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CNC

MELDAS AC SERVO/SPINDLE MDS-C1 Series

INSTRUCTION MANUAL

MELDAS

BNP-B2365B(ENG)

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.
All specifications for the MDS-C1 Series are described in this manual. However, each CNC may not be provided with all specifications, so refer to the specifications for the CNC on hand before starting use.

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 operator could be fatally or seriously injured 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 numeric control unit is configured of the control unit, operation board, servo drive unit, spindle drive unit, power supply unit, servomotor and spindle motor, etc.

In this section "Precautions for safety", the following items are generically called the "servomotor".

- Servomotor
- Spindle motor

In this section "Precautions for safety", the following items are generically called the "servo drive unit".

- Servo drive unit
- Spindle drive unit
- Power supply unit

WARNING

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 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.

Wait at least 15 minutes after turning the power OFF before starting wiring, maintenance or inspections. Failure to observe this could lead to electric shocks.

Ground the servo drive unit and servomotor with Class C (former class 3) grounding or higher.

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.

CAUTION

1. Fire prevention

Install the servo drive units, servomotors and regenerative resistor on noncombustible material. Direct installation on combustible material or near combustible materials could lead to fires.

Shut off the power on the servo drive unit side if the servo drive unit fails. 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.

2. Injury prevention

Do not apply a voltage other than that specified in Instruction 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.

The servo drive unit's fins, regenerative resistor and servomotor, etc., may reach high temperatures while the power is ON, and may remain hot for some time after the power is turned OFF. Touching these parts could result in burns.

⚠ 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 servomotor's hanging bolts only when transporting the servomotor. Do not transport the servomotor when it is installed on the machine.

⚠ Do not stack the products above the tolerable number.

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

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

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

⚠ Follow this Instruction Manual and install in a place where the weight can be borne.

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

⚠ Always observe the installation directions.

⚠ Secure the specified distance between the servo drive unit and control panel's inner wall, and between other devices.

⚠ Do not install or run a servo drive unit or servomotor that is damaged or missing parts.

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

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

⚠ The servo drive units and servomotors are precision devices, so do not drop them or apply strong impacts to them.

CAUTION

Store and use the units under the following environment conditions.

Environment	Conditions	
	Servo drive unit	Servomotor
Ambient temperature	0°C to +55°C (with no freezing)	0°C to +40°C (with no freezing)
Ambient humidity	90%RH or less (with no dew condensation)	80% RH or less (with no dew condensation)
Storage temperature	-15°C to +70°C	
Storage humidity	90%RH or less (with no dew condensation)	
Atmosphere	Indoors (where unit is not subject to direct sunlight), with no corrosive gas, combustible gas, oil mist, dust or conductive particles	
Altitude	1,000m or less above sea level	
Vibration	4.9m/s^2 (0.5G) or less	To follow each unit and motor specifications

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 motor, do not heat the rotor higher than 130°C. The magnet could be demagnetized, and the specifications characteristics will not be ensured.

If the unit has been stored for a long time, always check the operation before starting actual operation. Please contact the Service Center or Service Station.

⚠ CAUTION

(2) Wiring

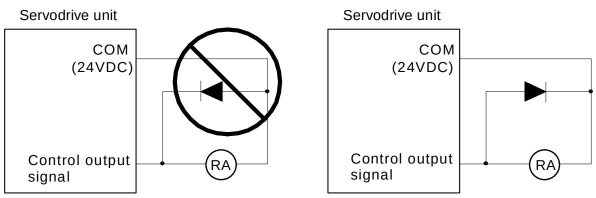
⚠ Correctly and securely perform the wiring. Failure to do so could lead to runaway of the servomotor.

⚠ Do not install a condensing capacitor, surge absorber or radio noise filter on the output side of the servo drive unit.

⚠ Correctly connect the output side (terminals U, V, W). Failure to do so could lead to abnormal operation of the servomotor.

⚠ 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 connect to a DC relay for the control output signals 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 connection 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.

CAUTION

(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 as the operation could become unstable.

(4) Usage methods

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 servo drive unit or servomotor.

Unqualified persons must not disassemble or repair the unit.

Never make modifications.

Reduce magnetic damage by installing a noise filter. The electronic devices used near the servo drive unit could be affected by magnetic noise.

Use the servo drive unit, servomotor and regenerative resistor with the designated combination. Failure to do so could lead to fires or trouble.

The brake (magnetic brake) assembled into the servomotor is 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 or the machine construction (when ball screw and servomotor are coupled via a timing belt, etc.). 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 the separate specifications manual 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.

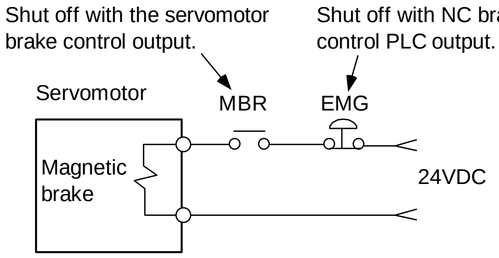
If a breaker is shared by several power supply units, the breaker may not activate when a short-circuit fault occurs in a small capacity unit. This is dangerous, so never share the breakers.

⚠ CAUTION

(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 input power OFF when an alarm occurs.

⚠ Never go near the machine after restoring the power after a power failure, as the machine could start suddenly. (Design the machine so that personal safety can be ensured even if the machine starts suddenly.)

(6) Maintenance, inspection and part replacement

⚠ Always carry out maintenance and inspection after backing up the servo drive unit's programs or parameters.

⚠ The capacity of the electrolytic capacitor will drop over time. 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 or Service Station for replacement.

⚠ Do not perform a megger test (insulation resistance measurement) during inspections.

⚠ If the battery low warning is issued, save 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.

(7) Disposal

⚠ Treat this unit as general industrial waste. Note that MDS Series unit with a heat dissipating fin protruding from the back of the unit contains substitute Freon. Do not dispose of this type of unit as general industrial waste. Always return to the Service Center or Service Station.

⚠ Do not disassemble the servo drive unit or servomotor parts.

⚠ Dispose of the battery according to local laws.

(8) General precautions

The drawings given in this Specifications and Maintenance Instruction 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.

CONTENTS

5. Spindle Adjustment

6. Troubleshooting

7. Maintenance

Appendix 1. Cable and Connector Specifications

Appendix 2. Compliance to EC Directives

Contents for MDS-C1 Series SPECIFICATIONS MANUAL (BNP-C3040D)

(Note) This is the content for SPECIFICATION MANUAL version D. The structure of section and page number may be different other than version D.

Contents for MDS-C1 Series SPECIFICATIONS MANUAL (BNP-C3040D)

(Note) This is the content for SPECIFICATION MANUAL version D. The structure of section and page number may be different other than version D.

1. Installation

1-1 Installation of servomotor

⚠ CAUTION	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.

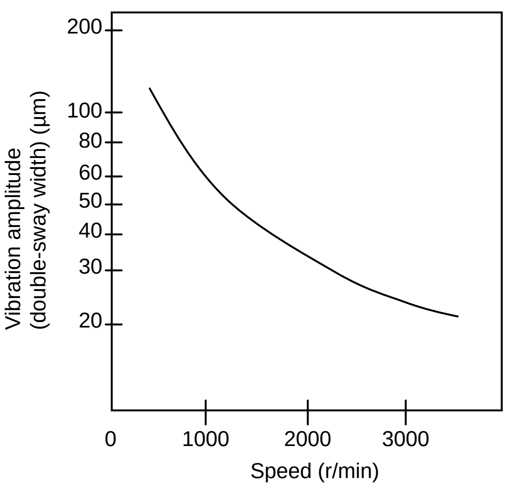
1-1-1 Environmental conditions

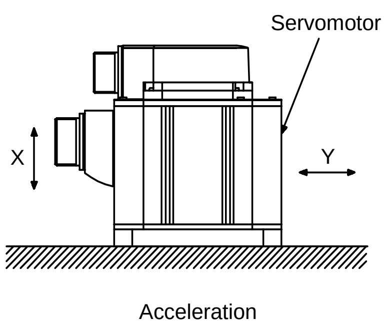
Environment	Conditions
Ambient temperature	0°C to +40°C (with no freezing)
Ambient humidity	80%RH or less (with no dew condensation)
Storage temperature	-15°C to +70°C (with no freezing)
Storage humidity	90%RH or less (with no dew condensation)
Atmosphere	Indoors (Where unit is not subject to direct sunlight) No corrosive gases, flammable gases, oil mist or dust
Altitude	Operation/storage: 1000m or less above sea level Transportation: 10000m or less above sea level

1-1-2 Quakeproof level

Motor type	Acceleration direction	
	Axis direction (X)	Direction at right angle to axis (Y)
HC52 to HC152, HC53 to HC153 HC103R to HC503R, HA053N to HA33N	9.8m/s^2 (1G) or less	24.5m/s^2 (2.5G) or less
HC202, HC352, HC203, HC353	19.6m/s^2 (2G) or less	49.0m/s^2 (5G) or less
HC452, HC702, HC453, HC703 HA-LF11K2-S8, HA-LF15K2-S8	11.7m/s^2 (1.2G) or less	29.4m/s^2 (3G) or less
HC902	9.8m/s^2 (1G) or less	24.5m/s^2 (2.5G) or less

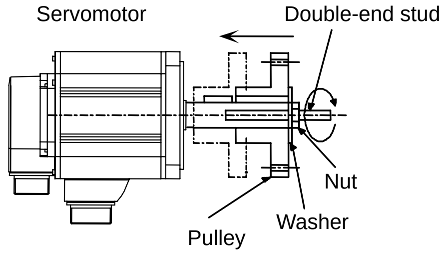
The vibration conditions are as shown below.





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.

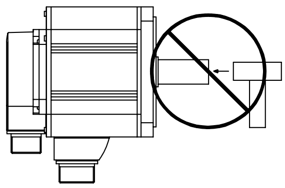


[2] When removing the pulley, use a pulley remover, and make sure not to apply an impact on the shaft.

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

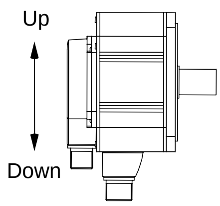
[4] The direction of the detector installed on the servomotor cannot be changed.

⚠ CAUTION Never hammer the end of the shaft during assembly.



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 "1-1-6 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.



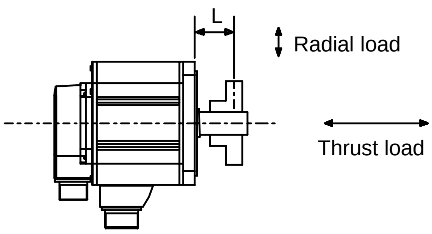
Standard installation direction

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.

Servomotor	Tolerable radial load	Tolerable thrust load
HA053NS, HA13NS	78.4N (L=26mm)	49N
HA23NS, HA33NS **HA23NT, HA33NT**	245N (L=30 mm)	147N
HC103RT, HC153RT, HC203RT	392N (L=45 mm)	196N
HC52T, HC102T, HC152T **HC53T, HC103T, HC153T**	392N (L=58 mm)	490N
HC103RS, HC153RS, HC203RS	686N (L=45 mm)	196N
HC353RS, HC503RS	980N (L=63 mm)	392N
HC52S, HC102S, HC152S **HC53S, HC103S, HC153S**	980N (L=55 mm)	490N
HC202S, HC352S, HC452S, HC702S **HC203S, HC353S, HC453S, HC703S**	2058N (L=79 mm)	980N
HC902S **HA-LF11K2-S8**	2450N (L=85 mm)	980N
HA-LF15K2-S8	2940N (L=100 mm)	980N

Note: The symbol L in the table refers to the value of L below.

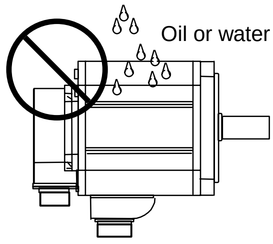


L : Length from flange installation surface to center of load weight [mm]

⚠ **CAUTION**	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. 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. 5. Do not use a rigid coupling as an excessive bending load will be applied on the shaft and could cause the shaft to break.

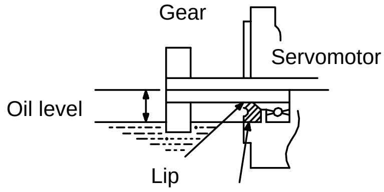
1-1-6 Oil/water standards

[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.

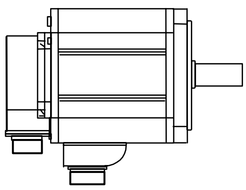


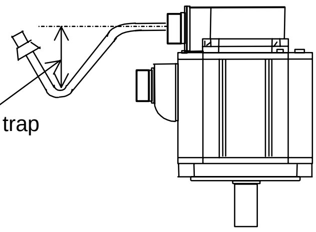
[2] When a gear box is installed on the servomotor, make sure that the oil level height from the center of the shaft is higher than the values given below. Open a breathing hole on the gear box so that the inner pressure does not rise.

Servomotor	Oil level (mm)
HA053N, HA13N	8
HA23N, HA33N	10
HC52, HC102, HC152 **HC53, HC103, HC153** **HC103R, HC153R, HC203R** **HC353R, HC503R**	20
HC202, HC352, HC452, HC702 **HC203, HC353, HC453, HC703**	25
HC902	30
HA-LF11K2-S8	34
HA-LF15K2-S8	48



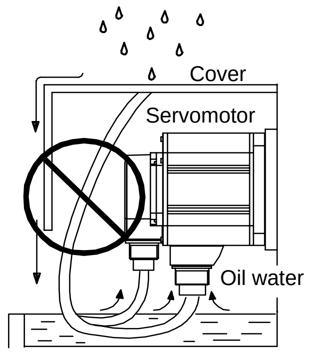
[3] When installing the servomotor horizontally, set the power cable and detector cable to face downward. When installing vertically or on an inclination, provide a cable trap.





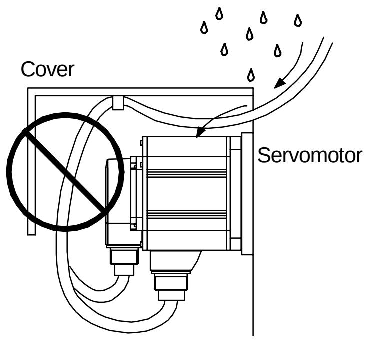
⚠ **CAUTION**	1. The servomotors, including those having IP65 specifications, do not have a completely waterproof (oil-proof) structure. Do not allow oil or water to constantly contact the motor, enter the motor, or accumulate on the motor. Oil can also enter the motor through cutting chip accumulation, 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. 3. Do not remove the detector from the motor. (The detector installation screw is treated for sealing.)

[4] Do not use the unit with the cable submerged in oil or water.
(Refer to right drawing.)



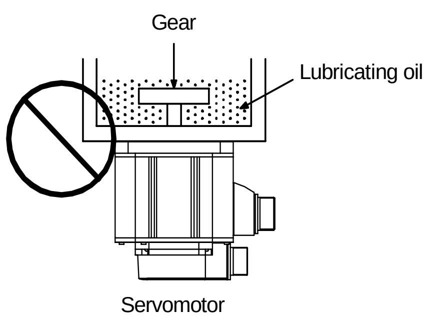
<Fault> Capillary tube phenomenon

[5] Make sure that oil and water do not flow along the cable into the motor or detector. (Refer to right drawing.)



<Fault> Respiration

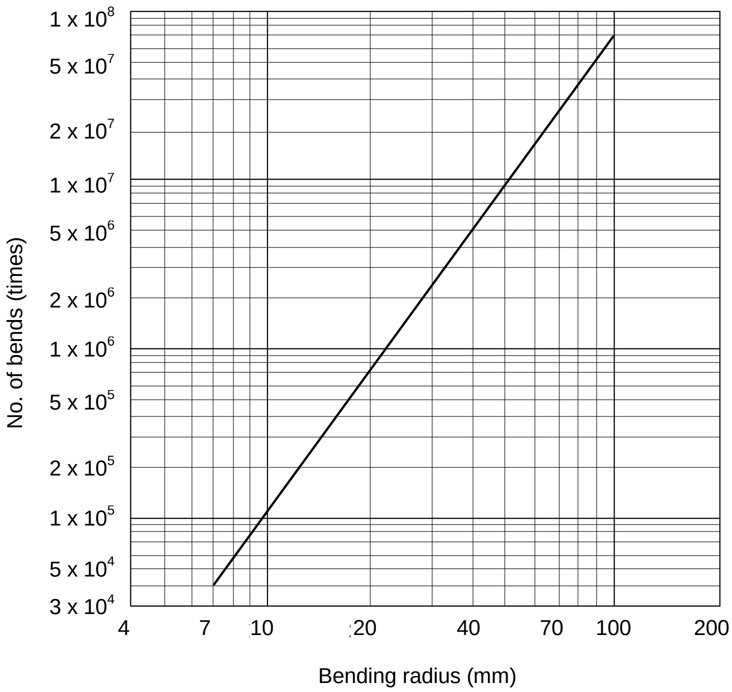
[6] When installing on the top of the shaft end, make sure that oil from the gear box, etc., does not enter the servomotor. The servomotor does not have a waterproof structure.



1-1-7 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 by contacting the machine corners, 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
(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

⚠ CAUTION	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.

1-2-1 Environmental conditions

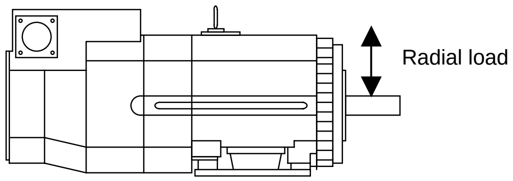
Environment	Conditions
Ambient temperature	0°C to +40°C (with no freezing)
Ambient humidity	90%RH or less (with no dew condensation)
Storage temperature	-20°C to +65°C (with no freezing)
Storage humidity	90%RH or less (with no dew condensation)
Atmosphere	Indoors (Where unit is not subject to direct sunlight) No corrosive gases, flammable gases, oil mist or dust
Altitude	Operation/storage: 1000m or less above sea level Transportation: 10000m or less above sea level

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

1-2-2 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 also affect the motor output torque, so consider them when designing the machine.

Spindle motor	Tolerable radial load
SJ-V3.7-02ZM	490 N
SJ-V2.2-01, SJ-V3.7-01 **SJ-V7.5-03ZM, SJ-V11-06ZM**	980 N
SJ-V5.5-01, SJ-V11-08ZM **SJ-PMF01830-00**	1470 N
SJ-V7.5-01, SJ-V11-01 **SJ-V22-06ZM, SJ-V30-02ZM, SJ-PMF03530-00**	1960 N
SJ-V11-09, SJ-V15-01, SJ-V15-03, SJ-V18.5-01, SJ-V18.5-03 **SJ-V22-01, SJ-V22-05, SJ-V26-01, SJ-30A**	2940 N
SJ-22XW5	3920 N
SJ-37BP	4900 N
SJ-22XW8, SJ-45BP **SJ-V55-01**	5880 N



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

1-3 Installation of the control unit

⚠ CAUTION	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 weight. 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.

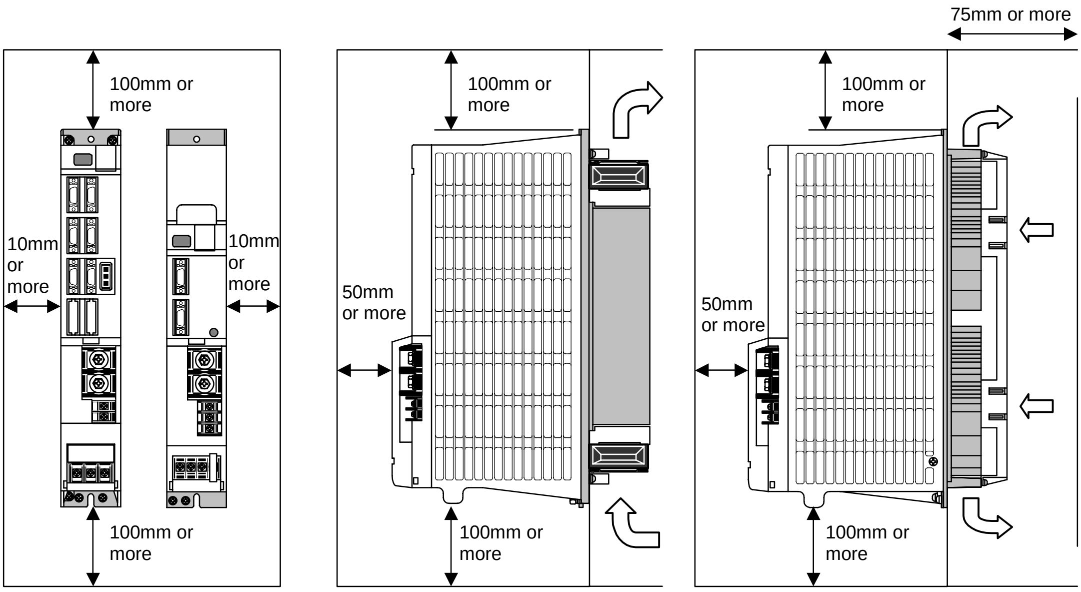
1-3-1 Environmental conditions

Environment	Conditions
Ambient temperature	0°C to +55°C (with no freezing)
Ambient humidity	90%RH or less (with no dew condensation)
Storage temperature	-15°C to +70°C (with no freezing)
Storage humidity	90%RH or less (with no dew condensation)
Atmosphere	Indoors (no direct sunlight); no corrosive gases, inflammable gases, oil mist, dust or conductive particles
Altitude	Operation/storage: 1000m or less above sea level Transportation: 10000m or less above sea level
Vibration	Operation/storage: 4.9m/s^2 (0.5G) or less Transportation: 49m/s^2 (5G) or less

(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.

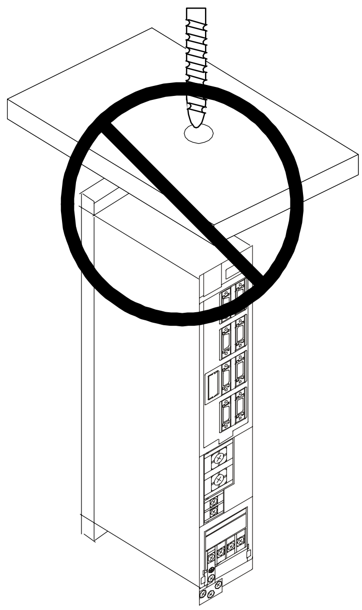


⚠ **CAUTION**	The ambient temperature condition for the power supply unit or the drive units is 55°C or less. Because heat can easily accumulate in the upper portion of the units, give sufficient consideration to heat dissipation when designing the panel. If required, install a fan in the panel to agitate the heat in the upper portion of the units.

1-3-3 Prevention of entering of foreign matter

Treat the cabinet with the following items.

