pulse edges).

### [#13225] SP225 SFNC5 Spindle function 5

#### bit 5: ddir Proximity switch signal enable edge

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Falling edge</td>
</tr>
<tr>
<td>1</td>
<td>Rising edge</td>
</tr>
</tbody>
</table>

### [#13227] SP227 SFNC7 Spindle function 7

#### bit F-C: dis Digital signal input selection

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No signal</td>
</tr>
<tr>
<td>1</td>
<td>SLS (Safety Limited Speed) function door state signal</td>
</tr>
<tr>
<td>4</td>
<td>Proximity switch signal detection</td>
</tr>
<tr>
<td>Other settings: setting prohibited</td>
<td></td>
</tr>
</tbody>
</table>

---

**<Related control signals>**

**Control input 5 bitD. Zero point re-detection request (ORC)**

When ORC is changed from 0 to 1, the Z phase passed will be 0 (control output2/bit0).

**Control output 5 bitD. Zero point re-detection complete (ORF)**

If the zero point re-detection is completed after the zero point re-detection request (control input5/bitD) is set to 1, ORF=1 is set. If the zero point re-detection request is set to 0, ORF=0 is set.
Safety function
3-1 Safety function

This drive unit offers the safety function which satisfies the following harmonized standard can be offered with this drive unit. Each function can be available in the system consisting of the safety function compliant control unit and drive unit, and various communication cables, sensors, and contactors.

3-1-1 Harmonized standard

<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>EN61800-5-1:2007</td>
</tr>
<tr>
<td></td>
<td>EN61800-5-2:2007</td>
</tr>
<tr>
<td></td>
<td>EN61326-3-1:2008</td>
</tr>
<tr>
<td></td>
<td>EN50178:1997</td>
</tr>
</tbody>
</table>

3-1-2 Outline of safety function

<table>
<thead>
<tr>
<th>Function</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emergency stop observation</td>
<td>NC control unit (CNC CPU unit) and the drive unit separately observe the input of emergency stop. At the emergency stop, the motor power is shut off by controlling the contactor with each of the PLC CPU unit (only for C70), NC control unit (CNC CPU unit) and the drive unit (power supply unit).</td>
</tr>
<tr>
<td>SLS (Safety Limited Speed)</td>
<td>NC control unit (CNC CPU unit) and the drive unit (servo/spindle drive unit) separately observe the followings. The motor power is shut off when an error is detected during the observation. -The command speed does not exceed the speed set with the parameter. -The rotation speed of the motor does not exceed the rotation speed set with the parameter.</td>
</tr>
<tr>
<td>STO (Safe Torque Off)</td>
<td>The torque is shut off by shutting off the energy supply to the motor. The motor power is electronically shut off inside the drive unit.</td>
</tr>
</tbody>
</table>

Safety function assumes the following configuration.
A) The machine is equipped with at least one safety door.
B) Safety is ensured when the safety door is closed.

When an operator requests to open the safety door, enable the safety function and release the lock on the safety door. Safety is ensured by enabling the safety function while the safety door is open. When canceling the safety door open request, the safety door enters the locked state and safety function will be released.

⚠️ WARNING The sequence of enabling or disabling the safety function by opening or closing the door is required to take necessary actions at the machine manufacturers.
1. The SLS (Safely Limited Speed) function is NC option. Make sure the compatibility with this function.

2. Make sure to input one of the door status signal for each control system to CN9B connector of servo or spindle drive unit. In the control system, it is conveyed to the axis which is not directly connected via the NC.

3. Using the SLS (Safely Limited Speed) function, it is required to set parameter in addition to the wiring mentioned above. To prevent a certain axis from being involved in the SLS (Safely Limited Speed) function, set SV113/bitF or SP229/bitF to 0.

---

**WARNING**

Precautions for the safety function described in this manual are as follows. Read carefully all the following fundamental precautions for safety to prevent human injury or property damage.

1. Only a qualified person is authorized to perform the installation, start, repair, or adjustment of the device in which these equipment are installed.

2. The qualified person must be familiar with the laws of the country where the device into which this product is built is installed, especially the standards described in this book, and the requirements which are listed in EN ISO 13849-1, IEC/EN 61508, IEC 61,800-5-2 and IEC 60,204-1.

3. To perform the start, programming, setting and maintenance of the device in accordance with the safety standards, the staff who undertakes these work should obtain permission from the company it belongs to.

---

**CAUTION**
Device manufacturer accepts responsibility for all the risk assessments and related residual risks. The followings are the residual risks relevant to the STO function. Mitsubishi Electric will not accept liability for any accidents such as damage or injury caused by such residual risks.

1. STO function is a function to remove the energy of the motor electronically and not the function to shut off the input power to the drive unit or the connection between the drive unit and the motor physically. Therefore, the risk for electric shocks cannot be eliminated with the STO function. To prevent electric shocks, use the EMG function.

2. STO function is a function to disable the energy to the motor electronically. It does not guarantee the shutoff or the procedure for the deceleration control of the motor. Read carefully the manual of each safety-related device for the correct installation, wiring, and adjustment.
   For all the safety-related relay, sensor, etc., use the one which satisfies the safety standards. TUV SUD has confirmed that the safety-related parts by Mitsubishi Electric described in this manual satisfy EN ISO13849-1 Category 3, PL d.

3. Even though the STO function is enabled by the STO switch, voltage may still be residual at the servo motor for the delay specific to the device.

4. Safety is not guaranteed until the installation or adjustment for the safety-related parts in the system has been completed.

5. When replacing the drive unit, make sure that the new product is the same as the one before the replacement. After the installation, be sure to confirm the performance of the safety function before operating the system.

6. Perform all the risk assessments and safety level certifications for the whole device and system. The use of a third-party certifier such as TUV SUD is recommended as a final safety certification of the system.

7. To prevent the accumulation of failure, perform an appropriate safety confirmation check at regular intervals as required by the safety standards. The safety confirmation check must be performed at least once a day regardless of the safety level of the system.

8. When up-and-down short circuit is occurred to the power module of the drive unit, the servo motor shaft rotates for up to 0.5 revolution.

9. Be sure to supply the STO input signal (STO1, STO2) from one power supply. If the power is divided, STO shutoff state may not be realized due to a malfunction of the STO function caused by a sneak current.

---

Improper installation of a safety-related device or a system could cause a operation state without safety guaranteed and may lead to a serious or fatal accident.

Preventive measure against the above danger
As described in IEC 61800-5-2, the STO (Safe Torque Off) function is a function not to supply a energy from a drive unit to a motor and does not guarantee that a motor is not moved by an external force and other influence.
Take safety measure such as brake or counter weight additionally when the external force is acted on by the motor itself.
3-2 Emergency stop observation

The double-protection for the emergency stop signal is provided and observes whether any abnormality is found in the emergency stop signal. The whole system will be in the emergency stop state when one emergency stop signal is in open state.

(1) Input circuit of an external emergency stop

Besides the emergency stop input from the NC controller, double-protection when an emergency stop occurs can be provided by directly inputting an emergency stop signal to the CN9B connector on the drive unit. Even if the emergency stop is not input from CNC for some reason, the contactors will be shut off by the external emergency stop input from CN9B connector on the drive unit. When the external emergency stop input and contactor are installed, compliance with "EN60204-1 category1" is basically possible.

(a) Connection

(b) Setting

Setting the rotary switch is not required.

1. The emergency stop signal input to the CNC side cannot be used as a substitute for the external emergency stop function (CN9B).

2. To provide double-protection when an emergency stop occurs, the emergency stop input of NC and the external emergency stop input of drive unit are always wired from same emergency stop switch.

3. The external emergency stop function is a function which helps the NC emergency stop.

CAUTION

Stop Categories in EN60204-1

Category 0 : The power is instantly shut off using machine parts.

Category 1 : The drive section is stopped with the control (hardware/software or communication network), and then the power is instantly shut off using machine parts.

(Caution) Refer to the Standards for details.

Refer to Section 9.2.5.4.2 in EN60204-1: Safety of Machinery Electrical Equipment of Machines - Part 1.
(2) Operation sequences of emergency stop

[1] Operation sequences of normal emergency stop

If the normal NC emergency stop and the external emergency stop are simultaneously input, the operation sequence will be the same as in the case of using only the NC emergency stop.

Immediately after the emergency stop is input, deceleration control is carried out in spindle control, and dynamic brake stop in servo control in a standard case, or deceleration control when the parameter is set. The ready signal is turned OFF after the NC confirms all axes stop, and the contactor control axis turns the contactor OFF.

Even when the NC emergency stop signal and the external emergency stop signal are not simultaneously input, the operation sequence will be the same as that of the normal emergency stop provided that both signals are input before all axes stop.
[2] When only the external emergency stop is input
If only the external emergency stop is input, all the drive units that share one NC communication enter an emergency stop state and deceleration control (servo/spindle) or dynamic brake stop (servo) is executed. At this time, the axis to which the external emergency stop is input enters "in external emergency stop" (EA display). The contactor is turned OFF in accordance with the gate off delay time (SV055/SP055), as the NC emergency stop is not input and the ready signal is not turned OFF.

<table>
<thead>
<tr>
<th></th>
<th>NC Emergency stop input (EMG)</th>
<th>External emergency stop input (EMGX)</th>
<th>Ready signal (RDY) (Contactor control command)</th>
<th>Motor break control output (MBR) (Servo only)</th>
<th>Motor speed</th>
<th>Contactor control output (MC)</th>
<th>Servo drive unit status display</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ON Cancel</td>
<td>ON Cancel</td>
<td>ON OFF</td>
<td>Cancel ON</td>
<td>0</td>
<td>ON OFF</td>
<td>dx E7 Cx→dx</td>
</tr>
<tr>
<td>Deceleration control, or dynamic brake stop</td>
<td>Gate off delay time SV055/SP055</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

When only the external emergency stop is input

[3] When only the NC emergency stop is input
Motors of all axes enter deceleration stop in the same sequence as normal operation (when both NC and external emergency stop signals are input) and the contactor is shut off. In case that all axes stop is not confirmed and the ready signal is not turned OFF, the contactor is shut off in accordance with the max. gate off delay time (SV055/SP055) which is set to the contactor control axis.

<table>
<thead>
<tr>
<th></th>
<th>NC Emergency stop input (EMG)</th>
<th>External emergency stop input (EMGX)</th>
<th>Ready signal (RDY) (Contactor control command)</th>
<th>Motor break control output (MBR) (Servo only)</th>
<th>Motor speed</th>
<th>Contactor control output (MC)</th>
<th>Drive unit status display</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ON Cancel</td>
<td>ON Cancel</td>
<td>ON OFF</td>
<td>Cancel ON</td>
<td>0</td>
<td>ON OFF</td>
<td>dx E7 Cx→dx</td>
</tr>
<tr>
<td>The contactor is shut off after RDY signal turns OFF, or after set time of SV055 or SP055.</td>
<td>NC confirms all axes stop</td>
<td>Deceleration control, or dynamic brake stop</td>
<td>Gate off delay time SV055/SP055</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
3-3 SLS (Safety Limited Speed) function

Safety Limited Speed function observes that the motors for servo and spindle do not exceed the specified speed when the safety door of the machine is open. The setup can be performed without shutting off the machine power and this contributes to reducing preparation time and improving operation. The speed is redundantly observed by the CPU of the drive unit and the NC control unit, and an alarm is issued when either one of the CPUs detects that the speed command or speed feedback exceeds the specified speed, which leads to the deceleration control in the motor. The power is shut off by the STO (Safe Torque Off) function after the motor stops.

**POINT**
In order to set up SLS function, perform the setup in this section and the setup in "3-4 STO (Safe Torque Off) function" additionally.

(1) Connection

The following three wirings are required for the SLS function.

1. The state signal for the safety door of the machine is wired to both the NC unit side (DI) and drive unit side (CN9B connector MPI1). The double-protection for the wiring must be provided by wiring the signal to each of the NC side and drive unit side as shown in the following figure.

2. Add the wiring to control the contactor in the NC unit side in order to shut the power when an error occurs.

3. In addition to the emergency stop wiring for the NC unit, add the external emergency stop wiring for the CN9B connector of the drive unit.

![](image)

The door state signal is on both servo side (CN9B-13) and spindle side (CN9B-2). Since it is sufficient to input on either side, select it according to other input signals.

The door state signal, battery box voltage drop signal and the proximity switch signal cannot be connected simultaneously.

When using these signals at the same time, consider to wire the door state signal to other drive units connecting to the same NC communication line.
1. The SLS (Safely Limited Speed) function is NC option. Make sure the compatibility with this function.

2. Make sure to input one of the door status signal for each control system to CN9B connector of servo or spindle drive unit. In the control system, it is conveyed to the axis which is not directly connected via the NC.

3. Using the SLS (Safely Limited Speed) function, it is required to set parameter in addition to the wiring mentioned above. To prevent a certain axis from being involved in the SLS (Safely Limited Speed) function, set SV113/bitF or SP229/bitF to 0.

(2) Parameter setting for servo drive unit

Starts the SLS (Safely Limited Speed) function.

【#2313】SV113  SSF8  Servo function 8

<table>
<thead>
<tr>
<th>bit F</th>
<th>ssc SLS (Safely Limited Speed) function</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Stop</td>
</tr>
<tr>
<td>1</td>
<td>Start</td>
</tr>
</tbody>
</table>

The digital signal input selection is set to "1" for the drive unit connected with the door state signal. The digital signal input selection is set to "0" for the other drive unit not connected with the signal.

【#2282】SV082  SSF5  Servo function 5

<table>
<thead>
<tr>
<th>bit F-C</th>
<th>dis Digital signal input selection</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No signal</td>
</tr>
<tr>
<td>1</td>
<td>SLS (Safely Limited Speed) function door state signal</td>
</tr>
<tr>
<td>2</td>
<td>Battery box voltage drop warning</td>
</tr>
<tr>
<td>3 to F</td>
<td>Setting prohibited</td>
</tr>
</tbody>
</table>
Sets the safely limited speed of the machine and motor for which the SLS (Safety Limited Speed) function is executed.

**[#2233] SV033 SSF2 Servo function 2**

<table>
<thead>
<tr>
<th>bit D : rps</th>
<th>Safely limited speed setting increment</th>
</tr>
</thead>
<tbody>
<tr>
<td>0: mm/min</td>
<td>1: 100mm/min</td>
</tr>
</tbody>
</table>

**[#2438] SV238 SSCFEED Safely limited speed**

Set the machine’s safely limited speed for the SLS (Safety Limited Speed) function.
Set this parameter within the following setting ranges.
- For linear axis: 2000mm/min or less
- For rotary axis: 18000°/min (50r/min) or less
When not using, set to "0".

---Setting range---
0 to 18000 (mm/min) or (°/min)
However, when SV033/bitD=1, the setting range is from -32768 to 32767 (100 mm/min) or (100°/min).

**[#2439] SV239 SSCRPM Safely limited motor speed**

Set the motor’s safely limited speed for the SLS (Safety Limited Speed) function.
Set a value to hold the following relationship.
Be aware when setting the parameter as the setting units for general motors and linear motors are different.

<<For general motor>>
SV239=(SV238/SV018) × (SV002/SV001)
Only when the product is 0, set to "1".

<<For linear motor>>
SV239=SV238/60
Only when the product is 0, set to "1".
When not using, set to "0".

---Setting range---
For general motor: 0 to 32767 (r/min)
For linear motor: 0 to 32767 (mm/s)

(Note) The value of the safely limited speed and safely limited motor speed must satisfy the above relation.
If this relation is not satisfied, the parameter error (37 or E4) will occur.(Error parameter No. is 239.)
Checking this relation is executed when the drive unit is turned ON and parameter is changed and speed observation mode (states when a speed observation command is turned ON) is entered.

\[
\frac{SV238}{SV018 : PIT} \times \frac{SV002 : PC2}{SV001 : PC1} = \frac{SV239}{SSCRPM}
\]

Note that "1 (r/min)" is applied when the calculation result is "0 (r/min)"
(3) Parameter setting for spindle drive unit
Starts the SLS (Safely Limited Speed) function.

**[#13229] SP229 SFNC9 Spindle function 9**

<table>
<thead>
<tr>
<th>bit F : ssc</th>
<th>SLS (Safely Limited Speed) function</th>
</tr>
</thead>
<tbody>
<tr>
<td>0: Disable</td>
<td>1: Enable</td>
</tr>
</tbody>
</table>

The digital signal input selection is set to "1" for the drive unit connected with the door state signal. The digital signal input selection is set to "0" for the other drive unit not connected with the signal.

<table>
<thead>
<tr>
<th>bit D : rps</th>
<th>Safely limited speed setting unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>0: Normal</td>
<td>1: 100°/min</td>
</tr>
</tbody>
</table>

Change the setting units of the specified speed signal output speed (SP030) and safely limited speed (SP238).

**[#13227] SP227 SFNC7 Spindle function 7**

<table>
<thead>
<tr>
<th>bit F-C : dis</th>
<th>Digital signal input selection</th>
</tr>
</thead>
<tbody>
<tr>
<td>0: No signal</td>
<td>1: SLS (Safely Limited Speed) function door state signal</td>
</tr>
<tr>
<td>4: Proximity switch signal detection</td>
<td></td>
</tr>
<tr>
<td>Other settings: setting prohibited</td>
<td></td>
</tr>
</tbody>
</table>

Sets the safely limited speed of the machine and motor for which the SLS (Safely Limited Speed) function is executed.

**[#13238] SP238 SSCFEED Safely limited speed**

Set the safely limited speed at the spindle end for the SLS (Safely Limited Speed) function.
When not using, set to "0".

---Setting range---
0 to 18000 (°/min)
However, when SP229/bitD is set to "1", the setting range is from -32768 to 32767 (100°/min).

**[#13239] SP239 SSCRPM Safely limited motor speed**

Set the motor’s safely limited speed for the SLS (Safely Limited Speed) function.
When not using, set to "0".

---Setting range---
0 to 32767 (r/min)

(Note) The value of the safely limited speed and safely limited motor speed must satisfy the following relation. If this relation is not satisfied, the parameter error (37 or E4) will occur. (Error parameter No. is 239.)
Checking this relation is executed when the drive unit is turned ON and parameter is changed and speed observation mode (states when a speed observation command is turned ON) is entered.

\[
\frac{SP238}{360} \times \frac{SP057}{GRA1} = \frac{SP061}{GRB1} = SP239 : SSCRPM
\]

Note that "1 (r/min)" is applied when the calculation result is "0 (r/min)"
3-4 STO (Safe Torque Off) function

Safe Torque Off function is a shutoff function which does not provide the energy to the motor capable of generating torque and it shuts off an energy supply electronically inside the drive unit. STO function can be used in the following two ways ((1) and (2) below).

(1) Network STO function

[1] System configuration and wiring

STO function shuts off the motor power of all axes in the system.

*A system configuration example when using network STO function>*

*A wiring diagram for network STO function (Dual emergency stop) >*

Insert the attached short-circuit connector.

Control the relay for contactor drive.
(2) Dedicated wiring STO function

[1] System configuration
This method is used to shut off the motor power with STO function only for the servo axes and spindle which are connected to the MDS-DM2-SPV drive unit while operating the system.
(Note) Always insert the provided short-circuit connector to CN8 for the drive unit other than MDS-DM2-SPV and cause short circuit in the STO signal.
Manufacturer : Tyco Electronics <Type> Connector : 1971153-1

<A system configuration example when using dedicated wiring STO function>

[2] Input/output signal and operation sequences
The drive unit is equipped with a connector (CN8) which provides dedicated wiring STO function. The energy supply to a motor can completely be shut off by using this connector with external safety device. The following wiring and parameter setting (SV113,SP229/bit8) are required when using the connector (CN8).
Dedicated wiring STO function can be disabled by inserting the following connector to CN8.
Manufacturer : Tyco Electronics <Type> Connector : 1971153-1

Connector for dedicated wiring STO signal (CN8) and signal array

<table>
<thead>
<tr>
<th>Signal name</th>
<th>Connector pin No.</th>
<th>Details</th>
<th>I/O class</th>
</tr>
</thead>
<tbody>
<tr>
<td>STO_COM</td>
<td>CN8-3</td>
<td>STO input signal common</td>
<td>DI</td>
</tr>
<tr>
<td>STO1</td>
<td>CN8-4</td>
<td>STO input signal 1</td>
<td>DI</td>
</tr>
<tr>
<td>STO2</td>
<td>CN8-5</td>
<td>STO input signal 2</td>
<td>DI</td>
</tr>
<tr>
<td>TOF1</td>
<td>CN8-6</td>
<td>TOF output signal 1 (STO1 signal input state)</td>
<td>DO</td>
</tr>
<tr>
<td>TOF2</td>
<td>CN8-7</td>
<td>TOF output signal 2 (STO2 signal input state)</td>
<td>DO</td>
</tr>
<tr>
<td>TOF_COM</td>
<td>CN8-8</td>
<td>TOF output signal common</td>
<td>DO</td>
</tr>
</tbody>
</table>
< Operation sequences for dedicated wiring STO function >

- Door open signal
- STO1 signal
- STO2 signal
- In STO signal input (RSTS2/bit5)
- READY ON command (XCMD1/bit0)
- Servo ON command (XCMD1/bit1)

Drive unit : Observe the STO signal input (power shutoff) state in servo ON
⇒ Dual signal error alarm (4D) is occurred by the STO signal input (power shutoff)

⚠️ **CAUTION**

Do not connect a cable to pin 1 and 2 of CN8. A malfunction or failure may result.

💡 **POINT**

1. For this function which inputs the STO signal directly to the drive unit, safety is ensured by inputting synonymous STO signals redundantly to shut off the energy supply with the independent control.

2. Diagnosis for the input status of STO signal can be performed by using TOF signal.
External input/output signal connection example when using a NC controller

Door signal contact

Detail description of external input/output signal connection
Details of the input/output signal as stated before (refer to "I/O class" in the table) are shown below. Connect to an external device by referring to this section.

(a) Digital input interface: DI
Provide a signal with a relay or open-collector transistor.

[1] Sink input/output interface

Switch

24VDC ± 10%

Sto1/Sto2

4kΩ

[2] Source input/output interface

Switch

24VDC ± 10%

Sto1/Sto2

4kΩ

(b) Digital output interface: DO
Maximum 1.3V of voltage drop occurs inside the drive unit.

Drive unit

The drive unit is damaged when the polarity is reversed.

CAUTION
Maximum 1.3V of voltage drop occurs inside the drive unit. Select an external connection device operable in the output voltage after the voltage drop.

| 1 | Input voltage at external contact ON | 24VDC ± 10% |
| 2 | Input current at external contact ON | 10mA or more |
| 3 | Input voltage at external contact OFF | 4V or less |
| 4 | Input current at external contact OFF | 2mA or less |
| 5 | Input resistance | 4kΩ |
| 6 | Tolerable chattering time | 1ms or less |
| 7 | Input signal holding time | 600ms or more |
| 8 | Input circuit operation delay time | 10ms typ 30ms or less |

CAUTION

Maximum 1.3V of voltage drop occurs inside the drive unit. Select an external connection device operable in the output voltage after the voltage drop.
3 Safety function

[3] Parameter setting
Input observation for dedicated wiring STO signal is set with the parameter SV113,SP229/bit8. The following parameter setting is not to enable or disable the shutoff function of STO function performed by the H/W. When using network STO function only, make sure to set to "0".

< Servo parameter >

[#2313] SV113   SSF8   Servo function 8

<table>
<thead>
<tr>
<th>bit 8 : sto Dedicated wiring STO function</th>
</tr>
</thead>
<tbody>
<tr>
<td>0: Dedicated wiring STO function unused</td>
</tr>
<tr>
<td>1: Dedicated wiring STO function used</td>
</tr>
</tbody>
</table>

< Spindle parameter >

[#13229] SP229   SFNC9   Spindle function 9

<table>
<thead>
<tr>
<th>bit 8 : sto Dedicated wiring STO function</th>
</tr>
</thead>
<tbody>
<tr>
<td>0: Dedicated wiring STO function unused</td>
</tr>
<tr>
<td>1: Dedicated wiring STO function used</td>
</tr>
</tbody>
</table>

[4] Related alarm and warning
When Dual signal error 4D occurs, eliminate the factor of illegal parameter setting or STO signal input by referring to the following.
In addition, while the power is shut off by STO signal, Dual signal warning A4 is detected regardless of SV113/bit8 or SP229/bit8 setting.

<table>
<thead>
<tr>
<th>Alarm No.</th>
<th>Name</th>
<th>Details</th>
<th>Reset method</th>
<th>Stop method</th>
</tr>
</thead>
</table>
| 4D        | Dual signal error     | - The parameter setting for dedicated wiring STO function (SV113/bit8 or SP229/bit8) is wrong.  
- The connector to disable STO is not installed correctly when not using dedicated wiring STO function.  
- STO signal is input by dedicated wiring STO function during servo ON.  
- STO signal is illegally input by dedicated wiring STO function during servo OFF.  
(Illegal input : Signal input state for STO1 and STO2 is mismatched.) | NR           | Servo: Dynamic stop  
Spindle: Coast to a stop |

(Note1) Resetting methods
NR: Reset with the NC RESET button.

<table>
<thead>
<tr>
<th>Warning No.</th>
<th>Name</th>
<th>Details</th>
<th>Reset method</th>
<th>Stop method</th>
</tr>
</thead>
<tbody>
<tr>
<td>A4</td>
<td>Dual signal warning</td>
<td>In shutoff by STO function.</td>
<td>*</td>
<td>-</td>
</tr>
</tbody>
</table>

(Note 1) Resetting methods
* : Automatically reset once the cause of the warning is removed.

(Note 2) Warning A4 is detected regardless of SV113/bit8 or SP229/bit8 setting while the power is shut off by STO signal.
4-1 Initial setup

4-1-1 Setting the rotary switch

The setting of the axis number is fixed as follows in the MDS-DM2-SPV Series.

<table>
<thead>
<tr>
<th>Setting the MDS-DM2-SPV Series</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st axis</td>
<td>Spindle axis</td>
</tr>
<tr>
<td>2nd axis</td>
<td>L-axis</td>
</tr>
<tr>
<td>3rd axis</td>
<td>M-axis</td>
</tr>
<tr>
<td>4th axis</td>
<td>S-axis (MDS-DM2-SPV3)</td>
</tr>
</tbody>
</table>

When using the MDS-DM2-SPV Series and MDS-D2 Series together, set the axis numbers from 4th axis or 5th axis.

4-1-2 Transition of LED display after power is turned ON

When CNC, each drive unit and the power supply unit power have been turned ON, each unit will automatically execute self-diagnosis and initial settings for operation, etc. The LEDs on the front of the units will change as shown below according to the progression of these processes.

If an alarm occurs, the alarm No. will appear on the LEDs. Refer to section "LED display when alarm or warning occurs" for details on the alarm displays.

**CAUTION**

1. Always input emergency stop when starting the servo system.
2. Do not insert or extract the external STO input connector (CN8) after starting the servo system. Motor power will be shut off and it may cause the collision of machine.
4-2 Setting the initial parameters for the servo drive unit

The servo parameters must be set before the servo system can be started up. The servo parameters are input from the NC. The input method differs according to the NC being used, so refer to each NC Instruction Manual. When setting the initial setting parameters, perform the following settings in each system.

<For semi closed loop control (single-axis control)>
(1) Set the standard parameters in the section "4-2-4 List of standard parameters for each servomotor".
(2) "4-2-1 Setting of servo specification parameters"

<For full closed loop control (single-axis control)>
(1) Set the standard parameters in the section "4-2-4 List of standard parameters for each servomotor".
(2) "4-2-1 Setting of servo specification parameters"
(3) "4-2-2 Setting of machine side detector"

<For full closed loop control with a distance-coded reference scale (single-axis control)>
(1) Set the standard parameters in the section "4-2-4 List of standard parameters for each servomotor".
(2) "4-2-1 Setting of servo specification parameters"
(3) "4-2-2 Setting of machine side detector"
(4) "4-2-3 Setting of distance-coded reference scale"

Setting the initial parameters above enables the test operation for the servo axis (Ex. manual pulse feed, low-speed JOG feed). When machine resonance occurs, check the machine resonance frequency at AFLT frequency on the drive monitor screen and set to the following servo parameters (When the AFLT frequency displays "0", resonance is not occurring).

[\#2238] SV038  FHz1  Notch filter frequency 1

Set the vibration frequency to suppress when machine vibration occurs.
(Normally, do not set 80 or less.)

---Setting range---
0 to 2250 (Hz)
4-2-1 Setting of servo specification parameters

(1) Basic specification parameters
When performing absolute position control, set the axis specification parameter #2049. When the setting value of #2049 is "1 to 4", "SV017/bit7" is automatically set to the absolute position control. It is not possible to set SV017/bit7 directly.

<table>
<thead>
<tr>
<th>#2049(PR)</th>
<th>type</th>
<th>Absolute position detection method</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0:</td>
<td>Not absolute position detection</td>
</tr>
<tr>
<td></td>
<td>1:</td>
<td>Marked point alignment method I (The grid point is the reference position.)</td>
</tr>
<tr>
<td></td>
<td>2:</td>
<td>Marked point alignment method II (The position with which the mark was aligned is the reference position.)</td>
</tr>
<tr>
<td></td>
<td>3:</td>
<td>Dog-type (align with dog and near point detection switch)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>#2217(PR)</th>
<th>SV017</th>
<th>SPEC1</th>
<th>Servo specification 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>bit 7</td>
<td>abs</td>
<td>Position control</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0: Incremental</td>
<td>1: Absolute position control</td>
<td></td>
</tr>
</tbody>
</table>

For C70 NC, set the following parameters. Ignore the unnecessary alarm history which occurs when the NC power is turned off.

<table>
<thead>
<tr>
<th>#2314</th>
<th>SV114</th>
<th>SSF9</th>
<th>Servo function 9</th>
</tr>
</thead>
<tbody>
<tr>
<td>bit 8</td>
<td>nohis</td>
<td>History of communication error alarm between NC and DRV (34, 36, 38, 39)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0: Enable</td>
<td>1: Disable</td>
<td></td>
</tr>
</tbody>
</table>

(2) Electronic gear related parameters
Servo control is performed by changing NC command unit to servo control unit with the following parameters (electric gear). Even if each parameter is within the setting range, overflow of the electric gear coefficient may be occur. When the overflow of the electric gear occurs, initial parameter error (servo alarm 37) will occur.

<table>
<thead>
<tr>
<th>#2201(PR)</th>
<th>SV001</th>
<th>PC1</th>
<th>Motor side gear ratio</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>#2202(PR)</th>
<th>SV002</th>
<th>PC2</th>
<th>Machine side gear ratio</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>#2218(PR)</th>
<th>SV018</th>
<th>PIT</th>
<th>Ball screw pitch/Magnetic pole pitch</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>#2219(PR)</th>
<th>SV019</th>
<th>RNG1</th>
<th>Sub side detector resolution</th>
</tr>
</thead>
</table>

Set the same value as SV020. For the full-closed loop control, refer to "Setting of machine side detector".
4-2 Setting the initial parameters for the servo drive unit

4-2-2 Setting of machine side detector

(1) Setting of the machine side detector specification

【#2225(PR)】 SV025   MTYP   Motor/Detector type
Set the position detector type, according to the machine side detector specifications.

<table>
<thead>
<tr>
<th>bit F-C: pen Position detector</th>
</tr>
</thead>
<tbody>
<tr>
<td>OSA105ET2, OSA166ET2(N)        : pen=6</td>
</tr>
<tr>
<td>Serial signal output rotary scale : pen=6</td>
</tr>
<tr>
<td>Rectangular wave signal output scale : pen=8</td>
</tr>
<tr>
<td>Serial signal output linear scale : pen=A</td>
</tr>
</tbody>
</table>

【#2219(PR)】 SV019   RNG1   Sub side detector resolution
For a ball screw end detector
OSA105ET2:  RNG1=1000
For a linear scale
Set the number of pulses per ball screw lead in one "kp" increments.
For a rotary scale
Set the number of pulses per revolution in one "kp" increments.

Note that the value must be input in increments of 10K pulses (the 1st digit of the setting value is "0").
If any restriction is imposed due to the above condition, also set SV117 in one pulse increments.

【#2317(PR)】 SV117   RNG1ex   Expansion sub side detector resolution
To set the resolution of the machine side detector in one pulse increments, set the number of pulses of the detector by 4-byte data in total to SV117 (high-order 16bit) and SV019 (low-order 16bit).

SV117= Quotient of the number of pulses divided by 65536 (If the quotient is 0, set SV117 to -1).
SV019= Remainder of the number of pulses divided by 65536 (SV019 can be set in one pulse increments).

If the NC is C70 and SV019 is greater than 32767, enter the (negative) value obtained by subtracting 65536 from the above remainder in SV019.

(2) Setting table for each detector
Rectangular wave signal output detector

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Detector type</th>
<th>Interface unit type</th>
<th>Control resolution</th>
<th>SV025</th>
<th>SV019</th>
<th>SV117</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnescale</td>
<td>SR74</td>
<td>Not required</td>
<td>1.0 μm</td>
<td>82</td>
<td>SV018 × 1000/1</td>
<td>-1</td>
</tr>
<tr>
<td></td>
<td>SR84</td>
<td></td>
<td>0.5 μm</td>
<td>82</td>
<td>SV018 × 1000/0.5</td>
<td>-1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.1 μm</td>
<td>82</td>
<td>SV018/0.1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.05 μm</td>
<td>82</td>
<td>SV018/0.05</td>
<td>0</td>
</tr>
<tr>
<td>HEIDENHAIN</td>
<td>LS187</td>
<td>IBV 101 (10 divisions)</td>
<td>0.5 μm</td>
<td>82</td>
<td>SV018 × 1000/0.5</td>
<td>-1</td>
</tr>
<tr>
<td></td>
<td>LS487</td>
<td>IBV 102 (100 divisions)</td>
<td>0.5 μm</td>
<td>82</td>
<td>SV018/0.05</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IBV 650B (400 divisions)</td>
<td>0.0125 μm</td>
<td>82</td>
<td>SV018/0.0125</td>
<td>0</td>
</tr>
</tbody>
</table>

(Note) When the quotient is "0", "SV117 = -1" is applied.
### Mitsubishi serial signal output detector (Incremental)

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Detector type</th>
<th>Interface unit type</th>
<th>Control resolution</th>
<th>SV025</th>
<th>SV019</th>
<th>SV117</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnescale</td>
<td>SR75</td>
<td>Not required</td>
<td>0.1 μm</td>
<td>A2</td>
<td>SV180.1</td>
<td>U</td>
</tr>
<tr>
<td></td>
<td>SR85</td>
<td>Not required</td>
<td>0.05 μm</td>
<td>A2</td>
<td>SV180.05</td>
<td>U</td>
</tr>
<tr>
<td></td>
<td>LS187/LS487</td>
<td>EIB192M A4 20 μm</td>
<td>(20/16384) μm</td>
<td>A2</td>
<td>(SV018 x 819200/65536 = remainder)</td>
<td>quotient</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EIB392M A4 20 μm</td>
<td>19,660,800/rev</td>
<td>62</td>
<td>0</td>
<td>300</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EIB192M C4 1200</td>
<td>EB192M C4 1200</td>
<td>62</td>
<td>0</td>
<td>512</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EIB192M C6 2048</td>
<td>EB192M C6 2048</td>
<td>62</td>
<td>0</td>
<td>512</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LS187C</td>
<td>MDS-B-HR Signal cycle μm/512</td>
<td>A2</td>
<td>(SV018 x 512000/signal cycle μm) ÷ 65536 = remainder</td>
<td>quotient</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LS487C</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(Note 1) When the quotient is "0", "SV117 = -1" is applied.

(Note 2) The communication specification of EIB192M/392M is "MITSU02-4".

### Mitsubishi serial signal output detector (Absolute position)

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Detector type</th>
<th>Interface unit type</th>
<th>Control resolution</th>
<th>SV025</th>
<th>SV019</th>
<th>SV117</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mitsubishi Electric</td>
<td>UPA105ET2A</td>
<td>Not required</td>
<td>1,000,000/rev/1μm</td>
<td>62</td>
<td>1000</td>
<td>U</td>
</tr>
<tr>
<td></td>
<td>MBA405SW</td>
<td>Not required</td>
<td>4,000,000/rev/1μm</td>
<td>62</td>
<td>4000</td>
<td>U</td>
</tr>
<tr>
<td>Magnescale</td>
<td>SR77</td>
<td>Not required</td>
<td>0.1 μm</td>
<td>A2</td>
<td>SV180.1</td>
<td>U</td>
</tr>
<tr>
<td></td>
<td>SR87</td>
<td>Not required</td>
<td>0.05 μm</td>
<td>A2</td>
<td>SV180.05</td>
<td>U</td>
</tr>
<tr>
<td></td>
<td>RU77</td>
<td>Not required</td>
<td>8,000,000/rev/1μm</td>
<td>62</td>
<td>8000</td>
<td>U</td>
</tr>
<tr>
<td></td>
<td>LC193M</td>
<td>Not required</td>
<td>0.05 μm</td>
<td>A2</td>
<td>SV180.05</td>
<td>U</td>
</tr>
<tr>
<td></td>
<td>LC493M</td>
<td>Not required</td>
<td>0.01 μm</td>
<td>A2</td>
<td>SV180.01</td>
<td>U</td>
</tr>
<tr>
<td>HEIDENHAIN</td>
<td>RCH223M</td>
<td>Not required</td>
<td>8,000,000/rev/1μm</td>
<td>62</td>
<td>8000</td>
<td>U</td>
</tr>
<tr>
<td></td>
<td>RCH273M</td>
<td>Not required</td>
<td>134,217,728/rev/1μm</td>
<td>62</td>
<td>0</td>
<td>2048</td>
</tr>
<tr>
<td></td>
<td>RCH277M</td>
<td>Not required</td>
<td>134,217,728/rev/1μm</td>
<td>62</td>
<td>0</td>
<td>2048</td>
</tr>
<tr>
<td></td>
<td>RCH287M</td>
<td>Not required</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mitutoyo</td>
<td>AT343</td>
<td>Not required</td>
<td>0.05 μm</td>
<td>A2</td>
<td>SV180.05</td>
<td>U</td>
</tr>
<tr>
<td></td>
<td>AT543</td>
<td>Not required</td>
<td>0.05 μm</td>
<td>A2</td>
<td>SV180.05</td>
<td>U</td>
</tr>
<tr>
<td></td>
<td>AT545</td>
<td>Not required</td>
<td>(20/4096) μm</td>
<td>A2</td>
<td>(SV018 x 20/4096 ÷ 65536 = remainder)</td>
<td>quotient</td>
</tr>
<tr>
<td>MHI MACHINE TOOL ENGINEERING</td>
<td>MPFZ Series</td>
<td>ADB-26711</td>
<td>8,000,000/rev/1μm</td>
<td>62</td>
<td>8000</td>
<td>U</td>
</tr>
<tr>
<td></td>
<td>MPS Series</td>
<td>ADB-26360</td>
<td>0.05 μm</td>
<td>A2</td>
<td>SV180.05</td>
<td>U</td>
</tr>
<tr>
<td></td>
<td>MPI Series</td>
<td>ADB-26360</td>
<td>7,200,000/rev/1μm</td>
<td>A2</td>
<td>SV180.05</td>
<td>U</td>
</tr>
<tr>
<td></td>
<td>SAM Series</td>
<td>Not required</td>
<td>0.05 μm</td>
<td>A2</td>
<td>SV180.05</td>
<td>U</td>
</tr>
<tr>
<td></td>
<td>SVAM Series</td>
<td>Not required</td>
<td>0.05 μm</td>
<td>A2</td>
<td>SV180.05</td>
<td>U</td>
</tr>
<tr>
<td></td>
<td>LAM Series</td>
<td>Not required</td>
<td>0.05 μm</td>
<td>A2</td>
<td>SV180.05</td>
<td>U</td>
</tr>
<tr>
<td></td>
<td>LAM Series</td>
<td>Not required</td>
<td>0.1 μm</td>
<td>A2</td>
<td>SV180.05</td>
<td>U</td>
</tr>
<tr>
<td>FAGOR</td>
<td>MAN Series</td>
<td>Not required</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(Note 1) When the quotient is "0", "SV117 = -1" is applied.

For MPI scale, set the following parameters depends on the number of poles.

### #2217(PR) SV017 SPEC1 Servo specification 1

**bit 8:** mmp MPI scale pole number setting

0: 360 poles  1: 720 poles

### (3) Setting of the installation polarity of the machine side detector

Since the installation polarity may not be judged from the detector appearance, confirm the installation polarity of the machine side detector with moving the axis by hand after the installation.

If "Motor end FB" or "Machine end FB" on the NC drive monitor screen changes to the opposite polarity when the axis is moved, set SV017/bit4 to "Reverse polarity".

### #2217(PR) SV017 SPEC1 Servo specification 1

**bit 4:** sdir Sub side detector feedback

0: Forward polarity  1: Reverse polarity
(4) When using MBA405W with the machine side detector

The absolute position in a rotation is decided by detecting Z-phase signal with the main head (Z-phase signal position mark passes the main head) at initial power ON for MBA405W although it is an absolute detector. Once this is completed, the absolute position is kept by the battery connected to the drive unit even if the power turns OFF. Therefore, unlike other absolute position detectors (such as OSA105), the following setup is required at initial power ON.

1. Alarm 37 / error number 2198 is detected before the initial setup operation, but this is not a fault. The alarm will be cleared after the initial setup is completed and by turning the NC power ON again.

2. The NC monitor displays "MB"405W" before the initial setup is completed. It will be correctly displayed as "MBA405W" after the initial setup is completed.
(5) Setting of the machine side detector alarm detection
When using a rectangular wave linear scale, set the following parameters.

[#2235] SV035 SSF4 Servo function 4

<table>
<thead>
<tr>
<th>bit 7 : ckab  No signal detection 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Set this to use rectangular wave output linear scale. This enables the detection of No signal 2 (alarm 21).</td>
</tr>
<tr>
<td>0: Disable 1: Enable</td>
</tr>
</tbody>
</table>

[#2398] SV198 NSE No signal 2 special detection width

Set the special detection width for the no signal 2 (alarm 21). When "0" is set, the detection will be performed with a $15 \mu m$ width.

---Setting range---
0 to 32767 ($\mu m$)
4-2-3 Setting of distance-coded reference scale

1) Setting of the base specifications

In order to set the distance-coded reference scale, the following setting follows "Setting of machine side detector".

【#2281(PR)】SV081 SPEC2 Servo specification 2

bit 7 : szchk Distance-coded reference scale reference mark

Set the number of reference marks to be passed during the reference position calculation. If an error occurs in passing the reference mark, the neighboring mark is checked. When an error is detected three times in total, the alarm "42" will occur.

0: Check at 4 points (standard)  1: Check at 3 points

bit 3 : absc Distance-coded reference scale

0: Disable  1: Enable

【#2330(PR)】SV130 RPITS Base reference mark interval

Set the interval between the base reference marks arranged at regular intervals on the distance-coded reference scale. When the base reference mark interval (SV130) and the reference mark's auxiliary interval are in the specified relationship, the distance-coded reference scale is judged to be connected.

Following is the specified relationship.

(SV130×1000) / SV131 >= 4 (No remainder)

---Setting range---

0 to 32767 (mm)

【#2331(PR)】SV131 DPITS Auxiliary reference mark interval

Set the auxiliary interval of reference mark in the distance-coded reference scale.

---Setting range---

0 to 32767 (μm)
(2) Setting of the distance-coded reference check function

If the reference marks are checked at four points by the basic point computer processing, the basic point can be recreated almost certainly. If you would like to strengthen the check further, set the distance-coded reference check function, which executes the relation check with a coordinate of the motor side detector during the basic point calculation after the power-on.

When an error occurs, "Alarm 42" is detected. The battery option is required to use this function since the motor side detector is under the absolute position control.

<Initial setup of the distance-coded reference check>

Performed this initial setup at the start of the system setup, linear scale exchange, or motor exchange.

(1) Complete the setup of the distance-coded reference scale.
   (Complete the base specification setting, and enable the basic point establishment.)

(2) Turn the power ON again after setting "SV137 = -1".
   (Under a state of the distance-coded reference check initial setup warning "A3").

(3) Perform the reference point return.

(4) Conform that the warning "A3" turns OFF.

(5) Set the value of "Rn", "Pn" and "MPOS" to "SV134", "SV135" and "SV136" on the drive monitor.

(6) When SV137=32767, the distance-coded reference check function is disabled.

---Special setting---

SV134 RRn0 Distance-coded reference check / revolution counter

SV135 RPn0H Distance-coded reference check / position within one rotation High

SV136 RPn0L Distance-coded reference check / position within one rotation Low

Set this parameter to operate distance-coded reference check when using distance-coded reference scale.

During the distance-coded reference check initial setup (SV137:RAER=-1), set the following items on the NC drive monitor screen after the distance-coded reference check initial setup warning A3 turns OFF.

SV134=Rn, SV135=Pn, SV136=MPOS

SV137 RAER Distance-coded reference check allowable width

For the distance-coded reference check function when using distance-coded reference scale, set the allowable gap from the reference point position data calculated by the main side detector. When the gap exceeds the allowable range, reference point created by distance-code is judged as wrong and detects alarm 42.

The standard setting value is "basic reference mark interval (SV130) / 4".
SV137=0 setting carries out the same operation as the standard setting value.
SV137=-1 setting enables the distance-coded reference check initial setup mode and displays setting values of SV134 to SV136 on NC drive monitor.

To enable the distance-coded reference check function, SV081/bit3=1 setting and a battery option are needed.

---Setting range---

-1 to 32767 (mm)
### 4-2-4 List of standard parameters for each servomotor

<table>
<thead>
<tr>
<th>Parameter</th>
<th>200V Standard motor HF Series</th>
<th>200V Standard motor HF Series</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. Abbrev.</td>
<td>Details</td>
<td>Motor</td>
</tr>
<tr>
<td>SV001</td>
<td>PCL</td>
<td>Motor side gear ratio</td>
</tr>
<tr>
<td>SV002</td>
<td>PCD</td>
<td>-</td>
</tr>
<tr>
<td>SV003</td>
<td>PGN1</td>
<td>Position loop gain 1</td>
</tr>
<tr>
<td>SV004</td>
<td>PGN2</td>
<td>Position loop gain 2</td>
</tr>
<tr>
<td>SV005</td>
<td>VGN1</td>
<td>Speed loop gain 1</td>
</tr>
<tr>
<td>SV006</td>
<td>VGN2</td>
<td>Speed loop gain 2</td>
</tr>
<tr>
<td>SV007</td>
<td>VIL</td>
<td>Speed loop delay compensation</td>
</tr>
<tr>
<td>SV008</td>
<td>VIA</td>
<td>Speed loop lead compensation</td>
</tr>
<tr>
<td>SV009</td>
<td>ICA</td>
<td>Current loop q axis lead compensation</td>
</tr>
<tr>
<td>SV010</td>
<td>IDA</td>
<td>Current loop q axis lead compensation</td>
</tr>
<tr>
<td>SV011</td>
<td>SSF1</td>
<td>Current loop q axis gain</td>
</tr>
<tr>
<td>SV012</td>
<td>IDG</td>
<td>Current loop d axis gain</td>
</tr>
<tr>
<td>SV013</td>
<td>ILM1</td>
<td>Current limit value</td>
</tr>
<tr>
<td>SV014</td>
<td>ILMtep</td>
<td>Current limit value in special control</td>
</tr>
<tr>
<td>SV015</td>
<td>IPC</td>
<td>-</td>
</tr>
<tr>
<td>SV016</td>
<td>LMC1</td>
<td>-</td>
</tr>
<tr>
<td>SV017</td>
<td>SPEC1</td>
<td>Servo specification 1</td>
</tr>
<tr>
<td>SV018</td>
<td>PIT</td>
<td>Ball screw pitch/Magnetic pole pitch</td>
</tr>
<tr>
<td>SV019</td>
<td>RNG1</td>
<td>Sub side detector resolution</td>
</tr>
<tr>
<td>SV020</td>
<td>RNG2</td>
<td>Main side detector resolution</td>
</tr>
<tr>
<td>SV021</td>
<td>UTL</td>
<td>Overload detection time constant</td>
</tr>
<tr>
<td>SV022</td>
<td>ULL</td>
<td>Overload detection level</td>
</tr>
<tr>
<td>SV023</td>
<td>OD1</td>
<td>Excessive error detection width during servo ON</td>
</tr>
<tr>
<td>SV024</td>
<td>INP</td>
<td>In-position detection width</td>
</tr>
<tr>
<td>SV025</td>
<td>MTP</td>
<td>Motor/Detector type</td>
</tr>
<tr>
<td>SV026</td>
<td>OD2</td>
<td>Excessive error detection width during servo OFF</td>
</tr>
<tr>
<td>SV027</td>
<td>SSF1</td>
<td>Servo function 1</td>
</tr>
<tr>
<td>SV028</td>
<td>SSF2</td>
<td>-</td>
</tr>
<tr>
<td>SV029</td>
<td>VCS</td>
<td>Speed at the change of speed loop gain</td>
</tr>
<tr>
<td>SV030</td>
<td>IVC</td>
<td>Voltage non-sensitive band compensation</td>
</tr>
<tr>
<td>SV031</td>
<td>OVS1</td>
<td>Overshooting compensation 1</td>
</tr>
<tr>
<td>SV032</td>
<td>TFO</td>
<td>Torque offset</td>
</tr>
<tr>
<td>SV033</td>
<td>SSF2</td>
<td>Servo function 2</td>
</tr>
<tr>
<td>SV034</td>
<td>SSF3</td>
<td>Servo function 3</td>
</tr>
<tr>
<td>SV035</td>
<td>SSF4</td>
<td>Servo function 4</td>
</tr>
<tr>
<td>SV036</td>
<td>P1TP</td>
<td>Power supply type/Regenerative resistor type</td>
</tr>
<tr>
<td>SV037</td>
<td>JL</td>
<td>Load inertia scale</td>
</tr>
<tr>
<td>SV038</td>
<td>FH1</td>
<td>Notch filter frequency 1</td>
</tr>
<tr>
<td>SV039</td>
<td>LMC1</td>
<td>Lost motion compensation timing 1</td>
</tr>
<tr>
<td>SV040</td>
<td>LMC2</td>
<td>Lost motion compensation non-sensitive band</td>
</tr>
<tr>
<td>SV041</td>
<td>QTO2</td>
<td>Overshooting compensation 2</td>
</tr>
<tr>
<td>SV042</td>
<td>OBS2</td>
<td>Disturbance observer filter frequency</td>
</tr>
<tr>
<td>SV043</td>
<td>OBS1</td>
<td>Disturbance observer gain</td>
</tr>
<tr>
<td>SV044</td>
<td>TRUB</td>
<td>Friction torque</td>
</tr>
<tr>
<td>SV045</td>
<td>FH2</td>
<td>Notch filter frequency 2</td>
</tr>
<tr>
<td>SV046</td>
<td>FH3</td>
<td>Notch filter frequency 3</td>
</tr>
<tr>
<td>SV047</td>
<td>EC</td>
<td>Inductive voltage compensation gain</td>
</tr>
<tr>
<td>SV048</td>
<td>EMGt</td>
<td>Vertical axis position detection</td>
</tr>
<tr>
<td>SV049</td>
<td>PGN1sp</td>
<td>Position loop gain 1 in spindle synchronous control</td>
</tr>
<tr>
<td>SV050</td>
<td>PGN2sp</td>
<td>Position loop gain 2 in spindle synchronous control</td>
</tr>
<tr>
<td>SV051</td>
<td>DFBY</td>
<td>Dual feedback control time constant</td>
</tr>
<tr>
<td>SV052</td>
<td>DBRN</td>
<td>Dual feedback control non-sensitive band</td>
</tr>
<tr>
<td>SV053</td>
<td>OD3</td>
<td>Excessive error detection width in special control</td>
</tr>
<tr>
<td>SV054</td>
<td>URL</td>
<td>Overrun detection width in closed loop control</td>
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<td>SV055</td>
<td>EMGx</td>
<td>Max. gate off delay time after emergency stop</td>
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<tr>
<td>SV056</td>
<td>EMG1</td>
<td>Deceleration time constant at emergency stop</td>
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<tr>
<td>SV057</td>
<td>SHGC</td>
<td>SHG control gain</td>
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<td>SV058</td>
<td>SHGsc</td>
<td>SHG control gain in spindle synchronous control</td>
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<tr>
<td>SV059</td>
<td>TCNY</td>
<td>Collision detection torque estimated gain</td>
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<td>SV060</td>
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<tr>
<td>SV061</td>
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<td>D/A output ch1 data No. for initial DC excitation level</td>
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<tr>
<td>SV062</td>
<td>DA2NO</td>
<td>D/A output ch2 data No. for final DC excitation level</td>
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<tr>
<td>SV063</td>
<td>DA1MPP</td>
<td>D/A output ch1 output scale for initial DC excitation time</td>
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### 4 Setup

#### MITSUBISHI CNC

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<thead>
<tr>
<th>Parameter</th>
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<tr>
<td>SV087</td>
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<tr>
<td>SV256</td>
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</tbody>
</table>

(System parameter area)

- **DA2MPY**: Unit value output ch2 output scale
- **TLC**: Machine end compensation gain
- **FESSF**: Specified speed output speed
- **LMC4G**: Lost motion compensation 4 spring constant
- **MPV**: Magnetic pole position error detection speed

---

<table>
<thead>
<tr>
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</table>
### 4-2-5 Servo parameters

The parameters with "(PR)" requires the CNC to be turned OFF after the settings. Turn the power OFF and ON to enable the parameter settings.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Setting Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>SV001 PC1</td>
<td>Motor side gear ratio</td>
<td>1 to 32767</td>
</tr>
<tr>
<td>SV002 PC2</td>
<td>Machine side gear ratio</td>
<td>1 to 32767</td>
</tr>
<tr>
<td>SV003 PGN1</td>
<td>Position loop gain 1</td>
<td>1 to 200 (rad/s)</td>
</tr>
<tr>
<td>SV004 PGN2</td>
<td>Position loop gain 2</td>
<td>0 to 999 (rad/s)</td>
</tr>
</tbody>
</table>

---

**SV001 PC1 Motor side gear ratio**

Set the gear ratio in the motor side when there is the gear between the servomotor’s shaft and machine (ball screw, etc.).

For the rotary axis, set the total deceleration (acceleration) ratio. Even if the gear ratio is within the setting range, the electronic gears may overflow and an initial parameter error (servo alarm 37) may occur.

For linear servo system
Set to "1".

---Setting range---
1 to 32767

**SV002 PC2 Machine side gear ratio**

Set the gear ratio in the machine side when there is the gear between the servomotor’s shaft and machine (ball screw, etc.).

For the rotary axis, set the total deceleration (acceleration) ratio. Even if the gear ratio is within the setting range, the electronic gears may overflow and an initial parameter error (servo alarm 37) may occur.

For linear servo system
Set to "1".

---Setting range---
1 to 32767

**SV003 PGN1 Position loop gain 1**

Set the position loop gain. The standard setting is "33". The higher the setting value is, the more accurately the command can be followed, and the shorter the settling time in positioning gets, however, note that a bigger shock will be applied to the machine during acceleration/deceleration.

When using the SHG control, also set SV004 (PGN2) and SV057 (SHGC).

---Setting range---
1 to 200 (rad/s)

**SV004 PGN2 Position loop gain 2**

When performing the SHG control, set the value of "SV003 x 8/3" to "SV004". When not using the SHG control, set to "0".

Related parameters: SV003, SV057

---Setting range---
0 to 999 (rad/s)
### Setup

**MITSUBISHI CNC**

1. **SV005 VGN1 Speed loop gain 1**
   - Set the speed loop gain.
   - The higher the setting value is, the more accurate the control will be, however, vibration tends to occur.
   - If vibration occurs, adjust by lowering by 20 to 30%.
   - The value should be determined to the 70 to 80% of the value at which the vibration stops.
   - The value differs depending on servo motors.
   - Aim at the standard value determined by the servo motor type and load inertia ratio to adjust.

   **---Setting range---**
   - 1 to 30000

2. **SV006 VGN2 Speed loop gain 2**
   - Set the speed loop gain at the motor limitation speed VLMT (maximum rotation speed x 1.15) with "VCS/SV029: Speed at the change of speed loop gain".
   - Use this to suppress noise at high speed rotation during rapid traverse, etc. Then, the speed loop gain decreases at faster speed than the setting value of VCS. When not using, set to "0".

   ![Gain diagram](image)

   **---Setting range---**
   - -1000 to 30000

3. **SV007 VIL Speed loop delay compensation**
   - Set this when the limit cycle occurs in the full-closed loop, or overshooting occurs in positioning. The speed loop delay compensation method can be selected with SV027/bit1,0.
   - Normally, use "Changeover type 2". Changeover type 2 controls the occurrence of overshooting by lowering the speed loop lead compensation after the position droop gets 0.
   - When setting this parameter, make sure to set the torque offset (SV032).

   **---Setting range---**
   - 0 to 32767

4. **SV008 VIA Speed loop lead compensation**
   - Set the gain of the speed loop integral control.
   - Standard setting: 1364  
   - Standard setting in the SHG control: 1900  
   - Adjust the value by increasing/decreasing this by about 100 at a time.
   - Raise this value to improve contour tracking accuracy in high-speed cutting.
   - Lower this value when the position droop does not stabilize (when the vibration of 10 to 20Hz occurs).

   **---Setting range---**
   - 1 to 9999

5. **SV009 IQA Current loop q axis lead compensation**
   - Set the fixed value of each motor.
   - Set the standard value for each motor described in the standard parameter list.

   **---Setting range---**
   - 1 to 20480
### 4-2 Setting the initial parameters for the servo drive unit

#### [2210] SV010 IDA  Current loop d axis lead compensation
Set the fixed value of each motor.
Set the standard value for each motor described in the standard parameter list.

---Setting range---
1 to 20480

#### [2211] SV011 IQG  Current loop q axis gain
Set the fixed value of each motor.
Set the standard value for each motor described in the standard parameter list.

---Setting range---
1 to 8192

#### [2212] SV012 IDG  Current loop d axis gain
Set the fixed value of each motor.
Set the standard value for each motor described in the standard parameter list.

---Setting range---
1 to 8192

#### [2213] SV013 ILMT  Current limit value
Set the current (torque) limit value in a normal operation.
This is a limit value in forward run and reverse run (for linear motors:forward and reverse direction).
When the standard setting value is "800", the maximum torque is determined by the specification of the motor.
Set this parameter as a proportion (%) to the stall current.

---Setting range---
0 - 999 (Stall current %)

#### [2214] SV014 ILMTsp  Current limit value in special control
Set the current (torque) limit value in a special operation (absolute position initial setting, stopper control and etc.).
This is a limit value in forward and reverse directions.
Set to "800" when not using.
Set this parameter as a proportion (%) to the stall current.

---Setting range---
0 - 999 (Stall current %)
However, when SV084/bitB=1, the setting range is from 0 to 32767 (Stall current 0.01%).

#### [2215] SV015 FFC  Acceleration rate feed forward gain
When a relative error in synchronous control is too large, set this parameter to the axis that is delaying.
The standard setting is "0". The standard setting in the SHG control is "50".
To adjust a relative error in acceleration/deceleration, increase the value by 50 at a time.

---Setting range---
0 to 999 (%)
[2216] SV016 LMC1 Lost motion compensation 1

Set this parameter when the protrusion (that occurs due to the non-sensitive band by friction, torsion, backlash, etc.) at quadrant change is too large. This sets the compensation torque at quadrant change (when an axis feed direction is reversed) by the proportion (%) to the stall torque. Whether to enable the lost motion compensation and the method can be set with other parameters.

Type 2: When SV027/bit9, 8=10 (Compatible with obsolete type)
Set the type 2 method compensation torque. The standard setting is double the friction torque.
Related parameters: SV027/bit9,8, SV033/bitF, SV039, SV040, SV041, SV082/bit2

Type 3: When SV082/bit1=1
Set the compensation torque equivalent of dynamic friction amount of the type 3 method compensation amount. The standard setting is double the dynamic friction torque.
Related parameters: SV041, SV082/bit2,1, SV085, SV086

To vary compensation amount according to the direction.
When SV041 (LMC2) is "0", compensate with the value of SV016 (LMC1) in both +/−directions.
If you wish to change the compensation amount depending on the command direction, set this and SV041 (LMC2).
(SV016: + direction, SV041: - direction. However, the directions may be opposite depending on other settings.)
When "-1" is set, the compensation will not be performed in the direction of the command.

---Setting range---
-1 to 200 (Stall current %)
Note that when SV082/bit2 is "1", the setting range is between -1 and 20000 (Stall current 0.01%).
### 4-2 Setting the initial parameters for the servo drive unit

Select the servo specifications. A function is allocated to each bit. Set this in hexadecimal format.

#### Bit F-C : spm  Motor series selection
- 0: 200V HF, HP motor 1
- 1: 200V HF, HP motor 2 (Standard)
- 2: 400V HF-H, HP-H motor 1
- 3: 400V HF-H, HP-H motor 2 (Standard)
- 6: 200V LM-F linear motor
- 7: 200V direct-drive motor
- 8: 400V LM-F linear motor
- 9: 400V direct-drive motor

#### Bit B :
Not used. Set to "0".

#### Bit A : drvup  Combined drive unit:
- For MDS-DM2 Series
  - 0: Normal setting (Combined drive unit: normal)
  - 1: Combined drive unit: one upgrade

#### Bit 9 :
Not used. Set to "0".

#### Bit 8 : mp  MPI scale pole number setting
- 0: 360 poles
- 1: 720 poles

#### Bit 7 : abs  Position control
These parameters are set automatically by the NC system.
- 0: Incremental
- 1: Absolute position control

#### Bit 6-5 :
Not used. Set to "0".

#### Bit 4 : sdir  Sub side detector feedback
Set the machine side detector's installation polarity.
- 0: Forward polarity
- 1: Reverse polarity

#### Bit 3 : vfb  Speed feedback filter
- 0: Stop
- 1: Start (2250Hz)

#### Bit 2 : seqh  Ready on sequence
- 0: Normal
- 1: High-speed

#### Bit 1 : dfbx  Dual feedback control
Control the position FB signal in full closed control by the combination of a motor side detector and machine side detector.
- 0: Stop
- 1: Start

Related parameters: SV051, SV052
**bit 0 : mdir Machine side detector feedback (for Linear/direct-drive motor)**

Set the detector installation polarity in the linear servo and direct-drive motor control.
0: Forward polarity  1: Reverse polarity

---

**【#2218(PR)】 SV018  PIT  Ball screw pitch/Magnetic pole pitch**

For servo motor:
Set the ball screw pitch. For the rotary axis, set to "360".

For direct-drive motor
Set to "360".

For linear motor
Set the ball screw pitch. (For LM-F series, set to "48")

---Setting range---
- For general motor: 1 to 32767 (mm/rev)
- For linear motor 1 to 32767 (mm)

---

**【#2219(PR)】 SV019  RNG1  Sub side detector resolution**

For semi-closed loop control
Set the same value as SV020.

For full-closed loop control
Set the number of pulses per ball screw pitch.

For direct-drive motor
Set the same value as SV020.

For 1000 pulse unit resolution detector, set the number of pulses in SV019 in increments of 1000 pulse (kp).
In this case, make sure to set "0" to SV117.
For high-accuracy binary resolution detector, set the number of pulses to four bite data of SV117 (high-order) and SV019 (low-order) in pulse (p) unit.
\[ SV117 = \text{number of pulses} / 65536 \text{ (when } =0, \text{ set } "-1" \text{ to } SV117) \]
\[ SV019 = \text{the remainder of number of "pulses} / 65536" \]
When the NC is C70 and "SV019 > 32767", set "the reminder of above - 65536 (negative number)" to "SV019".

---Setting range---
- When SV117 = 0, the setting range is from 0 to 32767 (kp)
  - When SV117 ≠ 0
    - M700V, M70V, M70, E70: 0 to 65536 (p)
    - C70: -32768 to 32767 (p)
4-2 Setting the initial parameters for the servo drive unit

**[#2220(PR)] SV020 RNG2 Main side detector resolution**

Set the number of pulses per revolution of the motor side detector.

- OSA18 (-A48) (260,000 p/rev) -------- SV020 = 260
- OSA105 (-A51) (1,000,000 p/rev) ------ SV020 = 1000
- OSA166 (-A74(N)) (16,000,000 p/rev) ----- SV020 = 16000

For linear motor
- Set the number of pulses of the detector per magnetic pole pitch with SV118.

For direct-drive motor
- Set the number of pulses per revolution of the motor side detector.

For 1000 pulse unit resolution detector, set the number of pulses to SV020 in increments of 1000 pulse(kp).

In this case, make sure to set SV118 to "0". For high-accuracy binary resolution detector, set the number of pulses to four byte data of SV118 (high-order) and SV020 (low-order) in pulse(p) unit.

- SV118 = number of pulses / 65536 (when =0, set "-1" to SV118)
- SV019 = the remainder of "number of pulses / 65536"

When the NC is C70 and "SV020 > 32767", set "the remainder of above - 65536 (negative number)" to "SV020".

---Setting range---

When SV118 = 0, the setting range is from 0 to 32767 (kp)

When SV118 ≠ 0
- For M700V, M70V, M70, E70: 0 to 65536 (p)
- For C70: -32768 to 32767 (p)

**[#2221] SV021 OLT Overload detection time constant**

Normally, set to "60". (For machine tool builder adjustment.)

Related parameters: SV022

---Setting range---

1 to 999 (s)

**[#2222] SV022 OLL Overload detection level**

Set the "Overload 1" (Alarm 50) current detection level as percentage to the stall current.

Normally set this parameter to "150". (For machine tool builder adjustment.)

Related parameters: SV021

---Setting range---

110 to 500 (Stall current %)

**[#2223] SV023 OD1 Excessive error detection width during servo ON**

Set the excessive error detection width in servo ON.

When set to "0", the excessive error alarm detection will be ignored, so do not set to "0".

<Standard setting value>

- OD1=OD2= \( \frac{(\text{Rapid traverse rate [mm/min]} / (60 \times \text{PGN1}) / 2 [\text{mm}]} \)

Related parameters: SV026

---Setting range---

0 to 32767 (mm)

However, when SV084/bitC=1, the setting range is from 0 to 32767 (μm).

**[#2224] SV024 INP In-position detection width**

Set the in-position detection width.

Set the positioning accuracy required for the machine.

The lower the setting is, the higher the positioning accuracy will be. However the cycle time (settling time) becomes longer.

The standard setting value is "50".

---Setting range---

0 to 32767 (μm)
## Setup

**MITSUBISHI CNC**

【#2225(PR)】 **SV025 MTYP Motor/Detector type**

Set the position detector type, speed detector type and motor type. The setting value is a four-digit hex (HEX).

<table>
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<tr>
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<tbody>
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</tr>
<tr>
<td>pen</td>
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</tbody>
</table>

### bit F-C : pen(HEX-4) Position detector

- **Semi-closed loop control by general motor**
  - pen=2

- **Full-closed loop control by general motor**
  - Ball screw end detector (OSA105ET2A, OSA166ET2NA)
    - pen=6
  - For serial signal output rotary scale (including MDS-B-HR)
    - pen=6
  - For rectangular wave signal output scale
    - pen=8
  - For serial signal output linear scale (including MDS-B-HR and MPI scale)
    - pen=A
  - For speed command synchronization control
    - Primary axis pen=A
    - Secondary axis pen=D

- For linear motor
  - pen=A

- For direct-drive motor
  - pen=2

### bit B-8 : ent(HEX-3) Speed detector

- For general motor: ent=2
- For linear motor: ent=A
- For direct-drive motor: ent=2
4-2 Setting the initial parameters for the servo drive unit

**bit 7-0 : mtyp(HEX-2,1) Motor type**

Set the motor type. Set this with SV017/bitF-C.

For SV017/bitF-C = 1 (200V standard motor series)

- HF75 : 01h  HP54 : 11h  HF-KP13 : E9h (Note 3)
- HF105 : 02h  HP104 : 12h  HF-KP23 : EAh
- HF54 : 03h  HP154 : 13h  HF-KP43 : EBh
- HF104 : 04h  HP224 : 1Bh  HF-KP73 : ECh
- HF154 : 05h, 0Fh (Note 1)  HP204 : 14h
- HF224 : 06h  HP354 : 15h
- HF204 : 07h  HP454 : 16h
- HF354 : 08h  HP704 : 17h
- HF123 : 24h  HP903 : 18h
- HF223 : 26h, 2Dh (Note 2)  HP1103 : 19h
- HF303 : 28h
- HF453 : 09h
- HF703 : 0Ah
- HF903 : 0Bh
- HF142 : 25h
- HF302 : 27h, 2Eh (Note 2)

(Note 1) When MDS-D2-V3 is connected  
(Note 2) When MDS-D2-V3 M/S axis is connected  
(Note 3) MDS-DJ-V1 only

For SV017/bitF-C = 3 (400V standard motor series)

- HF-H75 : 01h  HP-H54 : 11h
- HF-H105 : 02h  HP-H104 : 12h
- HF-H54 : 03h  HP-H154 : 13h
- HF-H104 : 04h  HP-H204 : 14h
- HF-H154 : 05h  HP-H354 : 15h
- HP-H454 : 16h
- HF-H204 : 07h  HP-H704 : 17h
- HF-H354 : 08h  HP-H903 : 18h
- HF-H453 : 09h  HP-H1103 : 19h
- HF-H703 : 0Ah
- HF-H903 : 0Bh  HP-H224 : 1Bh
- HC-H1502 : B9h

For linear motor and direct-drive motor, follow the settings stated in respective materials.

**【#2226】SV026 OD2 Excessive error detection width during servo OFF**

Set the excessive error detection width during servo OFF.

When set to “0”, the excessive error alarm detection will be ignored, so do not set to “0”.

<Standard setting value>

OD1=OD2= (Rapid traverse rate [mm/min]) / (60×PGN1) / 2 [mm]

Related parameters: SV023

---Setting range---

0 to 32767 (mm)

However, when SV084/bitC=1, the setting range is from 0 to 32767 (μm).
**Setup**

### MITSUBISHI CNC

**【#2227】SV027 SSF1 Servo function 1**

Select the servo functions. A function is assigned to each bit. Set this in hexadecimal format.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function</th>
<th>Setting Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>F</td>
<td>Not used. Set to &quot;0&quot;.</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>zrn2</td>
<td>Set to &quot;1&quot;. (Fixed)</td>
</tr>
<tr>
<td>D</td>
<td>Not used. Set to &quot;0&quot;.</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>Not used. Set to &quot;0&quot;.</td>
<td></td>
</tr>
<tr>
<td>B-A</td>
<td>ovs Overshooting compensation</td>
<td>Set if overshooting occurs during positioning.</td>
</tr>
<tr>
<td></td>
<td>bitB,A=</td>
<td></td>
</tr>
<tr>
<td></td>
<td>00: Compensation stop</td>
<td></td>
</tr>
<tr>
<td></td>
<td>01: Setting prohibited</td>
<td></td>
</tr>
<tr>
<td></td>
<td>10: Setting prohibited</td>
<td></td>
</tr>
<tr>
<td></td>
<td>11: Type 3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Set the compensation amount in</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SV031(OVS1) and SV042(OVS2).</td>
<td></td>
</tr>
<tr>
<td>9-8</td>
<td>lmc Lost motion compensation</td>
<td>Set this parameter when the protrusion at quadrant change is too large. Type 2</td>
</tr>
<tr>
<td></td>
<td>bit9,8=</td>
<td>has an obsolete type compatible control.</td>
</tr>
<tr>
<td></td>
<td>00: Compensation stop</td>
<td></td>
</tr>
<tr>
<td></td>
<td>01: Setting prohibited</td>
<td></td>
</tr>
<tr>
<td></td>
<td>10: Type 2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>11: Setting prohibited</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Set the compensation amount in</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SV016(LMC1) and SV041(LMC2).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Note) When &quot;SV082/bit1=1&quot;, the</td>
<td></td>
</tr>
<tr>
<td></td>
<td>lost motion compensation type 3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>will be selected regardless of</td>
<td></td>
</tr>
<tr>
<td></td>
<td>this setting.</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Not used. Set to &quot;0&quot;.</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Not used. Set to &quot;0&quot;.</td>
<td></td>
</tr>
<tr>
<td>5-4</td>
<td>vfct Jitter compensation pulse number</td>
<td>Suppress vibration by machine backlash when axis stops.</td>
</tr>
<tr>
<td></td>
<td>bit5,4=</td>
<td></td>
</tr>
<tr>
<td></td>
<td>00: Disable</td>
<td></td>
</tr>
<tr>
<td></td>
<td>01: 1 pulse</td>
<td></td>
</tr>
<tr>
<td></td>
<td>10: 2 pulse</td>
<td></td>
</tr>
<tr>
<td></td>
<td>11: 3 pulses</td>
<td></td>
</tr>
</tbody>
</table>
4-2 Setting the initial parameters for the servo drive unit

| bit 3 : | Not used. Set to "0". |
| bit 2 : | Not used. Set to "0". |

<table>
<thead>
<tr>
<th>bit 1-0 : vcnt</th>
<th>Speed loop delay compensation changeover type selection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normally, use &quot;Changeover type 2&quot;.</td>
<td></td>
</tr>
<tr>
<td>bit1,0=</td>
<td></td>
</tr>
<tr>
<td>00: Disable</td>
<td></td>
</tr>
<tr>
<td>01: Changeover type 1</td>
<td></td>
</tr>
<tr>
<td>10: Changeover type 2</td>
<td></td>
</tr>
<tr>
<td>11: Setting prohibited</td>
<td></td>
</tr>
</tbody>
</table>

Related parameters: SV007

**[#2228(PR)] SV028 MSFT  Magnetic pole shift amount (for linear/direct-drive motor)**

Set this parameter to adjust the motor magnetic pole position and detector's installation phase when using linear motors or direct-drive motors. During the DC excitation of the initial setup (SV034/bit4=1), set the same value displayed in "AFLT gain" on the NC monitor screen.

Related parameters: SV034/bit4, SV061, SV062, SV063

For general motor:
Not used. Set to "0".

---Setting range---
-18000 to 18000 (Mechanical angle 0.01°)

**[#2229] SV029 VCS  Speed at the change of speed loop gain**

Noise at high speed rotation including rapid traverse can be reduced by lowering the speed loop gain at high speeds. Set the speed at which the speed loop gain changes. Use this with SV006 (VGN2).
When not using, set to "0".

---Setting range---
0 to 9999 (r/min)

**[#2230] SV030 IVC  Voltage non-sensitive band compensation**

When 100% is set, the voltage reduction amount equivalent to the logical non-energization in the PWM control will be compensated. When "0" is set, 100% compensation will be performed. Adjust in increments of 10% from the default value of 100%. If increased too much, vibration or vibration noise may be generated.

---Setting range---
0 to 255 (%)
### #2231 SV031 OVS1 Overshooting compensation 1

This compensates the motor torque when overshooting occurs during positioning. This is valid only when the overshooting compensation (SV027/bitB,A) is selected.

**Type 3 SV027(SSF1)/bitB,A=11**

Set the compensation amount based on the motor stall current. Observing positioning droop waveform, increase in increments of 1% and find the value where overshooting does not occur.

To vary compensation amount depending on the direction.
- When SV042 (OVS2) is "0", change the SV031 (OVS1) value in both of the +/- directions to compensate.
- To vary the compensation amount depending on the command direction, set this and SV042 (OVS2).
  - (SV031: + direction, SV042: - direction. However, the directions may be opposite depending on other settings.)
- When "-1" is set, the compensation will not be performed in the direction of the command.

Related parameters: SV027/bitB,A, SV034/bitF-C, SV042, SV082/bit2

--- Setting range ---

-1 to 100 (Stall current %)

Note that the range will be "-1 - 10000" (Stall current 0.01%) when SV082/bit2 is "1".

### #2232 SV032 TOF Torque offset

Set the unbalance torque on vertical axis and inclined axis.
When the vertical axis pull up function is enabled, the pull up compensation direction is determined by this parameter's sign. When set to "0", the vertical axis pull up will not be executed.
This can be used for speed loop delay compensation and collision detection function.
To use load inertia estimation function (drive monitor display), set this parameter, friction torque (SV045) and load inertia display enabling flag(SV035/bitF).

Related parameters: SV007, SV033/bitE, SV059

--- Setting range ---

-100 to 100 (Stall current %)
4-2 Setting the initial parameters for the servo drive unit

【#2233】SV033 SSF2 Servo function 2

Select the servo functions.
A function is assigned to each bit.
Set this in hexadecimal format.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>F</td>
<td>lmc2a</td>
</tr>
<tr>
<td>E</td>
<td>zup</td>
</tr>
<tr>
<td>D</td>
<td>rps</td>
</tr>
<tr>
<td>C-8</td>
<td>nfd2</td>
</tr>
<tr>
<td>7-5</td>
<td>nfd1</td>
</tr>
<tr>
<td>4</td>
<td>fhz3</td>
</tr>
<tr>
<td>3-1</td>
<td>nfd1</td>
</tr>
<tr>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

- **bit F : lmc2a**  Lost motion compensation 2 timing
  
  0: Normal  1: Change

- **bit E : zup**  Vertical axis pull up function
  
  0: Stop  1: Enable
  
  Related parameters: SV032, SV095

- **bit D : rps**  Safely limited speed setting increment
  
  Change the setting units of the specified speed signal output speed (SV073) and safely limited speed (SV238).
  
  0: mm/min  1: 100mm/min
  
  Related parameters: SV073, SV238

- **bit C-8**
  
  Not used. Set to "0".

- **bit 7-5 : nfd2**  Depth of Notch filter 2
  
  Set the depth of Notch filter 2 (SV046).
  
  bit7,6,5=
  
  000: -∞
  001: -18.1[dB]
  010: -12.0[dB]
  011: -8.5[dB]
  100: -6.0[dB]
  101: -4.1[dB]
  110: -2.5[dB]
  111: -1.2[dB]

- **bit 4 : fhz3**  Notch filter 3
  
  0: Stop  1: Start (1,125Hz)

- **bit 3-1 : nfd1**  Depth of Notch filter 1
  
  Set the depth of Notch filter 1 (SV038).
  
  bit3,2,1=
  
  000: -∞
  001: -18.1[dB]
  010: -12.0[dB]
  011: -8.5[dB]
  100: -6.0[dB]
  101: -4.1[dB]
  110: -2.5[dB]
  111: -1.2[dB]

- **bit 0**
  
  Not used. Set to "0".
### [2234] SV034 SSF3 Servo function 3

Select the servo functions. A function is assigned to each bit. Set this in hexadecimal format.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>7-5</td>
<td>Not used. Set to &quot;0&quot;.</td>
</tr>
<tr>
<td>4</td>
<td>dcd (linear/direct-drive motor)</td>
</tr>
<tr>
<td>0</td>
<td>Normal setting     1: DC excitation mode</td>
</tr>
<tr>
<td>3</td>
<td>Not used. Set to &quot;0&quot;.</td>
</tr>
<tr>
<td>2</td>
<td>mohn Thermistor temperature detection (linear/direct-drive motor)</td>
</tr>
<tr>
<td>1</td>
<td>has HAS control</td>
</tr>
<tr>
<td>0</td>
<td>Not used. Set to &quot;0&quot;.</td>
</tr>
</tbody>
</table>

**bit F-C: ovsn Overshooting compensation type 3 Non-sensitive band**

Set the non-sensitive band of the model position droop overshooting amount in increments of 2 \( \mu \)m. In the feed forward control, set the non-sensitive band of the model position droop and ignore the overshooting of the model.

0 : 0 \( \mu \)m, 1: 2 \( \mu \)m, 2: 4 \( \mu \)m, ---, E : 28 \( \mu \)m, F: 30 \( \mu \)m

**bit B-8 : linN The number of parallel connections when using linear motors (for linear)**

Set to "2" to perform 1 amplifier 2 motor control by linear servo.

**bit 2 : mohn Thermistor temperature detection (linear/direct-drive motor)**

0: Normal setting 1: Disable

**bit 1 : has HAS control**

This stabilizes the speed overshooting by torque saturation phenomenon.

0: Normal setting 1: Enable

Related parameters: SV084/bitF
#2235  SV035  SSF4  Servo function 4

Select the servo functions.
A function is assigned to each bit.
Set this in hexadecimal format.

.bit F : clt  Inertia ratio display
  0: Setting for normal use
  1: Display the total inertia ratio estimated at acceleration/deceleration at the inertia ratio on the
      servo monitor screen
      To display it on the screen, set an imbalance torque and friction torque to both SV032 and SV045
      and repeat acceleration/deceleration operations for several times.

.bit E-C: clG1  G1 Collision detection level
  Set the collision detection level in the collision detection method 1 during cutting feed (G1) in
  multiples of that of rapid traverse (G0). When set to "0", detection of collision detection method 1
  during cutting feed will be ignored.
  G1 Collision detection level = G0 collision detection level (SV060) × clG1

.bit B : cl2n  Collision detection method 2
  0: Enable    1: Disable

.bit A :
  Not used. Set to "0".

.bit 9-8 : cltq  Retract torque in collision detection
  Set the retract torque in collision detection using the ratio of motor's maximum torque.
  bit9,8=
    00: 100%
    01: 90%
    10: 80%(Standard)
    11: 70%

.bit 7 : ckab  No signal detection 2
  Set this to use rectangular wave output linear scale.
  This enables the detection of No signal 2 (alarm 21).
  0: Disable    1: Enable

.bit 6-0 :
  Not used. Set to "0".
【#2236(PR)] SV036  PTYP  Power supply type/ Regenerative resistor type

**MDS-D2/DH2 Series: Power supply type**

When connecting a power supply unit, set a code for each power supply unit.

<table>
<thead>
<tr>
<th>Bit Code</th>
<th>Description</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>7-0</td>
<td>ptyp</td>
<td></td>
</tr>
<tr>
<td>1-8</td>
<td>rtyp</td>
<td></td>
</tr>
<tr>
<td>0-5</td>
<td>amp</td>
<td></td>
</tr>
</tbody>
</table>

**bit F-C : amp**

Not used. Set to "0".

**bit B-8 : rtyp**

Not used. Set to "0".

**bit 7-0 : ptyp  External emergency stop setting**

- When the emergency stop input signal of the power supply unit is "disabled"  
  - Power supply unit is not connected : 00
  - MDS-D2-CV-37 / MDS-DH2-CV-37 : 04
  - MDS-D2-CV-75 / MDS-DH2-CV-75 : 08
  - MDS-D2-CV-110 / MDS-DH2-CV-110 : 11
  - MDS-D2-CV-185 / MDS-DH2-CV-185 : 19
  - MDS-D2-CV-300 / MDS-DH2-CV-300 : 30
  - MDS-D2-CV-370 / MDS-DH2-CV-370 : 37
  - MDS-D2-CV-450 / MDS-DH2-CV-450 : 45
  - MDS-D2-CV-550 / MDS-DH2-CV-550 : 55
  - MDS-DH2-CV-750 : 75

- When the emergency stop input signal of the power supply unit is "enabled"  
  (Note) Set the power supply rotary switch to "4".  
  - Power supply unit is not connected : 00
  - MDS-D2-CV-37 / MDS-DH2-CV-37 : 44
  - MDS-D2-CV-75 / MDS-DH2-CV-75 : 48
  - MDS-D2-CV-110 / MDS-DH2-CV-110 : 51
  - MDS-D2-CV-185 / MDS-DH2-CV-185 : 59
  - MDS-D2-CV-300 / MDS-DH2-CV-300 : 70
  - MDS-D2-CV-370 / MDS-DH2-CV-370 : 77
  - MDS-D2-CV-450 / MDS-DH2-CV-450 : 85
  - MDS-D2-CV-550 / MDS-DH2-CV-550 : 95
  - MDS-DH2-CV-750 : B5

**MDS-DM2-SPV Series**

Not used. Set to "0000".

External emergency stop power supply type is set by spindle parameter (SP032).
4-2 Setting the initial parameters for the servo drive unit

MDS-DJ-V1 Series: Regenerative resistor type

Set the regenerative resistor type.

<table>
<thead>
<tr>
<th>Bit</th>
<th>F</th>
<th>E</th>
<th>D</th>
<th>C</th>
<th>B</th>
<th>A</th>
<th>9</th>
<th>8</th>
<th>7</th>
<th>6</th>
<th>5</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>emgx</td>
<td>rtyp</td>
<td>amp</td>
</tr>
</tbody>
</table>

**bit F-8 : amp(bit F-C) / rtyp(bit B-8)**

- Resistor built-in drive unit: 10
- Setting prohibited: 11
- MR-RB032: 12
- MR-RB12 or GZG200W39OHMK: 13
- MR-RB32 or GZG200W120OHMK 3 units connected in parallel: 14
- MR-RB30 or GZG200W39OHMK 3 units connected in parallel: 15
- MR-RB50 or GZG300W39OHMK 3 units connected in parallel: 16
- MR-RB31 or GZG200W20OHMK 3 units connected in parallel: 17
- MR-RB51 or GZG300W20OHMK 3 units connected in parallel: 18
- Setting prohibited: 19-1F
- Setting prohibited: 20-23
- FCUA-RB22: 24
- FCUA-RB37: 25
- FCUA-RB55: 26
- Setting prohibited: 27-28
- R-UNIT2: 29
- Setting prohibited: 2A-2C
- FCUA-RB75/2 2 units connected in parallel: 2D
- FCUA-RB55 2 units connected in parallel: 2E
- Setting prohibited: 2F

**bit 7-4 : emgx External emergency stop function**

Set the external emergency stop function.

0: Disable 4: Enable

**bit 3-0 :**

Not used. Set to "0".

---Setting range---

For general motor: 0 to 5000 (%)
For linear motor: 0 to 5000 (kg)

---Setting range---

For general motor: 0 to 5000 (%)
For linear motor: 0 to 5000 (kg)
【#2238】SV038  FHz1  Notch filter frequency 1
Set the vibration frequency to suppress when machine vibration occurs. (Normally, do not set 80 or less.)
Set to "0" when not using.

Related parameters: SV033/bit3-1, SV115

---Setting range---
0 to 2250 (Hz)

【#2239】SV039  LMCD  Lost motion compensation timing
Set this when the timing of lost motion compensation type 2 does not match.
Adjust increments of 10 at a time.

---Setting range---
0 to 2000 (ms)

【#2240】SV040  LMCT  Lost motion compensation non-sensitive band
Set the non-sensitive band of the lost motion compensation in the feed forward control.
When "0" is set, 2 μm is the actual value to be set. Adjust increments of 1 μm.