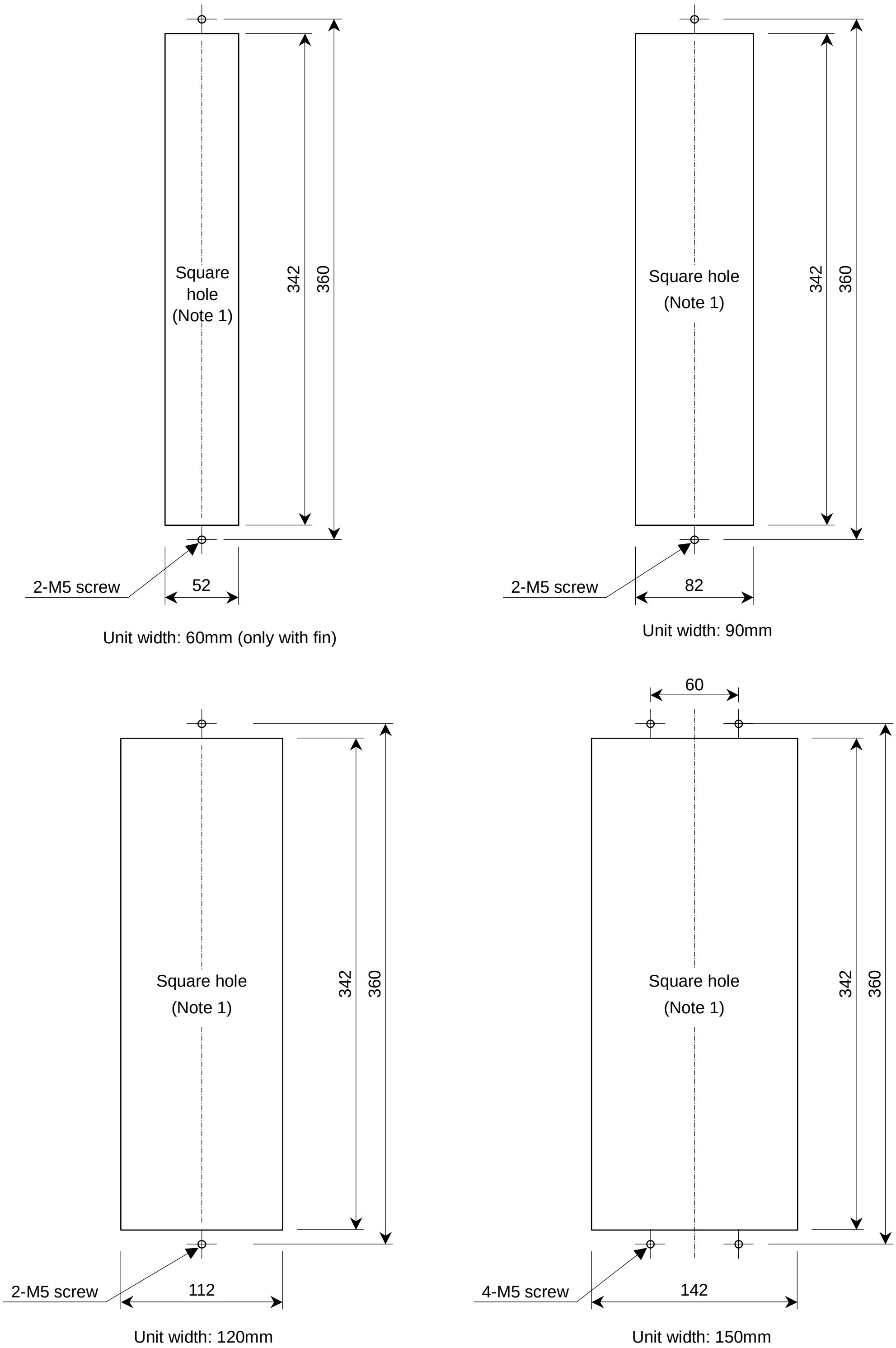
- Make sure that the cable inlet is dust and oil proof by using packing, etc.
- Make sure that the external air does not enter inside by using head radiating holes, etc.
- Close all clearances.
- Securely install door packing.
- If there is a rear cover, always apply packing.
- Oil will tend to accumulate 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.
- After installing each unit, avoid machining in the periphery. If cutting chips, etc., stick onto the electronic parts, trouble may occur.
- 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.

[Unit: mm]



POINT

1. Attach packing around the square hole to provide a seal.
2. A square hole does not need to be machined on the MDS-C1-V1-10 or smaller, MDS-C1-V2-1010 or smaller and MDS-C1-SP-15 or smaller units.

1-3-5 Heating value

Each heating value is calculated with the following values.
The values for the servo drive unit are for a stall output, and the values for the spindle drive unit are for a continuous rated output. The value for the power supply unit includes the AC reactor's heating value.

Servo drive unit						Spindle drive unit			Power supply unit		
Type MDS-C1-	Heating amount [W]		Type MDS-C1-	Heating amount [W]		Type MDS-C1-	Heating amount [W]		Type MDS-C1-	Heating amount [W]	
	Inside panel	Outside panel		Inside panel	Outside panel		Inside panel	Outside panel		Inside panel	Outside panel
V1- 01	21	0	**V2-0101**	38	0	**SP- 04**	30	0	**CV- 37**	21	34
V1- 03	27	0	**V2-0301**	41	0	**SP- 075**	40	0	**CV- 55**	23	42
V1- 05	37	0	**V2-0303**	43	0	**SP- 15**	49	0	**CV- 75**	25	55
V1- 10	53	0	**V2-0501**	46	0	**SP- 22**	26	42	**CV-110**	26	99
V1- 20	25	66	**V2-0503**	52	0	**SP- 37**	28	51	**CV-150**	29	126
V1- 35	30	102	**V2-0505**	62	0	**SP- 55**	31	76	**CV-185**	33	162
V1- 45S	34	124	**V2-1005**	78	0	**SP- 75**	35	102	**CV-220**	35	175
V1- 45	37	148	**V2-1010**	96	0	**SP-110**	41	140	**CV-260**	40	220
V1- 70S	38	151	**V2-2010**	37	117	**SP-150S**	48	140	**CV-300**	46	274
V1- 70	50	234	**V2-2020**	41	137	**SP-150**	48	187	**CV-370**	54	346
V1- 90	56	275	**V2-3510S**	44	146	**SP-185**	62	280			
V1-110	74	392	**V2-3510**	42	148	**SP-220**	65	301			
V1-150	96	545	**V2-3520S**	48	165	**SP-260**	80	403			
			V2-3520	45	168	**SP-300**	98	522			
			V2-3535	51	209						
			V2-4520	52	214						
			V2-4535	57	249						
			V2-4545S	55	225						
			V2-4545	64	295						
			V2-7035	70	336						
			V2-7045	77	382						
			V2-7070S	65	300						
			V2-7070	90	468						
			V2-9090S	65	300						

POINT

Design the panel's heating value taking the actual axis operation (load rate) into consideration. With a general machine tool, the servo drive unit's load rate is approx. 50%, so the heating values inside the panel are half the values shown above. (Excluding the power supply and spindle drive unit.)

(Example 1)

When using MDS-C1-CV-260, MDS-C1-SP[]-185 and MDS-C1-V2-3535

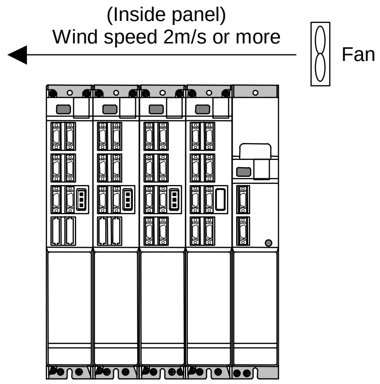
Total heating value = (40 + 220) + (62 + 280) + (51 + 209) = 862 [W]

Heating value in panel = (40) + (62) + (51 $\times$ 0.5) = 127.5 [W]

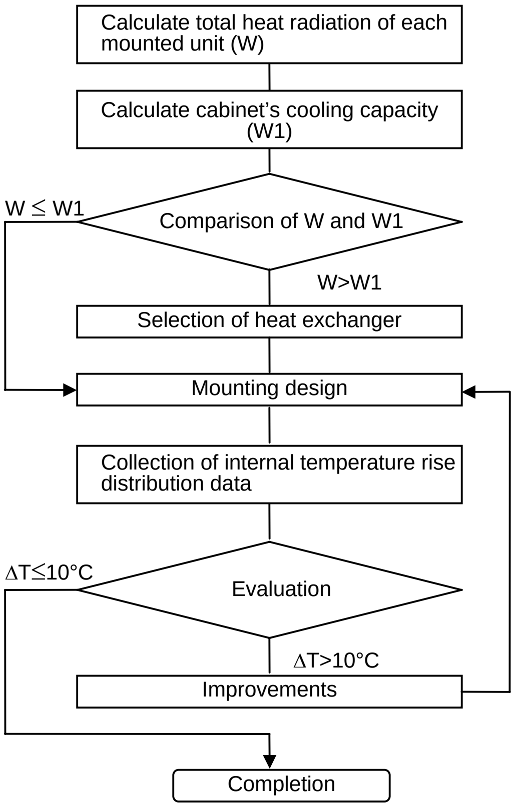
1-3-6 Heat radiation countermeasures

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

(Note) Due to the structure, heat easily accumulates at the top of the unit. Install a fan in the power distribution panel to circulate the heat at the top of the unit.



Please refer to following method for heat radiation countermeasures.



<Hypothetical conditions>

(1) Average temperature in cabinet : $T \leq 55°C$

(2) Cabinet peripheral temperature : $Ta \leq 0°C$ to $45°C$

(3) Internal temperature rise value : $\Delta T = T - Ta_{max} = 10°C$

<Supplement>

1) Refer to Specifications Manual, etc. for the heat generated by each unit.
2) Enclosed cabinet (thin steel plate) cooling capacity calculation equation

   $W1 = U \times A \times \Delta T$

   U: $6W/m^2 \times °C$ (with internal agitating fan)
   $4W/m^2 \times °C$ (without internal agitating fan)

   A: Effective heat radiation area (m^2)
   (Heat dissipation area in panel)
   Sections contacting other objects are excluded.

   ΔT: Internal temperature rise value (10°C)
3) Points of caution for heat radiation countermeasures when designing mounting state
   - Layout of convection in panel
   - Collect hot air at suction port in heat exchanger cabinet.
4) Understanding the temperature rise distribution in the panel

   ΔT (average value) $\leq 10°C$

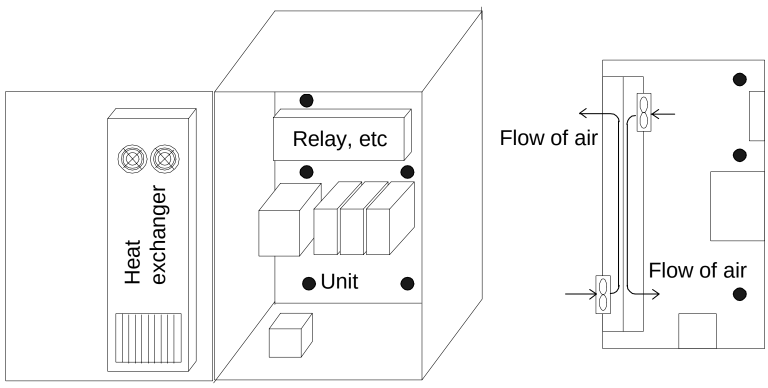
   ΔT_{max} (maximum value) $\leq 15°C$

   R (inconsistency) = $(\Delta T_{max} - \Delta T_{min}) \leq 6°C$

   (Evaluate existence of heat spots)

<u>Examples of mounting and temperature measurement positions (reference)</u>

● **Measurement position (example)**

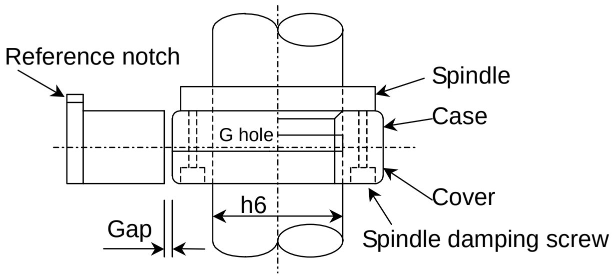


1-4 Installing the spindle detector

1-4-1 Magnetic sensor

(1) Installing the magnetic sensor

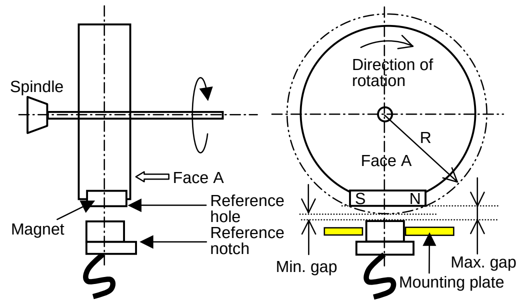
- Tolerance to shaft dimension should be "h6" on the part for installing a magnet.
- 2-øG hole can be used for positioning of spindle and magnet.
- Magnet shall be installed as shown to the right.
- Misalignment between sensor head and magnetic center line shall be within ±2mm.
- There is an NS indication on the side of the cover. Install so that the reference notch on the sensor head comes to the case side.



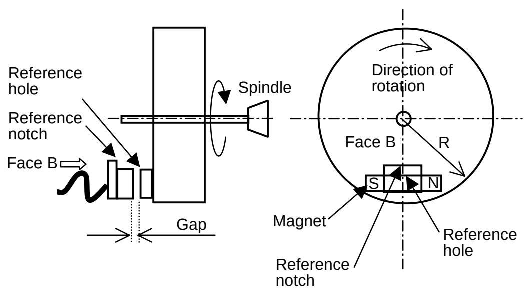
Reference drawing for magnet installation

(2) Gap between magnet and sensor

Circumference installation



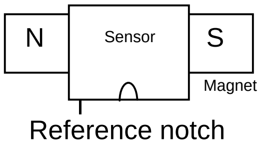
Horizontal installation

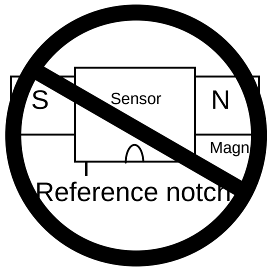


Magnet model	BKO-C1810H03			BKO-C1730H06			BKO-C1730H09	
Installation direction	Circumference installation		Horizontal installation	Circumference installation		Horizontal installation	Circumference installation	
R (Radius) mm	Gap mm			Gap mm			Gap mm	
	Max. value	Min. value		Max. value	Min. value		Max. value	Min. value
40	11.5±0.5	2.7±0.5	6.0±0.5	10.0±0.5	1.22±0.5	5.0±0.5	6.25±0.5	3.30±0.5
50	9.5±0.5	2.8±0.5	6.0±0.5	8.0±0.5	1.31±0.5	5.0±0.5	6.00±0.5	3.70±0.5
60	8.5±0.5	3.0±0.5	6.0±0.5	7.0±0.5	1.50±0.5	5.0±0.5	5.75±0.5	3.85±0.5
70	8.0±0.5	3.4±0.5		7.0±0.5	2.38±0.5		5.50±0.5	3.87±0.5

(3) Magnet and sensor installation directions

- Install so that the magnet's reference hole and sensor's reference notch are aligned. (Standard/high-speed standards)
- Install so that the magnet's N pole comes to the left side when the sensor's reference notch is faced downward. (High-speed compact/high-speed ring)



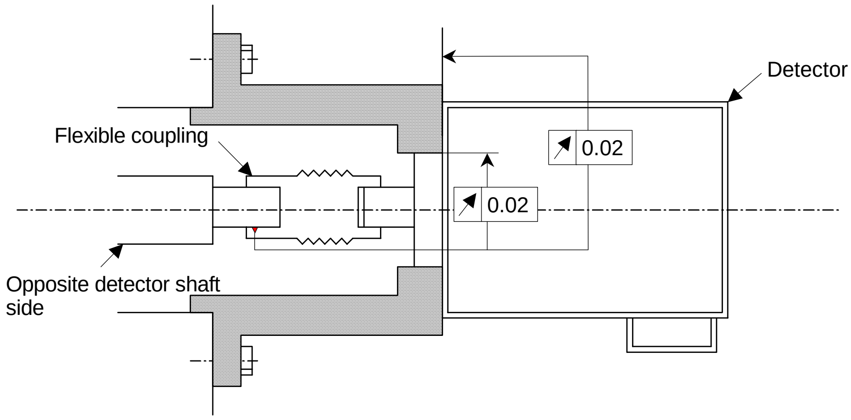


(4) Cautions

[1] Do not apply impacts on the magnet. Do not install strong magnets near the magnet.
[2] Sufficiently clean the surrounding area so that iron chips and cutting chips do not adhere to the magnet. Demagnetize the round disk before installing.
[3] Securely install the magnet onto the spindle with an M4 screw. Take measures to prevent screw loosening as required.
[4] Balance the entire spindle rotation with the magnet installed.
[5] Install a magnet that matches the spindle's rotation speed.
[6] When installing the magnet onto a rotating body's plane, set the speed to 6,000r/min or less.
[7] Install so that the center line at the end of the head matches the center of the magnet.
[8] The BKO-C1730 is not an oil-proof product. Make sure that oil does not come in contact with BNO-C1730 or BKO-C1810.
[9] When connecting to the spindle drive unit, wire so that the effect of noise is suppressed.

1-4-2 Spindle end detector

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



Detector and coupling installation accuracy

Recommended coupling

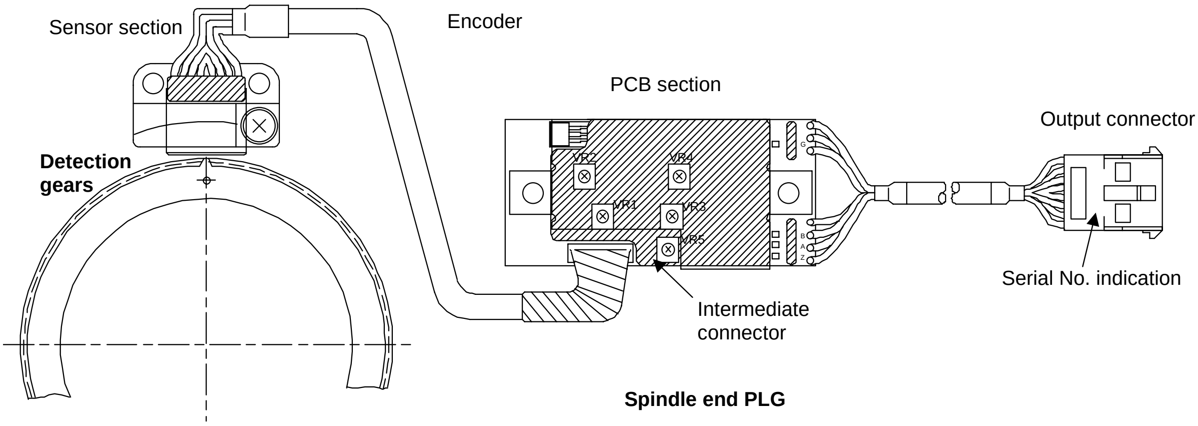
		Recommendation 1	Recommendation 2
Manufacturer		Tokushu Seiko	Eagle
Model		Model M1	FCS38A
Resonance frequency		1374Hz	3515Hz
Position detection error		0.8×10-3°	1.2×10-3°
Tolerable speed		20000r/min	10000r/min
Mis-alignment	**Core deviation**	0.7mm	0.16mm
	Angle displacement	1.5°	1.5°
Outline dimensions	**Max. length**	74.5mm	33mm
	Max. diameter	ø57mm	ø38mm

Refer to the coupling catalog, etc., for details on the coupling.

1-4-3 Spindle end PLG

(1) Part configuration

The detector is configured of an encoder (Sensor section and PCB section) and detection gears. The encoder section can be separated with an intermediate connector, but a type with the same serial No. must be used in combination. The serial No. is indicated on the intermediate connector of the sensor section and the output connector of the PCB section.



Spindle end PLG

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.

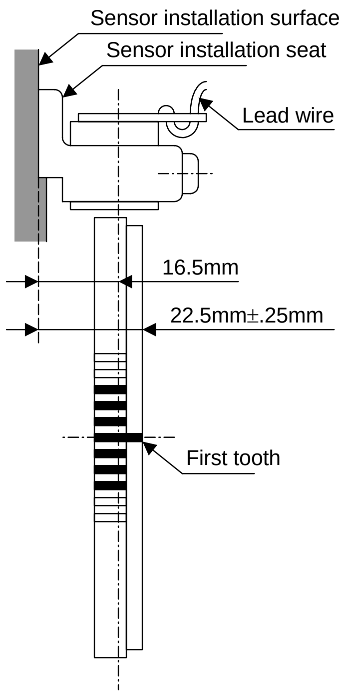
(2) Installing the detection gears and sensor section

[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 shrinkage fitting. Refer to the following table for the shrinkage fitting values. The detection gears should be heated evenly between 120 and 150°C using an electric furnace, etc.

Detection gear shrinkage fitting values

Detection gear specifications				Shrinkage fitting (mm)
Part type	No. of teeth	Outer diameter (mm)	Inner diameter (mm)	
MU1450N2137	128	ø52	ø40	0.02 to 0.04
MU1450N2730	180	ø72.8	ø55	0.03 to 0.055
MU1450N2236	256	ø103.2	ø80	0.03 to 0.055
MU1450N2534	512	ø205.6	ø140	0.05 to 0.085



Installing the detection gears

[3] Keep the deviation of the sensor center and detection gear center 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 edge of the detection gears is 22.5±0.25mm.

[4] Keep the deflection of the outer diameter, when the detection gears are installed on the shaft, to 0.02mm or less.

[5] To remove a detection gear fixed with shrinkage 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.

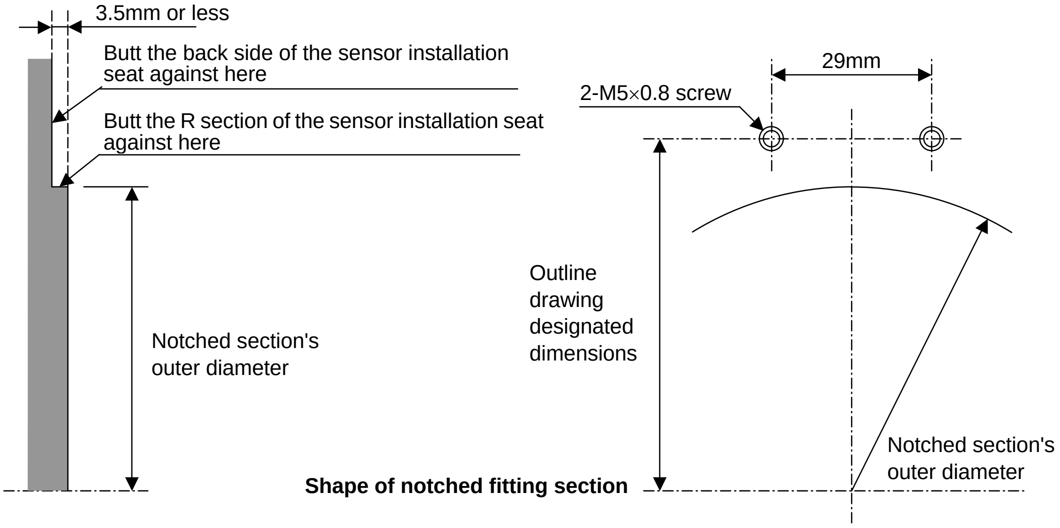
[6] Before reusing detection gears which have been removed, always measure the inner diameter dimensions, and carefully check that the inner diameter is not deformed, and that the sufficient tightening amount can be secured. Do not reuse the detection gears if the inner diameter is deformed, or if any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

[7] A notched fitting section and mounting screw hole are provided on the machine as shown in the following drawing. Contact the R section of the sensor installation seat against this and, install the sensor. The outline dimensions of the notched fitting section are shown in the following table.

Installing the sensor section

Encoder part type	Sensor installation seat's R dimensions (mm)	Notched fitting section's outer diameter (mm)
TS1860N2275	R35.5	ø71 $^{+0.200}_{+0.180}$
TS1860N2276		
TS1860N2777	R45	ø90 $^{+0.200}_{+0.180}$
TS1860N2775		
TS1860N2171	R61	ø122 $^{+0.200}_{+0.175}$
TS1860N2174		
TS1860N2571	R112.5	ø225 $^{+0.200}_{+0.170}$
TS1860N2572		

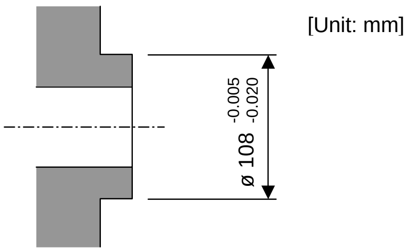
[8] With the sensor installation seat's R section butted against the notched fitting section, fix the sensor installation seat with a mounting screw (M5 x 0.8 screws). A locking agent should be applied on the mounting screw before it is tightened.



Shape of notched fitting section

[9] When using the specifications (TS1860N2770, TS1860N2776, TS1860N2183, TS1860N2187) with installation plate (ring) for the sensor section, provide a notched fitting section on the machine side as shown on the right, and fit the sensor installation plate's ø108H5 here. The gap does not need to be adjusted when using the installation plate.

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



Installing the sensor with Installation plate (ring)

(3) Installing the PCB section

[1] Install the PCB where it will not be subject to water or oil, etc.
[2] Drill two ø11mm or smaller installation seats, and fix the PCB with pan head screws (M5 × 0.8 screws).
[3] Provide a space of 25mm from the installation surface to treat the lead wires for the intermediate connector.
[4] Select the minimum required length for the lead wires from the sensor to the intermediate connector, and wire them as far away from other power wires as possible.
[5] Make sure that force is not constantly applied on the PCB lead wire connections.
[6] The check pins on the PCB could break if excessive force is applied.

1-5 Noise measures

Noise includes "propagation noise" generated from the power supply or relay, etc., and propagated along a cable causing the power supply unit or 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

- 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, and accurately ground the devices.
- Use one-point grounding for the drive unit and motor.
- Accurately ground the AC reactor.

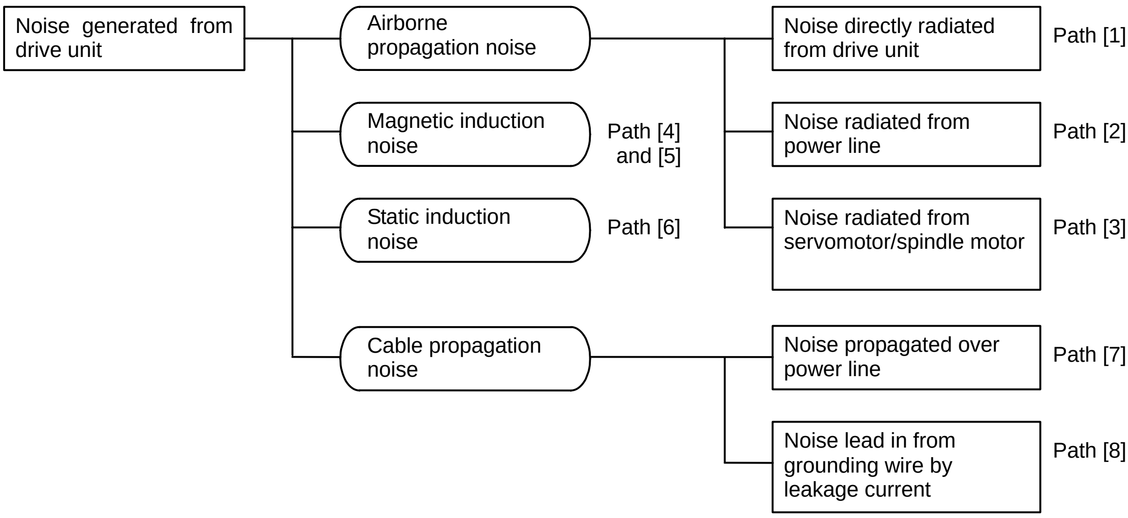
(2) Propagation noise measures

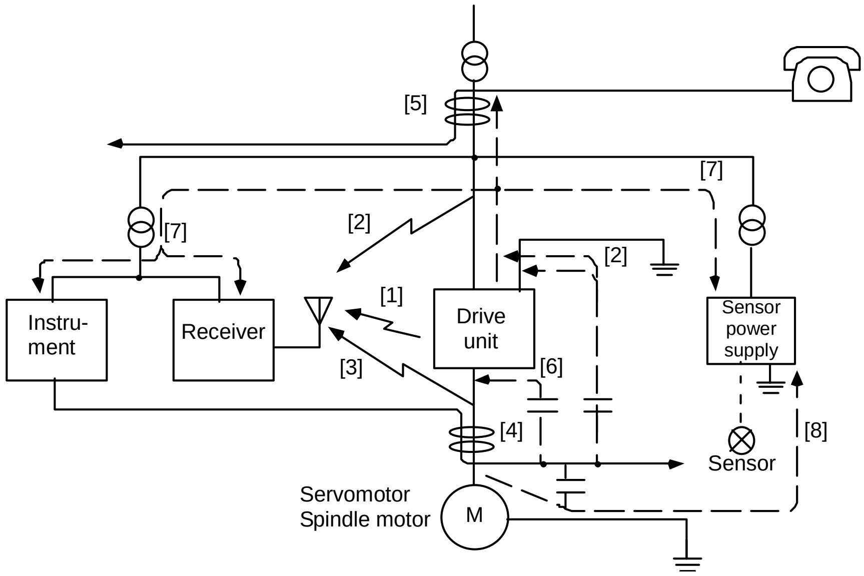
Take the following measures when noise generating devices are installed and the power supply unit or drive unit could malfunction.

- Install a surge killer on devices (magnetic contacts, relays, etc.) which generate high levels of noise.
- Install a power line filter in the stage before the power supply unit.
- Install a ferrite core on the signal wire.
- Ground the shield of the servo detector's cable with a cable clamp.
- 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.





Generated noise of drive system

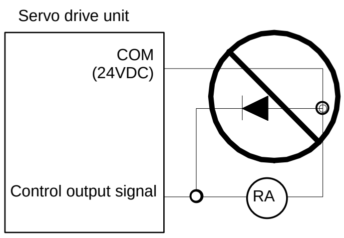
Noise propagation path	Measures
[1] [2] [3]	When devices such as instrument, receiver or sensor, which handle minute signals and are easily affected by noise, or the signal wire of these devices, are stored in the same panel as the drive units and the wiring is close, the device could malfunction due 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.
[4] [5] [6]	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.
[7]	If the power supply for the peripheral devices is connected to the power supply 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 power supply unit's power line. (b) Install a power filter on the power supply unit's power line.
[8]	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.

⚠ **DANGER**

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.
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.

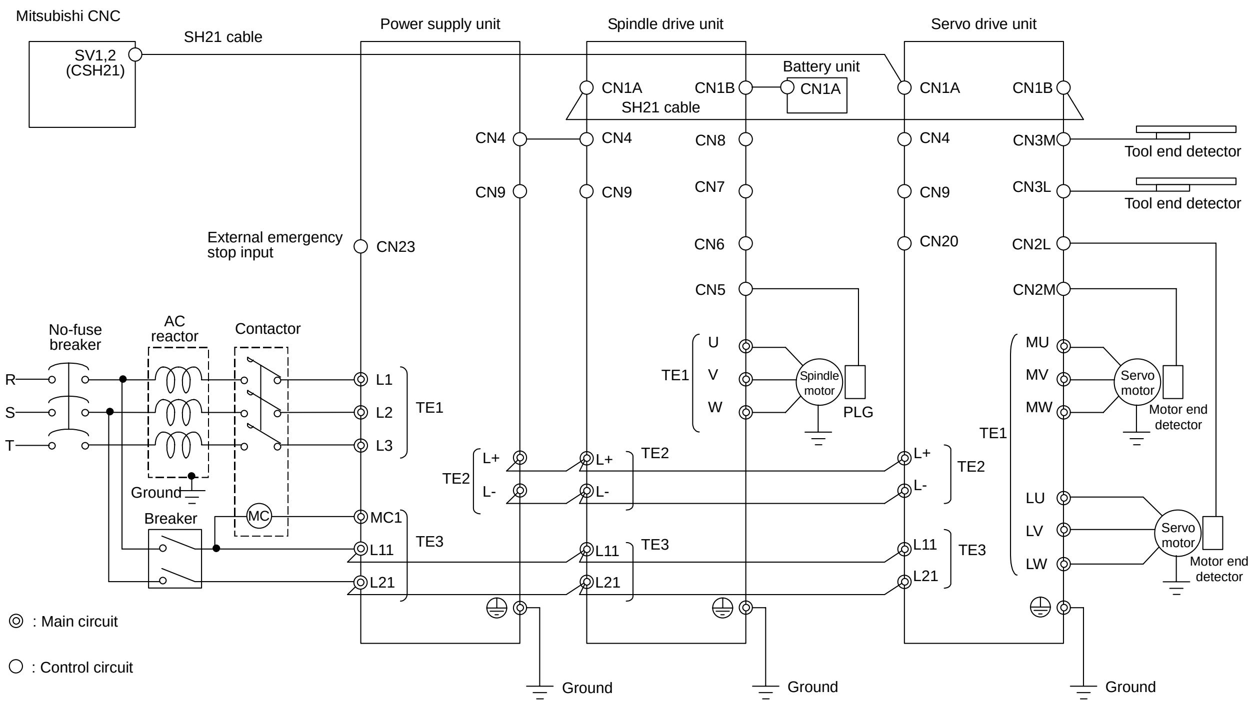
⚠ **CAUTION**

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.
   Failure to observe this item could lead to ruptures or damage, etc.
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.



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. The half-pitch connector (CN1A, etc.) on the front of the drive units have the same shape. If the connectors are connected incorrectly, faults could occur. Make sure that the connection is 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 SH21 cable must be within 30m.
(Note 2) The connection method will differ according to the used motor.
(Note 3) When not using a battery unit, connect the terminal connector (R-TM).
(Note 4) The main circuit (◎) and control circuit (○) are safely separated.

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.

Name	Signal name	Description
L1 · L2 · L3	Main circuit power supply	Main circuit power supply input terminal Connect a 3-phase 200VAC/200 to 230VAC, 50/60Hz power supply.
L11 L21	Control circuit power supply	Control circuit power supply input terminal Connect a single-phase 200VAC/200 to 230VAC, 50/60Hz power supply.
MC1	Contactor control	Contactor control terminal The MC1 terminal has the same phase as L21. Connect to a different phase than the phase connected to L21.
U · V · W	Motor output (Single-axis unit)	Servo/spindle motor power output terminal The servo/spindle motor power terminal (U, V, W) is connected.
LU · LV · LW **MU · MV · MW**	Motor output (Dual-axis unit)	Servo motor power output terminal (L-axis/M-axis) The servo/spindle motor power terminal (U, V, W) is connected.
⏚	Protective grounding (PE)	Grounding terminal The servomotor/spindle motor grounding terminal is connected and grounded.

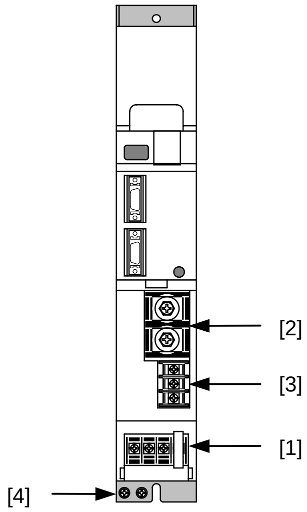
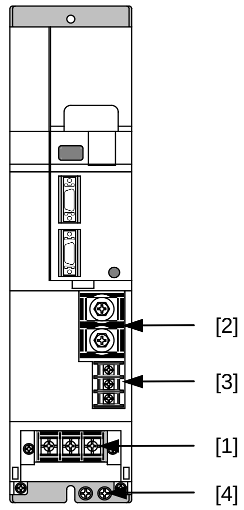
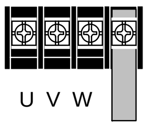
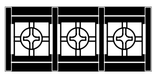
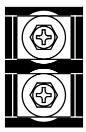
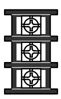
⚠ **CAUTION**	1. Always use one AC reactor per power supply unit. Failure to observe this could lead to unit damage. 2. When sharing a breaker for several power supply units, of a short-circuit fault occurs in a small capacity unit, the breaker could trip. This can be hazardous, so do not share the breaker. 3. Be sure to use the breaker of proper capacity for each power supply unit.

2-2-2 Connector pin assignment

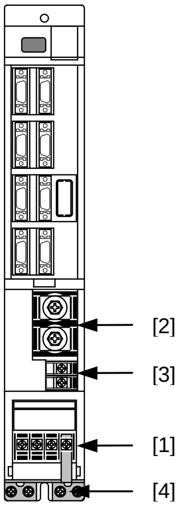
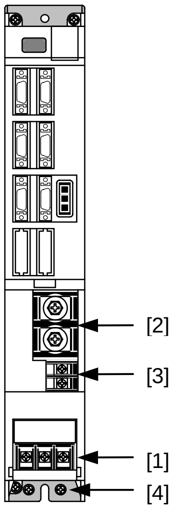
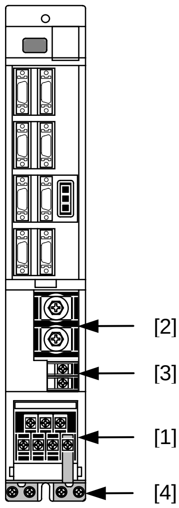
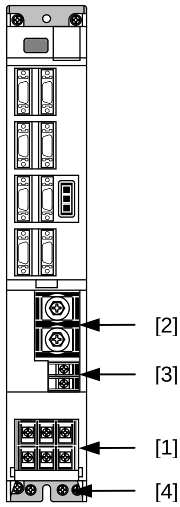
⚠ CAUTION	Do not apply a voltage other than that specified in Instruction Manual on each terminal. Failure to observe this item could lead to rupture or damage, etc.

(1) Main circuit terminal block

Power supply unit

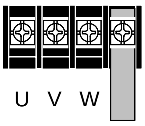
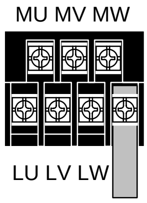
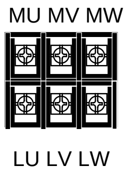
<table>
<tr><th colspan="3">Unit / Terminal</th><th>MDS-C1-CV-37 to 75</th><th>MDS-C1-CV-110 to 370</th></tr>
<tr><td colspan="3">Terminal position</td><td></td><td></td></tr>
<tr><td rowspan="4">Terminal specification/Pin assignment</td><td>[1]</td><td>TE1</td><td>
<table><tr><th>Compatible unit</th><th>CV-37 to 75</th></tr><tr><th>Screw size</th><td>M4</td></tr><tr><th>Tightening torque</th><td>1.6Nm</td></tr></table></td><td>
<table><tr><th>Compatible unit</th><th>CV-110 to 185</th><th>CV-220 to 370</th></tr><tr><th>Screw size</th><td>M5</td><td>M8</td></tr><tr><th>Tightening torque</th><td>3.37Nm</td><td>13.2Nm</td></tr></table></td></tr>
<tr><td>[2]</td><td>TE2</td><td colspan="2">
<table><tr><th>Compatible unit</th><th>CV-37 to 370</th></tr><tr><th>Screw size</th><td>M6</td></tr><tr><th>Tightening torque</th><td>5.0Nm</td></tr></table></td></tr>
<tr><td>[3]</td><td>TE3</td><td colspan="2">
<table><tr><th>Compatible unit</th><th>CV-37 to 75</th><th>CV-110 to 370</th></tr><tr><th>Screw size</th><td>M4</td><td>M4</td></tr><tr><th>Tightening torque</th><td>2.0Nm</td><td>1.6m</td></tr></table></td></tr>
<tr><td>[4]</td><td>⏚</td><td><table><tr><th>Compatible unit</th><th>CV-37 to 75</th></tr><tr><th>Screw size</th><td>M4</td></tr><tr><th>Tightening torque</th><td>2.0Nm</td></tr></table></td><td><table><tr><th>Compatible unit</th><th>CV-110 to 185</th><th>CV-220 to 370</th></tr><tr><th>Screw size</th><td>M5</td><td>M8</td></tr><tr><th>Tightening torque</th><td>3.37Nm</td><td>13.2Nm</td></tr></table></td></tr>
</table>

Servo/spindle drive unit

Terminal \ Unit	MDS-C1-V1-10 and smaller MDS-C1-SP-15 and smaller	MDS-C1-V1-20 and larger MDS-C1-SP-22 and larger	MDS-C1-V2-1010 and smaller	MDS-C1-V2-2010 and larger
Terminal position				

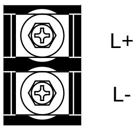
Terminal specification/Pin assignment

[1] TE1

MDS-C1-V1-10 and smaller / MDS-C1-SP-15 and smaller	MDS-C1-V1-20 and larger / MDS-C1-SP-22 and larger	MDS-C1-V2-1010 and smaller	MDS-C1-V2-2010 and larger
			

Compatible unit		01 to 35	45S,45 to 90	110 to 150
Compatible unit	V1-	01 to 35	45S,45 to 90	110 to 150
	V2-	0101 to 9090S	-	
	SP-	04 to 37	55 to 185	220 to 300
Screw size		M4	M5	M8
Tightening torque		2.0Nm	3.2Nm	13.2Nm

[2] TE2



Compatible unit	All V1/V2/SP
Screw size	M6
Tightening torque	5.0Nm

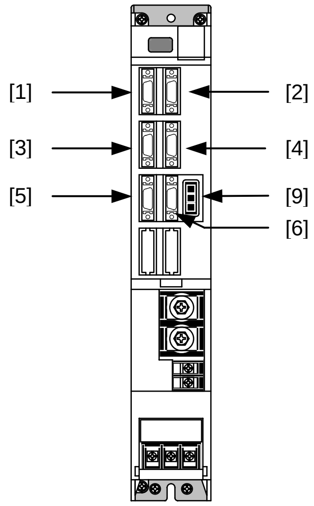
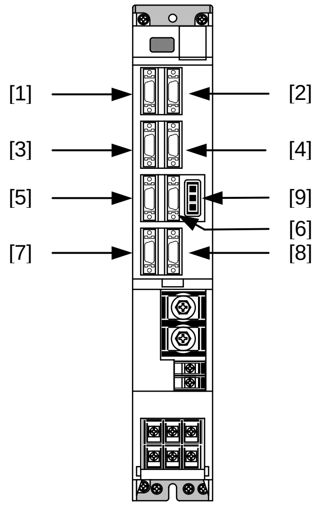
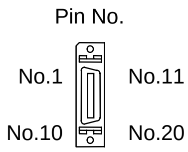
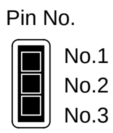
[3] TE3

Compatible unit	All V1/V2/SP
Screw size	M4
Tightening torque	2.0Nm

[4] ⏚

The PE screw size is the same as TE1.

(2) Control circuit connector

Terminal \ Unit		MDS-C1-V1	MDS-C1-V2
Connector position			
Connector specifications	[1] CN1A [2] CN1B [3] CN9 [4] CN4 [5] CN2L [6] CN3L [7] CN2M [8] CN2M		
	[9] CN20		

(Note) The [5] and [6] connector names differ for the MDS-C1-V1 unit. (CN2L, CN3L → CN2, CN3)

2-3 NC and drive unit connection

The NC bus cables are connected from the NC to each drive unit so that they run in a straight line from the NC to the terminal connector (battery unit). And up to 7 axes can be connected per system. Note that the number of connected axes is limited by the NC.

⚠ **CAUTION**	Wire the SH21 cable between the NC and drive unit so that the distance between the NC and terminal connector (battery unit) is within 30m.

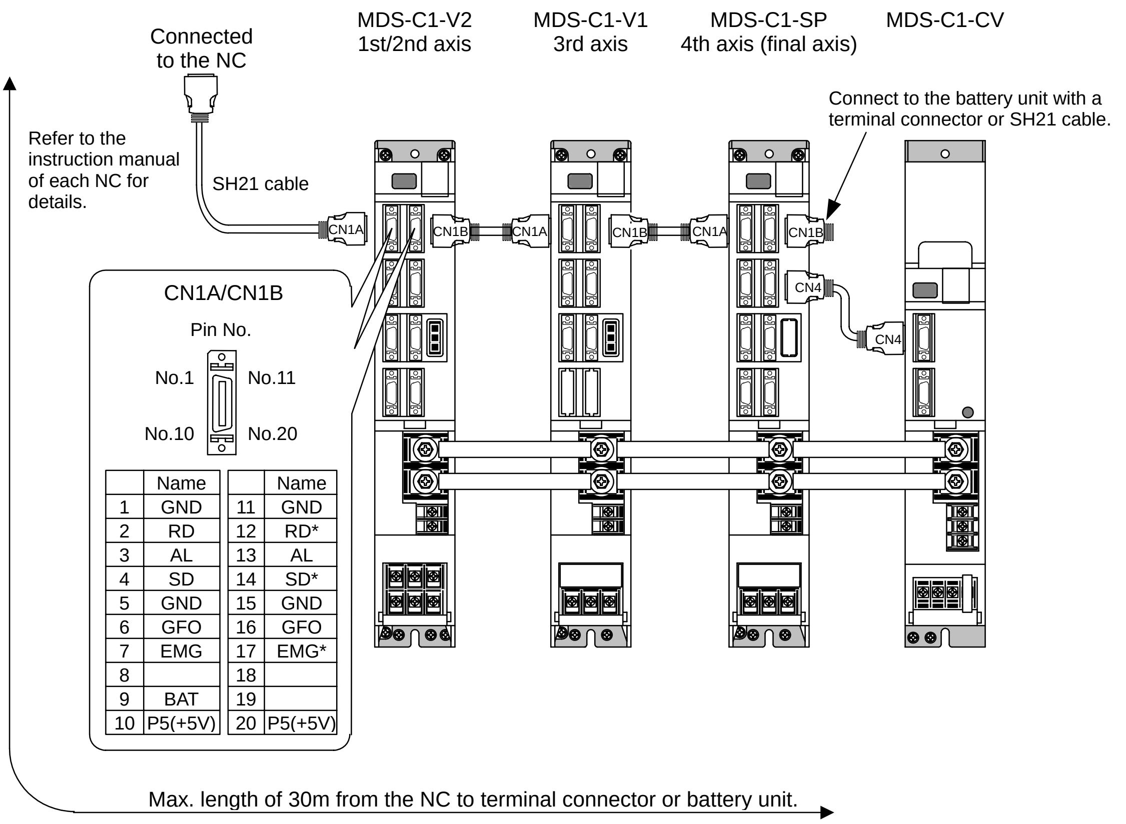
POINT	Axis Nos. are determined by the rotary switch for setting the axis No. (Refer to section "3-1-1 Setting the rotary switch".) The axis No. has no relation to the order for connecting to the NC.

(1) When using one power supply unit

Connect the largest-capacity spindle drive unit to the final axis of the NC communication bus in order to control the power supply unit. The spindle drive unit must be installed adjacent to the power supply unit. In the system with servo only, a servo drive unit for controlling unbalance axis must be installed in the same manner in the same way.

< Connection >

CN1A : CN1B connector on NC or previous stage's drive unit
CN1B : CN1A connector on next stage's drive unit or terminal connector (battery unit)
CN4 : Connector for communication between power supply unit (master side) and drive unit



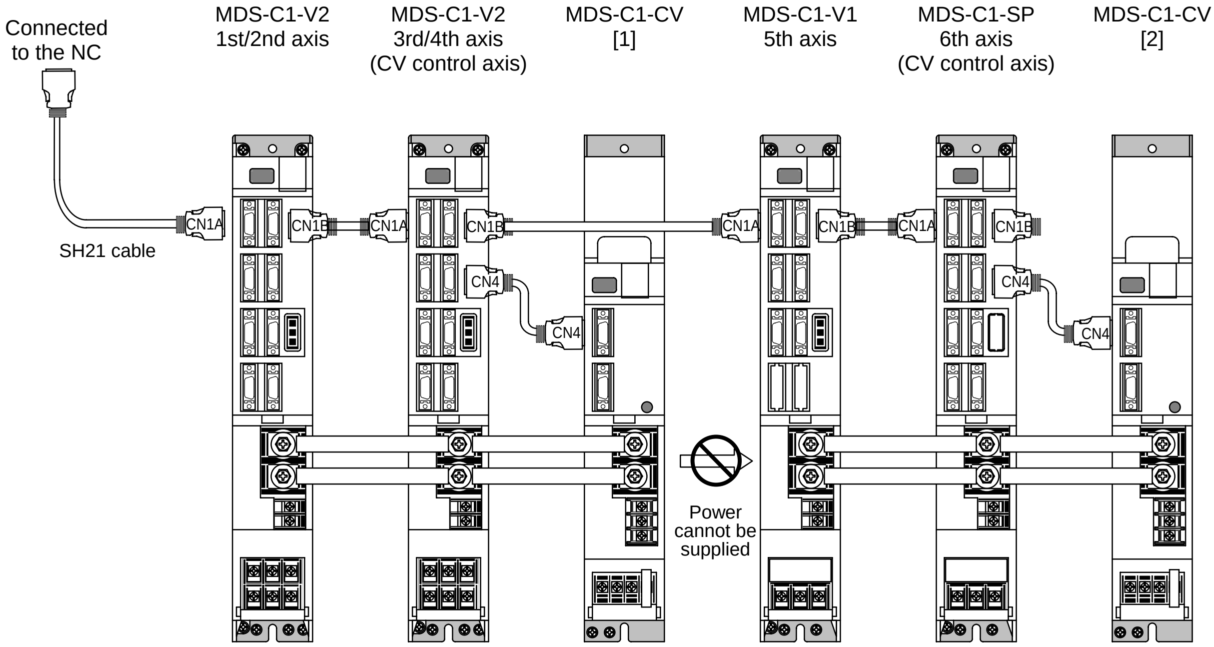
	Name		Name
1	GND	11	GND
2	RD	12	RD*
3	AL	13	AL
4	SD	14	SD*
5	GND	15	GND
6	GFO	16	GFO
7	EMG	17	EMG*
8		18	
9	BAT	19	
10	P5(+5V)	20	P5(+5V)

Connection when using one power supply unit

(2) When using two or more power supply units within a single NC communication bus system

Two or more power supply units may be required within a single NC communication bus system if the spindle drive unit capacity is large. The drive unit receiving power (L+, L-) from each power supply unit must always have NC communication bus connection at the NC side of each power supply unit. In the NC communication bus connection example below, power supply [1] cannot supply power (L+, L-) to the 5th axis servo drive unit.