---Setting range---
0 to 255 (μm)

【#2241】SV041  LMC2  Lost motion compensation 2
Set this with SV016 (LMC1) only when you wish to vary the lost motion compensation amount depending on the command directions.
Normally, set to "0".

---Setting range---
-1 to 200 (Stall current %)
Note that when SV082/bit2 is "1", the setting range is between -1 and 20000 (Stall current 0.01%).

【#2242】SV042  OVS2  Overshooting compensation 2
Set this with SV031 (OVS1) only when you wish to vary the overshooting compensation amount depending on the command directions.
Normally, set to "0".

---Setting range---
-1 to 100 (Stall current %)
Note that when SV082/bit2 is "1", the setting range is between -1 and 10000 (Stall current 0.01%).

【#2243】SV043  OBS1  Disturbance observer filter frequency
Set the disturbance observer filter band.
Normally, set to "100". Setting values of 49 or less is equal to "0" setting.
To use the disturbance observer, also set SV037 (JL) and SV044 (OBS2).
When disturbance observer related parameters are changed, lost motion compensation needs to be readjusted.
Set to "0" when not using.

---Setting range---
0 to 1000 (rad/s)
### #2244 SV044 OBS2 Disturbance observer gain

Set the disturbance observer gain. The standard setting is "100 to 300".
To use the disturbance observer, also set SV037 (JL) and SV043 (OBS1).
When disturbance observer related parameters are changed, lost motion compensation needs to be readjusted.
Set to "0" when not using.
---Setting range---
0 to 500 (%)

### #2245 SV045 TRUB Friction torque

Set the frictional torque when using the collision detection function.
To use load inertia estimation function (drive monitor display), set this parameter, imbalance torque (SV032) and load inertia display enabling flag (SV035/bitF).
---Setting range---
0 to 255 (Stall current %)

### #2246 SV046 FH22 Notch filter frequency 2

Set the vibration frequency to suppress when machine vibration occurs.
(Normally, do not set 80 or less.)
Set to "0" when not using.
Related parameters: SV033/bit7-5, SV115
---Setting range---
0 to 2250 (Hz)

### #2247 SV047 EC Inductive voltage compensation gain

Set the inductive voltage compensation gain. Standard setting value is "100".
If the current FB peak exceeds the current command peak, lower the gain.
---Setting range---
0 to 200 (%)

### #2248 SV048 EMGrt Vertical axis drop prevention time

Input the time required to prevent the vertical axis from dropping by delaying READY OFF until the brake works at an emergency stop.
Increase in increments of 100ms at a time, find and set the value where the axis does not drop.
When using a motor with a break of HF(-H) Series or HP(-H) Series, set to "200ms" as a standard.
When the pull up function is enabled (SV033/bitE=1), the pull up is established during the drop prevention time.
Related parameters: SV033/bitE, SV055, SV056
---Setting range---
0 to 20000 (ms)

### #2249 SV049 PGN1sp Position loop gain 1 in spindle synchronous control

Set the position loop gain during spindle synchronization control (synchronous tapping and synchronization control with spindle C-axis).
Set the same value as that of the position loop gain for spindle synchronous tapping control.
When performing the SHG control, set this parameter with SV050 (PGN2sp) and SV058 (SHGCsp).
When changing the value, change the value of "#2017 tap_g Axis servo gain".
---Setting range---
1 to 200 (rad/s)
# Setup

## SV050 PGN2sp Position loop gain 2 in spindle synchronous control

When using SHG control during spindle synchronous control (synchronous tapping and synchronization control with spindle C-axis), set this parameter with SV049 (PGN1sp) and SV058 (SHGCsp). Make sure to set the value 8/3 times that of SV049. When not using the SHG control, set to "0".

--- Setting range ---

0 to 999 (rad/s)

## SV051 DFBT Dual feedback control time constant

Set the control time constant in dual feedback. When "0" is set, it operates at 1ms. The higher the time constant is, the closer it gets to the semi-closed control, so the limit of the position loop gain will be raised.

For linear servo/direct-drive motor system

Not used. Set to "0".

Related parameters: SV017/bit1, SV052

--- Setting range ---

0 to 9999 (ms)

## SV052 DFBN Dual feedback control non-sensitive band

Set the non-sensitive band in the dual feedback control. Normally, set to "0".

For linear servo/direct-drive motor system

Not used. Set to "0".

Related parameters: SV017/bit1, SV052

--- Setting range ---

0 to 9999 (μ m)

## SV053 OD3 Excessive error detection width in special control

Set the excessive error detection width when servo ON in a special control (initial absolute position setting, stopper control, etc.). When "0" is set, excessive error detection will not be performed when servo ON during a special control.

--- Setting range ---

0 to 32767 (mm)

However, when SV084/bitC=1, the setting range is from 0 to 32767 (μ m).

## SV054 ORE Overrun detection width in closed loop control

Set the overrun detection width in the full-closed loop control. When the gap between the motor side detector and the linear scale (machine side detector) exceeds the value set by this parameter, it will be judged as overrun and "Alarm 43" will be detected. When "-1" is set, the alarm detection will not be performed. When "0" is set, overrun will be detected with a 2mm width.

For linear servo/direct-drive motor system

Not used. Set to "0".

--- Setting range ---

-1 to 32767 (mm)

However, when SV084/bitD=1, the setting range is from -1 to 32767 (μ m).
Setting the initial parameters for the servo drive unit

- **SV055 EMGx Max. gate off delay time after emergency stop**
  - Set the time required between an emergency stop and forced READY OFF.
  - Set the maximum value "+100ms" of the SV056 setting value of the servo drive unit electrified by the same power supply unit.
  - When executing the vertical axis drop prevention, the gate off will be delayed for the length of time set at SV048 even when SV055’s is smaller than that of SV048.

  Related parameters: SV048, SV056

  --- Setting range ---
  - 0 to 20000 (ms)

- **SV056 EMGt Deceleration time constant at emergency stop**
  - Set the time constant used for the deceleration control at emergency stop.
  - Set the time required to stop from rapid traverse rate (rapid).
  - The standard setting value is EMGt×G0tL×0.9.
  - However, note that the standard setting value differs from the above-mentioned value when the setting value of "#2003: smgst Acceleration and deceleration modes bit 3-0: Rapid traverse acceleration/deceleration type" is 8 or F. Refer to Instruction Manual of the drive unit (section "Deceleration control") for details.

  Related parameters: SV048, SV055

  --- Setting range ---
  - 0 to 20000 (ms)

- **SV057 SHGC SHG control gain**
  - When performing the SHG control, set to SV003(PGN1)×6.
  - When not using the SHG control, set to "0".

  Related parameters: SV003, SV004

  --- Setting range ---
  - 0 to 1200 (rad/s)

- **SV058 SHGCsp SHG control gain in spindle synchronous control**
  - When using SHG control during spindle synchronization control (synchronous tapping and synchronous control with spindle C-axis), set this parameter with SV049 (PGN1sp) and SV050 (PGN2sp).
  - Make sure to set the value 6 times that of SV049.
  - When not using the SHG control, set to "0".

  --- Setting range ---
  - 0 to 1200 (rad/s)

- **SV059 TCNV Collision detection torque estimated gain**
  - Set the torque estimated gain when using the collision detection function.
  - The standard setting value is the same as the load inertia ratio (SV037 setting value) including motor inertia.
  - Set to "0" when not using the collision detection function.

  Related parameters: SV032, SV035/bitF-8, SV037, SV045, SV060

  <<Drive monitor load inertia ratio display>>
  - Set SV035/bitF-1 and imbalance torque and friction torque to both SV032 and SV045, and then repeat acceleration/deceleration for several times.

  --- Setting range ---
  - For general motor: 0 to 5000 (%)
  - For linear motor: 0 to 5000 (kg)
### #2260 SV060 TLMT Collision detection level

When using the collision detection function, set the collision detection level at the G0 feeding. When "0" is set, none of the collision detection function will work.

Related parameters: SV032, SV035/bitF-8, SV037, SV045, SV059

--- Setting range ---
0 to 999 (Stall current %)

--- #2261 SV061 DA1NO D/A output ch1 data No. / Initial DC excitation level ---

Input the data number you wish to output to the D/A output channel 1. When using the 2-axis drive unit, set ",-1" to the axis that the data will not be output.

When the DC excitation is running (SV034/bit4=1):
- Use this when the DC excitation is running (SV034/bit4=1) to adjust the initial magnetic pole position (when measuring the magnetic pole shift amount) for linear motor and direct-drive motor.
- Set the initial excitation level in DC excitation control.
- Set 5% as standard.
- Related parameters: SV062, SV063

--- Setting range ---
-1 to 127
When the DC excitation is running (SV034/bit4=1): 0 to 100 (Stall current %)

--- #2262 SV062 DA2NO D/A output ch2 data No. / Final DC excitation level ---

Input the data number you wish to output to the D/A output channel 2. When using the 2-axis drive unit, set ",-1" to the axis that the data will not be output.

When the DC excitation is running (SV034/bit4=1):
- Use this when the DC excitation is running (SV034/bit4=1) to adjust the initial magnetic pole position (when measuring the magnetic pole shift amount) for linear motor and direct-drive motor.
- Set the final excitation level in DC excitation control.
- Set 5% as standard.
- When the magnetic pole shift amount measurement value is unsteady, adjust the value in increments of 5%.
- Related parameters: SV061, SV063

--- Setting range ---
-1 to 127
When the DC excitation is running (SV034/bit4=1): 0 to 10000 (ms)

--- #2263 SV063 DA1MPY D/A output ch1 output scale / Initial DC excitation time ---

Set output scale of the D/A output channel 1 in increment of 1/100. When "0" is set, the magnification is the same as when "100" is set.

When the DC excitation is running (SV034/bit4=1):
- Use this when the DC excitation is running (SV034/bit4=1) to adjust the initial magnetic pole position (when measuring the magnetic pole shift amount) for linear motor and direct-drive motor.
- Set the initial excitation time in DC excitation control.
- Set 500ms as standard.
- When the magnetic pole shift amount measurement value is unsteady, adjust the value in increments of 500ms.
- Related parameters: SV061, SV062

--- Setting range ---
-32768 to 32767 (1/100-fold)
When the DC excitation is running (SV034/bit4=1): 0 to 10000 (ms)

--- #2264 SV064 DA2MPY D/A output ch2 output scale ---

Set output scale of the D/A output channel 2 in increment of 1/100. When "0" is set, the magnification is the same as when "100" is set.

--- Setting range ---
-32768 to 32767 (1/100-fold)
**[#2265] SV065  TLC  Machine end compensation gain**

The shape of the machine end is compensated by compensating the spring effect from the machine end to the motor end.

Set the machine end compensation gain. Measure the error amount by roundness measurement and estimate the setting value by the following formula.

\[
\text{Compensation amount (\( \mu \text{m} \))} = \frac{\text{Command speed } F(\text{mm/min})^2 \times SV065}{(\text{Radius } R(\text{mm}) \times SV003 \times 16,200,000)}
\]

Set to "0" when not using.

---Setting range---
-30000 to 30000 (Acceleration ratio 0.1%)

---[#2266-2272] SV066 - SV072---

This parameter is set automatically by the NC system.

---[#2273(PR)] SV073  FEEDout  Specified speed output speed---

Set the specified speed.
Also set SV082/bit9,8 to output digital signal.

---Setting range---
0 to 32767 (r/min)
However, when SV033/bitD=1, the setting range is from 0 to 32767 (100mm/min).
(Only for MDS-D2/DH2 and MDS-DM2)

---[#2274-2280] SV074 - SV080---

This parameter is set automatically by the NC system.

---[#2281(PR)] SV081  SPEC2  Servo specification 2---

Select the servo functions.
A function is assigned to each bit.
Set this in hexadecimal format.

\[
\begin{array}{cccccccccc}
B & I & F & E & D & C & B & A & 9 & 8 & 7 & 6 & 5 & 4 & 3 & 2 & 1 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
\end{array}
\]

- **bit F-A**:
  Not used. Set to "0".

- **bit 9 : npg  Earth fault detection**
  0: Disable    1: Enable (standard)
  Set "0" and it is constantly "Enable" for MDS-DJ-V1 Series.

- **bit 8**:
  Not used. Set to "0".

- **bit 7 : szchk  Distance-coded reference scale reference mark**
  0: Check at 4 points (standard)    1: Check at 3 points

- **bit 6-4**:
  Not used. Set to "0".

- **bit 3 : absc  Distance-coded reference scale**
  0: Disable    1: Enable

- **bit 2-0**:
  Not used. Set to "0".
Select the servo functions. A function is assigned to each bit. Set this in hexadecimal format.

- **Bit 15-12**: dis Digital signal input selection
  - 0: No signal
  - 1: SLS (Safely Limited Speed) function door state signal
  - 2: Battery box voltage drop warning (It is not available for MDS-DJ-V1 Series.)
  - 3 to F: Setting prohibited

- **Bit 11-9**: dos3 Digital signal output 3 selection
  - Bit B, A =
  - 00: Disable
  - 01: Setting prohibited
  - 10: Contactor control signal output (For MDS-DJ-V1)
  - 11: Setting prohibited

- **Bit 8-6**: dos2 Digital signal output 2 selection
  - Bit 9, 8 =
  - 00: Disable
  - 01: Specified speed output
  - 10: Setting prohibited
  - 11: Setting prohibited

- **Bit 5-3**: Not used. Set to "0".

- **Bit 2**: ccu Lost motion overshoot compensation compensation amount setting increment
  - 0: Stall current %
  - 1: Stall current 0.01%

- **Bit 1**: Imc3 Lost motion compensation type 3
  - Set this when protrusion at a quadrant change is too big.
  - 0: Stop
  - 1: Start
  
  Related parameters: SV016, SV041, SV085, SV086

- **Bit 0**: Not used. Set to "0".
### Set the initial parameters for the servo drive unit

**SV083 SSF6 Servo function 6**

Select the servo functions. A function is assigned to each bit. Set this in hexadecimal format.

<table>
<thead>
<tr>
<th>Bit Position</th>
<th>Function</th>
<th>Setting</th>
</tr>
</thead>
</table>
| 7-5          | nfd5 Depth of Notch filter 5 | 000: -∞  
001: -18.1[dB]  
010: -12.0[dB]  
011: -8.5[dB]  
100: -6.0[dB]  
101: -4.1[dB]  
110: -2.5[dB]  
111: -1.2[dB] |
| 4            | nfd4 Depth of Notch filter 4  | 000: -∞  
001: -18.1[dB]  
010: -12.0[dB]  
011: -8.5[dB]  
100: -6.0[dB]  
101: -4.1[dB]  
110: -2.5[dB]  
111: -1.2[dB] |
| 0            |                | Not used. Set to "0". |

**bit F-8**  
Not used. Set to "0".

**bit 7-5 : nfd5 Depth of Notch filter 5**

Set the depth of Notch filter 5 (SV088).

<table>
<thead>
<tr>
<th>Setting</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>000: -∞</td>
<td>-∞</td>
</tr>
<tr>
<td>010: -12.0[dB]</td>
<td>-12.0[dB]</td>
</tr>
<tr>
<td>011: -8.5[dB]</td>
<td>-8.5[dB]</td>
</tr>
<tr>
<td>100: -6.0[dB]</td>
<td>-6.0[dB]</td>
</tr>
<tr>
<td>101: -4.1[dB]</td>
<td>-4.1[dB]</td>
</tr>
<tr>
<td>110: -2.5[dB]</td>
<td>-2.5[dB]</td>
</tr>
<tr>
<td>111: -1.2[dB]</td>
<td>-1.2[dB]</td>
</tr>
</tbody>
</table>

**bit 4**  
Not used. Set to "0".

**bit 3-1 : nfd4 Depth of Notch filter 4**

Set the depth of Notch filter 4 (SV087).

<table>
<thead>
<tr>
<th>Setting</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>000: -∞</td>
<td>-∞</td>
</tr>
<tr>
<td>010: -12.0[dB]</td>
<td>-12.0[dB]</td>
</tr>
<tr>
<td>011: -8.5[dB]</td>
<td>-8.5[dB]</td>
</tr>
<tr>
<td>100: -6.0[dB]</td>
<td>-6.0[dB]</td>
</tr>
<tr>
<td>101: -4.1[dB]</td>
<td>-4.1[dB]</td>
</tr>
<tr>
<td>110: -2.5[dB]</td>
<td>-2.5[dB]</td>
</tr>
<tr>
<td>111: -1.2[dB]</td>
<td>-1.2[dB]</td>
</tr>
</tbody>
</table>

**bit 0**  
Not used. Set to "0".
**[#2284] SV084 SSF7 Servo function 7**

Select the servo functions.
A function is assigned to each bit.
Set this in hexadecimal format.

### Bit F: h2c HAS control cancel amount

- 0: 1/4 (standard)
- 1: 1/2

Related parameters: SV034/bit1

### Bit E:

Not used. Set to "0".

### Bit D: oru Overrun detection width unit

- 0: mm (normal setting)
- 1: μm

### Bit C: odu Excessive error detection width unit

- 0: mm (normal setting)
- 1: μm

### Bit B: ilm2u Current limit value (SV014) in special control setting unit

- 0: Stall current % (normal setting)
- 1: Stall current 0.01%

### Bit A-1:

Not used. Set to "0".

### Bit 0: irms Motor current display

- 0: Motor q axis current display (normal)
- 1: Motor effective current display

---

**[#2285] SV085 LMCK Lost motion compensation 3 spring constant**

Set the machine system's spring constant when selecting lost motion compensation type 3.
When not using, set to "0".

Related parameters: SV016, SV041, SV082/bit2,1, SV086

---Setting range---

0 to 32767 (0.01%/μm)
4-2 Setting the initial parameters for the servo drive unit

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Setting Range</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>[2286] SV086</strong> LMCc</td>
<td>Lost motion compensation 3 viscous coefficient</td>
<td>Set the machine system's viscous coefficient when selecting lost motion compensation type 3. When not using, set to &quot;0&quot;.</td>
<td>0 to 32767 (0.01%•s/mm)</td>
</tr>
<tr>
<td>Related parameters: SV016, SV041, SV082/bit2,1, SV086</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>[2287] SV087</strong> FHz4</td>
<td>Notch filter frequency 4</td>
<td>Set the vibration frequency to suppress when machine vibration occurs. (Normally, do not set 80 or less.) Set to &quot;0&quot; when not using.</td>
<td>0 to 2250 (Hz)</td>
</tr>
<tr>
<td>Related parameters: SV083/bit3-1, SV115</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>[2288] SV088</strong> FHz5</td>
<td>Notch filter frequency 5</td>
<td>Set the vibration frequency to suppress when machine vibration occurs. (Normally, do not set 80 or less.) Set to &quot;0&quot; when not using.</td>
<td>0 to 2250 (Hz)</td>
</tr>
<tr>
<td>Related parameters: SV083/bit7-5, SV115</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>[2289] SV089</strong></td>
<td>Not used. Set to &quot;0&quot;.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>[2290] SV090</strong></td>
<td>Not used. Set to &quot;0&quot;.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>[2291] SV091</strong> LMC4G</td>
<td>Lost motion compensation 4 gain</td>
<td>Use this with LMC compensation type 3. As the delay in path tracking is monitored and compensated, the delay in path tracking will be minimized even if machine friction amount changes by aging. Use the lost motion compensation amount (SV016) * 5 (10% of the dynamic friction torque) as the target. The higher the setting value is, the more accurate the quadrant change be; however, the more likely vibrations occur.</td>
<td>0 to 20000 (Stall current 0.01%)</td>
</tr>
<tr>
<td><strong>[2292] SV092</strong></td>
<td>Not used. Set to &quot;0&quot;.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>[2293] SV093</strong></td>
<td>Not used. Set to &quot;0&quot;.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### [2294] SV094 MPV Magnetic pole position error detection speed

The magnetic pole position detection function monitors the command speed and motor speed at the position command stop and detects the magnetic pole position error alarm (3E) if any. Set the error detection level for the command speed and motor speed at the position command stop. Be aware when setting the parameter as the setting units for general motors and linear motors are different.

**<<For general motor>>**
When the command speed error detection level is set to "0", the magnetic pole position error (3E) is detected at 10r/min. Set "10" as standard. This detects the magnetic pole position error (3E) when the motor rotation speed is 100r/min and more.

**<<For linear motor>>**
When the command motor speed level is set to "0", the magnetic pole position error (3E) is detected at 1mm/s. Set "10" as standard. This detects the magnetic pole position error (3E) when the motor speed is 10mm/s and more.

---Setting range---
0 to 31999

**<<For general motor>>**
Ten-thousands digit, Thousands digit ----------- Command speed error detection level (10r/min)
Hundreds digit, Tens digit, Ones digit ----------- Motor speed error detection level (10r/min)

**<<For linear motor>>**
Ten-thousands digit, Thousands digit ----------- Command speed error detection speed level (1mm/s)
Hundreds digit, Tens digit, Ones digit ----------- Motor speed error detection level (1mm/s)

### [2295] SV095 ZUPD Vertical axis pull up distance

Set this parameter to adjust the pull up distance when the vertical axis pull up function is enabled. When the pull up function is enabled and this parameter is set to "0", for a rotary motor, 8/1000 of a rotation at the motor end is internally set as the pull up distance, and for a linear motor, 80[μm] is set.

**Related parameters:**
SV032 : The pull up direction is determined. When "0" is set, pull up control is not executed.
SV033/bitE : Start-up of the pull up function
SV048 : Set the drop prevention time. When "0" is set, pull up control is not executed.

---Setting range---
0 to 2000 (μm)

### [2296-2300] SV096 - SV100

Not used. Set to "0".

### [2301] SV101 TMA1 OMR-FF movement averaging filter time constant 1

Set the movement averaging filter time constant in OMR-FF control. The standard setting is "88". Set to "0" when not using OMR-FF control.

---Setting range---
0 to 711 (0.01ms)

### [2302] SV102 TMA2 OMR-FF movement averaging filter time constant 2

Set the movement averaging filter time constant in OMR-FF control. The standard setting is "88". Set to "0" when not using OMR-FF control.

---Setting range---
0 to 711 (0.01ms)
4-2 Setting the initial parameters for the servo drive unit

【#2303】SV103
Not used. Set to "0".

【#2304】SV104 FFR0 OMR-FF inner rounding compensation gain for G0
Set the inner rounding compensation amount (drive side feed forward gain) in OMR-FF control.
When a shape tracking error is too large in OMR-FF control, adjust it by setting this parameter.
The higher the setting value is, the less the shape tracking error will be, however, overshooting
during acceleration/deceleration will increase.
Lower the value when vibration occurs during the G0 acceleration/deceleration.
The standard setting is "10000".
Set to "0" when not using OMR-FF control.

---Setting range---
0 to 20000 (0.01%)

【#2305】SV105 FFR1 OMR-FF inner rounding compensation gain for G1
Set the inner rounding compensation amount (drive side feed forward gain) in OMR-FF control.
When a shape tracking error is too large in OMR-FF control, adjust it by setting this parameter.
The higher the setting value is, the less the shape tracking error will be, however, overshooting
during acceleration/deceleration will increase.
Lower the value when vibration occurs during the G1 acceleration/deceleration.
The standard setting is "10000".
Set to "0" when not using OMR-FF control.

---Setting range---
0 to 20000 (0.01%)

【#2306】SV106 PGM OMR-FF scale model gain
Set the scale model gain (position response) in OMR-FF control.
Set the same value as SV003(PGN1).
Increase the setting value to perform a high-speed machining such as a fine arc or to improve the
path error.
Lower the value when vibration occurs during acceleration/deceleration.
Set to "0" when not using OMR-FF control.

---Setting range---
0 to 300 (rad/s)

【#2307-2311】SV107 - SV111
Not used. Set to "0".

【#2312】SV112 IFF OMR-FF current feed forward gain
Set the current feed forward rate in OMR-FF control.
The standard setting is "10000".
Setting value of 0 is equal to "10000(100%)" setting.
Set to "0" when not using OMR-FF control.

---Setting range---
0 to 32767 (0.01%)
### #2313 SV113 SSF8 Servo function 8

Select the servo functions. A function is assigned to each bit. Set this in hexadecimal format.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function</th>
<th>Setting</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>F</td>
<td>ssc</td>
<td>0: Stop 1: Start</td>
<td>SLS (Safety Limited Speed) function</td>
</tr>
<tr>
<td>E-9</td>
<td>Not used.</td>
<td></td>
<td>Set to &quot;0&quot;.</td>
</tr>
<tr>
<td>8</td>
<td>sto</td>
<td></td>
<td>Dedicated wiring STO function</td>
</tr>
<tr>
<td>7-1</td>
<td>Not used.</td>
<td></td>
<td>Set to &quot;0&quot;.</td>
</tr>
<tr>
<td>0</td>
<td>omrffon</td>
<td>0: Disable 1: Enable</td>
<td>OMR-FF control enabled</td>
</tr>
</tbody>
</table>

### #2314 SV114 SSF9 Servo function 9

Select the servo functions. A function is assigned to each bit. Set this in hexadecimal format.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function</th>
<th>Setting</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>F-9</td>
<td>Not used.</td>
<td></td>
<td>Set to &quot;0&quot;.</td>
</tr>
<tr>
<td>8</td>
<td>nohis</td>
<td>0: Enable 1: Disable</td>
<td>History of communication error alarm between NC and DRV (34, 36, 38, 39)</td>
</tr>
<tr>
<td>7</td>
<td>cse</td>
<td>0: Normal setting 1: Enable</td>
<td>Command speed monitoring function</td>
</tr>
<tr>
<td>6-0</td>
<td>Not used.</td>
<td></td>
<td>Set to &quot;0&quot;.</td>
</tr>
</tbody>
</table>
## SV115 SSF10 Servo function 10

Select the servo functions. A function is assigned to each bit. Set this in hexadecimal format.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>F</td>
<td>Notch filter5 all frequencies adapted</td>
</tr>
<tr>
<td>E</td>
<td>Notch filter frequency display</td>
</tr>
<tr>
<td>D</td>
<td>Notch filter 5 / Adaptive follow-up function</td>
</tr>
<tr>
<td>C</td>
<td>Notch filter 4 / Adaptive follow-up function</td>
</tr>
<tr>
<td>B</td>
<td>Notch filter 2 / Adaptive follow-up function</td>
</tr>
<tr>
<td>A</td>
<td>Notch filter 1 / Adaptive follow-up function</td>
</tr>
<tr>
<td>9</td>
<td>Estimated resonance frequency display holding time</td>
</tr>
<tr>
<td>8</td>
<td>Estimated resonance frequency display</td>
</tr>
<tr>
<td>7-6</td>
<td>Estimated resonance frequency display holding time</td>
</tr>
</tbody>
</table>

### bit F: are Notch filter5 all frequencies adapted

When enabled, Notch filter5 all frequencies adaptive range is not limited regardless of SV115/bit4,5 setting.

- 0: Disable
- 1: Enable

### bit E-C: dsl Notch filter frequency display

Switch the "AFLT frequency" display on drive monitor screen to check every notch filter frequency. When the selected notch filter is not used, "0" is displayed.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>E-D-C</td>
<td>Estimated resonance frequency (Normal display)</td>
</tr>
<tr>
<td></td>
<td>Notch filter 1 frequency</td>
</tr>
<tr>
<td></td>
<td>Notch filter 2 frequency</td>
</tr>
<tr>
<td></td>
<td>Notch filter 3 frequency (always displays 1125Hz)</td>
</tr>
<tr>
<td></td>
<td>Notch filter 4 frequency</td>
</tr>
<tr>
<td></td>
<td>Notch filter 5 frequency</td>
</tr>
<tr>
<td></td>
<td>Other settings: setting prohibited</td>
</tr>
</tbody>
</table>

### bit B: ade5 Notch filter 5 / Adaptive follow-up function

- 0: Disable
- 1: Enable

### bit A: ade4 Notch filter 4 / Adaptive follow-up function

- 0: Disable
- 1: Enable

### bit 9: ade2 Notch filter 2 / Adaptive follow-up function

- 0: Disable
- 1: Enable

### bit 8: ade1 Notch filter 1 / Adaptive follow-up function

- 0: Disable
- 1: Enable

### bit 7-6: dsn Estimated resonance frequency display holding time

Set the estimated resonance frequency display holding time to the "AFLT frequency" display on drive monitor screen.

- 00: 4 [s]
- 01: 8 [s]
- 10: 12 [s]
- 11: 16 [s]
**bit 5-4 : dfhz  Notch filter frequency range**

Set the adaptive range of the notch filter frequency. When the adaptive follow-up function is enabled and if the estimated resonance frequency exists in the set range, the notch filter will be adapted. Normally set this parameter to "00".

bit5,4=
00: -10 to 10 [%]  
01: -20 to 20 [%]  
10: -30 to 30 [%]  
11: -40 to 40 [%]

**bit 3-0 : esn  Sensitivity of estimated resonance frequency**

Set the sensitivity of the estimated resonance frequency. Smaller setting value enables to detect smaller vibration component, however, adaptive movement will be repeated frequently. Normally set this parameter to "0".

0 : Normal setting (same sensitivity as A)  
1 : Sensitivity high to F : Sensitivity low

【#2316】SV116  SSF11  Servo function 11

Not used. Set to "0000".

【#2317(PR)】SV117  RNG1ex  Expansion sub side detector resolution

For high-accuracy binary resolution detector, set the number of pulses to four bite data of SV117 (high-order) and SV019 (low-order) by pulse(p). When SV117=0, the setting unit of SV019 is (kp). Refer to SV019 for details.

---Setting range---
-1 to 32767

【#2318(PR)】SV118  RNG2ex  Expansion main side detector resolution

When using high-accuracy binary resolution detector, set the number of pulses to four bite data of SV118 (high-order) and SV020 (low-order) by pulse(p). When SV118=0, the setting unit of SV020 is (kp). Refer to SV020 for details.

---Setting range---
-1 to 32767

【#2319-2328】SV119 - SV128

Not used. Set to "0".

【#2329】SV129  Kwf  Synchronous control feed forward filter frequency

Set the acceleration rate feed forward filter frequency in high-speed synchronous tapping control. The standard setting is "600".

---Setting range---
0 to 32767 (rad/s)
4-2 Setting the initial parameters for the servo drive unit

**【#2330(PR)】SV130 RPITS Base reference mark interval**

Set the base reference mark intervals of distance-coded reference scale. When the distance-coded reference scale is not used, set to "0".
The interval of basic reference mark (SV130) and auxiliary interval (SV131) must be in the specified relationship. Other settings cause the initial parameter error (alarm 37). Following is the specified relationship.

The quotient of (SV130×1000) / SV131 must be 4 or more and leaves no remainder.

Related parameters: SV081/bit7,3, SV131, SV134 to SV137

---Setting range---

0 to 32767 (mm)

**【#2331(PR)】SV131 DPITS Auxiliary reference mark interval**

Set the auxiliary interval of reference mark in the distance-coded reference scale. When the distance-coded reference scale is not used, set to "0".
The interval of basic reference mark (SV130) and auxiliary interval (SV131) must be in the specified relationship. Other settings cause the initial parameter error (alarm 37). Following is the specified relationship.

The quotient of (SV130×1000) / SV131 must be 4 or more and leaves no remainder.

Related parameters: SV081/bit7,3, SV130, SV134 to SV137

---Setting range---

0 to 32767 (μm)

**【#2332】SV132**

Not used. Set to "0".

**【#2333】SV133**

Not used. Set to "0".

**【#2334】SV134 RRn0 Distance-coded reference check / revolution counter**

Set this parameter to operate distance-coded reference check when using distance-coded reference scale.
During the distance-coded reference check initial setup (SV137:RAER=-1), set the following items on the NC drive monitor screen after the distance-coded reference check initial setup warning A3 turns OFF:

SV134=Rn, SV135=Pn, SV136=MPOS

When reference point is set, the warning A3 turns OFF.
To enable the distance-coded reference check function, SV081/bit3=1 setting and a battery option are needed.

Related parameters: SV081/bit3,7, SV130, SV131, SV134 to SV137

---Setting range---

-32768 to 32767
**#2335** SV135 RPn0H Distance-coded reference check / position within one rotation High

Set this parameter to operate distance-coded reference check when using distance-coded reference scale. During the distance-coded reference check initial setup (SV137:RAER=-1), set the following items on the NC drive monitor screen after the distance-coded reference check initial setup warning A3 turns OFF.

\[
SV134=Rn, SV135=Pn, SV136=MPOS
\]

When reference point is set, the warning A3 turns OFF. To enable the distance-coded reference check function, SV081/bit3=1 setting and a battery option are needed.

Related parameters: SV081/bit3,7, SV130, SV131, SV134 to SV137

---Setting range---
-32768 to 32767

**#2336** SV136 RPn0L Distance-coded reference check / position within one rotation Low

Set this parameter to operate distance-coded reference check when using distance-coded reference scale. During the distance-coded reference check initial setup (SV137:RAER=-1), set the following items on the NC drive monitor screen after the distance-coded reference check initial setup warning A3 turns OFF.

\[
SV134=Rn, SV135=Pn, SV136=MPOS
\]

When reference point is set, the warning A3 turns OFF. To enable the distance-coded reference check function, SV081/bit3=1 setting and a battery option are needed.

Related parameters: SV081/bit3,7, SV130, SV131, SV134 to SV137

---Setting range---
-32768 to 32767

**#2337** SV137 RAER Distance-coded reference check allowable width

For the distance-coded reference check function when using distance-coded reference scale, set the allowable gap from the reference point position data calculated by the main side detector. When the gap exceeds the allowable range, reference point created by distance-code is judged as wrong and detects alarm 42.

The standard setting value is "basic reference mark interval (SV130) / 4".

- SV137=0 setting carries out the same operation as the standard setting value.
- SV137=1 setting enables the distance-coded reference initial set up mode and displays setting values of SV134 to SV136 on NC drive monitor.

To enable the distance-coded reference check function, SV081/bit3=1 setting and a battery option are needed. When SV137=32767, the distance-coded reference check function is disabled.

Related parameters: SV081/bit3,7, SV130, SV131, SV134 to SV136

---Setting range---
-1 to 32767 (mm)

**#2338-2397** SV138 - SV197

Not used. Set to "0".

**#2398** SV198 NSE No signal 2 special detection width

Set the special detection width for the no signal 2 (alarm 21). This detects no signal 2 (alarm 21) when machine side feedback is not invoked even if the motor side detector feedback exceeds this setting in the rectangular wave signal output linear scale.

When "0" is set, the detection will be performed with a 15 \(\mu\) m width.

---Setting range---
0 to 32767 (\(\mu\) m)
MDS-DM2 Series Instruction Manual

4-2 Setting the initial parameters for the servo drive unit

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SV199 - SV237</td>
<td>Not used. Set to &quot;0&quot;.</td>
</tr>
<tr>
<td>SV238</td>
<td>SSCFEED Safely limited speed</td>
</tr>
<tr>
<td></td>
<td>Set the machine's safely limited speed for the SLS (Safely Limited Speed) function.</td>
</tr>
<tr>
<td></td>
<td>Set this parameter within the following setting ranges.</td>
</tr>
<tr>
<td></td>
<td>For linear axis: 2000mm/min or less</td>
</tr>
<tr>
<td></td>
<td>For rotary axis: 18000°/min (50r/min) or less</td>
</tr>
<tr>
<td></td>
<td>When not using, set to &quot;0&quot;.</td>
</tr>
<tr>
<td></td>
<td>Related parameters: SV033/bitD, SV113/bitF, SV239</td>
</tr>
<tr>
<td></td>
<td>---Setting range---</td>
</tr>
<tr>
<td></td>
<td>0 to 18000 (mm/min) or (°/min)</td>
</tr>
<tr>
<td></td>
<td>However, when SV033/bitD=1, the setting range is from -32768 to 32767 (100 mm/min) or (100°/min).</td>
</tr>
<tr>
<td>SV239</td>
<td>SSCRPM Safely limited motor speed</td>
</tr>
<tr>
<td></td>
<td>Set the motor's safely limited speed for the SLS (Safely Limited Speed) function.</td>
</tr>
<tr>
<td></td>
<td>Set a value to hold the following relationship.</td>
</tr>
<tr>
<td></td>
<td>Be aware when setting the parameter as the setting units for general motors and linear motors are different.</td>
</tr>
<tr>
<td></td>
<td>&lt;&lt;For general motor&gt;&gt;</td>
</tr>
<tr>
<td></td>
<td>SV239=(SV238/SV018) x (SV002/SV001)</td>
</tr>
<tr>
<td></td>
<td>Only when the product is 0, set to &quot;1&quot;.</td>
</tr>
<tr>
<td></td>
<td>&lt;&lt;For linear motor&gt;&gt;</td>
</tr>
<tr>
<td></td>
<td>SV239=SV238/60</td>
</tr>
<tr>
<td></td>
<td>Only when the product is 0, set to &quot;1&quot;.</td>
</tr>
<tr>
<td></td>
<td>When not using, set to &quot;0&quot;.</td>
</tr>
<tr>
<td></td>
<td>---Setting range---</td>
</tr>
<tr>
<td></td>
<td>For general motor: 0 to 32767 (r/min)</td>
</tr>
<tr>
<td></td>
<td>For linear motor: 0 to 32767 (mm/s)</td>
</tr>
<tr>
<td>SV240 - SV243</td>
<td>Not used. Set to &quot;0&quot;.</td>
</tr>
<tr>
<td>SV244</td>
<td>DUNIT Communication interpolation unit for communication among drive units</td>
</tr>
<tr>
<td></td>
<td>Set the communication interpolation unit among drive units in high-speed synchronous tapping control.</td>
</tr>
<tr>
<td></td>
<td>When set to &quot;0&quot;, it will be regarded as 20 (0.05μ m) is set.</td>
</tr>
<tr>
<td></td>
<td>Related parameters: SV129</td>
</tr>
<tr>
<td></td>
<td>---Setting range---</td>
</tr>
<tr>
<td></td>
<td>0 to 2000 (1/μ m)</td>
</tr>
<tr>
<td>SV245 - SV256</td>
<td>Not used. Set to &quot;0&quot;.</td>
</tr>
</tbody>
</table>
4-3 Setting the initial parameters for the spindle drive unit

The spindle specification parameters and spindle parameters must be set before the spindle system can be started up. The spindle related parameters are input from the NC. The input method differs according to the NC being used, so refer to each NC Instruction Manual.

### 4-3-1 Setting of parameters related to the spindle

The spindle specification parameters "#3001-#3138" and spindle parameters "#13001-#13256" must be set before the spindle is started up. Set the parameters depending on the spindle motor equipped to the machine and the machine specifications. The following parameters must be set for startup, so check the setting values.

< Common parameters set for starting >

Set the command time constant etc. up to the maximum rotation speed of the spindle end and the maximum rotation speed of the motor. Especially the maximum rotation speed should be set not to exceed the machine specifications. In addition, acceleration/deceleration of the spindle is executed with the constant torque control, so the time depends on the inertia size.

(1) Setting of the maximum rotation speed

Set the maximum rotation speed of S commands (synchronous tapping, etc.).

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>[#3001] slimit 1 Limit rotation speed (Gear: 00)</td>
<td>Set the spindle rotation speed for maximum motor speed when gear 00 is selected. Set the spindle rotation speed for the S analog output=10V during analog spindle control.</td>
</tr>
<tr>
<td>---Setting range---</td>
<td>0 to 99999 (r/min)</td>
</tr>
<tr>
<td>[#3002] slimit 2 Limit rotation speed (Gear: 01)</td>
<td></td>
</tr>
<tr>
<td>[#3003] slimit 3 Limit rotation speed (Gear: 10)</td>
<td></td>
</tr>
<tr>
<td>[#3004] slimit 4 Limit rotation speed (Gear: 11)</td>
<td></td>
</tr>
<tr>
<td>[#3005] smax 1 Maximum rotation speed (Gear: 00)</td>
<td>Set the maximum spindle rotation speed which is actually commanded when gear 00 is selected. Set this as smax1(#3005)&lt;= slimit1(#3001). By comparing the S command value and the values of gear 1 - 4, a spindle gear shift command will be output automatically.</td>
</tr>
<tr>
<td>---Setting range---</td>
<td>0 to 99999 (r/min)</td>
</tr>
<tr>
<td>[#3006] smax 2 Maximum rotation speed (Gear: 01)</td>
<td></td>
</tr>
<tr>
<td>[#3007] smax 3 Maximum rotation speed (Gear: 10)</td>
<td></td>
</tr>
<tr>
<td>[#3008] smax 4 Maximum rotation speed (Gear: 11)</td>
<td></td>
</tr>
</tbody>
</table>
(2) Time constant settings during acceleration/deceleration
Set the time constant from the stopped state to reach S commands of smax.

---Setting range---
0 to 30000 (ms)

(3) Spindle speed settings for Z-phase detection when starting
At the first spindle rotation after the power ON (including turning the power ON again only for NC), the spindle rotates at the speed of setting parameters during Z-phase detection for the detector. Set the rotation speed.

---Setting range---
1 to 99999 (r/min)

(4) Parameters set depending on the connected NC

---Initial parameters set depending on the machine specifications---
Set the following parameters depending on the spindle drive method (direct, gear drive, etc.) or inertia size of rotary sections for machine specifications.

(1) Adjustment parameters in orientation mode
When the inertia ratio is large for the spindle motor such as large lathes, set the following parameters so that abnormal noise or machine sway does not occur during orientation control.
4 Setup

【#3106】zrn_typ Zero point return specifications

**bit E : Control mode selection in orientation**

Select non-interpolation mode when vibration occurs since the gain is high during the orientation.
0: Interpolation mode (Use the interpolation mode gain "SP002").
1: Non-interpolation mode (Use the non-interpolation mode gain "SP001")

(2) Setting of the gear ratio

Set the following parameters depending on the spindle drive method (direct, gear drive, belt drive) for the machine.

【#13057(PR)】SP057 GRA1 Spindle side gear ratio 1

Set the number of gear teeth on the spindle side when "the gear selection command (control input 4/ bit6, 5) "is set to "00".

---Setting range---
1 to 32767

【#13058(PR)】SP058 GRA2 Spindle side gear ratio 2

【#13059(PR)】SP059 GRA3 Spindle side gear ratio 3

【#13060(PR)】SP060 GRA4 Spindle side gear ratio 4

【#13061(PR)】SP061 GRB1 Motor side gear ratio 1

Set the number of gear teeth on the spindle side when "the gear selection command (control input 4/ bit6, 5) " is set to "00".

---Setting range---
1 to 32767

【#13062(PR)】SP062 GRB2 Motor side gear ratio 2

【#13063(PR)】SP063 GRB3 Motor side gear ratio 3

【#13064(PR)】SP064 GRB4 Motor side gear ratio 4

< Setting parameters for the detector with semi/full-closed loop control >

Set parameters depending on the detector configured in the machine. For semi-closed loop, set the same value to the main side and the sub side. For full-closed loop, set the detector of the main side and the sub side.

【#13019(PR)】SP019 RNG1 Sub side detector resolution

[For semi-closed loop]
Set the same value as SP020 (RNG2). (Refer to the explanation of SP020.)

[For full-closed loop]
Set the number of pulses per revolution of the machine side detector.

When using ABZ pulse output detector (OSE-1024-3-15-68), set this combined with SP097(RNG1ex).

SP019 = 4096
SP097 = -1

---Setting range---
When SP097=0, the setting range is from 0 to 32767 (kp/rev)
When SP097 ≠ 0
M700V, M70V, E70: 0 to 65536 (p)
C70: -32768 to 32767 (p)
4-3 Setting the initial parameters for the spindle drive unit

**#13020(PR) SP020 RNG2 Main side detector resolution**

Set the number of pulses per revolution of the motor side detector. When using the detector interface unit MDS-B-HR, use this with SP098 (RNG2ex).

Detector

- TS691 (128 teeth): SP020 = 2000
- TS691 (180 teeth): SP020 = 2880
- TS691 (256 teeth): SP020 = 4000
- TS691 (384 teeth): SP020 = 6000
- TS691 (512 teeth): SP020 = 8000
- TS690 (64 teeth): SP020 = 2000
- TS690 (90 teeth): SP020 = 2880
- TS690 (128 teeth): SP020 = 4000
- TS690 (192 teeth): SP020 = 6000
- TS690 (256 teeth): SP020 = 8000
- TS690 (384 teeth): SP020 = 12000
- ERM280 (1200 teeth): SP020 = 4800
- ERM280 (2048 teeth): SP020 = 8000

MPCI: SP020 = 7200
MBE205: SP020 = 2000

Tool spindle motor
OSA18(-A48): SP020 = 260

---Setting range---

When SV118 = 0, the setting range is from 0 to 32767 (kp)
When SV118 ≠ 0
For M700V, M70V, M70, E70: 0 to 65536 (p)
For C70: -32768 to 32767 (p)

**#13097 SP097 RNG1ex Extension sub side detector resolution**

When setting the machine side detector resolution in pulse (p) unit, set the number of pulses to four bite data of SP097 (high-order) and SP019 (low-order) in pulse (p) unit.

When SP097 = 0, the setting unit of SP019 is (kp). Refer to SP019 for details.

---Setting range---

-1 to 32767

**#13098 SP098 RNG2ex Extension main side detector resolution**

When setting the motor side detector resolution in pulse (p) unit, set the number of pulses to four bite data of SP098 (high-order) and SP020 (low-order) in pulse (p) unit.

When SP098 = 0, the setting unit of SP020 is (kp). Refer to SP020 for details.

---Setting range---

-1 to 32767

**#13031(PR) SP031 MTYP Motor type**

Set the control system of the spindle drive unit.

- 2200: Semi closed loop control
- 4200: Full closed loop control by using spindle side ABZ pulse output detector
- 6200: Full closed loop control by using spindle side serial output detector
Setup

**MITSUBISHI CNC**

【#13054】SP054   ORE   Overrun detection width in closed loop control

Set the overrun detection width in the full-closed loop control.

When the gap between the motor side detector and the machine side detector exceeds the set value, it is judged as an overrun and "Alarm 43" is detected.

When "-1" is set, the alarm detection will not be performed.

When "0" is set, overrun will be detected with 2°.

In the full-closed loop control, normally set this parameter to "360". During V-belt drive, set to "-1".

---Setting range---

-1 to 32767 (°)

< Setting parameters of a proximity switch >

Set the following parameters when a proximity switch is equipped with the spindle end.

【#13227】SP227   SFNC7   Spindle function 7

<table>
<thead>
<tr>
<th>bit F-C : dis</th>
<th>Digital signal input selection</th>
</tr>
</thead>
<tbody>
<tr>
<td>0: No signal</td>
<td></td>
</tr>
<tr>
<td>1: SLS (Safely Limited Speed) function door state signal</td>
<td></td>
</tr>
<tr>
<td>4: Proximity switch signal detection</td>
<td></td>
</tr>
<tr>
<td>Other settings: setting prohibited</td>
<td></td>
</tr>
</tbody>
</table>

【#13225】SP225   SFNC5   Spindle function 5

<table>
<thead>
<tr>
<th>bit 5 : ddir</th>
<th>Proximity switch signal enable edge</th>
</tr>
</thead>
<tbody>
<tr>
<td>0: Falling edge</td>
<td></td>
</tr>
<tr>
<td>1: Rising edge</td>
<td></td>
</tr>
</tbody>
</table>

【#3106】zrn_typ   Zero point return specifications

<table>
<thead>
<tr>
<th>bit F</th>
<th>Spindle zero point detection with contactless switch</th>
</tr>
</thead>
<tbody>
<tr>
<td>0: Normal</td>
<td></td>
</tr>
<tr>
<td>1: Enable spindle zero point detection using proximity switch</td>
<td></td>
</tr>
</tbody>
</table>

< Cautions for starting the spindle >

The test operation (acceleration/deceleration, orientation) of the spindle can be executed by setting the initial parameters, however, check the spindle operation with caution.

- Check the wiring and ensure the safety of the surroundings before starting the operation.
- Do not operate at high-speed rotation at first. After checking that there are no problems as abnormal noise, vibration, etc. from the spindle at start up with no-load and small S commands, raise the S commands gradually.
- When vibration or abnormal noise occurs during the test operation, adjust or set the speed gain or the notch filter.
- For the first check of the orientation, the orientation should be executed gradually from small S commands.
### 4-3-2 List of standard parameters for each spindle motor

#### (1) Standard motor SJ-D Series (Normal)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Motor</th>
<th>Standard motor SJ-D Series (Normal)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SJ-D5.5/100-01</td>
<td>SJ-D7.5/100-01</td>
</tr>
<tr>
<td>No.</td>
<td>000</td>
<td>000</td>
</tr>
<tr>
<td>Abrev.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Details</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unit capacity</td>
<td>160</td>
<td>160</td>
</tr>
<tr>
<td>SP001</td>
<td>PVG</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Position loop gain non-interpolation mode</td>
<td>000</td>
</tr>
<tr>
<td>SP002</td>
<td>PGN</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Position loop gain interpolation mode</td>
<td>000C</td>
</tr>
<tr>
<td>SP003</td>
<td>PSG</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Position loop gain spindle synchronization</td>
<td>0000</td>
</tr>
<tr>
<td>SP004</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SP005</td>
<td>VGN1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Speed loop gain 1</td>
<td>150</td>
</tr>
<tr>
<td>SP006</td>
<td>VIA1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Speed loop lead compensation 1</td>
<td>1900</td>
</tr>
<tr>
<td>SP007</td>
<td>VIL1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Speed loop delay compensation 1</td>
<td>000</td>
</tr>
<tr>
<td>SP008</td>
<td>VGN2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Speed loop gain 2</td>
<td>150</td>
</tr>
<tr>
<td>SP009</td>
<td>VIA2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Speed loop lead compensation 2</td>
<td>1900</td>
</tr>
<tr>
<td>SP010</td>
<td>VIL2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Speed loop delay compensation 2</td>
<td>000</td>
</tr>
<tr>
<td>SP011</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SP012</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SP013</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SP014</td>
<td>PY1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Minimum excitation rate 1</td>
<td>50</td>
</tr>
<tr>
<td>SP015</td>
<td>PY2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Minimum excitation rate 2</td>
<td>100</td>
</tr>
<tr>
<td>SP016</td>
<td>CDT</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Phase alignment deceleration rate</td>
<td>000</td>
</tr>
<tr>
<td>SP017</td>
<td>SPEC1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Spindle specification 1</td>
<td>0500</td>
</tr>
<tr>
<td>SP018</td>
<td>SPEC2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Spindle specification 2</td>
<td>0000</td>
</tr>
<tr>
<td>SP019</td>
<td>RNG1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sub side detector resolution</td>
<td>0000</td>
</tr>
<tr>
<td>SP020</td>
<td>RNG2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Main side detector resolution</td>
<td>0000</td>
</tr>
<tr>
<td>SP021</td>
<td>ULC</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Overload detection time constant</td>
<td>600</td>
</tr>
<tr>
<td>SP022</td>
<td>ULL</td>
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### 4-3 Setting the initial parameters for the spindle drive unit

(2) Standard motor SJ-DJ Series (Compact & Lightweight output)

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## Setup

### MITSUBISHI CNC

**Parameter** | **Motor** | **DJ-DJ Series (Compact & Lightweight output)** |
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MDS-DM2 Series Instruction Manual
4-3 Setting the initial parameters for the spindle drive unit

(3)

Standard motor SJ-V Series (Normal)
Motor

Parameter
No.
Abbrev.
Details
Unit capacity
SP001
PGV
Position loop gain non-interpolation mode
SP002
PGN
Position loop gain interpolation mode
SP003
PGS
Position loop gain spindle synchronization
SP004
SP005 VGN1 Speed loop gain 1
SP006
VIA1
Speed loop lead compensation 1
SP007
VIL1
Speed loop delay compensation 1
SP008 VGN2 Speed loop gain 2
SP009
VIA2
Speed loop lead compensation 2
SP010
VIL2
Speed loop delay compensation 2
SP011
SP012
SP013
SP014
PY1
Minimum excitation rate 1
SP015
PY2
Minimum excitation rate 2
SP016
DDT
Phase alignment deceleration rate
SP017 SPEC1 Spindle specification 1
SP018 SPEC2 Spindle specification 2
SP019 RNG1 Sub side detector resolution
SP020 RNG2 Main side detector resolution
SP021
OLT
Overload detection time constant
SP022
OLL
Overload detection level
Excessive error detection width
SP023
OD1
(interpolation mode - spindle synchronization)
SP024
INP
In-position width
SP025
INP2
2nd in-position width
SP026
TSP
Maximum motor speed
SP027
ZSP
Motor zero speed
SP028 SDTS Speed detection set value
SP029 SDTR Speed detection reset width
SP030 SDT2 2nd speed detection setting value
SP031 MTYP Motor type
SP032 PTYP Power supply type/ Regenerative resistor type
SP033 SFNC1 Spindle function 1
SP034 SFNC2 Spindle function 2
SP035 SFNC3 Spindle function 3
SP036 SFNC4 Spindle function 4
SP037
JL
Load inertia scale
SP038
FHz1 Notch filter frequency 1
:
SP046
FHz2 Notch filter frequency 2
SP047
EC
Inductive voltage compensation gain
SP048 LMC1 Lost motion compensation 1
SP049
FFC
Acceleration rate feed forward gain
SP050
TOF
Torque offset
SP051 DFBT Dual feed back control time constant
SP052 DFBN Dual feedback control non-sensitive band
Excessive error detection width
SP053
ODS
(non-interpolation mode)
SP054
ORE
Overrun detection width in closed loop control
SP055 EMGx Max. gate off delay time after emergency stop
SP056 EMGt Deceleration time constant at emergency stop
SP057 GRA1 Spindle side gear ratio 1
SP058 GRA2 Spindle side gear ratio 2
SP059 GRA3 Spindle side gear ratio 3
SP060 GRA4 Spindle side gear ratio 4
SP061 GRB1 Motor side gear ratio 1
SP062 GRB2 Motor side gear ratio 2
SP063 GRB3 Motor side gear ratio 3
SP064 GRB4 Motor side gear ratio 4
SP065 TLM1 Torque limit 1
SP066 TLM2 Torque limit 2
SP067 TLM3 Torque limit 3
SP068 TLM4 Torque limit 4
SP069 PCMP Phase alignment completion width
SP070 KDDT Phase alignment deceleration rate scale
Variable current limit during deceleration,
SP071 DIQM
lower limit value
Variable current limit during deceleration,
SP072
DIQN
break point speed
SP073 VGVN Variable speed gain target value
SP074 VGVS Variable speed gain change start speed
Slip compensation scale during regeneration
SP075 DWSH
high-speed coil

Standard motor SJ-V Series (Normal)
SJ-V5.5- SJ-V7.5- SJ-V7.5SJ-V11SJ-V11SJ-V15SJ-V1501ZT
01ZT
03ZT
01ZT
13ZT
01ZT
09ZT
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Setup

MITSUBISHI CNC

SP076 DWSL Slip compensation scale during regeneration low-speed coil
0 0 0 0 0 0

SP077 IQA Q axis current lead compensation
4096 4096 4096 4096 4096 4096 4096

SP078 IDA D axis current lead compensation
4096 4096 4096 4096 4096 4096 4096

SP079 IQG Q axis current gain
1024 1024 1024 1024 1024 1024 1024

SP080 IDG D axis current gain
1024 1024 1024 1024 1024 1024 1024

SP081 IQAL Q axis current lead compensation low-speed coil
0 0 0 0 0 0 0

SP088 FH25 Notch filter frequency 5
0 0 0 0 0 0 0

SP089 TMKQ Spindle output stabilizing gain Q axis
0 0 0 0 0 0 0

SP090 TMKD Spindle output stabilizing gain D axis
0 0 0 0 0 0 0

SP112 IQA Q axis current lead compensation
150 150 150 150 150 150 150

SP113 IDA D axis current lead compensation
150 150 150 150 150 150 150

SP114 IQG Q axis current gain
1024 1024 1024 1024 1024 1024 1024

SP115 IDG D axis current gain
1024 1024 1024 1024 1024 1024 1024

SP116 IQAL Q axis current lead compensation low-speed coil
0 0 0 0 0 0 0

SP118 TMKQ Spindle output stabilizing gain Q axis
0 0 0 0 0 0 0

SP119 TMKD Spindle output stabilizing gain D axis
0 0 0 0 0 0 0

SP128 D/A output ch2 output scale
0 0 0 0 0 0 0

SP130 PM Motor unique constants (H)
222222 2

SP131 JM Motor unique constants (H)
14 24 25 30 30 58 58

SP132 ATYP Motor unique constants (H)
100 100 160 160 200 200 200

SP133 NR Motor unique constants (H)
12000 12000 12000 8000 12000 8000 8000

SP134 NS Motor unique constants (H)
1500 1500 1500 1500 1500 1500 1500

SP135 NF Motor unique constants (H)
1800 1800 2100 1800 1800 1800 1800

SP136 KT Motor unique constants (H)
1305 1218 963 1326 1194 1517 1330

SP137 KF1 Motor unique constants (H)
27 73 73 68 68 73 73

SP138 KF2 Motor unique constants (H)
3174 3070 3058 2854 3019 3005 3017

SP139 KF3 Motor unique constants (H)
2519 2693 2683 2744 2744 2591 2601

SP140 KF4 Motor unique constants (H)
1934 1907 1911 1922 1933 1933 1933

SP141 KF5 Motor unique constants (H)
1081 1408 1773 1498 1935 2614 3006

SP142 KF6 Motor unique constants (H)
1 877 95 6 45 15 2 3 9

SP143 TDIL Motor unique constants
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SP144 TMIL Motor unique constants (H)
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SP145 TMIL Motor unique constants (H)
430 460 362 366 439 307 265

SP146 TMIL Motor unique constants (H)
430 460 460 437 441 424 380

SP147 KE Motor unique constants (H)
60 63 63 64 63 60 60

SP148 LA Motor unique constants (H)
1294 970 607 861 696 618 473

SP149 IQSM Motor unique constants (H)
2083 3921 4955 5280 5865 6296 7177

SP150 IDSM Motor unique constants (H)
1081 1408 1773 1498 1935 2614 3006

SP151 KT Motor unique constants (H)
1305 1218 963 1326 1194 1517 1330

SP152 TMIL Motor unique constants (H)
60 63 63 64 63 60 60

SP153 KF1 Motor unique constants (H)
27 73 73 68 68 73 73

SP154 KF2 Motor unique constants (H)
3174 3070 3058 2854 3019 3005 3017

SP155 KF3 Motor unique constants (H)
2519 2693 2683 2744 2744 2591 2601

SP156 KF4 Motor unique constants (H)
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SP157 KF5 Motor unique constants (H)
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SP158 KF6 Motor unique constants (H)
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SP159 TMIL Motor unique constants (H)
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SP225 SFNC5 Spindle function 5
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SP226 SFNC6 Spindle function 6
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SP227 SFNC7 Spindle function 7
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SP228 SFNC8 Spindle function 8
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SP229 SFNC9 Spindle function 9
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SP230 SFNC10 Spindle function 10
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SP231 SFNC11 Spindle function 11
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SP232 SFNC12 Spindle function 12
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SP233 IVC Voltage non-sensitive band compensation
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SP234 R2H Temperature compensation gain
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SP235 R2R Temperature compensation time constant
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SP236 TCF Torque command filter
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### 4-3 Setting the initial parameters for the spindle drive unit

#### Standard motor SJ-V Series (High-speed) / (Wide range constant output)

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### Setup

#### Mitsubishi CNC

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### (5) Standard motor SJ-VL Series (Low-inertia)

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<td>SP153</td>
<td>TMLD</td>
<td>Motor unique constants (H)</td>
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<tr>
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<td>TMLS</td>
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<td>K11</td>
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<td>SNB</td>
<td>Motor unique constants (H)</td>
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<td>SP225</td>
<td>SFNC5</td>
<td>Spindle function 5</td>
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<td>SFNC6</td>
<td>Spindle function 6</td>
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<td>Temperature compensation gain</td>
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<td>SP236</td>
<td>WRH</td>
<td>Temperature compensation time constant</td>
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<td>Torque command filter</td>
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<td>SP239</td>
<td>SSCRPM</td>
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</table>
4-3-3 Spindle specification parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Setting Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>#3001 slimt 1 Limit rotation speed (Gear: 00)</td>
<td>Set the spindle rotation speed for maximum motor speed when gear 00 is selected. Set the spindle rotation speed for the S analog output=10V during analog spindle control.</td>
<td>0 to 99999 (r/min)</td>
</tr>
<tr>
<td>#3002 slimt 2 Limit rotation speed (Gear: 01)</td>
<td>Set the spindle rotation speed for maximum motor speed when gear 01 is selected. Set the spindle rotation speed for the S analog output=10V during analog spindle control.</td>
<td>0 to 99999 (r/min)</td>
</tr>
<tr>
<td>#3003 slimt 3 Limit rotation speed (Gear: 10)</td>
<td>Set the spindle rotation speed for maximum motor speed when gear 10 is selected. Set the spindle rotation speed for the S analog output=10V during analog spindle control.</td>
<td>0 to 99999 (r/min)</td>
</tr>
<tr>
<td>#3004 slimt 4 Limit rotation speed (Gear: 11)</td>
<td>Set the spindle rotation speed for maximum motor speed when gear 11 is selected. Set the spindle rotation speed for the S analog output=10V during analog spindle control.</td>
<td>0 to 99999 (r/min)</td>
</tr>
<tr>
<td>#3005 smax 1 Maximum rotation speed (Gear: 00)</td>
<td>Set the maximum spindle rotation speed which is actually commanded when gear 00 is selected. Set this as smax1(#3005)&lt;= slimit1(#3001). By comparing the S command value and the values of gear 1 - 4, a spindle gear shift command will be output automatically.</td>
<td>0 to 99999 (r/min)</td>
</tr>
<tr>
<td>#3006 smax 2 Maximum rotation speed (Gear: 01)</td>
<td>Set the maximum spindle rotation speed which is actually commanded when gear 01 is selected. Set this as smax2(#3006)&lt;= slimit2(#3002). By comparing the S command value and the values of gear 1 - 4, a spindle gear shift command will be output automatically.</td>
<td>0 to 99999 (r/min)</td>
</tr>
</tbody>
</table>

The parameters with "(PR)" requires the CNC to be turned OFF after the settings. Turn the power OFF and ON to enable the parameter settings.

**CAUTION**

The configuration of the spindle specification parameters (#3001 to #3138) can differ depending on the NC. This Instruction Manual explains using the configuration of the parameters for M700V/M70V Series.
4 Setup

**【#3007】smax 3 Maximum rotation speed (Gear: 10)**
Set the maximum spindle rotation speed which is actually commanded when gear 10 is selected. 
Set this as smax3(#3007)<= slimit3(#3003). 
By comparing the S command value and the values of gear 1 - 4, a spindle gear shift command will be output automatically.

---Setting range---
0 to 99999 (r/min)

**【#3008】smax 4 Maximum rotation speed (Gear: 11)**
Set the maximum spindle rotation speed which is actually commanded when gear 11 is selected. 
Set this as smax4(#3008)<= slimit4(#3004). 
By comparing the S command value and the values of gear 1 - 4, a spindle gear shift command will be output automatically.

---Setting range---
0 to 99999 (r/min)

**【#3009】ssift 1 Shift rotation speed (Gear: 00)**
Set the spindle speed for gear shifting with gear 00. 
(Note) Setting too large value may cause a gear nick when changing gears.

---Setting range---
0 to 32767 (r/min)

**【#3010】ssift 2 Shift rotation speed (Gear: 01)**
Set the spindle speed for gear shifting with gear 01.  
(Note) Setting too large value may cause a gear nick when changing gears.

---Setting range---
0 to 32767 (r/min)

**【#3011】ssift 3 Shift rotation speed (Gear: 10)**
Set the spindle speed for gear shifting with gear 10.  
(Note) Setting too large value may cause a gear nick when changing gears.

---Setting range---
0 to 32767 (r/min)

**【#3012】ssift 4 Shift rotation speed (Gear: 11)**
Set the spindle speed for gear shifting with gear 11. 
(Note) Setting too large value may cause a gear nick when changing gears.

---Setting range---
0 to 32767 (r/min)

**【#3013】stap 1 Synchronous tapping 1st step rotation speed (Gear: 00)**
Set the speed which switches from 1st step to 2nd step in synchronous tapping multi-step acceleration/deceleration control when gear 00 is selected. 
The inclination of linear acceleration/deceleration control for 1st step is determined by the ratio of stap1(#3013) to stap1(#3017). 
When the inclination is not set after 2nd step or it is higher than that of 1st step, the acceleration/ deceleration control is executed with the same inclination as the 1st step for the rotation speed of stap1 or higher.

---Setting range---
0 to 99999 (r/min)
### #3014 stap 2  Synchronous tapping 1st step rotation speed (Gear: 01)

Set the speed which switches from 1st step to 2nd step in synchronous tapping multi-step acceleration/deceleration control when gear 01 is selected. The inclination of linear acceleration/deceleration control for 1st step is determined by the ratio of stap2(#3014) to stapt2(#3018).

When the inclination is not set after 2nd step or it is higher than that of 1st step, the acceleration/deceleration control is executed with the same inclination as the 1st step for the rotation speed of stap2 or higher.

---Setting range---
0 to 99999 (r/min)

### #3015 stap 3  Synchronous tapping 1st step rotation speed (Gear: 10)

Set the speed which switches from 1st step to 2nd step in synchronous tapping multi-step acceleration/deceleration control when gear 10 is selected. The inclination of linear acceleration/deceleration control for 1st step is determined by the ratio of stap3(#3015) to stapt3(#3019).

When the inclination is not set after 2nd step or it is higher than that of 1st step, the acceleration/deceleration control is executed with the same inclination as the 1st step for the rotation speed of stap3 or higher.

---Setting range---
0 to 99999 (r/min)

### #3016 stap 4  Synchronous tapping 1st step rotation speed (Gear: 11)

Set the speed which switches from 1st step to 2nd step in synchronous tapping multi-step acceleration/deceleration control when gear 11 is selected. The inclination of linear acceleration/deceleration control for 1st step is determined by the ratio of stap4(#3016) to stapt4(#3020).

When the inclination is not set after 2nd step or it is higher than that of 1st step, the acceleration/deceleration control is executed with the same inclination as the 1st step for the rotation speed of stap4 or higher.

---Setting range---
0 to 99999 (r/min)
【#3017】stapt 1  Synchronous tapping 1st step acceleration/deceleration time constant
(Gear: 00)
Set the time constant for synchronous tapping 1st step linear acceleration/deceleration control when gear 00 is selected. (linear acceleration/deceleration pattern)
---Setting range---
1 to 5000 (ms)

【#3018】stapt 2  Synchronous tapping 1st step acceleration/deceleration time constant
(Gear: 01)
Set the time constant for synchronous tapping 1st step linear acceleration/deceleration control when gear 01 is selected. (linear acceleration/deceleration pattern)
---Setting range---
1 to 5000 (ms)

【#3019】stapt 3  Synchronous tapping 1st step acceleration/deceleration time constant
(Gear: 10)
Set the time constant for synchronous tapping 1st step linear acceleration/deceleration control when gear 10 is selected. (linear acceleration/deceleration pattern)
---Setting range---
1 to 5000 (ms)

【#3020】stapt 4  Synchronous tapping 1st step acceleration/deceleration time constant
(Gear: 11)
Set the time constant for synchronous tapping 1st step linear acceleration/deceleration control when gear 11 is selected. (linear acceleration/deceleration pattern)
---Setting range---
1 to 5000 (ms)
<Relation of spindle limit rotation speed and spindle maximum rotation speed>
The spindle rotation speed which can be attained at the spindle motor's maximum rotation speed is set for the limit rotation speed (slimit). This value is obtained by multiplying the gear ratio on the spindle motor maximum rotation speed (SP026). Set the maximum rotation speed (smax) when the rotation speed is to be limited according to the machine specifications, such as the spindle gear specifications. Up to four value can be set for gear changeover.

![Diagram of spindle rotation speed vs. SP026]

<Relation of spindle limit rotation speed and spindle maximum rotation speed>

The spindle rotation speed vs. SP026 graph shows the relationship between the spindle motor rotation speed (r/min) and the spindle rotation speed (r/min). The graph includes points such as smax1, slimit1, smax2, slimit2, smax(n), and slimit(n).

<synchronous tapping multi-step acceleration/deceleration control parameter>
The acceleration/deceleration control can be set up to three steps in synchronous tapping control to carry out an optimal acceleration/deceleration control in accordance with the spindle motor characteristics whose output torque steps down when exceeding the base rotation speed.
Set the inclination for 2nd step or subsequent steps when the maximum rotation speed exceeds the base rotation speed during synchronous tapping control.
When the inclination is not set after 2nd step or it is higher than that of 1st step, the acceleration/deceleration control is executed with the same inclination as the 1st step for all the rotation speed.

![Diagram of synchronous tapping multi-step acceleration/deceleration control]

<Diagram of synchronous tapping multi-step acceleration/deceleration control>

The diagram illustrates the acceleration/deceleration control steps for synchronous tapping with time (ms) and spindle rotation speed (r/min). The steps include steps1=300, steps2=900, steps3=5000, and slimit1=10000.
<Spindle synchronization multi-step acceleration/deceleration control parameter>

The acceleration/deceleration control can be set up to eight steps in spindle synchronization control to carry out an optimal acceleration/deceleration control in accordance with the spindle motor characteristics whose output torque steps down when exceeding the base rotation speed and further attenuate in output stepdown zone.

For 2nd step or subsequent steps, the specification allows to set the time constant magnification and changeover rotation speed based on the acceleration/deceleration setting of the 1st step.

Set the value of limit rotation speed or higher as the changeover rotation speed for the step not to be shifted when not carrying out a step shift.
4-3 Setting the initial parameters for the spindle drive unit

【#3021】
Not used. Set to "0".

【#3022】 sgear Encoder gear ratio
Set the deceleration rate of the detector to the spindle when inputting ABZ pulse output detector feedback to NC during analog spindle control.

   0: 1/1
   1: 1/2
   2: 1/4
   3: 1/8

---Setting range---
0 to 3

【#3023】 smini Minimum rotation speed
Set the minimum spindle speed.
If an S command below this setting is issued, the spindle will rotate at the minimum speed set by this parameter.

---Setting range---
0 to 32767 (r/min)

【#3024(PR)】 sout Spindle connection
Select the connection method with a spindle drive unit.

   0: No unit to connect
   1: Optical digital communication (Mitsubishi spindle drive unit)
   2 - 5: S-analog (Analog spindle drive unit)

---Setting range---
0 to 5

【#3025(PR)】 enc-on Spindle encoder
Set the connection specifications of a spindle's detector.

   0: Without detector feedback when using analog spindle and connecting to NC
   1: With detector feedback when using analog spindle and connecting to NC
   2: Mitsubishi spindle drive unit

---Setting range---
0 to 2

【#3026】 cs_ori Selection of winding in orientation mode
Select the coil control in orientation mode for the spindle motor which performs coil changeover.

   0: Perform coil changeover based on the command from NC. (depending on the setting of parameter #1239/bit0)
   1: Use the coil L

【#3027】 cs_syn Selection of winding in spindle synchronization control mode
Select the coil control in spindle synchronization control mode for the spindle motor which performs coil changeover.

   0: Perform coil changeover based on the command from NC. (depending on the setting of parameter #1239/bit0)
   1: Use the coil H

【#3028】 sprcmm Tap cycle M command selection
Set the M codes for the spindle forward run/reverse run commands during tapping cycle.

High-order 3 digits: Set the M code for spindle forward run command.
Low-order 3 digits: Set the M code for spindle reverse run command.
When "0" is set, it is handled assuming that "3004" is set (the M code for spindle forward run command is "3" and the M code for spindle reverse run command is "4").

---Setting range---
0 to 999999
**[#3029] tapsel  Asynchronous tap gear selection**

Select the speed which is compared with S command at gear selection when using asynchronous tapping control with the spindle which performs gear changeover.

0: Synchronous tapping 1st step rotation speed (stap)--- Multi-step acceleration/deceleration is not used.
1: Maximum speed (smax)--- Multi-step acceleration/deceleration is used.

This parameter is enabled only when "#1272 ext08/bit1 is 1".

**[#3030]**

Not used. Set to "0".

**[#3031(PR)] smcp_no  Drive unit l/F channel No. (spindle)**

Set the interface channel No. of CNC control unit to which the spindle is connected and the axis No. within each channel.

Set this parameter in 4-digit (hexadecimal) format.

---Setting range---

0000, 1001 to 1010, 2001 to 2010

- For MDS-DM2-SPV2/SPV3 Series
  These drive units have no rotary switches for axis No. selection.
  The spindle axis No. is fixed to 1st axis, so set "01" as the number of axes. (last 2 digits).

**[#3032]**

Not used. Set to "0".

**[#3035(PR)] spunit  Output unit**

Select the data unit for communication with the spindle drive unit.

This selection is applied to the data communicated between the NC and spindle drive unit as well as the spindle movement data. Although the standard setting is B (0.001deg), set the same value as "#1004 ctrl_unit" when using Spindle/C axis control.

B: 0.001deg (1μm)
C: 0.0001deg (0.1μm)
D: 0.00001deg (10nm)
E: 0.000001deg (1nm)
### #3037 taps21 Synchronous tapping 2nd step rotation speed (Gear: 00)
Set the speed which switches from 2nd step to 3rd step in synchronous tapping multi-step acceleration/deceleration control when gear 00 is selected.
The inclination of linear acceleration/deceleration control for 2nd step is determined by the ratio of taps21(#3037) to tapt21(#3041).
When the inclination is not set for 3rd step or it is higher than that of 2nd step, the acceleration/deceleration control is executed with the same inclination as the 2nd step for the rotation speed of taps21 or higher.

---Setting range---
0 to 99999 (r/min)

### #3038 taps22 Synchronous tapping 2nd step rotation speed (Gear: 01)
Set the speed which switches from 2nd step to 3rd step in synchronous tapping multi-step acceleration/deceleration control when gear 01 is selected.
The inclination of linear acceleration/deceleration control for 2nd step is determined by the ratio of taps22(#3038) to tapt22(#3042).
When the inclination is not set for 3rd step or it is higher than that of 2nd step, the acceleration/deceleration control is executed with the same inclination as the 2nd step for the rotation speed of taps22 or higher.

---Setting range---
0 to 99999 (r/min)

### #3039 taps23 Synchronous tapping 2nd step rotation speed (Gear: 10)
Set the speed which switches from 2nd step to 3rd step in synchronous tapping multi-step acceleration/deceleration control when gear 10 is selected.
The inclination of linear acceleration/deceleration control for 2nd step is determined by the ratio of taps23(#3039) to tapt23(#3043).
When the inclination is not set for 3rd step or it is higher than that of 2nd step, the acceleration/deceleration control is executed with the same inclination as the 2nd step for the rotation speed of taps23 or higher.

---Setting range---
0 to 99999 (r/min)

### #3040 taps24 Synchronous tapping 2nd step rotation speed (Gear: 11)
Set the speed which switches from 2nd step to 3rd step in synchronous tapping multi-step acceleration/deceleration control when gear 11 is selected.
The inclination of linear acceleration/deceleration control for 2nd step is determined by the ratio of taps24(#3040) to tapt24(#3044).
When the inclination is not set for 3rd step or it is higher than that of 2nd step, the acceleration/deceleration control is executed with the same inclination as the 2nd step for the rotation speed of taps24 or higher.

---Setting range---
0 to 99999 (r/min)

### #3041 tapt21 Synchronous tapping 2nd step acceleration/deceleration time constant (Gear: 00)
Set the time constant for synchronous tapping 2nd step linear acceleration/deceleration control when gear 00 is selected.

---Setting range---
1 to 5000 (ms)

### #3042 tapt22 Synchronous tapping 2nd step acceleration/deceleration time constant 2 (Gear: 01)
Set the time constant for synchronous tapping 2nd step linear acceleration/deceleration control when gear 01 is selected.

---Setting range---
1 to 5000 (ms)
### MITSUBISHI CNC

#### 4 Setup

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Setting Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>#3043</td>
<td>Synchronous tapping 2nd step acceleration/deceleration time constant</td>
<td>Set the time constant for synchronous tapping 2nd step linear acceleration/deceleration control when gear 10 is selected.</td>
</tr>
<tr>
<td>tapt23</td>
<td>(Gear: 10)</td>
<td>--- <strong>Setting range</strong> --- 1 to 5000 (ms)</td>
</tr>
<tr>
<td>#3044</td>
<td>Synchronous tapping 2nd step acceleration/deceleration time constant</td>
<td>Set the time constant for synchronous tapping 2nd step linear acceleration/deceleration control when gear 11 is selected.</td>
</tr>
<tr>
<td>tapt24</td>
<td>(Gear: 11)</td>
<td>--- <strong>Setting range</strong> --- 1 to 5000 (ms)</td>
</tr>
<tr>
<td>#3045</td>
<td>Synchronous tapping 3rd step acceleration/deceleration time constant</td>
<td>Set the time constant for synchronous tapping 3rd step linear acceleration/deceleration control when gear 00 is selected.</td>
</tr>
<tr>
<td>tapt31</td>
<td>(Gear: 00)</td>
<td>The inclination of linear acceleration/deceleration control for 3rd step is determined by the ratio of slimit1(#3001) to tapt31(#3045).</td>
</tr>
<tr>
<td></td>
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<td>--- <strong>Setting range</strong> --- 1 to 5000 (ms)</td>
</tr>
<tr>
<td>#3046</td>
<td>Synchronous tapping 3rd step acceleration/deceleration time constant</td>
<td>Set the time constant for synchronous tapping 3rd step linear acceleration/deceleration control when gear 01 is selected.</td>
</tr>
<tr>
<td>tapt32</td>
<td>(Gear: 01)</td>
<td>The inclination of linear acceleration/deceleration control for 3rd step is determined by the ratio of slimit2(#3002) to tapt32(#3046).</td>
</tr>
<tr>
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<td>--- <strong>Setting range</strong> --- 1 to 5000 (ms)</td>
</tr>
<tr>
<td>#3047</td>
<td>Synchronous tapping 3rd step acceleration/deceleration time constant</td>
<td>Set the time constant for synchronous tapping 3rd step linear acceleration/deceleration control when gear 10 is selected.</td>
</tr>
<tr>
<td>tapt33</td>
<td>(Gear: 10)</td>
<td>The inclination of linear acceleration/deceleration control for 3rd step is determined by the ratio of slimit3(#3003) to tapt33(#3047).</td>
</tr>
<tr>
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<td>--- <strong>Setting range</strong> --- 1 to 5000 (ms)</td>
</tr>
<tr>
<td>#3048</td>
<td>Synchronous tapping 3rd step acceleration/deceleration time constant</td>
<td>Set the time constant for synchronous tapping 3rd step linear acceleration/deceleration control when gear 11 is selected.</td>
</tr>
<tr>
<td>tapt34</td>
<td>(Gear: 11)</td>
<td>The inclination of linear acceleration/deceleration control for 3rd step is determined by the ratio of slimit4(#3004) to tapt34(#3048).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>--- <strong>Setting range</strong> --- 1 to 5000 (ms)</td>
</tr>
</tbody>
</table>
4-3 Setting the initial parameters for the spindle drive unit

**#3049】 spt Spindle synchronization acceleration/deceleration time constant**
Set the acceleration/deceleration time constant under spindle synchronization control. The inclination of acceleration/deceleration control is determined by the ratio to limit rotation speed (slimit). Set the same value for the reference axis and synchronous axis. The time constant for 2nd step or subsequent steps is the magnification setting on the basis of this setting value.

---Setting range---
0 to 9999 (ms)

**#3050】 sprlv Spindle synchronization rotation speed attainment level**
Set the level of speed difference between the basic and synchronous spindles during spindle synchronization control. Setting of the synchronous spindle side is enabled. When the difference becomes below the setting level, the spindle speed synchronization complete signal will turn ON.

---Setting range---
0 to 4095 (pulse) (1 pulse = 0.088°)

**#3051】 spplv Spindle phase synchronization attainment level**
Set the level of phase difference between the basic and synchronous spindles during spindle synchronization. Setting of the synchronous spindle side is validated. When the difference becomes below the setting level, the spindle phase synchronization complete signal will go ON.

---Setting range---
0 to 4095 (pulse) (1 pulse = 0.088°)

**#3052】 spplr Spindle motor spindle relative polarity**
Set the spindle motor and spindle's relative polarity.
0: Positive polarity (Spindle CW rotation at motor CW rotation)
1: Negative polarity (Spindle CCW rotation at motor CW rotation)

---Setting range---
0000/0001 (HEX)

**#3053】 sppst Spindle encoder Z phase position**
Set the deviation amount from the spindle’s basic point to the spindle detector’s Z phase. Obtain the deviation amount, considering a clockwise direction as positive when viewed from the spindle’s front side.

---Setting range---
0 to 359999 (1/1000°)

**#3054】 sptc1 Spindle synchronization multi-step acceleration/deceleration changeover speed 1**
Set the speed which switches from 1st step to 2nd step in spindle synchronization multi-step acceleration/deceleration control. Set the same value for the reference axis and synchronous axis. Set the value of limit rotation speed (slimit) or higher not to carry out a step shift.

---Setting range---
0 to 99999 (r/min)

**#3055】 sptc2 Spindle synchronization multi-step acceleration/deceleration changeover speed 2**
Set the speed which switches from 2nd step to 3rd step in spindle synchronization multi-step acceleration/deceleration control. Set the same value for the reference axis and synchronous axis. Set the value of limit rotation speed (slimit) or higher not to carry out a step shift.

---Setting range---
0 to 99999 (r/min)
4 Setup

【#3056】sptc3  Spindle synchronization multi-step acceleration/deceleration changeover

Speed 3

Set the speed which switches from 3rd step to 4th step in spindle synchronization multi-step acceleration/deceleration control. Set the same value for the reference axis and synchronous axis. Set the value of limit rotation speed (slimit) or higher not to carry out a step shift.

---Setting range---
0 to 99999 (r/min)

【#3057】sptc4  Spindle synchronization multi-step acceleration/deceleration changeover

Speed 4

Set the speed which switches from 4th step to 5th step in spindle synchronization multi-step acceleration/deceleration control. Set the same value for the reference axis and synchronous axis. Set the value of limit rotation speed (slimit) or higher not to carry out a step shift.

---Setting range---
0 to 99999 (r/min)

【#3058】sptc5  Spindle synchronization multi-step acceleration/deceleration changeover

Speed 5

Set the speed which switches from 5th step to 6th step in spindle synchronization multi-step acceleration/deceleration control. Set the same value for the reference axis and synchronous axis. Set the value of limit rotation speed (slimit) or higher not to carry out a step shift.

---Setting range---
0 to 99999 (r/min)

【#3059】sptc6  Spindle synchronization multi-step acceleration/deceleration changeover

Speed 6

Set the speed which switches from 6th step to 7th step in spindle synchronization multi-step acceleration/deceleration control. Set the same value for the reference axis and synchronous axis. Set the value of limit rotation speed (slimit) or higher not to carry out a step shift.

---Setting range---
0 to 99999 (r/min)

【#3060】sptc7  Spindle synchronization multi-step acceleration/deceleration changeover

Speed 7

Set the speed which switches from 7th step to 8th step in spindle synchronization multi-step acceleration/deceleration control. Set the same value for the reference axis and synchronous axis. Set the value of limit rotation speed (slimit) or higher not to carry out a step shift.

---Setting range---
0 to 99999 (r/min)

【#3061】spdiv1  Time constant magnification for changeover speed 1

Set the acceleration/deceleration time constant to be used at the speed of changeover speed 1 (sptc1) and higher in spindle synchronization multi-step acceleration/deceleration control. Set this as a magnification in relation to the spindle synchronization acceleration/deceleration time constant (spt).

---Setting range---
0 to 127

【#3062】spdiv2  Time constant magnification for changeover speed 2

Set the acceleration/deceleration time constant to be used at the speed of changeover speed 2 (sptc2) and higher in spindle synchronization multi-step acceleration/deceleration control. Set this as a magnification in relation to the spindle synchronization acceleration/deceleration time constant (spt).

---Setting range---
0 to 127
4-3 Setting the initial parameters for the spindle drive unit

【#3063】spdiv3 Time constant magnification for changeover speed 3
Set the acceleration/deceleration time constant to be used at the speed of changeover speed 3 (sptc3) and higher in spindle synchronization multi-step acceleration/deceleration control. Set this as a magnification in relation to the spindle synchronization acceleration/deceleration time constant (spt).

---Setting range---
0 to 127

【#3064】spdiv4 Time constant magnification for changeover speed 4
Set the acceleration/deceleration time constant to be used at the speed of changeover speed 4 (sptc4) and higher in spindle synchronization multi-step acceleration/deceleration control. Set this as a magnification in relation to the spindle synchronization acceleration/deceleration time constant (spt).

---Setting range---
0 to 127

【#3065】spdiv5 Time constant magnification for changeover speed 5
Set the acceleration/deceleration time constant to be used at the speed of changeover speed 5 (sptc5) and higher in spindle synchronization multi-step acceleration/deceleration control. Set this as a magnification in relation to the spindle synchronization acceleration/deceleration time constant (spt).

---Setting range---
0 to 127

【#3066】spdiv6 Time constant magnification for changeover speed 6
Set the acceleration/deceleration time constant to be used at the speed of changeover speed 6 (sptc6) and higher in spindle synchronization multi-step acceleration/deceleration control. Set this as a magnification in relation to the spindle synchronization acceleration/deceleration time constant (spt).

---Setting range---
0 to 127

【#3067】spdiv7 Time constant magnification for changeover speed 7
Set the acceleration/deceleration time constant to be used at the speed of changeover speed 7 (sptc7) and higher in spindle synchronization multi-step acceleration/deceleration control. Set this as a magnification in relation to the spindle synchronization acceleration/deceleration time constant (spt).

---Setting range---
0 to 127

【#3068】symtm1 Phase synchronization start confirmation time
Set the time to confirm that synchronization is attained before spindle phase synchronization control is started. When "0" is set, the time will be 500ms. When "100" or less is set, the time will be 100ms.

---Setting range---
0 to 9999 (ms)

【#3069】symtm2 Phase synchronization end confirmation time
Set a period of waiting time for spindle phase synchronization control's completion as a time in which the speed stays within the attainment range. When "0" is set, the time will be 500ms. When "100" or less is set, the time will be 100ms.

---Setting range---
0 to 9999 (ms)
### #3070 syprt Phase synchronization alignment speed
Set the amount of speed fluctuation of synchronous spindle during spindle phase synchronization control. Set this as a proportion to commanded speed. When "0" is set, the amount will be 5%.

---Setting range---
0 to 100 (%)

### #3071(PR) SscDrSelSp Speed monitor Door selection
Select which door group of the speed monitoring a spindle belongs to.
0000: Belong to the door 1 group.
0001: Belong to the door 1 group.
0002: Belong to the door 2 group.
0003: Belong to the door 1 and 2 groups.
(Note) Speed monitoring function is validated when "SP229/bitF=1".