For basic connection information, refer to "(1) When using one power supply unit".



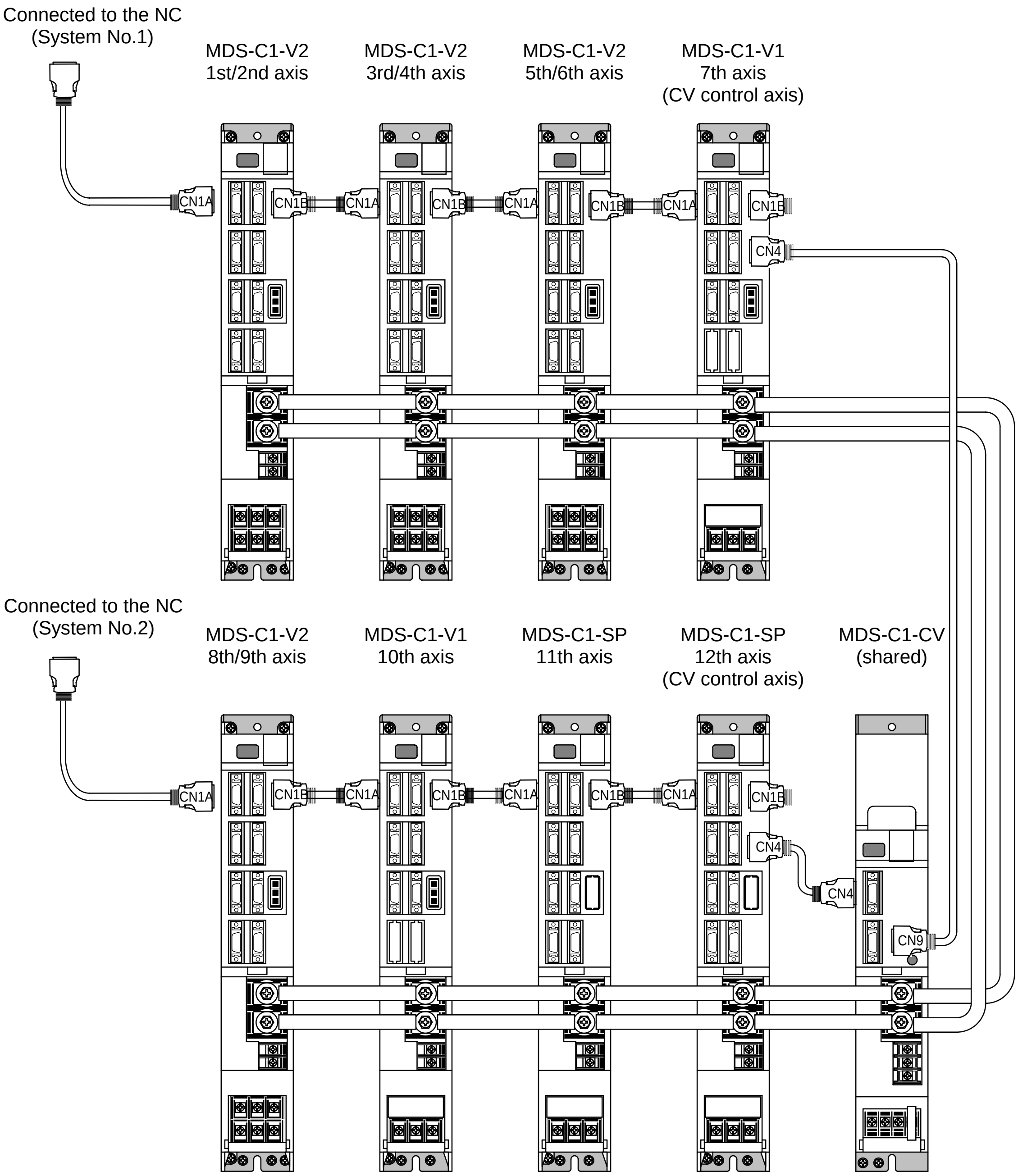
Connections when using two power supply units within a single NC communication bus system

⚠ **CAUTION**	The drive unit receiving power (L+, L-) from each power supply unit must always have NC communication bus connection at the NC side of each power supply unit.

(3) When using one power supply shared unit by two NC communication bus systems

In systems employing a number of small-capacity drive units, a single power supply unit can be shared by two NC communication bus systems. In this case, a power supply control axis must be set for each axis of each NC communication bus.

For basic connection information, refer to "(1) When using one power supply unit".



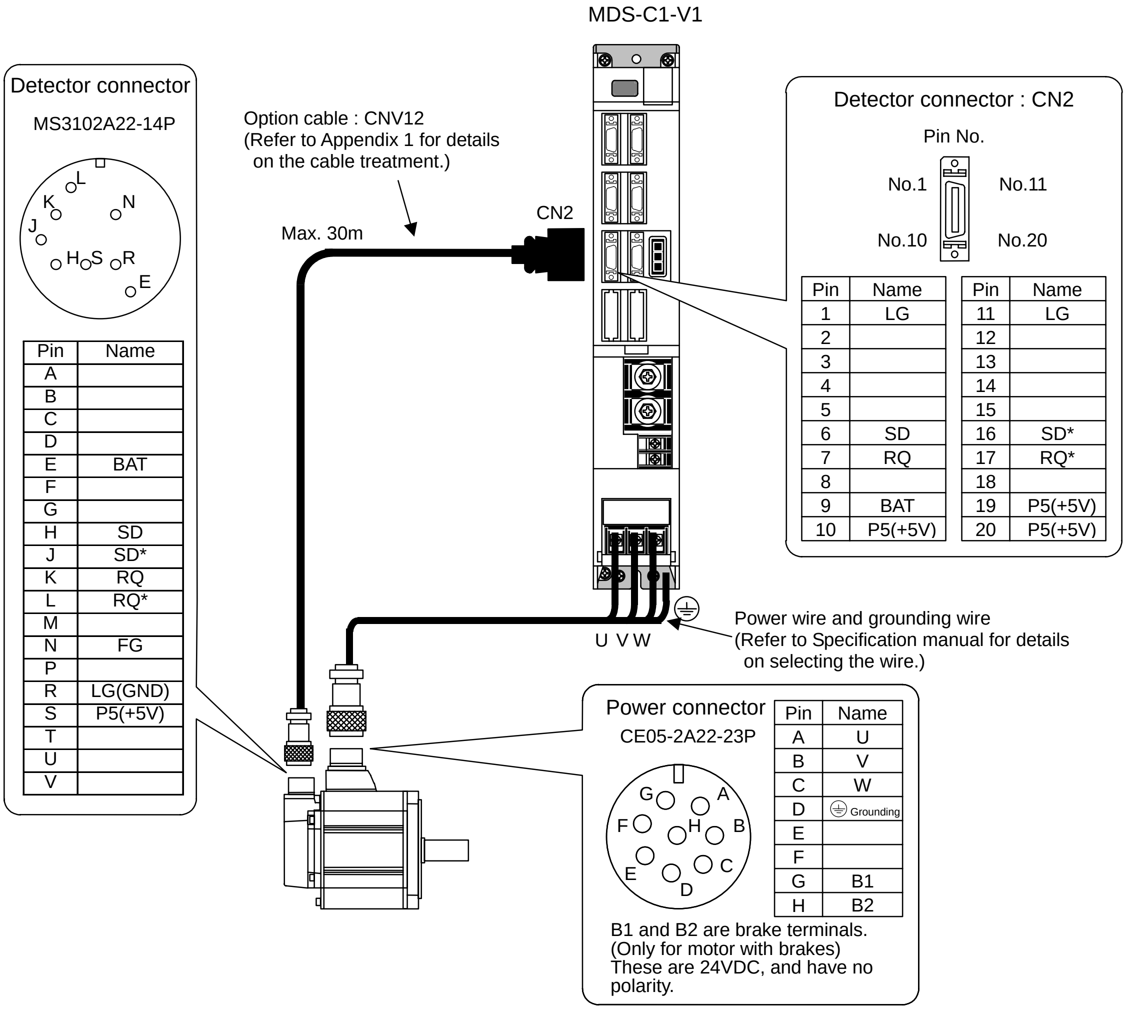
Connections when using one power supply shared by two NC communication bus systems

⚠ **CAUTION**	If the two NC communication bus systems include a spindle drive unit, connect the power supply unit's CN4 connector to the CN4 connector of the largest-capacity spindle drive unit. If there is no spindle drive unit, connect to the unbalance-axis servo drive unit.

2-4 Motor and detector connection

2-4-1 Connecting the servomotor

(1) Connecting the HC52(B)/HC102(B)/HC152(B)/HC53(B)/HC103(B)/HC153(B)/HC103R(B) /HC153R(B)/HC203R(B)



Detector connector MS3102A22-14P

Pin	Name
A	
B	
C	
D	
E	BAT
F	
G	
H	SD
J	SD*
K	RQ
L	RQ*
M	
N	FG
P	
R	LG(GND)
S	P5(+5V)
T	
U	
V	

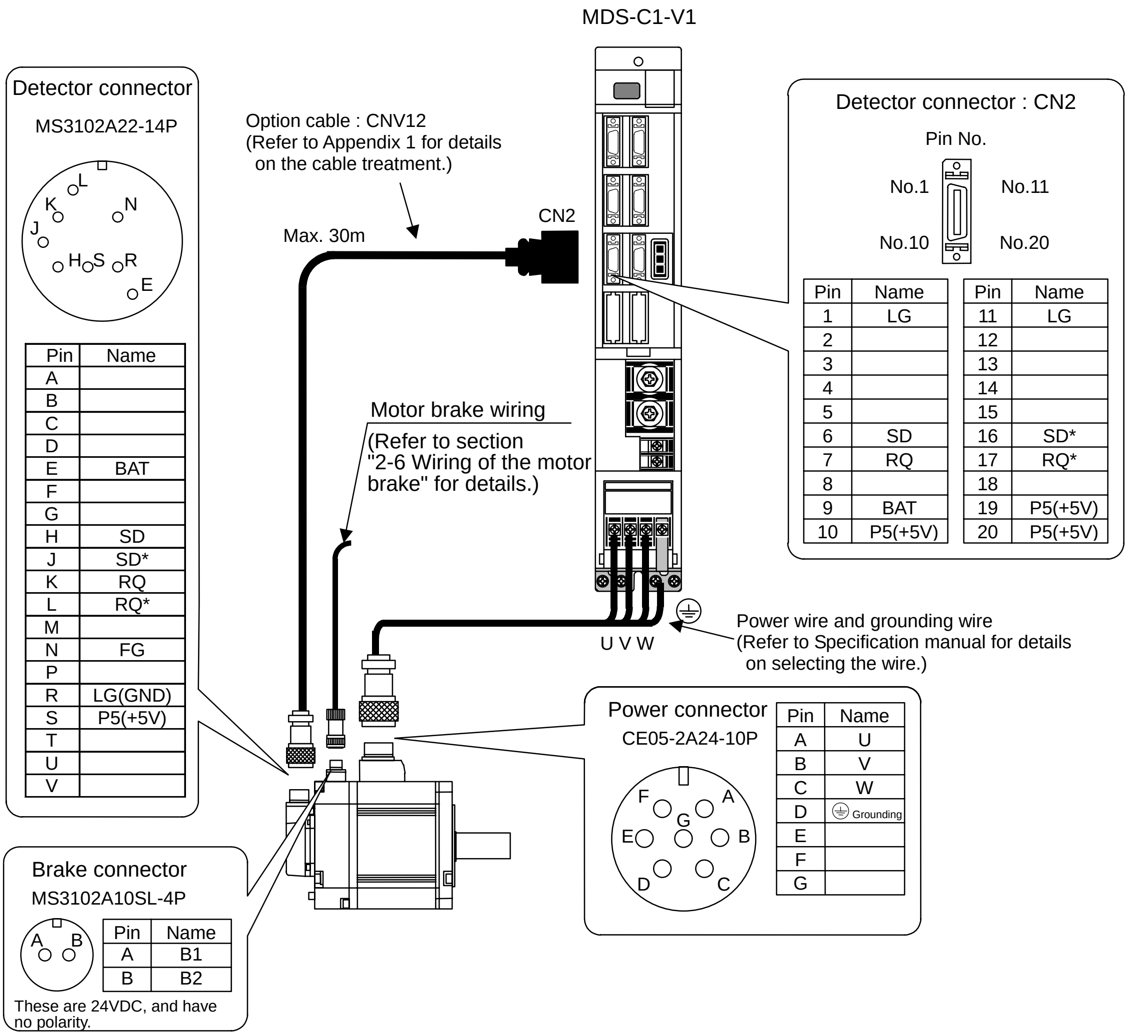
Detector connector : CN2

Pin	Name	Pin	Name
1	LG	11	LG
2		12	
3		13	
4		14	
5		15	
6	SD	16	SD*
7	RQ	17	RQ*
8		18	
9	BAT	19	P5(+5V)
10	P5(+5V)	20	P5(+5V)

Power connector CE05-2A22-23P

Pin	Name
A	U
B	V
C	W
D	Grounding
E	
F	
G	B1
H	B2

(2) Connecting the HC202(B)/HC352(B)/HC452(B)/HC203(B)/HC353(B)



Detector connector MS3102A22-14P

Pin	Name
A	
B	
C	
D	
E	BAT
F	
G	
H	SD
J	SD*
K	RQ
L	RQ*
M	
N	FG
P	
R	LG(GND)
S	P5(+5V)
T	
U	
V	

Detector connector : CN2

Pin	Name	Pin	Name
1	LG	11	LG
2		12	
3		13	
4		14	
5		15	
6	SD	16	SD*
7	RQ	17	RQ*
8		18	
9	BAT	19	P5(+5V)
10	P5(+5V)	20	P5(+5V)

Power connector CE05-2A24-10P

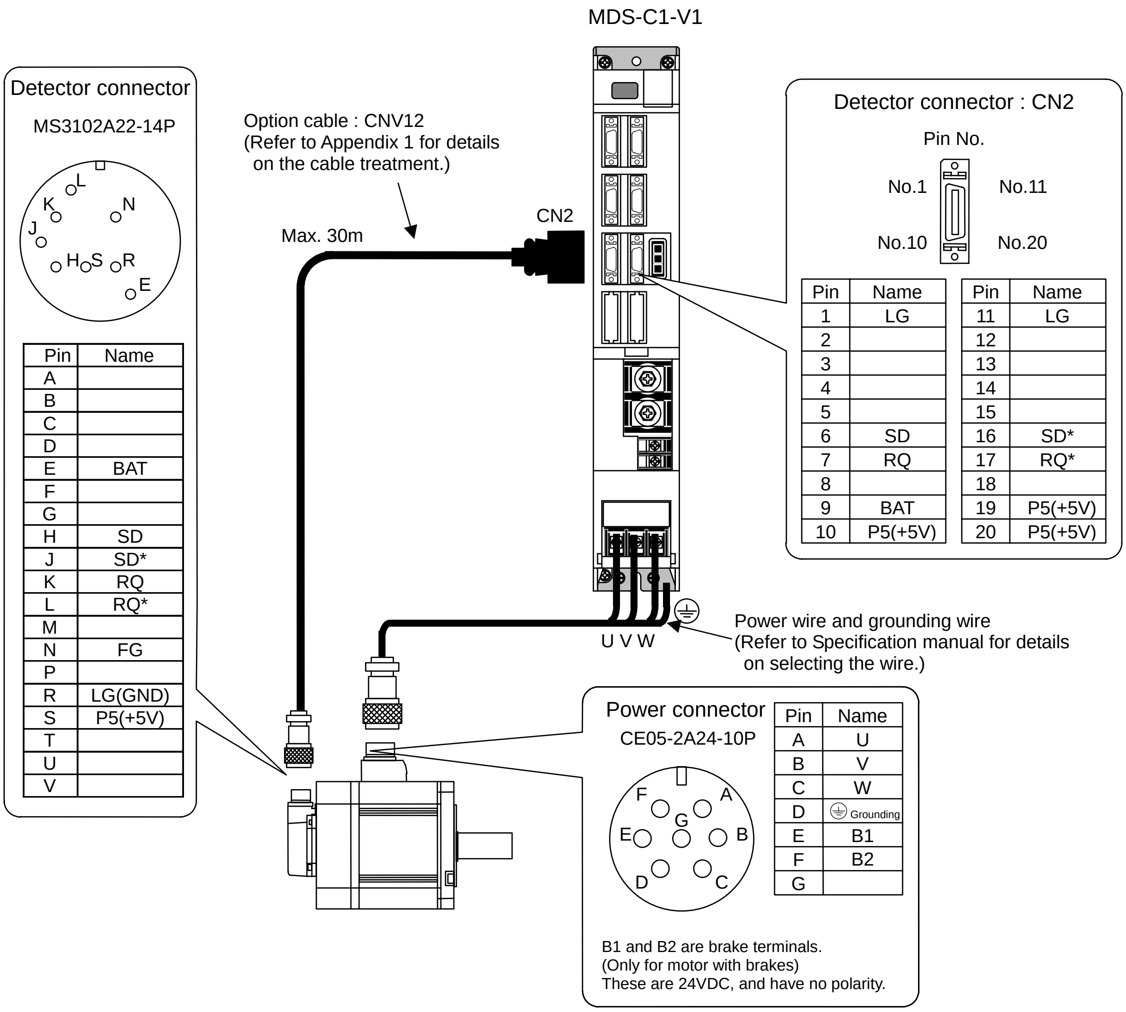
Pin	Name
A	U
B	V
C	W
D	Grounding
E	
F	
G	

Brake connector MS3102A10SL-4P

Pin	Name
A	B1
B	B2

These are 24VDC, and have no polarity.

(3) Connecting the HC353R(B)/HC503R(B)



Detector connector MS3102A22-14P

Pin	Name
A	
B	
C	
D	
E	BAT
F	
G	
H	SD
J	SD*
K	RQ
L	RQ*
M	
N	FG
P	
R	LG(GND)
S	P5(+5V)
T	
U	
V	

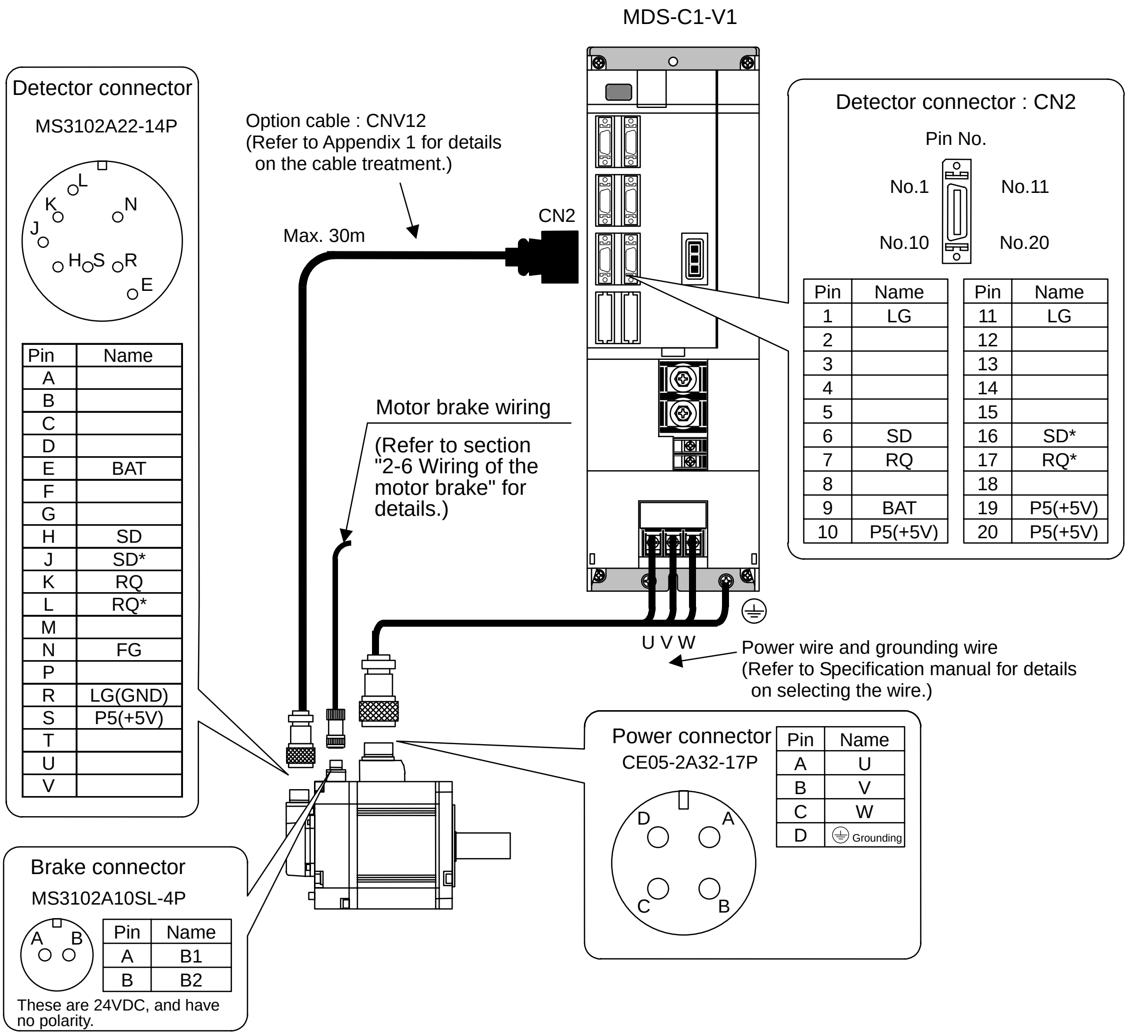
Detector connector : CN2

Pin	Name	Pin	Name
1	LG	11	LG
2		12	
3		13	
4		14	
5		15	
6	SD	16	SD*
7	RQ	17	RQ*
8		18	
9	BAT	19	P5(+5V)
10	P5(+5V)	20	P5(+5V)

Power connector CE05-2A24-10P

Pin	Name
A	U
B	V
C	W
D	Grounding
E	B1
F	B2
G	

(4) Connecting the HC702(B)/HC902(B)/HC453(B)/HC703(B)



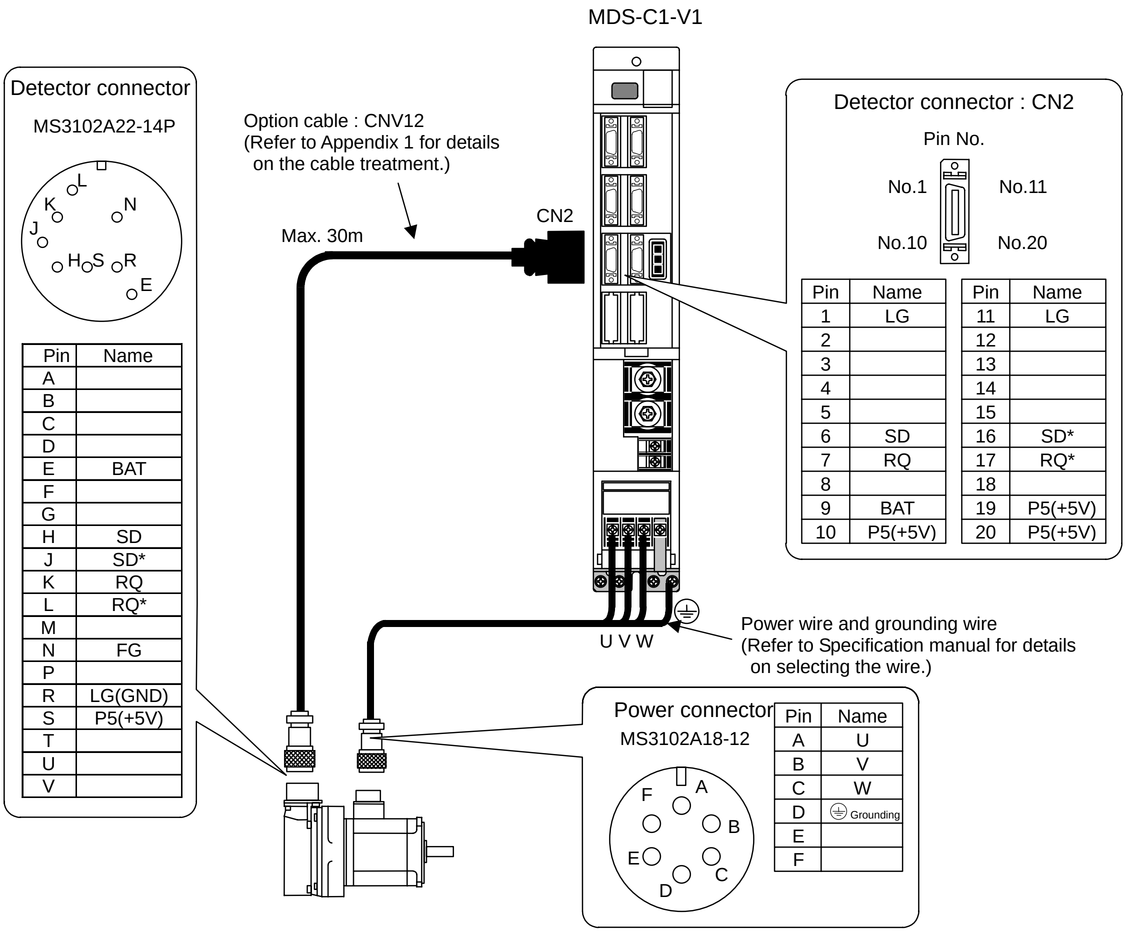
Pin	Name
A	
B	
C	
D	
E	BAT
F	
G	
H	SD
J	SD*
K	RQ
L	RQ*
M	
N	FG
P	
R	LG(GND)
S	P5(+5V)
T	
U	
V	

Pin	Name	Pin	Name
1	LG	11	LG
2		12	
3		13	
4		14	
5		15	
6	SD	16	SD*
7	RQ	17	RQ*
8		18	
9	BAT	19	P5(+5V)
10	P5(+5V)	20	P5(+5V)

Pin	Name
A	U
B	V
C	W
D	Grounding

Pin	Name
A	B1
B	B2

(5) Connecting the HA053N/HA13N

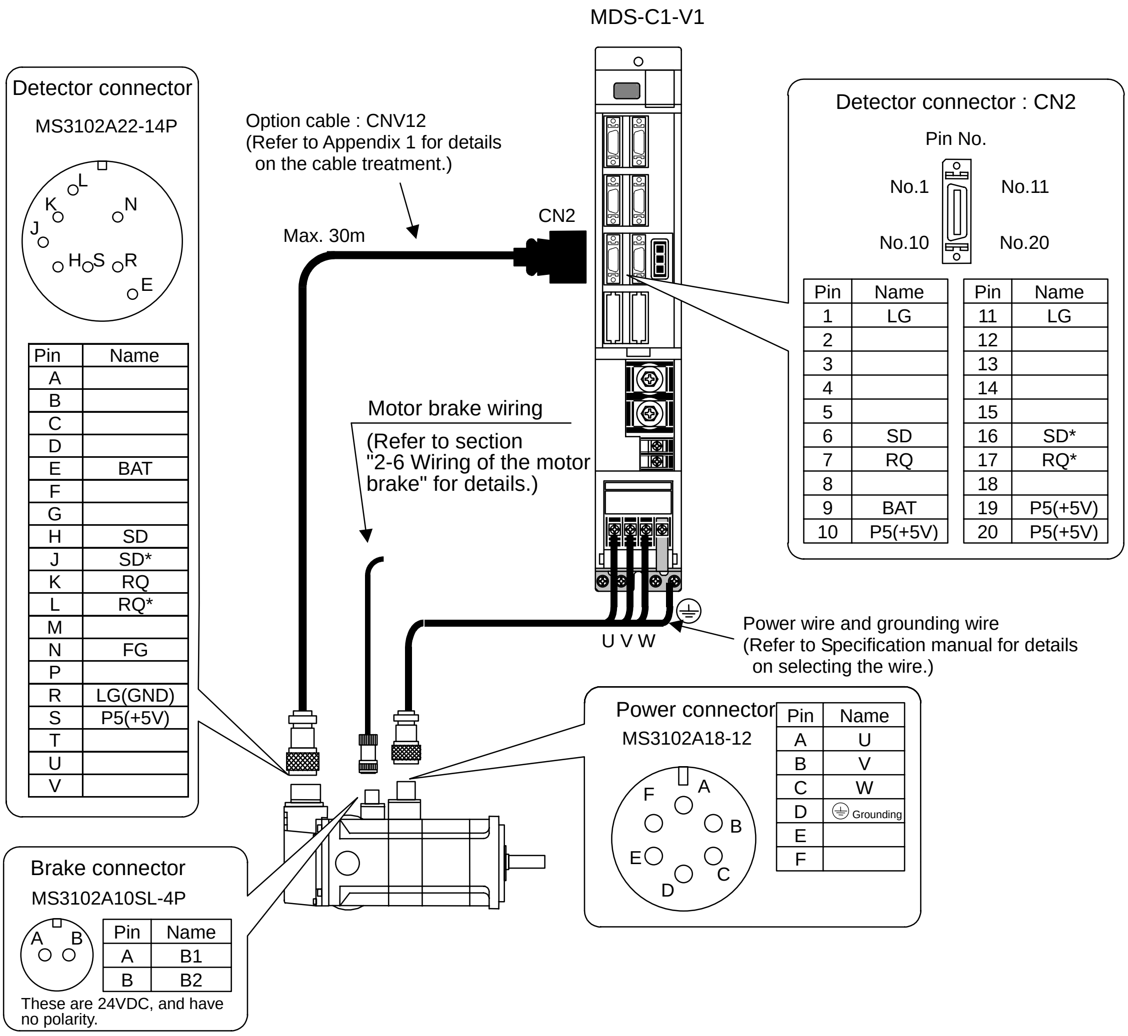


Pin	Name
A	
B	
C	
D	
E	BAT
F	
G	
H	SD
J	SD*
K	RQ
L	RQ*
M	
N	FG
P	
R	LG(GND)
S	P5(+5V)
T	
U	
V	

Pin	Name	Pin	Name
1	LG	11	LG
2		12	
3		13	
4		14	
5		15	
6	SD	16	SD*
7	RQ	17	RQ*
8		18	
9	BAT	19	P5(+5V)
10	P5(+5V)	20	P5(+5V)

Pin	Name
A	U
B	V
C	W
D	Grounding
E	
F	

(6) Connecting the HA23N(B)/HA33N(B)



Detector connector MS3102A22-14P

Pin	Name
A	
B	
C	
D	
E	BAT
F	
G	
H	SD
J	SD*
K	RQ
L	RQ*
M	
N	FG
P	
R	LG(GND)
S	P5(+5V)
T	
U	
V	

Detector connector : CN2

Pin	Name	Pin	Name
1	LG	11	LG
2		12	
3		13	
4		14	
5		15	
6	SD	16	SD*
7	RQ	17	RQ*
8		18	
9	BAT	19	P5(+5V)
10	P5(+5V)	20	P5(+5V)

Power connector MS3102A18-12

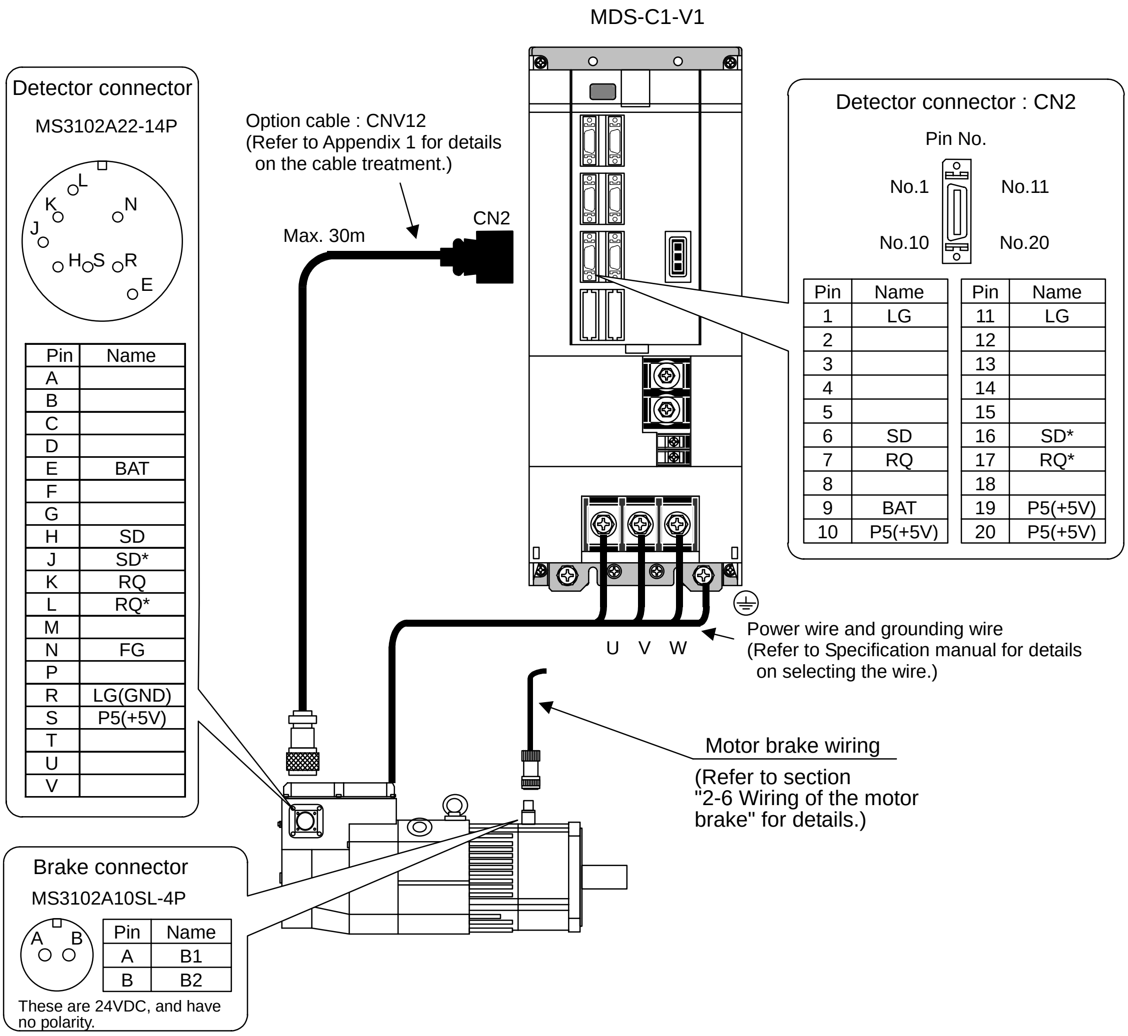
Pin	Name
A	U
B	V
C	W
D	Grounding
E	
F	

Brake connector MS3102A10SL-4P

Pin	Name
A	B1
B	B2

These are 24VDC, and have no polarity.

(7) Connecting the HA-LF11K2(B)-S8/HA-LF15K2(B)-S8



Detector connector MS3102A22-14P

Pin	Name
A	
B	
C	
D	
E	BAT
F	
G	
H	SD
J	SD*
K	RQ
L	RQ*
M	
N	FG
P	
R	LG(GND)
S	P5(+5V)
T	
U	
V	

Detector connector : CN2

Pin	Name	Pin	Name
1	LG	11	LG
2		12	
3		13	
4		14	
5		15	
6	SD	16	SD*
7	RQ	17	RQ*
8		18	
9	BAT	19	P5(+5V)
10	P5(+5V)	20	P5(+5V)

Brake connector MS3102A10SL-4P

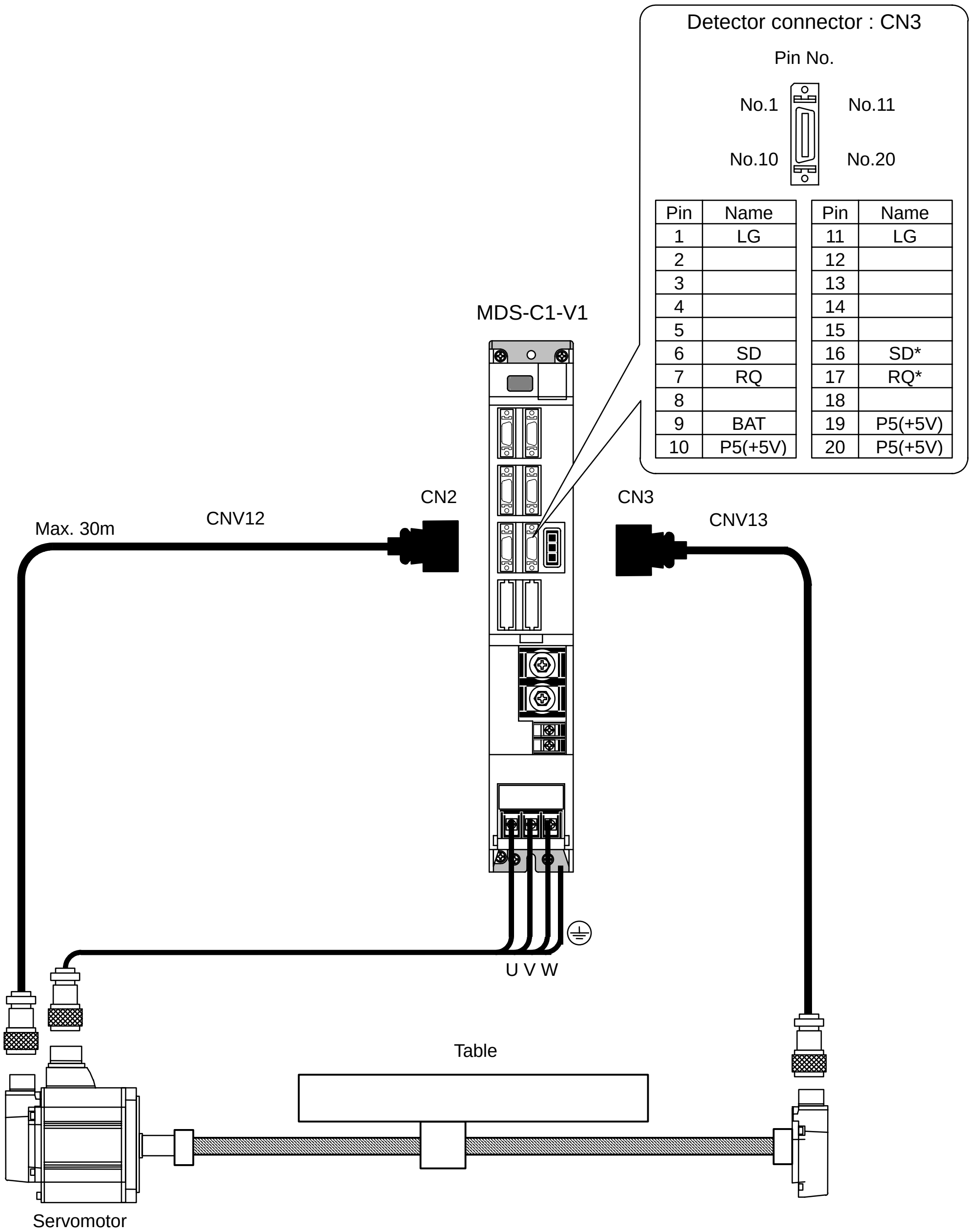
Pin	Name
A	B1
B	B2

These are 24VDC, and have no polarity.

2-4-2 Connecting the full-closed loop system

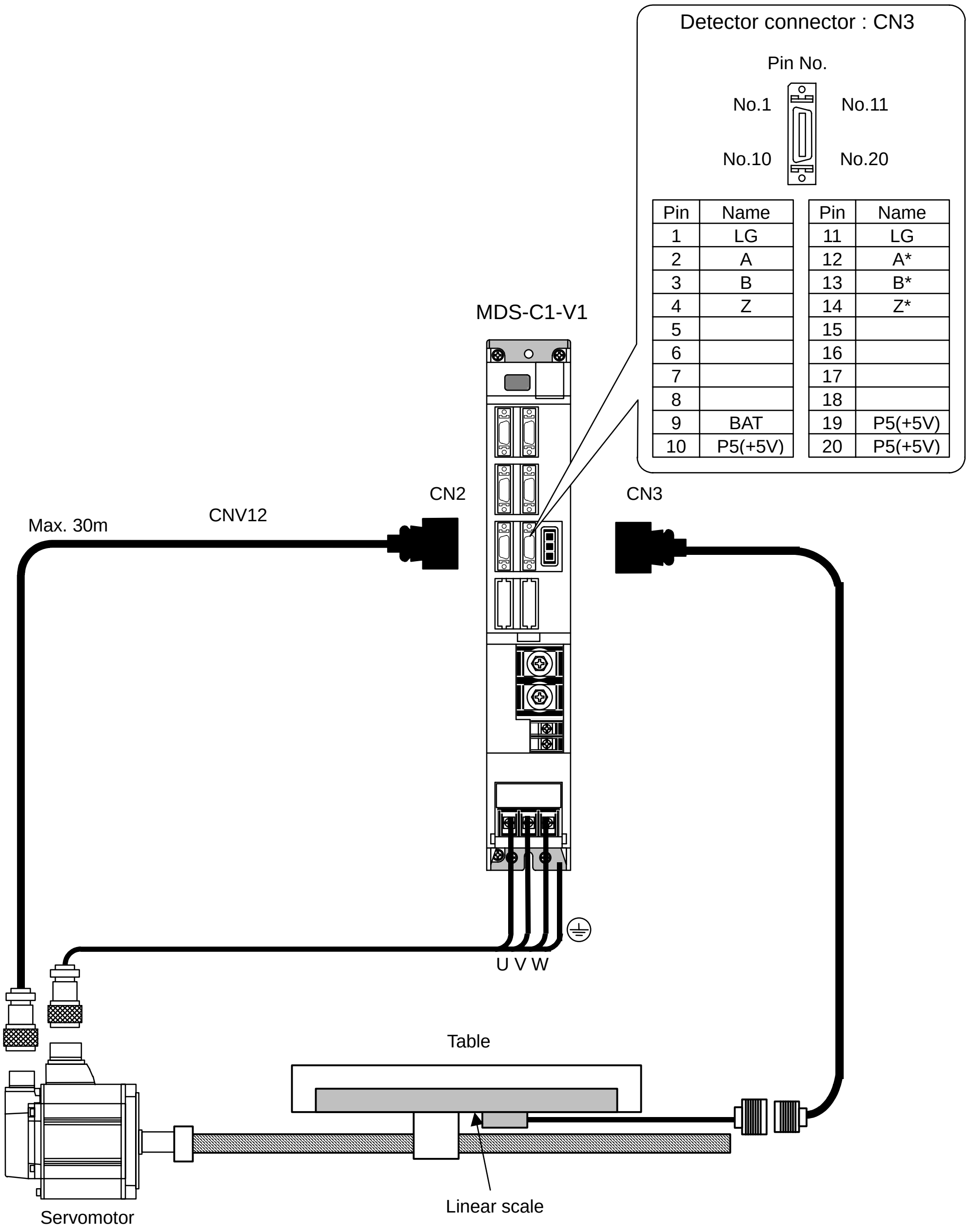
Refer to section "2-4-1 Connecting the servomotor" for details on connecting the each motor type.

(1) Connecting the ball screw end detector



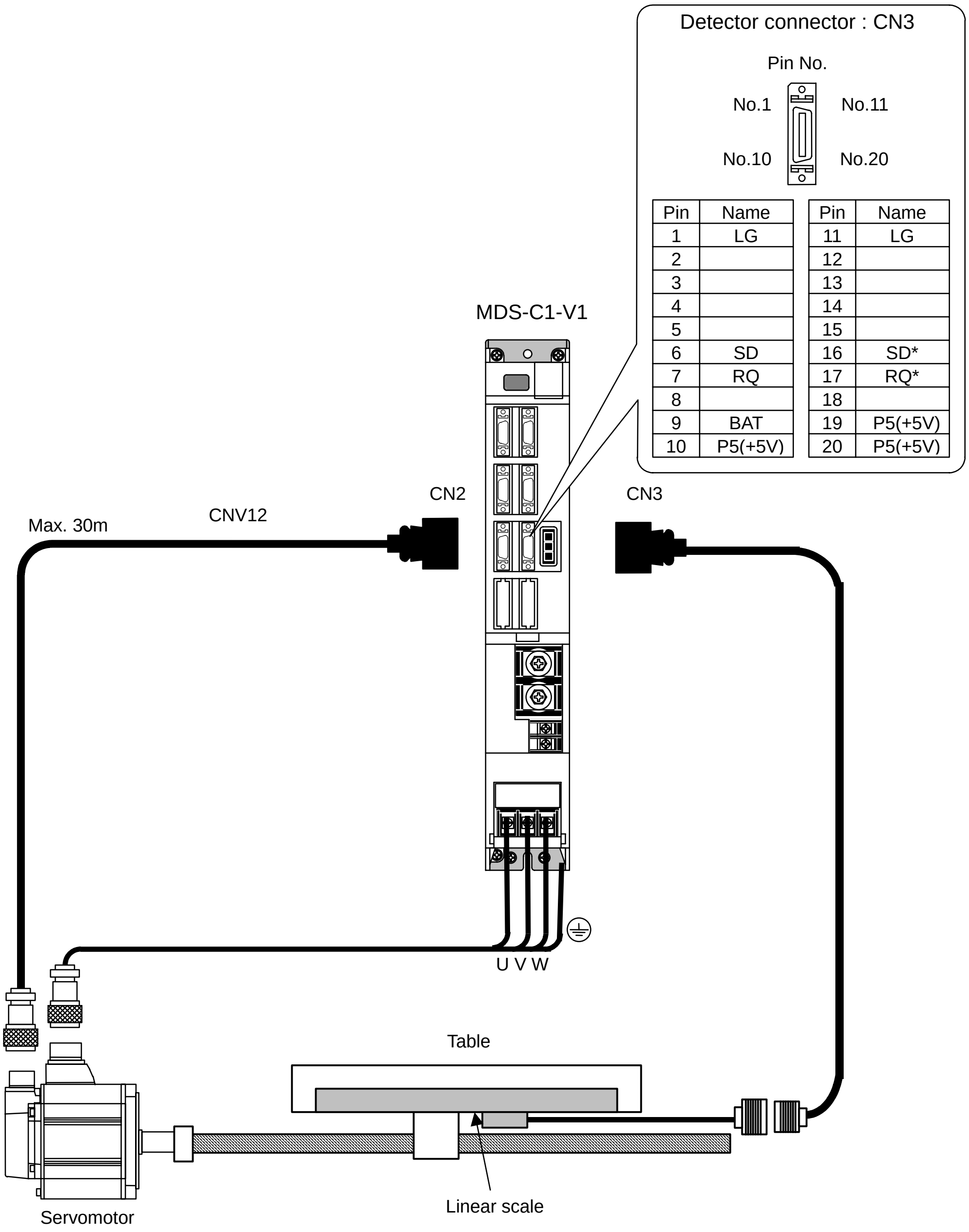
Pin	Name	Pin	Name
1	LG	11	LG
2		12	
3		13	
4		14	
5		15	
6	SD	16	SD*
7	RQ	17	RQ*
8		18	
9	BAT	19	P5(+5V)
10	P5(+5V)	20	P5(+5V)

(2) Connecting the linear scale (for oblong wave data output)