---Setting range---
0000 to 0003 (HEX)

### #3072(PR) Ssc Svof Filter Sp Speed monitor Error detection time during servo OFF
Set the error detection time for when an error of command speed monitoring or feedback speed monitoring is detected during servo OFF. The alarm will occur if actual speed exceeds safe speed or safe rotation speed for a period of time longer than this setting. When "0" is set, the detection time will be 200 (ms).
(Note) Speed monitoring function is validated when "SP229/bitF=1".

---Setting range---
0 to 9999 (ms)

### #3074 GBsp Guide bushing spindle synchronization control
Set the reference spindle and G/B spindle.
1:Reference spindle
2:Guide bushing spindle
0:Other

### #3101 sp_t 1 Acceleration/deceleration time constant with S command (Gear: 00)
Set the acceleration/deceleration time constant with S command (speed operation mode) when gear 00 is selected. Set the linear acceleration/deceleration time up to limit rotation speed (slimit1). Set the short time constant that the motor torque at acceleration is always saturated, however, when an abnormal noise or V-belt slip occurs, increase the time constant.

---Setting range---
0 to 30000 (ms)

### #3102 sp_t 2 Acceleration/deceleration time constant with S command (Gear: 01)
Set the acceleration/deceleration time constant with S command (speed operation mode) when gear 01 is selected. Set the linear acceleration/deceleration time up to limit rotation speed (slimit2). Set the short time constant that the motor torque at acceleration is always saturated, however, when an abnormal noise or V-belt slip occurs, increase the time constant.

---Setting range---
0 to 30000 (ms)

### #3103 sp_t 3 Acceleration/deceleration time constant with S command (Gear: 10)
Set the acceleration/deceleration time constant with S command (speed operation mode) when gear 10 is selected. Set the linear acceleration/deceleration time up to limit rotation speed (slimit3). Set the short time constant that the motor torque at acceleration is always saturated, however, when an abnormal noise or V-belt slip occurs, increase the time constant.

---Setting range---
0 to 30000 (ms)
### [#3104] sp_t 4 Acceleration/deceleration time constant with S command (Gear: 11)

Set the acceleration/deceleration time constant with S command (speed operation mode) when gear 11 is selected. Set the linear acceleration/deceleration time up to limit rotation speed (slimit4). Set the short time constant that the motor torque at acceleration is always saturated, however, when an abnormal noise or V-belt slip occurs, increase the time constant.

---Setting range---

0 to 30000 (ms)

### [#3105] sut Speed reach range

Set the speed deviation rate with respect to the commanded speed, at which the speed reach signal will be output.

- It will be 15% when set to "0".
- If the speed deviation is smaller than 45r/min, it will be set as 45r/min.

---Setting range---

0 to 100 (%)
# Setup

## MITSUBISHI CNC

【#3106】 zrn_typ  Zero point return specifications

Select the zero point return specification. Functions are allocated to each bit. Set this in hexadecimal format.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>Z phase detection direction</td>
</tr>
<tr>
<td>6</td>
<td>Orientation direction</td>
</tr>
<tr>
<td>5</td>
<td>Synchronous tapping zero point return/Deceleration stop designation</td>
</tr>
<tr>
<td>4</td>
<td>Synchronous tapping zero point return direction</td>
</tr>
<tr>
<td>3</td>
<td>Synchronous tapping command polarity</td>
</tr>
<tr>
<td>2</td>
<td>Spindle/C axis zero point return/Deceleration stop designation</td>
</tr>
<tr>
<td>1</td>
<td>Spindle/C axis zero point return direction</td>
</tr>
<tr>
<td>0</td>
<td>Interpolation mode selection in orientation</td>
</tr>
</tbody>
</table>

**bit F**: Spindle zero point detection with contactless switch
- 0: Normal
- 1: Enable spindle zero point detection using proximity switch

**bit E**: Control mode selection in orientation
- Select non-interpolation mode when vibration occurs since the gain is high during the orientation.
- 0: Interpolation mode (Use the interpolation mode gain "SP002")
- 1: Non-interpolation mode (Use the non-interpolation mode gain "SP001")

**bit D-B**: Not used. Set to "0".

**bit A-9**: Spindle/C axis zero point return direction

- 00: Short-cut
- 01: Forward run
- 10: Reverse run

**bit 8**: Designate zero point return
- 0: Automatically return to zero point simultaneously with C-axis changeover
- 1: Separate operations are required for zero point return

**bit 7**: Synchronous tapping command polarity
- 0: Forward direction
- 1: Reverse direction (The standard setting when spindle and motor are directly coupled)

**bit 6-5**: Synchronous tapping zero point return direction

- 00: Short-cut
- 01: Forward run
- 10: Reverse run

**bit 4**: Designate zero point return
- 0: Automatically return to zero point before synchronous tapping is started (tapping phase alignment)
- 1: Not return to zero point and immediately synchronous tapping is started

**bit 3**: Not used. Set to "0".

**bit 2-1**: Orientation direction

- 00: Short-cut
- 01: Forward run
- 10: Reverse run

**bit 0**: Z phase detection direction
- 0: Forward direction
- 1: Reverse direction
4-3 Setting the initial parameters for the spindle drive unit

【#3107】ori_spd Orientation command speed
Set the spindle speed during orientation command.
When the spindle is not running or running to the different direction with the orientation, the orientation is carried out with this speed after a stop. When the spindle is running to the same direction with the orientation, this parameter does not have a meaning because it decelerates directly and the orientation is carried out.

---Setting range---
1 to 99999 (r/min)

【#3108】ori_sft Position shift amount for orientation
The orientation stop position can be moved by this parameter setting although normally the position is Z-phase position.
During multi-point orientation control, the stop position is determined by the total value of this parameter and the position data for multi-point orientation of PLC input.

---Setting range---
-35999 to 35999 (0.01°)

【#3109】zdetspd Z phase detection speed
For the first S command after power is turned ON, the spindle rotates at the speed of setting value for this parameter until Z phase is detected twice.
When "#3106/bitF = 1" (Spindle zero point proximity switch detection enabled), also proximity switch is detected.

(Note) When spindle zero point proximity switch detection is enabled, the rotation direction of the orientation/zero point return (synchronous tapping, spindle/C axis) will follow Z phase detection direction. And the speed will follow Z phase detection speed.

---Setting range---
1 to 99999 (r/min)

【#3110】tap_spd Synchronous tapping zero point return speed
Set the zero point return speed during synchronous tapping control.

---Setting range---
1 to 99999 (r/min)

【#3111】tap_sft Synchronous tapping zero point return shift amount
Set the zero point return shift amount during synchronous tapping control. Zero point angle shifts from Z phase according to the setting angle.

---Setting range---
0 to 35999 (0.01°)

【#3112】cax_spd Spindle C axis zero point return speed
Set the zero point return speed during spindle C axis control.

---Setting range---
1 to 99999 (r/min)

【#3113】cax_sft Spindle C axis zero point return shift amount
Set the spindle C axis zero point return shift amount. Zero point angle shifts from Z phase according to the setting angle.

---Setting range---
0 to 359999 (0.001°)
### [#3114] `cax_para_chg` Spindle/C axis parameter switch

Parameter switches when switching the detector system between normal spindle control and C axis control, such as using spindle side detector only for C axis control in spindle drive system. It is validated with replacing a certain servo parameter of the corresponding servo axis to a spindle parameter.

- **0**: Not switch
- **1**: Switch

--- Setting range ---
0/1 (Standard: 0)

### [#3115] `sp2_t1` Time constant in orientation/interpolation mode automatic reference position return (Gear: 00)

Set the linear acceleration/deceleration time constant for zero point return control (#3106/bit4,8) which is automatically started at the time of switching orientation control, C axis control and synchronous tapping control when gear 00 is selected. The inclination is determined by the ratio to limit rotation speed (`slimit1`). Set the sufficiently large value compared to the acceleration/deceleration time constant with S command (`sp_t1`) so that the output torque is not saturated. When executing C axis zero point return manually, it depends on the axis specification parameter.

--- Setting range ---
0 to 30000 (ms)

### [#3116] `sp2_t2` Time constant in orientation/interpolation mode automatic reference position return (Gear: 01)

Set the linear acceleration/deceleration time constant for zero point return control (#3106/bit4,8) which is automatically started at the time of switching orientation control, C axis control and synchronous tapping control when gear 01 is selected. The inclination is determined by the ratio to limit rotation speed (`slimit2`). Set the sufficiently large value compared to the acceleration/deceleration time constant with S command (`sp_t2`) so that the output torque is not saturated. When executing C axis zero point return manually, it depends on the axis specification parameter.

--- Setting range ---
0 to 30000 (ms)

### [#3117] `sp2_t3` Time constant in orientation/interpolation mode automatic reference position return (Gear: 10)

Set the linear acceleration/deceleration time constant for zero point return control (#3106/bit4,8) which is automatically started at the time of switching orientation control, C axis control and synchronous tapping control when gear 10 is selected. The inclination is determined by the ratio to limit rotation speed (`slimit3`). Set the sufficiently large value compared to the acceleration/deceleration time constant with S command (`sp_t3`) so that the output torque is not saturated. When executing C axis zero point return manually, it depends on the axis specification parameter.

--- Setting range ---
0 to 30000 (ms)

### [#3118] `sp2_t4` Time constant in orientation/interpolation mode automatic reference position return (Gear: 11)

Set the linear acceleration/deceleration time constant for zero point return control (#3106/bit4,8) which is automatically started at the time of switching orientation control, C axis control and synchronous tapping control when gear 11 is selected. The inclination is determined by the ratio to limit rotation speed (`slimit4`). Set the sufficiently large value compared to the acceleration/deceleration time constant with S command (`sp_t4`) so that the output torque is not saturated. When executing C axis zero point return manually, it depends on the axis specification parameter.

--- Setting range ---
0 to 30000 (ms)
4-3 Setting the initial parameters for the spindle drive unit

### #3120 staptr Time constant reduction rate in high-speed synchronous tapping

When performing high-speed synchronous tapping control (#1281/bit5), set the reduction rate of the time constant compared to the time constant in normal synchronous tapping.

(Setting "0" or "100" will be regarded as reduction rate zero, so the time constant won't be reduced.)

E.g.) When set to "10", time constant in high-speed synchronous tapping will be 90% of that in normal synchronous tapping.

---Setting range---

0 to 100(%)  

### #3121 tret Turret indexing

Select the validity of turret indexing.

0: Invalid
1: Valid

### #3122 GRC Turret side gear ratio

Set the number of teeth on the turret side when the gear selection command (control input 4/bit6, 5) is set to 00. Set a value of GRC so that the ratio of GRC to the spindle side gear ratio (#13057 SP057) will be 1:N (an integer).

If GRC is set to "0", it will be regarded as "1".

---Setting range---

0 to 32767  

### #3123 tret_spd Turret indexing speed

Set the turret end indexing speed when in turret indexing.

When this parameter is set to 0, it follows the value set for Orientation command speed (#3107).

---Setting range---

0 to 32767(r/min)  

### #3124 tret_t Turret indexing time constant

Set the acceleration/deceleration time constant to reach Limit rotation speed (slimt1) at gear 00 when in turret indexing. Set this parameter to a larger value than time constant in orientation (#3115).

---Setting range---

0 to 30000 (ms)  

### #3125 tret_inpos Turret indexing in-position width

Set the position error range in which the index positioning complete signal is output when in turret indexing. When this parameter is set to 0, the value of In-position width (#13024 SP024) will be used for this width.

---Setting range---

0 to 32767(1°/1000)  

### #3126 tret_fin_off Index positioning complete signal OFF time

Set the time to forcibly turn OFF the index positioning complete signal since the indexing start signal turns ON. If this period of time has not passed yet, the index positioning complete signal will not turn ON even at the completion of index positioning.

---Setting range---

0 to 10000 (ms)
### SPECSP  Spindle specification

**bit0: Select the gear changeover method.**

0: Gear change type 1 (Gear is changed when the spindle stop signal is ON and when a gear recommended by NC and the one selected are different)
1: Gear change type 2 (Gear is changed when the spindle stop signal and spindle gear shift signal is ON)

---Setting range---
0x0000 to 0xffff (hexadecimal)

### ori_spec  Orientation control specification

**bit0: Orientation imposition advance output**

Reduce the orientation time by detecting an in-position faster. The in-position detection width is changed from SP024(#13024) to ori_inp2.

0: Invalid 1: Valid

---Setting range---
0x0000 to 0xffff (hexadecimal)

### cax_spec  Spindle/C axis control specification

Not used. Set to "0000".

### syn_spec  Spindle synchronization control specification

**bit0: Tool spindle synchronization II (hobbing) automatic compensation selection**

1: Compensate hobbing axis delay (advance) with workpiece axis.
0: No compensation.

### tap_spec  Synchronous tapping control specification

Not used. Set to "0000".

### ori_inp2  2nd in-position width for orientation

Set the in-position width when imposition advance output control (#3128/bit0) is valid. Reduce the orientation time by setting a bigger value than the value of conventional SP024 and detecting an in-position faster. Conventional SP024 is used for 2nd in-position signal detection width.

---Setting range---
0 to 32767 (1deg/1000)

### spherr  Hobbing axis delay (advance) allowable angle

Set the allowable angle between the commanded position and actual position of hobbing axis when it is in tool spindle synchronization II (hobbing) mode (X18AE ON), and also when hobbing axis and workpiece axis are synchronizing (X18A9 ON).

---Setting range---
0 to 32767 (1deg/1000)

### sphtc  Primary delay time constant for hobbing axis automatic compensation

Set the primary delay time constant of hobbing axis automatic compensation primary delay filter control in tool spindle synchronization II (hobbing).
When set to 0, primary delay filter control is invalid.

---Setting range---
0 to 32767 (ms)
4-3 Setting the initial parameters for the spindle drive unit

【#3135】sfwd_g  Feed forward gain for hobbing axis

Set the feed forward gain for the hobbing axis in tool spindle synchronization II (hobbing) mode.

---Setting range---
0 to 200 (%)

【#3137】stap_ax_off  High-speed synchronous tapping unsupported axis

Set the high-speed synchronous tapping control unsupported axis as a bit. Each bit (bit0 -) corresponds to the order of the axis name parameter (#1013) setting.

<table>
<thead>
<tr>
<th>bit 0-F</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>High-speed synchronous tapping supported axis</td>
</tr>
<tr>
<td>1</td>
<td>High-speed synchronous tapping unsupported axis</td>
</tr>
</tbody>
</table>

【#3138】motor_type  Spindle motor type

Set the spindle motor type. The set type will be displayed on the drive monitor screen, and it will be also output to the system configuration data.

---Setting range---
Character string within 26 characters including A-Z, a-z, 0-9, "." (decimal point), "," (hyphen), "/" (slash)
(Cleared by inputting "0".)

【#3140(PR)】S_DINSp  Speed observation input door No.

Set the door signal input in the drive unit. Use this parameter only when the axis with a door signal belongs to several door groups.

The correspondence between the door signals and bits are as follows.

<table>
<thead>
<tr>
<th>bit0</th>
<th>Door1 signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>bit1</td>
<td>Door2 signal</td>
</tr>
</tbody>
</table>

If the axis does not receive any door signal, set to "0".
An error (Y20 0027) will occur in the following cases.
- Several bits are enabled.
- Any bit other than those set in 
  "#3071 S_DSISp" is enabled.

---Setting range---
0000 to 0002 (HEX)
4-3-4 Spindle parameters

These parameters are sent to the spindle drive unit when the NC power is turned ON. The standard parameters are designated with the "Spindle parameter setting list" enclosed when the spindle motor is delivered. There may be cases when the machine specifications are unclear, so the parameters determined by the machine specifications should be confirmed by the user.

The parameters with "(PR)" requires the CNC to be turned OFF after the settings. Turn the power OFF and ON to enable the parameter settings.

【#13001】 SP001 PGV Position loop gain non-interpolation mode
Set the position loop gain for "Non-interpolation" control mode.
When the setting value increases, the command tracking ability will enhance and the positioning settling time can be shorter. However, the impact on the machine during acceleration/deceleration will increase.
Use the selection command, the control mode "bit 2, 1, 0 = 000" in control input 4.
(Note) The control mode is commanded by NC.

---Setting range---
1 to 200 (1/s)

【#13002】 SP002 PGN Position loop gain interpolation mode
Set the position loop gain for "interpolation" control mode.
When the setting value increases, the command tracking ability will enhance and the positioning settling time can be shorter. However, the impact on the machine during acceleration/deceleration will increase.
Use the selection command, the control mode "bit 2, 1, 0 = 010 or 100" in control input 4.
(Note) The control mode is commanded by NC.
When carrying out the SHG control, set SP035/bitC to "1".

---Setting range---
1 to 200 (1/s)

【#13003】 SP003 PGS Position loop gain spindle synchronization
Set the position loop gain for "spindle synchronization" control mode.
When the setting value increases, the command tracking ability will enhance and the positioning settling time can be shorter. However, the impact on the machine during acceleration/deceleration will increase.
Use the selection command, the control mode "bit 2, 1, 0 = 001" in control input 4.
(Note) The control mode is commanded by NC.
When carrying out the SHG control, set SP036/bit4 to "1".

---Setting range---
1 to 200 (1/s)

【#13004】 SP004
Not used. Set to "0".

【#13005】 SP005 VGN1 Speed loop gain 1
Set the speed loop gain.
Set this according to the load inertia size.
The higher setting value will increase the accuracy of control, however, vibration tends to occur.
If vibration occurs, adjust by lowering by 20 to 30%.
The final value should be 70 to 80% of the value at which the vibration stops.

---Setting range---
1 to 9999
### Setting the initial parameters for the spindle drive unit

**#13006** SP006 VIA1 Speed loop lead compensation 1

Set the speed loop integral control gain.
The standard setting is "1900". Adjust the value by increasing/decreasing the value by about 100.
Raise this value to improve the contour tracking accuracy in high-speed cutting.
Lower this value when the position droop does not stabilize (when the vibration of 10 to 20Hz occurs).

---Setting range---
1 to 9999

**#13007** SP007 VIL1 Speed loop delay compensation 1

Set this parameter when the limit cycle occurs in the full-closed loop or overshooting occurs in positioning.
When setting this parameter, make sure to set the torque offset "SP050(TOF)".
When not using, set to "0".

---Setting range---
0 to 32767

**#13008** SP008 VGN2 Speed loop gain 2

Normally SP005(VGN1) is used.
By setting "SP035/bit1, SP035/bit9 or SP036/bit1=1", gain 2 can be used according to the application.
Gain 2 can also be used by setting "Speed gain set 2 changeover request (control input 5/ bitC) = 1".
Refer to SP005(VGN1) for adjustment procedures.

---Setting range---
1 to 9999

**#13009** SP009 VIA2 Speed loop lead compensation 2

Normally SP006(VIA1) is used.
By setting "SP035/bit1, SP035/bit9 or SP036/bit1=1", gain 2 can be used according to the application.
Gain 2 can also be used by setting "Speed gain set 2 changeover request (control input 5/ bitC) = 1".
Refer to SP006(VIA1) for adjustment procedures.

---Setting range---
1 to 9999

**#13010** SP010 VIL2 Speed loop delay compensation 2

Normally SP007(VIL1) is used.
By setting "SP035/bit1, SP035/bit9 or SP036/bit1=1", gain 2 can be used according to the application.
Gain 2 can also be used by setting "Speed gain set 2 changeover request (control input 5/ bitC) = 1".
Refer to SP007(VIL1) for adjustment procedures.

---Setting range---
0 to 32767

**#13011** SP011

Not used. Set to "0".

**#13012** SP012

Not used. Set to "0".

**#13013** SP013

Not used. Set to "0".
【#13014】 SP014  PY1  Minimum excitation rate 1

Set the minimum value for the variable excitation rate. The standard setting is "50".
Set to "0" when using an IPM spindle motor.
If noise including gear noise is loud, select a small value. However, a larger setting value is more effective for impact response.
(Note) When setting a value at "50 or more", check if there is no problem with gear noise, motor excitation noise, vibration during low-speed rotation or vibration when the servo is locked during orientation stop, etc.
When setting a value at "less than 50", check if there is no problem with the impact load response or rigidity during servo lock.

---Setting range---
0 to 100 (%)

【#13015】 SP015  PY2  Minimum excitation rate 2

Normally, SP014(PY1) is used.
By setting "SP035/bit2, SP035/bitA or SP036/bit2=1", the excitation rate 2 can be used according to the application.
The excitation rate 2 can also be used by setting "the minimum excitation rate 2 changeover request (control input 5/ bitB) = 1". Refer to SP014(PY1) for adjustment procedures.
Set to "0" when using an IPM spindle motor.

---Setting range---
0 to 100 (%)

【#13016】 SP016  DDT  Phase alignment deceleration rate

Set the single-rotation position alignment deceleration rate for orientation stopping, phase alignment while rotating and switching from non-interpolation mode to spindle synchronization mode while rotating.
When the load inertia is larger, the setting value should be smaller.
When the setting value is larger, the orientation in-position and single-rotation position alignment complete faster, but the impact applied on the machine will increase.
To change the deceleration rate only during rotation command (command F Δ T ≠ 0), set this parameter together with SP070 (KDDT).

---Setting range---
1 to 32767 (0.1(r/min)/ms)
### #13017(PR) SP017 SPEC1 Spindle specification 1

Select the spindle specification. A function is allocated to each bit. Set this in hexadecimal format.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function</th>
<th>Value</th>
</tr>
</thead>
</table>
| F-C | msr Motor series selection | 0: 200V specification IM spindle motor  
1: 200V specification IPM spindle motor  
2: 400V specification IM spindle motor  
3: 400V specification IPM spindle motor  
4: 200V specification Tool spindle motor |
| B-5 | Not used. Set to "0". |
| 4 | fdir Position feedback | 0: Forward polarity  
1: Reverse polarity |
| 3 | vfb Speed feedback filter | 0: Disable  
1: Enable (2250Hz) |
| 2 | seqh READY ON sequence | 0: Normal  
1: High-speed |
| 1 | dfbx Dual feedback control | 0: Stop  
1: Start |
| 0 | fdir2 Speed feedback polarity | 0: Forward polarity  
1: Reverse polarity |

Related parameters: SP051, SP052
**[#13018(PR)] SP018 SPEC2 Spindle specification 2**

Select the spindle specification.  
A function is allocated to each bit.  
Set this in hexadecimal format.

```
Bit– F E D C B A 9 8 7 6 5 4 3 2 1 0
```

- **bit F-A :**  
  Not used. Set to "0".
- **bit 9 : mpg Earth fault detection**  
  0: Disable    1: Enable (standard)  
  Set "0" and it is constantly "Enable" for MDS-DJ-SP Series.
- **bit 8 : spsu Command speed limit value**  
  0: 33,750 r/min     1: 135,000 r/min
- **bit 7-6 :**  
  Not used. Set to "0".
- **bit 5 : mkch Coil switch function**  
  0: Disable  1: Enable
- **bit 4-2 :**  
  Not used. Set to "0".
- **bit 1 : oplp Open loop control**  
  This allows the operation in which no detector feedback signals are used.  
  It is used when adjusting the detector, etc.  
  0: Disable  1: Enable
- **bit 0 :**  
  Not used. Set to "0".

**[#13019(PR)] SP019 RNG1 Sub side detector resolution**

-[For semi-closed loop]-  
Set the same value as SP020 (RNG2). (Refer to the explanation of SP020.)

-[For full-closed loop]-  
Set the number of pulses per revolution of the machine side detector.

When using ABZ pulse output detector (OSE-1024-3-15-68), set this combined with SP097 (RNG1ex).  
SP019 = 4096  
SP097 = -1

---Setting range---  
When SP097=0, the setting range is from 0 to 32767 (kp/rev)  
When SP097 ≠ 0  
M700V, M70V, E70: 0 to 65536 (p)  
C70: -32768 to 32767 (p)
### #13020(PR) SP020 RNG2 Main side detector resolution

Set the number of pulses per revolution of the motor side detector. When using the detector interface unit MDS-B-HR, use this with SP098(RNG2ex).

**Detector**
- TS5691(128 teeth): SP020 = 2000
- TS5691(180 teeth): SP020 = 2880
- TS5691(256 teeth): SP020 = 4000
- TS5691(384 teeth): SP020 = 6000
- TS5691(512 teeth): SP020 = 8000
- TS5690(64 teeth): SP020 = 2000
- TS5690(90 teeth): SP020 = 2880
- TS5690(128 teeth): SP020 = 4000
- TS5690(192 teeth): SP020 = 6000
- TS5690(256 teeth): SP020 = 8000
- TS5690(384 teeth): SP020 = 12000
- ERM280(1200 teeth): SP020 = 4800
- ERM280(2048 teeth): SP020 = 8000
- MPCI: SP020 = 7200
- MBE205: SP020 = 2000

**Tool spindle motor**
- OSA18(-A48): SP020 = 260

---Setting range---
- When SV118=0, the setting range is from 0 to 32767 (kp)
- When SV118 ≠ 0
  - For M700V,M70V,M70,E70: 0 to 65536 (p)
  - For C70: -32768 to 32767 (p)

### #13021(PR) SP021 OLT Overload detection time constant

Set the detection time constant of Overload 1 (Alarm 50). (For machine tool builder adjustment) Normally, set to "60". Set to "300" when using an IPM spindle motor.

---Setting range---
1 to 15300 (s)

### #13022 SP022 OLL Overload detection level

Set the current detection level of "Overload 1" (Alarm 50) as a percentage against the motor short-time rated output current. (For machine tool builder adjustment) Normally, set to "120". Set to "100" when using an IPM spindle motor.

---Setting range---
1 to 200 (Short-time rated %)

### #13023 SP023 OD1 Excessive error detection width (interpolation mode - spindle synchronization)

Set the excessive error detection width for the interpolation mode and spindle synchronization. The standard setting is "120". When set to "0", the excessive error detection will be ignored, so do not set to "0".

---Setting range---
1 to 32767 (°)
Setup

**#13024 SP024 INP  In-position width**
Set the in-position detection width.
Set the positioning accuracy required to the machine.
Lower setting value increases the positioning accuracy, but makes the cycle time (settling time) longer.
The standard setting is "875".

---Setting range---
0 to 32767 (1°/1000)

**#13025 SP025 INP2 2nd in-position width**
Use this when detecting an in-position different from normal in-position width such as advancing the in-position signal. The adjustment procedure is the same as SP024 (INP).
The standard setting is "875".

---Setting range---
0 to 32767 (1°/1000)

**#13026(PR) SP026 TSP Maximum motor speed**
Set the maximum motor speed.
If the motor speed exceeds the set maximum speed, an overspeed alarm will occur.

---Setting range---
1 to 32767 (r/min)

**#13027 SP027 ZSP Motor zero speed**
Set the motor speed for detecting zero speed.
If the motor speed drops below the set speed, the zero speed signal turns ON.
The standard setting is "50".

---Setting range---
1 to 1000 (r/min)

**#13028 SP028 SDTS Speed detection set value**
Set the motor speed for detecting the speed.
If the motor speed drops below the set speed, the speed detection signal turns ON.
The standard setting is 10% of the maximum motor speed.

---Setting range---
10 to 32767 (r/min)

**#13029 SP029 SDTR Speed detection reset width**
Set the hysteresis width in which the speed detection changes from ON to OFF.
If the setting value is small, the speed detection will chatter easily.
The standard setting is "30".

---Setting range---
10 to 1000 (r/min)

**#13030 SP030 SDT2 2nd speed detection setting value**
Set the specified speed of the specified speed output.
When carrying out digital output of the specified speed output, set SP229/bitC to "1".
It is not available for MDS-DJ-SP Series.

---Setting range---
0 to 32767 (r/min)

**#13031(PR) SP031 MTYP Motor type**
Set the control system of the spindle drive unit.
2200: Semi closed loop control
4200: Full closed loop control by using spindle side ABZ pulse output detector
6200: Full closed loop control by using spindle side serial output detector
#13032(PR)  SP032  PTYP  Power supply type/ Regenerative resistor type

## MDS-D2/DH2 Series: Power supply type

When connecting a power supply unit, set a code for each power supply unit.

### Bit F-C : amp

Not used. Set to "0".

### Bit B-8 : rtyp

Not used. Set to "0".

### Bit 7-0 : ptyp  External emergency stop setting

When the emergency stop input signal of the power supply unit is "disabled"

<table>
<thead>
<tr>
<th>Power supply type</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>MDS-D2-CV-37 / MDS-DH2-CV-37</td>
<td>04</td>
</tr>
<tr>
<td>MDS-D2-CV-75 / MDS-DH2-CV-75</td>
<td>08</td>
</tr>
<tr>
<td>MDS-D2-CV-110 / MDS-DH2-CV-110</td>
<td>11</td>
</tr>
<tr>
<td>MDS-D2-CV-185 / MDS-DH2-CV-185</td>
<td>19</td>
</tr>
<tr>
<td>MDS-D2-CV-300 / MDS-DH2-CV-300</td>
<td>30</td>
</tr>
<tr>
<td>MDS-D2-CV-370 / MDS-DH2-CV-370</td>
<td>37</td>
</tr>
<tr>
<td>MDS-D2-CV-450 / MDS-DH2-CV-450</td>
<td>45</td>
</tr>
<tr>
<td>MDS-D2-CV-550 / MDS-DH2-CV-550</td>
<td>55</td>
</tr>
<tr>
<td>MDS-D2-CV-750</td>
<td>75</td>
</tr>
<tr>
<td>MDS-DH2-CV-750</td>
<td>B5</td>
</tr>
</tbody>
</table>

When the emergency stop input signal of the power supply unit is "enabled"

(Note) Set the power supply rotary switch to "4".

<table>
<thead>
<tr>
<th>Power supply type</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>MDS-D2-CV-37 / MDS-DH2-CV-37</td>
<td>44</td>
</tr>
<tr>
<td>MDS-D2-CV-75 / MDS-DH2-CV-75</td>
<td>48</td>
</tr>
<tr>
<td>MDS-D2-CV-110 / MDS-DH2-CV-110</td>
<td>51</td>
</tr>
<tr>
<td>MDS-D2-CV-185 / MDS-DH2-CV-185</td>
<td>59</td>
</tr>
<tr>
<td>MDS-D2-CV-300 / MDS-DH2-CV-300</td>
<td>70</td>
</tr>
<tr>
<td>MDS-D2-CV-370 / MDS-DH2-CV-370</td>
<td>77</td>
</tr>
<tr>
<td>MDS-D2-CV-450 / MDS-DH2-CV-450</td>
<td>85</td>
</tr>
<tr>
<td>MDS-D2-CV-550 / MDS-DH2-CV-550</td>
<td>95</td>
</tr>
<tr>
<td>MDS-DH2-CV-750</td>
<td>B5</td>
</tr>
</tbody>
</table>

## MDS-DM2-SPV Series: Power supply type

Set as follows for the spindle drive section of the MDS-DM2-SPV.

### Bit F-C : amp

Not used. Set to "0".

### Bit B-8 : rtyp

Not used. Set to "0".

### Bit 7-0 : ptyp  External emergency stop setting

<table>
<thead>
<tr>
<th>Normal</th>
<th>External emergency stop function</th>
</tr>
</thead>
<tbody>
<tr>
<td>19</td>
<td>59</td>
</tr>
</tbody>
</table>
### MITSUBISHI CNC

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### MDS-DJ-SP Series: Regenerative resistor type

Set the regenerative resistor type.

<table>
<thead>
<tr>
<th>Bit</th>
<th>F</th>
<th>E</th>
<th>D</th>
<th>C</th>
<th>B</th>
<th>A</th>
<th>9</th>
<th>8</th>
<th>7</th>
<th>6</th>
<th>5</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td>emgx</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>rtyp</td>
</tr>
<tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>amp</td>
</tr>
</tbody>
</table>

**bit F-8 : amp(bit F-C) / rtyp(bit B-8)**

- Setting prohibited : 10-12
- MR-RB12 or GZG200W39OHMK : 13
- MR-RB32 or GZG200W120OHMK 3 units connected in parallel : 14
- MR-RB30 or GZG200W39OHMK 3 units connected in parallel : 15
- MR-RB50 or GZG300W39OHMK 3 units connected in parallel : 16
- Setting prohibited : 17-1F
- Setting prohibited : 20-23
- FCUA-RB22 : 24
- FCUA-RB37 : 25
- FCUA-RB55 : 26
- FCUA-RB75/2 1 unit : 27
- R-UNIT1 : 28
- R-UNIT2 : 29
- R-UNIT3 : 2A
- R-UNIT4 : 2B
- R-UNIT5 : 2C
- FCUA-RB75/2 2 units connected in parallel : 2D
- FCUA-RB55/2 2 units connected in parallel : 2E
- Setting prohibited : 2F

**bit 7-4 : emgx  External emergency stop function**

Set the external emergency stop function.

- 0: Disable
- 4: Enable

**bit 3-0 :**

Not used. Set to "0". 
### SP033 SFNC1 Spindle function 1

Select the spindle specification.  
A function is allocated to each bit.  
Set this in hexadecimal format.

| Bit | F | E | D | C | B | A | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|-----|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0   | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

#### bit F-C :
Not used. Set to "0".

#### bit B-A : ovs Overshoot compensation

Set this parameter when overshooting occurs during positioning.  
\[ \text{bitB,A=} \]
- 00: Compensation stop  
- 01: Setting prohibited  
- 10: Setting prohibited  
- 11: Compensation type 3

Set the compensation amount in SP043(OVS1) and SP042(OVS2).

#### bit 9-8 : lmc Lost motion compensation type2

Set this parameter when the protrusion at quadrant change is too large.  
\[ \text{bit9,8=} \]
- 00: Compensation stop  
- 01: Setting prohibited  
- 10: Compensation type 2  
- 11: Setting prohibited

#### bit 7 : lmc2a Lost motion compensation 2 timing

\[ \text{0: Normal} \quad 1: \text{Change} \]

#### bit 6 :
Not used. Set to "0".

#### bit 5-4 : vfct Jitter compensation pulse number

Suppress vibration by machine backlash when axis stops.  
\[ \text{bit5,4=} \]
- 00: Disable  
- 01: 1 pulse  
- 10: 2 pulse  
- 11: 3 pulses

#### bit 3-0 :
Not used. Set to "0".
### [#13034] SP034 SFNC2 Spindle function 2

Select the spindle function.  
A function is allocated to each bit.  
Set this in hexadecimal format.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function</th>
<th>Setting</th>
</tr>
</thead>
</table>
| F   | nfd5 Depth of Notch filter 5 | Set the depth of Notch filter 5 (SP088).  
  bit F,E,D=  
  000: - ∞  
  001: -18.1[dB]  
  010: -12.0[dB]  
  011: -8.5[dB]  
  100: -6.0[dB]  
  101: -4.1[dB]  
  110: -2.5[dB]  
  111: -1.2[dB] |
| E   | Not used. Set to "0".  |
| D   | nfd4 Depth of Notch filter 4 | Set the depth of Notch filter 4 (SP087).  
  bit B,A,9=  
  000: - ∞  
  001: -18.1[dB]  
  010: -12.0[dB]  
  011: -8.5[dB]  
  100: -6.0[dB]  
  101: -4.1[dB]  
  110: -2.5[dB]  
  111: -1.2[dB] |
| C   | pwm Current control  
  0: Standard current control  
  1: High frequency current control  |
| B,A,9 | nfd2 Depth of Notch filter 2 | Set the depth of Notch filter 2 (SP046).  
  bit7,6,5=  
  000: - ∞  
  001: -18.1[dB]  
  010: -12.0[dB]  
  011: -8.5[dB]  
  100: -6.0[dB]  
  101: -4.1[dB]  
  110: -2.5[dB]  
  111: -1.2[dB] |
| fhz3 | Notch filter 3  
  0: Stop  
  1: Start (1125Hz)  |
4-3 Setting the initial parameters for the spindle drive unit

**bit 3-1 : nfd1  Depth of Notch filter 1**

Set the depth of Notch filter 1 (SP038).

- 000: $-\infty$
- 001: $-18.1\,[dB]$
- 010: $-12.0\,[dB]$
- 011: $-8.5\,[dB]$
- 100: $-6.0\,[dB]$
- 101: $-4.1\,[dB]$
- 110: $-2.5\,[dB]$
- 111: $-1.2\,[dB]$

**bit 0 :**

Not used. Set to "0".

**[#13035(PR)]  SP035  SFNC3  Spindle function 3**

Select the spindle function.

A function is allocated to each bit.

Set this in hexadecimal format.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>F-D</td>
<td>Not used. Set to &quot;0&quot;.</td>
</tr>
<tr>
<td>C</td>
<td>shgn  SHG control in interpolation mode</td>
</tr>
<tr>
<td>B</td>
<td>Not used. Set to &quot;0&quot;.</td>
</tr>
<tr>
<td>A</td>
<td>pyn  Excitation rate selection in interpolation mode</td>
</tr>
<tr>
<td>9</td>
<td>vgn  Speed loop gain set selection in interpolation mode</td>
</tr>
<tr>
<td>8-3</td>
<td>Not used. Set to &quot;0&quot;.</td>
</tr>
<tr>
<td>2</td>
<td>pyin  Excitation rate selection in non-interpolation mode</td>
</tr>
<tr>
<td>1</td>
<td>vgin Speed loop gain set selection in non-interpolation mode</td>
</tr>
<tr>
<td>0</td>
<td>Not used. Set to &quot;0&quot;.</td>
</tr>
</tbody>
</table>
4 Setup

---

**[#13036(PR)] SP036 SFNC4 Spindle function 4**

Select the spindle function.
A function is allocated to each bit.
Set this in hexadecimal format.

| Bit | F | E | D | C | B | A | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|-----|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|     | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 |

- **bit F-8:**
  Not used. Set to "0".

- **bit 7 : mksl  Coil selection in spindle synchronization mode**
  0: Select the coil commanded during synchronization  1: Select high-speed coil

- **bit 6-5:**
  Not used. Set to "0".

- **bit 4 : shgs  SHG control in spindle synchronization mode**
  0: Stop  1: Start

- **bit 3:**
  Not used. Set to "0".

- **bit 2 : pys  Excitation rate selection in spindle synchronization mode**
  0: Select Excitation rate 1  1: Select Excitation rate 2

- **bit 1 : vgs  Speed loop gain set selection in spindle synchronization mode**
  0: Select Set 1 (SP005,SP006,SP007)  1: Select Set 2 (SP008,SP009,SP010)

- **bit 0:**
  Not used. Set to "0".

---

**[#13037] SP037 JL Load inertia scale**

Set the motor axis conversion total load inertia including motor itself in proportion to the motor inertia.

\[
SV037(JL) = \frac{(Jm+Jl)}{Jm} \times 100
\]

- **Setting range:**
  0 to 5000 (%)

---

**[#13038] SP038 FHz1 Notch filter frequency 1**

Set the vibration frequency to suppress when machine vibration occurs.
(Enabled at 50 or more.)
When not using, set to "0".

- **Setting range:**
  0 to 2250 (Hz)

---

**[#13039] SP039 LMCD Lost motion compensation timing**

Set this parameter when the lost motion compensation type2 timing does not match.
Adjust by increasing the value by 10 at a time.

- **Setting range:**
  0 to 2000 (ms)
4-3 Setting the initial parameters for the spindle drive unit

**[#13040] SP040 LMC1 Lost motion compensation non-sensitive band**

Set the non-sensitive band of the lost motion compensation in the feed forward control. When "0" is set, 2°/1000 is set. Adjust by increasing the value by 1°/1000 at a time.

---Setting range---
-32768 to 32767 (1°/1000)

**[#13041] SP041 LMC2 Lost motion compensation 2**

Set this parameter with SP048(LMC1) only to vary the lost motion compensation amount depending on the command directions. Normally, set to "0".

---Setting range---
-1 to 200 (Short-time rated %)
  Note that when SP227/bit2 is "1", the range will be -1 to 20000 (Short-time rated 0.01%).

**[#13042] SP042 OVS2 Overshooting compensation 2**

Set this parameter with SP043(OVS1) only to vary the lost motion compensation amount depending on the command directions. Normally, set to "0".

---Setting range---
-1 to 100 (Short-time rated %)
  Note that when SP227/bit2 is "1", the range will be -1 to 10000 (Short-time rated 0.01%).

**[#13043] SP043 OVS1 Overshooting compensation 1**

Set this parameter when overshooting occurs during positioning. This compensates the motor torque during positioning. This is valid only when the overshooting compensation SP033 (SFNC1/ovs) is selected.

[Type 3 "When SP033/ bitB,A=11"]
Use this when performing overshoot compensation in the feed forward control during arc cutting mode. Set the compensation amount based on the motor short-time rated current. Increase the value in increments of 1% to find the value where overshooting ceases.

[To vary compensation amount depending on the direction]
When SV042 (OVS2) is "0", change the SP043 (OVS1) value in both +/- directions to compensate. To change the compensation amount depending on the command direction, set this with SP042 (OVS2).
(SP043: + direction, SP042: - direction, However, the directions may be opposite depending on other settings.)
When "-1" is set, the compensation will not be performed in the command direction.

---Setting range---
-1 to 100 (Short-time rated %)
  Note that when SP227/bit2 is "1", the range will be -1 to 10000 (Short-time rated 0.01%).

**[#13044] SP044 OBS2 Disturbance observer gain**

Set the disturbance observer gain. The standard setting is "100". To use the disturbance observer, also set SP037(JL), SP045(OBS1) and SP226/ bitE. When not using, set to "0".

---Setting range---
0 to 500 (%)

**[#13045] SP045 OBS1 Disturbance observer filter frequency**

Set the disturbance observer filter band. Normally, set to "100". To use the disturbance observer, also set SP037(JL), SP044(OBS2) and SP226/ bitE. When not using, set to "0".

---Setting range---
0 to 1000 (rad/s)
**Setup**

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### [#13046] SP046 FHz2 Notch filter frequency 2

Set the vibration frequency to suppress when machine vibration occurs.
(Enabled at 50 or more.)
When not using, set to "0".

Related parameters: SP034/bit7-5

---Setting range---

0 to 2250 (Hz)

### [#13047] SP047 EC Inductive voltage compensation gain

Set the inductive voltage compensation gain. Normally, set to "100".
Lower the gain when the current FB peak exceeds the current command peak.

---Setting range---

0 to 200 (%)

### [#13048] SP048 LMC1 Lost motion compensation 1

Set this parameter when the protrusion (that occurs due to the non-sensitive band by friction, torsion, backlash, etc.) at quadrant change is too large.
This sets the compensation torque at quadrant change (when an axis feed direction is reversed) by Short-time rated %.
Whether to enable the lost motion compensation and the method can be set with other parameters.

[Type 2 "When SP033/bit9,8=10"]
Set the compensation amount based on the motor short-time rated current.
The standard setting is double of the friction torque. The compensation amount will be 0 when "0" is set.

Related parameters: SP033/bit9-8, SP039, SP040, SP041, SP227/bit2

[To vary compensation amount depending on the direction]
When SP041 (LMC2) is "0", change SP048 (LMC1) value in both of +/- directions to compensate.
To vary the compensation amount depending on the command direction, set this with SP041 (LMC2).
(SP048: + direction, SP041: - direction, However, the directions may be opposite depending on other settings.)
When "-1" is set, the compensation will not be performed in the command direction.

---Setting range---

-1 to 200 (Short-time rated %)
Note that when SP227/bit2 is "1", the range will be -1 to 20000 (Short-time rated 0.01%).

### [#13049] SP049 FFC Acceleration rate feed forward gain

When a relative error in the synchronous control is too large, set this parameter to the axis that is delaying.
The standard setting is "0". The standard setting in the SHG control is "50".
Adjust relative errors in acceleration/deceleration by increasing the value by 50.

---Setting range---

0 to 999 (%)

### [#13050] SP050 TOF Torque offset

Set the imbalance torque.

---Setting range---

-100 to 100 (Short-time rated %)
### [#13051] SP051 DFBT  Dual feed back control time constant

Set the control time constant in dual feed back.  
When the function is valid, the standard setting is "100". When "0" is set, the value is 1 ms.  
When the time constant is increased, the operation will get closer to the semi-closed control and the limit of the position loop gain will be raised.  
However, this cannot be used when the spindle slip occurs in machine configuration such as V-belt drive.  

Related parameters: SP017/bit1, SP052  
---Setting range---  
0 to 9999 (ms)

### [#13052] SP052 DFBN  Dual feedback control non-sensitive band

Set the non-sensitive band in the dual feedback control.  
Normally set to "0".  

Related parameters: SP017/bit1, SP051  
---Setting range---  
0 to 9999 (1/1000°)

### [#13053] SP053 ODS  Excessive error detection width (non-interpolation mode)

Set the excessive error detection width in non-interpolation mode.  
Standard setting value: ODS = Maximum motor speed (r/min) × 6/PGV/2  
When set to "0", the excessive error detection will not be performed.  
---Setting range---  
0 to 32767 (°)

### [#13054] SP054 ORE  Overrun detection width in closed loop control

Set the overrun detection width in the full-closed loop control.  
When the gap between the motor side detector and the machine side detector exceeds the set value, it is judged as an overrun and "Alarm 43" is detected.  
When "-1" is set, the alarm detection will not be performed.  
When "0" is set, overrun will be detected with 2°.  
In the full-closed loop control, normally set this parameter to "360". During V-belt drive, set to "-1".  
---Setting range---  
-1 to 32767 (°)

### [#13055] SP055 EMGx  Max. gate off delay time after emergency stop

Set the time required to forcibly execute READY OFF after the emergency stop is input.  
Normally set to "20000".  
When "0" is set, READY OFF is forcibly executed with "7000ms".  
When the set time is shorter than the time to decelerate and stop, the spindle will stop with the dynamic brake after the set time is out.  

Related parameters: SP056  
---Setting range---  
0 to 29900 (ms)

### [#13056] SP056 EMGt  Deceleration time constant at emergency stop

Set the time constant used for the deceleration control at emergency stop. Set the time required to stop from the maximum motor speed (TSP).  
When "0" is set, the deceleration control is executed with "7000ms".  

Related parameters: SP055  
---Setting range---  
0 to 29900 (ms)
【#13057(PR)】 SP057 GRA1  Spindle side gear ratio 1
Set the number of gear teeth on the spindle side when "the gear selection command (control input 4/ bit6, 5) " is set to "00".

---Setting range---
1 to 32767

【#13058(PR)】 SP058 GRA2  Spindle side gear ratio 2
Set the number of gear teeth on the spindle side when "the gear selection command (control input 4/ bit6, 5) " is set to "01".

---Setting range---
1 to 32767

【#13059(PR)】 SP059 GRA3  Spindle side gear ratio 3
Set the number of gear teeth on the spindle side when "the gear selection command (control input 4/ bit6, 5) " is set to "10".

---Setting range---
1 to 32767

【#13060(PR)】 SP060 GRA4  Spindle side gear ratio 4
Set the number of gear teeth on the spindle side when "the gear selection command (control input 4/ bit6, 5) " is set to "11".

---Setting range---
1 to 32767

【#13061(PR)】 SP061 GRB1  Motor side gear ratio 1
Set the number of gear teeth on the motor side when "the gear selection command (control input 4/ bit6, 5) " is set to "00".

---Setting range---
1 to 32767

【#13062(PR)】 SP062 GRB2  Motor side gear ratio 2
Set the number of gear teeth on the motor side when "the gear selection command (control input 4/ bit6, 5) " is set to "01".

---Setting range---
1 to 32767

【#13063(PR)】 SP063 GRB3  Motor side gear ratio 3
Set the number of gear teeth on the motor side when "the gear selection command (control input 4/ bit6, 5) " is set to "10".

---Setting range---
1 to 32767

【#13064(PR)】 SP064 GRB4  Motor side gear ratio 4
Set the number of gear teeth on the motor side when "the gear selection command (control input 4/ bit6, 5) " is set to "11".

---Setting range---
1 to 32767

【#13065】 SP065 TLM1  Torque limit 1
Set the torque limit value when "the torque limit (control input 1/bitA, 9, 8) " is set to "001".

---Setting range---
0 to 999 (Short-time rated %)
【#13066】SP066  TLM2  Torque limit 2
Set the torque limit value when "the torque limit (control input 1/bitA, 9, 8)" is set to "010".

---Setting range---
0 to 999 (Short-time rated %)

【#13067】SP067  TLM3  Torque limit 3
Set the torque limit value when "the torque limit (control input 1/bitA, 9, 8)" is set to "011".

---Setting range---
0 to 999 (Short-time rated %)

【#13068】SP068  TLM4  Torque limit 4
Set the torque limit value when "the torque limit (control input 1/bitA, 9, 8)" is set to "100".

---Setting range---
0 to 999 (Short-time rated %)

【#13069】SP069  PCMP  Phase alignment completion width
Set the single-rotation position alignment completion width for phase alignment and changing from
non-interpolation to spindle synchronization mode during rotation.
Set the rotation error that is required to the machine.
When the setting value decreases, the rotation error will decrease, but the cycle time (settling time)
will get longer. The standard setting is "875".

---Setting range---
0 to 32767 (1°/1000)

【#13070】SP070  KDDT  Phase alignment deceleration rate scale
Set the scale for SP016 (DDT) to change the deceleration rate only during rotation command
(command F $\Delta$ T ≠ 0).
When the setting value increases, the single-rotation position alignment will be completed faster, but
the impact to the machine will also increase. When not using, set to "0".

---Setting range---
0 to 255 (1/16-fold)

【#13071】SP071  DIQM  Variable current limit during deceleration, lower limit value
Set this parameter to adjust the deceleration time by changing the current limit value during
deceleration depending on the motor speed.
As shown below, set the lower limit rate of the current limit in SP071 (DIQM), and use with SP072
(DIQN).
When DIQM is set to 100%, the standard current limit value in deceleration (TMLR) is applied.

---Setting range---
0 to 999 (%)
**[13072] SP072 DIQN Variable current limit during deceleration, break point speed**

Set this parameter to adjust the deceleration time by changing the current limit value during deceleration depending on the motor speed.

As shown below, set the lower limit rate of the current limit in SP071 (DIQM), and use with SP072 (DIQN).

When DIQM is set to 100%, the standard current limit value in deceleration (TMLR) is applied.

---Setting range---
1 to 32767 (r/min)

---Diagram---

**[13073] SP073 VGVN Variable speed gain target value**

If noise is bothersome during high speed rotation, it may be reduced by lowering the speed loop gain at high speed.

Set this value to ensure the adequate response by suppressing noise and vibration at low speeds and increasing the speed loop gain at high speeds for a high-speed spindle of machining center, etc.

As shown below, set the speed loop gain rate for the overspeed detection speed in SP073 (VGVN), and use with SP074 (VGVS).

When not using, set to "0".

The overspeed detection speed (VLMT) is 115% of the maximum motor speed (TSP). This function can be used when either Speed loop gain set 1 or Speed loop gain set 2 is selected.

---Setting range---
0 to 999 (%)
4-3 Setting the initial parameters for the spindle drive unit

**#13074 SP074 VGVS Variable speed gain change start speed**

If noise is bothersome during high speed rotation, it may be reduced by lowering the speed loop gain at high speed.

Set this value to ensure the adequate response by suppressing noise and vibration at low speeds and increasing the speed loop gain at high speeds for a high-speed spindle of machining center, etc.

As shown below, set the speed loop gain rate for the overspeed detection speed in SP073 (VGVN), and use with SP074 (VGVS).

When not using, set to "0".

The overspeed detection speed (VLMT) is 115% of the maximum motor speed (TSP).

This function can be used when either Speed loop gain set 1 or Speed loop gain set 2 is selected.

---Setting range---

0 to 32767 (r/min)

---Diagram---

![Diagram showing speed loop gain change start speed]

**#13075 SP075 DWSH Slip compensation scale during regeneration high-speed coil**

Set the slip frequency scale during deceleration.

Normally, set to "0". (For machine tool builder adjustment)

---Setting range---

0 to 255 (1/16-fold)

**#13076 SP076 DWSL Slip compensation scale during regeneration low-speed coil**

Set the slip frequency scale at deceleration when using the low-speed coil.

Normally, set to "0". (For machine tool builder adjustment)

---Setting range---

0 to 255 (1/16-fold)

**#13077 SP077 IQA Q axis current lead compensation**

Set the current loop gain.

To use the coil switch function, set the current loop gain for when the high-speed coil is selected.

The setting value is determined by the motor's electrical characteristics so that the value is fixed to each motor used.

Set the value given in the spindle parameter list. (For machine tool builder adjustment)

---Setting range---

1 to 20480

**#13078 SP078 IDA D axis current lead compensation**

Set the current loop gain.

To use the coil switch function, set the current loop gain for when the high-speed coil is selected.

The setting value is determined by the motor's electrical characteristics so that the value is fixed to each motor used.

Set the value given in the spindle parameter list. (For machine tool builder adjustment)

---Setting range---

1 to 20480
**4 Setup**

**[#13079] SP079 IQG Q axis current gain**
Set the current loop gain.
To use the coil switch function, set the current loop gain for when the high-speed coil is selected.
The setting value is determined by the motor's electrical characteristics so that the value is fixed to each motor used.
Set the value given in the spindle parameter list. (For machine tool builder adjustment)

---Setting range---
1 to 8192

**[#13080] SP080 IDG D axis current gain**
Set the current loop gain.
To use the coil switch function, set the current loop gain for when the high-speed coil is selected.
The setting value is determined by the motor's electrical characteristics so that the value is fixed to each motor used.
Set the value given in the spindle parameter list. (For machine tool builder adjustment)

---Setting range---
1 to 8192

**[#13081] SP081 IQAL Q axis current lead compensation low-speed coil**
When using coil switch function, set the current loop gain for when the low-speed coil is selected.
The setting value is determined by the motor's electrical characteristics so that the value is fixed to each motor used.
Set the value given in the spindle parameter list. (For machine tool builder adjustment)

---Setting range---
1 to 20480

**[#13082] SP082 IDAL D axis current lead compensation low-speed coil**
When using coil switch function, set the current loop gain for when the low-speed coil is selected.
The setting value is determined by the motor's electrical characteristics so that the value is fixed to each motor used.
Set the value given in the spindle parameter list. (For machine tool builder adjustment)

---Setting range---
1 to 20480

**[#13083] SP083 IQGL Q axis current gain low-speed coil**
When using coil switch function, set the current loop gain for when the low-speed coil is selected.
The setting value is determined by the motor's electrical characteristics so that the value is fixed to each motor used.
Set the value given in the spindle parameter list. (For machine tool builder adjustment)

---Setting range---
1 to 8192

**[#13084] SP084 IDGL D axis current gain low-speed coil**
When using coil switch function, set the current loop gain for when the low-speed coil is selected.
The setting value is determined by the motor's electrical characteristics so that the value is fixed to each motor used.
Set the value given in the spindle parameter list. (For machine tool builder adjustment)

---Setting range---
1 to 8192

**[#13085] SP085**
Not used. Set to "0".

**[#13086] SP086**
Not used. Set to "0".
4-3 Setting the initial parameters for the spindle drive unit

【#13087】SP087 FHz4 Notch filter frequency 4
Set the vibration frequency to suppress when machine vibration occurs. (Enabled at 50 or more.)
When not using, set to "0".
Related parameters: SP034/bitB-9
---Setting range---
0 to 2250 (Hz)

【#13088】SP088 FHz5 Notch filter frequency 5
Set the vibration frequency to suppress when machine vibration occurs. (Enabled at 50 or more.)
When not using, set to "0".
Related parameters: SP034/bitF-D
---Setting range---
0 to 2250 (Hz)

【#13089】SP089 TMKQ Spindle output stabilizing gain Q axis
Set the magnification of the torque current stabilizing gain. (For machine tool builder adjustment)
When set to "0", the torque current stabilization is disabled.
When not using, set to "0".
---Setting range---
0 to 32767

【#13090】SP090 TMKD Spindle output stabilizing gain D axis
Set the magnification of the excitation current stabilizing gain. (For machine tool builder adjustment)
When set to "0", the excitation current stabilization is disabled.
When not using, set to "0".
---Setting range---
0 to 32767

【#13091】SP091
Not used. Set to "0".

【#13092】SP092
Not used. Set to "0".

【#13093】SP093
Not used. Set to "0".

【#13094】SP094 MPV Magnetic pole error detection speed
In the magnetic pole position detection function, the command motor speed and motor speed during the position command stop are monitored.
Set the command motor speed level and motor speed level during the position command stop in "r/min" unit.
When the command motor speed level is set to "0", the magnetic pole position error is detected at 10r/min.
Set to "10" as a standard setting when the magnetic pole position error detection function is enabled.
This detects the magnetic pole position error when the motor speed is "100r/min".

Ten-thousands digit, Thousands digit ------------ Command motor speed level (10r/min)
Hundreds digit, Tens digit, Ones digit ----------- Motor speed level (10r/min)
---Setting range---
0 to 31999
### Setup

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##### 【#13095】SP095 VIAX Lead compensation scale during high-response acceleration/deceleration

Set the magnification against delay/lead compensation (SP006) of the high-response acceleration/deceleration (valid when SP226/ bitD is set to "1").

Normally, set to "0". Set this parameter to suppress overshooting when the speed is reached.

---Setting range---

0 to 10000 (0.01%)

##### 【#13096】SP096 SDW Speed slowdown allowable width

When the spindle slows down due to multiple cutting, set the processable speed as percentage against the NC command speed.

When "0" is set, the magnification is the same as when "85" is set. When set to "-1", the allowable width will be disabled.

---Setting range---

-1.0 to 100(%)  

##### 【#13097】SP097 RNG1ex Extension sub side detector resolution

When setting the machine side detector resolution in pulse (p) unit, set the number of pulses to four bite data of SP097 (high-order) and SP019 (low-order) in pulse (p) unit.

When SP097=0, the setting unit of SP019 is (kp).

Refer to SP019 for details.

Related parameters: SP019, SP020, SP098

---Setting range---

-1 to 32767

##### 【#13098】SP098 RNG2ex Extension main side detector resolution

When setting the motor side detector resolution in pulse (p) unit, set the number of pulses to four bite data of SP098 (high-order) and SP020 (low-order) in pulse (p) unit.

When SP098=0, the setting unit of SP020 is (kp).

Refer to SP020 for details.

Related parameters: SP019, SP020, SP097

---Setting range---

-1 to 32767

##### 【#13099】SP099

Not used. Set to "0".

##### 【#13100】SP100

Not used. Set to "0".

##### 【#13101】SP101 TMA1 OMR-FF movement averaging filter time constant 1

Set the movement averaging filter time constant in OMR-FF control.

The standard setting is "88".

Set to "0" when not using OMR-FF control.

---Setting range---

0 to 711 (0.01ms)
4-3 Setting the initial parameters for the spindle drive unit

【#13102】SP102  TMA2  OMR-FF movement averaging filter time constant 2
Set the movement averaging filter time constant in OMR-FF control.
The standard setting is "88".
Set to "0" when not using OMR-FF control.

---Setting range---
0 to 711 (0.01ms)

【#13103】SP103
Not used. Set to "0".

【#13104】SP104  FFR0  OMR-FF inner rounding compensation gain for G0
Set the inner rounding compensation amount (drive side feed forward gain) in OMR-FF control.
When a shape tracking error is too large in OMR-FF control, adjust it by setting this parameter.
The higher the setting value is, the less the shape tracking error will be, however, overshooting
during acceleration/deceleration will increase.
Lower the value when vibration occurs during the G0 acceleration/deceleration.
The standard setting is "10000".
Set to "0" when not using OMR-FF control.

---Setting range---
0 to 20000 (0.01%)

【#13105】SP105  FFR1  OMR-FF inner rounding compensation gain for G1
Set the inner rounding compensation amount (drive side feed forward gain) in OMR-FF control.
When a shape tracking error is too large in OMR-FF control, adjust it by setting this parameter.
The higher the setting value is, the less the shape tracking error will be, however, overshooting
during acceleration/deceleration will increase.
Lower the value when vibration occurs during the G1 acceleration/deceleration.
The standard setting is "10000".
Set to "0" when not using OMR-FF control.

---Setting range---
0 to 20000 (0.01%)

【#13106】SP106  PGM  OMR-FF scale model gain
Set the scale model gain (position response) in OMR-FF control.
Set the same value as SV003(PGN1).
Increase the setting value to perform a high-speed machining such as a fine arc or to improve the
path error.
Lower the value when vibration occurs during acceleration/deceleration.
Set to "0" when not using OMR-FF control.

---Setting range---
0 to 300 (rad/s)

【#13107-13111】SP107-SP111
Not used. Set to "0".

【#13112】SP112 IFF  OMR-FF current feed forward gain
Set the current feed forward rate in OMR-FF control.
The standard setting is "10000".
Setting value of 0 is equal to "10000(100%)" setting.
Set to "0" when not using OMR-FF control.

---Setting range---
0 to 32767 (0.01%)
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【#13113】SP113 OPLP Current command value for open loop
Set the current command value for when the open loop control is enabled. When "0" is set, the state will be the same as when "50" is set. When not using, set to "0". The open loop control is enabled when "SP018/bit1" is set to "1".

---Setting range---
0 to 999 (Short-time rated %)

【#13114】SP114 MKT Coil changeover gate cutoff timer
Set the time required to cut off the gate when turning OFF/ON the coil switch contactor. The value should be longer than the coil switch contactor's OFF/ON time. The standard setting is "150".

---Setting range---
0 to 3500 (ms)

【#13115】SP115 MKT2 Coil changeover current limit timer
Set the time required to limit the current immediately after the coil switch contactor ON/OFF is completed and the gate is turned ON. The standard setting is "250".

---Setting range---
0 to 3500 (ms)

【#13116】SP116 MKIL Coil changeover current limit value
Set the time required to limit the current immediately after the coil switch contactor ON/OFF is completed and the gate is turned ON. The standard setting is "120".

---Setting range---
0 to 999 (Short-time rated %)

【#13117】SP117 SETM Excessive speed deviation timer
Set the time to detect the speed excessive error alarm. Set the time required to the machine. The standard setting is "12".

---Setting range---
0 to 60 (s)

【#13118(PR)】SP118 MSFT Magnetic pole shift amount
Set the magnetic pole shift amount of IPM spindle motor. During DC excitation of the initial setup: Set the same value displayed in the "AFLT gain" on the NC monitor screen in SP225/bit4=1. When not using, set to "0".

---Setting range---
-18000 to 18000 (electrical angle 0.01°)

【#13119】SP119
Not used. Set to "0".

【#13120】SP120
Not used. Set to "0".
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SP121 MP Kpp</strong></td>
<td>Magnetic pole detection position loop gain &lt;br&gt;Set the position loop gain in the magnetic pole detection loop. This is used in the initial magnetic pole detection when the IPM spindle motor is turned ON. Set to &quot;0&quot; when using an IM spindle motor.  &lt;br&gt;---Setting range--- &lt;br&gt;0 to 32767</td>
</tr>
<tr>
<td><strong>SP122 MP Kvp</strong></td>
<td>Magnetic pole detection speed loop gain &lt;br&gt;Set the speed loop gain in the magnetic pole detection loop. This is used in the initial magnetic pole detection when the IPM spindle motor is turned ON. Set to &quot;0&quot; when using an IM spindle motor.  &lt;br&gt;---Setting range--- &lt;br&gt;0 to 32767</td>
</tr>
<tr>
<td><strong>SP123 MP Kvi</strong></td>
<td>Magnetic pole detection speed loop lead compensation &lt;br&gt;Set the speed loop lead compensation in the magnetic pole detection loop. This is used in the initial magnetic pole detection when the IPM spindle motor is turned ON. Set to &quot;0&quot; when using an IM spindle motor.  &lt;br&gt;---Setting range--- &lt;br&gt;0 to 32767</td>
</tr>
<tr>
<td><strong>SP124 ILMTsp</strong></td>
<td>Magnetic pole detection current limit value &lt;br&gt;Set the current limit value for the magnetic pole detection loop. This is used in the initial magnetic pole detection when the IPM spindle motor is turned ON. Set to &quot;0&quot; when using an IM spindle motor.  &lt;br&gt;---Setting range--- &lt;br&gt;0 to 999 (Short-time rated %)</td>
</tr>
<tr>
<td><strong>SP125 DA1NO</strong></td>
<td>D/A output ch1 data No. / Initial DC excitation level &lt;br&gt;Input the desired data number to D/A output channel. When using the 2-axis drive unit, set &quot;-1&quot; to the axis that the data will not be output. &lt;br&gt;When the DC excitation is running: Use in the DC excitation function. DC excitation: Set the initial excitation level when SP225/bit4=1. When &quot;0&quot; is set, the state will be the same as when &quot;20&quot; is set.  &lt;br&gt;---Setting range--- &lt;br&gt;-32768 to 32767</td>
</tr>
<tr>
<td><strong>SP126 DA2NO</strong></td>
<td>D/A output ch2 data No. / Final DC excitation level &lt;br&gt;Input the desired data number to D/A output channel. When using the 2-axis drive unit, set &quot;-1&quot; to the axis that the data will not be output. &lt;br&gt;When the DC excitation is running: Use in the DC excitation function. DC excitation: Set the final excitation level when SP225/bit4=1. When &quot;0&quot; is set, the state will be the same as when &quot;50&quot; is set.  &lt;br&gt;---Setting range--- &lt;br&gt;-32768 to 32767</td>
</tr>
</tbody>
</table>
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【#13127】SP127 DA1MPY D/A output ch1 output scale / Initial DC excitation time

Set the output scale in increments of 1/100.
When "0" is set, the scale is the same as when "100" is set.

When the DC excitation is running:
Use in the DC excitation function.
DC excitation: Set the initial excitation time when SP225/bit4=1.
When "0" is set, the state will be the same as when "10000" is set.

---Setting range---
-32768 to 32767 (1/100-fold)

【#13128】SP128 DA2MPY D/A output ch2 output scale

Set the output scale in increments of 1/100.
When "0" is set, the scale is the same as when "100" is set.

---Setting range---
-32768 to 32767 (1/100-fold)

【#13129(PR)-13141(PR)】SP129 - SP141

Set the unique constants for the spindle motor. (High-speed coil)
The setting value is determined by the motor's mechanical and electrical characteristics and specifications, so normally set the value given in the spindle parameter list.

【#13142(PR)】SP142

Set the unique constants for the spindle motor. (High-speed coil)
The setting value is determined by the motor's mechanical and electrical characteristics and specifications, so normally set the value given in the spindle parameter list.
For IPM spindle motor
This parameter is used in initial magnetic pole detection of IPM spindle motor.
(1) Pulse application time: Set it in [μs] unit (0 < application time < 350)
(2) Pulse application coil: To select a low-speed coil, add 1000 to the pulse application time.
(3) Polarity of estimated magnetic pole: When it is set to the reverse polarity, add "-" to the total of (1) and (2).
E.g.: When performing 333 μs pulse-applied magnetic pole estimation in a low-speed coil and selecting the reverse polarity for the estimated polarity
SP142 = -(333+1000) = -1333

【#13143(PR)-13160(PR)】SP143 - SP160

Set the unique constants for the spindle motor. (High-speed coil)
The setting value is determined by the motor's mechanical and electrical characteristics and specifications, so normally set the value given in the spindle parameter list.

【#13161(PR)-13192(PR)】SP161 - SP192

Set the unique constants for the spindle motor. (Low-speed coil)
The setting value is determined by the motor's mechanical and electrical characteristics and specifications, so normally set the value given in the spindle parameter list.

【#13193】SP193 LMR Change magnification for load meter standard output (High-speed coil)

Set the standard output to be displayed as 100% in load meter using the short-time rated output ratio.
To display the continuous rated output as 100%, set as follows.
   Continuous rated output/Short-time rated output × 100
When "0" is set, normal display will be applied.
It is not available for MDS-DJ-SP Series.

---Setting range---
0 to 100 (%)
### [13194] SP194 LMN Base speed for load meter standard output (High-speed coil)

Set the base speed of the standard output to be displayed as 100% in load meter. When "0" is set, the base speed of the short-time rated output will be applied. It is not available for MDS-DJ-SP Series.

---Setting range---
0 to 32767 (r/min)

### [13195] SP195 LMRL Change magnification for load meter standard output (Low-speed coil)

Set the standard output to be displayed as 100% in load meter using the short-time rated output ratio.
To display the continuous rated output as 100%, set as follows.
Continuous rated output/Short-time rated output × 100
When "0" is set, normal display will be applied. It is not available for MDS-DJ-SP Series.

---Setting range---
0 to 100 (%)

### [13196] SP196 LMNL Base speed for load meter standard output (Low-speed coil)

Set the base speed of the standard output to be displayed as 100% in load meter. When "0" is set, the base speed of the short-time rated output will be applied. It is not available for MDS-DJ-SP Series.

---Setting range---
0 to 32767 (r/min)

### [13197-13224] SP197 - SP224

Not used. Set to "0".
# Setup

## MITSUBISHI CNC

### 【#13225】 SP225 SFNC5 Spindle function 5

Select the spindle functions.  
Functions are allocated to each bit.  
Set this in hexadecimal format.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
<th>Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>F-C</td>
<td>Overshooting compensation type 3 non-sensitive band</td>
<td></td>
</tr>
</tbody>
</table>
Set the non-sensitive band of the overshooting compensation type 3 in increments of 2°/1000.  
In the feed forward control, set the non-sensitive band for the model position droop and ignore the model overshooting. Set to "2°/1000" as a standard. |
| B-9 | Not used. Set to "0". |
| 8   | Coil switch allowance in deceleration control |  
This enables a coil changeover while decelerating after an emergency stop for a spindle motor with coil changeover specification. A coil changeover may enable an excessive load inertia to stop within the maximum delay time.  
0: Normal (Disable)  
1: Enable |
| 7-6 | Thermistor characteristics |  
When SP225/bit3=0 (N type) is selected  
bit7,6=  
00: Mitsubishi spindle motor  
01: Setting prohibited  
10: Setting prohibited  
11: Setting prohibited  
When SP225/bit3=1 (P type) is selected  
bit7,6=  
00: KTY84-130 (Manufactured by Philips)  
01: Setting prohibited  
10: Setting prohibited  
11: Setting prohibited |
| 5   | Proximity switch signal enable edge |  
0: Falling edge  
1: Rising edge |
| 4   | DC excitation mode |  
0: Normal  
1: Start |
| 3   | Thermistor type |  
0: Type N thermistor (Mitsubishi standard)  
1: Type P thermistor |
| 2   | Thermistor temperature detection |  
0: Normal  
1: Disable (Except for TS5690/5691) |
| 1-0 | Not used. Set to "0". |
### #13226  SP226  SFNC6  Spindle function 6

Select the spindle functions. Functions are allocated to each bit. Set this in hexadecimal format.

<table>
<thead>
<tr>
<th>Bit F: clt</th>
<th>Spindle monitor load inertia ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Normal</td>
</tr>
<tr>
<td>1</td>
<td>Display</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Bit E: obs</th>
<th>Disturbance observer</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Normal</td>
</tr>
<tr>
<td>1</td>
<td>Enable</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Bit D: vup</th>
<th>High response acceleration / deceleration</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Normal acceleration/deceleration</td>
</tr>
<tr>
<td>1</td>
<td>High response acceleration/deceleration Enable</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Bit C: tqof</th>
<th>Spindle output stabilization during acceleration</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Normal</td>
</tr>
<tr>
<td>1</td>
<td>Disable</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Bit  B-9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not used. Set to &quot;0&quot;.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Bit  B-8  r2c</th>
<th>Temperature compensation adjustment indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Normal</td>
</tr>
<tr>
<td>1</td>
<td>Display</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Bit  7-6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not used. Set to &quot;0&quot;.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Bit  5  pon</th>
<th>IPM spindle pulse application magnetic pole estimation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Normal</td>
</tr>
<tr>
<td>1</td>
<td>Enable</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Bit  4-0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not used. Set to &quot;0&quot;.</td>
</tr>
</tbody>
</table>
## Setup

### SP227 SFNC7 Spindle function 7

Select the spindle functions. Functions are allocated to each bit. Set this in hexadecimal format.

<table>
<thead>
<tr>
<th>Bit</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
</tr>
</thead>
<tbody>
<tr>
<td>ccu</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>dos3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>dis</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**bit F-C : dis** Digital signal input selection

- 0: No signal
- 1: SLS (Safely Limited Speed) function door state signal
- 4: Proximity switch signal detection
- Other settings: setting prohibited

**bit B-A : dos3** Digital signal output 3 selection (MDS-DJ-SP)

- bitB.A=
  - 00: Disable
  - 01: Setting prohibited
  - 10: Contactor control signal output
  - 11: Setting prohibited

**bit 9-3 :**

Not used. Set to "0".

**bit 2 : ccu** Lost motion/overshoot compensation compensation amount setting unit

- 0: Short-time rated %
- 1: Short-time rated 0.01%

**bit 1-0 :**

Not used. Set to "0".

### SP228 SFNC8 Spindle function 8

Not used. Set to "0000".
### [13229] SP229 SFNC9 Spindle function 9
Select the spindle functions.
Functions are allocated to each bit.
Set this in hexadecimal format.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function</th>
<th>Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>F</td>
<td>ssc  SLS (Safety Limited Speed) function</td>
<td>0: Disable 1: Enable</td>
</tr>
<tr>
<td>E</td>
<td>Not used. Set to &quot;0&quot;.</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>rps  Safely limited speed setting unit</td>
<td>0: Normal 1: 100°/min</td>
</tr>
<tr>
<td>C</td>
<td>sdt2  Specified speed output digital signal 2 output</td>
<td>0: Normal 1: Enable</td>
</tr>
<tr>
<td>B-9</td>
<td>Not used. Set to &quot;0&quot;.</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>sto  Dedicated wiring STO function</td>
<td>Set this parameter to use dedicated wiring STO function. 0: Dedicated wiring STO function unused 1: Dedicated wiring STO function used</td>
</tr>
<tr>
<td>7-1</td>
<td>Not used. Set to &quot;0&quot;.</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>omrffon  OMR-FF control enabled</td>
<td>0: Disable 1: Enable</td>
</tr>
</tbody>
</table>

### [13230] SP230 SFNC10 Spindle function 10
Select the spindle functions.
Functions are allocated to each bit.
Set this in hexadecimal format.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Function</th>
<th>Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>F-9</td>
<td>Not used. Set to &quot;0&quot;.</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>nohis  History of communication error alarm between NC and DRV(34,36,38,39)</td>
<td>For C70, set &quot;1&quot;. 0: Enable 1: Disable</td>
</tr>
<tr>
<td>7</td>
<td>cse   Spindle C axis command speed monitoring function</td>
<td>0: Normal setting (function disabled) 1: Function enabled</td>
</tr>
<tr>
<td>6-0</td>
<td>Not used. Set to &quot;0&quot;.</td>
<td></td>
</tr>
</tbody>
</table>
**Setup**

**MITSUBISHI CNC**

---

**#13231** SP231

Not used. Set to "0000".

**#13232** SP232

Not used. Set to "0000".

**#13233** SP233 IVC Voltage non-sensitive band compensation

When 100% is set, the voltage equivalent to the logical non-energized time will be compensated. When "0" is set, 100% compensation will be performed. Adjust in increments of 10% from the default value 100%. If the value is too large, vibration or vibration noise may be generated.

---Setting range---

0 to 255 (%)

**#13234** SP234

Not used. Set to "0".

**#13235(PR)** SP235 R2H Temperature compensation gain

Set the magnification in converting the thermistor temperature to the control compensation amount. When "0" is set, the temperature compensation function is disabled. When not using, or when using an IPM spindle motor, set to "0".

---Setting range---

0 to 400 (%)

**#13236(PR)** SP236 WIH Temperature compensation time constant

Set the delay time constant from the thermistor temperature to the control compensation amount. When "0" is set, the delay time constant is disabled. When not using, or when using an IPM spindle motor, set to "0".

---Setting range---

0 to 150 (min)

**#13237(PR)** SP237 TCF Torque command filter

Set the filter for the torque command. When not using, set to "0". The standard value is "500" when using the motor side detector TS5690 or TS5691.

---Setting range---

0 to 4500 (Hz)

**#13238** SP238 SSCFEED Safely limited speed

Set the safely limited speed at the spindle end for the SLS (Safely Limited Speed) function. When not using, set to "0".

---Setting range---

0 to 18000 (°/min)

However, when SP229/bitD is set to "1", the setting range is from -32768 to 32767 (100°/min).
### [#13239] SP239  SSCRPM  Safely limited motor speed

Set the motor's safely limited speed for the SLS (Safely Limited Speed) function. Set a value to hold the following relationship.

\[ \text{SP239} = \left( \frac{\text{SP238}}{360} \right) \times \left( \frac{\text{SP061}}{\text{SP057}} \right) \]

Only when the product is 0, set to “1”.

When not using, set to "0".

Related parameters: SP229/bitD, SP229/bitF, SP238

--- Setting range ---

0 to 32767 (r/min)

### [#13240(PR)] SP240

Not used. Set to "0".

### [#13241(PR)-13256(PR)] SP241 - SP256

This is automatically set by the NC system.
Servo Adjustment
5-1 Servo adjustment procedure

Perform adjusting the servo in the factory configuration of the machine. When the servo is adjusted without having an enough running-in or a cover, friction torque, machine resonance frequency or resonance gain may be different, resulting in an incorrect adjustment.

CAUTION
## 5-2 Gain adjustment

### 5-2-1 Current loop gain

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SV009 IQA</td>
<td>Current loop q axis lead compensation</td>
<td>Set the fixed value of each motor. Set the standard value for each motor described in the standard parameter list.</td>
</tr>
<tr>
<td>SV010 IDA</td>
<td>Current loop d axis lead compensation</td>
<td>Set the fixed value of each motor. Set the standard value for each motor described in the standard parameter list.</td>
</tr>
<tr>
<td>SV011 IQG</td>
<td>Current loop q axis gain</td>
<td>Set the fixed value of each motor. Set the standard value for each motor described in the standard parameter list.</td>
</tr>
<tr>
<td>SV012 IDG</td>
<td>Current loop d axis gain</td>
<td>Set the fixed value of each motor. Set the standard value for each motor described in the standard parameter list.</td>
</tr>
</tbody>
</table>
5-2-2 Speed loop gain

(1) Setting the speed loop gain
The speed loop gain 1 (SV005: VGN1) is an important parameter for determining the responsiveness of the servo control. During servo adjustment, the highest extent that this value can be set to becomes important. The setting value has a large influence on the machine cutting precision and cycle time.

[1] Refer to the following standard VGN1 graphs and set the standard VGN1 according to the size of the entire load inertia (motor and machine load inertia).

[2] If the standard VGN1 setting value is exceeded, the current command fluctuation will increase even if the speed feedback fluctuates by one pulse. This can cause the machine to vibrate easily, so set a lower value to increase the machine stability.

<When machine resonance does not occur at the standard VGN1>
Set the standard VGN1. Use the standard value if no problem (such as machine resonance) occurs. If sufficient cutting precision cannot be obtained at the standard VGN1, VGN1 can be raised above the standard value as long as a 70 percent margin in respect to the machine resonance occurrence limit is maintained. The cutting accuracy can also be improved by adjusting with the disturbance observer.

<When machine resonance occurs at the standard VGN1>
Machine resonance is occurring if the shaft makes abnormal sounds when operating or stopping, and a fine vibration can be felt when the machine is touched while stopped. Machine resonance occurs because the servo control responsiveness includes the machine resonance points. (Speed control resonance points occur, for example, at parts close to the motor such as ball screws.) Machine resonance can be suppressed by lowering VGN1 and the servo control responsiveness, but the cutting precision and cycle time are sacrificed. Thus, set a vibration suppression filter and suppress the machine resonance (Refer to section "Vibration suppression measures"), and set a value as close as possible to the standard VGN1. If the machine resonance cannot be sufficiently eliminated even by using a vibration suppression filter, then lower the VGN1.

【#2205】SV005 VGN1 Speed loop gain 1
Set the speed loop gain.
The higher the setting value is, the more accurate the control will be, however, vibration tends to occur.
If vibration occurs, adjust by lowering by 20 to 30%.
The value should be determined to the 70 to 80% of the value at which the vibration stops.
The value differs depending on servo motors.
 Aim at the standard value determined by the servo motor type and load inertia ratio to adjust.

---Setting range---
1 to 30000

POINT
Suppressing the resonance with the vibration suppression function and increasing the VGN1 setting is effective for adjusting the servo later.
Load inertia ratio display

Perform the measurement in the section "Measuring unbalance torque and frictional torque", and set a torque offset (SV032) and frictional torque (SV045). When an acceleration/deceleration operation is executed with the setting of SV035/bitF=1, an estimated load inertia ratio will be displayed in "load inertia ratio " on the drive monitor screen.

Standard VGN1 graph (servo motor HF Series)
(2) Setting the speed loop lead compensation

The speed loop lead compensation (SV008: VIA) determines the characteristics of the speed loop mainly at low frequency regions. 1364 is set as a standard, and 1900 is set as a standard during SHG control. The standard value may drop in respect to loads with a large inertia.

When the VGN1 is set lower than the standard value because the load inertia is large or because machine resonance occurred, the speed loop control band is lowered. If the standard value is set in the leading compensation in this status, the leading compensation control itself will induce vibration. In concrete terms, a vibration of 10 to 20Hz could be caused during acceleration/ deceleration or stopping, and the position droop waveform could be disturbed when accelerating to a constant speed and when stopped. (Refer to lower left drawing)

This vibration cannot be suppressed by the vibration suppression functions. Lower the VIA in increments of 100 from the standard setting value. Set a value where vibration does not occur and the position droop waveform converges smoothly. Because lowering the VIA causes a drop in the position control's trackability, the vibration suppression is improved even when a disturbance observer is used without lowering the VIA. (Be careful of machine resonance occurrence at this time.)

If VIA is lowered, the position droop waveform becomes smooth and overshooting does not occur. However, because the trackability in respect to the position commands becomes worse, the positioning time and accuracy are sacrificed. VIA must be kept high (set the standard value) to guarantee precision, especially in high-speed contour cutting (generally F = 1000 or higher). In other words, in a machine aiming for high speed and high accuracy, a large enough value must be set in VGN1 so that VIA does not need to be lowered. When adjusting, the cutting precision will be better if adjustment is carried out to a degree where overshooting does not occur and a high VIA is maintained, without pursuing position droop smoothness.

If there are no vibration or overshooting problems, the high-speed contour cutting precision can be further improved by setting the VIA higher than the standard value. In this case, adjust by raising the VIA in increments of 100 from the standard value.

Setting a higher VIA improves the trackability regarding position commands in machines for which cycle time is important, and the time to when the position droop converges on the in-position width is shortened.

It is easier to adjust the VIA to improve precision and cycle time if a large value (a value near the standard value) can be set in VGN1, or if VGN1 can be raised equivalently using the disturbance observer.

---Setting range---
1 to 9999

Position droop vibration of 10Hz or less is not leading compensation control vibration. The position loop gain must be adjusted.
5-2-3 Position loop gain

(1) Setting the position loop gain
The position loop gain 1 (SV003: PGN1) is a parameter that determines the trackability to the command position. 33 is set as a standard. Set the same position loop gain value between interpolation axes. When PGN1 is raised, the trackability will be raised and the settling time will be shortened, but a speed loop that has a responsiveness that can track the position loop gain with increased response will be required. If the speed loop responsiveness is insufficient, several Hz of vibration or overshooting will occur during acceleration/deceleration. Vibration or overshooting will also occur when VGN1 is smaller than the standard value during VIA adjustment, but the vibration in the position loop occurs generally 10Hz or less. (The VIA vibration occurs from 10 to 20Hz.) When the position control includes machine resonance points (Position control machine resonance points occur at the tool end parts, etc.) because of insufficient machine rigidity, the machine will vibrate during positioning, etc. In either case, lower PGN1 and adjust so that vibration does not occur. If the machine also vibrates due to machine backlash when the motor stops, the vibration can be suppressed by lowering the PGN1 and smoothly stopping. If SHG control is used, an equivalently high position loop gain can be maintained while suppressing these vibrations. Adjust SHG control by raising the gain gradually after setting PGN1 as 1/2 a value of PGN1 at which a vibration does not occur under the normal control. If the PGN1 setting value is more than 1/2 of the normal control PGN1 when SHG control is used, there is an improvement effect in position control. (Note that for the settling time the improvement effect is at 1/\sqrt{2} or more.)

--- Setting range ---
1 to 200 (rad/s)

--- Setting range ---
0 to 999 (rad/s)

--- Setting range ---
0 to 1200 (rad/s)

CAUTION Always set the same value for the position loop gain between the interpolation axes.
(2) Setting the position loop gain for spindle synchronous control
During spindle synchronous control (synchronous tapping control, etc.), there are three sets of position loop gain parameters besides the normal control.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SV049</td>
<td>Position loop gain 1 in spindle synchronous control. Set the position loop gain during spindle synchronization control (synchronous tapping and synchronization control with spindle C-axis). When performing the SHG control, set this parameter with SV050 (PGN2sp) and SV058 (SHGCsp). ---Setting range--- 1 to 200 (rad/s)</td>
</tr>
<tr>
<td>SV050</td>
<td>Position loop gain 2 in spindle synchronous control. When using SHG control during spindle synchronous control (synchronous tapping and synchronization control with spindle C-axis), set this parameter with SV049 (PGN1sp) and SV058 (SHGCsp). Make sure to set the value 8/3 times that of SV049. When not using the SHG control, set to &quot;0&quot;. ---Setting range--- 0 to 999 (rad/s)</td>
</tr>
<tr>
<td>SV058</td>
<td>SHG control gain in spindle synchronous control. When using SHG control during spindle synchronization control (synchronous tapping and synchronization control with spindle C-axis), set this parameter with SV049 (PGN1sp) and SV050 (PGN2sp). Make sure to set the value 6 times that of SV049. When not using the SHG control, set to &quot;0&quot;. ---Setting range--- 0 to 1200 (rad/s)</td>
</tr>
</tbody>
</table>

Always set the same value for the position loop gain between the spindle and servo synchronous axes.

(3) SHG control
If the position loop gain is increased or feed forward control (NC function) is used to shorten the settling time or increase the precision, the machine system may vibrate easily. SHG control changes the position loop to a high-gain by stably compensating the servo system position loop through a delay. This allows the settling time to be reduced and a high precision to be achieved. (SHG: Smooth High-Gain)

(Feature 1) When the SHG control is set, even if PGN1 is set to the same value as the conventional gain, the position loop gain will be doubled.

(Feature 2) The SHG control response is smoother than conventional position control during acceleration/deceleration, so the gain can be increased further with SHG control compared to the conventional position control.