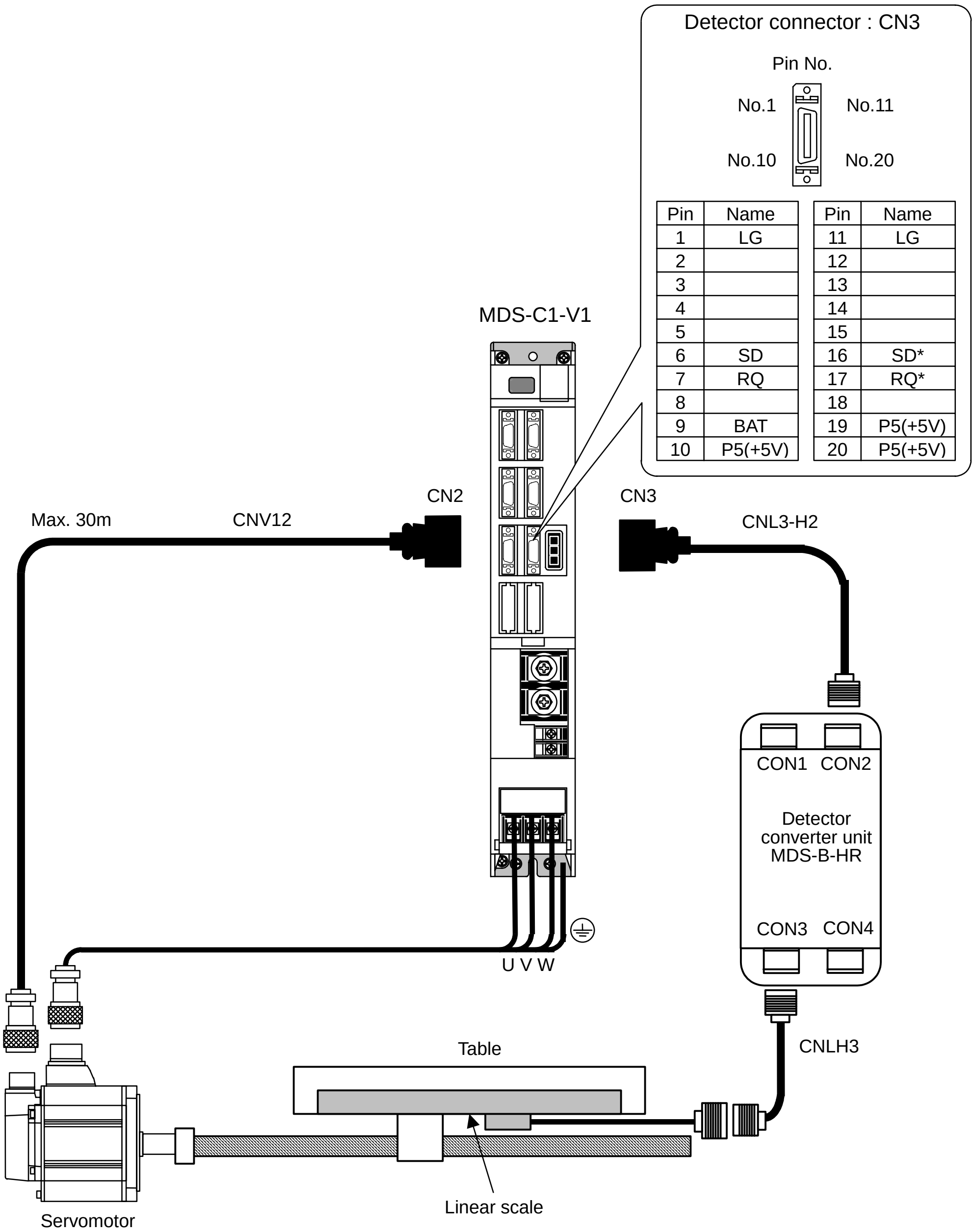
Pin	Name	Pin	Name
1	LG	11	LG
2	A	12	A*
3	B	13	B*
4	Z	14	Z*
5		15	
6		16	
7		17	
8		18	
9	BAT	19	P5(+5V)
10	P5(+5V)	20	P5(+5V)

(3) Connecting the linear scale (for serial data output)



Pin	Name	Pin	Name
1	LG	11	LG
2		12	
3		13	
4		14	
5		15	
6	SD	16	SD*
7	RQ	17	RQ*
8		18	
9	BAT	19	P5(+5V)
10	P5(+5V)	20	P5(+5V)

(4) Connecting the linear scale (for analog output)



Pin	Name	Pin	Name
1	LG	11	LG
2		12	
3		13	
4		14	
5		15	
6	SD	16	SD*
7	RQ	17	RQ*
8		18	
9	BAT	19	P5(+5V)
10	P5(+5V)	20	P5(+5V)

2-4-3 Connecting the synchronous control system

The connection method and motor/encoder type (SV025) setting combinations for each synchronous control system are shown in the table below. For power supply connections for each servomotor type, refer to "2-4-1 Connecting the servomotor".

<table>
<tr><th></th><th>Semi-closed system
(Only for motor side detector)</th><th>Full-closed system
(For machine side detector + motor side detector)</th></tr>
<tr><td>Position command synchronous control</td><td colspan="2">The operation is controlled with position commands from the NC, so there are no special connections.
A normal value is set for the SV025 setting.</td></tr>
<tr><td rowspan="2">Speed command synchronous control
Current command synchronous control</td><td>(1) When using MDS-C1-V1 drive unit</td><td>(3) When using MDS-C1-V1 drive unit
(Only compatible with serial output linear scale)</td></tr>
<tr><td>(2) When using MDS-C1-V2 drive unit</td><td>MDS-C1-V2 drive unit
(4-1) When using serial output linear scale
(4-2) When using analog output linear scale</td></tr>
</table>

Some control restrictions may apply when using speed and current command synchronous control, depending on the servo drive unit's control mode and control system configuration. Refer to the following table for details.

List of control systems and supported synchronous control (high-gain specifications)

<table>
<tr><th colspan="2">Control system type</th><th>Controlled by MDS-C1-V2</th><th>Controlled by MDS-C1-V1 x 2 Units</th></tr>
<tr><td rowspan="2">Semi-closed system</td><td>Incremental control</td><td>Speed command synchronous control
Current command synchronous control</td><td>Not supported</td></tr>
<tr><td>Absolute position control</td><td>Speed command synchronous control
Current command synchronous control</td><td>Speed command synchronous control
Current command synchronous control</td></tr>
<tr><td rowspan="2">Full-closed system (Note)</td><td>Incremental control</td><td>Speed command synchronous control
Current command synchronous control</td><td>Not supported</td></tr>
<tr><td>Absolute position control</td><td>Speed command synchronous control
Current command synchronous control</td><td>Speed command synchronous control</td></tr>
</table>

(Note) Pulse output linear scale is not supported.

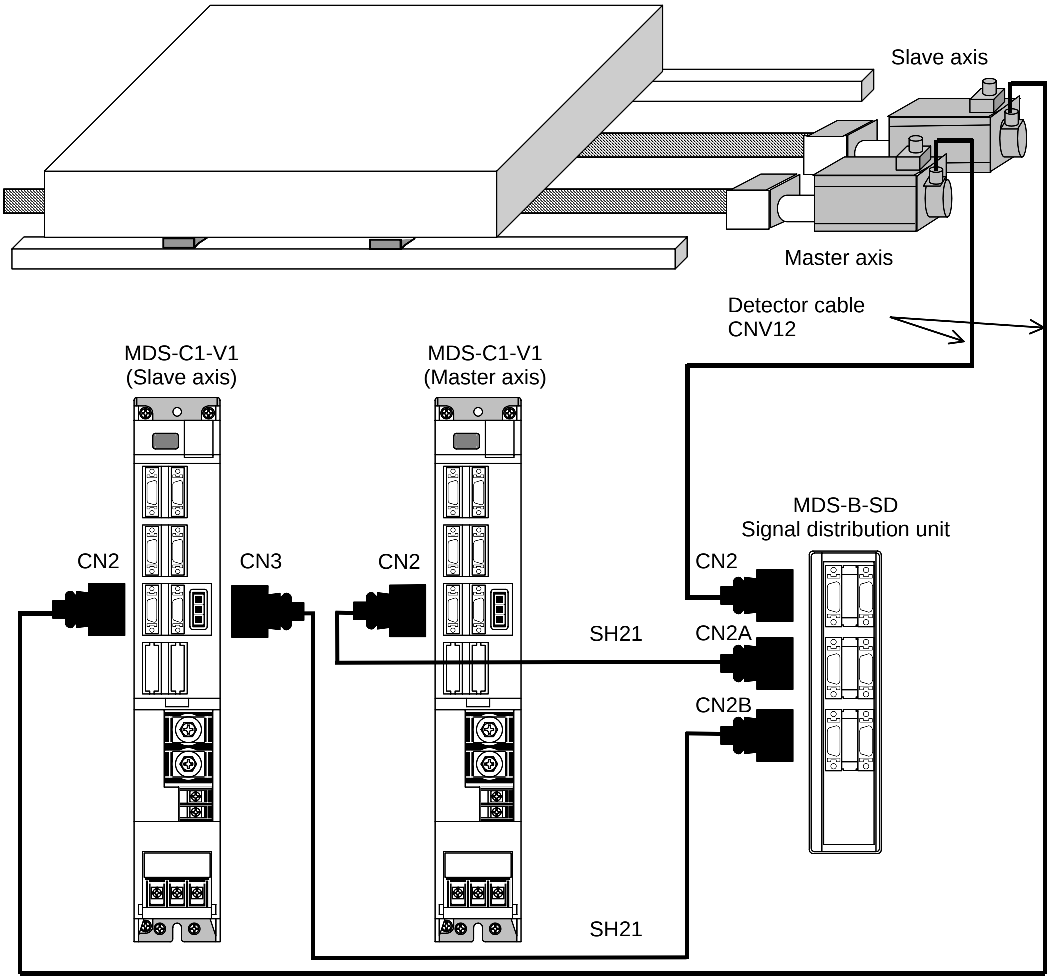
List of control systems and supported synchronous control (standard specifications)

<table>
<tr><th colspan="2">Control system type</th><th>Controlled by MDS-C1-V2</th><th>Controlled by MDS-C1-V1 x 2 Units</th></tr>
<tr><td rowspan="2">Semi-closed system</td><td>Incremental control</td><td>Not supported</td><td>Not supported</td></tr>
<tr><td>Absolute position control</td><td>Not supported</td><td>Speed command synchronous control
Current command synchronous control</td></tr>
<tr><td rowspan="2">Full-closed system</td><td>Incremental control</td><td>Not supported</td><td>Not supported</td></tr>
<tr><td>Absolute position control</td><td>Not supported</td><td>Not supported</td></tr>
</table>

POINT

1. Incremental control is only supported when using 2-axis servo drive unit. If two 1-axis units are used, be sure to carry out absolute position control.
2. When synchronous control operation is carried out at 2-axis servo drive unit, the L-axis is the master axis, and the M-axis is the slave axis.

(1) Connection for semi-closed synchronous control (when using MDS-C1-V1 drive unit)



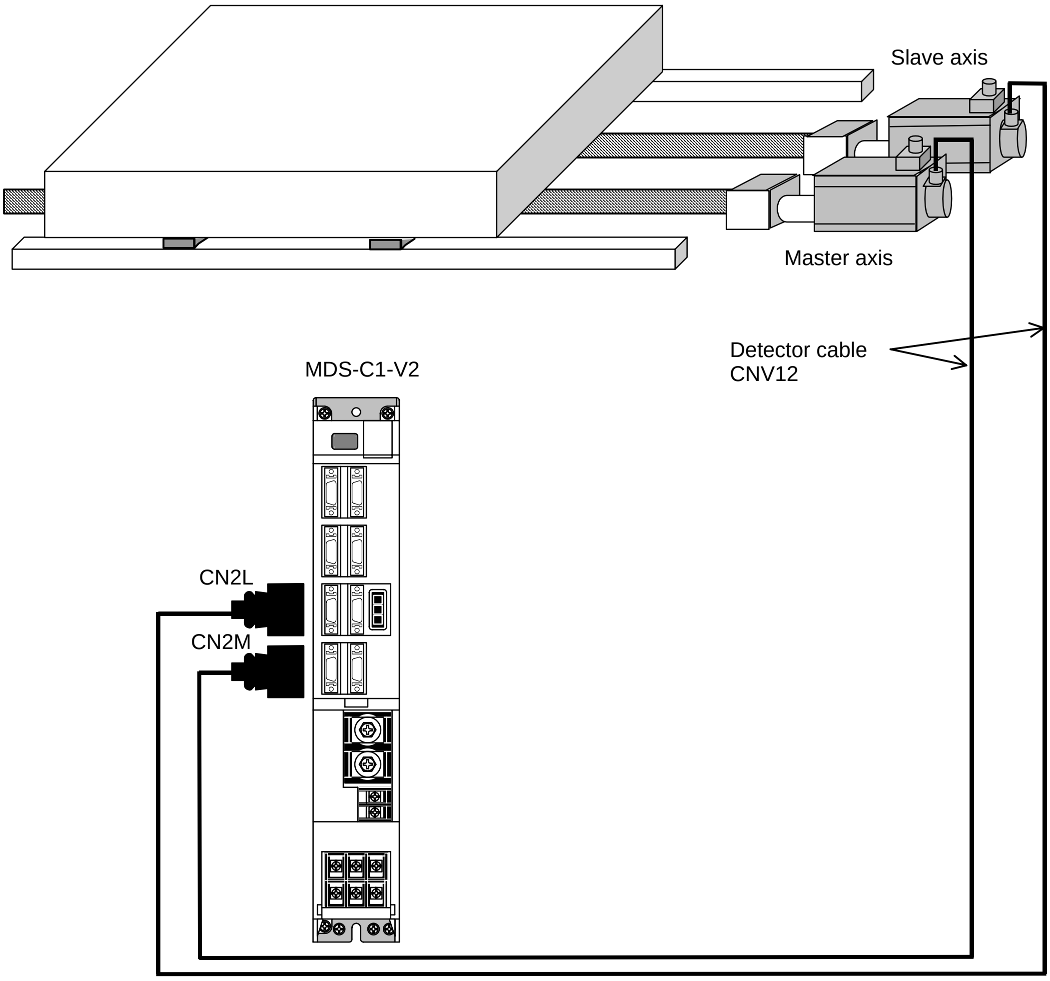
Parameter settings

<table>
<tr><th>No.</th><th>Abbrev.</th><th>Parameter name</th><th colspan="4">Description</th></tr>
<tr><td rowspan="4">SV025</td><td rowspan="4">MTYP</td><td rowspan="4">Motor/detector type</td><td colspan="4">Set the detector type. The value determined for each motor type is input to “xx” in the following table.</td></tr>
<tr><td></td><td>OSE104/OSE105</td><td>OSA104</td><td>OSA105</td></tr>
<tr><td>Speed command synchronous control</td><td>Not compatible</td><td>Master axis =11xx
Slave axis =C1xx</td><td>Master axis =22xx
Slave axis =C2xx</td></tr>
<tr><td>Current command synchronous control</td><td>Not compatible</td><td>Master axis =11xx
Slave axis =CCxx</td><td>Master axis =22xx
Slave axis =CCxx</td></tr>
</table>

Inner table column group header: **Motor end detector type** (spanning OSE104/OSE105, OSA104, OSA105).

(Note) A system in which two MDS-C1-V1 unit are used is not compatible with incremental system.

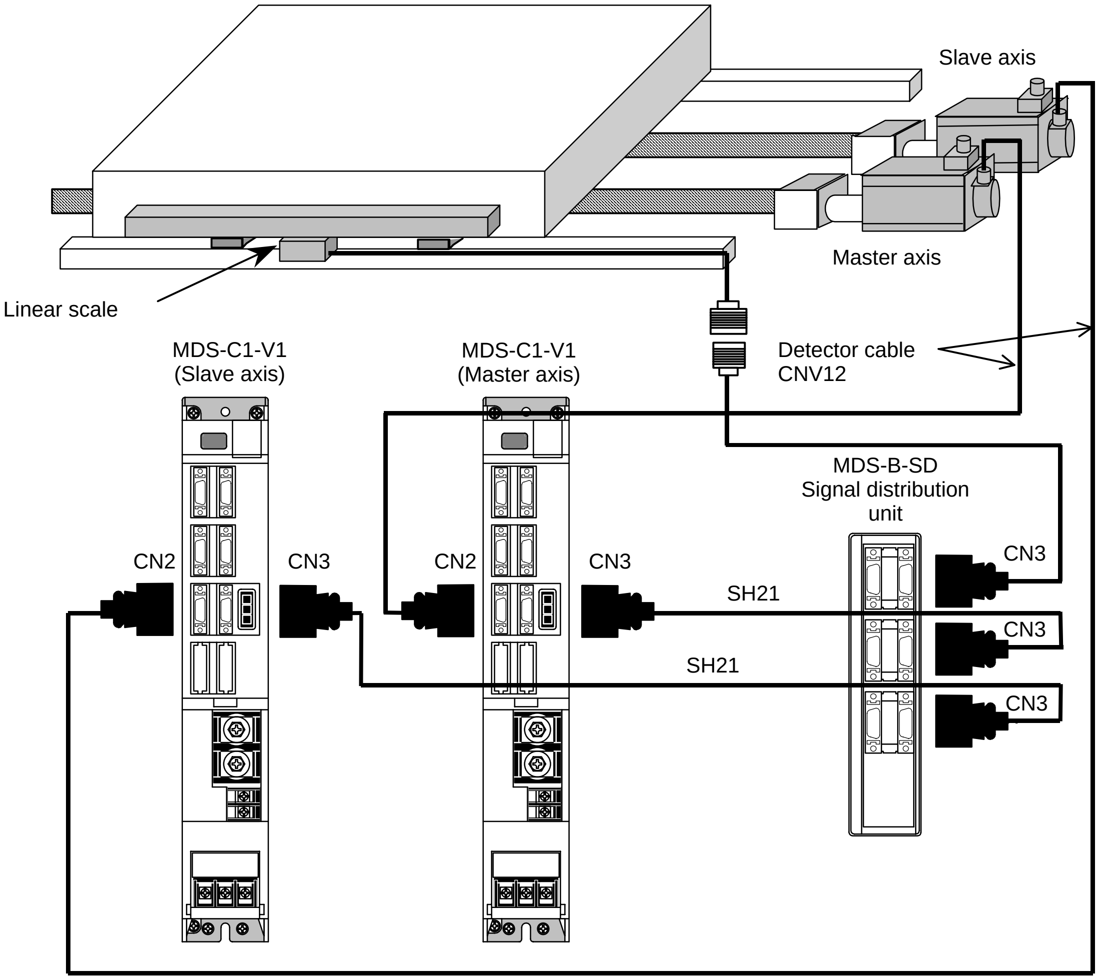
(2) Connection for semi-closed synchronous control (when using MDS-C1-V2 drive unit)



Parameter settings

<table>
<tr><th>No.</th><th>Abbrev.</th><th>Parameter name</th><th colspan="4">Description</th></tr>
<tr><td rowspan="5">SV025</td><td rowspan="5">MTYP</td><td rowspan="5">Motor/detector type</td><td colspan="4">Set the detector type. The value determined for each motor type is input to “xx” in the following table.</td></tr>
<tr><td rowspan="2"></td><td colspan="3">Motor end detector type</td></tr>
<tr><td>OSE104</td><td>OSA104</td><td>OSE105/OSA105</td></tr>
<tr><td>Speed command synchronous control</td><td>Master axis =00xx
Slave axis =C0xx</td><td>Master axis =11xx
Slave axis =C1xx</td><td>Master axis =22xx
Slave axis =C2xx</td></tr>
<tr><td>Current command synchronous control</td><td>Master axis =00xx
Slave axis =CCxx</td><td>Master axis =11xx
Slave axis =CCxx</td><td>Master axis =22xx
Slave axis =CCxx</td></tr>
</table>

(3) Connection for full-closed synchronous control (when using MDS-C1-V1 drive unit and serial output linear scale)



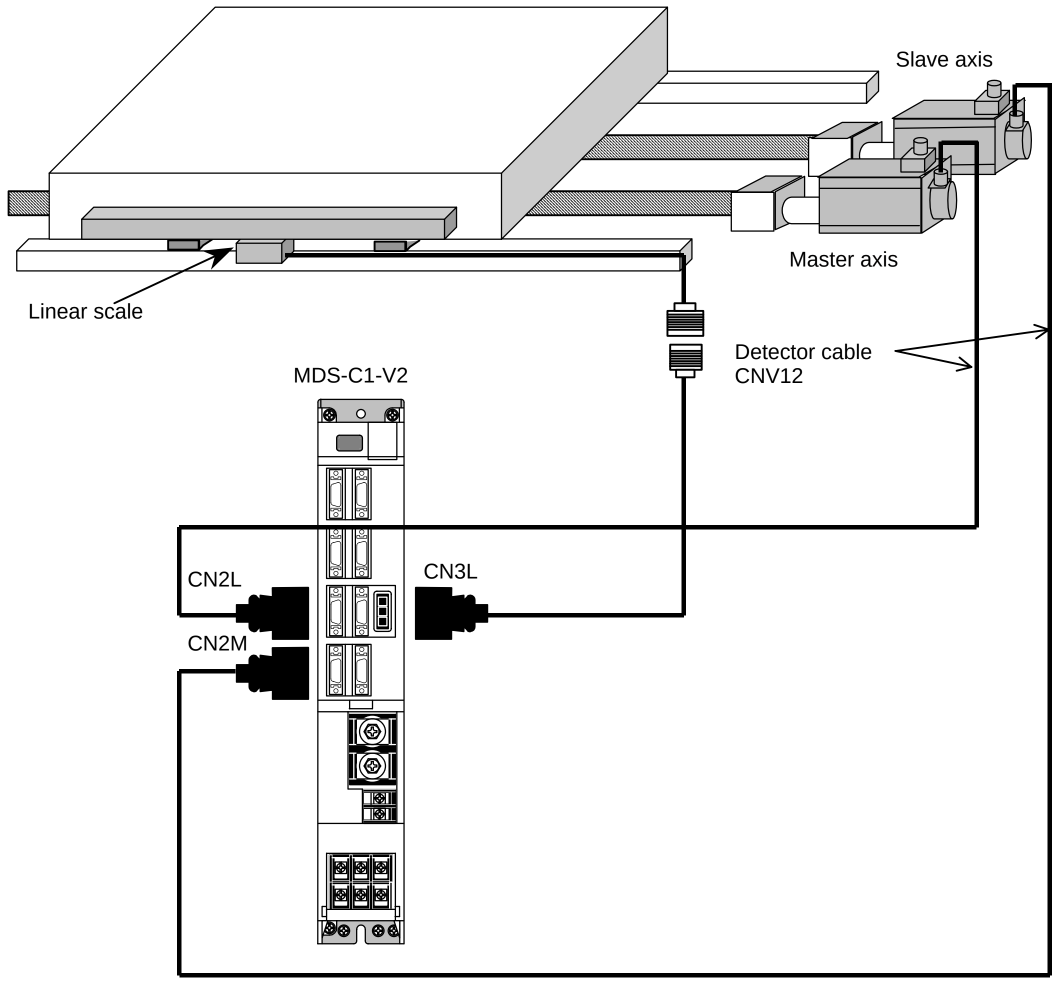
Parameter settings

<table>
<tr><th>No.</th><th>Abbrev.</th><th>Parameter name</th><th>Description</th></tr>
<tr><td>SV025</td><td>MTYP</td><td>Motor/detector type</td><td>Set the detector type. The value determined for each motor type is input to “xx” in the following table.
<table>
<tr><th rowspan="2"></th><th colspan="3">Motor end detector type</th></tr>
<tr><th>OSE104/OSE105</th><th>OSA104</th><th>OSA105</th></tr>
<tr><td>Speed command synchronous control</td><td>Not compatible</td><td>Master axis =A1xx
Slave axis =D1xx</td><td>Master axis =A2xx
Slave axis =D2xx</td></tr>
<tr><td>Current command synchronous control</td><td colspan="3">Not compatible</td></tr>
</table>
</td></tr>
</table>

(Note1) A system in which two MDS-C1-V1 unit are used is not compatible with incremental system.

(Note2) The full-closed system in which two MDS-C1-V1 units are used is not compatible with current command synchronous control.

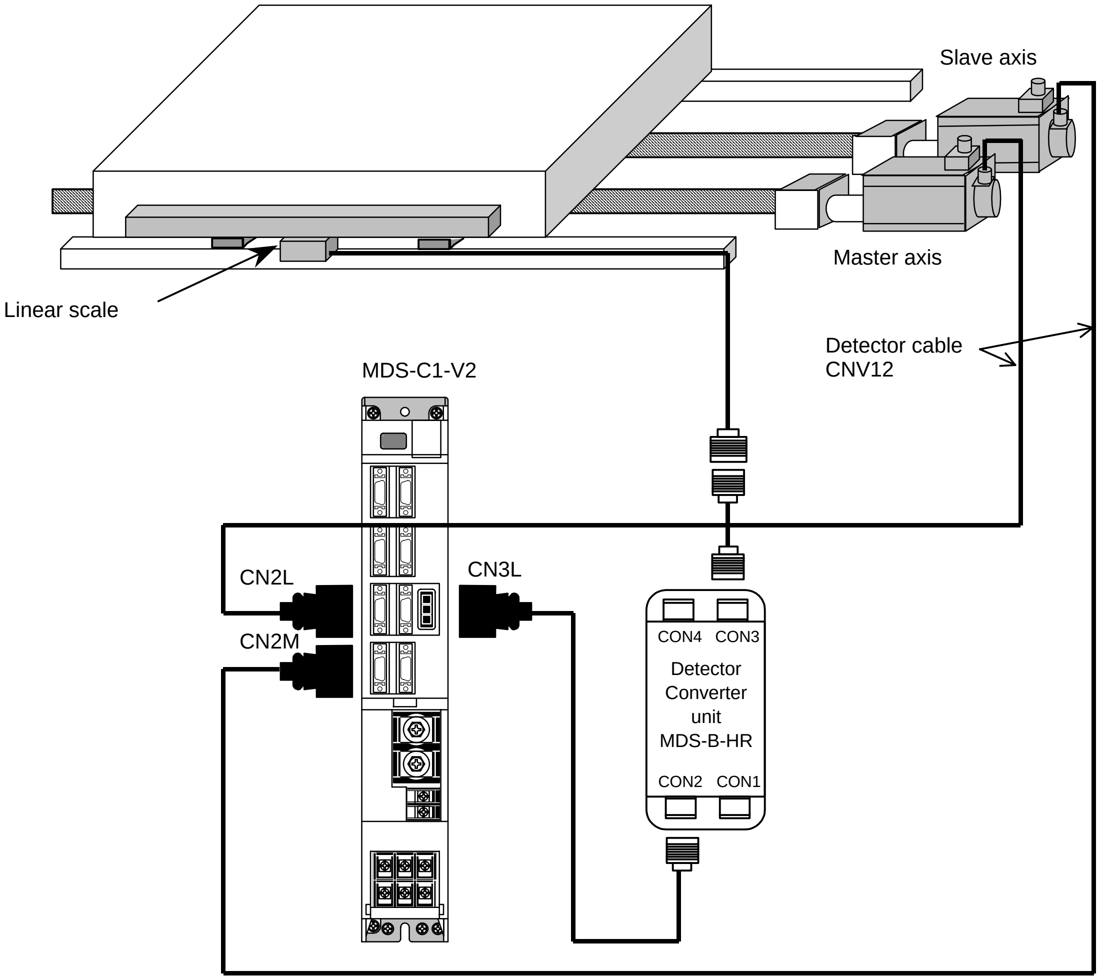
(4-1) Connection for full-closed synchronous control (when using MDS-C1-V2 drive unit and serial output linear scale)



Parameter settings

<table>
<tr><th>No.</th><th>Abbrev.</th><th>Parameter name</th><th colspan="4">Description</th></tr>
<tr><td rowspan="5">SV025</td><td rowspan="5">MTYP</td><td rowspan="5">Motor/detector type</td><td colspan="4">Set the detector type. The value determined for each motor type is input to "xx" in the following table.</td></tr>
<tr><td rowspan="2"></td><td colspan="3">Motor end detector type</td></tr>
<tr><td>OSE104</td><td>OSA104</td><td>OSE105/OSA105</td></tr>
<tr><td>Speed command synchronous control</td><td>Master axis =A0xx
Slave axis =D0xx</td><td>Master axis =A1xx
Slave axis =D1xx</td><td>Master axis =A2xx
Slave axis =D2xx</td></tr>
<tr><td>Current command synchronous control</td><td>Master axis =A0xx
Slave axis =DExx</td><td>Master axis =A1xx
Slave axis =DExx</td><td>Master axis =A2xx
Slave axis =DExx</td></tr>
</table>

(4-2) Connection for full-closed synchronous control (when using MDS-C1-V2 drive unit and analog output linear scale)



Parameter settings

<table>
<tr><th>No.</th><th>Abbrev.</th><th>Parameter name</th><th>Description</th></tr>
<tr><td>SV025</td><td>MTYP</td><td>Motor/detector type</td><td>Set the detector type. The value determined for each motor type is input to “xx” in the following table.
<table>
<tr><th rowspan="2"></th><th colspan="3">Motor end detector type</th></tr>
<tr><th>OSE104</th><th>OSA104/OSA105</th><th>OSE105</th></tr>
<tr><td>Speed command synchronous control</td><td>Master axis =A0xx
Slave axis =D0xx</td><td>Not compatible</td><td>Master axis =A2xx
Slave axis =D2xx</td></tr>
<tr><td>Current command synchronous control</td><td>Master axis =A0xx
Slave axis =DExx</td><td>Not compatible</td><td>Master axis =A2xx
Slave axis =DExx</td></tr>
</table></td></tr>
</table>

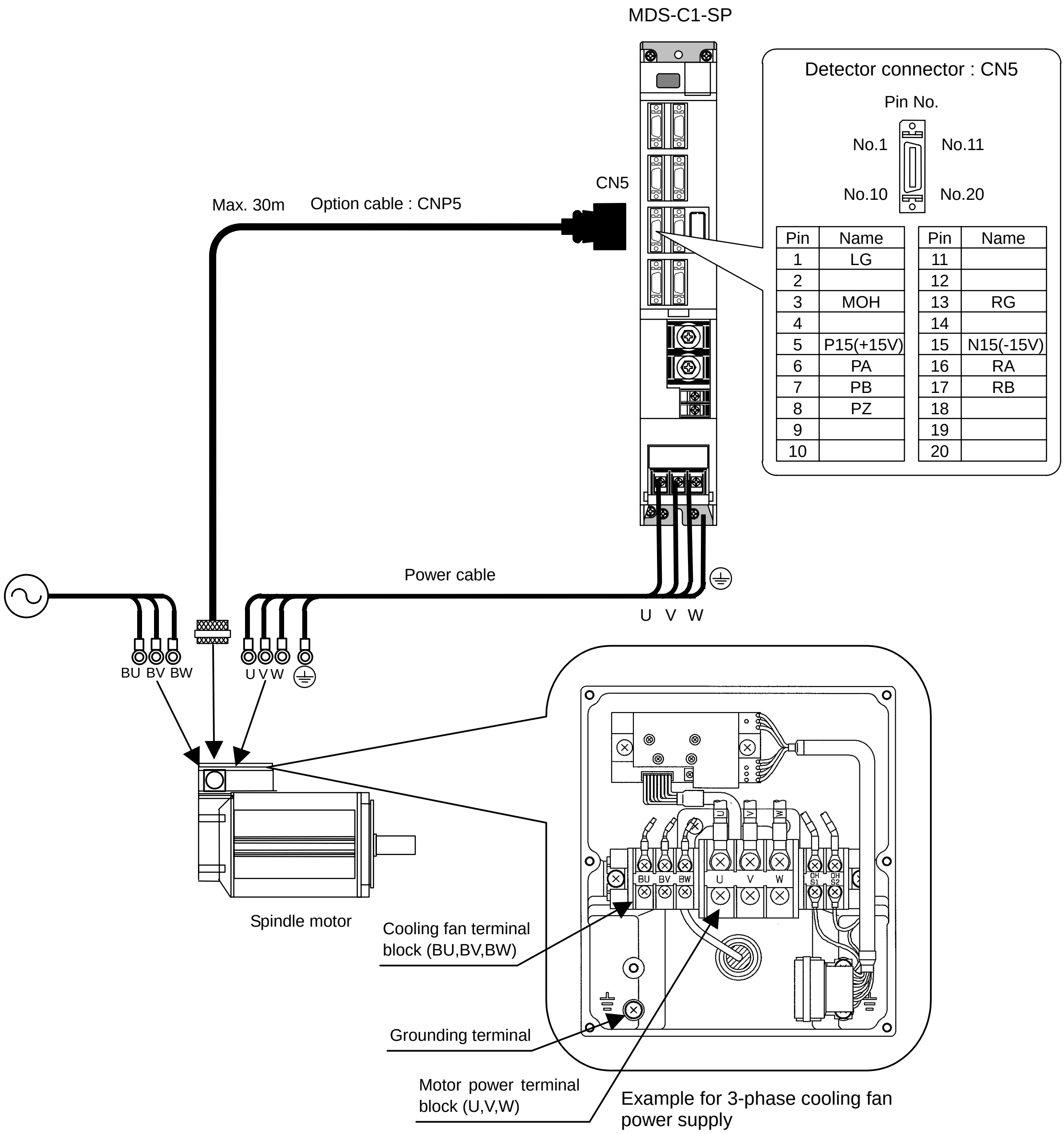
POINT

In a system in which MDS-B-HR is used, this connection is compatible only with incremental control.

2-4-4 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



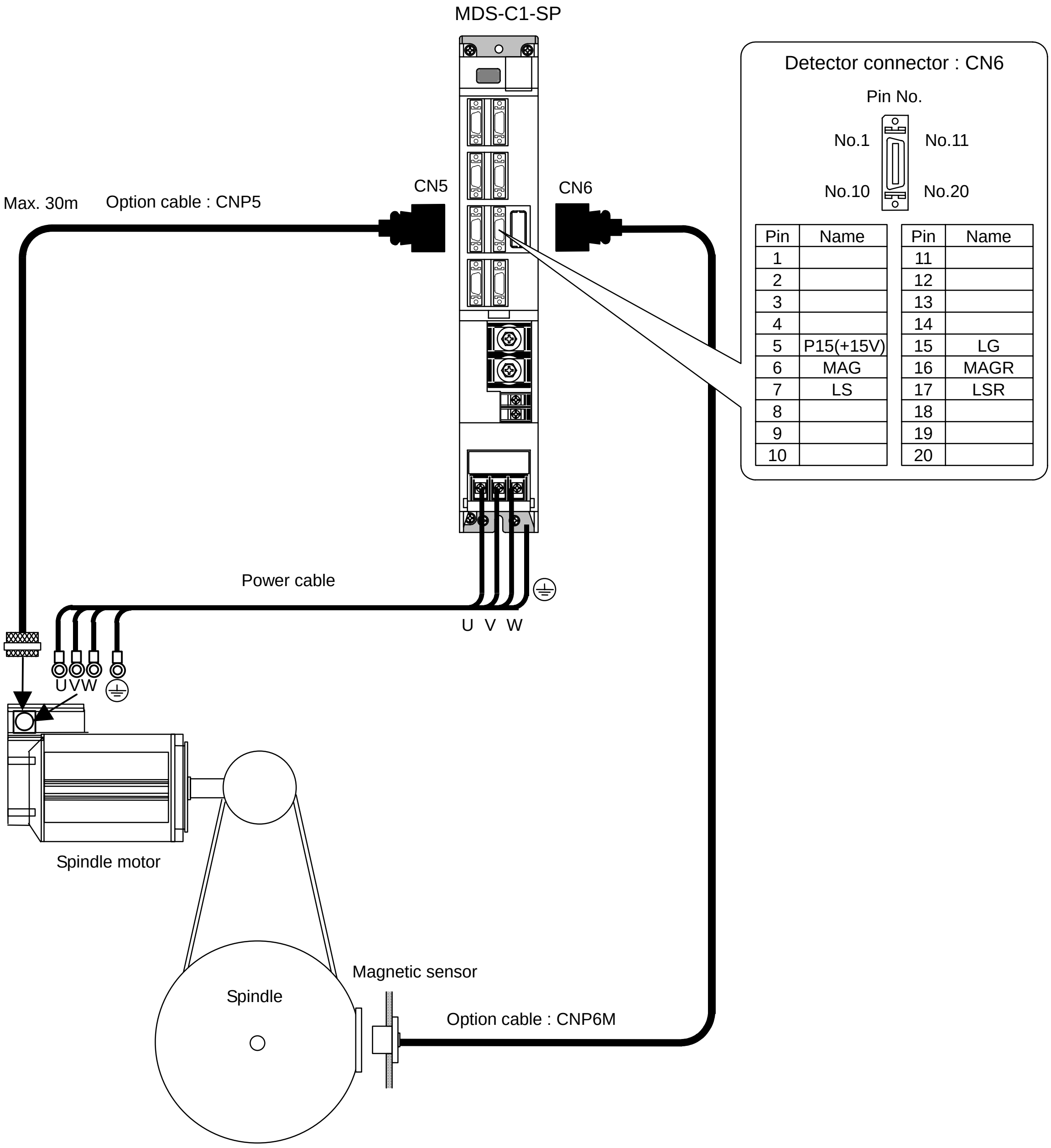
Pin	Name	Pin	Name
1	LG	11	
2		12	
3	MOH	13	RG
4		14	
5	P15(+15V)	15	N15(-15V)
6	PA	16	RA
7	PB	17	RB
8	PZ	18	
9		19	
10		20	

(Note) Either a single-phase or 3-phase power supply is used for the cooling fan. Refer to the Spindle Motor Specifications for details.

⚠ CAUTION	The shield of spindle detector cable is not FG. Do not ground.

(2) Connecting the magnetic sensor

Refer to section (1) for connection with the spindle motor.

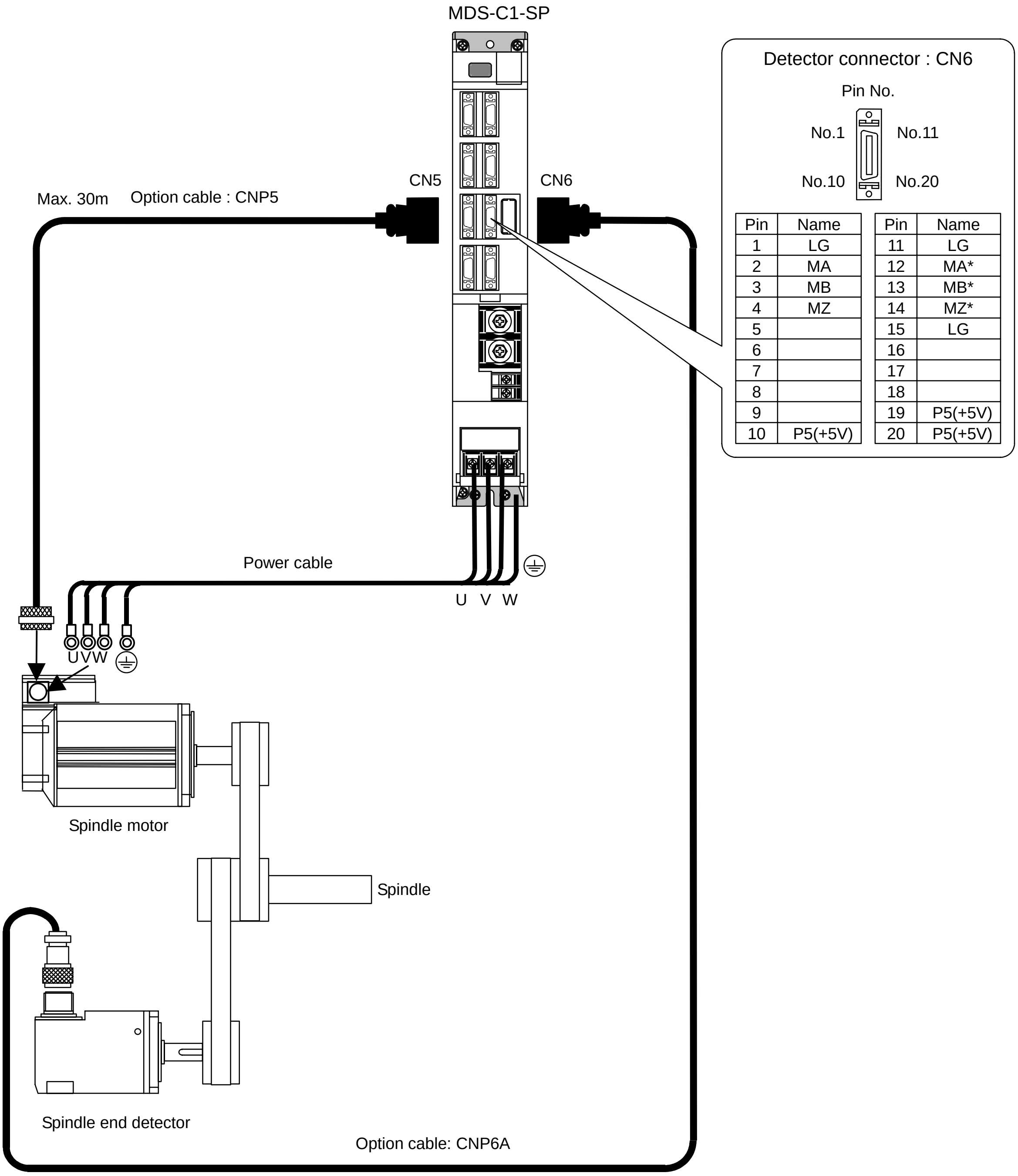


Pin	Name	Pin	Name
1		11	
2		12	
3		13	
4		14	
5	P15(+15V)	15	LG
6	MAG	16	MAGR
7	LS	17	LSR
8		18	
9		19	
10		20	

⚠ CAUTION The shield of spindle detector cable is not FG. Do not ground.

(3) Connecting the spindle end detector

Refer to section (1) for connection with the spindle motor.

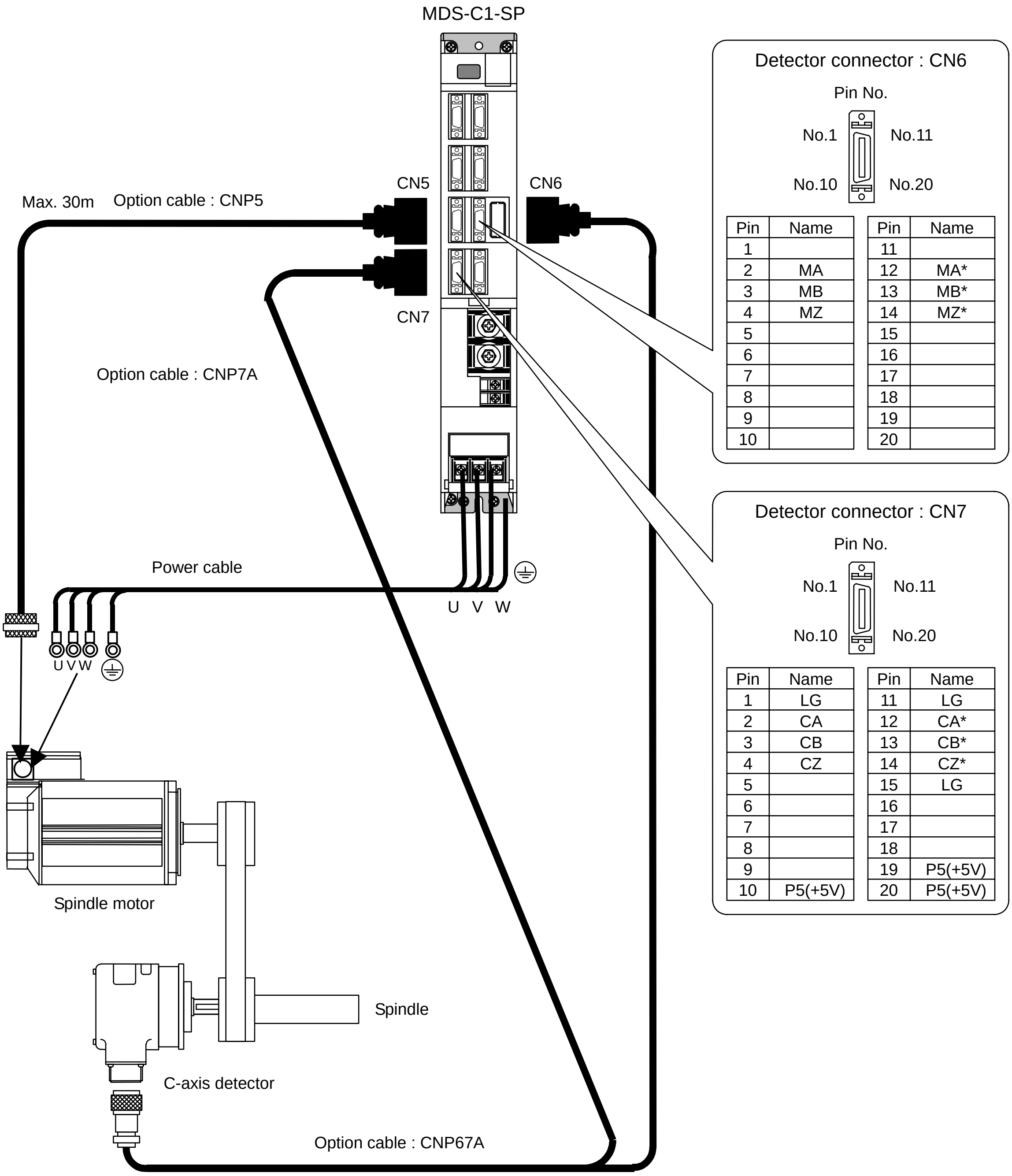


Pin	Name	Pin	Name
1	LG	11	LG
2	MA	12	MA*
3	MB	13	MB*
4	MZ	14	MZ*
5		15	LG
6		16	
7		17	
8		18	
9		19	P5(+5V)
10	P5(+5V)	20	P5(+5V)

⚠ CAUTION The shield of spindle detector cable is not FG. Do not ground.

(4) Connecting the for C-axis detector

Refer to section (1) for connection with the spindle motor.



Detector connector : CN6

Pin	Name	Pin	Name
1		11	
2	MA	12	MA*
3	MB	13	MB*
4	MZ	14	MZ*
5		15	
6		16	
7		17	
8		18	
9		19	
10		20	

Detector connector : CN7

Pin	Name	Pin	Name
1	LG	11	LG
2	CA	12	CA*
3	CB	13	CB*
4	CZ	14	CZ*
5		15	LG
6		16	
7		17	
8		18	
9		19	P5(+5V)
10	P5(+5V)	20	P5(+5V)

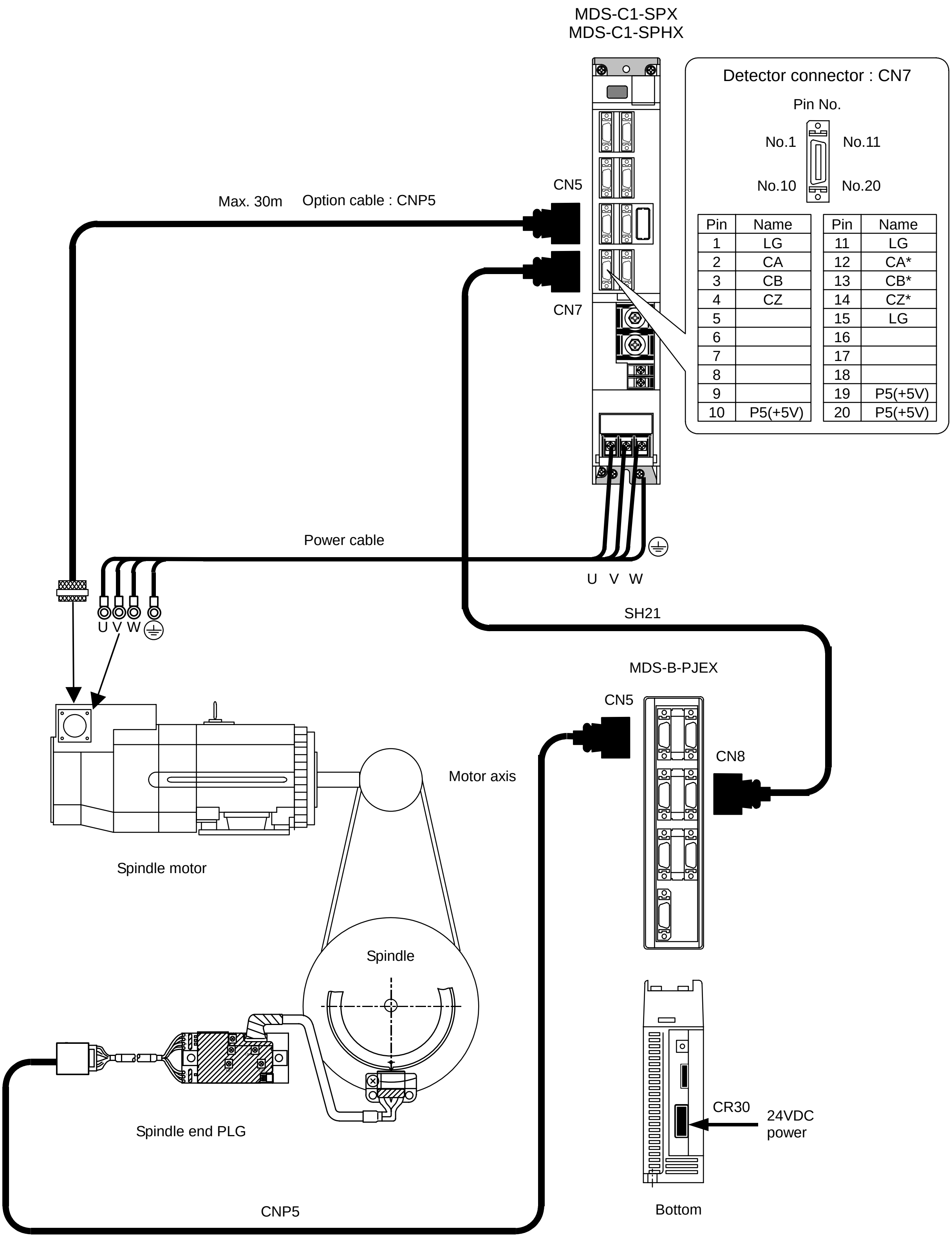
Supplement

1. The C-axis control function is connected to the CN7 connector.
2. When using both the C-axis control function and orientation function, two cables (two-wire cable) are connected from the detector.
3. The orientation signal connected to CN5 or CN6 can be connected to the NC with the differential output from the CN8 connector.