(Feature 3) With SHG control, a high gain is achieved so a high precision can be obtained during contour control. The following drawing shows an example of the improvement in roundness characteristics with SHG control.
Shape error characteristics

During SHG control, PGN1, PGN2 and SHGC are set with the following ratio.

\[
\text{PGN1} : \text{PGN2} : \text{SHGC} = 1 : 8/3 : 6
\]

During SHG control even if the PGN1 setting value is the same, the actual position loop gain will be higher, so the speed loop must have a sufficient response. If the speed loop response is low, vibration or overshooting could occur during acceleration/deceleration in the same manner as conventional control. If the speed loop gain has been lowered because machine resonance occurs, lower the position loop gain and adjust.

<table>
<thead>
<tr>
<th>No.</th>
<th>Abbrev.</th>
<th>Parameter name</th>
<th>Setting ratio</th>
<th>Setting example</th>
<th>Explanation</th>
<th>Setting range</th>
</tr>
</thead>
<tbody>
<tr>
<td>SV003</td>
<td>SV049</td>
<td>PGN1 (PGN1sp)</td>
<td>1</td>
<td>21 27 33 39 48</td>
<td>Always set with a combination of these three parameters.</td>
<td>1 to 200 (rad/s)</td>
</tr>
<tr>
<td>SV004</td>
<td>SV050</td>
<td>PGN2 (PGN2sp)</td>
<td>8/3</td>
<td>56 72 88 104 128</td>
<td></td>
<td>0 to 999 (rad/s)</td>
</tr>
<tr>
<td>SV057</td>
<td>SV058</td>
<td>SHGC (SHGCsp)</td>
<td>6</td>
<td>126 162 198 234 288</td>
<td></td>
<td>0 to 1200 (rad/s)</td>
</tr>
</tbody>
</table>

**<Effect>**

<table>
<thead>
<tr>
<th>Control method</th>
<th>Roundness error (μm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional control</td>
<td>22.5</td>
</tr>
<tr>
<td>SHG control</td>
<td>2.5</td>
</tr>
</tbody>
</table>

**【#2208】SV008 VIA Speed loop lead compensation**

Set the gain of the speed loop integral control.

Standard setting: 1364

Standard setting in the SHG control: 1900

Adjust the value by increasing/decreasing this by about 100 at a time.

Raise this value to improve contour tracking accuracy in high-speed cutting.

Lower this value when the position droop does not stabilize (when the vibration of 10 to 20Hz occurs).

---Setting range---

1 to 9999

**【#2215】SV015 FFC Acceleration rate feed forward gain**

When a relative error in synchronous control is too large, set this parameter to the axis that is delaying.

The standard setting is "0". The standard setting in the SHG control is "50".

To adjust a relative error in acceleration/deceleration, increase the value by 50 at a time.

---Setting range---

0 to 999 (%)
5-2-4 OMR-FF function

OMR-FF control improves the inner rounding amount of the arc, corner tracking error, or path vibration, etc. more comprehensively than conventional high-speed high-accuracy control by creating appropriate feed forward command for each of position, speed, and current depending on the vibration characteristics of the control target.

Feed forward is performed inside the drive unit according to the scale model and inertia setting in the OMR-FF generation part, and can independently set the command trackability with the scale model position loop gain (PGM) and the servo rigidity with the position control gain (PGN). This enables the higher and smoother trackability to the position command.

This function can be highly effective for linear servo, direct drive motors, or general motors in semi-closed loop control. OMR-FF control option for NC side is required when using this function.

OMR-FF function related parameters

<table>
<thead>
<tr>
<th>No.</th>
<th>Abbrev.</th>
<th>Parameter name</th>
<th>Setting range (unit)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SV037</td>
<td>JL</td>
<td>Load inertia scale</td>
<td>0 to 5000 (%)</td>
</tr>
<tr>
<td>SV101</td>
<td>TMA1</td>
<td>OMR-FF movement averaging filter time constant 1</td>
<td>0 to 711 (0.01ms)</td>
</tr>
<tr>
<td>SV102</td>
<td>TMA2</td>
<td>OMR-FF movement averaging filter time constant 2</td>
<td>0 to 711 (0.01ms)</td>
</tr>
<tr>
<td>SV104</td>
<td>FFR0</td>
<td>OMR-FF inner rounding compensation gain for G0</td>
<td>0 to 20000 (0.01%)</td>
</tr>
<tr>
<td>SV105</td>
<td>FFR1</td>
<td>OMR-FF inner rounding compensation gain for G1</td>
<td>0 to 20000 (0.01%)</td>
</tr>
<tr>
<td>SV106</td>
<td>PGM</td>
<td>OMR-FF scale model gain</td>
<td>0 to 300 (rad/s)</td>
</tr>
<tr>
<td>SV112</td>
<td>IFF</td>
<td>OMR-FF current feed forward gain</td>
<td>0 to 32767 (0.01%)</td>
</tr>
</tbody>
</table>

1. Always set the load inertia scale when using this function.
   Minimize errors for the load inertia value because the parameter is crucial to this function.

2. Disable SHG control when using this function.
**Setting method**

1. Adjust so that VGN1 is an appropriate value (the result of frequency response measurement on NC Analyzer is "Gain Margin > 8dB / Phase Margin > 30deg").
   
   -> For the adjustment method, refer to the section "Setting the speed loop gain".

2. Set the load inertia scale (SV037:JL) with the value of total load inertia in proportion to the motor inertia. For linear motors, set the gross mass of the moving sections in kg unit.
   
   -> Set SV035(SSF4)/bitF(clt) to "1" and check the estimated inertia value on the NC monitor screen.

3. Set SV003(PGN1).
   
   Check "Cross Freq (Hz)" with frequency response measurement on NC Analyzer.

4. Confirm that OMR-FF function option is enabled on the NC side.

   **Semi-closed loop control**
   
   $SV003(PGN1) = \text{"Cross Freq (Hz)"} \times \frac{2 \pi}{4}$
   
   (Example 1) Measurement value
   
   Cross Freq : 100Hz
   
   Since $100(\text{Hz}) \times \frac{2 \pi}{4} \approx 157$, set $SV003(PGN1)$ to 157.

   (Note) For the value of SV003(PGN1), the interpolation function will not be affected even if different values are set for each axis.

4. Confirm that OMR-FF function option is enabled on the NC side.

   And enable OMR-FF function.
   
   #2139 : omrff_off = "0"
   
   #2213 : SV113(SSF8)/bit0 = "1"

---

**CAUTION**

1. Always set the load inertia scale when using this function.

   Minimize errors for the load inertia value because the parameter is crucial to this function.

   Note that the display for the estimated inertia value is "0" if this function is enabled.

   When setting SV037(JL), set SV113(SSF8)/bit0(omrff) to 0.

2. Disable OMR-FF function (#2139:omrff_off = "1", SV113(SSF8)/bit0 = "0") to perform the above (1) to (3) adjustments.

3. Feed forward gain (#2010 : fwd_g) on NC side will be disabled while this function is enabled (#2139:omrff_off = "0").

4. The following functions will be disabled when using this function.
   - Machine side compensation function
   - Acceleration rate feed forward function
   - Overshoot compensation function
(5) Set OMR-FF function related parameters according to the following procedure. (Set with NC Analyzer)

1. After the above adjustment, set SV106 in the interpolation axes to the same value as the axis with the lowest SV106 value.

2. Perform the above confirmation of accuracy in G61.1(G88P1)(high-accuracy) mode; use the constant and filter for high-accuracy mode with OMR-FF function.  
   Note that only #2010: fwd-g (Feed forward gain) will be disabled.

3. When the setting value for SV105 increases, ΔR will decrease, however, overshooting or machine vibration tend to occur during acceleration/deceleration.  
   \[ \rightarrow \] Check the acceleration/deceleration waveforms again after setting SV105.

**CAUTION**
5-3 Characteristics improvement

5-3-1 Optimal adjustment of cycle time

The following items must be adjusted to adjust the cycle time. Refer to the Instruction Manuals provided with each CNC for the acceleration/deceleration pattern.

1. Rapid traverse rate (rapid) : This will affect the maximum speed during positioning.
2. Clamp speed (clamp) : This will affect the maximum speed during cutting.
3. Acceleration/deceleration time constant (G0t*, G1t*) : Set the time to reach the feedrate.
4. In-position width (SV024) : This will affect each block's movement command end time.
5. Position loop gain (SV003) : This will affect each block's movement command settling time.

(1) Adjusting the rapid traverse

To adjust the rapid traverse, the CNC axis specification parameter rapid traverse rate (rapid) and acceleration/deceleration time constant (G0t*) are adjusted. The rapid traverse rate is set so that the motor speed matches the machine specifications in the range below the maximum speed in the motor specifications. For the acceleration/deceleration time constants, carry out rapid traverse reciprocation operation, and set so that the maximum current command value at acceleration/deceleration is within the range shown below. The output torque is limited at areas near the maximum speed, so monitor the current FB waveform during acceleration/deceleration and adjust so that the torque is within the specified range.

If the drive unit's input voltage is less than the rated voltage, the torque will easily become insufficient, and excessive errors will occur easily during acceleration/deceleration.

Maximum tolerable current command value when adjusting the rapid traverse acceleration/deceleration time constant

<table>
<thead>
<tr>
<th>Motor model</th>
<th>Max. tolerable current command value</th>
</tr>
</thead>
<tbody>
<tr>
<td>HF54</td>
<td>Within 420%</td>
</tr>
<tr>
<td>HF104</td>
<td>Within 350%</td>
</tr>
<tr>
<td>HF154</td>
<td>Within 380%</td>
</tr>
<tr>
<td>HF224</td>
<td>Within 310%</td>
</tr>
<tr>
<td>HF204</td>
<td>Within 310%</td>
</tr>
<tr>
<td>HF354</td>
<td>Within 220%</td>
</tr>
<tr>
<td>HF223</td>
<td>Within 230%</td>
</tr>
<tr>
<td>HF303</td>
<td>Within 240%</td>
</tr>
<tr>
<td>HF453</td>
<td>Within 190%</td>
</tr>
<tr>
<td>HF302</td>
<td>Within 210%</td>
</tr>
</tbody>
</table>
(2) Adjusting the cutting feed

To adjust the cutting rate, the NC axis specification parameter clamp speed (clamp) and acceleration/deceleration time constant (G1t*) are adjusted. The in-position width at this time must be set to the same value as actual cutting.

- Determining the clamp rate and adjusting the acceleration/deceleration time constant

(Features) The maximum cutting rate (clamp speed) can be determined freely.

(Adjustment) Carry out cutting feed reciprocation operation with dwell at the maximum cutting rate and adjust the acceleration/deceleration time constant so that the maximum current command value during acceleration/deceleration is within the range shown below.

- Setting the step acceleration/deceleration and adjusting the clamp speed

(Features) The acceleration/deceleration time constant is determined with the position loop in the servo, so the acceleration/deceleration $F \Delta T$ can be reduced.

(Adjustment) Set 1 (step) for the acceleration/deceleration time constant and carry out cutting feed reciprocation operation with dwell. Adjust the cutting feed rate so that the maximum current command value during acceleration/deceleration is within the range shown below, and then set the value in the clamp speed.

Maximum tolerable current command value when adjusting the cutting feed acceleration/deceleration time constant

<table>
<thead>
<tr>
<th>Motor model</th>
<th>Max. tolerable current command value</th>
</tr>
</thead>
<tbody>
<tr>
<td>HF54</td>
<td>Within 294%</td>
</tr>
<tr>
<td>HF104</td>
<td>Within 245%</td>
</tr>
<tr>
<td>HF154</td>
<td>Within 266%</td>
</tr>
<tr>
<td>HF224</td>
<td>Within 217%</td>
</tr>
<tr>
<td>HF264</td>
<td>Within 217%</td>
</tr>
<tr>
<td>HF354</td>
<td>Within 196%</td>
</tr>
<tr>
<td>HF223</td>
<td>Within 161%</td>
</tr>
<tr>
<td>HF303</td>
<td>Within 168%</td>
</tr>
<tr>
<td>HF453</td>
<td>Within 129%</td>
</tr>
<tr>
<td>HF302</td>
<td>Within 147%</td>
</tr>
</tbody>
</table>

(3) Adjusting the in-position width

Because there is a response delay in the servomotor drive due to position loop control, a "settling time" is also required for the motor to actually stop after the command speed from the CNC reaches 0.

The movement command in the next block is generally started after it is confirmed that the machine has entered the "in-position width" range set for the machine.

Set the precision required for the machine as the in-position width. If a high precision is set needlessly, the cycle time will increase due to a delay in the settling time.

The in-position width is validated with the servo parameter settings, but there may be cases when it is validated with the NC parameters. Refer to each NC Instruction Manual.

[2224] SV024 INP In-position detection width

Set the in-position detection width.
Set the positioning accuracy required for the machine.
The lower the setting is, the higher the positioning accuracy will be. However the cycle time (settling time) becomes longer.
The standard setting value is "50".

---Setting range---
0 to 32767 (μm)

POINT

The in-position width setting and confirmation availability depend on the CNC parameters.
5-3-2 Vibration suppression measures

If vibration (machine resonance) occurs, it can be suppressed by lowering the speed loop gain 1 (VGN1). However, cutting precision and cycle time will be sacrificed. (Refer to "Speed loop gain".) Thus, try to maintain the VGN1 as high as possible, and suppress the vibration using the vibration suppression functions. If the VGN1 is lowered and adjusted because vibration cannot be sufficiently suppressed with the vibration suppression functions, adjust the entire gain (including the position loop gain) again.

(Examples of vibration occurrence)
  - A fine vibration is felt when the machine is touched, or a groaning sound is heard.
  - Vibration or noise occurs during rapid traverse.

If machine resonance occurs, the resonance frequency can be confirmed at AFLT frequency on NC drive monitor screen. Based on this frequency, the notch filter frequency can be set. When "0" is displayed, resonance is not occurring.

Suppress the vibration using the vibration suppression functions, and maintain the speed loop gain (SV005) as high as possible.
<Notch filter>
This servo drive unit mounts 5 notch filters. Measure the resonance frequency with AFLT frequency display on NC drive monitor screen and the current feedback analog output function, and set that frequency in parameter. However, if the notch filter is set to a particularly low frequency, another resonance frequency that did not vibrate initially may occur. If the notch filter's depth compensation (SV033, nfd1, nfd2) is adjusted so that the filter does not operate unless necessary, the servo control will be stabilized. Notch filter 3 is a filter with frequency fixed to 1125Hz, and has no depth compensation.

<Setting method>
[1] Set the resonance frequency in the notch filter frequency (1, 2, 4, 5).
[2] If the machine starts to vibrate at another frequency, raise (make shallower) the notch filter depth compensation value, and adjust to the optimum value at which the resonance can be eliminated.
[3] When the vibration cannot be completely eliminated, use also another notch filter for this frequency.

【#2233】SV033 SSF2 Servo function 2

bit 7-5 : nfd2 Depth of Notch filter 2
Set the depth of Notch filter 2 (SV046).
bit7,6,5=
000: -∞
001: -18.1[dB]
010: -12.0[dB]
011: -8.5[dB]
100: -6.0[dB]
101: -4.1[dB]
110: -2.5[dB]
111: -1.2[dB]

bit 4 : fhz3 Notch filter 3
0: Stop  1: Start (1,125Hz)

bit 3-1 : nfd1 Depth of Notch filter 1
Set the depth of Notch filter 1 (SV038).
bit3,2,1=
000: -∞
001: -18.1[dB]
010: -12.0[dB]
011: -8.5[dB]
100: -6.0[dB]
101: -4.1[dB]
110: -2.5[dB]
111: -1.2[dB]

【#2238】SV038 FHz1 Notch filter frequency 1
Set the vibration frequency to suppress when machine vibration occurs. (Normally, do not set 80 or less.)
Set to "0" when not using.
---Setting range---
0 to 2250 (Hz)

【#2246】SV046 FHz2 Notch filter frequency 2
Set the vibration frequency to suppress when machine vibration occurs. (Normally, do not set 80 or less.)
Set to "0" when not using.
---Setting range---
0 to 2250 (Hz)
### [#2283] SV083 SSF6 Servo function 6

**bit 7-5 : nfd5  Depth of Notch filter 5**

Set the depth of Notch filter 5 (SV088).

<table>
<thead>
<tr>
<th>Value</th>
<th>Depth (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>000:</td>
<td>-∞</td>
</tr>
<tr>
<td>001:</td>
<td>-18.1</td>
</tr>
<tr>
<td>010:</td>
<td>-12.0</td>
</tr>
<tr>
<td>011:</td>
<td>-8.5</td>
</tr>
<tr>
<td>100:</td>
<td>-6.0</td>
</tr>
<tr>
<td>101:</td>
<td>-4.1</td>
</tr>
<tr>
<td>110:</td>
<td>-2.5</td>
</tr>
<tr>
<td>111:</td>
<td>-1.2</td>
</tr>
</tbody>
</table>

**bit 3-1 : nfd4  Depth of Notch filter 4**

Set the depth of Notch filter 4 (SV087).

<table>
<thead>
<tr>
<th>Value</th>
<th>Depth (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>000:</td>
<td>-∞</td>
</tr>
<tr>
<td>001:</td>
<td>-18.1</td>
</tr>
<tr>
<td>010:</td>
<td>-12.0</td>
</tr>
<tr>
<td>011:</td>
<td>-8.5</td>
</tr>
<tr>
<td>100:</td>
<td>-6.0</td>
</tr>
<tr>
<td>101:</td>
<td>-4.1</td>
</tr>
<tr>
<td>110:</td>
<td>-2.5</td>
</tr>
<tr>
<td>111:</td>
<td>-1.2</td>
</tr>
</tbody>
</table>

### [#2287] SV087 FHz4 Notch filter frequency 4

Set the vibration frequency to suppress when machine vibration occurs.
(Normally, do not set 80 or less.)
Set to "0" when not using.

---Setting range---
0 to 2250 (Hz)

### [#2288] SV088 FHz5 Notch filter frequency 5

Set the vibration frequency to suppress when machine vibration occurs.
(Normally, do not set 80 or less.)
Set to "0" when not using.

---Setting range---
0 to 2250 (Hz)
<Notch filter frequency adaptive tracking function>

Machine system resonance can vary depending on secular changes or installation conditions of machine, resonance frequency may deviate from the notch filter frequency set at the initial adjustment. The adaptive tracking function estimates minor changes in resonance frequency from current command oscillating component, automatically adjusting notch filter effective frequency. The resonance frequency is estimated while G0 is moving and effective frequency is modified while the axis is stopped.

The adaptive tracking function can be applied to notch filter 1, 2, 4, 5 (SV038, SV046, SV087, SV088). When resonance frequency is detected within the adaptive ranges which centers in the frequency set by parameter, resonance frequency from which notch filter effective frequency with the closest setting value is detected, suppressing machine resonance.

<Other specifications>
(a) Machine resonance is detected at frequency ranges of 150Hz to 90Hz.
(b) The depth of notch filter is not automatically adjusted. Only the effective frequency will change while the filter depth remains fixed.
(c) When the notch filter 5 is adaptive to all frequency and also, others are not available, the effective frequency of notch filter 5 is changed.
(d) When parameter setting value is changed; if the effective frequency remains within the adaptive ranges, it will keep operating with the original frequency; if it doesn't, changed parameter value will be applied.

<table>
<thead>
<tr>
<th>Notch filter</th>
<th>Estimated adaptive frequency range</th>
<th>Avail. Adaptive operation</th>
<th>Adaptive range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Notch filter 1</td>
<td>150 to 900 [Hz]</td>
<td>SV115/bit8</td>
<td>Setting value(SV038) ± Adaptive range (SV115/bit4,5) [Hz]</td>
</tr>
<tr>
<td>Notch filter 2</td>
<td>150 to 900 [Hz]</td>
<td>SV115/bit9</td>
<td>Setting value (SV046) ± Adaptive range (SV115/bit4,5) [Hz]</td>
</tr>
<tr>
<td>Notch filter 3</td>
<td>Not included</td>
<td>Not included</td>
<td>Not included</td>
</tr>
<tr>
<td>Notch filter 4</td>
<td>150 to 900 [Hz]</td>
<td>SV115/bitA</td>
<td>Setting value (SV087) ± Adaptive range (SV115/bit4,5) [Hz]</td>
</tr>
<tr>
<td>Notch filter 5</td>
<td>150 to 900 [Hz]</td>
<td>SV115/bitB</td>
<td>Setting value (SV088) ± Adaptive range (SV115/bit4,5) [Hz] (Note) When adaptive to all frequency (SV115/bitF) 150 to 900 [Hz]</td>
</tr>
</tbody>
</table>

If adaptive ranges are set too wide, frequency may fluctuate so greatly that the control can become unstable.
When the notch filter 5 is set adaptive to all frequency, the depth of the filter shall be set shallowly to enable stable operation with low frequency.

【#2315】 SV115  SSF10  Servo function 10

bit F : are Notch filter5 all frequencies adopted

When enabled, Notch filter5 all frequencies adoptive range is not limited regardless of SV115/bit4,5 setting.
0: Disable  1: Enable

bit E-C: dsl  Notch filter frequency display

Switch the "AFLT frequency" display on drive monitor screen to check every notch filter frequency.
When the selected notch filter is not used, "0" is displayed.

bitE,D,C=
000 : Estimated resonance frequency (Normal display)
001 : Notch filter 1 frequency
010 : Notch filter 2 frequency
011 : Notch filter 3 frequency (always displays 1125Hz)
100 : Notch filter 4 frequency
101 : Notch filter 5 frequency
Other settings: setting prohibited

bit B : ade5  Notch filter 5 / Adoptive follow-up function

0: Disable  1: Enable
bit A : ade4  Notch filter 4 / Adoptive follow-up function
0: Disable  1: Enable

bit 9 : ade2  Notch filter 2 / Adoptive follow-up function
0: Disable  1: Enable

bit 8 : ade1  Notch filter 1 / Adoptive follow-up function
0: Disable  1: Enable

bit 7-6 : dsn  Estimated resonance frequency display holding time
Set the estimated resonance frequency display holding time to the "AFLT frequency" display on drive monitor screen.

bit7,6=
00: 4 [s]
01: 8 [s]
10: 12 [s]
11: 16 [s]

bit 5-4 : dfhz  Notch filter frequency range
Set the adaptive range of the notch filter frequency. When the adaptive follow-up function is enabled and if the estimated resonance frequency exists in the set range, the notch filter will be adapted. Normally set this parameter to "00".

bit5,4=
00: -10 to 10 [%]
01: -20 to 20 [%]
10: -30 to 30 [%]
11: -40 to 40 [%]

bit 3-0 : esn  Sensitivity of estimated resonance frequency
Set the sensitivity of the estimated resonance frequency. Smaller setting value enables to detect smaller vibration component, however, adoptive movement will be repeated frequently. Normally set this parameter to "0".

0 : Normal setting (same sensitivity as A)   1 : Sensitivity high to F : Sensitivity low

<Jitter compensation (Vibration control when motor is stopped.)>
The load inertia becomes much smaller than usual if the motor position enters the machine backlash when the motor is stopped. Because this means that an extremely large VGN1 is set for the load inertia, vibration may occur. Jitter compensation can suppress the vibration that occurs at the motor stop by ignoring the backlash amount of speed feedback pulses when the speed feedback polarity changes. Increase the number of ignored pulses by one pulse at a time, and set a value at which the vibration can be suppressed. (Because the position feedback is controlled normally, there is no worry of positional deviation.) When jitter compensation is set to an axis that is not vibrating is set, vibration could be induced, so take care.

【#2227】SV027  SSF1  Servo function 1

bit 5-4 : vfct  Jitter compensation pulse number
Suppress vibration by machine backlash when axis stops.

bit5,4=
00: Disable
01: 1 pulse
10: 2 pulse
11: 3 pulses

POINT  Jitter compensation vibration suppression is only effective when the motor is stopped.
If vibration occurs when the motor is rotating at a high speed, such during rapid traverse, or if disturbing noise occurs, the state can be improved by lowering the speed loop gain during high-speed rotation. The low-speed region speed loop gain used for cutting feed (G1 feed), etc., is maintained at a high level, so the vibration can be improved without dropping the machining accuracy.

**[2205] SV005 VGN1 Speed loop gain 1**

Set the speed loop gain.
The higher the setting value is, the more accurate the control will be, however, vibration tends to occur.
If vibration occurs, adjust by lowering by 20 to 30%.
The value should be determined to the 70 to 80% of the value at which the vibration stops.
The value differs depending on servo motors.
Aim at the standard value determined by the servo motor type and load inertia ratio to adjust.

---Setting range---
1 to 30000

**[2206] SV006 VGN2 Speed loop gain 2**

Set the speed loop gain at the motor limitation speed VLMT (maximum rotation speed x 1.15) with "VCS(SV029: Speed at the change of speed loop gain)".
Use this to suppress noise at high speed rotation during rapid traverse, etc. Then, the speed loop gain decreases at faster speed than the setting value of VCS.
When not using, set to "0".

---Setting range---
-1000 to 30000

**[2229] SV029 VCS Speed at the change of speed loop gain**

Noise at high speed rotation including rapid traverse can be reduced by lowering the speed loop gain at high speeds.
Set the speed at which the speed loop gain changes. Use this with SV006 (VGN2).
When not using, set to "0".

---Setting range---
0 to 9999 (r/min)
5-3-3 Improving the cutting surface precision

If the cutting surface precision or roundness is poor, these can be improved by increasing the speed loop gain (VGN1, VIA) or by using the disturbance observer function.

<Examples of faults>
- The surface precision in the 45° direction of a taper or arc is poor.
- The load fluctuation during cutting is large, causing vibration or surface precision defects to occur.

POINT Adjust by raising the speed loop gain equivalently to improve cutting surface precision, even if the measures differ. In this case, it is important how much the machine resonance can be controlled, so adjust making sufficient use of vibration suppression functions.

(1) Adjusting the speed loop gain (VGN1)
If the speed loop gain is increased, the cutting surface precision will be improved but the machine will resonate easily.

The final VGN1 setting should be approx. 70 to 80% of the maximum value where resonance does not occur. (Refer to "Setting the speed loop gain")

(2) Adjusting the speed loop leading compensation (VIA)
The VIA has a large influence on the position trackability, particularly during high-speed cutting (generally F1000 or more). Raising the setting value improves the position trackability, and the contour precision during high-speed cutting can be improved. For high-speed high-precision cutting machines, adjust so that a value equal to or higher than the standard value can be set.

When VIA is set lower than the standard value and set to a value differing between interpolation axes, the roundness may worsen (the circle may distort). This is due to differences occurring in the position trackability between interpolation axes. The distortion can be improved by matching the VIA with the smaller of the values. Note that because the position trackability is not improved, the surface precision will not be improved.

(Refer to "Setting the speed loop lead compensation")
Servo Adjustment

#2205 SV005 VGN1 Speed loop gain 1
Set the speed loop gain.
The higher the setting value is, the more accurate the control will be, however, vibration tends to occur.
If vibration occurs, adjust by lowering by 20 to 30%.
The value should be determined to the 70 to 80% of the value at which the vibration stops.
The value differs depending on servo motors.
Aim at the standard value determined by the servo motor type and load inertia ratio to adjust.

---Setting range---
1 to 30000

#2208 SV008 VIA Speed loop lead compensation
Set the gain of the speed loop integral control.
Standard setting: 1364
Standard setting in the SHG control: 1900
Adjust the value by increasing/decreasing this by about 100 at a time.
Raise this value to improve contour tracking accuracy in high-speed cutting.
Lower this value when the position droop does not stabilize (when the vibration of 10 to 20Hz occurs).

---Setting range---
1 to 9999

(3) Voltage non-sensitive zone (Td) compensation
With the PWM control of the inverter circuit, a dead time (non-energized time) is set to prevent short-circuits caused by simultaneous energizing of the P side and N side transistors having the same phase. The dead time has a non-sensitive zone for particularly low voltage commands. Thus, when feeding with a low speed and a low torque, the control may be unstable.
When an unbalanced axis is lowering, the frictional torque and unbalance torque, and the frictional torque and deceleration torque before the quadrant changes during circle cutting, are balanced. The motor output torque will be approximately zero, and the control accuracy may drop. In this case, the control accuracy can be improved by using the voltage non-sensitive band compensation. Note that this may cause vibration to be increased while the motor is running.

---Setting range---
0 to 255 (%)

#2230 SV030 IVC Voltage non-sensitive band compensation
When 100% is set, the voltage reduction amount equivalent to the logical non-energization in the PWM control will be compensated.
When "0" is set, 100% compensation will be performed.
Adjust in increments of 10% from the default value of 100%.
If increased too much, vibration or vibration noise may be generated.

---Setting range---
0 to 255 (%)
(4) Disturbance observer

The disturbance observer can reduce the effect caused by disturbance, frictional resistance or torsion vibration during cutting by estimating the disturbance torque and compensating it. It also is effective in suppressing the vibration caused by speed leading compensation control.

<Setting method>

[1] Adjust VGN1 to the value where vibration does not occur, and then lower it 10 to 20%.

[2] Set the load inertia scale (SV037: JL) with a percentage in respect to the motor inertia of the total load inertia.

[3] Set the observer filter band (observer pole) in the disturbance observer filter frequency (SV043: OBS1), and suppress the high frequency disturbance estimate to suppress the vibration. Set "100" as a standard.

[4] Set the observer gain in disturbance observer gain (SV044: OBS2). The disturbance observer will function here for the first time. Set 100 first, and if vibration does not occur, increase the setting by 50 at a time to increase the observer effect.

--- Setting method ---

SV037(JL)=\frac{(Jm+Jl)}{Jm}×100

Where:
- Jm: Motor inertia
- Jl: Motor axis conversion load inertia

For linear motor, set the gross mass of the moving sections in kg unit.

<<Drive monitor load inertia ratio display>>

Set SV035/bitF=1 and imbalance torque and friction torque to both SV032 and SV045, and then repeat acceleration/deceleration for several times.

--- Setting range ---

For general motor: 0 to 5000 (%)
For linear motor: 0 to 5000 (kg)

--- Setting range ---

SV043(OBS1) = 0 to 1000 (rad/s)

--- Setting range ---

SV044(OBS2) = 0 to 500 (%)

The lost motion compensation must be readjusted when the disturbance observer is started.
5-3-4 Improvement of characteristics during acceleration/deceleration

<SHG control>
Because SHG control has a smoother response during acceleration/deceleration than conventional position controls, the acceleration/deceleration torque (current FB) has more ideal output characteristics (A constant torque is output during acceleration/deceleration.) The peak torque is kept low by the same acceleration/deceleration time constant, enabling the time constant to be shortened.

Refer to item "(3) SHG control" in section "Position loop gain" for details on setting SHG control.

<table>
<thead>
<tr>
<th>No.</th>
<th>Abbrev.</th>
<th>Parameter name</th>
<th>Setting ratio</th>
<th>Setting example</th>
<th>Explanation</th>
<th>Setting range</th>
</tr>
</thead>
<tbody>
<tr>
<td>SV003 (SV049)</td>
<td>PGN1 (PGN1sp)</td>
<td>Position loop gain 1</td>
<td>1</td>
<td>21 27 33 39 48</td>
<td>Always set with a combination of these three parameters.</td>
<td>1 to 200 (rad/s)</td>
</tr>
<tr>
<td>SV004 (SV050)</td>
<td>PGN2 (PGN2sp)</td>
<td>Position loop gain 2</td>
<td>8/3</td>
<td>56 72 88 104 128</td>
<td>0 to 999 (rad/s)</td>
<td></td>
</tr>
<tr>
<td>SV057 (SV058)</td>
<td>SHGC (SHGCsp)</td>
<td>SHG control gain</td>
<td>6</td>
<td>126 162 198 234 288</td>
<td>0 to 1200 (rad/s)</td>
<td></td>
</tr>
</tbody>
</table>
<Acceleration feed forward>
Vibration may occur at 10 to 20 Hz during acceleration/deceleration when a short time constant of 30 ms or less is applied, and a position loop gain (PGN1) higher than the general standard value or SHG control is used. This is because the torque is insufficient when starting or when starting deceleration, and can be resolved by setting the acceleration rate feed forward gain (SV015: FFC). This is also effective in reducing the peak current (torque). While measuring the current command waveform, increase FFC by 50 to 100 at a time and set the value where vibration does not occur.

![Graph of current command vs. time with and without FFC setting]

Acceleration rate feed forward gain means that the speed loop gain during acceleration/deceleration is raised equivalently. Thus, the torque (current command) required during acceleration/deceleration starts sooner. The synchronization precision will improve if the FFC of the delayed side axis is raised between axes for which high-precision synchronous control (such as synchronous tapping control and superimposition control).

<table>
<thead>
<tr>
<th>#2215</th>
<th>SV015</th>
<th>FFC</th>
<th>Acceleration rate feed forward gain</th>
</tr>
</thead>
<tbody>
<tr>
<td>When a relative error in synchronous control is too large, set this parameter to the axis that is delaying. The standard setting is &quot;0&quot;. The standard setting in the SHG control is &quot;50&quot;. To adjust a relative error in acceleration/deceleration, increase the value by 50 at a time.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---Setting range---
0 to 999 (%)

**POINT**
Overshooting occurs easily when a value above the standard value is set during SHG control.
<Inductive voltage compensation>

The current loop response is improved by compensating the back electromotive force element induced by the motor rotation. This improved the current command efficiency, and allows the acceleration/deceleration time constant to the shortened.

<Adjustment method>

While accelerating/decelerating at rapid traverse, adjust the inductive voltage compensation gain (SV047: EC) so that the current FB peak (MAX current 3) is a few % smaller than the current command peak (MAX current 2).

![Inductive voltage compensation](image)

【#2247】 SV047 EC Inductive voltage compensation gain

Set the inductive voltage compensation gain. Standard setting value is “100”. If the current FB peak exceeds the current command peak, lower the gain.

---Setting range---

0 to 200 (%)

POINT

If the current FB peak (MAX current 3) becomes larger than the current command peak (MAX current 2) (over compensation), an overcurrent (alarm 3A) will occur easily. Note that over compensation will occur easily if the load inertia is large.
<HAS control>
If an output torque during acceleration/deceleration is close to the servo motor's maximum torque, the motor cannot accelerate with a commanded time constant when the torque is saturated due to input voltage fluctuation, etc. Generally, if an acceleration command is switched to a constant speed command, speed FB overshoots to compensate a delay of position droop, making the machine operation unstable.
When the HAS control is enabled, a delay of position droop will be compensated by controlling the amount of speed FB overshoot within 1% or less than maximum speed of the motor.
The controllable amount of position droop delay with HAS control HAS can be set at 1/4 or 1/2 of the excessive error detection width.

![Diagram showing HAS control effectiveness](image)

【#2234】SV034 SSF3 Servo function 3

bit 1 : has HAS control
This stabilizes the speed overshooting by torque saturation phenomenon.
  0: Normal setting     1: Enable

【#2284】SV084 SSF7 Servo function 7

bit F : h2c HAS control cancel amount
  0: 1/4 (standard)     1: 1/2

1. During G1 drive, if HAS control is started, the compensation amount can not be compensated. Therefore, adjust the feed speed cramp value or acceleration/deceleration time constant so that the current limit does not occur.

2. HAS control can not be used for axes in synchronous control since machine torsion may be occur.

3. Even if HAS control is enabled, adjust the acceleration/deceleration time constant so that the current limit does not occur.

4. If setting half of error excessive detector width to the droop compensation amount, error excessive alarm in acceleration may occur more easily than if 1/4.

POINT
5-3-5 Improvement of protrusion at quadrant changeover

The response delay (caused by dead band from friction, torsion, expansion/contraction, backlash, etc.) caused when the machine advance direction reverses is compensated with the lost motion compensation (LMC compensation) function. With this, the protrusions that occur at the quadrant changeover in the DBB measurement method, or the streaks that occur when the quadrant changes during circular cutting can be improved.

[1] LMC compensation type 2
This is an obsolete compensation method. When performing new adjustment, use LMC compensation type 3.

[2] LMC compensation type 3
In addition to frictional torque influence, this type compensates torsion and expansion/contraction influences in the machine system in which compensation amount is changed by travel speed. A mechanical system viscosity coefficient setting further enhances the compensation accuracy even if the travel speed is changed. Adjustment requires a machine roundness measurement.

[3] LMC compensation type 4
This is used in combination with LMC compensation type 3. Compensation is performed by monitoring path tracking delay. Therefore, even if the machine friction amount has changed due to aged deterioration, the path tracking delay is controlled so that it will be minimum.

**POINT**

1. LMC compensation performs adjustment while measuring the electrical end roundness waveform (detector position FB). Disable the NC side machine error compensation (pitch error compensation, relative position compensation, backlash compensation).
2. After the compensation adjustment is completed, adjust the machine error compensation while measuring the machine error compensation with DBB measurement method, etc.
### Measuring unbalance torque and frictional torque

Machine unbalance torque and frictional torque measurements are required before the LMC compensation can be set. However, the horizontal axis unbalance torque is necessarily "0".

Carry out the reciprocating operation (approx. F1000) with the measured axis, and the load current % value during constant-speed feed is measured at the NC servo monitor screen. The unbalance torque and frictional torque at that time are expressed by the following formulas.

\[
\text{Unbalance torque (\%)} = \frac{(+ \text{ feed load current \%}) + (- \text{ feed load current \%})}{2}
\]

\[
\text{Frictional torque (\%)} = \frac{|(+ \text{ feed load current \%}) - (- \text{ feed load current \%})|}{2}
\]

---(Example)---

Assume that the load current % was -55% in the + direction and -25% in the - direction when JOG feed was carried out at approx. F1000. The unbalance torque and frictional torque are as shown below.

\[
\text{Unbalance torque (\%)} = \frac{(-55) + (-25)}{2} = -40\%
\]

\[
\text{Frictional torque (\%)} = \frac{|(-55) - (-25)|}{2} = 15\%
\]

The measurement values are not used for LMC compensation type 3. However, since they are used for other controls, set them to the following parameters.

**[#2232] SV032 TOF Torque offset**

Set the unbalance torque on vertical axis and inclined axis. When the vertical axis pull up function is enabled, the pull up compensation direction is determined by this parameter's sign. When set to "0", the vertical axis pull up will not be executed. This can be used for speed loop delay compensation and collision detection function.

To use load inertia estimation function (drive monitor display), set this parameter, friction torque (SV045) and load inertia display enabling flag (SV035/bitF).

Related parameters: SV007, SV033/bitE, SV059

---Setting range---

-100 to 100 (Stall current %)

**[#2245] SV045 TRUB Friction torque**

Set the frictional torque when using the collision detection function. To use load inertia estimation function (drive monitor display), set this parameter, imbalance torque (SV032) and load inertia display enabling flag (SV035/bitF).

---Setting range---

0 to 255 (Stall current %)
(2) Setting and adjusting LMC compensation type 3

LCM compensation type 3 can be used to accommodate quadrant projection changes that accompany feed rate and circular radius changes which could not be accommodated by LCM compensation type 2. In this case, on a machine model where the travel direction is reversed, the effect caused by torsion or expansion and contraction on the machine system are also considered in addition to the friction, with compensation occurring in accordance with the changes in the cutting conditions.

Adjust Compensation parameter (SV016, SV041), a basis of compensation, while measuring roundness at low speed. Then adjust viscous coefficient (SV086) while measuring roundness at high speed.

LMC compensation type 3 parameter adjustments should be made while measuring an electrical end position FB waveform by the NC sampling function.

<Adjustment method>

1. Turn the NC side machine error compensation (pitch error compensation, relative position compensation or backlash compensation) OFF.
2. Set servo function selection 5 SV082/ bit=1. (The LMC compensation type 3 will start).
3. Set a value double the friction torque to the lost motion compensation 1 (SV016). The SV016 setting value will be used for compensation in the positive and negative directions when the lost motion compensation 2 (SV041) is 0.
4. Set the initial value, SV016 x 200 to the lost motion compensation viscous coefficient (SV086).
5. Perform a roundness measurement at such speed as radius R=100mm and feedrate F=1000mm/min and adjust SV016 value.
6. Set SV041, when changing the compensation amount in the direction for compensation. The setting of the compensation direction is shown below with the setting of CW/CCW in the NC parameter. If compensating only one direction, set −1 to the side not to be compensated.

<table>
<thead>
<tr>
<th>Compensation point</th>
<th>CW</th>
<th>CCW</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>X axis: SV041</td>
<td>X axis: SV016</td>
</tr>
<tr>
<td>B</td>
<td>Y axis: SV016</td>
<td>Y axis: SV041</td>
</tr>
<tr>
<td>C</td>
<td>X axis: SV016</td>
<td>X axis: SV041</td>
</tr>
<tr>
<td>D</td>
<td>Y axis: SV041</td>
<td>Y axis: SV016</td>
</tr>
</tbody>
</table>

7. Perform a roundness measurement at such speed as radius, R=100mm and feedrate, F=5000mm/min. (Select a condition to be used for the actual cutting according to the machine’s specification.) Adjust viscous coefficient (SV086) by increasing and reducing it approx. ±500 gradually to have minimum quadrant protrusion.
8. After adjusting SV086, verify its accuracy by performing roundness measurement at low speed again.
9. At this time, if requiring to improve the accuracy further, adjust the spring constant (SV085) in increments of about 50 while performing the machine roundness measurement at low speed.

---

1. As the acceleration of circular feed increases, the quadrant protrusion tends to get larger. Therefore, the quadrant protrusion gets larger as the circular feedrate increases for the same radius and as radius gets smaller for the same feedrate.
2. Torque offset (SV032) does not work for LMC compensation type 3.
3. Always set 0 to the lost motion compensation timing (SV039:LMCD).
【#2216】SV016  LMC1  Lost motion compensation 1
Set this parameter when the protrusion (that occurs due to the non-sensitive band by friction, torsion, backlash, etc.) at quadrant change is too large. This sets the compensation torque at quadrant change (when an axis feed direction is reversed) by the proportion (%) to the stall torque. Whether to enable the lost motion compensation and the method can be set with other parameters.

Type 2: When SV027/bit9, 8 =10 (Compatible with obsolete type)
Set the type 2 method compensation torque. The standard setting is double the friction torque.

Type 3: When SV082/bit1= 1
Set the compensation torque equivalent of dynamic friction amount of the type 3 method compensation amount. The standard setting is double the dynamic friction torque.

To vary compensation amount according to the direction.
When SV041 (LMC2) is "0", compensate with the value of SV016 (LMC1) in both +/-directions.
If you wish to change the compensation amount depending on the command direction, set this and SV041 (LMC2).
(SV016: + direction, SV041: - direction. However, the directions may be opposite depending on other settings.)
When "-1" is set, the compensation will not be performed in the direction of the command.

---Setting range---
-1 to 200 (Stall current %)
Note that when SV082/bit2 is "1", the setting range is between -1 and 20000 (Stall current 0.01%).

【#2241】SV041  LMC2  Lost motion compensation 2
Set this with SV016 (LMC1) only when you wish to vary the lost motion compensation amount depending on the command directions.
Normally, set to "0".

---Setting range---
-1 to 200 (Stall current %)
Note that when SV082/bit2 is "1", the setting range is between -1 and 20000 (Stall current 0.01%).

【#2282】SV082  SSF5  Servo function 5

bit 2 : ccu Lost motion overshoot compensation compensation amount setting increment
0: Stall current %  1: Stall current 0.01%

bit 1 : lmc3  Lost motion compensation type 3
Set this when protrusion at a quadrant change is too big.
0: Stop       1: Start

【#2285】SV085  LMck  Lost motion compensation 3 spring constant
Set the machine system's spring constant when selecting lost motion compensation type 3.
When not using, set to "0".

---Setting range---
0 to 32767 (0.01%/μm)

【#2286】SV086  LMcc  Lost motion compensation 3 viscous coefficient
Set the machine system's viscous coefficient when selecting lost motion compensation type 3.
When not using, set to "0".

---Setting range---
0 to 32767 (0.01%/s/mm)
(3) Setting and adjusting LMC compensation type 4
LMC compensation type 4 is enabled by being used with LMC compensation type 3. Make sure to adjust the LMC compensation type 3 before setting the LMC compensation type 4.

<Adjustment method>
[1] Set about 5-fold SV016 setting value in SV091. (Set about 10% of machine friction.)
[2] Increase SV0091 in increments of about 20%, and confirm the limit value where vibration does not occur. Note that the limit value is about 500.
[3] Set 50% of the limit value.

[SV091] LMC4G Lost motion compensation 4 gain
Use this with LMC compensation type 3. As the delay in path tracking is monitored and compensated, the delay in path tracking will be minimized even if machine friction amount changes by aging. Use the lost motion compensation amount (SV016) * 5 (10% of the dynamic friction torque) as the target. The higher the setting value is, the more accurate the quadrant change be; however, the more likely vibrations occur.

---Setting range---
0 to 20000 (Stall current 0.01%)

5-3-6 Improvement of overshooting
The phenomenon when the machine position goes past or exceeds the command during feed stopping is called overshooting. Overshooting is compensated by overshooting compensation (OVS compensation). Overshooting occurs due to the following two causes.
[1] Machine system torsion: Overshooting will occur mainly during rapid traverse settling.
Either phenomenon can be confirmed by measuring the position droop.

[Diagram 1] Overshooting during rapid traverse settling
[Diagram 2] Overshooting during pulse feed
(1) **Overshooting compensation (OVS compensation)**

In OVS compensation, the overshooting is suppressed by subtracting the torque command set in the parameters when the motor stops.

OVS compensation type 3 has a compensation effect for the overshooting during either rapid traverse settling or pulse feed. To compensate overshooting during feed forward control, refer to the following section "(2) Adjusting for feed forward control".

**<Setting and adjustment methods>**

1. Set the servo function selection 1 (SV027: SSF1)/bit A, B. (OVS compensation type 3 will start.)
2. Observe the position droop waveform using the D/A output, and increase the overshooting compensation 1 (SV031: OVS1) value 1% at a time. Set the smallest value where the overshooting does not occur. If SV042 (OVS2) is 0, the overshooting will be compensated in both the forward/reverse directions with the OVS1 setting value.
3. If the compensation amount is to be changed in the direction to be compensated, set the + direction compensation value in OVS1 and the - direction compensation value in OVS2. If only one direction is to be compensated, set the side not to be compensated as -1. The compensation direction setting will be as reversed with the NC parameter CW/CCW setting.

![POINT](image)

1. When either parameter SV031: OVS1 or SV042: OVS2 is set to 0, the same amount of compensation is carried out in both the positive and negative direction, using the setting value of the other parameter (the parameter not set to 0).
2. To compensate in only one direction, set -1 in the parameter (OVS1 or OVS2) for the direction in which compensation is prohibited.
3. For contour cutting, the projection at the arc end point is compensated with OVS compensation. LMC compensation is carried out at the arc starting point.

(2) **Adjusting for feed forward control**

When using feed forward control (high-speed high-accuracy control), the feed forward control must be stopped (fwd_g =0) before adjusting the overshooting compensation. After adjusting the overshooting compensation with normal control, set the overshooting compensation non-sensitive zone (SV034 (SSF3)/bitC to F (ovsn)) to 1 (2µm) and start up feed forward control.

If overshooting compensation is used during feed forward control, the overshooting will increase, or protrusions could appear during arc cutting. This is because, when the NC is carrying out feed forward (fwd) control, overshooting equivalent to the operation fraction unit occurs in the position command, and the OVS compensation is recognized as a change in the command direction, resulting in compensation in the reverse direction. This can be improved by setting the overshooting compensation non-sensitive zone width.

If overshooting does not occur during normal control, and occurs only during feed forward control, adjust the feed forward gain (fwd_g).
### #2231 SV031 OVS1 Overshooting compensation 1

This compensates the motor torque when overshooting occurs during positioning. This is valid only when the overshooting compensation (SV027/bitB,A) is selected.

Type 3  SV027(SSF1)/bitB,A = 11

Set the compensation amount based on the motor stall current. Observing positioning droop waveform, increase in increments of 1% and find the value where overshooting does not occur.

To vary compensation amount depending on the direction.

When SV042 (OVS2) is "0", change the SV031 (OVS1) value in both of the +/-directions to compensate.

To vary the compensation amount depending on the command direction, set this and SV042 (OVS2).

(SV031: + direction, SV042: - direction. However, the directions may be opposite depending on other settings.)

When "-1" is set, the compensation will not be performed in the direction of the command.

---Setting range---
-1 to 100 (Stall current %)
Note that the range will be "-1 - 10000" (Stall current 0.01%) when SV082/bit2 is "1".

### #2242 SV042 OVS2 Overshooting compensation 2

Set this with SV031 (OVS1) only when you wish to vary the overshooting compensation amount depending on the command directions.

Normally, set to "0".

---Setting range---
-1 to 100 (Stall current %)
Note that when SV082/bit2 is "1", the setting range is between -1 and 10000 (Stall current 0.01%).

### #2227 SV027 SSF1 Servo function 1

**bit B-A : ovs Overshooting compensation**

Set this if overshooting occurs during positioning.

bitB,A=

00: Compensation stop
01: Setting prohibited
10: Setting prohibited
11: Type 3

Set the compensation amount in SV031(OVS1) and SV042(OVS2).

Related parameters: SV031, SV042, SV034/bitF-C

### #2234 SV034 SSF3 Servo function 3

**bit F-C: ovsn Overshooting compensation type 3 Non-sensitive band**

Set the non-sensitive band of the model position droop overshooting amount in increments of $2 \mu m$.

In the feed forward control, set the non-sensitive band of the model position droop and ignore the overshooting of the model.

$0 : 0 \mu m, 1 : 2 \mu m, 2 : 4 \mu m, ..., E : 28 \mu m, F : 30 \mu m$

### #2282 SV082 SSF5 Servo function 5

**bit 2 : ccu Lost motion overshoot compensation compensation amount setting increment**

0: Stall current %  1: Stall current 0.01%

---

**POINT**

When using feed forward control (high-speed high-accuracy control), stop the feed forward control (fwd_g=0) before adjusting the overshooting compensation. If overshooting occurs during subsequent feed forward control, adjust the feed forward gain (fwd_g).
5-3-7 Improvement of the interpolation control path

(1) Machine end compensation control
The machine end compensation control compensates the shape of the tool end during high-speed and high-speed acceleration/deceleration. The spring effect from the machine (spindle) end to the motor (scale) end is compensated. If the machine has a large spring effect, the shape may be fine during low-speed operation. However, at high speeds (specially when using a small radius), the section from the machine (spindle) end to the outer sides of the motor (scale) end could swell, and cause the shape to become elliptical during measurement of the roundness. The machine end compensation control compensates the motor end position according to the acceleration size, so the tool end position is always controlled to the commanded position.

Without machine end compensation control
With machine end compensation control

1. Always evaluate the roundness accuracy at the machine side.
2. Adjust the parameter after adjusting the electrical end roundness accuracy.
<Adjustment methods>

1. Confirm that the motor side circle accuracy measured with the NC sampling function is appropriate.

2. In this state, measure the machine side low-speed and high-speed circle path without machine end compensation control. The difference of the high-speed circle path and low-speed circle path is the amount that path has swollen due to the spring effect of the machine system. Calculate the SV065 setting value with the following expression using this amount as the compensation amount.

\[
SV065 = \frac{\text{Compensation amount (μm)} \times \text{radius R (mm)} \times SV003 \times 16,200,000}{(\text{command speed F (mm/min)})^2}
\]

3. Input the value calculated in step [2] into SV065. Measure the high-speed circle path. If the shape is still elliptical, adjust by increasing/decreasing the SV065 value in 1/10 units.

4. Confirm that there is no problem with the low-speed circle path.

Example of low-speed and high-speed roundness measurement for adjusting machine compensation

<table>
<thead>
<tr>
<th>Low speed (reference circle)</th>
<th>When using grid encoder</th>
<th>When using DBB measurement</th>
<th>Acceleration</th>
</tr>
</thead>
<tbody>
<tr>
<td>R=25 [mm], F=500 [mm/min]</td>
<td>R=100 [mm], F=1000 [mm/min]</td>
<td>0.00028G</td>
<td></td>
</tr>
<tr>
<td>High-speed (when adjusting compensation amount)</td>
<td>R=25 [mm], F=10000 [mm/min]</td>
<td>R=100 [mm], F=20000 [mm/min]</td>
<td>0.11G</td>
</tr>
</tbody>
</table>

[#2265] SV065  TLC Machine end compensation gain

The shape of the machine end is compensated by compensating the spring effect from the machine end to the motor end.

Set the machine end compensation gain. Measure the error amount by roundness measurement and estimate the setting value by the following formula.

\[
\text{Compensation amount (μm)} = \frac{\text{Command speed F (mm/min)}^2 \times SV065}{\text{Radius R (mm)} \times SV003 \times 16,200,000}
\]

Set to "0" when not using.

---Setting range---
-30000 to 30000 (Acceleration ratio 0.1%)

1. To confirm the machine's spring element, adjust the electrical end roundness, and then machine roundness while changing the cutting speed. Confirm that the error increases with the speed.

2. The electrical roundness will have an error on the inner side when machine end compensation control is used.

If an excessive value is set in the machine end compensation gain (SV065), the machine could vibrate when stopping, resulting in a dangerous state.
5-4 Adjustment during full closed loop control

5-4-1 Outline

(1) Full closed loop control
The servo control is all closed loop control using the detector's feedback. "Full closed loop control" is the system that directly detects the machine position using a linear scale, whereas the general "semi-closed loop" is the one that detects the motor position.

In a machine that drives a table with a ball screw, the following factors exist between the motor and table end:
[1] Coupling or ball screw table bracket's backlash
[2] Ball screw pitch error

These can adversely affect the accuracy. If the table position is directly detected with a linear scale, high-accuracy position control which is not affected by backlash or pitch error is possible. However, with the full closed loop system, the machine system is also directly included in the position loop control. Thus, if the machine's rigidity is not high, the gain cannot be increased, and the required high accuracy cannot be attained.

The procedures for adjusting the servo with the full closed loop system are the same as the semi-closed loop system. Vibration or overshooting will occur easily, so the position loop gain is generally lower than the semi-closed loop.

(2) Overrun detection
With the full closed system, the position feedback (FB) detected with the linear scale is used for the position control. However, the motor position FB is detected at the same time, and the error of both FB is observed. If this FB error exceeds the servo parameter SV054 setting value, alarm 43 will be detected and the system will stop to prevent overrunning due to a scale FB error from occurring.

---Setting range---
-1 to 32767 (mm)
However, when SV084/bitD=1, the setting range is from -1 to 32767 (μm).
5-4-2 Speed loop delay compensation

Generally, the machine position follows the operation later than the motor position. With full closed loop position loop control, the machine position is used for position feedback, so the motor position could advance too far and cause the machine position to overshoot easily. Speed loop delay compensation suppresses overshooting by weakening the speed loop PI control (weakening lead compensation = delaying). If the compensation is too large and PI control is weakened too far, the positioning time could increase, or the position droop will remain when the motor is stopped.

<Adjustment method>

1. Set the servo function selection 1 (SV027: SSF1)/bit1, bit0 to 10. (Select delay compensation changeover type 2)
2. Set the axis unbalance torque to the torque offset (SV032: TOF). (Refer to "Measuring unbalance torque and frictional torque" for details on measuring the unbalance torque.)
3. Observe the position droop waveform, and confirm the overshooting. Increase SV007 (VIL) in increments of 5, and adjust so that the overshooting is improved. If set too high, the position droop will remain when the axis is stopped.

---Setting range---

0 to 32767

Torque offset

Set the unbalance torque on vertical axis and inclined axis. When the vertical axis pull up function is enabled, the pull up compensation direction is determined by this parameter's sign. When set to "0", the vertical axis pull up will not be executed. This can be used for speed loop delay compensation and collision detection function. To use load inertia estimation function (drive monitor display), set this parameter, friction torque (SV045) and load inertia display enabling flag (SV035/bitF).

---Setting range---

-100 to 100 (Stall current %)

---Setting type selection---

Normally, use "Changeover type 2".

<table>
<thead>
<tr>
<th>bit</th>
<th>Selection</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>Disable</td>
</tr>
<tr>
<td>01</td>
<td>Changeover type 1</td>
</tr>
<tr>
<td>10</td>
<td>Changeover type 2</td>
</tr>
<tr>
<td>11</td>
<td>Setting prohibited</td>
</tr>
</tbody>
</table>

CAUTION The position droop will remain if SV007 is set too high.
5-4-3 Dual feedback control

If the motor and machine coupling or machine system's rigidity is low (ex. large machine, etc.) when using a closed loop system, the response during acceleration/deceleration will vibrate and cause overshooting. This can cause the position loop gain from increasing. The dual feedback function is effective in this case.

To validate the dual feedback function, use position feedback with a motor side detector in ranges with high acceleration to enable stable control. In ranges with low acceleration, use position feedback with the machine side detector (scale). This will make it possible to increase the position loop gain.

The state will approach the semi-closed loop system as the primary delay filter's time constant increases, so the position loop gain limit will increase. Note that the limit of the position loop gain increased with the dual feedback function is the same as the position loop gain limit for a semi-closed system that does not use a machine side detector (scale, etc.). In addition, the positioning time will increase as the primary delay filter time constant increases.

1. Dual feedback control is a function that compensates symptoms resulting from insufficient machine rigidity. If there are items that can be improved on the machine (improvement of scale installation position, etc.) improve those first.

2. The position loop gain limit will not increase compared to the semi-closed loop system even when using dual feedback control.
<Adjustment method>

[1] Set the servo specifications (SV017: SPEC)/bit1 to 1, and turn the NC power ON again.

[2] Measure the position droop overshooting while increasing the dual feedback control time constant (SV051: DFBT) in increments of 5ms. Adjust to the time constant where overshoooting does not occur.

[3] For the final setting value, set a value 1.5 to 2-fold the value adjusted in 3.

【#2217(PR)】SV017 SPEC1 Servo specification 1

bit 1 : dfbx Dual feedback control
Control the position FB signal in full closed control by the combination of a motor side detector and machine side detector.
0: Stop 1: Start

【#2251】SV051 DFBT Dual feedback control time constant
Set the control time constant in dual feedback. When "0" is set, it operates at 1ms. The higher the time constant is, the closer it gets to the semi-closed control, so the limit of the position loop gain will be raised.

For linear servo/direct-drive motor system
Not used. Set to "0".

---Setting range---
0 to 9999 (ms)

【#2252】SV052 DFBN Dual feedback control non-sensitive band
Set the non-sensitive band in the dual feedback control. Normally, set to "0".

For linear servo/direct-drive motor system
Not used. Set to "0".

---Setting range---
0 to 9999 (μm)
## 5-5 Settings for emergency stop

Emergency stop in this section refers to the following states.
1. Emergency stop was input (including other axis alarms)
2. NC power down was detected
3. A drive unit alarm was detected

### 5-5-1 Deceleration control

With the servo drive unit, if the deceleration stop function is validated, the motor will decelerate following the set time constant while maintaining the READY ON state. READY will turn OFF and the dynamic brakes will function after stopping.
If an alarm, for which dynamic brakes are designated as the stopping method, occurs, the motor will stop with the dynamic brakes.

**<Features>**

When the load inertia is large, deceleration stop can be executed at a shorter time than the dynamic brakes.
(The stop time for the normal acceleration/deceleration time constants will be achieved.)

1. **Setting the deceleration control time constant**
   Set the time for stopping from the rapid traverse rate (rapid: axis specification parameter) in the deceleration time constant for emergency stop (SV056: EMGt). The operation stops with the position loop step when 0 is set.
   For the standard setting value of SV056, refer to the following table.
   When applying this setting to the synchronous control axes, set the same value with negative symbol to the both axes. Even if the dynamic break stop is applied to either axis, it is also applied to the other axis.

<table>
<thead>
<tr>
<th>#2003: smgst</th>
<th>#1219: aux03</th>
<th>SV056: EMGt Deceleration time constant at emergency stop</th>
<th>Standard setting value</th>
</tr>
</thead>
<tbody>
<tr>
<td>bit 3-0: Rapid traverse acceleration/deceleration type (hexadecimal)</td>
<td>bit 7: Time constant setting changeover for soft acceleration/deceleration</td>
<td>Standard setting value</td>
<td></td>
</tr>
<tr>
<td>1: Linear acceleration/deceleration</td>
<td>EMGt≤G0tL × 0.9</td>
<td>EMGt≤(G0tL-G0t1) × 0.9</td>
<td></td>
</tr>
<tr>
<td>8: Exponential acceleration and linear deceleration</td>
<td>EMGt≤(2 × G0t1) × 0.9</td>
<td>EMGt≤G0tL × 0.9</td>
<td></td>
</tr>
<tr>
<td>F: Soft acceleration/deceleration</td>
<td></td>
<td>EMGt≤G0tL × 0.9</td>
<td></td>
</tr>
<tr>
<td>A value other than the above</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>#2004: G0tL G0 time constant (linear)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>#2005: G0t1 G0 time constant (primary delay) / Second-step time constant for soft acceleration/deceleration</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**CAUTION**

If the deceleration control time constant at emergency stop (EMGt) is set to a value longer than the above value, the soft limit point (stroke end point) may be exceeded. Take care as the axis could collide the machine.
<Operation>
When an emergency stop occurs, the motor will decelerate at the same inclination from each speed.

---Setting range---
0 to 20000 (ms)

【#2255】SV055   EMGx   Max. gate off delay time after emergency stop
Set the time required between an emergency stop and forced READY OFF.
Set the maximum value "+ 100ms" of the SV056 setting value of the servo drive unit electrified by the same power supply unit.
When executing the vertical axis drop prevention, the gate off will be delayed for the length of time set at SV048 even when SV055's is smaller than that of SV048.

【#2256】SV056   EMGt   Deceleration time constant at emergency stop
Set the time constant used for the deceleration control at emergency stop.
Set the time required to stop from rapid traverse rate (rapid).
The standard setting value is EMGt ≤ G0TL × 0.9.
However, note that the standard setting value differs from the above-mentioned value when the setting value of "#2003: smgst Acceleration and deceleration modes bit 3-0: Rapid traverse acceleration/deceleration type" is 8 or F. Refer to Instruction Manual of the drive unit (section "Deceleration control") for details.

---Setting range---
0 to 20000 (ms)
(2) **Deceleration control stop distance**

The stopping distance $L_{emg}$ when the motor is stopped with deceleration control during an emergency stop can be approximated with the following expression. Note that the value will be higher than this if the current is limited during deceleration.

$$L_{emg} = \frac{F}{PGN1 \times 60} + \frac{1}{2} \times \frac{F}{60} \times \frac{F \times EMGt}{\text{rapid} \times 1000} \text{ (mm)}$$

- $F$ : Feedrate during emergency stop (mm/min)
- rapid : Rapid traverse rate (mm/min)
- PGN1 : Position loop gain 1 (SV003) (rad/s)
- EMGt : Deceleration time constant for emergency stop (SV056) (ms)

---

1. Deceleration control will not take place when a servo alarm, for which the stopping method is dynamic, occurs. The motor will stop with dynamic braking regardless of the parameter setting.

2. If the power fails and the deceleration time constant is set to a relatively long time, the braking method may change from deceleration control to dynamic braking due to a drop in the bus voltage in the drive unit.

---

**CAUTION**

If the deceleration control time constant (EMGt) is set to a value longer than the acceleration/deceleration time constant, the soft limit point (stroke end point) may be exceeded. Take care as the axis could collide the machine.
5-5-2 Vertical axis drop prevention control

The vertical axis drop prevention control is a function that prevents the vertical axis from dropping due to a delay in the brake operation when an emergency stop occurs. The no-control time until the brakes activate can be eliminated by delaying the servo READY OFF state by the time set in the parameters when an emergency stop occurs. Always use this function together with deceleration control.

<Setting procedures>

[1] Apply emergency stop while viewing the current position on the NC screen. Adjust the vertical axis drop prevention time (SV048), and set the 1.5-fold minimum delay time at which the axis does not drop. When using a motor with a break, confirm that the axis will not drop at the 150ms setting, and set 200ms.

[2] Set the value of the normal acceleration/deceleration time constant plus 100ms for the max. gate off delay time at emergency stop (SV055), and set the standard setting value of the axis for the deceleration control time constant at emergency stop (SV056). Refer to "Deceleration control" for details.

[3] For the axis for which the vertical drop is to be controlled, set the same value as the acceleration/deceleration time constant for the deceleration control time constant at emergency stop (SV056).

[4] If the vertical axis is MDS-DM2 Series (Multiaxis drive unit), set the servo parameters for the other axis in the same unit.

SV048 = Same value as adjusted vertical axis SV048
SV055 = Same value as adjusted vertical axis SV055
SV056 = Standard setting value of SV055 for the axis (Refer to "Deceleration control" for details.)

Vertical axis drop prevention control sequence

1. Always set deceleration control when using the vertical axis drop prevention control setting.

2. In the system with MDS-DM2-SPV unit only, configure so that the contactor is controlled directly by the axis which controls the vertical axis drop prevention control.

3. If an alarm, for which dynamic brake stopping is designated, occurs with the axis for which vertical axis drop prevention control is active, the function will not activate. To prevent axis dropping under all conditions, provide measures on the machine side by installing a balance unit, etc.

4. In consideration of the relay delay time for the break control, set the vertical axis drop prevention time.

CAUTION
5-5 Settings for emergency stop

【#2248】 SV048 EMGr 水平轴垂直轴下降防止时间

输入的时间是在垂直轴下降防止时，通过延迟READY OFF直到刹车工作来防止轴下降所需的时间。
增加时间范围为100ms为单位，找到并设置轴在不下降所需的值。
当使用带刹车电机时，设置为“200ms”作为标准。
当拉起功能启用（SV033/bitE=1）时，拉起功能会在下降防止时间期间建立。

---Setting range---
0 to 20000 (ms)

【#2255】 SV055 EMGx 最大通电延迟时间紧急停止后

设置紧急停止和强制READY OFF之间的时间。
设置最大值为SV056设置值的伺服驱动单元由同一电源单元供电。
在执行垂直轴下降防止时，即使SV055的小于SV048，执行延时也会设置。

---Setting range---
0 to 20000 (ms)

【#2256】 SV056 EMGt 加减速时间时间紧急停止

设置用于紧急停止时的减速控制时间。
设置从快速巡航速度（快速）所需的停止时间。
标准设置值为EMGt≤G0tL×0.9。
但是，请注意，标准设置值与上述值不同，当设置值为"#2003:smgst Acceleration and deceleration modes bit 3-0:Rapid traverse acceleration/deceleration type"是8或F时。参见驱动装置操作手册（章节"Deceleration control"）。

---Setting range---
0 to 20000 (ms)

1. SV048和SV055为每个轴设置，但当使用MDS-DM2系列（多轴驱动单元）时，轴由较大的设置值控制。
2. 如果一个报警，动态刹车停车被指定，轴对于垂直轴下降防止功能是活动的，功能不会激活。
3. 由于刹车的间隙，可能产生数µm到数10µm的下降。

POINT

1. 不要设置垂直轴下降防止时间更长于所需的时间。如果这些功能重叠时间在100ms内，伺服控制和刹车就不会相撞，不会出现过载报警或驱动装置损坏。
2. 垂直轴下降防止控制（包括加减速控制）超过100ms将不会在断电时保证功能。操作将切换到动态刹车。
3. 如果仅SV048和SV055设置，并且SV056设置为0，则加减速停止将是一个步显示，可能会导致与机器碰撞。

CAUTION
<Outline of system configurations and corresponding parameter settings>

[1] Only one MDS-DM2-SPV3 unit (vertical axis: Z axis)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Axis</th>
<th>X axis</th>
<th>Y axis</th>
<th>Z axis (Vertical axis)</th>
<th>Spindle</th>
</tr>
</thead>
<tbody>
<tr>
<td>SV048</td>
<td>MDS-DM2-SPV3</td>
<td>Same value as Z axis -&gt;</td>
<td>Same value as Z axis -&gt;</td>
<td>200ms as a standard (Set by adjustment)</td>
<td>Set as follows. SP055=20000</td>
</tr>
<tr>
<td>SV055</td>
<td>MDS-DM2-SPV3</td>
<td>X, Y, Z axis Maximum value of SV056 setting value +100ms</td>
<td></td>
<td></td>
<td>SP056=300</td>
</tr>
<tr>
<td>SV056</td>
<td>MDS-DM2-SPV3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(Note) For the standard setting value of SV056, refer to "Deceleration control".


<table>
<thead>
<tr>
<th>Parameter</th>
<th>Axis</th>
<th>X axis</th>
<th>Y axis</th>
<th>Z axis (Vertical axis)</th>
<th>Spindle</th>
</tr>
</thead>
<tbody>
<tr>
<td>SV048</td>
<td>MDS-DM2-SPV3</td>
<td>Same value as Z axis -&gt;</td>
<td>Same value as Z axis -&gt;</td>
<td>200ms as a standard (Set by adjustment)</td>
<td>Set as follows. SP055=20000</td>
</tr>
<tr>
<td>SV055</td>
<td>MDS-DM2-SPV3</td>
<td>X, Y, Z axis Maximum value of SV056 setting value +100ms</td>
<td></td>
<td></td>
<td>SP056=300</td>
</tr>
<tr>
<td>SV056</td>
<td>MDS-DM2-SPV3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(Note) For the standard setting value of SV056, refer to "Deceleration control".

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Axis other than the right (3-axis)</th>
<th>Z axis (Vertical axis)</th>
<th>Spindle</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MDS-DM2-SPV3</td>
<td>MDS-D2-V1</td>
<td>MDS-D2-CV</td>
</tr>
<tr>
<td>SV048</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>SV055</td>
<td>Each axis Maximum value of SV056 setting value +100ms</td>
<td>200ms as a standard (Set by adjustment)</td>
<td></td>
</tr>
<tr>
<td>SV056</td>
<td>Standard setting value for each axis (Note)</td>
<td>Set as follows. SP055=20000 SP056=300</td>
<td></td>
</tr>
</tbody>
</table>

(Note) For the standard setting value of SV056, refer to "Deceleration control".
5-5-3 Vertical axis pull-up control

Even when the vertical axis drop prevention control is applied, the axis will drop several \( \mu \)m due to the mechanical play of the motor brakes. Work could be damaged especially when the power fails during machining. For the vertical machining center, etc., vertical axis pull-up control protect works from collision by slightly pulling the vertical axis when an emergency stop (including the power failure) occurs.

If the pull-up control itself has possibility to cause interference during synchronous tapping machining or soft limit's stop, vertical axis pull-up control suppression command (servo control input 4/bit2) is input from NC and stops the pull-up control.

< Adjustment procedure >

1. Set "Vertical axis drop prevention control".
2. Set servo function selection 2 SV033/bitE = 1 (Vertical axis drop prevention control will start).
3. Set the torque offset SV032. The pull-up directions is distinguished by this setting value's sign. Refer to "Measuring unbalance torque and frictional torque measurement" for details on the setting.
4. Input emergency stop when axes stop and confirm the subject axis to be retracted upward.
5. If the pull-up range is insufficient, adjust vertical axis pull-up distance SV095.

\[ \text{SV032} \quad \text{TOF} \quad \text{Torque offset} \]

This function is valid for Z axis in the vertical machining center. Basically it cannot be used with the horizontal machining center's Y axis or the lathe's X axis as collisions could occur. Check the machine's working conditions carefully before using this function.

---Setting range---
-100 to 100 (Stall current %)
5-6 Protective functions

5-6-1 Overload detection

The servo drive unit is equipped with an electronic thermal that protects the servomotor and servo drive unit from overload conditions. The overload 1 alarm (alarm 50) is detected if an overload condition occurs, and the overload 2 alarm (alarm 51) is detected if 95% or more of the maximum current is commanded continuously for 1 second or longer due to a machine collision, etc. The parameters shown below are for machine tool builder adjustment purposes only, and should be kept at their standard settings (SV021=60, SV022=150).

For details concerning the overload protection characteristics, refer to the MDS-DM2 Series Specifications Manual (IB-1501136).

---Setting range---
1 to 999 (s)

---Setting range---
110 to 500 (Stall current %)

#2233] SV033 SSF2 Servo function 2

bit E : zup Vertical axis pull up function

0: Stop  1: Enable

#2248] SV048 EMGrt Vertical axis drop prevention time

Input the time required to prevent the vertical axis from dropping by delaying READY OFF until the brake works at an emergency stop.

Increase in increments of 100ms at a time, find and set the value where the axis does not drop.

When using a motor with a brake, set to “200ms” as a standard.

When the pull up function is enabled (SV033/bitE=1), the pull up is established during the drop prevention time.

---Setting range---
0 to 20000 (ms)

#2295] SV095 ZUPD Vertical axis pull up distance

Set this parameter to adjust the pull up distance when the vertical axis pull up function is enabled.

When the pull up function is enabled and this parameter is set to “0”, for a rotary motor, 8/1000 of a rotation at the motor end is internally set as the pull up distance, and for a linear motor, 80[μm] is set.

---Setting range---
0 to 2000 (μm)

5-6 Protective functions

#2221] SV021 OLT Overload detection time constant

Normally, set to “60”. (For machine tool builder adjustment.)

---Setting range---
1 to 999 (s)

---Setting range---
0 to 2000 (μm)
5-6-2 Excessive error detection

An excessive error (alarms 52, 53, 54) is detected when the difference between the servo’s commanded position and the FB position exceeds the value set by parameter. Separate excessive error detection width can be set for servo ON (SV023) and servo OFF (SV026) statuses. When a wider excessive error detection width than that used for standard control is required in stopper control, etc., the detection width setting can be changed to the SV053 setting value by NC command.

Follow-up control (NC commanded position tracks servo FB position) is used during emergency stop and during a servo OFF command, and so there is no excessive error detection at those times, although the follow-up control during a servo OFF status can be disabled by an NC system parameter setting.

[#2223] SV023 OD1 Excessive error detection width during servo ON

Set the excessive error detection width in servo ON.

<Standard setting value>

\[ OD1=OD2= \frac{\text{Rapid traverse rate [mm/min]}}{60 \times \text{PGN1}} \times 0.5 \] [mm]

When set to “0”, the excessive error alarm detection will be ignored, so do not set to “0”.

---Setting range---

0 to 32767 (mm)

However, when SV084/bitC=1, the setting range is from 0 to 32767 (μm).

[#2226] SV026 OD2 Excessive error detection width during servo OFF

Set the excessive error detection width during servo OFF.

<Standard setting value>

\[ OD1=OD2= \frac{\text{Rapid traverse rate [mm/min]}}{60 \times \text{PGN1}} \times 0.5 \] [mm]

When set to “0”, the excessive error alarm detection will be ignored, so do not set to “0”.

---Setting range---

0 to 32767 (mm)

However, when SV084/bitC=1, the setting range is from 0 to 32767 (μm).

[#2253] SV053 OD3 Excessive error detection width in special control

Set the excessive error detection width when servo ON in a special control (initial absolute position setting, stopper control and etc.). When “0” is set, excessive error detection will not be performed when servo ON during a special control.

---Setting range---

0 to 32767 (mm)

However, when SV084/bitC=1, the setting range is from 0 to 32767 (μm).
Collision detection function quickly detects a collision of the motor shaft, and decelerates and stops the motor. This suppresses the generation of an excessive torque in the machine tool, and helps to prevent an abnormal state from occurring. Impact at a collision will not be prevented by using this collision detection function, so this function does not necessarily guarantee that the machine tool will not be damaged or that the machine accuracy will be maintained after a collision. The same caution as during regular operation is required to prevent the machine from colliding.

### (1) Collision detection method 1

The required torque for the command is estimated from the position command issued from the NC, and the disturbance torque is obtained from the difference with the actual torque. When this disturbance torque exceeds the collision detection level set with the parameters, the motor will decelerate to a stop with a torque 80% (standard) value of the motor's maximum torque. After decelerating to a stop, alarm 58 or 59 will occur, and the system will stop.

The collision detection level for rapid traverse (G0) is set with SV060: TLMT. The collision detection level for cutting feed (G1) is set to 0 to 7-fold (SV35.clG1) based on the collision detection level for rapid traverse. When clG1 is set to 0, collision detection method 1 will not function during cutting feed. If SV060 is set to 0, all collision detection (including methods 1 and 2) will not function.

<table>
<thead>
<tr>
<th>Settings</th>
<th>Detected alarm</th>
</tr>
</thead>
<tbody>
<tr>
<td>During rapid traverse (During G0 feed)</td>
<td>SV060</td>
</tr>
<tr>
<td>During cutting feed (During G1 feed)</td>
<td>SV060 × c1G1(SV035)</td>
</tr>
</tbody>
</table>

### Speed command (r/min)

![Graph showing speed command](image)

### Estimated torque (stall%)

![Graph showing estimated torque](image)

### Collision detection function outline

(a) A collision of machine is detected.

(b) A retracting torque is generated.

The collision of machine is reduced.

The collision detection function does not guarantee safety or machine accuracy when a collision occurs. Thus, the same caution as during regular operation is required to prevent the machine from colliding.
(2) Collision detection method 2
When the current command reaches the motor's maximum current, the motor will decelerate and stop at a torque 80% (standard value) of the motor's maximum torque. After decelerating to a stop, alarm 5A will occur, and the system will stop. If the acceleration/deceleration time constant is short and incorrect detections easily occur during normal operation, lengthen the acceleration/deceleration time constant and adjust so that the current is not saturated (does not reach the maximum current) during acceleration.
If the acceleration/deceleration time constant cannot be lengthened, set parameter SV035/bitB (SSF4.c12n) to 1 to ignore collision detection method 2.

(3) Retracting torque
In each collision detection method, impact after a collision is reduced by generating the retracting torque after the collision is detected.
The retracting torque is a torque 70% to 100% which is set with SV035: SSF4/cltq (bit8, bit9) based on the current of the motor maximum ability.

1. Always validate SHG control when using the collision detection function, or when carrying out SV059 setting value operation.
2. Provide an allowance in the detection level setting to prevent incorrect detections.
3. All collision detection functions will be disabled when SV60 is set to 0.
4. Collision detection method 2 will function if a value other than 0 is set in SV060. Note that the detection can be ignored by setting the parameter (SV035/bitB).
5. The torque estimated gain (SV059) must be readjusted when there are changes in the detector replacement following maintenance, etc., in the detector resolution, or in the position control system such as detector loop gain (PGN), etc. (closed loop control and semi-closed loop has been changed).
6. The retracting torque generated when a collision is detected outputs the motor maximum torque. If the torque limitation is required in order to protect the machine, set “SV035: SSF4/cltq (bit8, bit9)”.
<Setting and adjustment methods>

[1] Confirm that SHG control is active. Collision detection function is valid only during SHG control.

[2] Set the axis unbalanced torque to the torque offset (SV032: TOF). (Refer to "Measuring unbalance torque and frictional torque" for details on measuring the unbalance torque.)

[3] Measure the frictional torque and set in the frictional torque (SV045: TRUB). Carry out reciprocation operation (approx. F1000) with the axis to be adjusted, and measure the load current % when the axis is fed at the constant speed on the NC SERVO MONITOR screen. This frictional torque is expressed with the following expression.

\[
\text{Frictional torque (\%)} = \frac{(+ \text{ feed load current \%}) - (- \text{ feed load current \%})}{2}
\]

[4] Set SV035: SSF4.clt (bitF) to 1 for the axis being adjusted, and move in both directions with JOG, etc., at the rapid traverse rate. When the load inertia ratio display on the NC SERVO MONITOR screen has stabilized, set that value for the torque estimated gain (SV059: TCNV). Return SV035: SSF4.clt (bitF) to 0.

[5] If the acceleration/deceleration time is short, and the current is limited, set SV035: SSF4.c12n (bitB) to 1 to invalidate collision detection method 2.

[6] Adjust the collision detection level (SV060: TLMT). First set 100. If operation at the rapid traverse rate results in an alarm, increase the setting value by approx. 20. If an alarm does not occur, lower the setting value by approx. 10. The estimated disturbance torque value on the servo monitor screen will indicate the estimated disturbance torque peak value for the latest two seconds. This value can be used as reference. Set the final setting value to a value approx. 1.5-fold the limit value at which an alarm does not occur.

[7] Divide the maximum cutting load with the value set for the collision detection level (SV060: TLMT). (Round up the decimal) Set this value in SV035: SSF4.clG1 (bitC-E).

(Example) For maximum cutting load: 200%, SV060: TLMT setting value: 80%

\[
\frac{200}{80} = 2.5 \rightarrow \text{The detection level is 3 (fold)}, \text{so set SV035:SSF4 to "3xx".}
\]

[8] Set the retracting torque when a collision is detected to SV035: SSF4.cltq (bit8,9).

(Example) To set the retracting torque to 70% of the motor maximum torque:

Set SV035:SSF4 to "x3xx".

---Setting range---

-100 to 100 (Stall current %)

[#2232] SV032 TOF Torque offset

Set the unbalance torque on vertical axis and inclined axis. When the vertical axis pull up function is enabled, the pull up compensation direction is determined by this parameter's sign. When set to "0", the vertical axis pull up will not be executed. This can be used for speed loop delay compensation and collision detection function. To use load inertia estimation function (drive monitor display), set this parameter, friction torque (SV045) and load inertia display enabling flag(SV035/bitF).
### Servo Adjustment

#### SV035 SSF4 Servo function 4

<table>
<thead>
<tr>
<th>Bit F: clt Inertia ratio display</th>
</tr>
</thead>
<tbody>
<tr>
<td>0: Setting for normal use</td>
</tr>
<tr>
<td>1: Display the total inertia ratio estimated at acceleration/deceleration at the inertia ratio on the servo monitor screen</td>
</tr>
<tr>
<td>To display it on the screen, set an imbalance torque and friction torque to both SV032 and SV045 and repeat acceleration/deceleration operations for several times.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Bit E-C: clG1 G1 Collision detection level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Set the collision detection level in the collision detection method 1 during cutting feed (G1) in multiples of that of rapid traverse (G0). When set to &quot;0&quot;, detection of collision detection method 1 during cutting feed will be ignored.</td>
</tr>
<tr>
<td>G1 Collision detection level = G0 collision detection level (SV060) × clG1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Bit B: cl2n Collision detection method 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>0: Enable</td>
</tr>
<tr>
<td>1: Disable</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Bit 9-8: cltq Retract torque in collision detection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Set the retract torque in collision detection using the ratio of motor's maximum torque.</td>
</tr>
<tr>
<td>bit9,8=</td>
</tr>
<tr>
<td>00: 100%</td>
</tr>
<tr>
<td>01: 90%</td>
</tr>
<tr>
<td>10: 80%(Standard)</td>
</tr>
<tr>
<td>11: 70%</td>
</tr>
</tbody>
</table>

#### SV045 TRUB Friction torque

Set the frictional torque when using the collision detection function.
To use load inertia estimation function (drive monitor display), set this parameter, imbalance torque (SV032) and load inertia display enabling flag (SV035/bitF).

---Setting range---
0 to 255 (Stall current %)

#### SV059 TCNV Collision detection torque estimated gain

Set the torque estimated gain when using the collision detection function.
The standard setting value is the same as the load inertia ratio (SV037 setting value) including motor inertia.
Set to "0" when not using the collision detection function.

<<Drive monitor load inertia ratio display>>
Set SV035/bitF=1 and imbalance torque and friction torque to both SV032 and SV045, and then repeat acceleration/deceleration for several times.

---Setting range---
For general motor: 0 to 5000 (%)
For linear motor: 0 to 5000 (kg)

#### SV060 TLMT Collision detection level

When using the collision detection function, set the collision detection level at the G0 feeding.
When "0" is set, none of the collision detection function will work.

---Setting range---
0 to 999 (Stall current %)
5-7 Servo control signal

The sequence input/output signals exchanged between the NC and servo drive unit are explained in this section. The status of each signal is displayed on the NC SERVO MONITOR screen.

5-7-1 Servo control input (NC to Servo)

(1) Servo control input 1

<table>
<thead>
<tr>
<th>Name</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Servo control input 1</td>
<td></td>
</tr>
<tr>
<td>bit0. READY ON command (RDY)</td>
<td>Status turns to ready ON at RDY=1.</td>
</tr>
<tr>
<td>bit1. Servo ON command (SRV)</td>
<td>[1] Drive unit turns ON at SRV=1 (servo ON status).</td>
</tr>
<tr>
<td></td>
<td>[2] Drive unit turns OFF at SRV=0 (servo OFF status).</td>
</tr>
<tr>
<td>bit4. Position loop gain changeover command (KPM)</td>
<td>[1] The position loop gain (SV049/SV050/SV058) for spindle synchronous (synchronous tapping, synchronous control with spindle C-axis, etc.) is selected at KPM=1.</td>
</tr>
<tr>
<td></td>
<td>[2] The normal position loop gain (SV003/SV004/SV057) is selected at KPM=0.</td>
</tr>
<tr>
<td>bit6. Excessive error detection width changeover command (EOM)</td>
<td>[1] The excessive error width (SV053) for the special control (initial absolute position setting, stopper control, etc.) is selected at EOM =1.</td>
</tr>
<tr>
<td></td>
<td>[2] The normal excessive error width (SV023) is selected at EOM =0.</td>
</tr>
<tr>
<td>bit7. Alarm reset command (ALMR)</td>
<td>NR alarm is reset at ALMR=1.</td>
</tr>
<tr>
<td>bit8. Current limit selection command (IL1)</td>
<td>[1] The current (torque) limit (SV014) for the special control (initial absolute position setting, stopper control, etc.) is selected at IL1 =1.</td>
</tr>
<tr>
<td></td>
<td>[2] The normal current (torque) limit (SV013) is selected at IL1 =0.</td>
</tr>
</tbody>
</table>

(Note) The bits other than those above are used for maintenance.
## (2) Servo control input 2

<table>
<thead>
<tr>
<th>Name</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Servo control input 2</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>bit</td>
<td>Details</td>
</tr>
<tr>
<td>9</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>1</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>2</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>3</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>4</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>5</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>6</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>7</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>8</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>9</td>
<td>SSW Speed monitor command valid</td>
</tr>
<tr>
<td>A</td>
<td>NCDC In door closed (controller)</td>
</tr>
<tr>
<td>B</td>
<td>SRVDC In door closed (all drive units)</td>
</tr>
<tr>
<td>C</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>D</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>E</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>F</td>
<td>(For maintenance)</td>
</tr>
</tbody>
</table>

- **bit9.** Speed monitor command valid (SSW)
  - When speed monitor command is valid, SSW = 1 (valid) is set.

- **bitA.** In door closed (controller) (NCDC)
  - When "In door closed" signal for controller is valid, NCDC = 1 (valid) is set.

- **bitB.** In door closed (all drive units) (SRVDC)
  - When the theoretical sum of "In door closed" signals for all drive units is valid, SRVDC = 1 (valid) is set.

*(Note)* The bits other than those above are used for maintenance.

## (3) Servo control input 3

<table>
<thead>
<tr>
<th>Name</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Servo control input 3</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>bit</td>
<td>Details</td>
</tr>
<tr>
<td>0</td>
<td>AXF Control axis detachment command</td>
</tr>
<tr>
<td>1</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>2</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>3</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>4</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>5</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>6</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>7</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>8</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>9</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>A</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>B</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>C</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>D</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>E</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>F</td>
<td>(For maintenance)</td>
</tr>
</tbody>
</table>

- **bit0.** Control axis detachment command (AXF)
  - The control axis is detached at AXF = 1.

*(Note)* The bits other than those above are used for maintenance.
(4) Servo control input 4
This is used for maintenance.

(5) Servo control input 5
This is used for maintenance.

(6) Servo control input 6
This is used for maintenance.
5-7-2 Servo control output (Servo to NC)

(1) Servo control output 1

<table>
<thead>
<tr>
<th>Name</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Servo control output 1</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>bit</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>RDY In ready ON</td>
</tr>
<tr>
<td>1</td>
<td>SRV In servo ON</td>
</tr>
<tr>
<td>2</td>
<td>KPM In position loop gain changeover</td>
</tr>
<tr>
<td>3</td>
<td>EOM In excessive error detection width changeover</td>
</tr>
<tr>
<td>4</td>
<td>ALMR In alarm</td>
</tr>
<tr>
<td>5</td>
<td>IL1 In current limit selection</td>
</tr>
<tr>
<td>6</td>
<td>INP In in-position</td>
</tr>
<tr>
<td>7</td>
<td>LMT In current limit</td>
</tr>
<tr>
<td>8</td>
<td>AER In warning</td>
</tr>
<tr>
<td>9</td>
<td>WRN In absolute position data loss</td>
</tr>
<tr>
<td>A</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td></td>
</tr>
</tbody>
</table>

- **bit0.** In ready ON (RDY)
  It indicates that the status is in ready ON at RDN=1.

- **bit1.** In servo ON (SRV)
  It indicates that the drive unit turns ON (servo ON) at SRV=1.

- **bit4.** In position loop gain changeover (KPM)
  [1] The position loop gain (SV049/SV050/SV058) for spindle synchronous (synchronous tapping, synchronous control with spindle C-axis, etc.) is being selected at KPM=1.
  [2] The normal position loop gain (SV003/SV004/SV057) is being selected at KPM=0.

- **bit6.** In excessive error detection width changeover (EOM)
  [1] The excessive error width (SV053) for the special control (initial absolute position setting, stopper control, etc.) is being selected at EOM =1.
  [2] The normal excessive error width (SV023) is being selected at EOM =0.

- **bit7.** In alarm (ALMR)
  It indicates that drive unit is in some alarm state at ALM=1.

- **bit8.** In current limit selection (IL1)
  [1] The current (torque) limit (SV014) for the special control (initial absolute position setting, stopper control, etc.) is being selected at IL1 =1.
  [2] The normal current (torque) limit (SV013) is being selected at IL1 =0.

- **bitC.** In in-position (INP)
  The status changes to INP=1 when position droop exists within the in-position area set by parameter SP024 (INP) regardless of serve ON or OFF.

- **bitD.** In current limit (LMT)
  It indicates that the drive unit is in current limit at LMT=1.
bitE. In absolute position data loss (AER)
   It indicates that the drive unit is in absolute position data loss at AER=1.

bitF. In warning (WRN)
   It indicates that drive unit is in some warning state at WRN=1.

(Note) The bits other than those above are used for maintenance.

(2) Servo control output 2

<table>
<thead>
<tr>
<th>Name</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Servo control output 2</td>
<td></td>
</tr>
<tr>
<td>bit0. Z phase passed (ZCN)</td>
<td></td>
</tr>
</tbody>
</table>
   ZCN is set to "1" after passing the Z phase at ZCN=0.

| bit3. In zero speed (ZS) |
   It indicates that the servomotor is stopping at ZS=1.

| bit7. In external emergency stop |
   It indicates that an external stop input to the power supply is being input.

| bit9. In speed monitor |
   It indicates that a signal in speed monitor command is being received.

| bitA. In door closed (controller) |
   It indicates that "In door closed" signal for controller is being received.

| bitB. In door closed (self drive unit) |
   It indicates the status of "In door closed" signal for self drive unit.

(Note) The bits other than those above are used for maintenance.
(3) Servo control output 3

<table>
<thead>
<tr>
<th>Name</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Servo control output 3</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>bit</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>AXF In control axis detachment (AXF)</td>
</tr>
<tr>
<td>1</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>2</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>3</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>4</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>5</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>6</td>
<td>(For maintenance)</td>
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<tr>
<td>7</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>8</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>9</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>A</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>B</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>C</td>
<td>(For maintenance)</td>
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<tr>
<td>D</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>E</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>F</td>
<td>(For maintenance)</td>
</tr>
</tbody>
</table>

bit0. In control axis detachment (AXF)
The control axis is being detached at AXF=1.

(Note) The bits other than those above are used for maintenance.

(4) Servo control output 4
This is used for maintenance.

(5) Servo control output 5
This is used for maintenance.

(6) Servo control output 6
This is used for maintenance.
Spindle Adjustment
6-1 Adjustment procedures for each control

1. Do not adjust when possible risks associated with adjustment procedures are not thoroughly taken into consideration.

2. Be careful when touching rotating section, or your hand may be caught in or cut.

3. Changing of parameters has to be done carefully.

6-1-1 Basic adjustments

(1) Items to check during trial operation

[1] When the power is ON for the first time, check the wiring. When the machine is operated for the first time, check the set parameters again.

[2] Confirm that the values of the NC side parameters "slimt1 to 4", "smax1 to 4", and "smini" comply with the machine specification.

[3] When the machine running-in has not been completed, gradually raise the rotation speed (in increments of 1000r/min) for the spindle. Raise the speed at the timing when the load meter value is stabilized during rotation.

If the load meter value is higher than the normal value, stop the operation and check the spindle section of the machine.

[4] Confirm that the command (S command) speed and actual speed match during running-in. When gear ratio is set, the spindle end speed and motor speed differ.

[5] Confirm that there is no abnormal noise, odor or motor overheat during running-in.

(2) Adjusting the spindle rotation speed

When the spindle motor and the spindle end are coupled using a gear or pulley, the rotation speeds of the spindle motor and the spindle end may not match. Adjust the command and the rotation speed of spindle end with the following method.

Apply the following adjustment methods [1] to [3] individually to each of the gears 00 to 11. Confirm that the machine's gear changes correctly before the adjustment.

[1] Set the spindle specification parameters, "sli m1 to 4".

Calculation expression:

\[ \text{slimt1 to 4} = \text{SP026} \times (\text{deceleration rate of the gears 00 to 11 between the motor and spindle end}) \]

[2] Set the S command to half of the maximum spindle rotation speed and confirm the rotation speed of the spindle end. Adjust slimt1 to 4 until the rotation speed matches.

[3] Set the S command to the maximum spindle end rotation speed and confirm that the S command speed and the spindle end speed match.
### 6-1-2 Gain adjustment

1. **Checking the current loop gain**
   Check to see if the settings of following parameters, SP077 to SP084, are the standard setting. Basically, parameters for current loop gain do not need to be changed.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Setting range</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>[13077]</strong> SP077 IQA Q axis current lead compensation</td>
<td>Set the current loop gain. To use the coil switch function, set the current loop gain for when the high-speed coil is selected. The setting value is determined by the motor's electrical characteristics so that the value is fixed to each motor used. Set the value given in the spindle parameter list. (For machine tool builder adjustment)</td>
<td>1 to 20480</td>
</tr>
<tr>
<td><strong>[13078]</strong> SP078 IDA D axis current lead compensation</td>
<td>Set the current loop gain. To use the coil switch function, set the current loop gain for when the high-speed coil is selected. The setting value is determined by the motor's electrical characteristics so that the value is fixed to each motor used. Set the value given in the spindle parameter list. (For machine tool builder adjustment)</td>
<td>1 to 20480</td>
</tr>
<tr>
<td><strong>[13079]</strong> SP079 IQG Q axis current gain</td>
<td>Set the current loop gain. To use the coil switch function, set the current loop gain for when the high-speed coil is selected. The setting value is determined by the motor's electrical characteristics so that the value is fixed to each motor used. Set the value given in the spindle parameter list. (For machine tool builder adjustment)</td>
<td>1 to 8192</td>
</tr>
<tr>
<td><strong>[13080]</strong> SP080 IDG D axis current gain</td>
<td>Set the current loop gain. To use the coil switch function, set the current loop gain for when the high-speed coil is selected. The setting value is determined by the motor's electrical characteristics so that the value is fixed to each motor used. Set the value given in the spindle parameter list. (For machine tool builder adjustment)</td>
<td>1 to 8192</td>
</tr>
<tr>
<td><strong>[13081]</strong> SP081 IQAL Q axis current lead compensation low-speed coil</td>
<td>When using coil switch function, set the current loop gain for when the low-speed coil is selected. The setting value is determined by the motor's electrical characteristics so that the value is fixed to each motor used. Set the value given in the spindle parameter list. (For machine tool builder adjustment)</td>
<td>1 to 20480</td>
</tr>
</tbody>
</table>
6 Spindle Adjustment

【#13082】 SP082 IDAL D axis current lead compensation low-speed coil

When using coil switch function, set the current loop gain for when the low-speed coil is selected. The setting value is determined by the motor's electrical characteristics so that the value is fixed to each motor used. Set the value given in the spindle parameter list. (For machine tool builder adjustment)

---Setting range---
1 to 20480

【#13083】 SP083 IQGL Q axis current gain low-speed coil

When using coil switch function, set the current loop gain for when the low-speed coil is selected. The setting value is determined by the motor's electrical characteristics so that the value is fixed to each motor used. Set the value given in the spindle parameter list. (For machine tool builder adjustment)

---Setting range---
1 to 8192

【#13084】 SP084 IDGL D axis current gain low-speed coil

When using coil switch function, set the current loop gain for when the low-speed coil is selected. The setting value is determined by the motor's electrical characteristics so that the value is fixed to each motor used. Set the value given in the spindle parameter list. (For machine tool builder adjustment)

---Setting range---
1 to 8192

(Note)  Low-speed coil setting SP081, SP082, SP083 and SP084 are set to "0" when coil changeover specification is not available.

(2) Adjusting the gain parameter

Adjust the gain parameters as usual or by application in accordance with the chart below.

<table>
<thead>
<tr>
<th>Gain</th>
<th>Control item</th>
<th>Regular adjustment</th>
<th>By-application adjustment (compensation)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Acceleration/deceleration or orientation (Note 3)</td>
<td>Synchronous tapping</td>
</tr>
<tr>
<td>Position loop gain</td>
<td>SP001, SP005, SP006, SP007</td>
<td>SP002</td>
<td>SP008, SP009, SP010</td>
</tr>
<tr>
<td>Speed loop gain</td>
<td>[1]Valid for SP035 bit9=0</td>
<td>[2]Switch the speed loop gain in the orientation stop to Set 2 with SP035 bit1=1</td>
<td>Valid for SP035 bit9=1</td>
</tr>
</tbody>
</table>

(Note 1) The speed loop gain can switch from Set 1 to Set 2 with the bit selection for SP035.
(Note 2) Position and speed loop gain is switched depend on the control item, so set the parameter correctly.
(Note 3) When "#3106 bitE" is set to "1".
(Note 4) When "#3106 bitE" is set to "0".
(3) Adjusting the speed loop parameter

---

**Adjust speed loop gain**

- Set SP001 = 15
- Command M19 (orientation stop)
- Set SP005 (standard setting 150)
- Increases value up to where resonance occurs. Set SP005 (standard setting 150)
- Resonance occurs?
  - Yes: Increase SP005 by +20
  - No: Increase SP005 by -20
- Emergency stop
- Command M19 (orientation stop)
- Acceleration/deceleration operation
  - YES: Resonance (abnormal noise) or abnormal operation occurs?
    - No: Subtract 20 from SP005
    - YES: Command M19 (orientation stop)
    - YES: Set the “Time-series data measurement” with NC Analyzer as shown on the right.
- NO: Subtract 3 from SP005
- Multiply SP005 by 0.9
- Adjustment completed

---

Note that the maximum setting value is as follows: SP005(max) ≤ 150 × inertia ratio (Inertia ratio = total inertia/motor inertia)

(Example) When inertia rate is double and the determined gain is 350, the setting value for SP005 is 315, which is 90% of the determined gain, however, the setting value for SP005 should be 300, because the maximum setting value is 150 × 2 (inertia rate) = 300.

---

*Waveform for Ref.*

- Position droop
- 0.045° or less
- Current command

---

*NC Analyzer setting (Time-series data measurement)*

<table>
<thead>
<tr>
<th>Waveform type</th>
<th>Position droop</th>
<th>Current command</th>
</tr>
</thead>
<tbody>
<tr>
<td>CH1</td>
<td>Position droop</td>
<td>Current command</td>
</tr>
<tr>
<td>CH2</td>
<td>Current command</td>
<td>Current command</td>
</tr>
</tbody>
</table>
**Spindle Adjustment**

**【#13005】 SP005 VGN1 Speed loop gain 1**

Set the speed loop gain.
Set this according to the load inertia size.
The higher setting value will increase the accuracy of control, however, vibration tends to occur.
If vibration occurs, adjust by lowering by 20 to 30%.
The final value should be 70 to 80% of the value at which the vibration stops.

---Setting range---
1 to 9999

(4) Adjusting the position loop gain (SP001: PGV non-interpolation mode position loop gain)

After setting the speed gain, in order to perform acceleration/deceleration operation, set the position loop gain (SP001) by increasing its setting value from 15. When overshooting occurs at the time of acceleration/deceleration completion, or when oscillation of the q axis current command gets bigger during a set rotation, the position loop gain is in limit state. Note that standard position loop gain below is set for the setting gain.

CAUTION !

Change "Excessive error detection width" (SP053) when "Position loop gain" (SP001) is changed.

**Method for checking the limitation of position loop gain**

![Diagram showing speed waveform and current command waveform](image)

(Example) As the closest value should be selected from the standard setting range shown below, set 47 to SP001 when the limit gain is 55.

<table>
<thead>
<tr>
<th>Standard position loop gain</th>
<th>15</th>
<th>18</th>
<th>21</th>
<th>23</th>
<th>26</th>
<th>33</th>
<th>38</th>
<th>47</th>
<th>60</th>
<th>70</th>
</tr>
</thead>
</table>

**【#13001】 SP001 PGV Position loop gain non-interpolation mode**

Set the position loop gain for "Non-interpolation" control mode.
When the setting value increases, the command tracking ability will enhance and the positioning settling time can be shorter. However, the impact on the machine during acceleration/deceleration will increase.
Use the selection command, the control mode "bit 2, 1, 0 = 000" in control input 4.
(Note) The control mode is commanded by NC.

---Setting range---
1 to 200 (1/s)
6-1-3 Adjusting the acceleration/deceleration operation

(1) Calculating the theoretical acceleration/deceleration time

The spindle motor output characteristics (shown on the right) have three ranges, which are constant torque, constant output, and deceleration ranges. Each range has different calculation method. The acceleration/deceleration time is calculated using the calculation expression which corresponds to each range of the rotation speed for calculation. Note that the load torque (friction torque) is not considered in the calculation expression, so the result may slightly differ from the actual acceleration/deceleration time.

(a) Maximum motor output during acceleration/deceleration: \( P_o \)

During acceleration/deceleration, the output is 1.2-fold the short-time rating.

The output \( P_o \) during acceleration/deceleration follows the expression below.

\[
P_o = (\text{Short-time rated output}) \times 1.2 \ [W]
\]

Substitute this value into \( P_o \) of the expression.

(b) Total load inertia: \( J_{all} \)

Total load inertia means the total inertia of the spindle motor and of the components which are rotated the motor (shaft, etc.).

\[
J_{all} = (\text{Motor inertia}) + (\text{Spindle conversion inertia}) \ [kg\cdot m^2]
\]

The values obtained in (a) and (b) are substituted into the following calculation expressions.

To calculate the acceleration/deceleration time of the rotation speed \( N \) [r/min], use the expression (c), (d) or (e) which is selected depending on the range that corresponds to the speed \( N \).

(c) Acceleration/deceleration time for constant torque range: \( t_1 \sim 0 \) to \( N \) [r/min] (0 \( \leq N \leq N_1 \))

(For \( N>N_1 \), apply \( N=N_1 \) and also calculate \( t_2 \) or \( t_3 \).)

\[
t_1 = \frac{1.097 \times 10^{-2} \times J_{all} \times N_1 \times N}{P_o} \ [s] \quad (\text{Caution 1})
\]

(d) Acceleration/deceleration time for constant output range: \( t_2 \sim N_1 \) to \( N \) [r/min] (\( N_1 < N \leq N_2 \))

(For \( N>N_2 \), apply \( N=N_2 \) and also calculate \( t_3 \).)

\[
t_2 = \frac{1.097 \times 10^{-2} \times J_{all} \times (N^2 - N_1^2)}{2 \times P_o} \ [s] \quad (\text{Caution 1})
\]

(e) Acceleration/deceleration time in deceleration output range: \( t_3 \sim N_2 \) to \( N \) [r/min] (\( N_2 < N \leq N_3 \))

\[
t_3 = \frac{1.097 \times 10^{-2} \times J_{all} \times (N^3 - N_2^3)}{3 \times P_o \times N_2} \ [s] \quad (\text{Caution 1})
\]

Based on the above expressions, the acceleration/deceleration time: \( t \) from 0 to \( N_3 \) [r/min] is:

\[
t = t_1 + t_2 + t_3 \ [s] \quad (\text{Caution 2})
\]
1. Note that the inertia (J) is a quarter of “GD²”.
   Ex.) When “GD²” is 0.2 [kg•m²], the inertia is “0.2 / 4 = 0.05 [kg•m²]”.

2. If the AC input power voltage to the power supply is low, or if the input power impedance is high, the acceleration/deceleration time may be long. (Especially, the acceleration/deceleration time of the deceleration output range may be long.)

3. For the actual measurement in comparison with the theoretical value, perform under the same condition as the calculated load inertia of J_all. The acceleration/deceleration time differs according to the inertia. When performing the measurement with a workpiece or tool installed to the spindle, confirm that the acceleration/deceleration time has been calculated when the total inertia is included in the installed workpiece and tool.

[Calculation example]

Calculate the acceleration/deceleration time from 0 to 10000[r/min] for an spindle motor having the output characteristics shown on the right when the motor inertia is 0.0148 [kg•m²], and when the motor shaft conversion load inertia is 0.05 [kg•m²].

\[
\text{Po} = \text{(Short-time rated output)} \times 1.2 = 5500 \times 1.2 = 6600 \, \text{[W]}
\]

\[
\text{J_all} = \text{(Motor inertia)} + \text{(load inertia)} = 0.0148 + 0.05 = 0.0648 \, \text{[kg•m²]}
\]

\[
t_1 = \frac{1.097 \times 10^{-2} \times \text{J_all} \times N_1^2}{\text{Po}} = \frac{1.097 \times 10^{-2} \times 0.0648 \times 1500^2}{6600} = 0.242 \, \text{[s]}
\]

\[
t_2 = \frac{1.097 \times 10^{-2} \times \text{J_all} \times (N_2^2 - N_1^2)}{2 \times \text{Po}} = \frac{1.097 \times 10^{-2} \times 0.0648 \times (6000^2 - 1500^2)}{2 \times 6600} = 1.818 \, \text{[s]}
\]

\[
t_3 = \frac{1.097 \times 10^{-2} \times \text{J_all} \times (N_3^3 - N_2^3)}{3 \times \text{Po} \times N_2} = \frac{1.097 \times 10^{-2} \times 0.0648 \times (10000^3 - 6000^3)}{3 \times 6600 \times 6000} = 4.691 \, \text{[s]}
\]

Thus,
\[
t = t_1 + t_2 + t_3 = 0.242 + 1.818 + 4.691 = 6.751 \, \text{[s]}
\]
(2) **Measuring the acceleration/deceleration waveforms**

Measure the motor speed and phase current feedback output by setting the monitor output data on "Time-series data measurement" with NC Analyzer, and check if theoretical acceleration/deceleration time is within ±15%. Refer to "NC Analyzer Instruction Manual (IB-1501086)" for details on setting the monitor output data.

![Acceleration/deceleration waveforms of spindle motor](image)

When acceleration/deceleration time does not match the theoretical value (an error rate 15% or more), check the following items.

1. There may be an error in calculating load inertia for the motor axis conversion used when calculating the theoretical acceleration/deceleration time. Check the load inertia again.
2. When acceleration time is long and deceleration time is short, friction torque is thought to be large. Check load meter value at the maximum speed (spindle monitor screen). If the load is 10% or more, friction torque is thought to be relatively large. Mechanical friction, such as bearing friction or timing belt friction, is assumed to be large. Measure the acceleration/deceleration time again following trial run.
3. Even if the problems above are not found, when acceleration/deceleration time does not match, there may be a possibility of using spindle motor and spindle drive unit that are not specified, or using wrong parameters. Check the spindle motor type and spindle drive unit type again, as well as the spindle parameter settings.

**POINT**

There are cases where acceleration/deceleration waveforms change depending on the spindle temperature. Check the waveforms when the spindle temperature is high (after continuous operation) and when it is low.

**CAUTION**

When performing measurement with a workpiece or tool installed, be careful during the operation at the maximum rotation speed, which may be dangerous because of the increase of inertia.
(3) Adjustment when the load inertia is large
When the load inertia is large and acceleration time is 10s or more, excessive speed deviation alarm (ALM23) may occur because the time in which deviation between speed command and speed FB, which is the actual spindle motor rotation speed, exists is prolonged. In this case, increase the time constant (3101 to 3104) during spindle rotation by S command. When the acceleration time is 10s or less, use the standard value 300 (300ms).
Alarm can be avoided by adjusting excessive speed deviation timer (SP117). However, in this case, alarm detection will be delayed during constant speed operation.
In order to improve current ripple waveforms during acceleration/deceleration, adjust by using speed command dual cushion explained later.

---

**[#13117] SP117 SETM Excessive speed deviation timer**
Set the time to detect the speed excessive error alarm.
Set the time required to the machine.
The standard setting is "12".
---Setting range---
0 to 60 (s)

**[#3101] sp_t 1 Acceleration/deceleration time constant with S command (Gear: 00)**
Set the acceleration/deceleration time constant with S command (speed operation mode) when gear 00 is selected. Set the linear acceleration/deceleration time up to limit rotation speed (slimit1). Set the short time constant that the motor torque at acceleration is always saturated, however, when an abnormal noise or V-belt slip occurs, increase the acceleration/deceleration time constant.
---Setting range---
0 to 30000 (ms)

**[#3102] sp_t 2 Acceleration/deceleration time constant with S command (Gear: 01)**
Set the acceleration/deceleration time constant with S command (speed operation mode) when gear 01 is selected. Set the linear acceleration/deceleration time up to limit rotation speed (slimit2).
---Setting range---
0 to 30000 (ms)

**[#3103] sp_t 3 Acceleration/deceleration time constant with S command (Gear: 10)**
Set the acceleration/deceleration time constant with S command (speed operation mode) when gear 10 is selected. Set the linear acceleration/deceleration time up to limit rotation speed (slimit3).
---Setting range---
0 to 30000 (ms)

**[#3104] sp_t 4 Acceleration/deceleration time constant with S command (Gear: 11)**
Set the acceleration/deceleration time constant with S command (speed operation mode) when gear 11 is selected. Set the linear acceleration/deceleration time up to limit rotation speed (slimit4).
---Setting range---
0 to 30000 (ms)
(4) Acceleration/deceleration adjustment
Checks acceleration waveform and adjusts deceleration time.

(a) Checking acceleration waveform

< NC Analyzer setting (Time-series data measurement) >

<table>
<thead>
<tr>
<th>Get</th>
<th>Waveform type</th>
</tr>
</thead>
<tbody>
<tr>
<td>CH1</td>
<td>DA1 *Monitor output data</td>
</tr>
<tr>
<td>CH2</td>
<td>DA2 *Monitor output data</td>
</tr>
</tbody>
</table>

*Monitor output data is an obtainable form of D/A data which is output from the drive unit with NC Analyzer.

Monitor output data setting

<table>
<thead>
<tr>
<th>DA1</th>
<th>Motor rotation speed</th>
<th>SP125 : 1</th>
<th>SP127: Set so that the maximum rotation speed is displayed.</th>
</tr>
</thead>
<tbody>
<tr>
<td>DA2</td>
<td>Phase current feedback</td>
<td>SP126 : 42</td>
<td>SP128: Set so that the phase current is displayed.</td>
</tr>
</tbody>
</table>

Perform acceleration/deceleration operation from the maximum rotation speed in 1000 rotations increments.
(b) Adjusting deceleration time
Adjusts deceleration time in the same manner as acceleration time by using SP071 (variable current limit during deceleration, lower limit value) and SP072 (variable current limit during deceleration, break point speed).

Set the “Time-series data measurement” with NC Analyzer as shown on the right.

Set SP071 and SP072

Acceleration/deceleration operation

< NC Analyzer setting (Time-series data measurement) >

<table>
<thead>
<tr>
<th>Monitor output waveform</th>
<th>Parameter setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>DA1</td>
<td>Motor rotation speed</td>
</tr>
<tr>
<td>DA2</td>
<td>Phase current feedback</td>
</tr>
</tbody>
</table>

When SP071=100 is set, current limit during deceleration is constant regardless of the speed. When setting SP071 to 100 or less and SP072 to maximum rotation speed or less, deceleration time will be longer as current limit during deceleration may be variable depending on the speed.
* Although a value more than 100 can be set to SP071, basically, 100 or less should be set.

Execute M5 stop operation from the maximum rotation speed.

Deceleration time adjustment completed
Relation between SP071 (variable current limit during deceleration, lower limit value) and SP072 (variable current limit during deceleration, break point speed)

**【#13071】SP071 DIQM Variable current limit during deceleration, lower limit value**

Set this parameter to adjust the deceleration time by changing the current limit value during deceleration depending on the motor speed. As shown below, set the lower limit rate of the current limit in SP071 (DIQM), and use with SP072 (DIQN). When DIQM is set to 100%, the standard current limit value in deceleration (TMLR) is applied.

<table>
<thead>
<tr>
<th>Motor rotation speed</th>
<th>Current limit</th>
<th>Decreasing current value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SP071</td>
<td>&quot;100&quot; is the setting value for the current limit during regeneration (SP152 (high-speed coil), SP184 (low-speed coil)).</td>
</tr>
</tbody>
</table>

---Setting range---
0 to 999 (%)

**【#13072】SP072 DIQN Variable current limit during deceleration, break point speed**

Set this parameter to adjust the deceleration time by changing the current limit value during deceleration depending on the motor speed. As shown below, set the lower limit rate of the current limit in SP071 (DIQM), and use with SP072 (DIQN). When DIQM is set to 100%, the standard current limit value in deceleration (TMLR) is applied.

---Setting range---
1 to 32767 (r/min)
6-1-4 Orientation adjustment

Adjusts orientation time by adjusting SP016.

(1) Orientation characteristics
When decelerating to stop is executed with orientation, the remaining distance to the orientation stop position is compensated within one rotation. Thus, as shown in Case 1 below, when the remaining distance in deceleration is about "0", orientation time would be the shortest (time required to decelerate and stop + 0s), and as shown in Case 2 below, when the remaining distance in deceleration is about as much as one rotation amount, orientation time would be the longest.

【#13016】 SP016  DDT  Phase alignment deceleration rate

Set the single-rotation position alignment deceleration rate for orientation stopping, phase alignment while rotating and switching from non-interpolation mode to spindle synchronization mode while rotating.

When the load inertia is larger, the setting value should be smaller.
When the setting value is larger, the orientation in-position and single-rotation position alignment complete faster, but the impact applied on the machine will increase.

To change the deceleration rate only during rotation command (command F \( \Delta T \neq 0 \)), set this parameter together with SP070 (KDDT).

---Setting range---
1 to 32767 (0.1(r/min)/ms)

【#13035(PR)】 SP035  SFNC3  Spindle function 3

**bit 2 : pyin  Excitation rate selection in non-interpolation mode**
The excitation rate after the in-position can be selected.
0: Select Excitation rate 1  1: Select Excitation rate 2

**bit 1 : vgin  Speed loop gain set selection in non-interpolation mode**
The speed loop gain set after the in-position can be selected.
0: Select Set 1  1: Select Set 2
(2) Confirmation in orientation stop at deceleration ⇐ 0 rotation according to spindle specification

If orientation stop is performed with the load inertia increased due to an excessive workpiece or tool installed to the spindle, the spindle may start vibrating by trying to reverse after overshooting the stop position and stop after converging the vibrations (refer to the waveform below). In this case, the orientation completion time is extended by the time to converge the spindle vibrations. Thus, the adjustment to suppress the reversing and vibrations at stop is required.

<Adjustment method>

1) Set SP016: Lower the setting value by 5. By lowering, the inclination of the speed becomes gradual. Set the optimum value while observing the speed waveform so that the speed will not vibrate.

2) Lower the position loop gain.
   By lowering the position loop gain, a sway that exceeds the stop position is suppressed.

3) Adjust the speed gain (SP005, SP006).
   The converging time becomes shorter if the rigidity during orientation stop is higher. However this affects the speed stability during constant feed, thus it is required to confirm the speed waveform at the constant speed and the machining surface during cutting.
(3) **Orientation time adjustment method**

(a) **Orientation adjustment from maximum rotation speed**

Check the orientation operation with the maximum inertia by installing a workpiece or tool to the spindle head. However, if it is dangerous to check the operation at the maximum speed, slow down to the safe speed to check.

---

**Adjust orientation time**

Set the "Time-series data measurement" with NC Analyzer as shown on the right

---

Rotate spindle at the maximum rotation speed

Command M19 (orientation stop)

---

Compens. amount = One rotation? (Current edge?)

---

Current edge < Current control value?

---

Increase SP016 by +5

---

Multiply SP016 setting value by 1/2

---

Rotate spindle at the maximum rotation speed

Command M19 (orientation stop)

---

(Orientation stop time) - (deceleration time) < 0.4s

---

Increase SP016 by +5

---

Orientation time adjustment completed

---

**< NC Analyzer setting (Time-series data measurement) >**

Get Waveform type

| CH1 | Speed feedback (r/min) |
| CH2 | Current feedback       |
| CH3 | Control output 1(bitC) "in-position signal" |

---

**orientation stop waveform example(e = 1 rotation)**

Ch1:Speed feedback

Ch2:Current feedback

Current limit range at deceleration (SP152 or SP184)

Current edge [1]

---

Set to SP016 as recovery time constant.

---

**orientation stop waveform example(e = 1 rotation)**

Ch1:Speed feedback

Ch3:In-position signal

Stop within In-position

---

**Check the orientation operation with the maximum inertia by installing a workpiece or tool to the spindle head. However, if it is dangerous to check the operation at the maximum speed, slow down to the safe speed to check.**
(b) Orientation adjustment from stop mode

Adjust orientation time

Set the "Time-series data measurement" with NC Analyzer as shown on the right

Command M19 (orientation stop)

Current edge < Current control value?

YES

Increase SP016 by +5

Emergency stop

Stop with approx.180° deviated

Cancel emergency stop

Command M19 (orientation stop)

Check the orientation stop time

Orientation time adjustment completed

< NC Analyzer setting (Time-series series measurement)>

Get Waveform type

CH1 Speed feedback (r/min)

CH2 Current feedback

CH3 Control output 1(bitC) *In-position signal

Screen operation

[1] Press the NC function key [DIAGN].
[2] Press the NC menu key [F diagn].
[3] Press the NC menu key [1-shot output].
[4] Input "R7009/4650" with the NC key.

<Stop at the side opposite to the orientation stop position (with 180° deviated).>

[6] Press the NC menu key [1-shot output].
[7] Input "R7009/0" with the NC key.

Orientation position

Spindle 180° rotation Spindle

Ch1: Speed feedback

Current limit at acceleration (SP153 or SP185)

Ch2: Current feedback

Current limit at regeneration (SP152 or SP184)

Ch3: In-position signal

standard value 0.4s or less

Get Waveform type

CH1 Speed feedback (r/min)

CH2 Current feedback

CH3 Control output 1(bitC) *In-position signal

Screen operation

[1] Press the NC function key [DIAGN].
[2] Press the NC menu key [F diagn].
[3] Press the NC menu key [1-shot output].
[4] Input "R7009/4650" with the NC key.

<Stop at the side opposite to the orientation stop position (with 180° deviated).>

[6] Press the NC menu key [1-shot output].
[7] Input "R7009/0" with the NC key.
6-1-5 Synchronous tapping adjustment

(1) Gain setting and time constant determination

[1] For speed loop gain during synchronous tapping, speed loop gain set 2, which consists of SP008 (speed loop gain 2), SP009 (speed loop lead compensation 2), and SP010 (speed loop delay compensation 2), is used. Thus, SP035 has to be set as follows. For position loop gain, set standard 33 to SP002 (position loop gain interpolation mode).

<List of parameters used for adjustment>

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Setting value</th>
</tr>
</thead>
<tbody>
<tr>
<td>SP002</td>
<td>33</td>
</tr>
<tr>
<td>SP008</td>
<td>Value in SP005 set at &quot;Gain adjustment&quot; (Initial setting value: 150)</td>
</tr>
<tr>
<td>SP009</td>
<td>1900</td>
</tr>
<tr>
<td>SP010</td>
<td>0</td>
</tr>
<tr>
<td>SP035</td>
<td>0200: Speed loop gain set 2 selection (Validate bit9)</td>
</tr>
</tbody>
</table>

<Related servo parameters>

Set the spindle and interpolation axis by tapping.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Setting value</th>
</tr>
</thead>
<tbody>
<tr>
<td>SV049</td>
<td>Set the same value as spindle parameter &quot;SP002&quot;</td>
</tr>
<tr>
<td>SV050</td>
<td>Set it when using SHG control (when not using, set to &quot;0&quot;)</td>
</tr>
<tr>
<td>SV058</td>
<td>Set it when using SHG control (when not using, set to &quot;0&quot;)</td>
</tr>
</tbody>
</table>

[2] Create a NC program so that the synchronous tapping operation program has 3000r/min of spindle rotation speed, 1mm (equivalent of M6 screw) of screw pitch size, and depths at which the following two different operation patterns are generated.

(Note that the operation conditions, such as spindle rotation speed and screw pitch, may be specified by the machine manufacturer.)

<table>
<thead>
<tr>
<th>Operation pattern 1</th>
<th>Operation pattern 2</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Spindle rotation speed waveform shapes trapezoids" /></td>
<td><img src="image2" alt="Spindle rotation speed waveform shapes mountain-valley" /></td>
</tr>
<tr>
<td>Spindle rotation speed (r/min)</td>
<td>Spindle rotation speed (r/min)</td>
</tr>
<tr>
<td>Constant speed area</td>
<td>No constant speed area</td>
</tr>
<tr>
<td>Time (sec)</td>
<td>Time (sec)</td>
</tr>
<tr>
<td>Adjust depth so that motor rotation speed waveform shapes trapezoids</td>
<td>Adjust depth so that motor rotation speed waveform shapes mountain-valley</td>
</tr>
</tbody>
</table>
[3] Select "Synchronous tapping error measurement" on NC Analyzer, and perform synchronous tapping operations with the operation pattern 2 above.
*The following measurement data of servo and spindle are automatically set when "Synchronous tapping error measurement" is selected.

< NC Analyzer setting (Time-series data measurement) >

<table>
<thead>
<tr>
<th>Get</th>
<th>Waveform type</th>
</tr>
</thead>
<tbody>
<tr>
<td>CH1</td>
<td>Synchronous tapping error *Position error of spindle and servo axis</td>
</tr>
<tr>
<td>CH2</td>
<td>Speed feed back of servo</td>
</tr>
<tr>
<td>CH3</td>
<td>Speed feed back of spindle</td>
</tr>
<tr>
<td>CH4</td>
<td>Current feed back of servo</td>
</tr>
<tr>
<td>CH5</td>
<td>Current feed back of spindle</td>
</tr>
</tbody>
</table>

[4] Check the waveform and adjust the synchronous tapping time constant so that the margin for current limit at acceleration/deceleration is 50% or more.

(2) Accuracy test using NC Analyzer
[1] Perform synchronous tapping operations using the time constant determined in (1) above.
[2] Check the synchronous tapping accuracy (for both operation pattern 1 and 2) by using the synchronous tapping accuracy check tool.

[3] If the number of error pulse is 100 (p-p) or less, satisfactory accuracy is secured, and the check is completed.
[4] If the number of error pulse exceeds 100, increase SP008 (VGN2) by 10 increments, and adjust so that the error pulse is 100 or less. Note that the maximum setting value is $150 \times \text{[inertia ratio]}$. 
### #13002 SP002 PGN Position loop gain interpolation mode
Set the position loop gain for "interpolation" control mode. When the setting value increases, the command tracking ability will enhance and the positioning settling time can be shorter. However, the impact on the machine during acceleration/deceleration will increase.

Use the selection command, the control mode "bit 2, 1, 0 = 010 or 100" in control input 4. (Note) The control mode is commanded by NC.

When carrying out the SHG control, set SP035/bitC to "1".

---Setting range---
1 to 200 (1/s)

### #13008 SP008 VGN2 Speed loop gain 2
Normally SP005(VGN1) is used.
By setting "SP035/bit9=1", gain 2 can be used according to the application.
Gain 2 can also be used by setting "Speed gain set 2 changeover request (control input 5/ bitC) = 1".
Refer to SP005(VGN1) for adjustment procedures.

---Setting range---
1 to 9999

### #13009 SP009 VIA2 Speed loop lead compensation 2
Normally SP006(VIA1) is used.
By setting "SP035/bit9=1", gain 2 can be used according to the application.
Gain 2 can also be used by setting "Speed gain set 2 changeover request (control input 5/ bitC) = 1".
Refer to SP006(VIA1) for adjustment procedures.

---Setting range---
1 to 9999

### #13010 SP010 VIL2 Speed loop delay compensation 2
Normally SP007(VIL1) is used.
By setting "SP035/bit9=1", gain 2 can be used according to the application.
Gain 2 can also be used by setting "Speed gain set 2 changeover request (control input 5/ bitC) = 1".
Refer to SP007(VIL1) for adjustment procedures.

---Setting range---
0 to 32767

### #13035(PR) SP035 SFNC3 Spindle function 3

<table>
<thead>
<tr>
<th>bit C : shgn</th>
<th>SHG control in interpolation mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>0: Stop</td>
<td>1: Start</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>bit A : pyn</th>
<th>Excitation rate selection in interpolation mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>0: Select Excitation rate 1</td>
<td>1: Select Excitation rate 2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>bit 9 : vgn</th>
<th>Speed loop gain set selection in interpolation mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>0: Select Set 1</td>
<td>1: Select Set 2</td>
</tr>
</tbody>
</table>
6-1-6 High-speed synchronous tapping

This function enables the reduction of synchronization errors by allowing data communication between drive units.

Normal synchronous tapping

High-speed synchronous tapping

<Adjustment method>

1. Adjust the normal synchronous tapping.
2. Set the total inertia rate with respect to the motor inertia to the servo parameter "SV037". If this value has already been set for adjustment of the other functions, use the same value.
3. Set 600 to the servo parameter "SV129".
4. Set the basic specification parameter "#1281/ bit5 =1(high-speed synchronous tapping valid)".
5. Adjust the spindle parameter "#3120" while confirming that the current margin and the number of error pulses are within the tolerable range in the high-speed synchronous tapping operation.

High-speed synchronous tapping time constant

= Normal synchronous tapping time constant × \( \frac{100 - \text{(Setting value of #3120)}}{100} \)

---Setting range---

For general motor: 0 to 5000 (%)
For linear motor 0 to 5000 (kg)

---Setting range---

For general motor: 0 to 5000 (%)
For linear motor 0 to 5000 (kg)

Set the acceleration rate feed forward filter frequency in high-speed synchronous tapping control. The standard setting is "600".

Related parameters: SV244

---Setting range---

0 to 32767 (rad/s)
6 Spindle Adjustment

【#1281(PR)】 ext17

bit5: High-speed synchronous tapping valid
Select whether to enable the high-speed synchronous tapping.
0: Disable
1: Enable

【#3120】 staptr  Time constant reduction rate in high-speed synchronous tapping
When performing high-speed synchronous tapping control (#1281/bit5), set the reduction rate of the
time constant compared to the time constant in normal synchronous tapping.
(Setting "0" or "100" will be regarded as reduction rate zero, so the time constant won't be reduced.)
E.g.) When set to "10", time constant in high-speed synchronous tapping will be 90% of that in
normal synchronous tapping.
---Setting range---
0 to 100(\%)

6-1-7 Spindle C axis adjustment (For lathe system)

(1) Setting the gain
For spindle C axis speed loop gain, SP008 (speed loop gain 2), speed loop gain set 2, which consists of SP009
(speed loop lead compensation 2), and SP010 (speed loop delay compensation 2), is used. Thus, SP035 has to be
set as follows. For position loop gain, set standard 33 to SP002 (position loop gain, interpolation mode).

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Setting value</th>
</tr>
</thead>
<tbody>
<tr>
<td>SP002</td>
<td>33</td>
</tr>
<tr>
<td>SP008</td>
<td>SP005 setting value set in &quot;Basic adjustments&quot; (Initial setting value: 150)</td>
</tr>
<tr>
<td>SP009</td>
<td>1900</td>
</tr>
<tr>
<td>SP010</td>
<td>0</td>
</tr>
<tr>
<td>SP035</td>
<td>0200: Speed loop gain set 2 selection (validate bit9)</td>
</tr>
</tbody>
</table>

<Related servo parameters>
Set the spindle and interpolation axis.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Setting value</th>
</tr>
</thead>
<tbody>
<tr>
<td>SV003</td>
<td>Set the same value as spindle parameter &quot;SP002&quot;</td>
</tr>
<tr>
<td>SV004</td>
<td>Set it when using SHG control (when not using, set to &quot;0&quot;)</td>
</tr>
<tr>
<td>SV007</td>
<td>Set it when using SHG control (when not using, set to &quot;0&quot;)</td>
</tr>
</tbody>
</table>

(2) Gain adjustment and accuracy test during C axis operation
[1] Set the "Time-series data measurement" with NC Analyzer as follows during stopped in C axis mode (servo
ON status) or when executing cutting feed with G01 F20. Then check the droop fluctuation is within 10°/1000.

< NC Analyzer setting (Time-series data measurement) >

<table>
<thead>
<tr>
<th>Get</th>
<th>Waveform type</th>
</tr>
</thead>
<tbody>
<tr>
<td>CH1</td>
<td>Position droop</td>
</tr>
<tr>
<td>CH2</td>
<td>Current command</td>
</tr>
</tbody>
</table>

Offset is 2.5V.
[2] When satisfactory accuracy is not secured, increase SP008 (VGN2) by 10 increments and adjust so that the accuracy level meets the standard. Note that the maximum setting value is 150 x [inertia ratio].

(3) Setting the notch filter
During spindle C axis operation, there are times where motor is rotated while brake is applied, resulting in resonance occurred. In this case, measure resonance frequency from q axis current command waveform and set the value to SP038 (notch filter 1). Also, depending on the set frequency, filter depth must be set to SP034. When notch filter is set, perform acceleration/deceleration operation at the maximum speed and confirm that no abnormal oscillation or noise is found.

**Notch filter's set frequency and standard depth setting**

<table>
<thead>
<tr>
<th>SP034</th>
<th>Setting example: When there are 16 wavelengths within 0.02 sec.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bit3=0</td>
<td>Bit2=0 Bit1=0 Setting value: XXX0</td>
</tr>
<tr>
<td>Bit3=0</td>
<td>Bit2=1 Bit1=0 Setting value: XXX4</td>
</tr>
<tr>
<td>Bit3=1</td>
<td>Bit2=0 Bit1=0 Setting value: XXX8</td>
</tr>
<tr>
<td>Notch filter 1 Setting frequency</td>
<td>2000(Hz) to 400(Hz)</td>
</tr>
</tbody>
</table>

Set 800 to SP038 and XXX0 to SP034. Measure position droop and current command at this time, and adjust notch filter's frequency and depth so that the position droop is within standard range.
1. When incorrect frequency is set, suddenly resonance can occur and big abnormal noise can be generated. Input the appropriate value.

2. Do not set the value to low-frequency (50Hz).

【#13002】 SP002 PGN Position loop gain interpolation mode
Set the position loop gain for "interpolation" control mode.
When the setting value increases, the command tracking ability will enhance and the positioning settling time can be shorter. However, the impact on the machine during acceleration/deceleration will increase.
Use the selection command, the control mode "bit 2, 1, 0 = 010 or 100" in control input 4.
(Note) The control mode is commanded by NC.
When carrying out the SHG control, set SP035/bitC to "1".
---Setting range---
1 to 200 (1/s)

【#13008】 SP008 VGN2 Speed loop gain 2
Normally SP005(VGN1) is used.
By setting "SP035/bit9=1", gain 2 can be used according to the application.
Gain 2 can also be used by setting "Speed gain set 2 changeover request (control input 5/ bitC) = 1".
Refer to SP005(VGN1) for adjustment procedures.
---Setting range---
1 to 9999

【#13009】 SP009 VIA2 Speed loop lead compensation 2
Normally SP006(VIA1) is used.
By setting "SP035/bit9=1", gain 2 can be used according to the application.
Gain 2 can also be used by setting "Speed gain set 2 changeover request (control input 5/ bitC) = 1".
Refer to SP006(VIA1) for adjustment procedures.
---Setting range---
1 to 9999

【#13010】 SP010 VIL2 Speed loop delay compensation 2
Normally SP007(VIL1) is used.
By setting "SP035/bit9=1", gain 2 can be used according to the application.
Gain 2 can also be used by setting "Speed gain set 2 changeover request (control input 5/ bitC) = 1".
Refer to SP007(VIL1) for adjustment procedures.
---Setting range---
0 to 32767
【#13034】 SP034 SFNC2 Spindle function 2

### bit F-D : nfd5 Depth of Notch filter 5
Set the depth of Notch filter 5 (SP088).

- bit F,E,D:
  - 000: - ∞
  - 001: -18.1 [dB]
  - 010: -12.0 [dB]
  - 011: -8.5 [dB]
  - 100: -6.0 [dB]
  - 101: -4.1 [dB]
  - 110: -2.5 [dB]
  - 111: -1.2 [dB]

### bit B-9 : nfd4 Depth of Notch filter 4
Set the depth of Notch filter 4 (SP087).

- bit B,A,9:
  - 000: - ∞
  - 001: -18.1 [dB]
  - 010: -12.0 [dB]
  - 011: -8.5 [dB]
  - 100: -6.0 [dB]
  - 101: -4.1 [dB]
  - 110: -2.5 [dB]
  - 111: -1.2 [dB]

### bit 7-5 : nfd2 Depth of Notch filter 2
Set the depth of Notch filter 2 (SP046).

- bit 7,6,5:
  - 000: - ∞
  - 001: -18.1 [dB]
  - 010: -12.0 [dB]
  - 011: -8.5 [dB]
  - 100: -6.0 [dB]
  - 101: -4.1 [dB]
  - 110: -2.5 [dB]
  - 111: -1.2 [dB]

### bit 4 : fhz3 Notch filter 3
0: Stop 1: Start (1125Hz)

### bit 3-1 : nfd1 Depth of Notch filter 1
Set the depth of Notch filter 1 (SP038).

- bit 3,2,1:
  - 000: - ∞
  - 001: -18.1 [dB]
  - 010: -12.0 [dB]
  - 011: -8.5 [dB]
  - 100: -6.0 [dB]
  - 101: -4.1 [dB]
  - 110: -2.5 [dB]
  - 111: -1.2 [dB]

【#13035(PR)】 SP035 SFNC3 Spindle function 3

### bit C : shgn SHG control in interpolation mode
0: Stop 1: Start

### bit A : pyn Excitation rate selection in interpolation mode
0: Select Excitation rate 1 1: Select Excitation rate 2

### bit 9 : vgn Speed loop gain set selection in interpolation mode
0: Select Set 1 1: Select Set 2
### [#13038] SP038  FHz1  Notch filter frequency 1
Set the vibration frequency to suppress when machine vibration occurs.
(Enabled at 50 or more.)
When not using, set to "0".

--- Setting range ---
0 to 2250 (Hz)

### [#13046] SP046  FHz2  Notch filter frequency 2
Set the vibration frequency to suppress when machine vibration occurs.
(Enabled at 50 or more.)
When not using, set to "0".

--- Setting range ---
0 to 2250 (Hz)

### [#13087] SP087  FHz4  Notch filter frequency 4
Set the vibration frequency to suppress when machine vibration occurs.
(Enabled at 50 or more.)
When not using, set to "0".

--- Setting range ---
0 to 2250 (Hz)

### [#13088] SP088  FHz5  Notch filter frequency 5
Set the vibration frequency to suppress when machine vibration occurs.
(Enabled at 50 or more.)
When not using, set to "0".

--- Setting range ---
0 to 2250 (Hz)
6-1-8 Spindle synchronization adjustment (For lathe system)

(1) Setting the gain, changeover rotation speed and time constant

[1] For speed loop gain during spindle synchronization, SP005 (speed loop gain 1), SP006 (speed loop lead compensation 1), and SP007 (speed loop delay compensation 2) are used. For position loop gain, set standard 15 to SP003 (position loop gain spindle synchronization).

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Setting value</th>
</tr>
</thead>
<tbody>
<tr>
<td>SP003</td>
<td>15</td>
</tr>
<tr>
<td>SP036</td>
<td>0000</td>
</tr>
</tbody>
</table>

(Note1) To change the setting value of SP003, set the synchronous and basic spindles to the same value.
(Note2) For the adjustment of SP005, SP006 and SP007, conduct "Adjusting the speed loop parameter" as a single unit beforehand.

[2] Set rotation speed and time constant during acceleration/deceleration figured by theoretical calculations.

[3] Set "Time-series data measurement" with NC Analyzer as follows and output speed feedback and current command.

< NC Analyzer setting (Time-series data measurement) >

<table>
<thead>
<tr>
<th>Get</th>
<th>Waveform type</th>
</tr>
</thead>
<tbody>
<tr>
<td>CH1</td>
<td>Speed feedback (r/min)</td>
</tr>
<tr>
<td>CH2</td>
<td>Current command</td>
</tr>
</tbody>
</table>

(2) Confirming the current margin

Perform acceleration/deceleration up to the maximum current speed in spindle synchronization mode. At this time, confirm that the current value for both acceleration side and deceleration side secure 30% or more of margin in respect to the current limit value. Also, confirm that no oscillation, etc. are found in the current waveforms.

(Note) If a margin is 30% or less, extend the acceleration/deceleration time constant so that the margin is adjusted to 30% or more.
Set the position loop gain for "spindle synchronization" control mode. When the setting value increases, the command tracking ability will enhance and the positioning settling time can be shorter. However, the impact on the machine during acceleration/deceleration will increase.

Use the selection command, the control mode "bit 2, 1, 0 = 001" in control input 4.
(Note) The control mode is commanded by NC.

When carrying out the SHG control, set SP036/bit4 to "1".

---Setting range---
1 to 200 (1/s)

**#13036(PR)**

<table>
<thead>
<tr>
<th>SP036</th>
<th>SFNC4</th>
<th>Spindle function 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>bit 4</td>
<td>shgs</td>
<td>SHG control in spindle synchronization mode</td>
</tr>
<tr>
<td>0: Stop</td>
<td>1: Start</td>
<td></td>
</tr>
<tr>
<td>bit 2</td>
<td>pys</td>
<td>Excitation rate selection in spindle synchronization mode</td>
</tr>
<tr>
<td>0: Select Excitation rate 1</td>
<td>1: Select Excitation rate 2</td>
<td></td>
</tr>
<tr>
<td>bit 1</td>
<td>vgs</td>
<td>Speed loop gain set selection in spindle synchronization mode</td>
</tr>
<tr>
<td>0: Select Set 1 (SP005,SP006,SP007)</td>
<td>1: Select Set 2 (SP008,SP009,SP010)</td>
<td></td>
</tr>
</tbody>
</table>
6-1-9 Deceleration coil changeover valid function by emergency stop

If a large workpiece is mounted on a large workpiece chuck in lathe, the acceleration/deceleration time increases because of the increase of the total inertia. When the deceleration stop time at emergency stop exceeds the upper limit value (29900ms) of the gate shutoff delay time (SP055), the spindle motor will coast. This function enables the coil changeover motor to change to low-speed coil during emergency stop and if the deceleration time is reduced to complete within the gate shutoff time, the spindle enters an emergency stop state.

---Diagram---

- **SP225 SFNC5 Spindle function 5**
  - **bit 8 : mken Coil switch allowance in deceleration control**
    - This enables a coil changeover while decelerating after an emergency stop for a spindle motor with coil changeover specification. A coil changeover may enable an excessive load inertia to stop within the maximum delay time.
    - 0: Normal (Disable) 1: Enable

- **SP055 EMGx Max. gate off delay time after emergency stop**
  - Set the time required to forcibly execute READY OFF after the emergency stop is input. Normally set to "20000". When "0" is set, READY OFF is forcibly executed with "7000ms". When the set time is shorter than the time to decelerate and stop, the spindle will stop with the dynamic brake after the set time is out.
  - __Setting range__
    - 0 to 29900 (ms)

- **SP056 EMGt Deceleration time constant at emergency stop**
  - Set the time constant used for the deceleration control at emergency stop. Set the time required to stop from the maximum motor speed (TSP).
    - When "0" is set, the deceleration control is executed with "7000ms".
  - __Setting range__
    - 0 to 29900 (ms)
6-1-10 High-response acceleration/deceleration function

Under continuous position control method makes position droop is set with primary delay depending on the position control gain during the acceleration/deceleration by S command. If the position gain is set lower, the zero speed detection which indicates the spindle stop is more conspicuously delayed. This function enables the position droop’s primary delay to be shorter and the zero speed detection to be faster.

![Diagram of high-response acceleration/deceleration function]

【#13095】 SP095 VIAX Lead compensation scale during high-response acceleration/deceleration

Set the magnification against delay/lead compensation (SP006) of the high-response acceleration/deceleration (valid when SP226/ bitD is set to "1"). Normally, set to "0". Set this parameter to suppress overshooting when the speed is reached.

---Setting range---

0 to 10000 (0.01%)

【#13226】 SP226 SFNC6 Spindle function 6

bit D : vup High response acceleration / deceleration

This suppresses a temporal delay which occurs when the target speed is attained from acceleration and when the spindle stops from deceleration.

0: Normal acceleration/deceleration  1: High response acceleration/deceleration Enable

This function is invalid during orientation and interpolation control (spindle synchronous/C axis/synchronous tapping control) even when it is set.
6-1-11 Spindle cutting withstand level improvement

Conventionally, the spindle rotation speed was slowed down due to heavy cutting that exceeds the spindle output characteristics, and this caused the alarm (Excessive error 52, Overload command 51) to stop the machining. This function enables setting of the dropping speed allowable value by parameter. As long as the speed is the set value or higher, machining can be executed within the output characteristics without being stopped by the alarm. Even when the parameter setting value is the normal value of 0, the standard value of 85 is applied. This can improve the efficiency of heavy cutting (feed per revolution).

If excessive speed dropping occurs and the speed exceeds the allowable range, the excessive speed deviation alarm 23 is output to reduce the damage to the machine.

**[#13096] SP096 SDW Speed slowdown allowable width**

When the spindle slows down due to multiple cutting, set the processable speed as percentage against the NC command speed. If the speed reduces below the tolerable range, the alarm 23 (Excessive speed error) will occur.

*E.g.* When set to 90 [%]

If S1000 is commanded, the speed reduced by 900r/min (=1000r/min × 90%) is the allowable lower limit. Thus if the spindle speed reduces to 100r/min or below, the alarm will occur.

When “0” is set, the magnification is the same as when “85” is set. When set to “-1”, the allowable width will be disabled.

---Setting range---

-1.0 to 100(%)
6-2 Settings for emergency stop

Emergency stop in this section refers to the following states.

1. Emergency stop was input (including other axis alarms)
2. NC power down was detected
3. A drive unit alarm was detected

6-2-1 Deceleration control

(1) Setting the deceleration control time constant
Set the time for stopping from the maximum motor speed (TSP) in the deceleration time constant for emergency stop (SV056: EMGt). When "0" is set, the deceleration stop is executed with "7000ms".

<Operation>
When an emergency stop occurs, the motor will decelerate at the same inclination from each speed.

(Note) If the setting value of SP056 is longer than the value of SP055, the motor will coast.

--- Setting range ---
0 to 29900 (ms)

[#13055] SP055  EMGx  Max. gate off delay time after emergency stop
Set the time required to forcibly execute READY OFF after the emergency stop is input. Normally set to "20000". When "0" is set, READY OFF is forcibly executed with "7000ms". When the set time is shorter than the time to decelerate and stop, the spindle will stop with the dynamic brake after the set time is out.

--- Setting range ---
0 to 29900 (ms)

[#13056] SP056  EMGt  Deceleration time constant at emergency stop
Set the time constant used for the deceleration control at emergency stop. Set the time required to stop from the maximum motor speed (TSP). When "0" is set, the deceleration control is executed with "7000ms".

--- Setting range ---
0 to 29900 (ms)
6-3 Spindle control signal

The sequence input/output signals exchanged between the NC and spindle drive unit are explained in this section. The status of each signal is displayed on the NC SPINDLE MONITOR screen.

6-3-1 Spindle control input (NC to Spindle)

(1) Spindle control input 1

<table>
<thead>
<tr>
<th>Name</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>spindle control input 1</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>E</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>RDY</td>
</tr>
<tr>
<td>1</td>
<td>SRV</td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>ALMR</td>
</tr>
<tr>
<td>8</td>
<td>TL1</td>
</tr>
<tr>
<td>9</td>
<td>TL2</td>
</tr>
<tr>
<td>A</td>
<td>TL3</td>
</tr>
<tr>
<td>B</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td></td>
</tr>
</tbody>
</table>

bit0. READY ON command (RDY)
Status turns to ready ON at RDY=1.

bit1. Servo ON command (SRV)

[1] Drive unit turns ON at SRV=1 (gate ON status), and rotation control starts.
Plus or minus of the rotation direction is determined depending on +/- of the NC command F Δ T.

[2] Servo immediately turns OFF (SON=0) at SRV=0 during rotation control. Drive unit also turns OFF (gate OFF status) at this time.

bit7. Alarm reset command (ALMR)
NR alarm is reset at ALMR=1.

bit8. Torque limit 1 selection command (TL1)
bit9. Torque limit 2 selection command (TL2)
bitA. Torque limit 3 selection command (TL3)

The following 4 types of torque limit are available depending on TL1, TL2 and TL3 bit combinations.

<table>
<thead>
<tr>
<th>TL3</th>
<th>TL2</th>
<th>TL1</th>
<th>Torque limit value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>1</td>
<td>Torque limit value (%) set with parameter SP065</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>0</td>
<td>Torque limit value (%) set with parameter SP066</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>1</td>
<td>Torque limit value (%) set with parameter SP067</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
<td>Torque limit value (%) set with parameter SP068</td>
</tr>
</tbody>
</table>

(Note) The ratio to motor short time rated torque (load meter 100%) is indicated in %.

(Note) The bits other than those above are used for maintenance.
(2) Spindle control input 2

<table>
<thead>
<tr>
<th>Name</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spindle control input 2</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>bit</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>1</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>2</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>3</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>4</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>5</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>6</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>7</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>8</td>
<td>SSW: Speed monitor command valid</td>
</tr>
<tr>
<td>9</td>
<td>NCDC: In door closed (controller)</td>
</tr>
<tr>
<td>A</td>
<td>SRVDC: In door closed (all drive units)</td>
</tr>
<tr>
<td>B</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>C</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>D</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>E</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>F</td>
<td>(For maintenance)</td>
</tr>
</tbody>
</table>

bit9. Speed monitor command valid (SSW)
When speed monitor command is valid, SSW=1 (valid) is set.

bitA. In door closed (controller) (NCDC)
When "In door closed" signal for controller is valid, NCDC =1 (valid) is set.

bitB. In door closed (all drive units) (SRVDC)
When the theoretical sum of "In door closed" signals for all drive units is valid, SRVDC =1 (valid) is set.

(Note) The bits other than those above are used for maintenance.

(3) Spindle control input 3
This is used for maintenance.

(4) Spindle control input 4

<table>
<thead>
<tr>
<th>Name</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spindle control input 4</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>bit</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>1</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>2</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>3</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>4</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>5</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>6</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>7</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>8</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>9</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>A</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>B</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>C</td>
<td>M coil selection command</td>
</tr>
<tr>
<td>D</td>
<td>L coil selection command</td>
</tr>
<tr>
<td>E</td>
<td>Sub-motor selection command</td>
</tr>
</tbody>
</table>

bit0. Spindle control mode selection command 1 (SC1)
bit1. Spindle control mode selection command 2 (SC2)
bit2. Spindle control mode selection command 3 (SC3)
Drive unit operation mode can be selected with the bit correspondences below.

Mode changeover is valid during in-position (INP=1) or other than during droop cancel / phase compensation (DCSL=PCMP=0).

(Note) When selecting bits other than above, control mode error (4E) occurs.

Continuity cannot be guaranteed for the value of position FB in non-interpolation mode. (Position may be skipped for multiple rotations due to droop cancel or phase compensation.)

In gear changeover command (GKC)
By inputting GKC=1, the gear ratio is changed to the gear ratio specified with the gear selection command (GR1, GR2). This command is invalid during the interpolation mode.

Gear selection command 1 (GR1)
Gear selection command 2 (GR2)

The following 4 types of gear ratio are available depending on GR1 and GR2 2-bit input combinations.

Gear specifications in semi-closed position control do not secure a position within one rotation of the spindle.

M coil selection command (MCS) (IPM spindle motor only)
M coil is selected at MCS=1 when 3-step coil changeover is valid.

L coil selection command (LCS)
L coil is selected at LCS=1 when coil changeover is valid.

Sub-motor selection command (MS)
When 1 drive unit 2 motor function is valid, a main motor is selected at MS=0 and a sub-motor is selected at MS=1. An input cannot be changed during motor changeover.

The bits other than those above are used for maintenance.

<table>
<thead>
<tr>
<th>SC3</th>
<th>SC2</th>
<th>SC1</th>
<th>Operation mode</th>
<th>Conventional method</th>
<th>New method</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>Speed/orientation control</td>
<td>Non interpolation control</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>1</td>
<td>Spindle synchronization</td>
<td>Spindle synchronization</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>0</td>
<td>C-axis control</td>
<td></td>
<td>Interpolation control</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
<td>Synchronous tapping control</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Parameters requiring gear ratio setting

<table>
<thead>
<tr>
<th>GR2</th>
<th>GR1</th>
<th>Parameters requiring gear ratio setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>SP057 (GRA1), SP061 (GRB1)</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>SP058 (GRA2), SP062 (GRB2)</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>SP059 (GRA3), SP063 (GRB3)</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>SP060 (GRA4), SP064 (GRB4)</td>
</tr>
</tbody>
</table>
(5) Spindle control input 5

<table>
<thead>
<tr>
<th>bit</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>1</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>2</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>3</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>4</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>5</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>6</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>7</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>8</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>9</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>A</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>B</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>C</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>D</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>E</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>F</td>
<td>(For maintenance)</td>
</tr>
</tbody>
</table>

### bitB. Minimum excitation rate 2 changeover request (PY2)

1. When PY2=1 is set, the minimum excitation rate 2 (SP015) is selected.
2. When PY2=0 is set, the minimum excitation rate 1 (SP014) is selected.

### bitC. Speed gain set 2 changeover request (VG2)

1. When VG2=1 is set, the gain parameter (SP008/SP009/SP010) used in the speed loop is selected.
2. When VG2=0 is set, the gain parameter (SP005/SP006/SP007) used in the speed loop is selected.
3. The speed gain set changeover is valid during the in-position.

### bitD. Zero point re-detection request (ORC)

- When ORC is changed from 0 to 1, the Z phase passed will be 0 (control output2/bit0).

### bitE. Spindle holding force up (TLUP)

- Spindle holding force up (disturbance observer) starts at TLUP=1 and that state is retained during TLUP=1.

(Note) The bits other than those above are used for maintenance.

(6) Spindle control input 6

This is used for maintenance.
6-3-2 Spindle control output (Spindle to NC)

(1) Spindle control output 1

<table>
<thead>
<tr>
<th>Name</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spindle control output 1</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Bit</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 RDY</td>
<td>In ready ON</td>
</tr>
<tr>
<td>1 SRV</td>
<td>In servo ON</td>
</tr>
<tr>
<td>2 F</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>3 F</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>4 F</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>5 F</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>6 F</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>7 ALMR</td>
<td>In alarm</td>
</tr>
<tr>
<td>8 TL1</td>
<td>In torque limit 1 selection</td>
</tr>
<tr>
<td>9 TL2</td>
<td>In torque limit 2 selection</td>
</tr>
<tr>
<td>A TL3</td>
<td>In torque limit 3 selection</td>
</tr>
<tr>
<td>B F</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>C INP</td>
<td>In in-position</td>
</tr>
<tr>
<td>D LMT</td>
<td>In torque limit</td>
</tr>
<tr>
<td>E F</td>
<td>(For maintenance)</td>
</tr>
<tr>
<td>F WRN</td>
<td>In warning</td>
</tr>
</tbody>
</table>

bit0. In ready ON (RDY)

It indicates that the status is in ready ON at RDY=1.

bit1. In servo ON (SRV)

[1] It indicates that the status is in servo ON at SRV=1.

[2] NC position command executes a followed up during SRV=0.

bit7. In alarm (ALMR)

It indicates that drive unit is in some alarm state at ALMR=1.

bit8. In torque limit 1 selection (TL1)
bit9. In torque limit 2 selection (TL2)
bitA. In torque limit 3 selection (TL3)

These are the answer outputs for torque limit 1, 2 and 3 (TL1, TL2 and TL3).

bitC. In in-position (INP)

The status changes to INP=1 when position droop exists within the in-position area set by parameter SP024 (INP) regardless of serve ON or OFF.

bitD. In torque limit (LMT)

It indicates that current command value is limited with motor maximum output current value or torque limit 1, 2 or 3 at LMT=1.

bitF. In warning (WRN)

It indicates that drive unit is in some warning state at WRN=1.

(Note) The bits other than those above are used for maintenance.
(2) Spindle control output 2

<table>
<thead>
<tr>
<th>Name</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>bit0. Z phase passed</td>
<td>(ZCN)</td>
</tr>
<tr>
<td></td>
<td>[1] When Z phase is passed, ZCN=0 is turned to ZCN=1.</td>
</tr>
<tr>
<td></td>
<td>[2] Grid amount (within one rotation) is transmitted when ZCN =0 is changed to ZCN =1.</td>
</tr>
<tr>
<td>bit3. In zero speed (ZS)</td>
<td>[1] Approximately 200ms after the motor speed reaches parameter SP027 (ZSP) + 15r/min, ZS=0 is set.</td>
</tr>
<tr>
<td></td>
<td>[2] When the motor speed becomes slower than the speed set by parameter SP027 (ZSP), ZS=1 is set. ZS signal is detected by the motor speed absolute value regardless of the rotation direction.</td>
</tr>
<tr>
<td>bit7. In external emergency stop</td>
<td>It indicates that an external stop input to the power supply is being input.</td>
</tr>
<tr>
<td>bit9. In speed monitor</td>
<td>It indicates that a signal in speed monitor command is being received.</td>
</tr>
<tr>
<td>bitA. In door closed (controller)</td>
<td>It indicates that &quot;In door closed&quot; signal for controller is being received.</td>
</tr>
<tr>
<td>bitB. In door closed (self drive unit)</td>
<td>It indicates the status of &quot;In door closed&quot; signal for self drive unit.</td>
</tr>
</tbody>
</table>

(Note) The bits other than those above are used for maintenance.

(3) Spindle control output 3
This is used for maintenance.
(4) Spindle control output 4

<table>
<thead>
<tr>
<th>Name</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spindle control output 4</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>E</td>
</tr>
<tr>
<td>LCS</td>
<td>-</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Bit</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>In spindle control mode selection 1 (SC1)</td>
</tr>
<tr>
<td>1</td>
<td>In spindle control mode selection 2 (SC2)</td>
</tr>
<tr>
<td>2</td>
<td>In spindle control mode selection 3 (SC3)</td>
</tr>
<tr>
<td>3</td>
<td>For maintenance</td>
</tr>
<tr>
<td>4</td>
<td>In gear changeover command (GKC)</td>
</tr>
<tr>
<td>5</td>
<td>For maintenance</td>
</tr>
<tr>
<td>6</td>
<td>For maintenance</td>
</tr>
<tr>
<td>7</td>
<td>For maintenance</td>
</tr>
<tr>
<td>8</td>
<td>For maintenance</td>
</tr>
<tr>
<td>9</td>
<td>For maintenance</td>
</tr>
<tr>
<td>A</td>
<td>For maintenance</td>
</tr>
<tr>
<td>B</td>
<td>For maintenance</td>
</tr>
<tr>
<td>C</td>
<td>For maintenance</td>
</tr>
<tr>
<td>D</td>
<td>In L coil selection (LCS)</td>
</tr>
<tr>
<td>E</td>
<td>For maintenance</td>
</tr>
<tr>
<td>F</td>
<td>For maintenance</td>
</tr>
</tbody>
</table>

bit0. In spindle control mode selection 1 (SC1)

bit1. In spindle control mode selection 2 (SC2)

bit2. In spindle control mode selection 3 (SC3)

These are the answer outputs for control mode selection command 1, 2, 3 (SC1, SC2, SC3).

bit4. In gear changeover command (GKC)

[1] This is an answerer output for the gear changeover command.
[2] The position feedback is generated from the speed detector at GKC=1.

bit5. In gear selection 1 (GR1)

bit6. In gear selection 2 (GR2)

These are the answer outputs for gear selection command 1 and 2 (GR1 and GR2).

bitD. In L coil selection (LCS)

It indicates that L coil is being selected at LCSA=1.

(Note) The bits other than those above are used for maintenance.
(5) Spindle control output 5

<table>
<thead>
<tr>
<th>Name</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spindle control output 5</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Bit</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Current detection (CD)</td>
</tr>
<tr>
<td>1</td>
<td>Speed detection (MD)</td>
</tr>
<tr>
<td>2</td>
<td>Magnetic pole position not set (MPN)</td>
</tr>
<tr>
<td>3</td>
<td>In coil changeover (MKC)</td>
</tr>
<tr>
<td>4</td>
<td>In speed gain set 2 selection (IPM spindle motor)</td>
</tr>
<tr>
<td>5</td>
<td>In minimum excitation rate 2 selection (IPM spindle motor)</td>
</tr>
<tr>
<td>6</td>
<td>In speed detection OFF (IPM spindle motor)</td>
</tr>
<tr>
<td>7</td>
<td>In speed detection ON (IPM spindle motor)</td>
</tr>
</tbody>
</table>

**bit0. Current detection (CD)**

It indicates that current command value is over 110% of the motor short time rating at CD=1.

**bit1. Speed detection (MD)**

1. When motor speed exceeds the speed set by parameter SP028 (SDTS) + SP029 (SDTR), SD=0 is set.
2. When motor speed becomes slower than the speed set by parameter SP028 (SDTS), SD=1 is set. SD signal is detected by the motor speed absolute value regardless of rotation direction.

**bit6. In coil changeover (MKC)**

MKC=1 is set for the amount of time set by parameter SP114 (MKT) during coil changeover operation.

**bit7. Magnetic pole position not set (MPN)**

It indicates that the magnetic pole position of the motor is not established at MPN=1.

**bit9. 2nd speed detection (SD2) (IPM spindle motor)**

1. The status changes to SD2=0 when motor speed exceeds the speed set by parameter SP030 (SDT2) + SP029 (SDTR).
2. The status changes to SD2=1 when motor speed becomes slower than the speed set by parameter SP030 (SDT2).
3. It is used as M coil changeover speed. (IPM spindle motor only)
bitB. In minimum excitation rate 2 selection (PY2)
   [1] When PY2=1 is set, the minimum excitation rate 2 (SP015) is being selected.
   [2] When PY2=0 is set, the minimum excitation rate 1 (SP014) is being selected.

bitC. In speed gain set 2 selection (VG2)
   [1] When VG2=1 is set, the gain parameter (SP008/SP009/SP010) used in the speed loop is being selected.
   [2] When VG2=0 is set, the gain parameter (SP005/SP006/SP007) used in the speed loop is being selected.

bitD. Zero point re-detection complete
   If the zero point re-detection is completed after the zero point re-detection request (control input5/bitD) is set to 1, ORF=1 is set. If the zero point re-detection request is set to 0, ORF=0 is set.

bitF. In 2nd in-position (INP2)
   The status changes to INP2=1 when position droop exists within the in-position area set by parameter SP025 (INP2) regardless of serve ON or OFF.

(Note) The bits other than those above are used for maintenance.

(6) Spindle control output 6
   This is used for maintenance.
Troubleshooting
7-1 Points of caution and confirmation

If an error occurs in the drive unit, the warning or alarm will occur. When a warning or alarm occurs, check the state while observing the following points, and inspect or remedy the unit according to the details given in this section.

<Points of confirmation>
1. What is the alarm code display?
2. Can the error or trouble be repeated? (Check alarm history)
3. Is the motor and servo drive unit temperature and ambient temperature normal?
4. Are the servo drive unit, control unit and motor grounded?
5. Was the unit accelerating, decelerating or running at a set speed? What was the speed?
6. Is there any difference during forward and backward run?
7. Was there a momentary power failure?
8. Did the trouble occur during a specific operation or command?
9. At what frequency does the trouble occur?
10. Is a load applied or removed?
11. Has the drive unit been replaced, parts replaced or emergency measures taken?
12. How many years has the unit been operating?
13. Is the power supply voltage normal? Does the state change greatly according to the time band?

1. This drive unit uses a large capacity electrolytic capacitor. When the CHARGE lamp on the front of the power supply unit is lit, voltage is still present. Do not touch the terminal block in this state.

⚠️ CAUTION
2. Before replacing the unit, etc., always confirm that there is no voltage with a tester or wait at least 15 minutes after turning the main power OFF.
3. The conductivity in the unit cannot be checked.
4. Never carry out a megger test on the drive unit as the unit could be damaged.

7-1-1 LED display when alarm or warning occurs

(1) Servo and spindle drive unit
(Example) Spindle: an alarm occurs, Servo: Emergency stop

(2) LED display during an alarm occurs

(Note) MDS-DM2-SPV Series has no segment, so confirm the alarm No. on the NC screen monitor.
When an alarm occurs, the servo drive unit will make the motor stop by the deceleration control or dynamic brake. The spindle drive unit will coast to a stop or will decelerate to a stop. At the same time, the alarm No. will appear on the NC monitor screen and with the LEDs on the front of the drive unit. Check the alarm No., and remove the cause of the alarm by following this list.

(1) Drive unit alarm

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Details</th>
<th>Reset method</th>
<th>Servo stop method</th>
<th>Spindle stop method</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>Insufficient voltage</td>
<td>A drop of bus voltage was detected in main circuit.</td>
<td>PR Dynamic stop</td>
<td>Coast to a stop</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Axis selection error</td>
<td>The axis selection rotary switch has been incorrectly set.</td>
<td>AR Initial error</td>
<td>Initial error</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Memory error 1</td>
<td>A hardware error was detected during the power ON self-check.</td>
<td>AR Initial error</td>
<td>Initial error</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Software processing error 1</td>
<td>An error was detected for the software execution state.</td>
<td>PR Dynamic stop</td>
<td>Coast to a stop</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Software processing error 2</td>
<td>The current processor is not operating correctly.</td>
<td>AR Dynamic stop</td>
<td>Coast to a stop</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Initial magnetic pole position detection error</td>
<td>In the built-in motor which uses the absolute position detector, the servo ON has been set before the magnetic pole shift amount is set. The magnetic pole position, detected in the initial magnetic pole position detection control, is not correctly set.</td>
<td>PR Dynamic stop</td>
<td>Coast to a stop</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>A/D converter error</td>
<td>A current feedback error was detected.</td>
<td>PR Dynamic stop</td>
<td>Coast to a stop</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>Main side detector: Initial communication error</td>
<td>An error was detected in the initial communication with the motor side detector.</td>
<td>PR Initial error</td>
<td>Initial error</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Detector communication error in synchronous control</td>
<td>An error of the shared detector on the machine side was detected on the secondary axis of the speed command synchronization control.</td>
<td>PR Dynamic stop</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>1A</td>
<td>Sub side detector: Initial communication error</td>
<td>An error was detected in the initial communication with the machine side detector.</td>
<td>PR Initial error</td>
<td>Initial error</td>
<td></td>
</tr>
<tr>
<td>1B</td>
<td>Sub side detector: Error 1</td>
<td>An error was detected by the detector connected to the machine side.</td>
<td>Dynamic stop</td>
<td>Coast to a stop</td>
<td></td>
</tr>
<tr>
<td>1C</td>
<td>Sub side detector: Error 2</td>
<td>The error details are different according to the detector type. Refer to &quot;Detector alarm&quot; for details.</td>
<td>PR Dynamic stop</td>
<td>Coast to a stop</td>
<td></td>
</tr>
<tr>
<td>1D</td>
<td>Sub side detector: Error 3</td>
<td>An error was detected by the detector connected to the machine side.</td>
<td>Dynamic stop</td>
<td>Coast to a stop</td>
<td></td>
</tr>
<tr>
<td>1E</td>
<td>Sub side detector: Error 4</td>
<td>An error was detected by the detector connected to the machine side.</td>
<td>Dynamic stop</td>
<td>Coast to a stop</td>
<td></td>
</tr>
<tr>
<td>1F</td>
<td>Sub side detector: Communication error</td>
<td>An error was detected in the communication with the machine side detector.</td>
<td>PR Dynamic stop</td>
<td>Coast to a stop</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>Sub side detector no signal 2</td>
<td>In the machine side detector, ABZ-phase feedback cannot be returned even when the motor moves.</td>
<td>PR Dynamic stop</td>
<td>Coast to a stop</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>Detector data error</td>
<td>An error was detected in the feedback data from the position detector.</td>
<td>AR Dynamic stop</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>Excessive speed error</td>
<td>The state that there is a difference between the actual speed and command speed continued for longer than the excessive speed deviation timer setting.</td>
<td>NR -</td>
<td>Coast to a stop</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>Grounding</td>
<td>The motor power cable is in contact with FG (Frame Ground).</td>
<td>PR Dynamic stop</td>
<td>Coast to a stop</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>Unused axis error</td>
<td>The absolute position data was lost in the detector.</td>
<td>AR Initial error</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>Sub side detector: Error 5</td>
<td>An error was detected by the detector connected to the machine side.</td>
<td>Dynamic stop</td>
<td>Coast to a stop</td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>Sub side detector: Error 6</td>
<td>The error details are different according to the detector type. Refer to &quot;Detector alarm&quot; for details.</td>
<td>Dynamic stop</td>
<td>Coast to a stop</td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>Sub side detector: Error 7</td>
<td>An error was detected by the detector connected to the machine side.</td>
<td>Dynamic stop</td>
<td>Coast to a stop</td>
<td></td>
</tr>
<tr>
<td>2A</td>
<td>Sub side detector: Error 8</td>
<td>An error was detected by the detector connected to the machine side.</td>
<td>Dynamic stop</td>
<td>Coast to a stop</td>
<td></td>
</tr>
<tr>
<td>2B</td>
<td>Main side detector: Error 1</td>
<td>An error was detected by the detector connected to the machine side.</td>
<td>Dynamic stop</td>
<td>Coast to a stop</td>
<td></td>
</tr>
<tr>
<td>2C</td>
<td>Main side detector: Error 2</td>
<td>The error details are different according to the detector type. Refer to &quot;Detector alarm&quot; for details.</td>
<td>Dynamic stop</td>
<td>Coast to a stop</td>
<td></td>
</tr>
<tr>
<td>2D</td>
<td>Main side detector: Error 3</td>
<td>An error was detected by the detector connected to the machine side.</td>
<td>Dynamic stop</td>
<td>Coast to a stop</td>
<td></td>
</tr>
<tr>
<td>2E</td>
<td>Main side detector: Error 4</td>
<td>An error was detected by the detector connected to the machine side.</td>
<td>Dynamic stop</td>
<td>Coast to a stop</td>
<td></td>
</tr>
<tr>
<td>2F</td>
<td>Main side detector: Communication error</td>
<td>An error was detected in the communication with the motor side detector.</td>
<td>PR Dynamic stop</td>
<td>Coast to a stop</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>Over regeneration</td>
<td>Over-regeneration level exceeded 100%. The regenerative resistor is overloaded.</td>
<td>PR Dynamic stop</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>31</td>
<td>Overspeed</td>
<td>The motor speed exceeded the allowable speed.</td>
<td>PR Deceleration stop enabled</td>
<td>Deceleration stop enabled</td>
<td></td>
</tr>
</tbody>
</table>

(Note1) Definitions of terms in the table are as follows.
- Main side detector: Detector connected to CN2
- Sub side detector: Detector connected to CN3

(Note2) Resetting methods
- NR: Reset with the NC RESET button. This alarm can also be reset with the PR and AR resetting conditions.
- PR: Reset by turning the NC power ON again. This alarm can also be reset with the AR resetting conditions.
- AR: Reset by turning the servo drive unit power ON again.
<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Details</th>
<th>Reset method</th>
<th>Servo stop method</th>
<th>Spindle stop method</th>
</tr>
</thead>
<tbody>
<tr>
<td>32</td>
<td>Power module error (overcurrent)</td>
<td>The power module detected the overcurrent.</td>
<td>PR</td>
<td>Dynamic stop</td>
<td>Coast to a stop</td>
</tr>
<tr>
<td>33</td>
<td>Overvoltage</td>
<td>The bus voltage in main circuit exceeded the allowable value.</td>
<td>PR</td>
<td>Dynamic stop</td>
<td>Coast to a stop</td>
</tr>
<tr>
<td>34</td>
<td>NC communication: CRC error</td>
<td>The data received from the NC was outside the setting range.</td>
<td>PR</td>
<td>Deceleration stop enabled</td>
<td>Deceleration stop enabled</td>
</tr>
<tr>
<td>35</td>
<td>NC command error</td>
<td>The travel command data received from the NC was excessive.</td>
<td>PR</td>
<td>Deceleration stop enabled</td>
<td>Deceleration stop enabled</td>
</tr>
<tr>
<td>36</td>
<td>NC communication: Communication error</td>
<td>The communication with the NC was interrupted.</td>
<td>PR</td>
<td>Deceleration stop enabled</td>
<td>Deceleration stop enabled</td>
</tr>
<tr>
<td>37</td>
<td>Initial parameter error</td>
<td>An incorrect set value was detected among the parameters send from the NC at the power ON.</td>
<td>PR</td>
<td>Initial error</td>
<td>Initial error</td>
</tr>
<tr>
<td>38</td>
<td>NC communication: Protocol error 1</td>
<td>An error was detected in the communication frames received from the NC. Or, removing an axis or changing an axis was performed in the synchronous control.</td>
<td>PR</td>
<td>Deceleration stop enabled</td>
<td>Deceleration stop enabled</td>
</tr>
<tr>
<td>39</td>
<td>NC communication: Protocol error 2</td>
<td>An error was detected in the axis data received from the NC. Or, in changing an axis, the parameter setting of the synchronous control was applied when the axis was installed.</td>
<td>PR</td>
<td>Deceleration stop enabled</td>
<td>Deceleration stop enabled</td>
</tr>
<tr>
<td>4A</td>
<td>Overcurrent</td>
<td>Excessive motor drive current was detected.</td>
<td>PR</td>
<td>Dynamic stop</td>
<td>Coast to a stop</td>
</tr>
<tr>
<td>4B</td>
<td>Power module error (overheat)</td>
<td>The power module detected an overheat.</td>
<td>PR</td>
<td>Dynamic stop</td>
<td>Coast to a stop</td>
</tr>
<tr>
<td>4C</td>
<td>Regeneration circuit error</td>
<td>An error was detected in the regenerative transistor or in the regenerative resistor.</td>
<td>PR</td>
<td>Dynamic stop</td>
<td>-</td>
</tr>
<tr>
<td>4D</td>
<td>Power supply voltage error at acceleration/deceleration</td>
<td>A motor control error during acceleration/deceleration, due to a power voltage failure, was detected.</td>
<td>PR</td>
<td>Dynamic stop</td>
<td>-</td>
</tr>
<tr>
<td>4E</td>
<td>Magnetic pole position detection error</td>
<td>The magnetic pole position, detected in the magnetic pole position detection control, is not correctly detected.</td>
<td>AR</td>
<td>Dynamic stop</td>
<td>Coast to a stop</td>
</tr>
<tr>
<td>4F</td>
<td>Feedback error 1</td>
<td>Either a missed feedback pulse in the position detection or an error in the Z-phase was detected in the full closed loop system.</td>
<td>PR</td>
<td>Dynamic stop</td>
<td>Coast to a stop</td>
</tr>
<tr>
<td>4G</td>
<td>Feedback error 2</td>
<td>An excessive difference in feedback was detected between the machine side detector and the motor side detector.</td>
<td>PR</td>
<td>Dynamic stop</td>
<td>Coast to a stop</td>
</tr>
<tr>
<td>4H</td>
<td>Fan stop</td>
<td>An overheat of the power module was detected during the cooling fan stopping.</td>
<td>PR</td>
<td>Dynamic stop</td>
<td>Coast to a stop</td>
</tr>
<tr>
<td>4I</td>
<td>Motor overheat / Thermal error</td>
<td>Either the motor or the motor side detector detected an overheat. Or, the thermistor signal receiving circuit of the linear motor or direct-drive motor was disconnected. Or, the thermistor signal receiving circuit was short-circuited.</td>
<td>NR</td>
<td>Deceleration stop enabled</td>
<td>Deceleration stop enabled</td>
</tr>
<tr>
<td>4J</td>
<td>Main side detector: Error 5</td>
<td>An error was detected by the detector connected to the main side.</td>
<td>Dynamic stop</td>
<td>Coast to a stop</td>
<td></td>
</tr>
<tr>
<td>4K</td>
<td>Main side detector: Error 6</td>
<td>The error details are different according to the connected detector. Refer to &quot;Detector alarm&quot;.</td>
<td>Dynamic stop</td>
<td>Coast to a stop</td>
<td></td>
</tr>
<tr>
<td>4L</td>
<td>Main side detector: Error 7</td>
<td></td>
<td>Dynamic stop</td>
<td>Coast to a stop</td>
<td></td>
</tr>
<tr>
<td>4M</td>
<td>Main side detector: Error 8</td>
<td></td>
<td>Dynamic stop</td>
<td>Coast to a stop</td>
<td></td>
</tr>
<tr>
<td>4N</td>
<td>Current error at initial magnetic pole estimate</td>
<td>Current detection failed at the initial magnetic pole estimation.</td>
<td>NR</td>
<td>Dynamic stop</td>
<td>Coast to a stop</td>
</tr>
<tr>
<td>4O</td>
<td>Dual signal error</td>
<td>An error was detected in the signal related to the dual signal.</td>
<td>NR</td>
<td>Dynamic stop</td>
<td>Coast to a stop</td>
</tr>
<tr>
<td>4P</td>
<td>NC command mode error</td>
<td>An error was detected in the control mode send from the NC.</td>
<td>NR</td>
<td>Deceleration stop enabled</td>
<td>Deceleration stop enabled</td>
</tr>
<tr>
<td>4Q</td>
<td>Instantaneous power interrupt</td>
<td>The control power supply has been shut down for 50ms or more.</td>
<td>NR</td>
<td>Deceleration stop enabled</td>
<td>Deceleration stop enabled</td>
</tr>
<tr>
<td>50</td>
<td>Overload 1</td>
<td>Overload detection level became 100% or more. The motor or the drive unit is overloaded.</td>
<td>NR</td>
<td>Deceleration stop enabled</td>
<td>Deceleration stop enabled</td>
</tr>
<tr>
<td>51</td>
<td>Overload 2</td>
<td>In a servo system, current command of 95% or more of the unit’s max. current was given continuously for 1 second or longer. In a spindle system, current command of 95% or more of the motor’s max. current was given continuously for 1 second or longer.</td>
<td>NR</td>
<td>Deceleration stop enabled</td>
<td>Deceleration stop enabled</td>
</tr>
<tr>
<td>52</td>
<td>Excessive error 1</td>
<td>A position tracking error during servo ON was excessive.</td>
<td>NR</td>
<td>Deceleration stop enabled</td>
<td>Deceleration stop enabled</td>
</tr>
<tr>
<td>53</td>
<td>Excessive error 2</td>
<td>A position tracking error during servo OFF was excessive.</td>
<td>NR</td>
<td>Dynamic stop</td>
<td>-</td>
</tr>
</tbody>
</table>

(Note1) Definitions of terms in the table are as follows.
Main side detector: Detector connected to CN2  Sub side detector: Detector connected to CN3

(Note2) Resetting methods
NR: Reset with the NC RESET button. This alarm can also be reset with the PR and AR resetting conditions.
PR: Reset by turning the NC power ON again. This alarm can also be reset with the AR resetting conditions.
When the control axis is removed, this alarm can be reset with the NC RESET button. (Excluding alarms 32 and 37.)
AR: Reset by turning the servo drive unit power ON again.
<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Details</th>
<th>Reset method</th>
<th>Servo stop method</th>
<th>Spindle stop method</th>
</tr>
</thead>
<tbody>
<tr>
<td>54</td>
<td>Excessive error 3</td>
<td>There was no motor current feedback when the alarm &quot;Excessive error 1&quot; was detected.</td>
<td>NR</td>
<td>Dynamic stop</td>
<td>Coast to a stop</td>
</tr>
<tr>
<td>56</td>
<td>Commanded speed error</td>
<td>In the C-axis control mode, excessive speed error was detected.</td>
<td>NR</td>
<td>-</td>
<td>Deceleration stop enabled</td>
</tr>
<tr>
<td>58</td>
<td>Collision detection 1: G0</td>
<td>A disturbance torque exceeded the allowable value in rapid traverse modal (G0).</td>
<td>NR</td>
<td>Maximum capacity deceleration stop</td>
<td>-</td>
</tr>
<tr>
<td>59</td>
<td>Collision detection 1: G1</td>
<td>A disturbance torque exceeded the allowable value in the cutting feed modal (G1).</td>
<td>NR</td>
<td>Maximum capacity deceleration stop</td>
<td>-</td>
</tr>
<tr>
<td>5A</td>
<td>Collision detection 2</td>
<td>A current command with the maximum drive unit current value was detected.</td>
<td>NR</td>
<td>Maximum capacity deceleration stop</td>
<td>-</td>
</tr>
<tr>
<td>5B</td>
<td>Safety limited: Commanded speed monitoring error</td>
<td>A commanded speed exceeding the safety limited speed was detected in the safety limited mode.</td>
<td>PR</td>
<td>Deceleration stop enabled</td>
<td>Deceleration stop enabled</td>
</tr>
<tr>
<td>5D</td>
<td>Safety limited: Door state error</td>
<td>The door state signal input in the NC does not coincide with the door state signal input in the drive unit in the safety limited mode. Otherwise, door open state was detected in normal mode.</td>
<td>PR</td>
<td>Deceleration stop enabled</td>
<td>Deceleration stop enabled</td>
</tr>
<tr>
<td>5E</td>
<td>Safety limited: Speed feedback monitoring error</td>
<td>A motor speed exceeding the safety limited speed was detected in the safety limited mode.</td>
<td>PR</td>
<td>Deceleration stop enabled</td>
<td>Deceleration stop enabled</td>
</tr>
<tr>
<td>5F</td>
<td>External contactor error</td>
<td>A contact of the external contactor is welding.</td>
<td>NR</td>
<td>Deceleration stop enabled</td>
<td>Deceleration stop enabled</td>
</tr>
<tr>
<td>60</td>
<td>Power supply alarm</td>
<td>The power supply unit detected an error. The error details are different according to the connected power supply unit. Refer to &quot;Power supply alarm&quot; for details.</td>
<td></td>
<td>Dynamic stop</td>
<td>Coast to a stop</td>
</tr>
<tr>
<td>80</td>
<td>Main side detector cable error</td>
<td>The cable type of the motor side detector cable is for rectangular wave signal.</td>
<td>AR</td>
<td>Initial error</td>
<td>-</td>
</tr>
<tr>
<td>81</td>
<td>Sub side detector cable error</td>
<td>The cable type of the machine side detector cable does not coincide with the detector type which is set by the parameter.</td>
<td>AR</td>
<td>Initial error</td>
<td>-</td>
</tr>
<tr>
<td>87</td>
<td>Drivers communication error</td>
<td>The communication frame between drive units was aborted.</td>
<td>PR</td>
<td>Dynamic stop</td>
<td>Coast to a stop</td>
</tr>
<tr>
<td>88</td>
<td>Watchdog</td>
<td>The drive unit does not operate correctly.</td>
<td>AR</td>
<td>Dynamic stop</td>
<td>Coast to a stop</td>
</tr>
<tr>
<td>8A</td>
<td>Drivers communication data error 1</td>
<td>The communication data 1 between drivers exceeded the tolerable value in the communication between drive units.</td>
<td>PR</td>
<td>Dynamic stop</td>
<td>Coast to a stop</td>
</tr>
<tr>
<td>8B</td>
<td>Drivers communication data error 2</td>
<td>The communication data 2 between drivers exceeded the tolerable value in the communication between drive units.</td>
<td>PR</td>
<td>Dynamic stop</td>
<td>Coast to a stop</td>
</tr>
</tbody>
</table>

(Note1) Definitions of terms in the table are as follows.
- Main side detector: Detector connected to CN2
- Sub side detector: Detector connected to CN3

(Note2) Resetting methods
- NR: Reset with the NC RESET button. This alarm can also be reset with the PR and AR resetting conditions.
- PR: Reset by turning the NC power ON again. This alarm can also be reset with the AR resetting conditions.
- AR: Reset by turning the servo drive unit power ON again.
### Detector alarm (Servo drive unit)

<table>
<thead>
<tr>
<th>Alarm number when the detector is connected to CN2 side</th>
<th>2B</th>
<th>2C</th>
<th>2D</th>
<th>2E</th>
<th>48</th>
<th>49</th>
<th>4A</th>
<th>4B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alarm number when the detector is connected to CN3 side</td>
<td>1B</td>
<td>1C</td>
<td>1D</td>
<td>1E</td>
<td>27</td>
<td>28</td>
<td>29</td>
<td>2A</td>
</tr>
<tr>
<td>OSA105, OSA105ET2A, OSA166, OSA166ET2NA</td>
<td>MITSUBISHI</td>
<td>Memory alarm</td>
<td>LED alarm</td>
<td>Data alarm</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>OSA18</td>
<td></td>
<td>CPU alarm</td>
<td>-</td>
<td>Data alarm</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>MDS-B-HR</td>
<td></td>
<td>Memory error</td>
<td>-</td>
<td>Data error</td>
<td>-</td>
<td>Scale not connected</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>MBA405W</td>
<td></td>
<td>CPU error</td>
<td>Waveform error</td>
<td>Data error</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Count error</td>
</tr>
</tbody>
</table>

### Detector alarm (Spindle drive unit)

<table>
<thead>
<tr>
<th>Alarm number when the detector is connected to CN2 side</th>
<th>2B</th>
<th>2C</th>
<th>2D</th>
<th>2E</th>
<th>48</th>
<th>49</th>
<th>4A</th>
<th>4B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alarm number when the detector is connected to CN3 side</td>
<td>1B</td>
<td>1C</td>
<td>1D</td>
<td>1E</td>
<td>27</td>
<td>28</td>
<td>29</td>
<td>2A</td>
</tr>
<tr>
<td>TS5690, TS5691</td>
<td>MITSUBISHI</td>
<td>Memory error</td>
<td>Waveform error</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Count error</td>
</tr>
<tr>
<td>MDS-B-HR</td>
<td></td>
<td>Initialization error</td>
<td>-</td>
<td>Data error</td>
<td>-</td>
<td>Connection error</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>OSA18</td>
<td></td>
<td>CPU error</td>
<td>-</td>
<td>Data error</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>MBE405W</td>
<td></td>
<td>CPU error</td>
<td>Waveform error</td>
<td>Data error</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Count error</td>
</tr>
</tbody>
</table>

### Note
A driver processes all reset types of alarms as "PR". However, "AR" will be applied according to the detector.
## 7-2 Protective functions list of units

### Power supply alarm

<table>
<thead>
<tr>
<th>No.</th>
<th>LED display</th>
<th>Name</th>
<th>Details</th>
<th>Reset method</th>
</tr>
</thead>
<tbody>
<tr>
<td>61</td>
<td></td>
<td>Power supply: Power module overcurrent</td>
<td>Overcurrent protection function in the power module has started its operation.</td>
<td>PR</td>
</tr>
<tr>
<td>62</td>
<td></td>
<td>Power supply: Frequency error</td>
<td>The input power supply frequency increased above the specification range.</td>
<td>PR</td>
</tr>
<tr>
<td>66</td>
<td></td>
<td>Process error</td>
<td>An error occurred in the process cycle.</td>
<td>PR</td>
</tr>
<tr>
<td>67</td>
<td></td>
<td>Power supply: Phase interruption</td>
<td>An open-phase condition was detected in input power supply circuit.</td>
<td>PR</td>
</tr>
<tr>
<td>68</td>
<td></td>
<td>Power supply: Watchdog</td>
<td>The system does not operate correctly.</td>
<td>AR</td>
</tr>
<tr>
<td>69</td>
<td></td>
<td>Power supply: Grounding</td>
<td>The motor power cable is in contact with FG (Frame Ground).</td>
<td>PR</td>
</tr>
<tr>
<td>6A</td>
<td></td>
<td>Power supply: External contactor welding</td>
<td>A contact of the external contactor is welding.</td>
<td>PR</td>
</tr>
<tr>
<td>6B</td>
<td></td>
<td>Power supply: Rush circuit error</td>
<td>An error was detected in the rush circuit.</td>
<td>PR</td>
</tr>
<tr>
<td>6C</td>
<td></td>
<td>Power supply: Main circuit error</td>
<td>An error was detected in charging operation of the main circuit capacitor.</td>
<td>PR</td>
</tr>
<tr>
<td>6D</td>
<td></td>
<td>Parameter setting error</td>
<td>An error was detected in the parameter sent from the drive unit.</td>
<td>PR</td>
</tr>
<tr>
<td>6E</td>
<td></td>
<td>Memory error</td>
<td>An error was detected in the internal memory.</td>
<td>AR</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Unit ID error</td>
<td>An error was detected in the unit identification.</td>
<td>AR</td>
</tr>
<tr>
<td>6F</td>
<td></td>
<td>Power supply error</td>
<td>No power supply is connected to the drive unit, or a communication error was detected.</td>
<td>AR</td>
</tr>
<tr>
<td>70</td>
<td></td>
<td>Power supply: External emergency stop error</td>
<td>A mismatch of the external emergency stop input and NC emergency stop input continued for 30 seconds.</td>
<td>PR</td>
</tr>
<tr>
<td>71</td>
<td></td>
<td>Power supply: Instantaneous power interruption</td>
<td>The power was momentarily interrupted.</td>
<td>NR</td>
</tr>
<tr>
<td>72</td>
<td></td>
<td>Power supply: Fan stop</td>
<td>A cooling fan built in the power supply unit stopped, and overheat occurred in the power module.</td>
<td>PR</td>
</tr>
<tr>
<td>73</td>
<td></td>
<td>Power supply: Over regeneration</td>
<td>Over-regeneration detection level became over 100%. The regenerative resistor is overloaded. This alarm cannot be reset for 15 min from the occurrence to protect the regeneration resistor. Leave the drive system energized for more than 15 min, then turn the power ON to reset the alarm.</td>
<td>NR</td>
</tr>
<tr>
<td>75</td>
<td></td>
<td>Power supply: Overvoltage</td>
<td>L+ and L- bus voltage in main circuit exceeded the allowable value. As the voltage between L+ and L- is high immediately after this alarm, another alarm may occur if this alarm is reset in a short time. Wait more than 5 min before resetting so that the voltage drops.</td>
<td>NR</td>
</tr>
<tr>
<td>76</td>
<td></td>
<td>Power supply: External emergency stop setting error</td>
<td>The rotary switch setting of external emergency stop is not correct, or a wrong external emergency stop signal input.</td>
<td>AR</td>
</tr>
<tr>
<td>77</td>
<td></td>
<td>Power supply: Power module overheat</td>
<td>Thermal protection function in the power module has started its operation.</td>
<td>PR</td>
</tr>
</tbody>
</table>

(Note 1) If a power supply alarm (60 to 77) occurs, all servos will stop with the dynamic brakes, and all spindles will coast to a stop.

(Note 2) "b", "c", and "d" displayed on the power supply unit's LED as a solid light (not flickering) do not indicate an alarm.

(Note 3) For MDS-DM2-SPV Series, alarms in the above are the power supply alarms inside the MDS-DM2-SPV2/SPV3 section.
# Troubleshooting

## 7-2-2 List of warnings

When a warning occurs, a warning No. will appear on the NC monitor screen and with the LEDs on the front of the drive unit. Check the warning No., and remove the cause of the warning by following this list.

### (1) Drive unit warning

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Details</th>
<th>Reset method</th>
<th>Stop method</th>
</tr>
</thead>
<tbody>
<tr>
<td>96</td>
<td>Scale feedback error</td>
<td>An excessive difference in feedback amount was detected between the main side detector and the MPI scale in MPI scale absolute position detection system.</td>
<td>*</td>
<td>-</td>
</tr>
<tr>
<td>97</td>
<td>Scale offset error</td>
<td>An error was detected in the offset data that is read at the NC power-ON in MPI scale absolute position detection system.</td>
<td>PR</td>
<td>-</td>
</tr>
<tr>
<td>9B</td>
<td>Incremental detector/magnetic pole shift warning</td>
<td>The difference between the magnetic pole position after the phase Z has been passed (magnetic pole shift amount:SV028) and the initially detected position is excessive in the built-in motor’s incremental control system. The magnetic pole is controlled by the initial detection value.</td>
<td>*</td>
<td>-</td>
</tr>
<tr>
<td>9E</td>
<td>Absolute position detector: Revolution counter error</td>
<td>An error was detected in the revolution counter data of the absolute position detector. The accuracy of absolute position is not guaranteed.</td>
<td>*</td>
<td>-</td>
</tr>
<tr>
<td>9F</td>
<td>Battery voltage drop</td>
<td>The battery voltage to be supplied to the absolute position detector is dropping.</td>
<td>NR</td>
<td>-</td>
</tr>
<tr>
<td>A3</td>
<td>Distance-coded reference check / initial setup warning</td>
<td>This warning is detected until the axis reaches the reference position during the initial setup of the distance-coded reference check function. This warning turns OFF after the axis has reached the position, thus set the value displayed on the drive monitor to the parameter. This warning is detected during the initial setup of MBA405W. This warning turns OFF after the initial setup is completed when the axis has passed the Z-phase of MBA405W and the NC power has been turned again.</td>
<td>*</td>
<td>-</td>
</tr>
<tr>
<td>A4</td>
<td>Dual signal warning</td>
<td>An input was detected in the signal related to the dual signal.</td>
<td>*</td>
<td>-</td>
</tr>
<tr>
<td>A6</td>
<td>Fan stop warning</td>
<td>A cooling fan in the drive unit stopped.</td>
<td>*</td>
<td>-</td>
</tr>
<tr>
<td>A8</td>
<td>Overregeneration warning</td>
<td>Over-regeneration detection level exceeded 80%.</td>
<td>*</td>
<td>-</td>
</tr>
<tr>
<td>E1</td>
<td>Overload warning</td>
<td>A level of 80% of the Overload 1 alarm state was detected.</td>
<td>*</td>
<td>-</td>
</tr>
<tr>
<td>E4</td>
<td>Parameter warning</td>
<td>An incorrect set value was detected among the parameters send from the NC in the normal operation.</td>
<td>*</td>
<td>-</td>
</tr>
<tr>
<td>E6</td>
<td>Control axis detachment warning</td>
<td>A control axis is being detached. (State display)</td>
<td>*</td>
<td>-</td>
</tr>
<tr>
<td>E7</td>
<td>NC emergency stop</td>
<td>In NC emergency stop. (State display)</td>
<td>Deceleration stop enabled</td>
<td>-</td>
</tr>
<tr>
<td>E8 to EF</td>
<td>Power supply warning</td>
<td>The power supply unit detected a warning. The error details are different according to the connected power supply unit. Refer to “Power supply warning”.</td>
<td>*</td>
<td>“EA: Deceleration stop enabled”</td>
</tr>
</tbody>
</table>

(Note 1) Definitions of terms in the table are as follows.
- Main side detector: Detector connected to CN2
- Sub side detector: Detector connected to CN3

(Note 2) Resetting methods:
- *: Automatically reset once the cause of the warning is removed.
- NR: Reset with the NC RESET button. This warning can also be reset with the PR and AR resetting conditions.
- PR: Reset by turning the NC power ON again. This warning can also be reset with the AR resetting conditions.
- AR: Reset by turning the servo drive unit power ON again.

(Note 3) Servo and spindle motor do not stop when the warning occurs.

(Note 4) When an emergency stop is input, servo and spindle motor decelerate to a stop.

(When SV048, SV055 or SV056 is set for servo and when SP055 or SP056 is set for spindle.)
### (2) Power supply warning

<table>
<thead>
<tr>
<th>No.</th>
<th>LED display</th>
<th>Name</th>
<th>Details</th>
<th>Reset method</th>
</tr>
</thead>
<tbody>
<tr>
<td>E9</td>
<td>🟢</td>
<td>Instantaneous power interruption warning</td>
<td>The power was momentarily interrupted.</td>
<td>NR</td>
</tr>
<tr>
<td>EA</td>
<td>🟢</td>
<td>In external emergency stop state</td>
<td>External emergency stop signal was input.</td>
<td>*</td>
</tr>
<tr>
<td>EB</td>
<td>🟢</td>
<td>Power supply: Over regeneration warning</td>
<td>Over-regeneration detection level exceeded 80%.</td>
<td>*</td>
</tr>
<tr>
<td>EE</td>
<td>🟢</td>
<td>Power supply: Fan stop warning</td>
<td>A cooling fan built in the power supply unit stopped.</td>
<td>*</td>
</tr>
</tbody>
</table>

(Note 1) Resetting methods

* : Automatically reset once the cause of the warning is removed.

NR: Reset with the NC RESET button. This warning can also be reset with the PR and AR resetting conditions.

PR: Reset by turning the NC power ON again. This warning can also be reset with the AR resetting conditions.

When the control axis is removed, this warning can be reset with the NC RESET button. (Excluding warning 93.)

AR: Reset by turning the servo drive unit power ON again.

(Note 2) Servo and spindle motor do not stop when the warning occurs.

(Note 3) For MDS-DM2-SPV Series, alarms in the above are the power supply alarms inside the MDS-DM2-SPV2/SPV3 section.
7-3 Troubleshooting

Follow this section to troubleshoot the alarms that occur during start up or while the machine is operating. If the state is not improved with the following investigations, the drive unit may be faulty. Exchange the unit with another unit of the same capacity, and check whether the state is improved.

7-3-1 Troubleshooting at power ON

If the NC system does not start up correctly and a system error occurs when the NC power is turned ON, the drive unit may not have been started up properly. Check the LED display on the drive unit, and take measures according to this section.

<table>
<thead>
<tr>
<th>LED display</th>
<th>Symptom</th>
<th>Cause of occurrence</th>
<th>Investigation method</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>AA</td>
<td>Initial communication with the CNC was not completed correctly.</td>
<td>The drive unit axis No. setting is incorrect.</td>
<td>Is there any other drive unit that has the same axis No. set?</td>
<td>Set correctly.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The CNC setting is incorrect.</td>
<td>Is the No. of CNC controlled axes correct?</td>
<td>Set correctly.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Communication with CNC is incorrect.</td>
<td>Is the connector (CN1A, CN1B) connected?</td>
<td>Connect correctly.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Is the cable broken?</td>
<td>Replace the cable.</td>
<td></td>
</tr>
<tr>
<td>Ab</td>
<td>Initial communication with the CNC was not carried out.</td>
<td>The axis is not used, the setting is for use inhibiting.</td>
<td>Is the DIP switch set correctly?</td>
<td>Set correctly.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Communication with CNC is incorrect.</td>
<td>Is the connector (CN1A, CN1B) connected?</td>
<td>Connect correctly.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Is the cable broken?</td>
<td>Replace the cable.</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>An error was detected in the unit's memory and IC during the self-diagnosis at power ON.</td>
<td>The CPU peripheral circuit is abnormal.</td>
<td>Check the repeatability.</td>
<td>Replace the unit.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Check whether there is any abnormality with the unit's surrounding environment, etc.</td>
<td>Improve the surrounding environment.</td>
<td></td>
</tr>
</tbody>
</table>

The drive unit has started up normally if the following type of emergency stop (E7) is displayed on the display unit's LED display.

![Normal drive unit LED display at NC power ON (for 1st axis)](image-url)
## 7-3-2 Troubleshooting for each alarm No.

### Alarm No. 10
**Insufficient voltage**
Insufficient bus voltage was detected in main circuit.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>SV</th>
<th>SP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Check the timing when the alarm occurs.</td>
<td>The moment of READY ON</td>
<td>Check the investigation item No. 2.</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2 Did the external contactor turn ON at the READY ON?</td>
<td>The external contactor did not turn ON.</td>
<td>Check the investigation item No. 3.</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3 Check the wiring of contactor excitation circuit.</td>
<td>The wiring is correct.</td>
<td>Replace the contactor.</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4 Check the input voltage of the drive unit by a tester. (Voltage between L1 and L2, L2 and L3, L1 and L3)</td>
<td>The input voltage is normal.</td>
<td>Replace the drive unit.</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

### Alarm No. 11
**Axis selection error**
The axis selection rotary switch is incorrectly set.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Check the setting of the axis selection switch (rotary switch) on the top of the unit.</td>
<td>The same axis No. is set for the L and M axes.</td>
<td>Correctly set the axis No. 0 = No. 1 axis, 1 = No. 2 axis, ...</td>
</tr>
<tr>
<td>2 The value is duplicated with other axis.</td>
<td>Correctly set the axis No. 0 = No. 1 axis, 1 = No. 2 axis, ...</td>
<td>Replace the drive unit.</td>
</tr>
</tbody>
</table>

### Alarm No. 12
**Memory error 1**
Hardware error (a CPU or an internal memory error was detected during the power ON self-check.)

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Check the repeatability.</td>
<td>The error is always repeated.</td>
<td>Replace the drive unit.</td>
</tr>
<tr>
<td>2 Check if there is any abnormality in the unit's ambient environment. (Ex. Ambient temperature, noise, grounding)</td>
<td>The state returns to normal once, but occurs sometimes thereafter.</td>
<td>Check the investigation item No. 2.</td>
</tr>
</tbody>
</table>

### Alarm No. 13
**Software processing error 1**
An error was detected in the software execution state.
Software processing has not finished within the specified time.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Check the repeatability.</td>
<td>The error is always repeated.</td>
<td>Replace the drive unit.</td>
</tr>
<tr>
<td>2 Check if there is any abnormality in the unit's ambient environment. (Ex. Ambient temperature, noise, grounding)</td>
<td>The state returns to normal once, but occurs sometimes thereafter.</td>
<td>Check the investigation item No. 2.</td>
</tr>
<tr>
<td>3 Machine grounding check</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Alarm No. 14
**Software processing error 2**
The current processor is not operating correctly.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Check the repeatability.</td>
<td>The error is always repeated.</td>
<td>Replace the drive unit.</td>
</tr>
<tr>
<td>2 Check if there is any abnormality in the unit's ambient environment. (Ex. Ambient temperature, noise, grounding)</td>
<td>The state returns to normal once, but occurs sometimes thereafter.</td>
<td>Check the investigation item No. 2.</td>
</tr>
</tbody>
</table>

### Alarm No. 15
**Software processing error 3**
The current processor is not responding correctly.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Check the repeatability.</td>
<td>The error is always repeated.</td>
<td>Replace the drive unit.</td>
</tr>
<tr>
<td>2 Check if there is any abnormality in the unit's ambient environment. (Ex. Ambient temperature, noise, grounding)</td>
<td>The state returns to normal once, but occurs sometimes thereafter.</td>
<td>Check the investigation item No. 2.</td>
</tr>
</tbody>
</table>
### 7 Troubleshooting

#### Alarm No. 16

**Initial magnetic pole position detection error**

- **In linear motor or IPM spindle motor using absolute position detector, the servo ON has been set before the magnetic pole shift amount(servo:SV028, spindle:SP118) is set. In the initial magnetic pole position detection control, the pole position was not correctly set.**

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>SV</th>
<th>SP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Check the parameters, SV028 (for the servo) and SP118 (for the spindle).</td>
<td>The parameters have not been set. The parameters have been set, but the alarm occurs. The setting parameter value is the same even when initial magnetic pole function was executed again.</td>
<td>Set the magnetic shift pole amount(S118). Carry out the magnetic pole estimation again, as the setting value is wrong. Check the investigation item No. 2.</td>
<td>◯</td>
<td>◯</td>
</tr>
<tr>
<td>2 Check the repeatability.</td>
<td>The error is always repeated. The state returns to normal once, but occurs sometimes thereafter.</td>
<td>Replace the drive unit. Check the investigation item No. 3.</td>
<td>◯</td>
<td>◯</td>
</tr>
<tr>
<td>3 Check if there is any abnormality in the unit's ambient environment. (Ex. Ambient temperature, noise, grounding)</td>
<td>Take remedies according to the causes of the abnormality in the ambient environment.</td>
<td></td>
<td>◯</td>
<td>◯</td>
</tr>
</tbody>
</table>

#### Alarm No. 17

**A/D converter error**

- **An error was detected in the current FB.**

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>SV</th>
<th>SP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Check the repeatability.</td>
<td>The error is always repeated. The state returns to normal, but occurs thereafter.</td>
<td>Replace the drive unit. Check the investigation item No. 2.</td>
<td>◯</td>
<td>◯</td>
</tr>
<tr>
<td>2 Check if there is any abnormality in the unit's ambient environment. (Ex. Ambient temperature, noise, grounding)</td>
<td>Take remedies according to the causes of the abnormality in the ambient environment.</td>
<td></td>
<td>◯</td>
<td>◯</td>
</tr>
</tbody>
</table>

#### Alarm No. 18

**Main side detector: Initial communication error**

- **An error was detected in the initial communication with the motor side detector.**

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>SV</th>
<th>SP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Check the servo parameter (SV025.ent) setting value. Check the spindle parameter(SP020) setting value.</td>
<td>The value is not set correctly. The value is set correctly.</td>
<td>Correctly set SV025 for the servo, and SP020 for the spindle. Check the investigation item No. 3.</td>
<td>◯</td>
<td>◯</td>
</tr>
<tr>
<td>2 Check the detector. Check if a pulse detector is used for serial detector specifications.</td>
<td>The pulse detector is used. The serial detector is used.</td>
<td>Replace the detector to the serial. Check the investigation item No. 3.</td>
<td>◯</td>
<td>◯</td>
</tr>
<tr>
<td>3 Jiggle the detector connectors (drive unit side and detector side) and check if they are disconnected.</td>
<td>The connector is disconnected (or loose). The connector is not disconnected.</td>
<td>Correctly install. Check the investigation item No. 4.</td>
<td>◯</td>
<td>◯</td>
</tr>
<tr>
<td>4 Turn on the power OFF, and check the detector cable connection with a tester.</td>
<td>The connection is faulty. The connection is normal.</td>
<td>Replace the detector cable. Check the investigation item No. 5.</td>
<td>◯</td>
<td>◯</td>
</tr>
<tr>
<td>5 Replace with another unit, and check whether the fault is on the unit side or detector side.</td>
<td>The alarm is on the drive unit side. The alarm is on the detector side.</td>
<td>Replace the drive unit. Check the investigation item No. 6.</td>
<td>◯</td>
<td>◯</td>
</tr>
<tr>
<td>6 Check if there is any abnormality in the detector's ambient environment. (Ex. Ambient temperature, noise, grounding)</td>
<td>Take remedies according to the causes of the abnormality in the ambient environment.</td>
<td></td>
<td>◯</td>
<td>◯</td>
</tr>
</tbody>
</table>

#### Alarm No. 19

**Detector communication error in synchronous control:**

- **An error was detected in the machine side detector of the secondary axis at the speed command synchronization control.**

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>SV</th>
<th>SP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Check the servo parameter value of secondary axis (SV025.pen:position detector).</td>
<td>The value is not set correctly. The value is set correctly.</td>
<td>Correctly set. Check the investigation item No. 2.</td>
<td>◯</td>
<td>◯</td>
</tr>
<tr>
<td>2 Check if there are no problems in the connection between the detector (linear scale) and MDS-B-HR.</td>
<td>The screw connected to MDS-B-HR is wound down. No problems found in the connector connection.</td>
<td>Tighten up the screw. Check the investigation item No. 3.</td>
<td>◯</td>
<td>◯</td>
</tr>
<tr>
<td>3 Jiggle the detector connectors (drive unit side and detector side) and check if they are disconnected.</td>
<td>The connector is disconnected (or loose). The connector is not disconnected.</td>
<td>Correctly install. Check the investigation item No. 3.</td>
<td>◯</td>
<td>◯</td>
</tr>
<tr>
<td>4 Turn on the power OFF, and check the detector cable connection with a tester.</td>
<td>The connection is faulty. The connection is normal.</td>
<td>Replace the detector cable. Check the investigation item No. 4.</td>
<td>◯</td>
<td>◯</td>
</tr>
<tr>
<td>5 Replace with another unit, and check whether the fault is on the unit side or detector side.</td>
<td>The alarm is on the drive unit side. The alarm is on the detector side.</td>
<td>Replace the drive unit. Check the investigation item No. 5.</td>
<td>◯</td>
<td>◯</td>
</tr>
<tr>
<td>6 Check if there is any abnormality in the detector's ambient environment. (Ex. Ambient temperature, noise, grounding)</td>
<td>Take remedies according to the causes of the abnormality in the ambient environment.</td>
<td></td>
<td>◯</td>
<td>◯</td>
</tr>
</tbody>
</table>
### Alarm No. 1A
**Sub side detector: Initial communication error**

Initial communication with the machine side detector failed.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Check the servo parameter (SV025:pen:position detector) setting value.</td>
<td>The value is not set correctly.</td>
<td>Correctly set SV025:</td>
</tr>
<tr>
<td>Check the spindle parameter (SP019) setting value.</td>
<td>The value is set correctly.</td>
<td>Check the investigation item No. 2.</td>
</tr>
<tr>
<td>Are the serial communication type detector parameters set for the pulse type detector?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Check the detector.</td>
<td>The pulse detector is used.</td>
<td>Replace the detector.</td>
</tr>
<tr>
<td></td>
<td>The serial detector is used.</td>
<td>Check the investigation item No. 3.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jiggle the detector connectors (drive unit side and detector side) and check if they are disconnected.</td>
<td>The connector is disconnected (or loose).</td>
<td>Correctly install.</td>
</tr>
<tr>
<td></td>
<td>The connector is not disconnected.</td>
<td>Check the investigation item No. 4.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turn the power OFF, and check the detector cable connection with a tester.</td>
<td>The connection is faulty.</td>
<td>Replace the detector cable.</td>
</tr>
<tr>
<td></td>
<td>The connection is normal.</td>
<td>Check the investigation item No. 5.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Replace with another unit, and check whether the fault is on the unit side or detector side.</td>
<td>The alarm is on the drive unit side.</td>
<td>Replace the drive unit.</td>
</tr>
<tr>
<td></td>
<td>The alarm is on the detector side.</td>
<td>Check the investigation item No. 6.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Check if there is any abnormality in the detector's ambient environment. (Ex. Ambient temperature, noise, grounding)</td>
<td></td>
<td>Take remedies according to the causes of the abnormality in the ambient environment.</td>
</tr>
</tbody>
</table>

### Alarm No. 1B
**Sub side detector: Error 1**
The machine side detector (CN3 side) detected an error. As details differ for each detector, refer to section "Detector alarm".

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Check whether the servo axis has moved and the spindle has rotated when an alarm occurred.</td>
<td>The axis has operated.</td>
<td>Check the investigation item No. 3.</td>
</tr>
<tr>
<td></td>
<td>The axis has not operated.</td>
<td>Check the investigation item No. 2.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Check whether the operation at low speed is normal.</td>
<td>The operation is normal.</td>
<td>Check the investigation item No. 3.</td>
</tr>
<tr>
<td></td>
<td>The operation is not normal.</td>
<td>Check the cautions at power ON.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>[1] Wiring check</td>
</tr>
<tr>
<td></td>
<td></td>
<td>[2] Parameter check</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jiggle the detector connectors (drive unit side and detector side) and check if they are disconnected.</td>
<td>The connector is disconnected (or loose).</td>
<td>Correctly install.</td>
</tr>
<tr>
<td></td>
<td>The connector is not disconnected.</td>
<td>Check the investigation item No. 4.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turn the power OFF, and check the detector cable connection with a tester.</td>
<td>The connection is faulty.</td>
<td>Replace the detector cable.</td>
</tr>
<tr>
<td></td>
<td>The connection is normal.</td>
<td>Check the investigation item No. 5.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Replace with another unit, and check whether the fault is on the unit side or detector side.</td>
<td>The alarm is on the drive unit side.</td>
<td>Replace the drive unit.</td>
</tr>
<tr>
<td></td>
<td>The alarm is on the detector side.</td>
<td>Check the investigation item No. 6.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Check if there is any abnormality in the detector's ambient environment. (Ex. Ambient temperature, noise, grounding)</td>
<td></td>
<td>Take remedies according to the causes of the abnormality in the ambient environment.</td>
</tr>
</tbody>
</table>

### Alarm No. 1C
**Sub side detector: Error 2**
The machine side detector (CN3 side) detected an error. As details differ for each detector, refer to section "Detector alarm".

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Check the alarm No. &quot;1B&quot; items.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Alarm No. 1D
**Sub side detector: Error 3**
The machine side detector (CN3 side) detected an error. As details differ for each detector, refer to section "Detector alarm".

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Check the alarm No. &quot;1B&quot; items.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Alarm No. 1E
**Sub side detector: Error 4**
The machine side detector (CN3 side) detected an error. As details differ for each detector, refer to section "Detector alarm".

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Check the alarm No. &quot;1B&quot; items.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

7 - 13
## Alarm No. 1F
### Sub side detector: Communication error
An error was detected in communication data with the linear scale or the ball screw side detector. Or the communication was interrupted.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>SV</th>
<th>SP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Jiggle the detector connectors (drive unit side and detector side) and check if they are disconnected.</td>
<td>The connector is not disconnected (or loose).</td>
<td>Correctly install.</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>2 Is the detector cable wired in the same conduit as the motor’s power cable, or are the two cables laid in parallel near each other?</td>
<td>The cables are wired near each other. (Noise is entering from the power cable.)</td>
<td>Wire the detector cable away from the power cable.</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>3 Is the motor FG wire connected only to the drive unit which drives it? (Is the motor grounded to one point?)</td>
<td>The motor FG wire is grounded on the motor side.</td>
<td>Ground the motor to one point, connecting the wires together on the drive unit side.</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>4 Turn the power OFF, and check the detector cable connection with a tester. (Is the cable shielded?)</td>
<td>The connection is faulty.</td>
<td>Replace the detector cable.</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>5 Replace with another unit, and check whether the fault is on the unit side or detector side.</td>
<td>The alarm is on the drive unit side.</td>
<td>Replace the drive unit.</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>6 Check if there is any abnormality in the detector’s ambient environment. (Ex. Ambient temperature, noise, grounding)</td>
<td></td>
<td>Take remedies according to the causes of the abnormality in the ambient environment.</td>
<td>✔</td>
<td>✔</td>
</tr>
</tbody>
</table>

## Alarm No. 21
### Sub side detector: No signal
When an excessive error alarm occurred, no signal from the machine side detector was detected.

An error was detected in the ABZ-phase in the full closed loop control system.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>SV</th>
<th>SP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Check the servo parameter (SV025: pen: machine side detector), and spindle parameter (SP019) setting value. Are the pulse type detector parameters set for a serial communication type detector?</td>
<td>The value is not set correctly.</td>
<td>Correctly set SV025:pen for the servo and SP019 for the spindle (including SP097 for pulse type).</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>2 Jiggle the detector connectors (drive unit side and detector side) and check if they are disconnected.</td>
<td></td>
<td>Check the investigation item No. 3.</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>3 Turn the power OFF, and check the detector cable connection with a tester.</td>
<td></td>
<td>Check the investigation item No. 4.</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>4 Replace with another unit, and check whether the fault is on the unit side or detector side.</td>
<td></td>
<td>Check the investigation item No. 5.</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>5 Check if there is any abnormality in the detector’s ambient environment. (Ex. Ambient temperature, noise, grounding)</td>
<td></td>
<td>Check the investigation item No. 6.</td>
<td>✔</td>
<td>✔</td>
</tr>
</tbody>
</table>

## Alarm No. 22
### Detector data error:
Drive unit received a wrong feedback data (scattered data) from the detector and position deviation occurred.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>SV</th>
<th>SP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Check if the installation of the detector is loosened.</td>
<td>It is loosened.</td>
<td>Tightly install the detector.</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>2 Check if an excessive vibration is occurring during machining.</td>
<td>An excessive vibration is occurring.</td>
<td>Check the installation of the machine.</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>3 Check the investigation item No. 2 or subsequent items in Alarm No. 21.</td>
<td>An excessive vibration is not occurring.</td>
<td>Check the investigation item No. 3.</td>
<td>✔</td>
<td>✔</td>
</tr>
</tbody>
</table>
# MDS-DM2 Series Instruction Manual
## 7-3 Troubleshooting

### Alarm No. 23
**Excessive speed error**
A difference between the speed command and speed feedback was continuously exceeding 50 r/min for longer than the setting time.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>SV</th>
<th>SP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Check the U, V and W wiring connected to the spindle drive unit.</td>
<td>The wires are not correctly connected.</td>
<td>Correctly connect.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>The wires are correctly connected.</td>
<td>Check the investigation item No. 2.</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Check the spindle parameter SP020, SP026, SP027, from SP057 to SP064 and spindle specification parameters from slimit1 to slimit4 setting value.</td>
<td>The correct values are not set.</td>
<td>Correctly set.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>The correct values are set.</td>
<td>Check the investigation item No. 3.</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Measure the acceleration/ deceleration time from 0 to the point where the spindle speed reaches its maximum.</td>
<td>If the alarm occurs when forward run is changed to reverse run, measure the acceleration/ deceleration time from the forward to reverse. Also measure it from the reverse to forward.</td>
<td>The speed deterioration due to load amount has exceeded the tolerable range which is determined by the parameter SP096.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- If SP096 is set to 0, it is regarded as 85%. Thus a speed of 85% of the machining speed or faster will be the tolerable speed.</td>
<td>Reduce the cutting load to mitigate the speed deterioration.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>The load amount is within the SP096 setting value.</td>
<td>Replace the tool.</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Check the load amount when the alarm occurred during cutting.</td>
<td>The correct values are set.</td>
<td>Review the power supply capacity.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>The correct values are not set.</td>
<td>Establish the zero point.</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Check the fluctuation of the input voltage into the power supply unit with a tester.</td>
<td>Voltage drop during acceleration is 200V or less</td>
<td>Review the power supply capacity.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Voltage drop during deceleration is 200V or more</td>
<td>Establish the zero point.</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Check the capacity of the drive unit.</td>
<td>The capacity does not satisfy the motor output.</td>
<td>Change the capacity to the selected one.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>The capacity satisfies the motor output.</td>
<td>Replace the unit.</td>
<td></td>
</tr>
</tbody>
</table>

### Alarm No. 24
**Grounding**
The motor power cable is in contact with FG (Frame Ground).

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>SV</th>
<th>SP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Measure the insulation across the power cables (U,V,W) for connected motors and the ground. (Carry out a megger test.) When the insulation is measured, disconnect wires from the drive unit.</td>
<td>Less than 1MΩ.</td>
<td>The motor or power cable may be ground faulted.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1MΩ or more.</td>
<td>Check the investigation item No. 2.</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Has oil come in contact with the motor or power cable?</td>
<td>Oil has come in contact.</td>
<td>Take measures so that oil does not come in contact. Check the motor's cannon connector and the inside of the terminal box, and clean as necessary.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Oil has not come in contact.</td>
<td>Clean the drive unit.</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Measure the insulation again.</td>
<td>Less than 1MΩ.</td>
<td>Replace the motor or cable.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1MΩ or more.</td>
<td>Check the investigation item No. 4.</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Measure the resistance across the U, V, W phase terminals of the servo/spindle drive unit and the ground with a tester. (Note) Do not measure the insulation as the unit is damaged.</td>
<td>Less than 100kΩ.</td>
<td>Replace the drive unit.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>100kΩ or more.</td>
<td>Replace the power supply unit.</td>
<td></td>
</tr>
</tbody>
</table>

### Alarm No. 25
**Absolute position data lost**
The absolute position was lost, as the backup battery voltage dropped in the absolute position detector.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>SV</th>
<th>SP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Is warning 9F occurring at the same time?</td>
<td>The warning is occurring.</td>
<td>Check the investigation item No. 2.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>The warning is not occurring.</td>
<td>Check the investigation item No. 3.</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Measure the battery voltage with a tester at the DC range.</td>
<td>Less than 3V.</td>
<td>Replace the battery, and establish the zero point.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3V or more.</td>
<td>Check the NC bus cable connection.</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Did alarm No.18 occur when the power was turned ON the last time?</td>
<td>Alarm No.18 occurred.</td>
<td>Turn the drive unit control power ON again, and establish the zero point.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Alarm No.18 did not occur.</td>
<td>Check the investigation item No. 4.</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Was the detector cable or battery cable left disconnected from the unit for a long time?</td>
<td>The unit was left disconnected for a long time.</td>
<td>Turn the drive unit control power ON again, and establish the zero point.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Guide at delivery: 20 hours or more After 5 years: 10 hours or more</td>
<td>Check the investigation item No. 5.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>The cables were not left disconnected.</td>
<td>Check the investigation item No. 6.</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Check the detector cable or battery cable connection with a tester.</td>
<td>The connection is faulty.</td>
<td>Replace the cable.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>The connection is normal.</td>
<td>Replace the drive unit.</td>
<td></td>
</tr>
</tbody>
</table>
### 7 Troubleshooting

#### Alarm No. 26
**Unused axis error**
A power module error occurred in the axis whose axis No. selection switch was set to "F" (free axis).

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>SV</th>
<th>SP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Check the repeatability.</td>
<td>The error is always repeated.</td>
<td>Replace the drive unit.</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>2. Check if there is any abnormality in the unit's ambient environment. (Ex. Ambient temperature, noise, grounding)</td>
<td>The state returns to normal once, but occurs sometimes thereafter.</td>
<td>Check the investigation item No. 2.</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

#### Alarm No. 27
**Sub side detector: Error 5**
The machine side detector (CN3 side) detected an error. As details differ for each detector, refer to section "Detector alarm".

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>SV</th>
<th>SP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Check the alarm No. &quot;1B&quot; items.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Alarm No. 28
**Sub side detector: Error 6**
The machine side detector (CN3 side) detected an error. As details differ for each detector, refer to section "Detector alarm".

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>SV</th>
<th>SP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Check the alarm No. &quot;1B&quot; items.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Alarm No. 29
**Sub side detector: Error 7**
The machine side detector (CN3 side) detected an error. As details differ for each detector, refer to section "Detector alarm".

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>SV</th>
<th>SP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Check the alarm No. &quot;1B&quot; items.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Alarm No. 2A
**Sub side detector: Error 8**
The machine side detector (CN3 side) detected an error. As details differ for each detector, refer to section "Detector alarm".

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>SV</th>
<th>SP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Check the alarm No. &quot;1B&quot; items.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Alarm No. 2B
**Main side detector: Error 1**
The motor side detector (CN2 side) detected an error.
(Note) It includes the linear scale in the case of linear motor.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>SV</th>
<th>SP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Check the alarm No. &quot;1B&quot; items.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Alarm No. 2C
**Main side detector: Error 2**
The motor side detector (CN2 side) detected an error.
(Note) It includes the linear scale in the case of linear motor.
As details differ for each detector, refer to section "Detector alarm".

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>SV</th>
<th>SP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Check the alarm No. &quot;1B&quot; items.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Alarm No. 2D
**Main side detector: Error 3**
The motor side detector (CN2 side) detected an error.
(Note) It includes the linear scale in the case of linear motor.
As details differ for each detector, refer to section "Detector alarm".

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>SV</th>
<th>SP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Check the alarm No. &quot;1B&quot; items.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Alarm No. 2E
Main side detector: Error 4
The motor side detector (CNZ side) detected an error. (Note) It includes the linear scale in the case of linear motor. As details differ for each detector, refer to section "Detector alarm".

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>SV</th>
<th>SP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Check the alarm No. &quot;1B&quot; items.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Alarm No. 2F
Main side detector: Communication error
An error was detected in communication data with the motor side detector or with the linear scale of a linear servo system. Or the communication was interrupted.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>SV</th>
<th>SP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Jiggle the detector connectors (drive unit side and detector side) and check if they are disconnected.</td>
<td>The connector is disconnected (or loose).</td>
<td>Correctly install.</td>
<td>○</td>
</tr>
</tbody>
</table>

### Alarm No. 30
Over regeneration:
Over-regeneration detection level became over 100%. The regenerative resistor is overloaded.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>SV</th>
<th>SP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Check if the regenerative capacity exceeds the regenerative resistor tolerant capacity.</td>
<td>The regenerative capacity exceeds the regenerative resistor tolerant capacity.</td>
<td>Add the option regenerative resistor or replace it.</td>
<td>○</td>
</tr>
<tr>
<td>2</td>
<td>Check if the parameter is set incorrectly, and check the values of sv036 and sp032.</td>
<td>The parameters are set incorrectly.</td>
<td>Change the parameters.</td>
<td>○</td>
</tr>
<tr>
<td>3</td>
<td>Is an external regenerative resistor used?</td>
<td>An external regenerative resistor is used.</td>
<td>Check the investigation item No. 5.</td>
<td>○</td>
</tr>
<tr>
<td>4</td>
<td>Is the short wire connected between P and O terminal? Are there any problems with the connection condition?</td>
<td>The wire is not connected.</td>
<td>Connect the wire.</td>
<td>○</td>
</tr>
<tr>
<td>5</td>
<td>Is the connection of the regenerative resistor or regeneration resistor cable correct?</td>
<td>The connection is incorrect.</td>
<td>Rewire.</td>
<td>○</td>
</tr>
<tr>
<td>6</td>
<td>Is the regeneration resistor or the regeneration resistor cable broken? Disconnect the regeneration resistor terminal and check the resistance value with a tester.</td>
<td>The regeneration resistor is broken. Or the resistance value is large.</td>
<td>Replace the regenerative resistor.</td>
<td>○</td>
</tr>
<tr>
<td>7</td>
<td>Check if the power supply voltage is too high.</td>
<td>The power supply voltage exceeded 253V.</td>
<td>Review the power supply.</td>
<td>○</td>
</tr>
</tbody>
</table>
### Alarm No. 31: Overspeed
The motor was detected to rotate at a speed exceeding the allowable speed (in the case of linear motor, it was detected to move at a speed exceeding the allowable speed).

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>SV</th>
<th>SP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Check if the unit in which the alarm was detected is servo or spindle.</td>
<td>The alarm was detected in servo.</td>
<td>Check the investigation item No. 2.</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>2. Check the servo parameters SV001 (PC1), SV002 (PC2), SV018 (PIT), and SV025 (MTYP) settings.</td>
<td>The settings are incorrect.</td>
<td>Correctly set.</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>3. Check the spindle parameter SP026 (TSP) setting.</td>
<td>The setting is incorrect.</td>
<td>Correctly set.</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>4. Check the PLG output waveform.</td>
<td>There is a problem.</td>
<td>Adjust the PLG output waveform.</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>5. Check whether the speed waveform is overshooting.</td>
<td>The waveform is overshooting.</td>
<td>Check if there is any abnormality in the unit’s ambient environment. (Ex.: Ambient temperature, noise, grounding)</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>6. Check the repeatability.</td>
<td>[1] The alarm occurs when the motor is stopped. [2] The rotation speed displayed on the drive monitor varies when the motor is stopped.</td>
<td>Replace the detector or detector cable.</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

### Alarm No. 32: Power module overcurrent
Overcurrent protection function in the power module has started its operation.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>SV</th>
<th>SP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Disconnect the power cable (U, V, W) from the unit’s terminal block and motor, and check whether a short-circuit between the power cable or whether conduction at both end of wiring occurs with a tester.</td>
<td>[1] Before disconnecting the power cable, the cable connector or screw has been loosened. [2] The short-circuit condition persists even after disconnecting the cable from the unit and motor.</td>
<td>[1] Tighten it. [2] Check the motor wiring. [3] Replace the power cable.</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>2. Check the motor insulation with a (megger) tester. -Between motor power and ground earth</td>
<td>Less than 1MΩ. (Grounding)</td>
<td>Replace the motor.</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>3. Check the unit capacity. [1] The same size but smaller than the selected capacity. [2] The combination of the motor and axis is alternated in a 2-axis unit.</td>
<td>The capacity is small.</td>
<td>Replace to the unit of the selected capacity or change the axis.</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>4. Check the current loop gain parameters.</td>
<td>Different from the standard parameter settings.</td>
<td>Adjust the value to the standard setting.</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>5. Jiggle the detector connectors (drive unit side and detector side) and check if they are disconnected.</td>
<td>The connector is disconnected (or loose).</td>
<td>Correctly install.</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>6. Turn the power OFF, and check the detector cable connection with a tester.</td>
<td>Connection is faulty.</td>
<td>Replace the detector cable.</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>7. Check the repeatability.</td>
<td>The state returns to normal once, but occurs sometimes thereafter.</td>
<td>Check the investigation item No. 8.</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>8. Check for any abnormalities in the unit’s ambient environment. (Ex.: Ambient temperature, noise, grounding)</td>
<td></td>
<td>Take remedies according to the causes of the abnormality in the ambient environment.</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>
### Alarm No. 33: Overvoltage

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>SV</th>
<th>SP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is an external regenerative resistor used?</td>
<td>An external regenerative resistor is used.</td>
<td>Check the investigation item No. 3.</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>Is the short wire connected between P and D terminal?</td>
<td>The wire is not connected.</td>
<td>Connect the wire.</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>Are there any problems with the connection condition?</td>
<td>The connector is disconnected.</td>
<td>Reconnect the connector.</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The connector has a contact fault.</td>
<td>Replace the connector.</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The connection is correct.</td>
<td>Check the investigation item No. 6.</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>Is the combination of the used regenerative resistor and drive unit appropriate?</td>
<td>The combination is incorrect.</td>
<td>Replace the correct regenerative resistor.</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The combination is normal.</td>
<td>Check the investigation item No. 4.</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>Is the connection of the regenerative resistor or regeneration resistor cable correct?</td>
<td>The connection is incorrect.</td>
<td>Rewire.</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The connection is correct.</td>
<td>Check the investigation item No. 5.</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>Is the regeneration resistor or the regeneration resistor cable broken?</td>
<td>The regeneration resistor is broken.</td>
<td>Replace the regeneration resistor.</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Or the resistance value is large.</td>
<td>Replace the regenerative resistor.</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>Disconnect the regeneration resistor terminal and check the resistance value with a tester.</td>
<td>The resistance value is normal.</td>
<td>Check the investigation item No. 6.</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>The acceleration/deceleration time constant is too short. At acceleration/deceleration, has the speed overshoot reached to the current limit?</td>
<td>Reached to the current limit.</td>
<td>Increase the acceleration/deceleration time constant.</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The speed overshoot is applied.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>The connection is normal.</td>
<td>Replace the drive unit.</td>
<td>✔</td>
<td></td>
</tr>
</tbody>
</table>

### Alarm No. 34: NC-DRV communication: CRC error

An error was detected in the data received from the CNC.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>SV</th>
<th>SP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gently shake the connectors of the optical cables by hand that link between NC and drive unit or between drive units to check for loosening and disconnection. Also check if an excessive force is not applied on them.</td>
<td>The connector is loose or nearly disconnected. The tab of the connector is damaged.</td>
<td>Correctly install. Replace the cable.</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The connector is not disconnected.</td>
<td>Check the investigation item No. 2.</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>Check for damages at the ends of the optical communication cable. Replace the cable.</td>
<td>The damage is found at the end of the cable.</td>
<td>Replace the communication cable.</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The connection is normal.</td>
<td>Check the investigation item No. 3.</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>Check whether the NC or drive unit software version was changed recently.</td>
<td>The version was changed.</td>
<td>Change software version back to the original.</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The version was not changed.</td>
<td>Check the investigation item No. 4.</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>Replace with another drive unit, and check whether the fault is on the NC side or drive unit side.</td>
<td>The alarm is on the drive unit side.</td>
<td>Replace the drive unit.</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The alarm is on the unit connections.</td>
<td>Check the investigation item No. 5.</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>Check if there is any abnormality in the unit’s ambient environment. (Ex. Ambient temperature, noise, grounding)</td>
<td>Take remedies according to the causes of the abnormality in the ambient environment.</td>
<td>✔</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Alarm No. 35: NC command error

The travel command data that was received from the CNC was excessive.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>SV</th>
<th>SP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Please contact the Service Center, Service Station, Sales Office or dealer.</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Alarm No. 36: NC-DRV communication: Communication error

The communication with the CNC was interrupted.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>SV</th>
<th>SP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Check the alarm No. 34 items.</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Alarm No. 37
### Initial parameter error

An incorrect parameter was detected among the parameters received from the CNC at the power ON.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Check if the unit in which the alarm was detected is servo axis or spindle.</td>
<td>The alarm was detected in servo axis.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The alarm was detected in spindle.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Wrong parameters were set.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The electronic gears are overflowing.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The absolute position detection parameter is valid when OSE104 and OSE105 are connected. (Absolute position control cannot be used.)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SV082/bitC to F are the same setting in one unit.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SV082/bitC to F are not the same setting in one unit.</td>
</tr>
<tr>
<td>2</td>
<td>Check the error parameters displayed on the NC diagnosis screen.</td>
<td>Servo parameters: SV001 to SV065, SV082</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Check if the unit in which the alarm was detected is servo axis or spindle.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The alarm was detected in spindle.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Wrong parameters were set.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The electronic gears are overflowing.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The absolute position detection parameter is valid when OSE104 and OSE105 are connected. (Absolute position control cannot be used.)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SV082/bitC to F are the same setting in one unit.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SV082/bitC to F are not the same setting in one unit.</td>
</tr>
<tr>
<td>3</td>
<td>Check the error parameters displayed on the NC diagnosis screen.</td>
<td>Spindle parameters: SP001 to SP240</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Check if the unit in which the alarm was detected is servo axis or spindle.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The alarm was detected in spindle.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Wrong parameters were set.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The electronic gears are overflowing.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The absolute position detection parameter is valid when OSE104 and OSE105 are connected. (Absolute position control cannot be used.)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SV082/bitC to F are the same setting in one unit.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SV082/bitC to F are not the same setting in one unit.</td>
</tr>
<tr>
<td>4</td>
<td>Check the alarm No. “34” items.</td>
<td></td>
</tr>
</tbody>
</table>

## Alarm No. 38
### NC-DRV communication: Protocol error 1

An error was detected in the communication frames received from the CNC.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Check the alarm No. “34” items.</td>
<td></td>
</tr>
</tbody>
</table>

## Alarm No. 39
### NC-DRV communication: Protocol error 2

An error was detected in the axis information data received from the CNC.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Check the alarm No. “34” items.</td>
<td></td>
</tr>
</tbody>
</table>

## Alarm No. 3A
### Overcurrent

Excessive current was detected in the motor drive current.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Check whether vibration is occurring at the table or spindle.</td>
<td>Vibration is occurring.</td>
</tr>
<tr>
<td>[2] Check if the vibration caused by the load fluctuation is occurring.</td>
<td>There is no vibration.</td>
<td>Check the investigation item No. 2.</td>
</tr>
<tr>
<td>2</td>
<td>Check the repeatability of the alarm at the rapid traverse feed for the servo and at acceleration/ deceleration for the spindle.</td>
<td>The alarm occurs.</td>
</tr>
<tr>
<td>(Note) Check the phenomenon caused by the load fluctuation.</td>
<td>The alarm does not occur.</td>
<td>Check the investigation item No. 3.</td>
</tr>
<tr>
<td>3</td>
<td>For the servo, perform the rapid traverse feed repeatedly and check if the max. current value is within the tolerable value.</td>
<td>The displayed value is high.</td>
</tr>
<tr>
<td>For the spindle, check the load meter value at the unloaded max. rotation speed.</td>
<td>The displayed value is appropriate.</td>
<td>Check the investigation item No. 4.</td>
</tr>
<tr>
<td>4</td>
<td>Disconnect the power cable (U,V,W) from the terminal block and the cannon plug from the motor. Check the insulation of the cable and motor with a tester.</td>
<td>The resistance value of the power cable for each phase is not “∞”.</td>
</tr>
<tr>
<td>The resistance value of the motor terminal and unit (shaft) is 1MΩ or less.</td>
<td>Replace the motor (Note) For the motors equipped with the absolute position detector, the zero point must be established.</td>
<td></td>
</tr>
<tr>
<td>The values below are met when measured with a tester.</td>
<td>Check the investigation item No. 5.</td>
<td></td>
</tr>
<tr>
<td>Cable: ∞ Motor terminal - unit:1MΩ or more</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Check the insulation between the motor power cable and FG.</td>
<td>There is a ground fault at the power cable.</td>
</tr>
<tr>
<td>There is no problem.</td>
<td>Check the investigation item No. 6.</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Check if there is any abnormality in the motor’s ambient environment. (Ex. Ambient temperature, cutting water)</td>
<td>Take remedies according to the causes of the abnormality in the ambient environment.</td>
</tr>
</tbody>
</table>
## MDS-DM2 Series Instruction Manual
### 7-3 Troubleshooting

### Alarm No. 3B  
**Power module overheat**
Thermal protection function in the power module has started its operation.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>SV</th>
<th>SP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Check that the fan of the drive unit is rotating correctly.</td>
<td>Large amounts of cutting oil or cutting chips, etc., are adhered to the fan, or the rotation is slow.</td>
<td>Clean or replace the fan.</td>
<td>○</td>
</tr>
<tr>
<td></td>
<td>The fan is rotating properly.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Check whether the heat dissipating fins are dirty.</td>
<td>Cutting oil or cutting chips, etc., are adhered, and the fins are clogged.</td>
<td>Clean the fins.</td>
<td>○</td>
</tr>
<tr>
<td></td>
<td>Cutting chips etc. are not adhered to the fins.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Measure the drive unit's ambient temperature.</td>
<td>55°C or more.</td>
<td>Improve the efficiency cooling for the power distribution panel.</td>
<td>○</td>
</tr>
<tr>
<td></td>
<td>Less than 55°C.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Check if there is any abnormality in the unit's ambient environment. (Ex. Ambient temperature, noise, grounding)</td>
<td></td>
<td>Take remedies according to the causes of the abnormality in the ambient environment.</td>
<td>○</td>
</tr>
</tbody>
</table>

### Alarm No. 3C  
**Regeneration circuit error:**  
An error was detected in the regenerative transistor or in the regenerative resistor.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>SV</th>
<th>SP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Check if an external regenerative resistor is used.</td>
<td>An external regenerative resistor is used.</td>
<td>Check the investigation item No. 3.</td>
<td>○</td>
</tr>
<tr>
<td></td>
<td>A built-in regenerative resistor is used.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Is the short wire connected between P and D terminal? Are there any problems with the connection condition? (looseness of the screw)</td>
<td>The wire is not connected.</td>
<td>Connect the wire.</td>
<td>○</td>
</tr>
<tr>
<td></td>
<td>The connector is disconnected.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>The connector has a contact fault.</td>
<td>Reconnect the connector.</td>
<td>Replace the connector.</td>
<td>○</td>
</tr>
<tr>
<td></td>
<td>The connection is correct.</td>
<td>Replace the drive unit.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Is the connection of the regenerative resistor or regeneration resistor cable correct?</td>
<td>The wire is not connected.</td>
<td>Connect the wire.</td>
<td>○</td>
</tr>
<tr>
<td></td>
<td>The connection is correct.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Is the regeneration resistor or the regeneration resistor cable broken? Disconnect the regenerative resistor terminal and check the resistance value with a tester.</td>
<td>The regeneration resistor is broken. Or the resistance value is different from the specified value.</td>
<td>Replace the regenerative resistor.</td>
<td>○</td>
</tr>
<tr>
<td></td>
<td>The regeneration resistor cable is broken.</td>
<td>Replace the cable.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>The resistance value is normal.</td>
<td>Replace the drive unit.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Alarm No. 3D  
**Power supply voltage error at acceleration/deceleration:**  
A motor control error was detected at acceleration/deceleration due to an input voltage drop.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>SV</th>
<th>SP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Measure the input voltage during operations with a tester.</td>
<td>During operations, the voltage fluctuates widely.</td>
<td>Increase the power capacity (KVA).</td>
<td>○</td>
</tr>
<tr>
<td></td>
<td>During operations, the voltage is stable.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| 2                     | Check the load inertia. | The load inertia (workpiece etc.) is excessive. | [1] Lower the load inertia.  
[2] Extend the rapid traverse time constant for G0/G1. | ○ | ○ |
|                       | The load inertia is normal. | | | | |
| 3                     | Check the cooling fan of the drive unit. | The fan is stopped. | Replace the fan. If the state is not improved, replace the drive unit. | ○ | ○ |
|                       | The fan is rotating correctly. | | | | |
| 4                     | Check the ambient temperature of the drive unit during operation. | The ambient temperature exceeds the specified value. | Correct the ambient temperature within the specified value. | ○ | ○ |
|                       | There is no problem in temperature. | | | | |

### Alarm No. 3E  
**Magnetic pole position detection error:**  
The magnetic pole position is not reliable in the magnetic pole position detection control. This alarm occurs at the detection level which is set in SV094.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>SV</th>
<th>SP</th>
</tr>
</thead>
</table>
| 1                     | Adjust the setting value of the servo parameter SV094 and detect the magnetic pole position. | Set SV094. | Set SV094.  
The standard value for a rotary motor is 10.  
The standard value for a linear motor is 10. | ○ | - |
|                       | SV094 is set. | Set the optimal value allowing for the coasting distance (increase the value). | | | |

---
## Alarm No. 41
### Feedback error 3
Either a missed feedback pulse in the main side incremental detector or an error in the Z-phase was detected in the full closed loop system. In the servo, Z-phase was not detected by a rotary detector within 2 rotations.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>SV</th>
<th>SP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Check the connection condition of the cable and detector. - Check if the cable is disconnected.</td>
<td>The cable is disconnected.</td>
<td>Replace the cable.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>The cable is normal.</td>
<td>Check for dirt on the connector terminal and reconnect it.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>The alarm occurs even after it is reconnected.</td>
<td>Replace the detector.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Alarm No. 42
### Feedback error 1
An error was detected in the sub side detector (feedback signals of the position detector in a servo system, or PLL’s feedback signals in a spindle system).

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>SV</th>
<th>SP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Check SP019 and SP020.</td>
<td>Parameter is set incorrectly.</td>
<td>Correctly set.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Parameter is set correctly.</td>
<td>Check the investigation item No. 2.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Check the alarm No. “2C” items.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Alarm No. 43
### Feedback error 2
Excessive difference was detected in position data between the motor side detector and the machine side detector.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>SV</th>
<th>SP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Check if the connecting pulley ratio of the spindle end to ABZ pulse encoder meets the machine specifications.</td>
<td>The pulley ratio of the spindle end to encoder is 1:1.</td>
<td>Check the parameter setting.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>The spindle end and encoder are not equal in the pulley ratio.</td>
<td>Check the parameter setting.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>No problem.</td>
<td>When the encoder is smaller than the spindle end in the pulley ratio, replace the pulley.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Check the setting value of the spindle parameter from SP057 to SP064.</td>
<td>The correct values are not set.</td>
<td>Correctly set.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>The correct values are set.</td>
<td>Check the investigation item No. 3.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 Check the spindle parameter SP054 setting value.</td>
<td>V-belt is used for the spindle end driving.</td>
<td>Set “1” to the spindle parameter “SP054”.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Other than V-belt (gears or timing belt) is used for the spindle end driving.</td>
<td>Set “360” to the spindle parameter “SP054”.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>SP054 is set corresponding to the machine specifications.</td>
<td>Check the investigation item No. 4.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 Jiggle the detector connectors (drive unit side and detector side) and check if they are disconnected.</td>
<td>The connector is disconnected (or loose).</td>
<td>Correctly install.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>The connector is not disconnected.</td>
<td>Check the investigation item No. 5.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 Is the detector cable wired in the same conduit as the motor’s power cable, or are the two cables laid in parallel near each other?</td>
<td>The cables are wired near each other. Noise is entering from the power cable.</td>
<td>Improve the cable wiring.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>The wires are sufficiently separated.</td>
<td>Check the investigation item No. 6.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 Is the motor FG wire connected only to the drive unit which drives it? (Is the motor grounded to one point?)</td>
<td>The motor FG wire is grounded on the motor side.</td>
<td>Ground the motor to one point, connecting the wires together on the drive unit side.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>The motor is grounded to one point.</td>
<td>Check the investigation item No. 7.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 Turn the power OFF, and check the detector cable connection with a tester. (Is the cable shielded?)</td>
<td>The connection is faulty.</td>
<td>Replace the detector cable.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>The connection is normal.</td>
<td>Check the investigation item No. 8.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 Replace with another unit, and check whether the fault is on the unit side or detector side.</td>
<td>The alarm is on the drive unit side.</td>
<td>Replace the drive unit.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>The alarm is on the detector side.</td>
<td>Check the investigation item No. 9.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9 Check if there is any abnormality in the detector’s ambient environment. (Ex. Ambient temperature, noise, grounding)</td>
<td>Take remedies according to the causes of the abnormality in the ambient environment.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 Check SP019, SP020, SV019, and SV020.</td>
<td>Parameter is set incorrectly.</td>
<td>Correctly set.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Parameter is set correctly.</td>
<td>Check the investigation item No. 11.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11 Check the alarm No. “1B” items.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### 7-3 Troubleshooting

**Alarm No. 45**  
**Fan stop**  
A cooling fan built in the drive unit stopped, and overheat occurred in the power module.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>SV</th>
<th>SP</th>
</tr>
</thead>
</table>
| Turn the unit power ON again, and confirm the rotation of the fan.  
Note) Assure more than 10 seconds for the time from when the power is turned OFF till when it is turned ON. For the fan used for the drive unit, assuring more than 10 seconds for the time from when the power is turned OFF till when it is turned ON is required. | The fan is rotating, and an alarm did not occur again. | Continue to use.  
The power may be turned ON without assuring more than 10 seconds for the time from when the power is turned OFF till when it is turned ON. Leave for more than 10 seconds, and turn the power ON again. | ○ | ○ |
| Check if the connector connected to a fan is loosened or disconnected in the unit. | [1]The connector is loosened.  
Replace the fan. | ○ | ○ |
| Check if oil or cutting chips are adhered to the fan. | Oil or cutting chips are adhered. | Improve the use environment and replace the drive unit. | ○ | ○ |
| Is the unbalance torque high? | The connector is not disconnected. Check the investigation item No. 3. | ○ | ○ |

**Alarm No. 46**  
**Motor overheat / Thermal error**  
Thermal protection function of the motor or in the detector, has started its operation.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>SV</th>
<th>SP</th>
</tr>
</thead>
</table>
| Check the repeatability.  
(Note) For the spindle, check the "temperature" of the "spindle unit" displayed on the drive monitor screen. | [1] The alarm occurs before operation.  
[2] The "temperature" displayed on the drive monitor screen is different from ambient temperature. | Check the investigation item No. 2. | ○ | ○ |
| Jiggle the detector connectors (drive unit side and detector side) and check if they are disconnected. | The connector is disconnected (or loose). | Correctly install. | ○ | ○ |
| Turn the power OFF, and check the detector cable connection with a tester. | The connection is faulty. | Replace the cable. | ○ | ○ |
| When using MDS-DM2/HR, check if the motor is validated even if a motor thermal is not provided? | SV034/bit2 = 0  
SV034/bit2 = 1 | Set SP034/bit2 to 1.  
Check the investigation item No. 5. | ○ | ○ |
| Check the overload % (servo) or load meter (spindle). | The load is large. | Servo:  
Check the investigation item No. 6.  
Spindle:  
Check the investigation item No. 8. | ○ | ○ |
| Is the unbalance torque high? | The load is not large. | The constant load torque (friction + unbalance) is 60% or more.  
The constant load torque is less than 60%. | ○ | ○ |
| Was the overload alarm (50) forcibly reset by turning the drive unit power OFF? | The alarm was forcibly reset.  
The alarm was not forcibly reset. | Do not turn the drive unit's power OFF when an overload alarm occurs. (The NC power can be turned OFF.)  
Check the investigation item No. 9. | ○ | ○ |
| Check the parameter settings. | The parameter is not set correctly. | Correctly set. | ○ | ○ |
| Measure the motor temperature when the alarm occurs.  
(Note) For the spindle motor, check the "temperature" of the "spindle unit" shown on the drive monitor screen. | The motor unit is hot. | Check the investigation item No. 10. | ○ | ○ |
| When using a motor with fan, check whether the fan is stopped, or it is clogged with dust, etc. | The motor fan was stopped. | Check the investigation item No. 11. | ○ | ○ |
| Check the fan wiring. | The motor fan wind flow is poor. | Clean the fan and ventilation holes inside of the motor. | ○ | ○ |
| Replace the drive unit or motor with another drive unit or motor, and check whether the fault is on the drive unit side or motor side | The alarm is on the drive unit side.  
The alarm is on the motor side. | Replace the drive unit.  
Replace the motor. | ○ | ○ |
| Check if there is any abnormality in the unit’s ambient environment.  
(Ex. Ambient temperature, noise, grounding) | Take remedies according to the causes of the abnormality in the ambient environment. | ○ | ○ |
### Alarm No. 48
**Motor side detector: Error 5**
The motor side detector (linear scale in the case of linear motor) detected an error. As details differ for each detector, refer to section "Detector alarm".

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Check the alarm No. &quot;1B&quot; items.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Alarm No. 49
**Motor side detector: Error 6**
The motor side detector (linear scale in the case of linear motor) detected an error. As details differ for each detector, refer to section "Detector alarm".

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Check the alarm No. &quot;1B&quot; items.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Alarm No. 4A
**Motor side detector: Error 7**
The motor side detector (linear scale in the case of linear motor) detected an error. As details differ for each detector, refer to section "Detector alarm".

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Check the alarm No. &quot;1B&quot; items.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Alarm No. 4B
**Motor side detector: Error 8**
The motor side detector (linear scale in the case of linear motor) detected an error. As details differ for each detector, refer to section "Detector alarm".

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Check the alarm No. &quot;1B&quot; items.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Alarm No. 4C
**Current error at magnetic pole estimate**
Current detection failed at the pulse-applied magnetic pole estimation by IPM spindle motor.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Check the pulse-applied time.</td>
<td>The pulse-applied time can be short. Set the pulse-applied time longer. Setting parameter:SP142 1) The pulse-applied time (0 to 350) 2) For low-speed coil:1)*1000 3) The polarity of magnetic pole estimation: Reverse polarity is &quot;-&quot; After the adjustment, perform the magnetic pole detection control again. The alarm also occurs after the pulse-applied time is set. Replace the unit.</td>
<td></td>
</tr>
</tbody>
</table>

### Alarm No. 4D
**Dual signal error**
An error was detected in the signal related to the dual signal.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 When not using dedicated wiring STO function</td>
<td>Is the connector to disable STO installed correctly? Set SV113,SP229/bit8. When using dedicated wiring STO function, set to &quot;1 &quot; .</td>
<td></td>
</tr>
<tr>
<td>2 When using dedicated wiring STO function</td>
<td>Is the parameter setting (SV113,SP229/bit8) correct? The error is detected during the servo OFF. The error is detected during the servo ON. Input the STO signal after turning the servo OFF. Remedy the wiring and signal for STO cable.</td>
<td></td>
</tr>
</tbody>
</table>

### Alarm No. 4E
**NC command mode error**
The mode outside the specification was input in spindle control mode selection.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Check the wiring and setting environment. 1) Correctly grounded? 2) Any noise generating devices around the unit? 3) Are the speed/position detector cables correctly shielded?</td>
<td>1) The grounding is incomplete. Correctly ground. 2) The alarm occurs easily when a specific device operates. Use noise measures on the device described on the left. 3) The cable is not correctly shielded. Correctly shield the cable. No abnormality is found in particular. Replace the drive unit.</td>
<td></td>
</tr>
</tbody>
</table>
# MDS-DM2 Series Instruction Manual

## 7-3 Troubleshooting

**(Note)** NR and PR resetting are not possible when the overload level is 50% or more. Do not forcibly reset (AR) by turning the unit power OFF. If AR resetting is used at 50% or higher, the level is set to 80% when the power is turned ON next. (Servo)

### Alarm No. 4F
**Instantaneous power interrupt**
The control power supply has been shut down for 50ms or more.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>SV</th>
<th>SP</th>
</tr>
</thead>
</table>
| 1 Check the repeatability. | The alarm occurs occasionally. | Check the power facilities. | - | |}

### Alarm No. 50
**Overload 1**
Overload detection level became over 100%. The motor or the drive unit is overloaded.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>SV</th>
<th>SP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Check the overload parameters. Servo:SV021, SV022 Spindle:SP021, SP022</td>
<td>The standard values (below) are not set. Servo:SV021 = 60, SV022 = 150 Spindle:SP021=60,SP022=120 IPM:SP021=300,SP022=100</td>
<td>Set the standard values.</td>
<td>o</td>
<td></td>
</tr>
<tr>
<td>2 Check the items below displayed on the drive monitor screen during operation.</td>
<td>The standard values are set.</td>
<td>Investigate item 2.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max.current 3 (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overload(%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Load meter(%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Alarm No. 50
**Overload 2**
Overload detection level became over 100%. The motor or the drive unit is overloaded.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>SV</th>
<th>SP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Check the overload parameters. Servo:SV021, SV022 Spindle:SP021, SP022</td>
<td>The standard values (below) are not set. Servo:SV021 = 60, SV022 = 150 Spindle:SP021=60,SP022=120 IPM:SP021=300,SP022=100</td>
<td>Set the standard values.</td>
<td>o</td>
<td></td>
</tr>
<tr>
<td>2 Check the items below displayed on the drive monitor screen during operation.</td>
<td>The standard values are set.</td>
<td>Investigate item 2.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max.current 3 (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overload(%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Load meter(%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Alarm No. 50
**Overload 3**
Overload detection level became over 100%. The motor or the drive unit is overloaded.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>SV</th>
<th>SP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Check the overload parameters. Servo:SV021, SV022 Spindle:SP021, SP022</td>
<td>The standard values (below) are not set. Servo:SV021 = 60, SV022 = 150 Spindle:SP021=60,SP022=120 IPM:SP021=300,SP022=100</td>
<td>Set the standard values.</td>
<td>o</td>
<td></td>
</tr>
<tr>
<td>2 Check the items below displayed on the drive monitor screen during operation.</td>
<td>The standard values are set.</td>
<td>Investigate item 2.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max.current 3 (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overload(%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Load meter(%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Alarm No. 50
**Overload 4**
Overload detection level became over 100%. The motor or the drive unit is overloaded.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>SV</th>
<th>SP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Check the overload parameters. Servo:SV021, SV022 Spindle:SP021, SP022</td>
<td>The standard values (below) are not set. Servo:SV021 = 60, SV022 = 150 Spindle:SP021=60,SP022=120 IPM:SP021=300,SP022=100</td>
<td>Set the standard values.</td>
<td>o</td>
<td></td>
</tr>
<tr>
<td>2 Check the items below displayed on the drive monitor screen during operation.</td>
<td>The standard values are set.</td>
<td>Investigate item 2.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max.current 3 (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overload(%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Load meter(%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Alarm No. 50
**Overload 5**
Overload detection level became over 100%. The motor or the drive unit is overloaded.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>SV</th>
<th>SP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Check the overload parameters. Servo:SV021, SV022 Spindle:SP021, SP022</td>
<td>The standard values (below) are not set. Servo:SV021 = 60, SV022 = 150 Spindle:SP021=60,SP022=120 IPM:SP021=300,SP022=100</td>
<td>Set the standard values.</td>
<td>o</td>
<td></td>
</tr>
<tr>
<td>2 Check the items below displayed on the drive monitor screen during operation.</td>
<td>The standard values are set.</td>
<td>Investigate item 2.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max.current 3 (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overload(%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Load meter(%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Alarm No. 50
**Overload 6**
Overload detection level became over 100%. The motor or the drive unit is overloaded.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>SV</th>
<th>SP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Check the overload parameters. Servo:SV021, SV022 Spindle:SP021, SP022</td>
<td>The standard values (below) are not set. Servo:SV021 = 60, SV022 = 150 Spindle:SP021=60,SP022=120 IPM:SP021=300,SP022=100</td>
<td>Set the standard values.</td>
<td>o</td>
<td></td>
</tr>
<tr>
<td>2 Check the items below displayed on the drive monitor screen during operation.</td>
<td>The standard values are set.</td>
<td>Investigate item 2.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max.current 3 (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overload(%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Load meter(%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Alarm No. 50
**Overload 7**
Overload detection level became over 100%. The motor or the drive unit is overloaded.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>SV</th>
<th>SP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Check the overload parameters. Servo:SV021, SV022 Spindle:SP021, SP022</td>
<td>The standard values (below) are not set. Servo:SV021 = 60, SV022 = 150 Spindle:SP021=60,SP022=120 IPM:SP021=300,SP022=100</td>
<td>Set the standard values.</td>
<td>o</td>
<td></td>
</tr>
<tr>
<td>2 Check the items below displayed on the drive monitor screen during operation.</td>
<td>The standard values are set.</td>
<td>Investigate item 2.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max.current 3 (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overload(%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Load meter(%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Alarm No. 50
**Overload 8**
Overload detection level became over 100%. The motor or the drive unit is overloaded.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>SV</th>
<th>SP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Check the overload parameters. Servo:SV021, SV022 Spindle:SP021, SP022</td>
<td>The standard values (below) are not set. Servo:SV021 = 60, SV022 = 150 Spindle:SP021=60,SP022=120 IPM:SP021=300,SP022=100</td>
<td>Set the standard values.</td>
<td>o</td>
<td></td>
</tr>
<tr>
<td>2 Check the items below displayed on the drive monitor screen during operation.</td>
<td>The standard values are set.</td>
<td>Investigate item 2.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max.current 3 (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overload(%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Load meter(%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Alarm No. 51: Overload 2

Current command of more than 95% of the unit's max. current was being continuously given for longer than 1 second in a servo system. In a spindle system, current command of more than 95% of the motor's max. current was being continuously given for longer than 1 second.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>SV</th>
<th>SP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Did the alarm occur immediately after READY ON?</td>
<td>The alarm occurred after ready ON before operation starts.</td>
<td>Investigate item 2.</td>
<td>○</td>
<td></td>
</tr>
<tr>
<td>2 Check that the PN voltage is supplied to the drive unit.</td>
<td>The alarm occurred after normal operation.</td>
<td>Investigate item 5.</td>
<td>○</td>
<td></td>
</tr>
<tr>
<td>MDS-DJ Series is not connected to the power supply unit, so investigate item 3 for MDS-DJ.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[1] Is the CHARGE lamp ON?</td>
<td>The CHARGE lamp becomes dark.</td>
<td>Increase the capacity of power supply. Tighten the L+ and L- screws.</td>
<td>○</td>
<td></td>
</tr>
<tr>
<td>[2] Is the cable connected to the motor for another axis?</td>
<td>Approx. 300V is correctly supplied.</td>
<td>Investgate item 3.</td>
<td>○</td>
<td></td>
</tr>
<tr>
<td>3 Check the motor power cable (U, V, W phases).</td>
<td>The connections are incorrect.</td>
<td>Connect correctly.</td>
<td>○</td>
<td></td>
</tr>
<tr>
<td>[1] Is the cable connected to the motor for another axis?</td>
<td>The connections are correct.</td>
<td>Investigate item 4.</td>
<td>○</td>
<td></td>
</tr>
<tr>
<td>[2] Is the cable connected to the motor for another axis?</td>
<td>The connections are incorrect.</td>
<td>Connect correctly.</td>
<td>○</td>
<td></td>
</tr>
<tr>
<td>4 Check the detector cable connection.</td>
<td>The connections are incorrect.</td>
<td>Connect correctly.</td>
<td>○</td>
<td></td>
</tr>
<tr>
<td>[1] Is the cable connected to the motor for another axis?</td>
<td>The connections are correct.</td>
<td>Investigate item 5.</td>
<td>○</td>
<td></td>
</tr>
<tr>
<td>5 Check whether the machine has collided.</td>
<td>The machine has collided.</td>
<td>Check the machining program and soft limit settings.</td>
<td>○</td>
<td></td>
</tr>
<tr>
<td>6 Check whether the current value on the NC Servo Monitor screen is saturated during acceleration/ deceleration.</td>
<td>The current is saturated during acceleration/ deceleration.</td>
<td>Increase the acceleration/ deceleration time constant.</td>
<td>○</td>
<td></td>
</tr>
<tr>
<td>The current value during acceleration/ deceleration is appropriate.</td>
<td>Investigate item 7.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 Check the detector Feedback.</td>
<td>The Feedback signal is abnormal.</td>
<td>Replace the detector.</td>
<td>○</td>
<td></td>
</tr>
<tr>
<td>[1] The droop does not stabilize.</td>
<td>(With the absolute position system, the zero point must be established.)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Servo SV053</td>
<td>Servo standard value: SV053 = (RAPID/(60*PGN1))/2</td>
<td>Set appropriate values.</td>
<td>○</td>
<td></td>
</tr>
<tr>
<td>Spindle SP023 (Interpolation, spindle synchronization)</td>
<td>Spindle standard value: No alarm is set at SP023 =120.0 SP053 =motor max. speed × 6/PGV/2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SP053 (Non-interpolation)</td>
<td>Appropriate values are set.</td>
<td>Investigate item 3.</td>
<td>○</td>
<td></td>
</tr>
<tr>
<td>8 Check the load meter value.</td>
<td>The value is large.</td>
<td>Lower the load.</td>
<td>○</td>
<td></td>
</tr>
<tr>
<td>9 Check the PLG output waveform.</td>
<td>There is a problem.</td>
<td>Adjust the PLG output waveform.</td>
<td>○</td>
<td></td>
</tr>
<tr>
<td>For TS5690, waveform cannot be checked.</td>
<td>Normal</td>
<td>Replace the drive unit.</td>
<td>○</td>
<td></td>
</tr>
</tbody>
</table>

### Alarm No. 52: Excessive error 1

A difference between the actual and theoretical motor positions during servo ON exceeded the setting value.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>SV</th>
<th>SP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 The load inertia is large.</td>
<td>The load inertia is excessive.</td>
<td>[1] Lower the machine weight applied to the servo motors (by the unbalance torque). [2] Lower the weight of the workpiece.</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>The unbalance torque in the Z (gravity) direction is high.</td>
<td>The load inertia is normal.</td>
<td>Investigate item 2.</td>
<td>○</td>
<td></td>
</tr>
<tr>
<td>An excessive workpiece or tool is mounted on the spindle.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Check the excessive error detection width.</td>
<td>The excessive error detection width is too small.</td>
<td></td>
<td>○</td>
<td></td>
</tr>
<tr>
<td>Servo SV053</td>
<td>Servo standard value: SV053 = (RAPID/(60*PGN1))/2</td>
<td>Set appropriate values.</td>
<td>○</td>
<td></td>
</tr>
<tr>
<td>Spindle SP023 (Interpolation, spindle synchronization)</td>
<td>Spindle standard value: No alarm is set at SP023 =120.0 SP053 =motor max. speed × 6/PGV/2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SP053 (Non-interpolation)</td>
<td>Appropriate values are set.</td>
<td>Investigate item 3.</td>
<td>○</td>
<td></td>
</tr>
<tr>
<td>3 Check the position detector polarity.</td>
<td>The polarity is reversed.</td>
<td>Correctly set the parameters.</td>
<td>○</td>
<td></td>
</tr>
<tr>
<td>SV017/bit4 (Servo)</td>
<td>Normal.</td>
<td>Investigate item 4.</td>
<td>○</td>
<td></td>
</tr>
<tr>
<td>SP017/bit4 (Spindle: position FB)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SP017/bit0 (Spindle: speed FB)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>#3106/bit7 (Synchronous tap control)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 Check the alarm No. &quot;51&quot; items.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Alarm No. 53  Excessive error 2

A difference between the actual and theoretical motor positions during servo OFF exceeded the setting value.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>SV</th>
<th>SP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Check the follow-up function while the NC is in the servo OFF state.</td>
<td>The axis detachment function (NC parameter) is invalid. (Note) For the axis detachment function, refer to the NC manual.</td>
<td>Check the investigation item No. 2.</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>Check whether the axis has moved during servo OFF (either by visual inspection or monitor the position droop waveform).</td>
<td>[1] The axis has moved. [2] The servo OFF is applied during the mode.</td>
<td>[1] Adjust the brakes, etc. so that the axis does not move. [2] Avoid the servo OFF from being applied during position control.</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>Check the excessive error detection width. SV026 (Servo) (Note) Set the same value to SV023.</td>
<td>The excessive error detection width is too small. SV026 = (RAPID/(60*PGN1))/2</td>
<td>Set an appropriate value.</td>
<td>0</td>
</tr>
</tbody>
</table>

#### Investigation details

1. Check that the PN voltage is supplied to the drive unit.  
   - [1] Is the CHARGE lamp ON?  
     - The voltage is not supplied. Correctly supply the PN voltage.  
     - It is correctly supplied (DC300V). Investigate item 2.  

2. Check the motor power cable (U, V, W phases).  
   - [1] The power cable is not connected.  
     - The connections are incorrect. Connect correctly.  
   - [2] Is the cable connected to the motor for another axis?  
     - The connections are correct. Replace the drive unit.  

### Supplement (servo)

Depending on the ideal machine position in respect to the command position, the actual machine position could enter the actual shaded section shown below, which is separated more than the distance set in OD1.
### Alarm No. 56  Commanded speed error
In C axis control mode, excessive NC commanded speed was detected. 

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Check the rotation speed displayed on the spindle drive monitor to see if the C axis rotation speed exceeds 1.15 times of the set speed during rapid traverse.</td>
<td>Exceed.</td>
<td>Increase the rapid traverse time constant.</td>
</tr>
<tr>
<td></td>
<td>Not exceed.</td>
<td>Check if the maximum rapid traverse rate settings are correct. After changing the setting, turn the NC power ON again.</td>
</tr>
</tbody>
</table>

### Alarm No. 58  Collision detection 1: G0
When collision detection function (set to SV060) was valid, the disturbance torque in rapid traverse (G0) exceeded the collision detection level.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Check whether the machine has collided during G0 operation.</td>
<td>A collision has occurred at the table, turret or spindle head in the machine during movement.</td>
<td>Check the machining program and soft limit settings.</td>
</tr>
<tr>
<td></td>
<td>There is no collision at the table, turret and spindle head in the machine during movement</td>
<td>Adjust the tolerable disturbance torque SV060.</td>
</tr>
</tbody>
</table>

### Alarm No. 59  Collision detection 1: G1
When collision detection function was valid (SV035.c1G1 was set), the disturbance torque in cutting feed (G1) exceeded the collision detection level.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Check whether the machine has collided during G0 operation.</td>
<td>The machine has collided during movement.</td>
<td>Increase the detection level (SV035.c1G1). G1 collision detection level = SV060 × c1G1(001 to 111)</td>
</tr>
<tr>
<td></td>
<td>The machine has not collided.</td>
<td>(Note) Set the detection level to be 1.5 times or more of the maximum cutting load.</td>
</tr>
</tbody>
</table>

### Alarm No. 5A  Collision detection 2
When collision detection function was valid, the command torque reached the max. motor torque.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Check whether the machine has collided.</td>
<td>The machine has collided.</td>
<td>Check the machining program and soft limit settings.</td>
</tr>
<tr>
<td></td>
<td>The machine has not collided.</td>
<td>Check the investigation item No. 2.</td>
</tr>
<tr>
<td>2 Check whether the current value on the NC Servo Monitor screen is saturated during acceleration/ deceleration.</td>
<td>The current is saturated during acceleration/ deceleration.</td>
<td>Check the investigation item No. 3.</td>
</tr>
<tr>
<td></td>
<td>The current value during acceleration/ deceleration is appropriate.</td>
<td>Investigate the cause of the load fluctuation.</td>
</tr>
<tr>
<td>3 Can the acceleration/deceleration time constant be changed?</td>
<td>The constant can be changed.</td>
<td>Increase the acceleration/ deceleration time constant.</td>
</tr>
<tr>
<td></td>
<td>The constant cannot be changed.</td>
<td>Set to ignore collision detection method 2.</td>
</tr>
</tbody>
</table>

### Alarm No. 5B  Safely limited: Commanded speed error
In safely limited mode, the commanded speed was detected to exceed the safely limited speed.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Check the commanded speed on the NC side.</td>
<td>The commanded speed and safely limited speed limit value are the same.</td>
<td>Reduce the commanded speed on the NC side or increase the safely limited speed limit value.</td>
</tr>
<tr>
<td></td>
<td>The commanded speed is slower than the safely limited speed.</td>
<td>Replace the drive unit.</td>
</tr>
</tbody>
</table>

### Alarm No. 5D  Safely limited: Door state error
In safely limited mode, the door state signal from the NC and the same signal from the drive unit don't match. Otherwise, door open state was detected in normal mode.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Check the DI input timing.</td>
<td>Both NC side and drive unit side input timings match one another within 500ms.</td>
<td>Review the DI input sequence.</td>
</tr>
<tr>
<td></td>
<td>NC side and drive unit side inputs do not match one another within 500ms.</td>
<td>Check if the cable for the DI input signal is broken.</td>
</tr>
<tr>
<td></td>
<td>Investigate the wiring and connection environment.</td>
<td></td>
</tr>
</tbody>
</table>

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### Alarm No. 5E | Safely limited: Feedback speed error

In safely limited mode, the motor speed was detected to exceed the safely limited speed.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>SV</th>
<th>SP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Check the DI input timing.</td>
<td>The feedback speed and safely limited speed limit value are the same.</td>
<td>Reduce the commanded speed on the NC side or increase the safely limited speed limit value.</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td></td>
<td>The feedback speed is slower than the safely limited speed.</td>
<td>Replace the drive unit.</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

### Alarm No. 5F | External contactor error

A contact of the external contactor is welding.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>SV</th>
<th>SP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Check whether the contactor's contact has melted</td>
<td>The contactor is melted.</td>
<td>Replace the contactor.</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td></td>
<td>The contactor is not melted.</td>
<td>Check the investigation item No. 2.</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

### Alarm No. 61 | Power supply: Power module overcurrent

Overcurrent protection function in the power module of power supply has started its operation.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>CV</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Check the state of the operation when the alarm occurs, and check the repeatability.</td>
<td>The alarm occurs immediately after 200VAC is supplied or after READY is turned ON.</td>
<td>Replace the unit.</td>
<td>○</td>
</tr>
<tr>
<td></td>
<td>The alarm occurs occasionally during READY ON.</td>
<td>Check the investigation item No. 3.</td>
<td>○</td>
</tr>
<tr>
<td></td>
<td>The alarm occurs after continuous operation for a long time.</td>
<td>Check the investigation item No. 2.</td>
<td>○</td>
</tr>
<tr>
<td>2 Check the load state of all motors (during stopped).</td>
<td>The total load of all motors exceeds the rated capacity of the power supply unit.</td>
<td>Lower the motor load and operation frequency.</td>
<td>○</td>
</tr>
<tr>
<td></td>
<td>The total does not exceed the capacity.</td>
<td>Check the investigation item No. 3.</td>
<td>○</td>
</tr>
</tbody>
</table>

### Further Investigation Details

- **Investigation No. 2**
  - Check whether the axis where an alarm occurred was a contactor control axis.
  - The alarm occurred at the axis where the contactor control is not executed.
  - Check the parameter. (DJ Series)
    - With contactor control: Servo:SV082, Spindle:SP227
      - 0800h is added to the setting value.
      - Without contactor control: Change "Bit A,B" to "00" in the parameter above.

- **Investigation No. 3**
  - Check the load state of all motors (during stopped).
  - The total load of all motors exceeds the rated capacity of the power supply unit.
  - Lower the motor load and operation frequency.

- **Investigation No. 4**
  - Measure the voltage across wires.
    - The voltage drops to 170V or less occasionally.
      - Increase the power capacity of the facility.

- **Investigation No. 5**
  - Measure the voltage across wires.
    - The difference of the voltage across wires is 10V or more.
      - Improve the power phase balance.

- **Investigation No. 6**
  - Measure the voltage across wires.
    - The difference of the voltage across wires is less than 10V.
      - Check the investigation item No. 5.

- **Investigation No. 7**
  - Measure the voltage across wires.
    - Abnormal noise is heard from an AC reactor when stopping at the servo ON.
      - Improve the source of the distortion.
      - For example, when abnormal noise is heard from another machine that is in operation, move the wiring to the power which is far from the machine's power supply.

- **Investigation No. 8**
  - Measure the voltage across wires.
    - Abnormal noise is not heard.
      - Check the investigation item No. 6.

- **Investigation No. 9**
  - Measure the voltage across wires.
    - Take remedies according to the causes of the abnormality in the ambient environment.
## Alarm No. 62
### Power supply: Frequency error
The input power supply frequency increased above the specification range.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>CV</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Check the state of the operation when the alarm occurs, and check the repeatability.</td>
<td>The alarm occurs each time immediately after the power is turned ON. Or, the alarm occurs occasionally regardless of the operation state.</td>
<td>Check the investigation item No. 2.</td>
</tr>
<tr>
<td></td>
<td>The alarm occurs only while the motor is accelerating/decelerating.</td>
<td>Check the investigation item No. 3.</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Measure the power voltage waveform during normal operation.</td>
<td>The frequency is deviated from $50Hz \pm 3%$ or $60Hz \pm 3%$.</td>
<td>Review the power facilities.</td>
</tr>
<tr>
<td></td>
<td>The voltage waveform dips at some sections.</td>
<td>Improve the source of the distortion.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>There is no problem.</td>
<td>Install an AC reactor.</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Measure the power voltage when the motor is accelerating/decelerating.</td>
<td>The frequency greatly fluctuates during acceleration/deceleration.</td>
<td>Review the power facilities.</td>
</tr>
<tr>
<td></td>
<td>The voltage waveform during deceleration dips in some sections.</td>
<td>Improve the source of the distortion.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>There is no problem.</td>
<td>Install an AC reactor.</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Check if there is any abnormality in the unit's ambient environment. (Ex. Noise, grounding, etc.)</td>
<td>Take remedies according to the causes of the abnormality in the ambient environment.</td>
<td></td>
</tr>
</tbody>
</table>

## Alarm No. 66
### Process error
An error occurred in the process cycle.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>CV</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Check the repeatability.</td>
<td>The alarm occurs each time after the power is turned ON.</td>
<td>Replace the unit.</td>
</tr>
<tr>
<td></td>
<td>The alarm occurs occasionally.</td>
<td>Check the investigation item No. 2.</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Check if there is any abnormality in the unit's ambient environment. (Ex. Noise, grounding, etc.)</td>
<td>Take remedies according to the causes of the abnormality in the ambient environment.</td>
<td></td>
</tr>
</tbody>
</table>

## Alarm No. 67
### Power supply: Phase interruption
An open-phase condition was detected in input power supply circuit.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>CV</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Check the voltage for each input phase.</td>
<td>There are phases with no voltage.</td>
<td>Correct the power supply.</td>
</tr>
<tr>
<td></td>
<td>There is no problem.</td>
<td>Check the investigation item No. 2.</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Check the alarm No. &quot;71&quot; items.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Alarm No. 68
### Power supply: Watchdog
The system does not operate correctly.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>CV</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Check the repeatability.</td>
<td>The alarm occurs each time READY is turned ON.</td>
<td>Replace the unit.</td>
</tr>
<tr>
<td></td>
<td>The alarm occurs occasionally.</td>
<td>Check the investigation item No. 2.</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Check if there is any abnormality in the unit's ambient environment. (Ex. Noise, grounding, etc.)</td>
<td>Take remedies according to the causes of the abnormality in the ambient environment.</td>
<td></td>
</tr>
</tbody>
</table>

## Alarm No. 69
### Power supply: Grounding
The motor power cable is in contact with FG (Frame ground).

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>SY</th>
<th>SP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Measure the insulation across the power cables (U,V,W) for all motors and the ground. (Carry out a megger test.)</td>
<td>Less than 100kΩ. (Grounding)</td>
<td>The motor or power cable may be ground faulted.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>100kΩ or more. (Normal)</td>
<td>Check the investigation item No. 2.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Has oil come in contact with the motor or power cable?</td>
<td>Oil has come in contact.</td>
<td>Take measures so that oil does not come in contact. Check the motor's cannon connector and the inside of the terminal box, and clean as necessary.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Oil has not come in contact.</td>
<td>Check the investigation item No. 3.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Measure the insulation again.</td>
<td>Less than 1MΩ. (Grounding)</td>
<td>Replace the motor or cable.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1MΩ or more. (Normal)</td>
<td>Check the investigation item No. 2.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Measure the resistance across the U, V, W phase terminals of the servo/spindle drive unit and the ground. (Do not measure the insulation as the unit could be damaged.)</td>
<td>Less than 100kΩ.</td>
<td>Replace the drive unit.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>100kΩ or more.</td>
<td>Replace the power supply unit.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Check whether there is any axis in which alarm has occurred.</td>
<td>There is an axis in which alarm has occurred.</td>
<td>Check the alarm No. &quot;24&quot; items.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>There is no axis in which alarm has occurred.</td>
<td>Check the investigation item No. 2.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Alarm No. 6A
**Power supply: External contactor welding**  
A contact of the external contactor is welding.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>CV</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Check whether any alarm has occurred on the drive unit side.</td>
<td>An alarm has occurred.</td>
<td>Remove the cause of the alarm on the drive side, and check the investigation item No. 2.</td>
<td>○</td>
</tr>
<tr>
<td>2 Check whether the contactor’s contact has melted.</td>
<td>The contactor has melted.</td>
<td>Replace the contactor.</td>
<td>○</td>
</tr>
<tr>
<td>3 Check that the contactor excitation wiring is correctly connected from the power supply unit’s MC1 terminal.</td>
<td>The connection is incorrect.</td>
<td>Replace the power supply unit.</td>
<td>○</td>
</tr>
</tbody>
</table>

### Alarm No. 6B
**Power supply: Rush circuit error**  
A thyristor for rush short circuit is ON when rushing.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>CV</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Check whether any alarm has occurred on the drive unit side.</td>
<td>An alarm has occurred.</td>
<td>Remove the cause of the alarm on the drive side, and then carry out the investigation details 2.</td>
<td>○</td>
</tr>
<tr>
<td>2 Check the repeatability.</td>
<td>The alarm occurs each time READY is turned ON.</td>
<td>Replace the unit.</td>
<td>○</td>
</tr>
<tr>
<td>3 Check if there is any abnormality in the unit’s ambient environment. (Ex. Noise, grounding, etc.)</td>
<td>The alarm occurs occasionally.</td>
<td>Check the investigation item No. 3.</td>
<td>○</td>
</tr>
</tbody>
</table>

### Alarm No. 6C
**Power supply: Main circuit error**  
An error was detected in charging operation of the main circuit capacitor.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>CV</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Check the CHARGE lamp state when the alarm occurs.</td>
<td>[1] The light of the lamp becomes faint. [2] An alarm occurs when ready is turned ON again.</td>
<td>Replace the power supply unit.</td>
<td>○</td>
</tr>
</tbody>
</table>
| 2 Disconnect the power supply unit’s PN terminal block wiring, and measure the resistance value at 1) and 2) shown below.  
(Not)  
When disconnecting the PN wiring, turn OFF the power, make sure the CHARGE lamp has turned OFF at contactor OFF and then wait at least fifteen minutes before disconnecting. Do not disconnect immediately after the power OFF. | 1) The drive unit side is abnormal.  
2) The drive unit side is abnormal. | Disconnect the PN wiring, and then check the drive unit side. | ○ |

### Alarm No. 6D
**Parameter setting error**  
An error was detected in the parameter sent from the drive unit.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>CV</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Check the repeatability.</td>
<td>The alarm occurs each time after the power is turned ON.</td>
<td>Replace the unit.</td>
<td>○</td>
</tr>
<tr>
<td>2 Check if there is any abnormality in the unit’s ambient environment. (Ex. Noise, grounding, etc.)</td>
<td>Take remedies according to the causes of the abnormality in the ambient environment.</td>
<td>○</td>
<td></td>
</tr>
</tbody>
</table>
### Alarm No. 6E
**Power supply: Memory error/AD error**
An error was detected in the internal memory or AD converter.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>CV</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Check the repeatability.</td>
<td>The alarm occurs each time READY is turned ON.</td>
<td>Replace the unit.</td>
<td>○</td>
</tr>
<tr>
<td></td>
<td>The alarm occurs occasionally.</td>
<td>Check the investigation item No. 2.</td>
<td></td>
</tr>
<tr>
<td>2. Check if there is any abnormality in the unit's ambient environment. (Ex. Noise, grounding, etc.)</td>
<td>Take remedies according to the causes of the abnormality in the ambient environment.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note** Alarm 6F is detected at the same time other power supply alarms occur.

### Alarm No. 6F
**Power supply error**
No power supply is connected to the drive unit, or a communication error was detected.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>CV</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Check the LED display on the power supply unit.</td>
<td>&quot;F&quot; is flickering. An A/D converter error has occurred. Check the alarm No. &quot;6E&quot; items.</td>
<td></td>
<td>○</td>
</tr>
<tr>
<td></td>
<td>&quot;F&quot; is displayed.</td>
<td>Check the investigation item No. 2.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&quot;F&quot; is displayed.</td>
<td>Check the investigation item No. 2.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&quot;F&quot;, &quot;O&quot;, &quot;0&quot; is displayed.</td>
<td>Check the investigation item No. 3.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Something else is displayed.</td>
<td>Check the alarm No. &quot;68&quot; items.</td>
<td></td>
</tr>
<tr>
<td>2. Check the rotary switch setting.</td>
<td>0 or 4 is set.</td>
<td>Check the investigation item No. 3.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>A value other than the above is set.</td>
<td>Correctly set the rotary switch.</td>
<td>○</td>
</tr>
<tr>
<td>3. Check the communication cable (CN4) connected with the drive unit.</td>
<td>There is a problem with the wiring or shield. Replace the cable.</td>
<td></td>
<td>○</td>
</tr>
<tr>
<td></td>
<td>There is no problem.</td>
<td>Replace the unit.</td>
<td></td>
</tr>
</tbody>
</table>

### Alarm No. 70
**Power supply: External emergency stop error**
A mismatch of the external emergency stop input and CNC emergency stop input continued for 30 seconds.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>CV</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Check the connection between external emergency stop and NC emergency stop.</td>
<td>Not wired.</td>
<td>Correctly wire the external emergency stop and NC emergency stop.</td>
<td>○</td>
</tr>
<tr>
<td>2. Check if there is any abnormality in the unit's ambient environment.</td>
<td>No abnormality is found in particular.</td>
<td>Replace the drive unit.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The grounding is incomplete.</td>
<td>Take remedies according to the causes of the abnormality. Additionally ground and review.</td>
<td></td>
</tr>
</tbody>
</table>

### Alarm No. 71
**Power supply: Instantaneous power interruption**
The power was momentarily interrupted.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>CV</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Investigate the sequence to check whether the contactor has been turned OFF with an emergency stop button, etc.</td>
<td>The contactor has been turned OFF externally.</td>
<td>Review the machine sequence. When turning the contactor OFF with external means, such as an emergency stop button, this alarm can be avoided by inputting NC emergency stop at the same time.</td>
<td>○</td>
</tr>
<tr>
<td></td>
<td>The contactor has not been turned OFF.</td>
<td>Check the investigation item No. 2.</td>
<td></td>
</tr>
<tr>
<td>2. Check the repeatability.</td>
<td>The alarm occurs each time READY is turned ON.</td>
<td>Check the investigation item No. 3.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The alarm occurs at a certain operation.</td>
<td>Check the investigation item No. 1.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The alarm occurs occasionally during operation.</td>
<td>Check the investigation item No. 3.</td>
<td></td>
</tr>
<tr>
<td>3. Check whether the power input wire and contactor are correctly wired.</td>
<td>The wiring is incorrect.</td>
<td>Correctly connect.</td>
<td>○</td>
</tr>
<tr>
<td></td>
<td>There is no problem.</td>
<td>Check the investigation item No. 4.</td>
<td></td>
</tr>
<tr>
<td>4. Check the power voltage waveform with a synchroscope.</td>
<td>An instantaneous power failure or voltage drop occurs frequently.</td>
<td>Correct the power facility.</td>
<td>○</td>
</tr>
<tr>
<td></td>
<td>There is no problem.</td>
<td>Replace the unit.</td>
<td></td>
</tr>
</tbody>
</table>
### Alarm No. 72
**Power supply: Fan stop**

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>CV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turn the unit power ON again, and confirm the rotation of the fan. Note: Assure more than 10 seconds for the time from when the power is turned OFF till when it is turned ON. For the fan used for the drive unit, assuring more than 10 seconds for the time from when the power is turned OFF till when it is turned ON is required.</td>
<td>The fan is rotating, and an alarm did not occur again.</td>
<td>Continue to use. The power may be turned ON without assuring more than 10 seconds for the time from when the power is turned OFF till when it is turned ON. Leave for more than 10 seconds, and turn the power ON again.</td>
<td>O</td>
</tr>
<tr>
<td>Check if the connector connected to a fan is disconnected.</td>
<td>The connector is disconnected.</td>
<td>Correctly connect the connector.</td>
<td>O</td>
</tr>
<tr>
<td>Check if oil or cutting chips are adhered to the fan.</td>
<td>Oil or cutting chips are adhered.</td>
<td>Improve the use environment and replace the drive unit.</td>
<td>O</td>
</tr>
</tbody>
</table>

### Alarm No. 73
**Power supply: Over regeneration**

Over-regeneration detection level became over 100%. The regenerative resistor is overloaded. This alarm cannot be reset for 15 min from the occurrence. Leave the drive system energized for more than 15 min, then turn the power ON to reset the alarm.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>CV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Check the alarm occurrence state and regenerative load displayed on the NC Monitor screen while changing the operation mode.</td>
<td>The regenerative load value increases when the power is turned ON and the motor is not rotated.</td>
<td>Check whether the state is affected by power fluctuation, grounding or noise. If there is no problem, replace the unit.</td>
<td>O</td>
</tr>
<tr>
<td>Check whether the parameter (regenerative resistor type) of the drive unit controlling the power supply unit is correct.</td>
<td>The setting is incorrect.</td>
<td>Correctly set. (Check the alarm No. &quot;6D&quot; items.)</td>
<td>O</td>
</tr>
<tr>
<td>Check the alarm No. &quot;75&quot; items.</td>
<td>There is no problem.</td>
<td>Check the investigation item No. 4.</td>
<td>O</td>
</tr>
</tbody>
</table>

### Alarm No. 75
**Power supply: Overvoltage**

L+ and L- bus voltage in main circuit exceeded the allowable value. As the voltage between L+ and L- is high immediately after this alarm, another alarm may occur if this alarm is reset in a short time. Wait more than 5 min before resetting so that the voltage drops.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>CV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Check the repeatability.</td>
<td>The alarm occurs each time the motor decelerates.</td>
<td>Check the investigation item No. 3.</td>
<td>O</td>
</tr>
<tr>
<td>Check the power supply's alarm history.</td>
<td>Auxiliary regeneration frequency over (E8) occurs just before the over-voltage occurs. Others.</td>
<td>Limit the occurrence of the excessive instantaneous regeneration by not decelerating multiple axes at the same time. Check the investigation item No. 3.</td>
<td>O</td>
</tr>
<tr>
<td>Check the power capacity.</td>
<td>The power capacity is insufficient.</td>
<td>Increase the power capacity.</td>
<td>O</td>
</tr>
<tr>
<td>Measure the voltage across wires. [1] Is the voltage 170V or more even when the motor is accelerating?</td>
<td>The voltage drops to 170V or less occasionally.</td>
<td>Increase the power capacity.</td>
<td>O</td>
</tr>
<tr>
<td>Measure the voltage with a synchroscope, and check whether there is any distortion. [1] Are there any other devices causing the power distortion?</td>
<td>The power voltage is distorted.</td>
<td>Improve the source of the distortion. Install an AC reactor.</td>
<td>O</td>
</tr>
<tr>
<td>Check if there is any abnormality in the unit's ambient environment. (Ex. Noise, grounding, etc.)</td>
<td>The power voltage waveform is not abnormal.</td>
<td>Check the investigation item No. 6.</td>
<td>O</td>
</tr>
</tbody>
</table>

**Note:** Assure more than 10 seconds for the time from when the power is turned OFF till when it is turned ON. For the fan used for the drive unit, assuring more than 10 seconds for the time from when the power is turned OFF till when it is turned ON is required.
## Troubleshooting

### Alarm No. 76
**Power supply: External emergency stop setting error**
The rotary switch setting of external emergency stop is not correct, or a wrong external emergency stop signal is input.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>CV</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Check the rotary switch setting.</td>
<td>When using external emergency stop, rotary switch is not set to &quot;4&quot;.</td>
<td>Set the rotary switch to &quot;4&quot;.</td>
<td>○</td>
</tr>
<tr>
<td>2 Check if there is any abnormality in the unit's ambient environment.</td>
<td>No abnormality is found in particular.</td>
<td>Replace the drive unit.</td>
<td>○</td>
</tr>
<tr>
<td></td>
<td>The grounding is incomplete.</td>
<td>Take remedies according to the causes of the abnormality.</td>
<td>○</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Additionally ground and review.</td>
<td>○</td>
</tr>
</tbody>
</table>

### Alarm No. 77
**Power supply: Power module overheat**
Thermal protection function in the power module has started its operation.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>CV</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Confirm that the fan is properly rotating.</td>
<td>Large amounts of cutting oil or cutting chips, etc., are adhered, or the rotation is slow.</td>
<td>Clean or replace the fan.</td>
<td>○</td>
</tr>
<tr>
<td>2 Check whether the heat dissipating fins are dirty.</td>
<td>Cutting oil or cutting chips, etc., are adhered, and the fins are clogged.</td>
<td>Clean the fins.</td>
<td>○</td>
</tr>
<tr>
<td>3 Measure the power supply unit's ambient temperature.</td>
<td>55°C or more</td>
<td>Improve the ventilation and cooling for the power distribution panel.</td>
<td>○</td>
</tr>
<tr>
<td></td>
<td>Less than 55°C.</td>
<td></td>
<td>○</td>
</tr>
<tr>
<td>4 Check if there is any abnormality in the unit's ambient environment. (Ex. Ambient temperature, noise, grounding)</td>
<td></td>
<td>Take remedies according to the causes of the abnormality in the ambient environment.</td>
<td>○</td>
</tr>
</tbody>
</table>

### Alarm No. 80
**Main side detector cable error**
A pulse type cable is used for the motor side detector.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>SV</th>
<th>SP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Check the parameters. Servo:SV025 = &quot;x200&quot; Spindle:SP031 = &quot;x200&quot; And then, check the connected cable and the detector.</td>
<td>The cable type is pulse.</td>
<td>Replace the cable to the serial type.</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td></td>
<td>There is no problem with the selection of the detector and cable.</td>
<td>Replace the detector or cable.</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

### Alarm No. 81
**Sub side detector cable error**
The cable type of machine side detector does not match the detector specifications set by the parameter.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>SV</th>
<th>SP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Check if the below parameters match the connected detector and cable. Servo: SV025 Spindle: SP031</td>
<td>The detector does not match the specifications.</td>
<td>Set the parameters so that they meet the machine side detector. <a href="">Servo:SV025</a> - Rotary Pulse 2xxx Serial 6xxx - Scale Pulse 8xxx Serial Axxx <a href="">Spindle:SP031</a> Pulse 4200 Serial 6200</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td></td>
<td>The parameter is not correct.</td>
<td></td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td></td>
<td></td>
<td>There is no problem with the selection of the detector and cable.</td>
<td>Replace the detector or cable.</td>
<td>○</td>
</tr>
</tbody>
</table>

### Alarm No. 87
**Drive unit communication error**
The communication frame between drive units was aborted.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>SV</th>
<th>SP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Check the connection of the optical communication cable between drive units.</td>
<td>The cable and connector were loose.</td>
<td>Connect again so as not to be loosened.</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td></td>
<td>The cable and connector were not loose.</td>
<td>Replace the cable.</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>2 Check the repeatability.</td>
<td>The error is always repeated (in high-speed synchronous tapping).</td>
<td>Replace the servo drive or spindle drive unit that is used for high-speed synchronous tapping.</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>
7-3 Troubleshooting

### Alarm No. 88: Watchdog
The system does not operate correctly.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>SV</th>
<th>SP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Check whether the servo or spindle software version was changed recently.</td>
<td>The version was changed.</td>
<td>Change software version back to the original.</td>
<td>☒</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The version was not changed.</td>
<td>Check the investigation item No. 2.</td>
<td>☒</td>
</tr>
<tr>
<td>2</td>
<td>Check the repeatability.</td>
<td>The error is always repeated.</td>
<td>Replace the drive unit.</td>
<td>☒</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The state returns to normal once, but occurs sometimes thereafter.</td>
<td>Check the investigation item No. 3.</td>
<td>☒</td>
</tr>
<tr>
<td>3</td>
<td>Check if there is any abnormality in the unit’s ambient environment. (Ex. Ambient temperature, noise, grounding)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Take remedies according to the causes of the abnormality in the ambient environment.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(Note) For MDS-DJ-V1/SP Series, "888" is displayed.

### Alarm No. 8A: Drive unit communication data error 1
The communication data 1 between drive units exceeded the tolerable value in the communication between drive units.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>SV</th>
<th>SP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Check if the error has occurred during high-speed synchronous tapping.</td>
<td>The error occurs during the synchronous tapping.</td>
<td>[1] Check the tool. [2] Adjust the tapping.</td>
<td>☒</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The error does not occur during the synchronous tapping.</td>
<td>Check the investigation item No. 2.</td>
<td>☒</td>
</tr>
<tr>
<td>2</td>
<td>Check the repeatability.</td>
<td>The error is always repeated.</td>
<td>Replace the drive unit.</td>
<td>☒</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The state returns to normal once, but occurs sometimes thereafter.</td>
<td>Check the investigation item No. 3.</td>
<td>☒</td>
</tr>
<tr>
<td>3</td>
<td>Check if there is any abnormality in the unit’s ambient environment. (Ex. Ambient temperature, noise, grounding)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Take remedies according to the causes of the abnormality in the ambient environment.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Alarm No. 8B: Drive unit communication data error 2
The communication data 2 between drive units exceeded the tolerable value in the communication between drive units.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>SV</th>
<th>SP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Check if the error was occurred during the synchronous tapping.</td>
<td>The error occurs during the synchronous tapping.</td>
<td>[1] Check the tool. [2] Adjust the tapping.</td>
<td>☒</td>
</tr>
<tr>
<td></td>
<td>Check if the error has occurred during high-speed synchronous tapping.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Check the repeatability.</td>
<td>The error is always repeated.</td>
<td>Replace the drive unit.</td>
<td>☒</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The state returns to normal once, but occurs sometimes thereafter.</td>
<td>Check the investigation item No. 3.</td>
<td>☒</td>
</tr>
<tr>
<td>3</td>
<td>Check if there is any abnormality in the unit’s ambient environment. (Ex. Ambient temperature, noise, grounding)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Take remedies according to the causes of the abnormality in the ambient environment.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 7-3-3 Troubleshooting for each warning No.

#### Warning No. 96: Scale feedback error
An excessive difference in feedback amount was detected between the main side detector and the MPI scale in MPI scale absolute position detection system.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>SV</th>
<th>SP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Check if there is any abnormality in the detector’s ambient environment. (Ex. Ambient temperature, noise, grounding)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Take remedies according to the causes of the abnormality in the ambient environment.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Check the repeatability.</td>
<td>Occurs frequently.</td>
<td>Replace the detector.</td>
<td>☒</td>
</tr>
<tr>
<td></td>
<td>Is not repeated.</td>
<td></td>
<td>Check the investigation item No. 1.</td>
<td>☒</td>
</tr>
</tbody>
</table>

#### Warning No. 97: Scale offset error
An error was detected in the offset data that is read at the NC power-ON in MPI scale absolute position detection system.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>SV</th>
<th>SP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Check if there is any abnormality in the detector’s ambient environment. (Ex. Ambient temperature, noise, grounding)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Take remedies according to the causes of the abnormality in the ambient environment.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Check the repeatability.</td>
<td>Occurs frequently.</td>
<td>Replace the detector.</td>
<td>☒</td>
</tr>
<tr>
<td></td>
<td>Is not repeated.</td>
<td></td>
<td>Check the investigation item No. 1.</td>
<td>☒</td>
</tr>
</tbody>
</table>
### 7 Troubleshooting

#### Warning No. 9B
**Incremental detector/magnetic pole shift warning**
For the incremental detector, an error was detected in the magnetic pole shift amount set in the magnetic pole shift amount parameter "SV028".

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>SV</th>
<th>SP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Check if there is any abnormality in the detector's ambient environment. (Ex. Ambient temperature, noise, grounding)</td>
<td>Take remedies according to the causes of the abnormality in the ambient environment.</td>
<td>○</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Check the repeatability.</td>
<td>Occurs occasionally.</td>
<td>Execute magnetic pole detection control again and reset SV028.</td>
<td>□</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Is not repeated.</td>
<td>Check the investigation item No. 1.</td>
<td>□</td>
</tr>
</tbody>
</table>

#### Warning No. 9E
**Absolute position detector: Revolution counter error**
An error was detected in the revolution counter of the absolute position detector. The absolute position data cannot be compensated.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>SV</th>
<th>SP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Check if there is any abnormality in the detector's ambient environment. (Ex. Ambient temperature, noise, grounding)</td>
<td>Take remedies according to the causes of the abnormality in the ambient environment.</td>
<td>○</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Check the repeatability.</td>
<td>Occurs frequently.</td>
<td>Replace the detector.</td>
<td>□</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Is not repeated.</td>
<td>Check the investigation item No. 1.</td>
<td>□</td>
</tr>
</tbody>
</table>

#### Warning No. 9F
**Battery voltage drop**
The battery voltage that is supplied to the absolute position detector dropped. The absolute position data is retained.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>SV</th>
<th>SP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Change the used battery and check whether the warning does not occur. (Turning the power OFF and ON is required.)</td>
<td>The warning does not occur.</td>
<td>The battery has been drained.</td>
<td>○</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The warning occurs.</td>
<td>Check the investigation item No. 2.</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Check whether the battery cable is disconnected, broken, or wired incorrectly.</td>
<td>The connection is faulty.</td>
<td>Correct the connection.</td>
<td>Replace the cable.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The connection is normal.</td>
<td>Check the investigation item No. 3.</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Measure the new battery voltage.</td>
<td>Less than 3.4V.</td>
<td>Replace the battery.</td>
<td>□</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3.4V or more.</td>
<td>Check the investigation item No. 6.</td>
<td>□</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The connection is faulty.</td>
<td>Correct the connection.</td>
<td>Replace the cable.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The connection is normal.</td>
<td>Check the investigation item No. 5.</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Check whether the cable connecting between the battery box and CN9 is short-circuited, broken, or wired incorrectly.</td>
<td>The connection is faulty.</td>
<td>Correct the connection.</td>
<td>Replace the cable.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The connection is normal.</td>
<td>Check the investigation item No. 5.</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Disconnect the BT-LG cable of the battery box, and then measure the voltage between DO(ALM) and DOCOM terminals at power ON.</td>
<td>Low voltage.</td>
<td>Replace the battery box.</td>
<td>□</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Equivalent of 24V.</td>
<td>Check the investigation item No. 6.</td>
<td>□</td>
</tr>
<tr>
<td>6</td>
<td>Perform a conductivity check with the detector cable between BT and LG of the drive unit in which the warning was detected. (Note)Make sure that the detector side connector is disconnected.</td>
<td>Resistance value is low.</td>
<td>Replace the cable.</td>
<td>□</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Resistance value is 100MΩ or more.</td>
<td>Replace the detector. (With the absolute position system, the zero point must be established.)</td>
<td>□</td>
</tr>
</tbody>
</table>

(Note) When warning 9F occurs, do not turn the drive unit power OFF to ensure that the absolute position data is held. Replace the battery with the drive unit power ON.

#### Warning No. A3
**Distance-coded reference check / initial setup warning**
When the detector with distance-coded reference marks is used, this warning is issued until the axis reaches the reference position during the initial setup of the distance-coded reference check function. This warning disappears after the axis has reached the position.
Or it is issued during the initial setup of MBA405W. This warning disappears after the axis has passed the Z-phase during the initial setup and the NC power has been turned ON again.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>SV</th>
<th>SP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Warning does not disappear.</td>
<td>Detector with distance-coded reference marks</td>
<td>Stopped on the way to the reference position.</td>
<td>Setup again.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MBA405W</td>
<td>The cycle counter is displayed.</td>
<td>Turn the NC power ON again.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The display of the cycle counter is &quot;0&quot;.</td>
<td>Turn the NC power ON again after the axis has passed the Z-phase.</td>
<td>○</td>
</tr>
</tbody>
</table>

#### Warning No. A4
**Dual signal warning**
An input was detected in the signal related to the dual signal.

<table>
<thead>
<tr>
<th>Investigation details</th>
<th>Investigation results</th>
<th>Remedies</th>
<th>SV</th>
<th>SP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Warning does not disappear.</td>
<td>In emergency stop state?</td>
<td>Cancel the emergency stop.</td>
<td>○</td>
</tr>
<tr>
<td>Warning No.</td>
<td>Description</td>
<td>Investigation details</td>
<td>Investigation results</td>
<td>Remedies</td>
</tr>
<tr>
<td>------------</td>
<td>-------------</td>
<td>-----------------------</td>
<td>-----------------------</td>
<td>----------</td>
</tr>
<tr>
<td>A6</td>
<td>Fan stop warning</td>
<td>A cooling fan built in the drive unit stopped.</td>
<td>Check the alarm No. &quot;45&quot; items.</td>
<td></td>
</tr>
<tr>
<td>E0</td>
<td>Over regeneration warning</td>
<td>Over-regeneration detection level exceeded 80%.</td>
<td>Check the acceleration/deceleration cycle. The cycle operation being conducted is severe for the average output. No problem.</td>
<td>Extends the cycle operation time to the length that will not cause a warning. Check the investigation item No. 2.</td>
</tr>
<tr>
<td>E1</td>
<td>Overload warning</td>
<td>Overload detection level exceeded 80%.</td>
<td>Check if the motor is hot. Motor is not hot. Check if an error occurs when executing acceleration/deceleration operation. Error is not found in operation. Error is found in operation.</td>
<td>Ease the operation pattern, if possible. If no alarm occurs, operation can be continued as it is. Check the investigation item 3 or later of Alarm No. 50.</td>
</tr>
<tr>
<td>E4</td>
<td>Set parameter warning</td>
<td>An incorrect parameter was detected among the parameters received from the CNC.</td>
<td>Check the error parameter No. SV001 to SV256 SP001 to SP256</td>
<td>Set the value within the designated setting range.</td>
</tr>
<tr>
<td>E6</td>
<td>Control axis detachment warning</td>
<td>Control axis detachment was commanded.</td>
<td>Check the spindle control input 4/bit 0 to 2. Selected other than 000, 001, 010 and 100 when the alarm occurred.</td>
<td>Correctly select.</td>
</tr>
<tr>
<td>E7</td>
<td>In NC emergency stop state</td>
<td>Emergency stop was input from the CNC.</td>
<td>Check if the emergency stop is applied on the NC side. The emergency stop is applied. The emergency stop is cancelled.</td>
<td>Check the investigation item No. 2. Check the investigation item No. 3.</td>
</tr>
<tr>
<td>E9</td>
<td>Instantaneous power interruption warning</td>
<td>The power was momentarily interrupted.</td>
<td>Check the alarm No. &quot;71&quot; items.</td>
<td></td>
</tr>
</tbody>
</table>
7 Troubleshooting

7-3-4 Parameter numbers during initial parameter error

If an initial parameter error (alarm 37) or set parameter warning (warning E4) occurs, the axis name and the No. of the error parameter that exceeds the setting range will appear on the NC Diagnosis screen as shown below:

S02 Initial parameter error ○○○○□ ○○○○ □: Error parameter No. □: Axis name

If an error No. in the following table is displayed as the error parameter No. even when the parameter is set to a value within the setting range, an error is occurring due to the hardware compatibility or specifications or in relation to several other parameters. Check the specifications of the servo and spindle system and the descriptions in the following table to correctly set the parameters.

<table>
<thead>
<tr>
<th>Error parameter  No.</th>
<th>Details</th>
<th>Related parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>2194</td>
<td>The base reference mark interval in the distance-coded reference scale is invalid.</td>
<td>SV019, SV117, SV130</td>
</tr>
<tr>
<td>2198</td>
<td>The absolute position detection is enabled when an incremental detector is connected as a position detector.</td>
<td>SV025, #2049</td>
</tr>
<tr>
<td>2199</td>
<td>The following settings are overflowing: -Electronic gear -Position loop gain -Conversion from the speed detection unit to position detection unit</td>
<td>SV001, SV002, SV003, SV018, SV019, SV020, SV049, SV117, SV118</td>
</tr>
<tr>
<td>2217</td>
<td>The motor selected is of a motor series different from the drive unit’s input voltage (200V/400V).</td>
<td>SV017</td>
</tr>
<tr>
<td>2219</td>
<td>In a semi-closed loop control system, the setting value of SV019 is different from that of SV020. Set them to the same value.</td>
<td>SV019</td>
</tr>
<tr>
<td>2220</td>
<td>The resolution of the motor side detector actually connected is not consistent with the setting value for SV020. -SV020 is set to a value outside the setting range.</td>
<td>SV020</td>
</tr>
<tr>
<td>2225</td>
<td>Incompatible motor type is selected. The machine side detector type or the motor side detector type is incorrectly set. -For the speed command synchronous control system with MDS-D2/DH2-V2, -The L axis for the drive unit is set as the secondary axis. Set the M axis as the secondary axis. -The motor side detectors for the L axis and the M axis are different. Use detectors of the same specifications.</td>
<td>SV017, SV025</td>
</tr>
<tr>
<td>2228</td>
<td>The magnetic pole shift amount (SV028) is set for a general servo motor (not a built-in motor).</td>
<td>SV028</td>
</tr>
<tr>
<td>Error parameter No.</td>
<td>Details</td>
<td>Related parameters</td>
</tr>
<tr>
<td>---------------------</td>
<td>---------</td>
<td>-------------------</td>
</tr>
</tbody>
</table>
| 2233                | The vertical axis pull up function (SV033/bitE) is set in the following conditions:  
- when the vertical axis pull up direction is not set (SV02=0)  
- when the drop prevention function is not set (SV048=0)  
The vertical axis pull up function (SV033/bitE) is not set in the following condition:  
- when the vertical axis pull up distance is set (SV095 ≠ 0) | SV032, SV033, SV048 SV095 |
| 2234                | Parallel connection is set when the motor is not a linear servo motor.  
Or the DC excitation mode (SV034/bit4) is set in the following conditions:  
- when the NC is powered ON  
- when a general servo motor (not a built-in motor) is used. | SV034 |
| 2236                | For the MDS-D2/DH2 Series:  
The power supply type (SV036) is set but a power supply unit is not connected.  
Always set the power supply type for the drive unit connected last on the NC optical communication cable.  
For the MDS-DM2 Series:  
Do not set the power supply type. It is set from the spindle side.  
For the MDS-DJ Series:  
The selected regenerative resistor is not supported in the drive unit of this capacity. | SV036 |
| 2261                | When the DC excitation mode (SV034/bit4) is set, the initial DC excitation level (SV061) is set to a value outside the setting range. | SV034, SV061 |
| 2262                | When the DC excitation mode (SV034/bit4) is set, the final DC excitation level (SV062) is set to a value outside the setting range. | SV034, SV062 |
| 2263                | When the DC excitation mode (SV034/bit4) is set, the initial DC excitation time (SV063) is set to a value outside the setting range. | SV034, SV063 |
| 2281                | - When the distance-coded reference scale (SV081/bit3) is set, the base reference mark interval (SV130) or the auxiliary reference mark interval (SV131) is not set.  
- When a HEIDENHAIN serial conversion interface unit is connected, the reference mark is set to be checked at 3 points (SV081/bit7=1). | SV025, SV081, SV130 SV131 |
| 2282                | With a multiple-axis drive unit, the digital signal input selection (SV082/bitF-C) is set to a different value for each axis in the same unit. | SV082 |
| 2317                | - The expansion sub side detector resolution (SV117) is set to "0" for a detector that requires the resolution expansion setting.  
If the upper 16 bits for the detector resolution are 0, this should be set to "-1".  
- The expansion sub side detector resolution (SV117) is set to a value other than "0" for a detector that does not support the resolution expansion setting. | SV019,SV025,SV117 |
| 2318                | - The expansion main side detector resolution (SV118) is set to "0" for a detector that requires the resolution expansion setting.  
If the upper 16 bits for the detector resolution are 0, this should be set to "-1".  
- The expansion main side detector resolution (SV118) is set to a value other than "0" for a detector that does not support the resolution expansion setting. | SV020,SV025,SV118 |
| 2330                | - The relation between the base reference mark interval (SV130) and the auxiliary reference mark interval (SV131) is invalid.  
- The base reference mark interval (SV130) is set to "0" when a distance-coded reference scale is connected.  
- The base reference mark interval (SV130) is set to a value other than "0" when a distance-coded reference scale is not connected.  
- The base reference mark interval (SV130) is set to a value other than "0" when the semi-closed loop is set. | SV018, SV025, SV130 SV131 |
| 2331                | - The auxiliary reference mark interval (SV131) is not set when a distance-coded reference scale is connected.  
- The auxiliary reference mark interval (SV131) is set to a value other than "0" when a distance-coded reference scale is not connected. | SV130, SV131 |
| 2334                | The distance-coded reference check / revolution counter (SV134) is set to a value other than "0" when the distance-coded reference scale is not set (SV081/bit3=0). | SV081, SV134 |
| 2335                | - In the distance-coded reference scale system, the distance-coded reference check /position within one rotation High (SV135) is set to a value outside the motor side detector's data range.  
- The distance-coded reference check /position within one rotation High (SV135) is set to a value other than "0" when the distance-coded reference scale is not set (SV081/bit3=0). | SV081, SV135, SV136 |
| 2336                | The distance-coded reference check /position within one rotation Low (SV136) is set to a value other than "0" when the distance-coded reference scale is not set (SV081/bit3=0). | SV081, SV136 |
| 2337                | The distance-coded reference check allowable width (SV137) is set to a value other than "0" when the distance-coded reference scale is not set (SV081/bit3=0). | SV081, SV137 |
| 2438                | The safety observation safety speed (SV238) and the safety observation safety motor speed (SV239) do not satisfy the following equation.  
(Round down the first decimal place. When the calculation results in "0", set SV239 to 1.)  
$\frac{SV238 \cdot SSCFEED}{SV018 \cdot PIT} - \frac{SV002 \cdot PC2}{SV001 \cdot PC1} = \frac{SV239 \cdot SSCRPM}{SV239}$ | SV238,SV239 |
| 2439                | The safety observation safety motor speed (SV239) is set to a value greater than the overspeed detection motor speed. | SV239 |
## 7 Troubleshooting

### (2) Spindle parameter error No.

<table>
<thead>
<tr>
<th>Error parameter No.</th>
<th>Details</th>
<th>Related parameters</th>
</tr>
</thead>
</table>
| 12999              | The following settings are overflowing:  
- Electronic gear and motor side gear  
- Position loop gain  
- Conversion from the speed detection unit to position detection unit | SP057 to SP060  
SP061 to SP064  
SP001 to SP003  
SP019, SP020 |
| 13017              | The motor selected is of a motor series different from the drive unit's input voltage (200V/400V).  
Or a motor of an incompatible motor series is selected. | SP017 |
| 13032              | For the MDS-D2/DH2 Series:  
The power supply type (SP032) is set, but a power supply unit is not connected.  
Always set the power supply type for the drive unit connected last on the NC optical communication cable.  
For the MDS-DM2 Series:  
Set SP032 to 0019 (normal setting), or 0059 (external emergency stop function).  
For the MDS-DJ Series:  
The selected regenerative resistor is not supported in the drive unit of this capacity. | SP032 |
| 13097              | The expansion sub side detector resolution (SP097) is set to "0" for a detector that requires the resolution expansion setting.  
If the upper 16 bits for the detector resolution are "0", this should be set to "-1".  
The expansion sub side detector resolution (SP097) is set to a value other than "0" for a detector that does not support the resolution expansion setting. | SP019, SP031, SP097 |
| 13098              | The expansion main side detector resolution (SP098) is set to "0" for a detector that requires the resolution expansion setting.  
If the upper 16 bits for the detector resolution are 0, this should be set to "-1".  
The expansion main side detector resolution (SP098) is set to a value other than "0" for a detector that does not support the resolution expansion setting. | SP020, SP031, SP098 |
| 13125              | When the DC excitation mode (SP225/bit4) is set, the initial DC excitation level (SP125) is set to a value outside the setting range. | SP225, SP125 |
| 13126              | When the DC excitation mode (SP225/bit4) is set, the final DC excitation level (SP126) is set to a value outside the setting range. | SP225, SP126 |
| 13127              | When the DC excitation mode (SP225/bit4) is set, the initial DC time (SP127) is set to a value outside the setting range. | SP225, SP127 |
| 13142              | The pulse application time for an IPM spindle motor is excessive. Set the pulse application time (SP142) to a value lower than 350 μs.  
The coil switch function is disabled and the pulse application coil for an IPM spindle motor is set to the low-speed coil. Set the pulse application coil to the high-speed coil, or enable the coil switch function. | SP017, SP018, SP142, SP226 |
| 13225              | The DC excitation mode (SP225/bit4) has been set before the axis passes the Z phase. Set the DC excitation mode after the axis passes the Z phase. | SP225 |
| 13238              | The safety observation safety speed (SP238) and the safety observation safety motor speed (SP239) do not satisfy the following equation:  
(Round down the first decimal place. When the calculation results in "0", set SP239 to 1.)  
SP238 : SSCFEED  
SP239 : SSCRPM  
SP057 : GRA1  
SP061 : GRB1 |
| 13239              | The safety observation safety motor speed calculated from the actual gear ratio exceeds the overspeed detection motor speed.  
(Note) The safety observation safety motor speed calculated from the actual gear ratio = SP238 : SSCFEED / 360 × PC2 / PC1  
PC2 : Spindle side gear ratio (SP057 to SP060)  
PC1 : Motor side gear ratio (SP061 to SP064) | SP239 |
7-3-5 Troubleshooting the spindle system when there is no alarm or warning

If an abnormality is observed in the spindle system but no alarm or warning has occurred, refer to the following table and check the state.


<table>
<thead>
<tr>
<th>Investigation item</th>
<th>Investigation results</th>
<th>Remedies</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Check the commanded speed and the spindle rotation speed displayed on the drive monitor screen.</td>
<td>The speed command is not input correctly.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The speed command is correct.</td>
</tr>
<tr>
<td>2</td>
<td>Check whether there is slipping between the motor and spindle. (When connected with a belt or clutch.)</td>
<td>There is slipping.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No particular problems found.</td>
</tr>
<tr>
<td>3</td>
<td>Check the spindle parameters (SP026, SP129 and following).</td>
<td>The correct values are not set.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The correct values are set.</td>
</tr>
</tbody>
</table>

[2] The acceleration/deceleration time is long or has increased in length.

<table>
<thead>
<tr>
<th>Investigation item</th>
<th>Investigation results</th>
<th>Remedies</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Check whether the friction torque or load inertia has increased.</td>
<td>The friction torque has increased.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No particular problems found.</td>
</tr>
<tr>
<td>2</td>
<td>Check if there is any abnormality in the motor's rotation during coasting.</td>
<td>The bearings do not rotate smoothly.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The bearings rotate smoothly.</td>
</tr>
<tr>
<td>3</td>
<td>Check whether the torque limit signal has been input.</td>
<td>The signal has been input.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The signal is not input.</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Investigation item</th>
<th>Investigation results</th>
<th>Remedies</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Check the load rate (load meter value) during cutting.</td>
<td>The load meter sways over 120% during cutting.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No particular problems found.</td>
</tr>
<tr>
<td>2</td>
<td>Carry out the same investigations and remedies as section (4).</td>
<td></td>
</tr>
</tbody>
</table>

[4] The vibration and noise (gear noise), etc., are large.

<table>
<thead>
<tr>
<th>Investigation item</th>
<th>Investigation results</th>
<th>Remedies</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Check the machine's dynamic balance. (Coast from the maximum speed.)</td>
<td>The same noise is heard during coasting.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No particular problems found.</td>
</tr>
<tr>
<td>2</td>
<td>Check whether there is a resonance point in the machine. (Coast from the maximum speed.)</td>
<td>Vibration and noise increase at a set rotation speed during coasting.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No particular problems found.</td>
</tr>
<tr>
<td>3</td>
<td>Check the machine's backlash.</td>
<td>The backlash is great.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No particular problems found.</td>
</tr>
<tr>
<td>4</td>
<td>Change the setting of the speed loop parameter (SP005:VGN1).</td>
<td>The vibration and noise are lost when the setting value is lowered by approx. 100.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The symptoms do not change even if the above value is set.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Jiggle the detector connectors (drive unit side and detector side) and check if they are disconnected.</td>
<td>The connection is loosened.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The connector fixing is normal.</td>
</tr>
<tr>
<td>6</td>
<td>Turn the power OFF, and check the connection of the speed detector cable with a tester.</td>
<td>The connection is faulty or disconnected.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The connection is normal.</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Investigation item</th>
<th>Investigation results</th>
<th>Remedies</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>When connected with a belt or clutch, check whether there is slipping between the motor and spindle.</td>
<td>There is slipping.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No particular problems found.</td>
</tr>
</tbody>
</table>
## 7 Troubleshooting


<table>
<thead>
<tr>
<th>Investigation item</th>
<th>Investigation results</th>
<th>Remedies</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Check the spindle parameter SP005 (SP008) settings.</td>
<td>The rotation stabilizes when the settings values are both set to approx. double.</td>
<td>Change the setting value. Note that the gear noise may increase.</td>
</tr>
<tr>
<td></td>
<td>The symptoms do not change even when the above value is set.</td>
<td>Return the setting values to the original values. Check the investigation item No. 2.</td>
</tr>
<tr>
<td>2 Manually shake the speed detector connectors (spindle drive unit side and speed detector side) to check if they are disconnected.</td>
<td>The connector is disconnected (or loose).</td>
<td>Correctly connect the connector.</td>
</tr>
<tr>
<td></td>
<td>The connector is not disconnected (or loose).</td>
<td>Check the investigation item No. 2.</td>
</tr>
<tr>
<td>3 Turn the power OFF, and check the connection of the speed detector cable with a tester. (Especially check the shield wiring.)</td>
<td>The connection is faulty.</td>
<td>Replace the detector cable. Correct the connection.</td>
</tr>
<tr>
<td></td>
<td>The connection is normal.</td>
<td>Check the investigation item No. 4.</td>
</tr>
<tr>
<td>4 Investigate the wiring and installation environment. 1) Is the ground correctly connected? 2) Are there any noise-generating devices near the drive unit?</td>
<td>1) The grounding is incomplete.</td>
<td>Correctly ground.</td>
</tr>
<tr>
<td></td>
<td>2) The alarm occurs easily when a specific device operates.</td>
<td>Use noise measures on the device described on the left.</td>
</tr>
<tr>
<td></td>
<td>No particular problems found.</td>
<td>Replace the spindle drive unit.</td>
</tr>
</tbody>
</table>

### [7] The speed does not rise above the command speed sometimes.

<table>
<thead>
<tr>
<th>Investigation item</th>
<th>Investigation results</th>
<th>Remedies</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Check the speed command. Check whether the override input is input from the machine operation panel.</td>
<td>The speed command is not input correctly.</td>
<td>Input the correct speed command.</td>
</tr>
<tr>
<td></td>
<td>The speed command is input correctly.</td>
<td>Check the investigation item No. 2.</td>
</tr>
<tr>
<td>2 Check whether the load has suddenly become heavier.</td>
<td>The load has become heavier.</td>
<td>Repair the machine side.</td>
</tr>
<tr>
<td></td>
<td>No particular problems found.</td>
<td>Check the investigation item No. 3.</td>
</tr>
<tr>
<td>3 Manually rotate the motor bearings and check the movement.</td>
<td>The bearings do not rotate smoothly.</td>
<td>Replace the spindle motor.</td>
</tr>
<tr>
<td></td>
<td>The bearings rotate smoothly.</td>
<td>Check the investigation item No. 4.</td>
</tr>
<tr>
<td>4 Manually shake the speed detector connectors (spindle drive unit side and speed detector side) to check if they are disconnected.</td>
<td>The connector is disconnected (or loose).</td>
<td>Correctly connect the connector.</td>
</tr>
<tr>
<td></td>
<td>The connector is not disconnected (or loose).</td>
<td>Check the investigation item No. 5.</td>
</tr>
<tr>
<td>5 Turn the power OFF, and check the connection of the speed detector cable with a tester. (Especially check the shield wiring.)</td>
<td>The connection is faulty.</td>
<td>Replace the detector cable. Correct the connection.</td>
</tr>
<tr>
<td></td>
<td>The waveform is normal.</td>
<td>Replace the spindle drive unit.</td>
</tr>
</tbody>
</table>
Maintenance
8 Maintenance

8-1 Periodic inspections

8-1-1 Inspections

Periodic inspection of the following items is recommended.

1. Are any of the screws on the terminal block loose? If loose, tighten them.
2. Is any abnormal noise heard from the servomotor bearings or brake section?
3. Are any of the cables damaged or cracked? If the cables move with the machine, periodically inspect the cables according to the working conditions.
4. Is the core of the load coupling shaft deviated?

8-1-2 Cleaning of spindle motor

If you continue to use the spindle motor with dirt such as oil mist and dust adhered, its cooling performance degrades and the motor is unable to fully exercise its performance, which may cause the spindle motor overheat alarm. In some cases this may result in damage to the bearing or cooling fan. To ensure the cooling capability of the spindle motor's fan, carry out periodical cleaning of the spindle motor and its cooling fan according to the following cleaning procedure.

Note that the spindle motor SJ-D Series and the spindle motor SJ-VL Series is used as an example in this procedure. When cleaning the other spindle motors, carry it out based on this procedure.

Controller is OFF

Do not touch the motor for some time after turning OFF the power, as the motor remains at a high temperature. This may lead to burns.
<For the spindle motor SJ-D Series>

(1) Detaching the cooling fan unit
  Remove the cooling fan unit from the spindle motor.

[1] Remove fixing screws (hexagon socket screws at four locations) for the terminal box cover.


[3] Remove the three lead wires (BU, BV, and BW) for the cooling fan from the one-touch terminal block.
  [3-1] Applicable flat-blade screwdriver
  Always use a flat-blade screwdriver whose blade edge size is 0.6×3.5mm for working.
  (SZF1-0.6×3.5 manufactured by Phoenix Contact)

[3-2] Insert the screwdriver into the insertion point (small square hole) of the one-touch terminal block in a diagonal direction. When the spring touches the blade edge, push the screwdriver down to the position that hits a conductive plate to the direction of arrow (a), tilting it in the inside direction of the terminal block. The screwdriver is held if it inserts appropriately.

[3-3] After confirming that the spring is open, slowly unplug the lead wires for the cooling fan to the direction of arrow (b).

(Note 1) Do not let foreign objects enter the motor. In particular, if conductive objects such as screws or metal wires, etc., or combustible materials such as oil enter, the motor could be damaged.
[4] Remove the fixing screws (hexagon socket screws at four locations) for the cooling fan unit.

(Note 1) Some spindle motors have the fixing screws (hexagon socket screws) for the cooling fan unit at two locations.

[5] Slowly unplug the lead wire of the cooling fan from the section where the lead wire for the cooling fan is led out. At this time, slowly unplug the protection tube which protects the lead wire for the cooling fan together. Slowly unplug the protection tube by pushing it out from inside the terminal box or pulling it from outside the terminal box not to overload the cooling fan side.

(Note 1) Take special care not to damage the lead wire for the cooling fan.
[6] Slowly remove the cooling fan unit in the direction of arrow (c).

(Note 1) Do not strike the side face of the cooling fan unit. Failure to observe this may result in damages of the fan unit.

(Note 2) Perform it so as not to touch the edge part of the cooling fan unit. Failure to observe this may result in injury.

(Note 3) Do not grip the cooling fan lead wire (including the protection tube) when carrying the cooling fan unit. Carrying with gripping them may result in damages of the fan unit.
(2) Removal of the bellmouth inside the cooling fan unit
   [1] Remove the bellmouth fixing screws (hexagon socket screws at four locations).

   (Note 1) Some spindle motors have the bellmouth fixing screws (hexagon socket screws) at two locations.


   (Note 1) Perform it so as not to touch the edge part of the cooling fan unit or the end part of the bellmouth. Failure to observe this may result in injury.
   (Note 2) Do not let bellmouth fixing screws enter the cooling fan unit. Failure to observe this could lead to breakage or faults of the cooling fan.

(3) Cleaning
   [1] Check the situation of the cooling fan blade part and inside the case of the cooling fan unit by visual inspection.
[2] Clean up the inside of the cooling fan unit and the cooling air vent.
Wipe dirt off the inside of the cooling fan unit and the cooling air vent using wastes, etc.

(Note 1) Never disassemble or modify the cooling fan. Failure to observe this could lead to breakage or faults of the cooling fan.
(Note 2) Do not drop the cooling fan or immerse it in water. Failure to observe this could lead to breakage or faults of the cooling fan.
(Note 3) Do not use air blow as this may cause foreign matters to enter the inner part of the cooling fan motor.
(Note 4) Do not wash with liquid detergent as the cooling fan motor is an electrical appliance.
(Note 5) Take extra care not to damage the cooling fan during cleaning.

[3] Clean up the air duct of the spindle motor frame
[3-1] Prepare the cleaning jigs (two types) as illustrated below.
The main body of the jigs A and B is a wire stick (approx. $\phi 2\text{mm}$) with the length of approx. 500mm. A brush is attached at the top of the cleaning jig B. For the brush on the jig B, do not choose a hard brush such as the one made of wires.
[3-2] Use the cleaning jigs to clean the air ducts of the spindle motor frame. Insert the cleaning jigs A and B into the motor frame's air ducts from the counter-load side of the spindle motor, scrape out the dirt, and wipe it off with wastes, etc.

(4) Assembling

[1] After all the cleaning processes have been completed, attach the cooling fan unit to the motor in the order opposite to that of the detachment process.

[2] Precautions in installing cooling fan unit
(a) The section where the cooling fan lead wires are led out must be in the state without a space by inserting a protection tube for the cooling fan. A space could lead to faults of the motor by allowing foreign matters enter there.
(b) Draw the lead wires including the protection tube of the cooling fan unit into the terminal box not to project at the back side of the motor. Failure to observe this could lead to breakage of the lead wires.

![Diagram of Spindle motor and Cooling fan unit with lead wires]

(c) When installing the three lead wires (BU, BV, and BW) of the cooling fan to the one-touch terminal block, do not mistake the terminal connections. Improper connection could lead to breakage or malfunction.

(d) Make sure not to pinch the cooling fan lead wire when installing the terminal box cover. Failure to observe this could lead to electric shocks.

[3] After attaching the unit, perform a test run to check the air blow direction of the fan, etc.
<For the spindle motor SJ-VL Series>

(1) Detaching the cooling fan unit

Remove the cooling fan unit from the spindle motor.

[1] Disconnect the cooling fan's terminals from the terminal block (See the diagram below).

[2] Detach the cooling fan unit from the spindle motor.

Remove the four hexagon socket screws used to secure the cooling fan unit to the spindle motor.

When slowly removing the cooling fan unit from the spindle motor, also unplug the fan drive cable slowly with the rubber packing left in the terminal box.

(Note 1) Pull out the solderless terminals one by one as the hole on the terminal box is small.

(Note 2) Take extra care not to damage the cable.
8-1 Periodic inspections

(2) Cleaning

(a) Clean up the backside of the cooling fan unit and the air duct in the counter-load side bracket of the spindle motor. Wipe dirt off the backside of the cooling fan unit and the air duct of the counter-load side bracket using wastes, etc.

(Note 1) Do not use air blow as this may cause foreign matters to enter the inner part of the cooling fan motor.

(Note 2) Do not wash with liquid detergent as the cooling fan motor is an electrical appliance.

(b) Clean up the inner part of the fan case and the air duct of the spindle motor body.

[1] Prepare the cleaning jigs (two types) as illustrated below.

The main body of the jigs A and B is a wire stick (approx. 2mm) with the length of approx. 500mm. A brush is attached at the top of the cleaning jig B. For the brush on the jig B, do not choose a hard brush such as the one made of wires.
[2] Detach the finger guard from the cooling fan unit. Remove the four screws used for securing the finger guard.

[3] Wipe dirt off the finger guard using wastes, etc.

[4] Use the cleaning jigs to clean the inner part of the cooling fan case.

   Use the cleaning jigs A and B to scrape out dirt between the fan case and blades in the cooling fan unit, and wipe it off with wastes, etc.

   (Note 1) Do not use air blow as this may cause foreign matters to enter the inner part of the cooling fan motor.

   (Note 2) Do not wash with liquid detergent as the cooling fan motor is an electrical appliance.

   (Note 3) Take extra care not to damage the cooling fan during cleaning.
[5] Use the cleaning jigs to clean the air ducts of the spindle motor body. Insert the cleaning jigs A and B into the motor's air ducts from the counter-load side bracket, scrape out the dirt, and wipe it off with wastes, etc.

(3) Assembling
After all the cleaning processes have been completed, attach the cooling fan unit to the motor in the order opposite to that of the detachment process. After attaching the unit, perform a test run to check the air blow direction of the fan, etc. Be careful not to pinch the cable between the cooling fan unit and the terminal box.
8-2 Service parts

A guide to the part replacement cycle is shown below. Note that these will differ according to the working conditions or environmental conditions, so replace the parts if any abnormality is found. Contact Mitsubishi branch or your dealer for repairs or part replacements.

<table>
<thead>
<tr>
<th>Part name</th>
<th>Standard replacement time</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Servo drive unit</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smoothing capacitor</td>
<td>10 years</td>
<td></td>
</tr>
<tr>
<td>Cooling fan</td>
<td>10,000 to 30,000 hours (2 to 3 years)</td>
<td></td>
</tr>
<tr>
<td>Battery</td>
<td>10,000 hours</td>
<td>(for ER6V-C119B / MDS-BTBOX-36)</td>
</tr>
<tr>
<td><strong>Servomotor</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bearings</td>
<td>20,000 to 30,000 hours</td>
<td></td>
</tr>
<tr>
<td>Detector</td>
<td>20,000 to 30,000 hours</td>
<td></td>
</tr>
<tr>
<td>Oil seal, V-ring</td>
<td>5,000 hours</td>
<td></td>
</tr>
</tbody>
</table>

The standard replacement time is a reference. Even if the standard replacement time is not reached, the part must be replaced if any abnormality is found.

[1] Power smoothing capacitor:
The characteristics of the power smoothing capacitor will deteriorate due to the effect of ripple currents, etc. The capacitor life is greatly affected by the ambient temperature and working conditions. However, when used continuously in a normal air-conditioned environment, the service life will be ten years.

[2] Relays:
Contact faults will occur due to contact wear caused by the switching current. The service life will be reached after 100,000 cumulative switches (switching life) although this will differ according to the power capacity.

[3] Servomotor bearings:
The motor bearings should be replaced after 20,000 to 30,000 hours of rated load operation at the rated speed. This will be affected by the operation state, but the bearings must be replaced when any abnormal noise or vibration is found in the inspections.

[4] Servomotor oil seal, V-ring:
These parts should be replaced after 5,000 hours of operation at the rated speed. This will be affected by the operation state, but these parts must be replaced if oil leaks, etc., are found in the inspections.
8-3 Adding and replacing units and parts

1. Correctly transport the product according to its weight. Failure to do so could result in injury.
2. Do not stack the product above the indicated limit.
3. Installation directly on or near combustible materials could result in fires.
4. Install the unit as indicated at a place which can withstand the weight.
5. Do not get on or place heavy objects on the unit. Failure to observe this could result in injury.
6. Always use the unit within the designated environment condition range.
7. Do not allow conductive foreign matter such as screws or metal chips, or combustible foreign matter such as oil enter the servo drive or servomotor.
8. Do not block the intake or exhaust ports of the servo drive of servomotor. Failure to observe this could result in faults.
9. The servo drive and servomotor are precision devices. Do not drop them or apply strong impacts.
10. Do not install or operate a servo drive or servomotor which is damaged or missing parts.
11. When the unit has been stored for a long time, contact the Service Center or Service Station.
12. Connect the detector (CN2/CN3) immediately after the installation of the servo drive unit. In addition, when a battery box is used, immediately connect to the BTA/BTB connector. (prevention of absolute position data lost)

8-3-1 Replacing the drive unit

(1) Arrangement of replacing parts
Contact Mitsubishi branch or your dealer for an order or a replacement of the drive unit.
Place an order for the same type of a drive unit as the one to be replaced.

(2) Replacement procedure
Replace the drive unit with the following procedures.

Procedures
[1] Turn the breaker for the input power OFF. Make sure the CHARGE lamp of the power supply unit is turned OFF.
[2] Disconnect all the connectors and the wires connected to the drive unit.
[3] Remove the two (four) screws fixing the drive unit onto the control panel. Remove the drive unit from the control panel.
[4] Make a same setting for the rotary switch and the dip switch of the new drive unit as those of the uninstalled drive unit.
[5] Install a new drive unit by following the removal procedure in reverse.

(3) Restoration
Data backup and restoration is not required before replacing drive units because drive units’ data such as parameters are stored in the controller. However, carry out a backup of the whole system before replacement as a precautionary measure.
The power for keeping the detector’s position data of an absolute position system is supplied from the battery connected to the drive unit. Keep the power ON once for 30 minutes or more if possible, and make sure to complete the replacement within 60 minutes after charging the detector’s capacitor.
8-3-2 Replacing the unit fan

(1) Replacing parts

<table>
<thead>
<tr>
<th>Unit fan type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drive unit type</td>
</tr>
<tr>
<td>MDS-DM2-SPV Series</td>
</tr>
</tbody>
</table>

(2) Replacement procedure
Replace the unit fan with the following procedures.

[1] Remove the mounting screws on the top of the fan.


[4] Remove the fan guard, then replace the fan.
8-3-3 Replacing the battery

(1) Replacing parts
    <Replacing a battery equipped with the spindle/servo drive unit
    or the battery unit, MDS-BTBOX-36>
When the battery voltage is low (warning 9F), place an order for the same type of a battery as the one currently
equipped with the unit.
Battery type LR20 is commercially available as a size-D alkaline battery. The battery may be purchased and
replaced by the user.

<table>
<thead>
<tr>
<th>Type</th>
<th>Battery equipped unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>ER6V-C119B</td>
<td>Spindle/servo drive unit</td>
</tr>
<tr>
<td>LR20 (size-D alkaline battery)</td>
<td>Battery unit, MDS-BTBOX-36</td>
</tr>
</tbody>
</table>

(Note) Four LR20 size-D alkaline batteries are needed for per battery unit, MDS-BTBOX-36.

1. When the battery voltage is low (warning 9F), do not shut OFF the power of the drive unit until replacement of the battery to protect the data
2. Replace the MDS-BTBOX-36 battery with new batteries (LR20) that is within the recommended service period.
(2) Replacement procedure
Replace the battery with the following procedures.

1. Replace the batteries with new ones immediately after the battery voltage drop alarm (9F) has been output.

2. Replace the batteries while applying the drive unit’s control power.

<Replacement procedure for the cell battery ER6V-C119B>
[1] Turn the breaker for the input power OFF. Make sure the power of the replacing drive unit is turned OFF.
[2] Open the battery holder cover located at the front of the drive unit.
[3] Pull out the battery connector connected with the drive unit. Remove the battery.
[4] Connect a new battery connector to the connector position where the old battery connector was pulled out from in step [2].
[5] Cancel the warning 9F by executing an alarm reset (pushing the NC reset button).
(Note) Replace the batteries while applying the drive unit’s control power.
<Replacement procedure for the battery unit MDS-BTBOX-36>

Possible backup period
Possible backup period is at most one year. Thus, make sure to exchange the batteries in the one-year cycle.

How to replace the battery
[1] Remove the battery box cover (four screws).
[2] Replace the batteries with new ones. Be careful not to mistake the polarity.
[3] Attach the cover, and fix it with the four screws.
[4] Cancel the warning 9F by restarting the drive unit to reset the voltage drop detection circuit of the battery box.

(Note 1) Replace the batteries while applying control power to the servo drive unit.
(Note 2) If the cover is ill-set, mist enters through the interstices and enter into the panel. Tighten the screws.

1. Use new batteries that are within the recommended service period. (Check the recommended service period written on the batteries before using them.)

2. Replace the batteries with new ones immediately after the battery voltage drop alarm (9F) has been output.

3. Replace the batteries while applying the servo drive unit’s control power.

4. Wrong connection may cause liquid leakage, heat generation and/or explosion.

5. Do not mix new batteries with used ones or mix different type batteries.
Appendix 1

Cable and Connector Specifications
Appendix 1-1 Selection of cable
Appendix 1-1-1 Cable wire and assembly

(1) Cable wire
The specifications of the wire used for each cable, and the machining methods are shown in this section. When manufacturing the detector cable and battery connection cable, use the recommended wires shown below or equivalent products.

(a) Heat resistant specifications cable

<table>
<thead>
<tr>
<th>Wire type (other manufacturer’s product)</th>
<th>Finish outer diameter</th>
<th>Sheath material</th>
<th>No. of pairs</th>
<th>Configuration</th>
<th>Conductive resistor</th>
<th>Withstand voltage</th>
<th>Insulation resistance</th>
<th>Heat resistance temperature</th>
<th>Flexibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>BD20032 Compound 6-pair shielded cable Specification No. Bangishi-16903 Revision No. 3 (Note 2)</td>
<td>8.7mm</td>
<td>Heat resistant PVC</td>
<td>2</td>
<td>100 strands/0.08mm</td>
<td>40.7 Ω/km or less</td>
<td>500VAC/1min</td>
<td>1000 MΩ/km or more</td>
<td>105° C</td>
<td>70 × 10^4 times or more at R200</td>
</tr>
</tbody>
</table>

(Note 1) BANDO Electric Wire (http://www.bew.co.jp/)
(Note 2) The Mitsubishi standard cable is the (a) Heat resistant specifications cable. For MDS-C1/CH series, (b) or equivalent is used as the standard cable.

(b) General-purpose heat resistant specifications cable

<table>
<thead>
<tr>
<th>Wire type (other manufacturer’s product)</th>
<th>Finish outer diameter</th>
<th>Sheath material</th>
<th>No. of pairs</th>
<th>Configuration</th>
<th>Conductive resistor</th>
<th>Withstand voltage</th>
<th>Insulation resistance</th>
<th>Heat resistance temperature</th>
<th>Flexibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>BD20032 Compound 6-pair shielded cable Specification No. Bangishi-16903 Revision No. 3 (Note 2)</td>
<td>8.7mm</td>
<td>PVC</td>
<td>2</td>
<td>100 strands/0.08mm</td>
<td>40.7 Ω/km or less</td>
<td>500VAC/1min</td>
<td>1000 MΩ/km or more</td>
<td>60° C</td>
<td>100 × 10^4 times or more at R200</td>
</tr>
</tbody>
</table>

Core identification

<table>
<thead>
<tr>
<th>Pair No.</th>
<th>Insulator color</th>
</tr>
</thead>
<tbody>
<tr>
<td>L1</td>
<td>L2</td>
</tr>
<tr>
<td>A1 (0.5mm²)</td>
<td>Red White</td>
</tr>
<tr>
<td>A2 (0.5mm²)</td>
<td>Black White</td>
</tr>
<tr>
<td>B1 (0.2mm²)</td>
<td>Brown Orange</td>
</tr>
<tr>
<td>B2 (0.2mm²)</td>
<td>Blue Green</td>
</tr>
<tr>
<td>B3 (0.2mm²)</td>
<td>Purple White</td>
</tr>
<tr>
<td>B4 (0.2mm²)</td>
<td>Yellow White</td>
</tr>
</tbody>
</table>

Compound 6-pair cable structure drawing
(2) **Cable assembly**

Assemble the cable with the cable shield wire securely connected to the ground plate of the connector.

![Cable assembly diagram]

(3) **Battery connection cable**

<table>
<thead>
<tr>
<th>Wire type (other manufacturer’s product)</th>
<th>Finish outer diameter</th>
<th>Sheath material</th>
<th>No. of pairs</th>
<th>Configuration</th>
<th>Conductive resistor</th>
<th>withstand voltage</th>
<th>Insulation resistance</th>
<th>Heat resistance temperature</th>
<th>Minimum bend radius</th>
</tr>
</thead>
<tbody>
<tr>
<td>J14B101224-00 Two core shield cable</td>
<td>3.3mm</td>
<td>PVC</td>
<td>1</td>
<td>7strands / 0.2mm</td>
<td>91.2Ω/km or less</td>
<td>AC500V/1min</td>
<td>1000MΩ/km or less</td>
<td>80°C</td>
<td>R33mm</td>
</tr>
</tbody>
</table>

(Note 1) Junkosha Inc.  [http://www.junkosha.co.jp/english/](http://www.junkosha.co.jp/english/)

Dealer: TOA ELECTRIC INDUSTRIAL CO., LTD.  [http://www.toadenki.co.jp/index_e.html](http://www.toadenki.co.jp/index_e.html)

![Two core shield cable structure drawing]

**Core identification**

<table>
<thead>
<tr>
<th>No.</th>
<th>Insulator color</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Red</td>
</tr>
<tr>
<td>2</td>
<td>Black</td>
</tr>
</tbody>
</table>
Appendix 1-2 Cable connection diagram

1. Take care not to mistake the connection when manufacturing the detector cable. Failure to observe this could lead to faults, runaway or fire.

2. When manufacturing the cable, do not connect anything to pins which have no description.

Appendix 1-2-1 Battery cable

<DG21 cable connection diagram (Connection cable between drive unit and A6BAT (MR-BAT) (MDS-BTCASE)> 

Drive unit side connector
(Hirose Electric)
Connector: DF1B-2S-2.5R
Contact: DF1B-2428SCA

Battery unit side connector
(3M)
Connector: 10120-3000VE
Shell kit: 10320-52F0-008

<DG22 cable connection diagram (Connection cable between drive unit and drive unit)> 

Drive unit side connector
(Hirose Electric)
Connector: DF1B-2S-2.5R
Contact: DF1B-2428SCA

<DG23 cable connection diagram (Connection cable between drive unit and MDS-BTBOX-36)> 

Drive unit side connector
(Hirose Electric)
Connector: DF1B-2S-2.5R
Contact: DF1B-2428SCA

Battery box side

<DG24 cable connection diagram (Connection cable for alarm output between drive unit and MDS-BTBOX-36)> 

Drive unit side connector
(3M)
Connector: 10120-3000VE
Shell kit: 10320-52F0-008

Battery box side

When DG24 cable is used, proximity switch or external emergency stop cannot be wired, so these functions cannot be used.
Appendix 1-2-2 Optical communication repeater unit cable

< F070 cable connection diagram >

24VDC power side terminal (J.S.T.)
Crimping Terminal: V1.25-3 or V1.25-4 × 2

Optical communication repeater unit side connector (Tyco Electronics)
Connector: 2-178288-3
Contact: 1-175218-5 × 3

0V
24VDC

DCIN

< F110 cable connection diagram >

24VDC power side connector (Tyco Electronics)
Connector: 3-178127-6
Contact: 1-175218-5 (for AWG16) × 3
1-175217-5 (for AWG22) × 2

Optical communication repeater unit side connector (Tyco Electronics)
Connector: 2-178288-3
Contact: 1-175218-5 × 3

<ACFAIL (CF01)>
S1030-0230
S0084-6160 × 2

Appendix 1-2-3 STO cable

<CN8 STO input connector connection diagram>

Drive unit side (Tyco Electronics)
Connector set: 2069250-1

STO1 input
STO2 input
24G
TOF1 output
TOF2 output
24V
CN8

STO1
STO2
STOCOM
TOF1
TOF2
TOFOM
Appendix 1-2-4 Servo detector cable

<CVN2E-8P, CVN2E-9P cable connection diagram>

<table>
<thead>
<tr>
<th>Drive unit side connector (3M)</th>
<th>Motor detector/ Ball screw side detector side connector (DDK)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Receptacle: 36210-0100PL</td>
<td>Plug: CMV1-SP10S-M2 (Straight)</td>
</tr>
<tr>
<td>Shell kit: 36310-3200-008</td>
<td>CMV1-AP10S-M2 (Angle)</td>
</tr>
<tr>
<td>Connector set: 54599-1019</td>
<td>Contact: CMV1-#22ASC-S1</td>
</tr>
</tbody>
</table>

Motor detector/ Ball screw side detector side connector
Plug: CMV1-SP10S-M2 (Straight)
CMV1-AP10S-M2 (Angle)
Contact: CMV1-#22ASC-S1

- Drive unit side connector
- Motor detector/ Ball screw side detector side connector
- Plug: CMV1-SP10S-M2 (Straight)
- CMV1-AP10S-M2 (Angle)
- Contact: CMV1-#22ASC-S1

<For 15m or less>

Drive unit side connector
Receptacle: 36210-0100PL
Shell kit: 36310-3200-008
Connector set: 54599-1019

- Drive unit side connector
- Motor detector/ Ball screw side detector side connector
- Plug: CMV1-SP10S-M2 (Straight)
- CMV1-AP10S-M2 (Angle)
- Contact: CMV1-#22ASC-S1

<For 15m to 30m>
<CNV2E-HP cable connection diagram>

Drive unit side connector
(3M)
Receptacle: 36210-0100PL
Shell kit: 36310-3200-008
(MOLEX)
Connector set: 54599-1019

MDS-B-HR unit side connector
(Hirose Electric)
Plug: RM15WTP-8S
Clamp: RM15WTP-CP (10)

<Detector conversion unit side connector>
(Hirose Electric)
Plug: RM15WTP-12P
Clamp: RM15WTP-CP (10)

(Note) This cable must be prepared by the user.
<Rectangular wave communication detector (linear scale, etc.) cable connection diagram>

Drive unit side connector
(3M)
Receptacle: 36210-0100PL
Shell kit: 36310-3200-008
(MOLEX)
Connector set: 54599-1019

Machine side rectangular wave communication detector

<table>
<thead>
<tr>
<th>Drive unit side connector</th>
<th>Machine side rectangular wave communication detector</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>PS(+5V)</td>
<td>LG</td>
</tr>
<tr>
<td>A</td>
<td>A*</td>
</tr>
<tr>
<td>B</td>
<td>B*</td>
</tr>
<tr>
<td>Z</td>
<td>Z*</td>
</tr>
<tr>
<td>SHD</td>
<td></td>
</tr>
</tbody>
</table>

Case grounding: PE

(Note) Contact the detector manufacturer for the details.
(Note) Contact the detector manufacturer about whether to perform the P5V wiring or not.

(Note) This cable must be prepared by the user.

<Serial communication detector (linear scale, etc.) cable connection diagram>

Drive unit side connector
(3M)
Receptacle: 36210-0100PL
Shell kit: 36310-3200-008
(MOLEX)
Connector set: 54599-1019

Machine side serial communication detector

<table>
<thead>
<tr>
<th>Drive unit side connector</th>
<th>Machine side serial communication detector</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>PS(+5V)</td>
<td>LG</td>
</tr>
<tr>
<td>RQ</td>
<td>RQ*</td>
</tr>
<tr>
<td>SD</td>
<td>SD*</td>
</tr>
<tr>
<td>SHD</td>
<td></td>
</tr>
</tbody>
</table>

Case grounding: PE

(Note) Contact the detector manufacturer for the details.

(Note) Contact the detector manufacturer about whether to perform the P5V wiring or not.

(Note) This cable must be prepared by the user.

For compatible detector, refer to the section "Servo option" in Specifications Manual.
Appendix 1-2-5 Spindle detector cable

<Appendix 1-2-5 Spindle detector cable>

<CNP2E-1 cable connection diagram>

Spindle drive unit side connector
(3M)
Receptacle: 36210-0100PL
Shell kit: 36310-3200-008
(MOLEX)
Connector set: 54599-1019

Spindle motor side connector
(Tyco Electronics)
Connector: 172169-1
Contact: 170363-1(AWG26-22)
170364-1(AWG22-18)

1       2       5       6       7       8       3       4
3       4       4       4       9

P5(+5V)  LG
MT1      MT2
SD       SD*
RQ       RQ*
Case     grounding
PE

(Note) For the pin "7" or "8", use the contact "170364-1".
For the other pins, use the contact "170363-1".

<For 15m or less>

Spindle drive unit side connector
(3M)
Receptacle: 36210-0100PL
Shell kit: 36310-3200-008
(MOLEX)
Connector set: 54599-1019

Spindle motor side connector
(Tyco Electronics)
Connector: 172169-1
Contact: 170363-1(AWG26-22)
170364-1(AWG22-18)

1       2       5       6       7       8       3       4
3       4       4       4       9

P5(+5V)  LG
MT1      MT2
SD       SD*
RQ       RQ*
Case     grounding
PE

(Note) For the pin "7" or "8", use the contact "170364-1".
For the other pins, use the contact "170363-1".

<For 15m to 30m>
### Appendix 1 Cable and Connector Specifications

**<CNP3EZ-2P, CNP3EZ-3P cable connection diagram>**

#### Spindle drive unit side connector
- **(3M)**
- Receptacle: 36210-0100PL
- Shell kit: 36310-3200-008
- (MOLEX)
- Connector set: 54599-1019

#### Spindle motor side connector
- **(DDK)**
- Connector: MS3106A20-29S (D190)
- Back shell: CE02-20BS-S (straight)
  - CE-20BA-S (angle)
- Clamp: CE3057-12A-3

#### For 15m or less

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
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<tbody>
<tr>
<td>PE</td>
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<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

#### For 15m to 30m

<table>
<thead>
<tr>
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<th>4</th>
<th>5</th>
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<th>7</th>
<th>8</th>
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</thead>
<tbody>
<tr>
<td>PE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

**Spindle drive unit side connector**
- **(3M)**
- Receptacle: 36210-0100PL
- Shell kit: 36310-3200-008
- (MOLEX)
- Connector set: 54599-1019

**Spindle motor side connector**
- **(DDK)**
- Connector: MS3106A20-29S (D190)
- Back shell: CE02-20BS-S (straight)
  - CE-20BA-S (angle)
- Clamp: CE3057-12A-3
Appendix 1-2-6 Twin-head magnetic detector cable

<Twin-head magnetic detector (MBA Series)>

Drive unit side connector
(3M)
Receptacle: 36210-0100PL
Shell kit: 36310-3200-008
(MOLEX)
Connector set: 54599-1019

Detector preamplifier side
connector
(Hirose Electric)
Plug: RM15WTPZK-12S
Cord clamp: JR13WCCA-8(72)

(Note) The above wiring diagrams apply to both MBA405W and MBE405W.
The connection of BT can be omitted for MBE405W (incremental).

<For 10m or less>

Drive unit side connector
(3M)
Receptacle: 36210-0100PL
Shell kit: 36310-3200-008
(MOLEX)
Connector set: 54599-1019

Detector preamplifier side
connector
(Hirose Electric)
Plug: RM15WTPZK-12S
Cord clamp: JR13WCCA-9(72)

(Note) The above wiring diagrams apply to both MBA405W and MBE405W.
The connection of BT can be omitted for MBE405W (incremental).
Appendix 1-3 Main circuit cable connection diagram

The methods for wiring to the main circuit are shown below.

<DRSV1/DRSV2/DRSV3 cable connection diagram>

These cables are used to connect the drive unit’s TE1 terminal and HF motor.
- **DRSV1 cable:**
  This is the power line for the multi axis integrated unit (MDS-DM2-SPV2-, MDS-DM2-SPV3-) L-axis.
- **DRSV2 cable:**
  This is the power line for the multi axis integrated unit (MDS-DM2-SPV2-, MDS-DM2-SPV3-) M-axis.
- **DRSV3 cable:**
  This is the power line for the multi axis integrated unit (MDS-DM2-SPV3-) S-axis.

1. The main circuit cable must be manufactured by the user.
2. Refer to the section “Specification of Peripheral Devices” in Specifications Manual when selecting the wire material.
3. Lay out the terminal block on the drive unit side as shown in "DRIVE SYSTEM DATA BOOK".
4. Refer to "DRIVE SYSTEM DATA BOOK" for details on the motor’s connectors and terminal block.

![Diagram of cable connection](image-url)
Appendix 1-4 Connector outline dimension drawings

Appendix 1-4-1 Connector for drive unit

Optical communication cable connector

**Optical communication connector**

For wiring between drive units (inside panel)
Manufacturer: Japan Aviation Electronics Industry
<Type>
Connector: 2F-2D103

![Diagram of connector for drive unit](image)

**Cable appearance**

<Type>
Connector: 2F-2D103 (Japan Aviation Electronics Industry)
Optical fiber: ESKA Premium (MITSUBISHI RAYON)

(Note 1) The POF fiber's light amount will drop depending on how the fibers are wound. So, try to avoid wiring the fibers.
(Note 2) Do not wire the optical fiber cable to moving sections.
(Note 3) Contact: Japan Aviation Electronics Industry, Limited  [http://www.jae.com/jaehome.htm](http://www.jae.com/jaehome.htm)

Optical communication connector

For wiring between drive units (outside panel)
Manufacturer: Tyco Electronics
<Type>
Connector: 1123445-1

![Diagram of connector for drive unit](image)

**Cable appearance**

<Type>
Connector: 1123445-1 (Tyco Electronics)
Optical fiber: ESKA Premium (MITSUBISHI RAYON)

(Note 1) The PCF fiber's light amount will drop depending on how the fibers are wound. So, try to avoid wiring the fibers.
(Note 2) Do not wire the optical fiber cable to moving sections.

For wiring between NC and drive unit
Refer to the instruction manual for CNC.
### STO input connector

<table>
<thead>
<tr>
<th>Drive unit connector for CN8 (STO input)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturer: Tyco Electronics</td>
</tr>
<tr>
<td>&lt;Type&gt;</td>
</tr>
<tr>
<td>Connector set: 2069250-1</td>
</tr>
</tbody>
</table>

![Diagram of STO input connector](image1)

### Connector for detector cable

<table>
<thead>
<tr>
<th>Spindle drive unit Connector for CN2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturer: 3M</td>
</tr>
<tr>
<td>&lt;Type&gt;</td>
</tr>
<tr>
<td>Receptacle: 36210-0100PL</td>
</tr>
<tr>
<td>Shell kit: 36310-3200-008</td>
</tr>
<tr>
<td>Manufacturer: MOLEX</td>
</tr>
<tr>
<td>&lt;Type&gt;</td>
</tr>
<tr>
<td>Connector set: 54599-1019</td>
</tr>
</tbody>
</table>

![Diagram of connector for detector cable](image2)
### Connector for CN9A/CN9B

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Type</th>
<th>Connector</th>
<th>Shell kit</th>
</tr>
</thead>
<tbody>
<tr>
<td>3M</td>
<td>10120-3000VE</td>
<td>10320-52F0-008</td>
<td></td>
</tr>
</tbody>
</table>

![Connector for CN9A/CN9B diagram]

This connector is integrated with the cable, and is not available as a connector set option.

### Power connector for drive unit CN31L/M/S, for MDS-DM2-SPV Series

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Type</th>
<th>Connector</th>
</tr>
</thead>
<tbody>
<tr>
<td>DDK</td>
<td>DK-5200M-04R</td>
<td></td>
</tr>
</tbody>
</table>

![Power connector diagram]
Appendix 1 - Cable and Connector Specifications

**Control power connector for drive unit CN22, for MDS-DM2-SPV Series**

- Manufacturer: DDK
- **Type:** Connector: DK-3200S-02R
- [Unit:mm]

**Connector for motor brake control output**

**Brake connector for motor brake control output**

- Manufacturer: DDK
- **Type:** Connector: DK-3200S-03R
- [Unit:mm]

**Battery power input connector**

**Battery connector for drive unit**

- Manufacturer: Hirose Electric
- **Type:** Connector: DF1B-2S-2.5R
- [Unit:mm]
Appendix 1-4-2 Connector for servo

Motor detector connector

Motor side detector connector / Ball screw side detector for connector

<table>
<thead>
<tr>
<th>Manufacturer: DDK</th>
<th>Plug: CMV1-SP10S-M2</th>
</tr>
</thead>
<tbody>
<tr>
<td>[Unit:mm]</td>
<td><img src="image1" alt="Connector diagram" /></td>
</tr>
</tbody>
</table>

(Note) For the manufacturing method of CMV1 series connector, refer to the section "Cable and connector assembly" in Instruction Manual.
Contact: Fujikura Ltd. http://www.fujikura.co.jp/eng/

Brake connector

<table>
<thead>
<tr>
<th>Manufacturer: DDK</th>
<th>Plug: CMV1-SP2S-2</th>
</tr>
</thead>
<tbody>
<tr>
<td>[Unit:mm]</td>
<td><img src="image2" alt="Connector diagram" /></td>
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(Note) For the manufacturing method of CMV1 series connector, refer to the section "Cable and connector assembly" in Instruction Manual.
Contact: Fujikura Ltd. http://www.fujikura.co.jp/eng/

<table>
<thead>
<tr>
<th>Manufacturer: DDK</th>
<th>Plug: CMV1-AP10S-M2</th>
</tr>
</thead>
<tbody>
<tr>
<td>[Unit:mm]</td>
<td><img src="image3" alt="Connector diagram" /></td>
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<table>
<thead>
<tr>
<th>Manufacturer: DDK</th>
<th>Plug: CMV1-AP2S-S</th>
</tr>
</thead>
<tbody>
<tr>
<td>[Unit:mm]</td>
<td><img src="image4" alt="Connector diagram" /></td>
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</table>

(Note) For the manufacturing method of CMV1 series connector, refer to the section "Cable and connector assembly" in Instruction Manual.
Contact: Fujikura Ltd. http://www.fujikura.co.jp/eng/
Motor power connector

Motor power connector

Manufacturer: DDK

Plug:

<table>
<thead>
<tr>
<th>Type</th>
<th>A</th>
<th>B</th>
<th>+0</th>
<th>C ± 0.8</th>
<th>D or less</th>
<th>W</th>
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</thead>
<tbody>
<tr>
<td>CE05-6A18-10SD-C-BSS</td>
<td>34.13</td>
<td>32.1</td>
<td>57</td>
<td>1-20UNEF-2A</td>
<td></td>
<td></td>
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<tr>
<td>CE05-6A22-22SD-C-BSS</td>
<td>40.48</td>
<td>38.3</td>
<td>61</td>
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<td></td>
<td></td>
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<tr>
<td>CE05-6A32-17SD-C-BSS</td>
<td>56.33</td>
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<td>79</td>
<td>1-1/4-18UNS-2A</td>
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Manufacturer: DDK

Plug:

<table>
<thead>
<tr>
<th>Type</th>
<th>A</th>
<th>B</th>
<th>D or less</th>
<th>W</th>
</tr>
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<tbody>
<tr>
<td>CE05-8A18-10SD-C-BAS</td>
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<td>1-20UNEF-2A</td>
<td></td>
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<tr>
<td>CE05-8A22-22SD-C-BAS</td>
<td>40.48</td>
<td>75.5</td>
<td>1-1/16-18UNEF-2A</td>
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<tr>
<td>CE05-8A32-17SD-C-BAS</td>
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<td>93.5</td>
<td>1-1/4-18UNS-2A</td>
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Manufacturer: DDK

Clamp:

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<th>Type</th>
<th>Shell size</th>
<th>Total length A</th>
<th>Outer dia. B</th>
<th>Avail. screw length C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>Fitting screw V</th>
<th>Bushing</th>
<th>Applicable cable</th>
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<tbody>
<tr>
<td>CE3057-10A-1(D240)</td>
<td>18</td>
<td>23.8</td>
<td>30.1</td>
<td>10.3</td>
<td>15.9</td>
<td>14.1</td>
<td>3.2</td>
<td>1-20UNEF-2B</td>
<td>CE3420-10-1</td>
<td>ϕ10.5 to ϕ14.1</td>
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<td></td>
</tr>
<tr>
<td>CE3057-12A-1(D240)</td>
<td>20</td>
<td>23.8</td>
<td>35</td>
<td>10.3</td>
<td>19</td>
<td>16.0</td>
<td>3.3</td>
<td>1-1/16-18UNEF-2B</td>
<td>CE3420-12-1</td>
<td>ϕ12.5 to ϕ16.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CE3057-20A-1(D240)</td>
<td>32</td>
<td>27.8</td>
<td>51.6</td>
<td>11.9</td>
<td>43</td>
<td>23.8</td>
<td>6.3</td>
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<td>CE3420-20-1</td>
<td>ϕ22.0 to ϕ23.8</td>
<td></td>
<td></td>
</tr>
</tbody>
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Appendix 1 - 18
MDS-B-HR connector

Manufacturer: Hirose Electric
<Type>
Plug:
RM15WTP-8S (for CON1,2)
RM15WTP-12P (for CON3)

Motor detector connector

Motor side PLG (TS5690) connector

Appendix 1-4-3 Connector for spindle

Manufacturer: Hirose Electric
<Type>
Plug: RM15WTP-CP(10)

Manufacturer: Tyco Electronics
<Type>
Plug: 172169-1
Spindle side detector connector (for OSE-1024)

Manufacturer: DDK
<Type>
Connector: MS3106A20-29S(D190)

Manufacturer: DDK
<Type>
Straight back shell: CE02-20BS-S

Manufacturer: DDK
<Type>
Angle back shell: CE-20BA-S

Manufacturer: DDK
<Type>
Cable clamp: CE3057-12A-3
Appendix 2

Cable and Connector Assembly
Appendix 2-1 CMV1-SPxxS-x plug connector

This section explains how to assemble the wire to CMV1 plug connector.

(1) Cutting a cable
Cut the cable to the following dimensions:
(Note) Not to change cable length.

Cable length after cutting = \( 35 \pm 0.5 \text{mm for CMV1-SPxxS-x} + \text{Cable length} \)
= \( 35 \pm 0.5 \text{mm} + \text{Cable length} \)

(2) Inserting parts
Insert the clamp nut, the cable clamp, the bushing and the back shell to the cable.
(Note) Pay attention to the direction each part is inserted.
Make sure that every part is inserted.

(3) Stripping a cable
Strip the cable’s sheath to the A length, cut the wire set at its root and strip the core wire to the B length.
(Note) Make sure to strip the cable to the correct length.
Do not leave cutting or scratch to the cable core.
* When making CMV1-SPxxS-x, strip the cable for No. 10 terminal in a way that the A length becomes 1mm longer than that of other cables.
(This is to prevent excessive tension of the cable when inserting the contact to the housing in the next process.)

(4) Soldering a contact
Apply preliminary soldering to each contact and to the cable’s core wire, then solder the core wire to the contacts.
(Note) Make sure that the core wire does not come out of the contact.
When soldering, make sure that the solder does not stick to the circumference of the solder cup.
When using a drain wire, attach a heat shrink tube to the drain cable after soldering.
* When making CMV1-SPxxS-x, the cable for No. 10 terminal is 1mm longer than other cables. (To avoid the cable tension when inserting a contact to the housing in a later process.)
* The difference in the total A length of the cables for other than No. 10 terminal must be 1mm or less.
(5) Inserting the contact

Insert the contact into the specified terminal number point in the housing.
(Insert grounding wire or drain wire into terminal No. 10).

* When the contact catches the housing, you will hear a snap.
* Pulling the wire for confirming the correct position.

(Note) Before inserting the contact, check that the clamp nut, cable clamp, bushing and back shell is inserted. Take care not to insert the contact upside down as shown below.

* Insert the contact so that the terminal number face the same direction. However, in case of CMV1-SP2S-x, insert the contact so that the lance and the terminal number face the opposite direction.

* Using a pull out tool for pulling up inserted contact.
Tool No.: 357J-53184T
Refer to the instruction manual in case of using pull up tool.

* As Lance falls down easily after pulling up, set up to original position before re-insert.

(6) Back clamp nut tightening, shell tightening

[1] To prevent the straight back shell from loosening, coat 2 threads of the circumference of the straight back shell with adhesive.

Recommended adhesive:
1401B (Three Bond Co., Ltd.)

[2] Rotate the back shell coupling of the connector and temporarily tighten the straight back shell.

* When tightening temporarily, match the concavity and convexity of the plug shell with those of the angle back shell. (You can confirm the correct connection of concavity and convexity waving lightly back shell just before inserting to BS coupling.)

[3] Fix the 2 surface width of the angle back shell on the tightening guide.

[4] Set the tightening wrench adjusting to the back shell coupling.

[5] With the wrench, tighten the back shell coupling to the angle back shell.

Recommended tightening torque: 5N•m

(Note 1) When setting the work to the wrench, adjust it to the 2 surface width.
To remove, take the reverse steps.

(Note 2) Manufactured by DDK
Contact: Fujikura Ltd. http://www.fujikura.co.jp/eng/
(7) **Insert a busing and a cable clamp**

Insert the busing and the cable clamp in the back shell.

(Note) After the Bushing insert, confirm that cable position should be inside of Bushing.

(8) **Tightening a clamp nut**

1. Temporarily tighten the clamp nut on the angle back shell.
   *To prevent the loosening, it is recommended to coat the straight back shell with adhesive.
   
   **Recommended adhesive: 1401B (Three Bond Co., Ltd.)**

2. Fix the 2 surface width of the angle back shell on the tightening guide.
3. Set the tightening wrench adjusting the 2 surface width of the clamp nut.
4. With the wrench, tighten the clamp nut on the angle back shell.
   
   **Recommended tightening torque: 5N•m**

   (Note 1) When setting the work to the wrench, adjust the 2 surface width.
   
   In case of squeezing the clamp nut with excessed torque provided as above, the clamp nut may be broken. Please use the torque wrench.
   
   To remove, take the reverse steps.

   (Note 2) Manufactured by DDK
   
   Contact: Fujikura Ltd. [http://www.fujikura.co.jp/eng/](http://www.fujikura.co.jp/eng/)
Appendix 2-1 CMV1-SPxxS-x plug connector

(9) When connecting

[1] Set the △ mark of each other’s connectors.

[2] Each other’s key (concavity and convexity) are fit in. Push it straight, take care not to tilt.

* To remove, rotate the coupling and pull out to straight.

(10) When using a conduit

[1] Tighten the nipple of conduit connector on the plug connector (CMV1).

[2] Set the conduit on the nipple of conduit connector.

[3] Fix the conduit to the plug connector (CMV1). If the conduit is used in a moving part, fix the conduit with a saddle, etc. so that no load is applied to the plug connector (CMV1) and to the conduit connector. If the conduit is fixed with a saddle, etc., make sure that no load is applied to the fixing area. Set the protective cover (rubber etc.) on the conduit to avoid cable damage.

Recommended conduit
Type: VF   Type: SR   Type: FBN   Type: EM   Type: VFS   Type: SRK   etc

Recommended connector

<table>
<thead>
<tr>
<th>Recommended connector</th>
<th>Applicable connector type</th>
<th>Applicable cable range</th>
</tr>
</thead>
<tbody>
<tr>
<td>RCM103S</td>
<td>CMV1-SP10S-S/CMV1-AP10S-S</td>
<td>φ 4.0 to φ 6.0mm</td>
</tr>
<tr>
<td>RCM103M</td>
<td>CMV1-SP10S-M2/CMV1-AP10S-M2</td>
<td>φ 7.0 to φ 9.0mm</td>
</tr>
</tbody>
</table>

(Note) Manufactured by NIPPON FLEX CO.,LTD.
Contact: NIPPON FLEX CO.,LTD. http://www.nipolex.co.jp/
Appendix 2-2 CMV1-APxxS-x angle plug connector

This section explains how to assemble the wire to CMV1 angle plug connector.

(1) Cutting a cable
Cut the cable to the following dimensions:
(Note) Not to change cable length.

\[
\text{Cable length after cutting} = \text{measurement A for CMV1-APxxS-x} + \text{Cable length} = A + \text{Cable length}
\]

<table>
<thead>
<tr>
<th>Product name</th>
<th>A [mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMV1-APxxS-S</td>
<td>40 ± 0.5</td>
</tr>
<tr>
<td>CMV1-APxxS-M2</td>
<td></td>
</tr>
</tbody>
</table>

(2) Stripping a cable sheath
Strip the cable sheath to the length A as shown below.
(Note) Take care the cable peel length.
Take care not to damage anything.

* When making CMV1-APxxS-x, strip the cable for No. 10 terminal in a way that makes the A length 1mm longer than other cables.
(To avoid the cable tension when inserting a contact to the housing in a later process.)

<table>
<thead>
<tr>
<th>Product name</th>
<th>A [mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMV1-APxxS-S</td>
<td>30 ± 0.5</td>
</tr>
<tr>
<td>CMV1-APxxS-M2</td>
<td></td>
</tr>
</tbody>
</table>

(3) Inserting parts
Insert the clamp nut, the cable clamp, the bushing and the angle back shell to the cable stripped.
(Note) Pay attention to the direction each part is inserted.
Make sure that every part is inserted.

* To insert the angle back shell, bend the cable.

(4) Stripping a core wire
Strip the cable’s core wire to the length 4.5 to 5.0mm.
(Note) Do not mistake the length of the core wire to be stripped.
Do not leave cut or scratch to the cable core.
(5) Soldering a contact

Apply preliminary soldering to each contact and to the cable’s core wire, then solder the core wire to the contacts.

<table>
<thead>
<tr>
<th>Connector name</th>
<th>Applicable contact</th>
<th>Applicable cable</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMV1-SP10S-x</td>
<td>CMV1-#22ASC-S1</td>
<td>AWG20 or below</td>
</tr>
<tr>
<td>CMV1-SP2S-x</td>
<td>CMV1-#22BSC-S2</td>
<td>AWG16 or below</td>
</tr>
</tbody>
</table>

(Note) Make sure that the core wire does not come out of the contact.
When soldering, make sure that the solder does not stick to the circumference of the solder cup.
When using a drain wire, attach a heat shrink tube to the drain cable after soldering.
* When making CMV1-APxxS-x, the cable for No. 10 terminal is 1mm longer than other cables.
  (To avoid the cable tension when inserting a contact to the housing in a later process.)
* The difference in the total A length of the cables for other than No. 10 terminal must be 1mm or less.

(6) Inserting the contact

Insert the contact into the specified terminal number point in the housing.
(Insert grounding wire or drain wire into terminal No. 10)
* When the contact catches the housing, you will hear a snap.
* Pulling the wire for confirming the correct position.

(Note) Before inserting the contact, check that the clamp nut, cable clamp, bushing and angle back shell is inserted.
Take care not to insert the contact upside down as shown below.
* Insert the contact so that the terminal number face the same
direction. However, in case of CMV1-AP2S-x, insert the contact so that the
lance and the terminal number face the opposite direction.

* Using a pull out tool for pulling up inserted contact.
  Tool No.: 357J-53184T
  Refer to the instruction manual in case of using pull up tool.

* As Lance falls down easily after pulling up, set up to original
  position before re-insert.

(7) Tightening an angle back shell

[1] To prevent loosening, the adhesive should be applied
to the angle back shell by two threads around the
circumference.

  Recommended adhesive:
  1401B (Three Bond Co., Ltd.)

[2] Rotate and temporarily tighten the back shell coupling by setting the
connector and the angle back shell to the specified angle.
  * When tightening temporarily, match the concavity and convexity of
    the plug shell with those of the angle back shell.
    (You can confirm the correct connection of concavity and convexity
    waving lightly back shell just before inserting to BS coupling.)

[3] Fix the 2 surface width of the angle back shell on the tightening guide.
[4] Set the back shell wrench adjusting to the 2 surface width of the back
  shell coupling.
[5] With the wrench, tighten the back shell coupling to the angle back shell.
  Recommended tightening torque: 5N•m
  (Note 1) When setting the work to the wrench, adjust it to the 2 surface width.
  To remove, take the reverse steps.
  (Note 2) Manufactured by DDK
  Contact: Fujikura Ltd. http://www.fujikura.co.jp/eng/

(Note) To change the back shell angle, adjust the tooth position of the plug shell and back shell.

- Recommended jigs and tools: Back shell wrench (357J-51333T)
  * Bit (357J-51344T)
  * Torque wrench (CL6N x 8D, Tonichi Mfg.)
- * Recommended tightening guide: (357J-52658T)
(8) **Inserting a busing and a cable clamp**
Insert the bushing and the cable clamp to the back shell.

(Note) After the Bushing insert, confirm that cable position should be inside of Bushing.

(9) **Tightening a clamp nut**

[1] Temporarily tighten the clamp nut on the angle back shell.  
* To prevent loosening, the adhesive should be applied to the angle back shell.  
**Recommended adhesive: 1401B (Three Bond Co., Ltd.)**

[3] Set the tightening wrench adjusting the 2 surface width of the clamp nut.  
[4] With the wrench, tighten the clamp nut on the angle back shell.  
**Recommended tightening torque: 5N•m**  
(Note 1) To set the work to the wrench, adjust the 2 surface width.  
* In case of squeezing the clamp nut with excessed torque provided as above, the clamp nut may be broken. Please use the torque wrench.  
* To remove, take the reverse steps.  
(Note 2) Manufactured by DDK  
Contact: Fujikura Ltd. http://www.fujikura.co.jp/eng/

(10) **When connecting**

[1] Set the Δ mark of each other's connectors.
Each other’s key (concavity and convexity) are fit in. Push it straight, take care not to tilt.

* To remove, rotate the coupling and pull out to straight.

(11) When using a conduit

[1] Tighten the nipple of conduit connector on the plug connector (CM10).
[2] Set the conduit on the nipple of conduit connector.
[3] Fix the conduit to the plug connector (CM10). If the conduit is used in a moving part, fix the conduit with a saddle, etc. so that no load is applied to the plug connector (CM10) and to the conduit connector.

If the conduit is fixed with a saddle, etc., make sure that no load is applied to the fixing area.

Set the protective cover (rubber etc..) on the conduit to avoid cable damage.

Recommended conduit

Type: VF  Type: SR  Type: FBN  Type: EM  Type: VFS  Type: SRK  etc

Recommended connector

<table>
<thead>
<tr>
<th>Recommended connector</th>
<th>Applicable connector type</th>
<th>Applicable cable range</th>
</tr>
</thead>
<tbody>
<tr>
<td>RCM103S</td>
<td>CMV1-SP10S-S/CMV1-AP10S-S</td>
<td>φ 4.0 to φ 6.0mm</td>
</tr>
<tr>
<td>RCM103M</td>
<td>CMV1-SP10S-M2/CMV1-AP10S-M2</td>
<td>φ 7.0 to φ 9.0mm</td>
</tr>
</tbody>
</table>

(Note) Manufactured by NIPPON FLEX CO.,LTD.
Contact: NIPPON FLEX CO.,LTD. http://www.nipolex.co.jp/
Appendix 2-3 1747464-1 plug connector

Appendix 2-3-1 Applicable products

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Descriptions</th>
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<tbody>
<tr>
<td>1674320-1</td>
<td>Encoder cable I/O kit</td>
</tr>
<tr>
<td>1674320-2</td>
<td>Receptacle contact</td>
</tr>
</tbody>
</table>

Appendix 2-3-2 Applicable cable

<table>
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<th>Wire conductor size</th>
<th>Cable jacket outside diameter</th>
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<tbody>
<tr>
<td>#26-22AWG</td>
<td>6.8 - 7.4 mm</td>
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Refer to Product Specification and Application Specification for details.

Appendix 2-3-3 Related documents

<table>
<thead>
<tr>
<th>No.</th>
<th>Details</th>
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<tbody>
<tr>
<td>108-5864</td>
<td>Product Specification</td>
</tr>
<tr>
<td>114-5335</td>
<td>Rec, Contact Application Specification</td>
</tr>
<tr>
<td>114-5338</td>
<td>Ground Clip Application Specification</td>
</tr>
</tbody>
</table>

Appendix 2-3-4 Assembly procedure

Assemble the cable in the following procedure:

1. Insert accessories to the cable.

2. Remove the sheath of the cable jacket and core wires referring to the typical dimensions in the right figure.
   Do not damage the core wires. Retry it if the core wires are partly cut off or damaged.
   The length of mesh shield should be decided referring to the right figure and be turned up on the outside of a jacket.

   (Note) Even when the dimensions above is applied, product performance problem can occur depending on the wires which is used.
   Be sure to contact with the sales department of the manufacturer below if you consider to adopt this connector.

3. Twist a copper foil tape with conductive adhesive of width 5mm around the mesh shield.
   Cable finish outside diameter: Φ7.3 to 7.7

4. Refer to Application Specification (114-5335) and crimp the contacts. After crimping, check the state in accordance with the Specification.
(5) Verifying the direction, insert the crimped contact into the receptacle housing. After the insertion, pull each wire lightly to make sure that the contacts are fully inserted. (Lock feeling and sound can be confirmed when the contact is fully/ correctly inserted.)

(6) Crimp the ground clip. As receptacle housing is settled inside a ground clip, it opts for direction according to the purpose, and positions as shown in the right figure. (Note) Direction of receptacle housing is unchangeable after ground slip crimping.

Positioning the cable jacket end as shown in the right figure. Refer to the Application Specification (114-5338) and crimp the ground clip.

(7) Store the receptacle housing and ground clip in the receptacle case. Pull the cable side and draw the receptacle housing side as shown in the right figure, without pushing in it.

Work will become easy when the crimping part of the ground clip is pushed and the cable is bent as shown in the right figure.

When the ground clip interferes with receptacle case at the position in the right figure and cause difficulty in continuing to draw in, push the ground clip to distort and drawing become easy.

(Note) To prevent a fracture, do not use the ground clip which is bend and unbend 3 times or more.

Turn the form of the ground clip back to normal and position it for the receptacle case as shown in the right figure.

Adjust the projection of receptacle housing to the slit of the receptacle case and push in until it is fixed to the case.

(Note) See that the contact of receptacle housing goes inside a ground clip.
(8) Shift the wire rubber packing and wire clamp to the position in the right figure, and tighten the wire fixed set screw to fix the cable to receptacle case.

Tighten it not to create the space between the receptacle case and wire fixed set screw.
(Note) Confirm that the cable is fixed.

(9) To ensure that there is no leaning on the receptacle housing in the receptacle case assembly, drop the POST BASE for inspection naturally as shown in the right figure.

Confirm that the space between the receptacle case assembly and the POST BASE is within 1mm. Regarding POST BASE for inspection, contact with the sales department of the manufacturer below.

(10) Insert the assembled connector until it stick fast to the POST BASE and then, tighten the four bind screws to fix. The tightening torque of the bind screw is 5.0 to 10.0 N-cm.
Appendix 3

D/A Output Specifications for Drive Unit
Appendix 3-1 D/A output specifications

Drive unit has a function to D/A output the various control data. The servo and spindle adjustment data required for setting the servo and spindle parameters to match the machine can be D/A output. Measure using a high-speed waveform recorder, oscilloscope, etc.

D/A output specifications

<table>
<thead>
<tr>
<th>Item</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of channels</td>
<td>2ch</td>
</tr>
<tr>
<td>Output cycle</td>
<td>0.8ms (min. value)</td>
</tr>
<tr>
<td>Output precision</td>
<td>12bit</td>
</tr>
<tr>
<td>Output voltage range</td>
<td>0V to 2.5V (zero) to +5V</td>
</tr>
<tr>
<td>Output magnification setting</td>
<td>-32768 to 32767 (1/100-fold)</td>
</tr>
<tr>
<td>Output pin (servo side: CN9B connector)</td>
<td>MO1 = Pin 9, MO2 = Pin 19, LG = Pin 1,11</td>
</tr>
<tr>
<td>Output pin (spindle side: CN9A connector)</td>
<td>MO1 = Pin 9, MO2 = Pin 19, LG = Pin 1,11</td>
</tr>
</tbody>
</table>

The D/A output for the 2nd axis or the 3rd axis is also 2ch. When using the 2nd axis or the 3rd axis, set "-1" for the output data (SV061, SV062) of the servo axis that is not to be measured.

When the output data is 0, the offset voltage is 2.5V. If there is an offset voltage, adjust the zero level position in the measuring instrument side.

![Example of D/A output waveform](image)
Appendix 3-2 Output data settings

Appendix 3-2-1 Servo drive unit settings

<Standard output>

**[[#2261] SV061 DA1NO D/A output ch1 data No.**

Input the data number you wish to output to the D/A output channel 1. When using the 2-axis drive unit, set "-1" to the axis that the data will not be output.

---Setting range---
-1 to 127

**[[#2262] SV062 DA2NO D/A output ch2 data No.**

Input the data number you wish to output to the D/A output channel 2. When using the 2-axis drive unit, set "-1" to the axis that the data will not be output.

---Setting range---
-1 to 127

<table>
<thead>
<tr>
<th>No.</th>
<th>Output data</th>
<th>Standard output unit</th>
<th>Output cycle</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Linear axis</td>
<td>Rotary axis</td>
</tr>
<tr>
<td>-1</td>
<td>D/A output not selected</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>Commanded rotation speed</td>
<td>1000(r/min)/V</td>
<td>0.8ms</td>
</tr>
<tr>
<td>1</td>
<td>Motor rotation speed</td>
<td>1000(r/min)/V</td>
<td>0.8ms</td>
</tr>
<tr>
<td>2</td>
<td>Torque command</td>
<td>Motor stall rated ratio 100%/V</td>
<td>0.8ms</td>
</tr>
<tr>
<td>3</td>
<td>Torque feedback</td>
<td>Motor stall rated ratio 100%/V</td>
<td>0.8ms</td>
</tr>
<tr>
<td>6</td>
<td>Effective current command</td>
<td>100%/V</td>
<td>0.8ms</td>
</tr>
<tr>
<td>7</td>
<td>Effective current feedback</td>
<td>100%/V</td>
<td>0.8ms</td>
</tr>
<tr>
<td>8</td>
<td>Machine vibration frequency</td>
<td>500Hz/V</td>
<td>0.8ms</td>
</tr>
<tr>
<td>9</td>
<td>HAS control droop cancel amount</td>
<td>1mm/V</td>
<td>1° /V</td>
</tr>
<tr>
<td>30</td>
<td>Collision detection estimated torque</td>
<td>100%/V</td>
<td>0.8ms</td>
</tr>
<tr>
<td>31</td>
<td>Collision detection disturbance estimated torque</td>
<td>100%/V</td>
<td>0.8ms</td>
</tr>
<tr>
<td>32</td>
<td>Estimated load inertia ratio</td>
<td>100%/V</td>
<td>0.8ms</td>
</tr>
<tr>
<td>35</td>
<td>Disturbance observer estimated disturbance torque</td>
<td>100%/V</td>
<td>0.8ms</td>
</tr>
<tr>
<td>42</td>
<td>U-phase current feedback</td>
<td>0.1A/V</td>
<td>0.8ms</td>
</tr>
<tr>
<td>43</td>
<td>V-phase current feedback</td>
<td>0.1A/V</td>
<td>0.8ms</td>
</tr>
<tr>
<td>50</td>
<td>Position droop</td>
<td>1μm/V</td>
<td>1/1000° /V</td>
</tr>
<tr>
<td>51</td>
<td>Position command</td>
<td>1μm/V</td>
<td>1/1000° /V</td>
</tr>
<tr>
<td>52</td>
<td>Position feedback</td>
<td>1μm/V</td>
<td>1/1000° /V</td>
</tr>
<tr>
<td>53</td>
<td>Position FΔT</td>
<td>1μm/s/V</td>
<td>1/1000° /s/V</td>
</tr>
<tr>
<td>54</td>
<td>Deviation from ideal position (considering servo tracking delay)</td>
<td>1μm/V</td>
<td>1/1000° /V</td>
</tr>
<tr>
<td>60</td>
<td>Position droop</td>
<td>1mm/V</td>
<td>1° /V</td>
</tr>
<tr>
<td>61</td>
<td>Position command</td>
<td>1mm/V</td>
<td>1° /V</td>
</tr>
<tr>
<td>62</td>
<td>Position feedback</td>
<td>1mm/V</td>
<td>1° /V</td>
</tr>
<tr>
<td>63</td>
<td>Position FΔT</td>
<td>1mm/s/V</td>
<td>1° /s/V</td>
</tr>
<tr>
<td>64</td>
<td>Deviation from ideal position (considering servo tracking delay)</td>
<td>1mm/V</td>
<td>1° /V</td>
</tr>
<tr>
<td>70</td>
<td>Position droop</td>
<td>1m/V</td>
<td>1000° /V</td>
</tr>
<tr>
<td>71</td>
<td>Position command</td>
<td>1m/V</td>
<td>1000° /V</td>
</tr>
<tr>
<td>72</td>
<td>Position feedback</td>
<td>1m/V</td>
<td>1000° /V</td>
</tr>
<tr>
<td>73</td>
<td>Position FΔT</td>
<td>1m/s/V</td>
<td>1000° /s/V</td>
</tr>
<tr>
<td>74</td>
<td>Deviation from ideal position (considering servo tracking delay)</td>
<td>1m/V</td>
<td>1000° /V</td>
</tr>
<tr>
<td>126</td>
<td>Saw tooth wave</td>
<td>1.5V to 3.5V</td>
<td>0.8ms</td>
</tr>
<tr>
<td>127</td>
<td>2.5V test data</td>
<td>2.5V</td>
<td>0.8ms</td>
</tr>
</tbody>
</table>
(Servo control signal)

<table>
<thead>
<tr>
<th>No.</th>
<th>Servo control input (NC to Servo)</th>
<th>No.</th>
<th>Servo control output (Servo to NC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>16384</td>
<td>Servo control input 1-0 READY ON command</td>
<td>16400</td>
<td>Servo control output 1-C in-position</td>
</tr>
<tr>
<td>16385</td>
<td>Servo control input 1-1 SERVO ON command</td>
<td>16401</td>
<td>Servo control output 1-D in current limit</td>
</tr>
<tr>
<td>16388</td>
<td>Servo control input 1-4 Position loop gain changeover command</td>
<td>16402</td>
<td>Servo control output 1-E in absolute position data loss</td>
</tr>
<tr>
<td>16390</td>
<td>Servo control input 1-6 Excessive error detection width changeover command</td>
<td>16403</td>
<td>Servo control output 1-F in warning</td>
</tr>
<tr>
<td>16391</td>
<td>Servo control input 1-7 Alarm reset command</td>
<td>16404</td>
<td>Servo control output 2-0 Z phase passed</td>
</tr>
<tr>
<td>16392</td>
<td>Servo control input 1-8 Current limit selection command</td>
<td>16405</td>
<td>Servo control output 2-1 Z phase passed</td>
</tr>
<tr>
<td></td>
<td></td>
<td>16406</td>
<td>Servo control output 2-2 Z phase passed</td>
</tr>
<tr>
<td></td>
<td></td>
<td>16407</td>
<td>Servo control output 2-3 In zero speed</td>
</tr>
<tr>
<td></td>
<td></td>
<td>16408</td>
<td>Servo control output 2-4 In external emergency stop</td>
</tr>
<tr>
<td>16410</td>
<td>Servo control input 2-9 Speed monitor command valid</td>
<td>16409</td>
<td>Servo control output 2-5 In speed monitor</td>
</tr>
<tr>
<td>16411</td>
<td>Servo control input 2-B In door closed (all drive units)</td>
<td>16410</td>
<td>Servo control output 2-6 In door closed (self drive unit)</td>
</tr>
<tr>
<td>16416</td>
<td>Servo control input 3-0 Control axis detachment command</td>
<td>16411</td>
<td>Servo control output 3-0 In control axis detachment</td>
</tr>
</tbody>
</table>

(Note) For details on the servo signals, refer to the section "Servo control signal".
Appendix 3-2-2 Spindle drive unit settings

<Standard output>

**[13125] SP125 DA1NO D/A output ch1 data No.**

Input the desired data number to D/A output channel.
When using the 2-axis drive unit, set "-1" to the axis that the data will not be output.

---Setting range---
-32768 to 32767

**[13126] SP126 DA2NO D/A output ch2 data No.**

Input the desired data number to D/A output channel.
When using the 2-axis drive unit, set "-1" to the axis that the data will not be output.

---Setting range---
-32768 to 32767

<table>
<thead>
<tr>
<th>No.</th>
<th>Output data</th>
<th>Output unit for standard setting</th>
<th>Output cycle</th>
</tr>
</thead>
<tbody>
<tr>
<td>-1</td>
<td>D/A output stop</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>Commanded motor rotation speed</td>
<td>1000(r/min)/V</td>
<td>0.8ms</td>
</tr>
<tr>
<td>1</td>
<td>Motor rotation speed</td>
<td>1000(r/min)/V</td>
<td>0.8ms</td>
</tr>
<tr>
<td>2</td>
<td>Torque current command</td>
<td>Short time rated ratio 100%V</td>
<td>0.8ms</td>
</tr>
<tr>
<td>3</td>
<td>Torque current feedback</td>
<td>Short time rated ratio 100%V</td>
<td>0.8ms</td>
</tr>
<tr>
<td>35</td>
<td>Disturbance observer estimated disturbance torque</td>
<td>Short time rated torque current value ratio 100%V</td>
<td>0.8ms</td>
</tr>
<tr>
<td>42</td>
<td>U-phase current feedback</td>
<td>0.1A/V</td>
<td>0.8ms</td>
</tr>
<tr>
<td>43</td>
<td>V-phase current feedback</td>
<td>0.1A/V</td>
<td>0.8ms</td>
</tr>
<tr>
<td>50</td>
<td>Position droop</td>
<td>1/1000° /V</td>
<td>0.8ms</td>
</tr>
<tr>
<td>51</td>
<td>Position command</td>
<td>1/1000° /V</td>
<td>0.8ms</td>
</tr>
<tr>
<td>52</td>
<td>Position feedback</td>
<td>1/1000° /V</td>
<td>0.8ms</td>
</tr>
<tr>
<td>53</td>
<td>Position F ΔT</td>
<td>1/1000° /s/V</td>
<td>0.8ms</td>
</tr>
<tr>
<td>54</td>
<td>Deviation from ideal position (considering spindle tracking delay)</td>
<td>1/1000° /V</td>
<td>0.8ms</td>
</tr>
<tr>
<td>60</td>
<td>Position droop</td>
<td>1° /V</td>
<td>0.8ms</td>
</tr>
<tr>
<td>61</td>
<td>Position command</td>
<td>1° /V</td>
<td>0.8ms</td>
</tr>
<tr>
<td>62</td>
<td>Position feedback</td>
<td>1° /V</td>
<td>0.8ms</td>
</tr>
<tr>
<td>63</td>
<td>Position F ΔT</td>
<td>1° /s/V</td>
<td>0.8ms</td>
</tr>
<tr>
<td>64</td>
<td>Deviation from ideal position (considering spindle tracking delay)</td>
<td>1° /V</td>
<td>0.8ms</td>
</tr>
<tr>
<td>70</td>
<td>Position droop</td>
<td>1000° /V</td>
<td>0.8ms</td>
</tr>
<tr>
<td>71</td>
<td>Position command</td>
<td>1000° /V</td>
<td>0.8ms</td>
</tr>
<tr>
<td>72</td>
<td>Position feedback</td>
<td>1000° /V</td>
<td>0.8ms</td>
</tr>
<tr>
<td>73</td>
<td>Position F ΔT</td>
<td>1000° /s/V</td>
<td>0.8ms</td>
</tr>
<tr>
<td>74</td>
<td>Deviation from ideal position (considering spindle tracking delay)</td>
<td>1000° /V</td>
<td>0.8ms</td>
</tr>
<tr>
<td>110</td>
<td>3.0V output load meter (Note)</td>
<td>40%/V, 120%/3V</td>
<td>0.8ms</td>
</tr>
<tr>
<td>126</td>
<td>Saw tooth wave</td>
<td>1.5V to 3.5V</td>
<td>0.8ms</td>
</tr>
<tr>
<td>127</td>
<td>2.5V test data output</td>
<td>2.5V</td>
<td>0.8ms</td>
</tr>
</tbody>
</table>

(Note)  Load meter displays "100%(=2.5V)" when the control power turns ON and the NC is starting. After the NC has been run, it displays "0%(=0V%)".
The result of PLG(TS5690) installation accuracy diagnosis is output to D/A output. D/A output magnification:SP127(DA1MPY) and SP128(DA2MPY) is 0.

PLG installation diagnosis function can be enabled during the rotation, when open loop control is enabled:SP018(SPEC2)/bit1=1.

<table>
<thead>
<tr>
<th>D/A output No.</th>
<th>Details</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>120</td>
<td>Motor end PLG installation</td>
<td>Motor end PLG installation gap is diagnosed.</td>
</tr>
<tr>
<td></td>
<td>Gap diagnosis</td>
<td>When the gap is good, 2.5V is output.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>When the gap is excessive, 2.5V+1V is output.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>When the gap is too small, 2.5V-1V is output.</td>
</tr>
<tr>
<td>121</td>
<td>Motor end PLG installation</td>
<td>Motor end PLG installation error (including the gap) is diagnosed.</td>
</tr>
<tr>
<td></td>
<td>All errors diagnosis</td>
<td>When the installation is good, 2.5V is output.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>When the installation is incorrect, 2.5V+1V is output.</td>
</tr>
<tr>
<td>122</td>
<td>Spindle end PLG installation</td>
<td>Spindle end PLG installation gap is diagnosed.</td>
</tr>
<tr>
<td></td>
<td>Gap diagnosis</td>
<td>Diagnostic procedure is the same as that of motor end PLG.</td>
</tr>
<tr>
<td>123</td>
<td>Spindle end PLG installation</td>
<td>Spindle end PLG installation error (including the gap) is diagnosed.</td>
</tr>
<tr>
<td></td>
<td>All errors diagnosis</td>
<td>Diagnostic procedure is the same as that of motor end PLG.</td>
</tr>
</tbody>
</table>
## Appendix 3-2 Output data settings

### < Spindle control signal>

<table>
<thead>
<tr>
<th>No.</th>
<th>Spindle control input (NC to Spindle)</th>
<th>Spindle control output (Spindle to NC)</th>
<th>No.</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>16384</td>
<td>Spindle control input 1-0 READY ON command</td>
<td>Spindle control output 1-0 In ready ON</td>
<td>16480</td>
<td>Spindle control output 1-0 In ready ON</td>
</tr>
<tr>
<td>16385</td>
<td>Spindle control input 1-1 Servo ON command</td>
<td>Spindle control output 1-1 In servo ON</td>
<td>16481</td>
<td>Spindle control output 1-1 In servo ON</td>
</tr>
<tr>
<td>16391</td>
<td>Spindle control input 1-7 Alarm reset command</td>
<td>Spindle control output 1-7 In alarm</td>
<td>16487</td>
<td>Spindle control output 1-7 In alarm</td>
</tr>
<tr>
<td>16392</td>
<td>Spindle control input 1-8 Torque limit 1 selection command</td>
<td>Spindle control output 1-8 In torque limit 1 selection</td>
<td>16488</td>
<td>Spindle control output 1-8 In torque limit 1 selection</td>
</tr>
<tr>
<td>16393</td>
<td>Spindle control input 1-9 Torque limit 2 selection command</td>
<td>Spindle control output 1-9 In torque limit 2 selection</td>
<td>16489</td>
<td>Spindle control output 1-9 In torque limit 2 selection</td>
</tr>
<tr>
<td>16394</td>
<td>Spindle control input 1-A Torque limit 3 selection command</td>
<td>Spindle control output 1-A In torque limit 3 selection</td>
<td>16490</td>
<td>Spindle control output 1-A In torque limit 3 selection</td>
</tr>
</tbody>
</table>

(Note 1) Control signal is bit output. Setting the No. of the table above to the data output (SP125, SP126), and when the scale (SP127, SP128) is set to "0", the output is "0V" for bit 0, and "2.5V" for bit 1.

(Note 2) Refer to "Spindle control signal" for details on the spindle control signal.
Appendix 3-3 Setting the output magnification

Appendix 3-3-1 Servo drive unit settings

Set when outputting other than the standard output unit. When "0" is set, the magnification will be the same as "100".

(Example 1) When SV061=1 and SV063=50
The motor rotation speed is output at 2000(r/min)/V.
(Example 2) When SV062=3 and SV064=50
The torque feedback is output to D/A output channel 2 with 200%/V unit.

【#2263】SV063 DA1MPY D/A output ch1 output scale
Set output scale of the D/A output channel 1 in increment of 1/100.
When "0" is set, the magnification is the same as when "100" is set.

---Setting range---
-32768 to 32767 (1/100-fold)

【#2264】SV064 DA2MPY D/A output ch 2 output scale
Set output scale of the D/A output channel 2 in accruement of 1/100.
When "0" is set, the magnification is the same as when "100" is set.

---Setting range---
-32768 to 32767 (1/100-fold)
Appendix 3-3 Setting the output magnification

Internal data output (Data No. -1 to 3, 50, 60, 127)
Set when outputting data other than in standard magnification (the magnification is 1). When "0" is set, the magnification will be 1, which is the same as when "100" is set.

(Example 1) When SP125=1, SP127=50
Commanded motor rotation speed is output to D/A output channel 1 in increments of 2000r/min/V.
(Example 2) When SP126=2, SP128=200
The torque axis current command is output to D/A output channel 2 in increments of 50%/V.

【#13127 SP127 DA1MPY D/A output ch1 output scale】
Set the output scale in increments of 1/100.
When "0" is set, the scale is the same as when "100" is set.
---Setting range---
-32768 to 32767 (1/100-fold)

【#13128 SP128 DA2MPY D/A output ch2 output scale】
Set the output scale in increments of 1/100.
When "0" is set, the scale is the same as when "100" is set.
---Setting range---
-32768 to 32767 (1/100-fold)

Example of D/A output waveform: 3000r/min during acceleration and deceleration
Precautions in Installing Spindle Motor
1. When a spindle motor is driven at a high speed, slight unbalance generated on the rotor causes increase of the whirling load on the rotor. Thus rotational vibration occurs, which may result in abnormal sound, shorter bearing life and/or damages (fretting or flaking). Therefore, it is important to minimize the unbalance of rotational objects including the gear, pulley, coupling, rotary joint for coolant, etc. that are attached on the motor shaft.

2. For Mitsubishi frame-type spindle motors, we consider key-less specification as standard in order to simplify balancing procedure of such as gear, pulley, coupling and rotary joint for coolant. We recommend you to choose a gear, pulley and coupling that have a fully symmetric shape, and arrange screw holes on their end faces at short and equal intervals in the circumferential direction. We also recommend you to use a fastener such as a shaft lock element to fix those fittings to the motor shaft.

3. Carry out balancing by suppressing the circumferential vibrations as well as by such as adding screws to the screw holes formed on the gear, pulley and coupling for the purpose of balancing.

Appendix 4-1 Precautions in transporting motor

(1) When you carry the motor, use the eye bolt, and do not grip the motor shaft, power line or fan case, etc. If you grasp the motor shaft in carrying, the shaft may distort and the bearing may be damaged, resulting in abnormal vibration or sound, or shorter bearing life.

(2) When you place the motor vertically, use a cylinder tool so that the motor weight is supported on the load-side bracket flange attachment surface. If the weight is born by the shaft, the bearing may be damaged.

---

**CAUTION**

- Cylinder tool

---

**Vertical placement of motor**

---

**OK**

---

**NG**
Appendix 4-2 Precautions in selecting motor fittings

1. When you select fittings for the motor shaft, such as a gear, pulley, coupling and rotary joint for coolant, choose those that meet the motor specifications (shaft diameter, rotation speed and output torque). If any of the fittings is outside the specifications, the motor failure or accident may result. Apply such fastening method as a shaft lock element so as not to apply impact of a hammer, etc. during installation.

2. The unbalance of the rotary fittings should be as small as possible. We recommend you to choose such fittings that have a fully symmetric shape, and arrange screw holes on their end faces at short and equal intervals in the circumferential direction. When you do balancing of the fittings before installation to the motor, suppress the circumferential vibrations as well as add screws to the screw holes formed on the fittings for the purpose of balancing. After balancing, apply thread locker on the screws to avoid loosening.

3. If you use a rotary joint for coolant for a hollow shaft specification motor, prepare a coolant drain route by such as making a draining hole in order to prevent leaked coolant from intruding into the motor. The coolant intruded into the motor may degrade the motor insulation or may cause bearing deterioration.

Appendix 4-3 Precautions in mounting fittings

1. When you attach fittings such as a gear, pulley, coupling and rotary joint for coolant to the motor shaft, be careful not to apply excessive impact by striking with a hammer, etc. This may cause the shaft distortion and bearing damage, resulting in abnormal vibration, sound or shorter bearing life.

2. After attaching the fittings, carry out no-load operation up to the motor's maximum speed, and use an accelerometer or vibrometer to confirm there is no abnormal vibration. The points to measure are the bracket sections where bearings are stored (on the load and opposite load sides).

3. The vibration acceleration shall be 0.5G (4.9m/s²) or less or the vibration amplitude shall be V5 (peak-to-peak is 5 μm) or less in all the speed range. If these values are not met, the unbalance of the attached fittings may be too large. In such case, carry out balancing for the attached fittings or for the motor with the fittings attached.
Appendix 4 Precautions in Installing Spindle Motor

Appendix 4-4 Precautions in coupling shafts

(1) When direct coupling between the motor shaft and spindle shaft is not accurate, abnormal vibration and/or sound may result. Therefore, do not rely too much on the coupling's flexibility but perform centering and parallel correcting carefully during shaft coupling.

(2) According to the motor specifications, the allowable load on the motor shaft in the motor's inward direction (thrust direction) is 0 [kgf]. Thus you have to choose a coupling that causes no thrust load on the motor shaft, and also pay attention to the extension by thermal expansion.

(3) If a gear coupling or Oldham coupling is used, the motor shaft may be kept pushed into the motor's inward when the shaft is inserted into the spindle head. For a hollow-shaft specification, measure the distance A or B before and after insertion to confirm that there is no difference between before and after insertion (the allowance is ±0.1mm)

- Distance A: between the rotary joint fitting attachment surface and the rotation seal's end face (*1)
- Distance B: between the rotary joint fitting attachment surface and the opposite load side shaft end (*2)
Appendix 4-5 Precautions in installing motor in machine

1. After mounting the motor on a machine and engaging the shafts, perform unloaded operation up to the motor's maximum speed to confirm there is no abnormal vibration or sound. If abnormal vibration or sound is generated, shaft coupling failure or unbalance on the spindle side can be the cause. Therefore check again on these two items.

2. If you apply coolant piping for a hollow shaft specification motor, be careful so that peripheral components such as a tube will not apply tension on the motor rotor or cause unbalance.

3. If you have punched a hole or cutout on a distance block for coolant pipe, cover the hole or cutout with a metal sheet after piping. If you leave the hole, this may degrade the motor cooling performance or machine rigidity, etc.

Appendix 4-6 Other Precautions

1. To yield good cooling performance, provide a space of at least 30 [mm] between the cooling fan and wall. If the motor is covered by a structure and the air is not exchanged, its cooling performance degrades and the motor is unable to fully exercise its performance, which may cause the spindle motor overheat alarm. Thus avoid use of the spindle motor in an enclosed space with little ventilation.

2. Under the standard cooling fan specifications, air is taken in from the load side and exhausted from the counter-load side. To secure the motor's cooling performance, arrange the machine structure so that the exhaust from the counter-load side will not flow to the load side and external air (at a room temperature) can be taken in from the load side.

3. If you continue to use the spindle motor with dirt such as oil mist and dust adhered, its cooling performance degrades and the motor is unable to fully exercise its performance, which may cause the spindle motor overheat alarm. In some cases this may result in damage to the bearing or cooling fan. Use a filter, etc. to protect the motor from oil mist and dust.

4. To secure the cooling performance, perform cleaning of spindle motor and cooling fan on a regular basis.

Appendix 4-7 Example of unbalance correction

Unbalance correction is normally performed by rotating a rotor at a constant speed. The unbalance on the rotor appears in the form of vibration that has a frequency of one cycle per revolution.

<How to balance>

Step 1
To grasp the present situation, drive the motor with the gear, pulley and coupling attached, and detect the reflection sticker attached on the rotor using a revolution indicator (this is a rotation signal). And also detect an acceleration signal using an acceleration pickup attached on the bracket. Then input these signals to each balancing machine to measure the present unbalance force.

Step 2
Add trial weights to the balance correction holes on the gear, pulley and coupling and measure the unbalance in the same way.

Step 3
When you input the two data in a balancing machine, the machine shows where to correct. Then, follow the instruction to carry out balancing.

Step 4
For confirmation, check the unbalance again.
* If further balancing is required, repeat from Step 2.
Appendix 4-8 Precautions in balancing of motor with key

For a motor with key, the balancing with a half key attached to the key groove on the shaft is performed before shipment. The balancing is carried out so that the rotor’s residual unbalance is reduced to 0.1g or less.

However if a full key is attached instead (See Figure 9 below), spaces that need balancing are generated when a fitting such as a gear, pulley and coupling is installed. Therefore take into consideration these spaces during the balancing of each fitting, or carry out balancing with the fittings attached to the motor.
Appendix 5

EMC Installation Guidelines
Appendix 5-1 Introduction

EMC Instructions became mandatory as of January 1, 1996. The subject products must have a CE mark attached indicating that the product complies with the Instructions.

As the NC unit is a component designed to control machine tools, it is believed to be out of the direct EMC Instruction subject. However, we would like to introduce the following measure plans to backup EMC Instruction compliance of the machine tool as the NC unit is a major component of the machine tools.

1. Methods for installation in control/operation panel
2. Methods of wiring cable outside of panel
3. Introduction of countermeasure parts

Mitsubishi is carrying out tests to confirm the compliance to the EMC Standards under the environment described in this manual. However, the level of the noise will differ according to the equipment type and layout, control panel structure and wiring lead-in, etc. Thus, we ask that the final noise level be confirmed by the machine manufacturer.

For measures for CNC, refer to "EMC INSTALLATION GUIDELINES" of each NC Connection Manual.

Appendix 5-2 EMC instructions

The EMC Instructions regulate mainly the following two withstand levels.

Emission .... Capacity to prevent output of obstructive noise that adversely affects external sources.

Immunity .... Capacity not to malfunction due to obstructive noise from external sources.

The details of each level are classified as Table 1. It is assumed that the Standards and test details required for a machine are about the same as these.

Table 1

<table>
<thead>
<tr>
<th>Class</th>
<th>Name</th>
<th>Details</th>
<th>Generic Standard</th>
<th>Standards for determining test and measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emission</td>
<td>Radiated noise</td>
<td>Electromagnetic noise radiated through the air</td>
<td>EN61000-6-4</td>
<td>EN61800-3 (Industrial environment)</td>
</tr>
<tr>
<td></td>
<td>Conductive noise</td>
<td>Electromagnetic noise discharged from power line</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Immunity</td>
<td>Static electricity electrical</td>
<td>(Example) Withstand level of discharge of electricity charged in a human body.</td>
<td>EN61000-4-2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>discharge immunity test</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Radiated radio-frequency magnetic</td>
<td>(Example) Simulation of immunity from digital wireless transmitters</td>
<td>EN61000-4-3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>field immunity test</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Electrical fast transient/burst</td>
<td>(Example) Withstand level of noise from relays or connecting/disconnecting live wires</td>
<td>EN61000-4-4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>immunity test</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Immunity to conducted disturbance</td>
<td>(Example) Withstand level of noise entering through power line, etc.</td>
<td>EN61000-6-2</td>
<td>EN61800-3 (Industrial environment)</td>
</tr>
<tr>
<td></td>
<td>induced by radio-frequency magnetic field</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Power supply frequency field</td>
<td>(Example) 50/60Hz power frequency noise</td>
<td></td>
<td>EN61000-4-8</td>
</tr>
<tr>
<td></td>
<td>immunity test</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Immunity test for voltage dip,</td>
<td>(Example) Power voltage drop withstand level</td>
<td></td>
<td>EN61000-4-11</td>
</tr>
<tr>
<td></td>
<td>short-time power failure and voltage fluctuation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Surge immunity test</td>
<td>(Example) Withstand level of noise caused by lightning</td>
<td></td>
<td>EN61000-4-5</td>
</tr>
</tbody>
</table>
Appendix 5-3 EMC measures

The main items relating to EMC measures include the following.

1. Store the device in an electrically sealed metal panel.
2. Earth all conductors that are floating electrically. (Lower the impedance.)
3. Wire the power line away from the signal wire.
4. Use shielded wires for the cables wired outside of the panel.
5. Install a noise filter.

Ensure the following items to suppress noise radiated outside of the panel.

1. Securely install the devices.
2. Use shielded wires.
3. Increase the panel's electrical seal. Reduce the gap and hole size.

Note that the electromagnetic noise radiated in the air is greatly affected by the clearance of the panel and the quality of the cable shield.

Appendix 5-4 Measures for panel structure

The design of the panel is a very important factor for the EMC measures, so take the following measures into consideration.

Appendix 5-4-1 Measures for control panel unit

1. Use metal for all materials configuring the panel.
2. For the joining of the top plate and side plates, etc., mask the contact surface with paint, and fix with welding or screws.
   In either case, keep the joining clearance to a max. of 20cm for a better effect.
3. Note that if the plate warps due to the screw fixing, etc., creating a clearance, noise could leak from that place.
4. Plate the metal plate surface (with nickel, tin) at the earthing section, such as the earthing plate.
5. The max. tolerable hole diameter of the openings on the panel surface, such as the ventilation holes, must be 3cm to 5cm. If the opening exceeds this size, use a measure to cover it. Note that even when the clearance is less than 3cm to 5cm, noise may still leak if the clearance is long.
Appendix 5-4-2 Measures for door

[1] Use metal for all materials configuring the door.
[2] Use an EMI gasket or conductive packing for the contact between the door and control panel unit.
[3] The EMI gasket or conductive packing must contact at a uniform and correct position of the metal surface of the control panel unit.
[4] The surface of the control panel unit contacted with the EMI gasket or conductive packing must have conductance treatment.
   (Example) Weld (or screw) a plate that is plated (with nickel, tin).

[5] As a method other than the above, the control panel unit and door can be connected with a plain braided wire. In this case, the panel and door should be contacted at as many points as possible.

Appendix 5-4-3 Measures for operation board panel

[1] Always connect the operation board and indicator with an earthing wire.
[2] If the operation board panel has a door, use an EMI gasket or conductive packing between the door and panel to provide electrical conductance in the same manner as the control panel.
[3] Connect the operation board panel and control panel with a sufficiently thick and short earthing wire.

Appendix 5-4-4 Shielding of the power supply input section

[1] Separate the input power supply section from other parts in the control panel so that the input power supply cable will not be contaminated by radiated noise.
[2] Do not lead the power line through the panel without passing it through a filter.

The power supply line noise is eliminated by the filter, but cable contains noise again because of the noise radiated in the control panel.

Use a metal plate, etc., for the shielding partition. Make sure not to create a clearance.
Appendix 5-5 Measures for various cables

The various cables act as antennas for the noise and discharge the noise externally. Thus appropriate treatment is required to avoid the noise.

The wiring between the drive unit and motor act as an extremely powerful noise source, so apply the following measures.

Appendix 5-5-1 Measures for wiring in panel

[1] If the cables are led unnecessarily in the panel, they will easily pick up the radiated noise. Thus, keep the wiring length as short as possible.

[2] The noise from other devices will enter the cable and be discharged externally, so avoid internal wiring near the openings.

[3] Connect the control device earthing terminal and earthing plate with a thick wire. Take care to the leading of the wire.

Appendix 5-5-2 Measures for shield treatment

Common items

Use of shield clamp fittings is recommended for treating the shields. The fittings are available as options, so order as required. (Refer to the section "Shield clamp fitting" in this chapter.)

Clamp the shield at a position within 10cm from the panel lead out port.

1. When leading the cables, including the grounding wire (FG), outside of the panel, clamp the cables near the panel outlet (recommendation: within 10cm).

2. When using a metal duct or conduit, the cables do not need to be clamped near the panel outlet.

3. When leading cables not having shields outside the panel, follow the instructions given for each cable. (Installation of a ferrite core, etc., may be required.)
Appendix 5-5-3 Servo/spindle motor power cable

[1] Use four wires (3-phase + earthing) for the power cable that are completely shielded and free from breaks.
[2] Earth the shield on both the control panel side and motor chassis side.
[3] Earth the shield with a metal P clip or U clip.
   (A cable clamp fitting can be used depending on the wire size.)
[4] Directly earth the shield. Do not solder the braided shield onto a wire and earth the end of the wire.

[5] When not using a shield cable for the power cable, use a conventional cabtyre cable. Use a metal conduit outside the cable.
[6] Earth the power cable on the control panel side at the contact surface of the conduit connector and control panel.
   (Mask the side wall of the control panel with paint.)
[7] Follow the treatment shown in the example for the conduit connector to earth the power cable on the motor side.
   (Example: Use a clamp fitting, etc.)
Appendix 5-4 Servo/spindle motor feedback cable

Use a shield pair cable for feed back cable of the servo motor to earth on NC side (inside the control panel.) Mounting a ferrite core directly behind the unit connector is also effective in suppressing noise.

![Diagram of feedback cable for servomotor]

Appendix 5-6 EMC countermeasure parts

Appendix 5-6-1 Shield clamp fitting

The effect can be enhanced by connecting the cable directly to the earthing plate. Install an earthing plate near each panel’s outlet (within 10cm), and press the cable against the earthing plate with the clamp fitting. If the cables are thin, several can be bundled and clamped together. Securely earth the earthing plate with the frame ground. Install directly on the cabinet or connect with an earthing wire.

![Outline drawing of clamp fitting]

(Note 1) Screw hole for wiring to earthing plate in cabinet.
(Note 2) The earthing plate thickness is 1.6mm.

<table>
<thead>
<tr>
<th>Enclosed fittings</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ground Plate #D</td>
<td>100</td>
<td>86</td>
<td>30</td>
</tr>
<tr>
<td>Ground Plate #E</td>
<td>70</td>
<td>56</td>
<td>--</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>L1 (maximum dimension when it is open)</th>
<th>L2 (reference dimension)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clamp fitting A</td>
<td>25</td>
<td>(77)</td>
</tr>
<tr>
<td>Clamp fitting B</td>
<td>12</td>
<td>(54)</td>
</tr>
</tbody>
</table>
Appendix 5-6-2 Ferrite core

A ferrite core is integrated and mounted on the plastic case. Quick installation is possible without cutting the interface cable or power cable. This ferrite core is effective against common mode noise, allowing measures against noise to be taken without affecting the signal quality.

*1 A fixing band is enclosed when shipped.

ZCAT-B type: Cabinet fixed type, installation hole ø4.8 to 4.9mm, plate thickness 0.5 to 2mm
ZCAT-C type: Structured so that it cannot be opened easily by hand once closed.

Appendix 5-6-3 Power line filter

< Power line filter for 200V >
HF3000A-TM Series for 200V

### Features
(a) 3-phase 3-wire type (250V series, 500V series)
(b) Compliant with noise standards German Official Notice Vfg243, EU Standards EN55011 (Class B)
(c) Effective for use with IGBT inverter and MOS-FET inverter.
(d) Easy mounting with terminal block structure, and outstanding reliability.

### Application
(a) Products which must clear noise standards German Official Notice Vfg243 and EU Standards EN55011 (Class B).
(b) For input of power converter using advanced high-speed power device such as IGBT MOS-FET.
Specifications (250V series)

<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>Rated voltage</td>
<td>250V AC</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Rated current</td>
<td>5A</td>
<td>10A</td>
<td>15A</td>
<td>20A</td>
<td>30A</td>
<td>40A</td>
<td>50A</td>
<td>60A</td>
<td>80A</td>
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<td>150A</td>
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<tr>
<td>Leakage current</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>1.5mA MAX</td>
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<td></td>
</tr>
</tbody>
</table>


<Example of measuring voltage at noise terminal> Measured with IGBT inverter

German Official Notice Vfg243 measurement data
EU Standards EN55011 (Class B) measurement data

Typical characteristics

Circuit diagram

Outline dimensions

<table>
<thead>
<tr>
<th>Model</th>
<th>Dimension [Unit: mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>HF3005A-TM</td>
<td>180</td>
</tr>
<tr>
<td>HF3010A-TM</td>
<td></td>
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<tr>
<td>HF3015A-TM</td>
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<tr>
<td>HF3020A-TM</td>
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<td>HF3030A-TM</td>
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</tr>
<tr>
<td>HF3040A-TM</td>
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<td>HF3050A-TM</td>
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<td>HF3060A-TM</td>
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<td>HF3080A-TM</td>
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<tr>
<td>HF3100A-TM</td>
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<tr>
<td>HF3150A-TM</td>
<td></td>
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<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### MX13 Series 3-phase high attenuation noise filter for 200V

#### Features
- (a) Perfect for mounting inside control panel: New shape with uniform height and depth dimensions
- (b) Easy mounting and maintenance work: Terminals are centrally located on the front
- (c) Complaint with NC servo and AC servo noise: High attenuation of 40dB at 150KHz
- (d) Safety Standards: UL1283, CSAC22.2 No.8, EN60939(SEMKO)
- (e) Patent and design registration pending

#### Specifications

<table>
<thead>
<tr>
<th>Item</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item 1: Rated voltage (AC)</td>
<td>MX13030 3-phase 250VAC (50/60Hz)</td>
</tr>
<tr>
<td>Item 2: Rated current (AC)</td>
<td>30A 50A 100A 150A</td>
</tr>
<tr>
<td>Item 3: Test voltage (AC for one minute across terminal and case)</td>
<td>2500VAC (100mA) at 25°C, 70% RH</td>
</tr>
<tr>
<td>Item 4: Insulation resistance (500VDC across terminal and case)</td>
<td>100MΩ min. at 25°C, 70% RH</td>
</tr>
<tr>
<td>Item 5: Leakage current (250V, 60Hz)</td>
<td>3.5mA max 8mA max</td>
</tr>
<tr>
<td>Item 6: DC resistance</td>
<td>30mΩ max 11mΩ max 5.5mΩ max 3.5mΩ max</td>
</tr>
<tr>
<td>Item 7: Temperature rise</td>
<td>30°C max</td>
</tr>
<tr>
<td>Item 8: Working ambient temperature</td>
<td>-25°C to +65°C</td>
</tr>
<tr>
<td>Item 9: Working ambient humidity</td>
<td>30% to 95% RH (non condensing)</td>
</tr>
<tr>
<td>Item 10: Storage ambient temperature</td>
<td>-40°C to +85°C</td>
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<tr>
<td>Item 11: Storage ambient humidity</td>
<td>10% to 95% RH (non condensing)</td>
</tr>
<tr>
<td>Item 12: Mass (typ)</td>
<td>2.8kg 3.9kg 11.5kg 16kg</td>
</tr>
</tbody>
</table>

(Note) This is the value at Ta ≤ 50°C.
Refer to the following output derating for Ta > 50°C.
Contact: TDK-Lambda Corporation http://www.tdk-lambda.com/
■ Example of using MX13 Series

This is a noise filter with the same dimensions as the drive unit depth (200mm) and height (380mm). This unit can be laid out easily in the device by arranging it in a row with the servo unit. As with the servo unit, the terminals are arranged on the front enabling ideal wire lead-out. Refer to the following figure for details.

![Diagram of MX13 Series setup](image)

■ Example of noise terminal voltage attenuation

![Graph showing noise terminal voltage attenuation](image)

■ Output derating

![Graph showing output derating](image)
Appendix 5 EMC Installation Guidelines

Outline dimension drawings
MX13030, MX13050

<table>
<thead>
<tr>
<th></th>
<th>MX13030</th>
<th>MX13050</th>
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<tbody>
<tr>
<td>A</td>
<td>66</td>
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<td>B</td>
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<td>C</td>
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<td>D</td>
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<td>67</td>
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<td>E</td>
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<td>F</td>
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<tr>
<td>G</td>
<td>177</td>
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<tr>
<td>H</td>
<td>M4 screw</td>
<td>M6 screw</td>
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<tr>
<td>I</td>
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<td>J</td>
<td>M4 screw</td>
<td>M6 screw</td>
</tr>
<tr>
<td>K</td>
<td>195</td>
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MX13100, MX13150

<table>
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<tr>
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<tbody>
<tr>
<td>A</td>
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<td>D</td>
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<td>M8 screw</td>
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<td>96.5</td>
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<tr>
<td>K</td>
<td>115</td>
<td>149.5</td>
</tr>
<tr>
<td>L</td>
<td>276</td>
<td>284</td>
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</table>
Appendix 5-6-4 Surge protector

Insert a surge protector in the power input section to prevent damage to the control panel or power supply unit, etc. caused by the surge (lightning or sparks, etc.) applied on the AC power line. Use a surge protector that satisfies the following electrical specifications.

< Surge protector for 200V >

200V R•A•V-BYZ Series (for protection between lines)

<table>
<thead>
<tr>
<th>Part name</th>
<th>Circuit voltage 50/60Hz</th>
<th>Maximum tolerable circuit voltage</th>
<th>Clamp voltage</th>
<th>Surge withstand level 8/20 µs</th>
<th>Surge withstand level 1.2/50 µs</th>
<th>Electrostatic capacity</th>
<th>Service temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>RAV-781BYZ-2</td>
<td>3AC 250V</td>
<td>300V</td>
<td>783V ± 10%</td>
<td>2500A</td>
<td>20kV</td>
<td>75pF</td>
<td>-20 to 70°C</td>
</tr>
</tbody>
</table>

(Note) Refer to the manufacturer's catalog for details on the surge protector's characteristics and specifications.

200V R•A•V-BXZ Series (for protection between line and earth)

<table>
<thead>
<tr>
<th>Part name</th>
<th>Circuit voltage 50/60Hz</th>
<th>Maximum tolerable circuit voltage</th>
<th>Clamp voltage</th>
<th>Surge withstand level 8/20 µs</th>
<th>Surge withstand level 1.2/50 µs</th>
<th>Electrostatic capacity</th>
<th>Service temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>RAV-781BXZ-4</td>
<td>3AC 250V</td>
<td>300V</td>
<td>1700V ± 10%</td>
<td>2500A</td>
<td>2kV</td>
<td>75pF</td>
<td>-20 to 70°C</td>
</tr>
</tbody>
</table>

(Note) Refer to the manufacturer's catalog for details on the surge protector's characteristics and specifications.
< Surge protector for both between phases and between phase and earth >

■ Features
This surge protector can protect both between phases and between phase and earth. This contains a fuse and has windows to check malfunction or device degradation.

■ Specifications
LT-C Series 200V

<table>
<thead>
<tr>
<th>Part name</th>
<th>Circuit voltage 50/60Hz</th>
<th>Maximum tolerable circuit voltage</th>
<th>AC operation start voltage (between line and earth)</th>
<th>AC operation start voltage (between lines)</th>
<th>Voltage protection level (Up)</th>
<th>Nominal discharge current (8/20µs)</th>
<th>Maximum discharge current (8/20µs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LT-C32G801WS</td>
<td>3AC 250Vrms</td>
<td>275Vrms</td>
<td>560V ± 20%</td>
<td>410V ± 20%</td>
<td>1.5kV</td>
<td>2500A</td>
<td>5000A</td>
</tr>
</tbody>
</table>

(Note) Refer to the manufacturer's catalog for details on the surge protector's characteristics and specifications, etc.

■ Outline dimensions

< Example of surge protector installation >
An example of installing the surge protector in the machine control panel is shown below.
A short-circuit fault will occur in the surge protector if a surge exceeding the tolerance is applied. Thus, install a circuit protector in the stage before the surge protector. Note that almost no current flows to the surge protector during normal use, so a circuit protector installed as the circuit protection for another device can be used for the surge protector.

Installing the surge absorber

1. The wires from the surge protector should be connected without extensions.
2. If the surge protector cannot be installed just with the enclosed wires, keep the wiring length of A and B to 2m or less. If the wires are long, the surge protector's performance may drop and inhibit protection of the devices in the panel.
3. Surge protector to be selected varies depending on input power voltage.

CAUTION
Appendix 6

EC Declaration of Conformity
Appendix 6-1 EC Declaration of conformity

Each series can respond to LVD and EMC directive. Approval from a third party certification organization has been also acquired for the Low Voltage Directive.

The declaration of conformity of each unit is shown below.

Appendix 6-1-1 Low voltage equipment

MDS-DM2 Series

EC Declaration of Conformity
(According to Low Voltage Directive 2006/95/EC)

We hereby state that the following components have been designed and manufactured in accordance with the following transposed Harmonized European Standards.

Product Description: MITSUBISHI CNC
AC Servo / Spindle Drive Unit, Power Supply Unit

Type Designation: MDS-DM[y]-SPV2[x]-SPV3[x], -SPHV3 Series
[x]: Blank, F, S
[y]: Blank, 2

Manufacturer and Address:
MITSUBISHI ELECTRIC CORPORATION, NAGOYA Works
1-14 Yada-Minami 5-Chome, Higashi-Ku, NAGOYA, 461-8670, Japan

Seller and Address:
MITSUBISHI ELECTRIC EUROPE B. V.
Golhaer Strasse, 6, 40880 Ratingen, Germany


Standard: EN 61800-5-1:2007 (Adjustable speed electrical power drive systems)

The last two digit of the year in which the CE marking was affixed for Low Voltage Directive is 10.

Date of Issued: 2012/11/30

[Signature]
Kenny Hayashi
Senior Manager, Drive System Dept.
MITSUBISHI ELECTRIC Corporation
Nagoya Works

[Signature]
Hartmut Pütz
Golhaer Str. 8, 40880 Ratingen, Germany
FA Product Marketing Director, MITSUBISHI ELECTRIC, EUROPE B. V., German Branch

Reference number: BNP-B3640-029-D
Appendix 7

Higher Harmonic Suppression Measure Guidelines
Appendix 7-1 Higher harmonic suppression measure guidelines

These guidelines apply to users for which the 6-pulse equivalent capacity total of the installed higher harmonic generator exceeds the reference in the following table. (Note that household appliances and general-purpose products having a rated current of 20A/phase or less connected to a 300V or less commercial power supply are excluded from the generators.)

Use the following flow chart to confirm whether the total exceeds the reference.

Higher Harmonic Suppression Guidelines were set in September 1994 by the Ministry of International Trade and Industry's Agency of Natural Resources and Energy.

- Higher Harmonic Suppression Measure Guidelines for Household Appliances and General-purpose Products
- Higher Harmonic Suppression Measure Guidelines for Consumers Receiving High Voltage or Special High Voltage Power
Appendix 7-1-1 Calculating the equivalent capacity of the higher harmonic generator

As a principle, the higher harmonic suppression measure guidelines must be followed by the customer.

(1) Calculating the total equivalent capacity (Step 1)
Calculate the total equivalent capacity with the following expression.

**Total equivalent circuit:** \( P_0 = \sum Ki \cdot Pi \)
- \( Ki \) : Conversion coefficient (Refer to following table)
- \( Pi \) : Rated input capacity of each device

**Table 1**  Rated capacity of each unit

<table>
<thead>
<tr>
<th>Unit type</th>
<th>Rated input capacity ( pi ) [kVA]</th>
</tr>
</thead>
<tbody>
<tr>
<td>MDS-DM2-</td>
<td></td>
</tr>
<tr>
<td>SPV3-10080</td>
<td>26.47</td>
</tr>
<tr>
<td>SPV3-16080</td>
<td>27.2</td>
</tr>
<tr>
<td>SPV3-20080</td>
<td>35.9</td>
</tr>
<tr>
<td>SPV3-200120</td>
<td>44.7</td>
</tr>
<tr>
<td>SPHV3-20080</td>
<td>31.2</td>
</tr>
<tr>
<td>SPV2-10080</td>
<td>21.77</td>
</tr>
<tr>
<td>SPV2-16080</td>
<td>22.5</td>
</tr>
<tr>
<td>SPV2-20080</td>
<td>31.2</td>
</tr>
</tbody>
</table>

(Note) The rated capacity \( Pi \) above, is the value used to calculate whether the product corresponds to the higher harmonic guidelines. Thus, the value will differ from the actual power facility's capacity.

(The power supply unit is not included.)

**Table 2**  Circuit class and conversion coefficient for each unit

<table>
<thead>
<tr>
<th>Name</th>
<th>Model</th>
<th>Circuit class</th>
<th>Circuit type</th>
<th>Conversion coefficient ( Ki )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Servo drive unit</td>
<td>MDS-D2/DH2-V1/V2 Series</td>
<td>3</td>
<td>3-phase bridge (with smoothing capacitor)</td>
<td>K32=1.8</td>
</tr>
<tr>
<td>Spindle drive unit</td>
<td>MDS-D2/DH2-SP Series</td>
<td>3</td>
<td>3-phase bridge (with smoothing capacitor)</td>
<td>K32=1.8</td>
</tr>
</tbody>
</table>

(Note) This applies when an AC reactor is installed on the power supply unit.

**Table 3**  Limit values for total equivalent capacity

<table>
<thead>
<tr>
<th>Incoming voltage</th>
<th>Total of 6-pulse equivalent capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.6kV</td>
<td>50kVA</td>
</tr>
<tr>
<td>22/33kV</td>
<td>300kVA</td>
</tr>
<tr>
<td>66kV or more</td>
<td>2,000kVA</td>
</tr>
</tbody>
</table>

If the total equivalent capacity \( P_0 \) exceeds the limit value given in (Table 3), proceed to "(2) Calculating the higher harmonic current flow".

Measures are not required if the value is not exceeded.
(2) Calculating the higher harmonic current flow (Step 2)
To calculate the higher harmonic current flow, calculate the rated current for the incoming power voltage conversion.

**Rated current for incoming power voltage conversion (mA) = a • Pi**

(Table 4) Incoming power voltage conversion coefficient a

<table>
<thead>
<tr>
<th>Incoming power voltage</th>
<th>Coefficient a</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.6kV</td>
<td>87.5</td>
</tr>
<tr>
<td>22 kV</td>
<td>26.2</td>
</tr>
<tr>
<td>33 kV</td>
<td>17.5</td>
</tr>
<tr>
<td>66 kV</td>
<td>8.75</td>
</tr>
<tr>
<td>77 kV</td>
<td>7.5</td>
</tr>
</tbody>
</table>

(Table 5) Upper limit of higher harmonic current flow (mA/kW)

<table>
<thead>
<tr>
<th>Conversion coefficient</th>
<th>5th-order</th>
<th>7th-order</th>
<th>11th-order</th>
<th>13th-order</th>
<th>17th-order</th>
<th>19th-order</th>
<th>23rd-order</th>
<th>25th-order</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.6kV</td>
<td>3.5</td>
<td>2.5</td>
<td>1.6</td>
<td>1.3</td>
<td>1.0</td>
<td>0.9</td>
<td>0.76</td>
<td>0.70</td>
</tr>
<tr>
<td>22kV</td>
<td>1.8</td>
<td>1.3</td>
<td>0.82</td>
<td>0.69</td>
<td>0.53</td>
<td>0.47</td>
<td>0.39</td>
<td>0.36</td>
</tr>
<tr>
<td>33kV</td>
<td>1.2</td>
<td>0.88</td>
<td>0.55</td>
<td>0.46</td>
<td>0.35</td>
<td>0.32</td>
<td>0.26</td>
<td>0.24</td>
</tr>
<tr>
<td>66kV</td>
<td>0.59</td>
<td>0.42</td>
<td>0.27</td>
<td>0.23</td>
<td>0.17</td>
<td>0.16</td>
<td>0.13</td>
<td>0.12</td>
</tr>
<tr>
<td>77kV</td>
<td>0.50</td>
<td>0.38</td>
<td>0.23</td>
<td>0.19</td>
<td>0.15</td>
<td>0.13</td>
<td>0.11</td>
<td>0.10</td>
</tr>
</tbody>
</table>

Obtain the upper limit of the higher harmonic current flow (judgment value) for each order.
(Contracted electricity must be known for this.)

**Upper limit of higher harmonic current flow (mA) = Contracted electricity, flow upper limit value**

Flow upper limit value :
Insert a value from Table 5 according to the higher harmonic order to be calculated.

Obtain the higher harmonic current flow for each order using the following expression.

**Higher harmonic current flow (mA) = (a • Pi), Device's maximum operation rate, target order**

Device's maximum operation rate : The user must set the operation rate.
Target order : Insert a value from Table 6 according to the higher harmonic order to be calculated.

(Table 6) Higher harmonic current generation rate %

<table>
<thead>
<tr>
<th>Conversion coefficient</th>
<th>5th-order</th>
<th>7th-order</th>
<th>11th-order</th>
<th>13th-order</th>
<th>17th-order</th>
<th>19th-order</th>
<th>23rd-order</th>
<th>25th-order</th>
</tr>
</thead>
<tbody>
<tr>
<td>K32 = 1.8</td>
<td>38.0</td>
<td>14.5</td>
<td>7.4</td>
<td>3.4</td>
<td>3.2</td>
<td>1.9</td>
<td>1.7</td>
<td>1.3</td>
</tr>
<tr>
<td>K31 = 3.4</td>
<td>65.0</td>
<td>41.0</td>
<td>8.5</td>
<td>7.7</td>
<td>4.3</td>
<td>3.1</td>
<td>2.6</td>
<td>1.8</td>
</tr>
</tbody>
</table>

Values when basic wave current is 100%.

Check whether the calculated results exceed the limit value.
If the limit value for the higher harmonic current flow is exceeded, consider the higher harmonic measures shown below.

**Examples of higher harmonic measures**

<table>
<thead>
<tr>
<th>Item</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power-factor improving capacitor</td>
<td>Higher harmonics are suppressed by adding a leading capacitor for improving the power factor.</td>
</tr>
<tr>
<td>Installation of AC line filter</td>
<td>A reactor and capacitor are combined to reduce the impedance for specific frequencies.</td>
</tr>
</tbody>
</table>
Appendix 7 - 5

MDS-DM2 Series Instruction Manual

Appendix 7-1 Higher harmonic suppression measure guidelines

(3) Higher harmonic current flow calculation form

A higher harmonic current flow calculation form is shown below for reference.

No. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15
---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---
User name | Industry | Incoming power voltage | kV | Contracted electricity | kW |

Higher harmonic generating device's higher harmonic current flow calculation form (Part 1)

Step 1: Details of higher harmonic generating device

| No. | Device name | Maker | Type | Rated capacity (kVA) | Qty. of devices | Total capacity Pi (kVA) | Circuit type classification No. | 6-pulse calculation coefficient Ki | 6-pulse equivalent capacity [Ki x Pi] (kVA) | Rated current value for incoming power voltage conversion [a x Pi] (mA) | Device’s maximum operation rate (%) | Higher harmonic current flow per order |
---|---|---|---|---|---|---|---|---|---|---|---|---|
1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |

Step 2: Calculation of higher harmonic current flow rate

6-pulse equivalent capacity total Po

Total

Necessity of measures

Higher harmonic current flow upper limit value

(Higher harmonic current flow upper limit per contracted kW x contracted electricity)

| Order | 5th-order | 7th-order | 11th-order | 13th-order | 17th-order | 19th-order | 23rd-order | 25th-order |
---|---|---|---|---|---|---|---|---|
Current upper limit value (mA)

Instructions for completing form:

- Indicate the details of the higher harmonic generating device.
- Refer to the reference and indicate the circuit type classification No., etc.
- If the device's circuit type classification No. is 10, complete the application shown in "Format 3".
- If P > 50kVA (6kV incoming power), 300kVA (22, 33kV incoming power), 2000kVA (66kV or higher incoming power), proceed to Step 2. (Step 2 does not need to be completed in all other cases.)

Step 2

- If the current flow > current flow upper limit value at each order, then
  - If there is a facility that lowers the higher harmonics in the factory, or when suppression measures are implemented, proceed to Calculation Form (Part 2)
  - In all other cases, separate measures must be taken
## Revision History

<table>
<thead>
<tr>
<th>Date of revision</th>
<th>Manual No.</th>
<th>Revision details</th>
</tr>
</thead>
<tbody>
<tr>
<td>May 2013</td>
<td>IB(NA)1501139-A</td>
<td>First edition created.</td>
</tr>
</tbody>
</table>
Global Service Network

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Notice

Every effort has been made to keep up with software and hardware revisions in the contents described in this manual. However, please understand that in some unavoidable cases simultaneous revision is not possible. Please contact your Mitsubishi Electric dealer with any questions or comments regarding the use of this product.

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MITSUBISHI ELECTRIC CORPORATION
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Specifications are subject to change without notice.