⚠ **CAUTION**	The shield of spindle detector cable is not FG. Do not ground.

(5) Connecting the simple C-axis control

Refer to section (1) for connection with the spindle motor.



Pin	Name	Pin	Name
1	LG	11	LG
2	CA	12	CA*
3	CB	13	CB*
4	CZ	14	CZ*
5		15	LG
6		16	
7		17	
8		18	
9		19	P5(+5V)
10	P5(+5V)	20	P5(+5V)

⚠ CAUTION The shield of spindle detector cable is not FG. Do not ground.

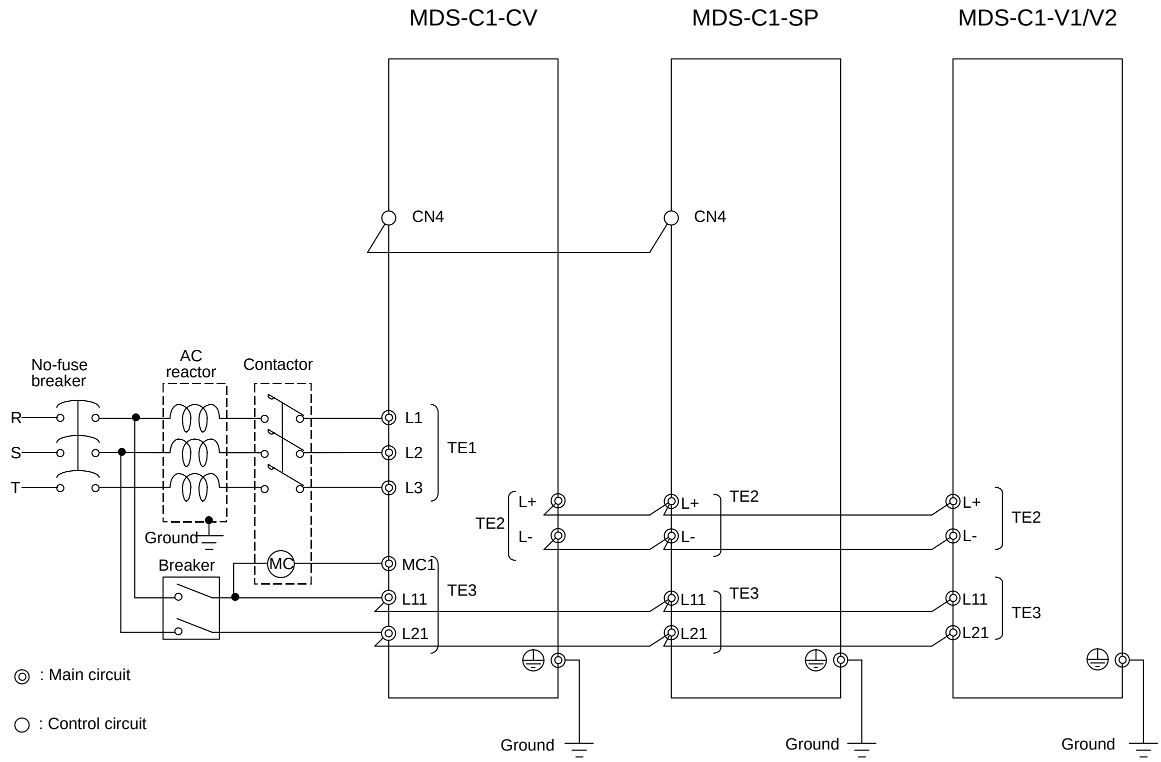
2-5 Connection of power supply

⚠ CAUTION	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 No-fuse breaker (NFB), 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. 5. A semiconductor element is used in the power supply unit's magnetic contact drive circuit, and a surge absorber is installed to protect the element. Therefore, a leakage current of approx. 15mA is passed. Confirm that the exciting coil in the magnetic contact will not function at 15mA or less.

2-5-1 Power supply input connection

(1) **When using one power supply unit**

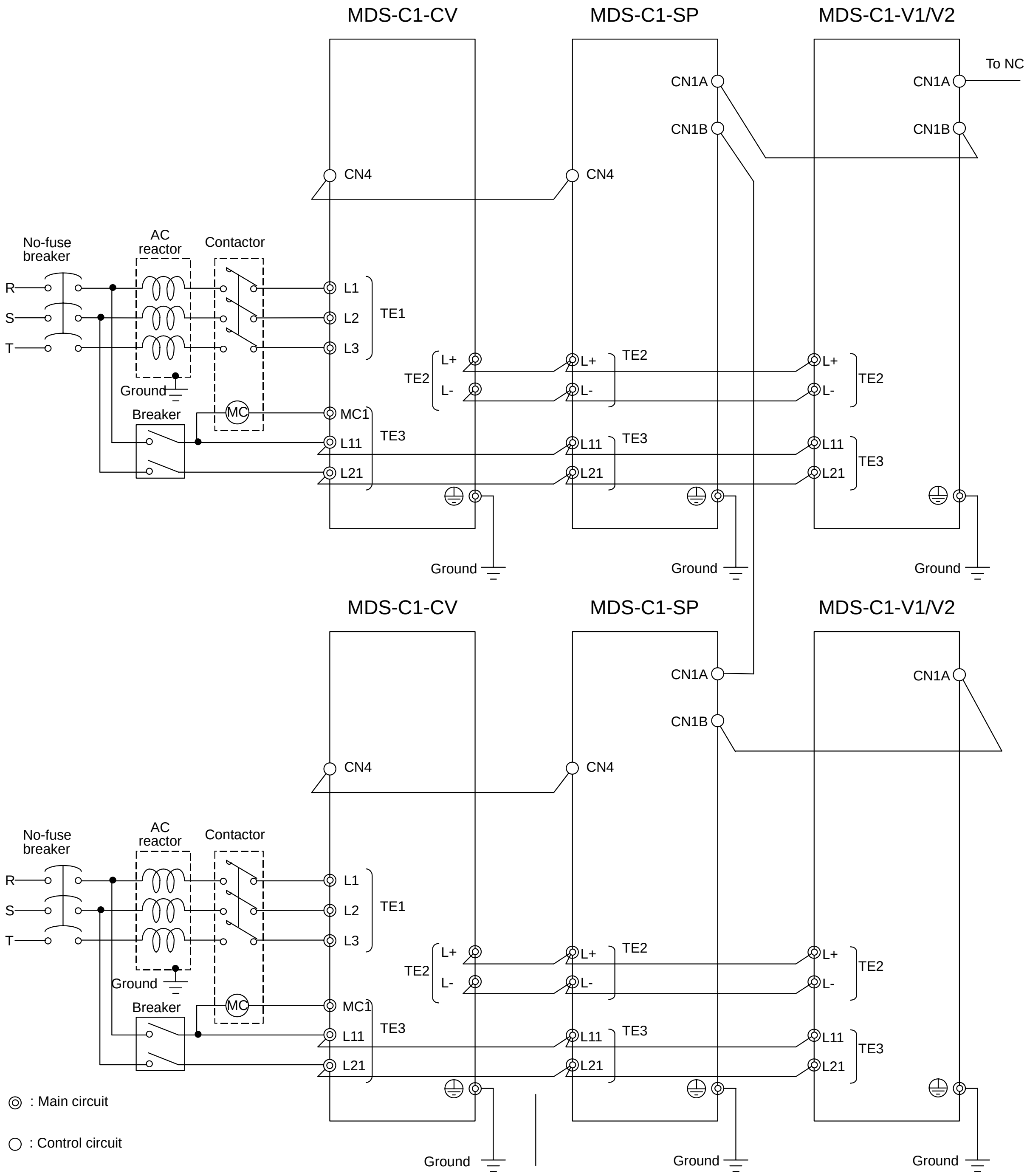
Install the drive unit so that the DC power supply bus (L+, L-) is as near to the power supply unit as possible. Large-capacity spindle drive units, in particular, should be installed adjacent to the power supply unit which they control.



⚠ **CAUTION**	1. The power supply unit is a power supply regenerative type converter; an AC reactor is surely installed in the power supply line. 2. When connecting to the TE3 terminal, connect to the power supply side (primary side) of the AC reactor. 3. Connect the power supply unit's CN4 connector with the spindle drive unit of the maximum capacity. If there is no spindle drive unit, connect to the servo drive unit which is the unbalance axis. 4. When installing the units dispersed install the spindle drive unit adjacent to the power supply unit, and connections for other drive units should be such that the total TE2 wiring length is 50cm or less.

(2) When using two or more power supply units within a single NC communication bus system

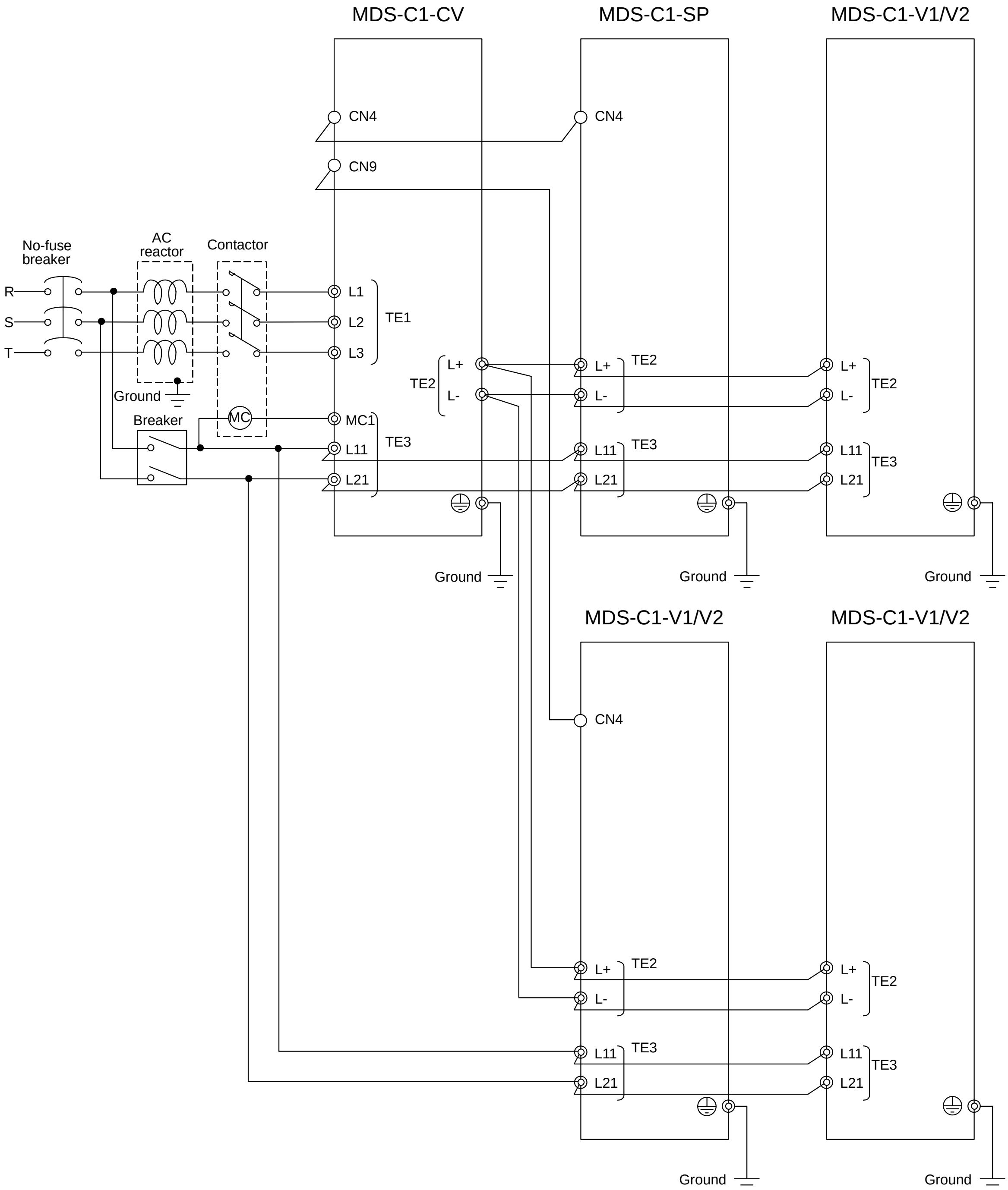
Install a no-fuse breaker and a contactor for each of the power supply units.



⚠ **CAUTION**	1. An AC reactor and breaker are required for each power supply unit. 2. When installing the units dispersed install the spindle drive unit adjacent to the power supply unit, and connections for other drive units should be such that the total TE2 wiring length is 50cm or less.

(3) When using one power supply shared by two NC communication bus systems

The axis connected to the power supply unit's CN4 connector becomes the power supply unit control axis.



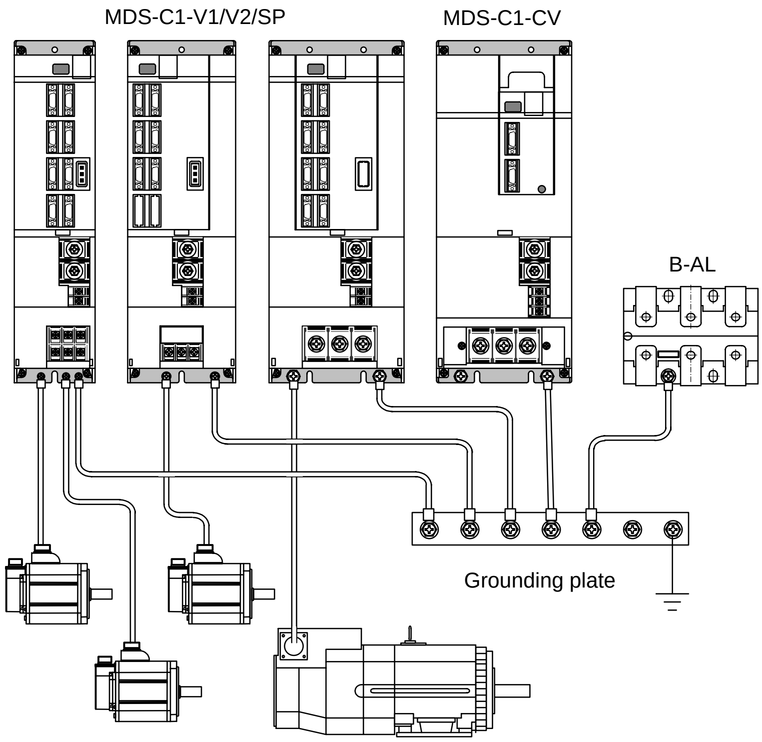
⚠ **CAUTION**	1. If the two NC communication bus systems include a spindle drive unit, connect the power supply unit's CN4 connector to the CN4 connector of the largest-capacity spindle drive unit. If there is no spindle drive unit, connect to the unbalance-axis servo drive unit. 2. Install the spindle drive unit adjacent to the power supply unit, and connections for other drive units should be such that the total TE2 wiring length is 50cm or less.

2-5-2 Connecting the grounding cable

(1) Connecting the protective grounding (PE) and frame ground (FG)

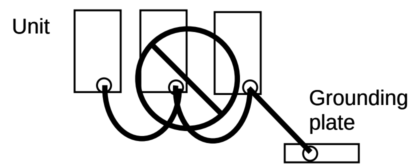
Each unit has a terminal or mounting hole to connect PE (⏚) or FG.
Please connect an earth wire to the main ground of a cabinet or a machine frame at one point.
Ground each device according to the grounding conditions set forth by each country. (Typically, a Y-connection neutral point ground is used in Europe.)

PE: Grounding to provide protection from electric shock, etc.
FG: Grounding to stabilize the operation of the devices, etc. (Suppress noise)



POINT

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

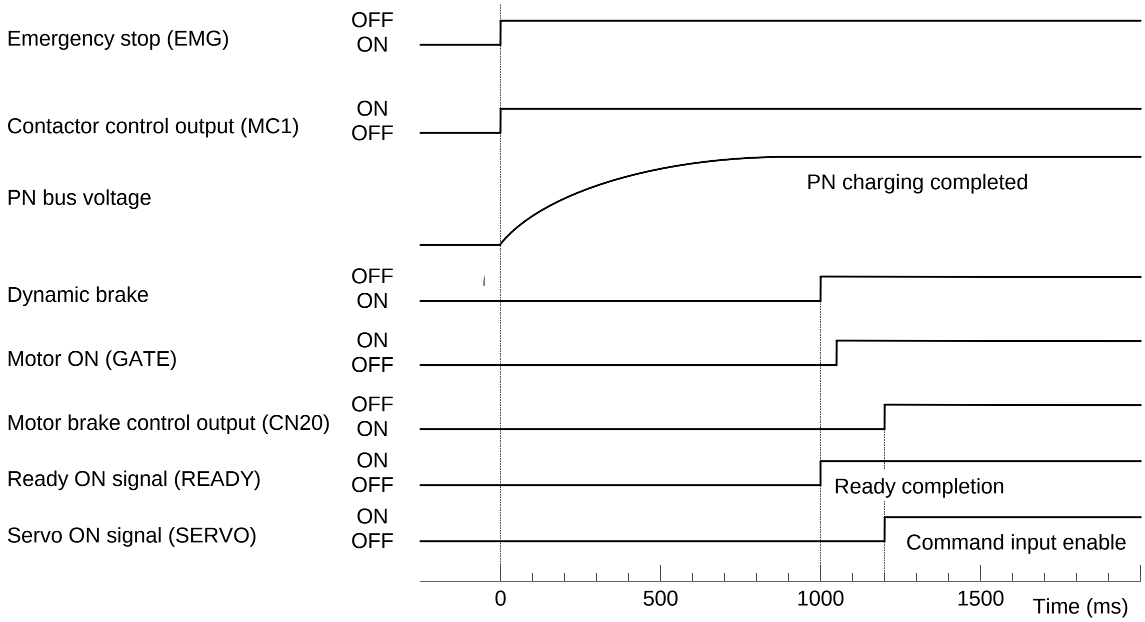
Earth wire size should follow the following table.

Type	Grounding cable size (Required grounding)
MDS-C1-CV Unit	Larger than thickness of wire connected to TE1 (L1/L2/L3). (PE)
MDS-C1-V1/V2/SP[] Unit	Larger than thickness of wire connected to TE1 (U/V/W). (PE)
B-AL (AC Reactor)	5.5 mm^2 (AWG10) or more (FG)

2-5-3 Main circuit control

(1) Contactor ON sequence

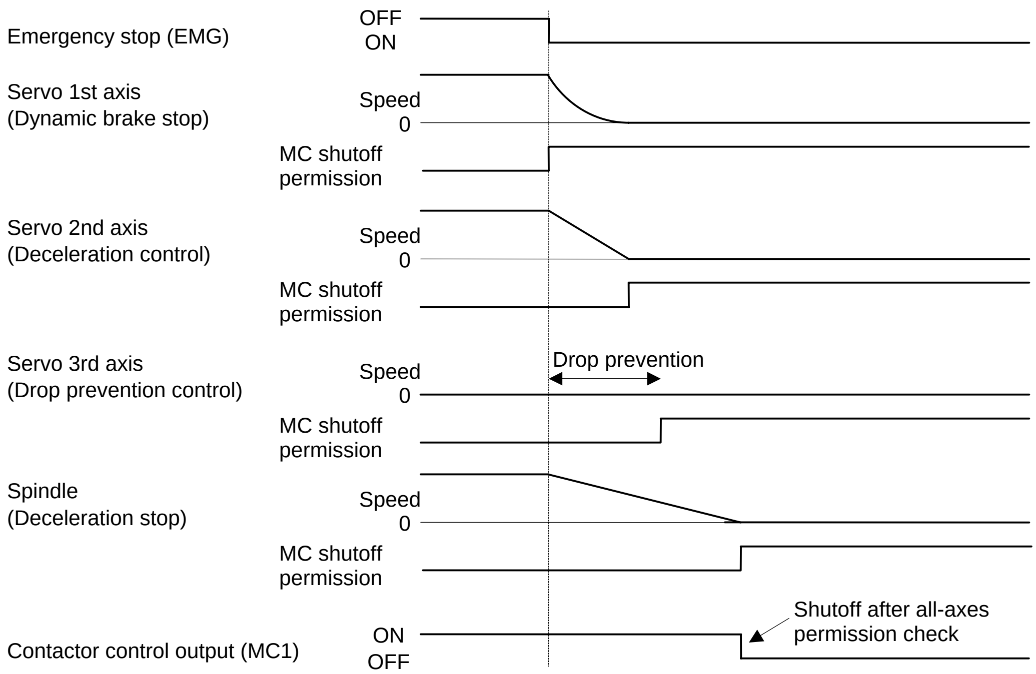
Main circuit power is turned ON in the sequence shown below when an emergency stop status is canceled.



Contactor ON sequence

(2) Contactor shutoff sequence

When an emergency stop occurs, the NC checks the MC shutoff permission (motor stop or dynamic brake operation) status for all axes and then shuts off the contactors. If there is no MC shutoff permission output, the contactors are forced off 30 seconds later by their control units. Contactors are shut off immediately if an alarm occurs.



Contactor shutoff sequence

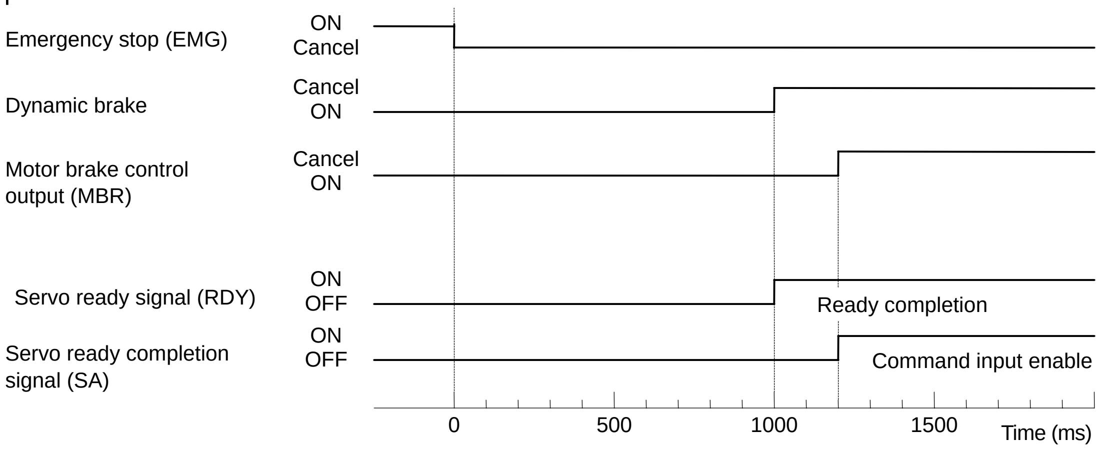
2-6 Wiring of the motor brake

2-6-1 Wiring of the motor magnetic brake

The magnetic brake of servomotors with a magnetic brake is controlled by the motor brake control connector (CN20) 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 release sequence

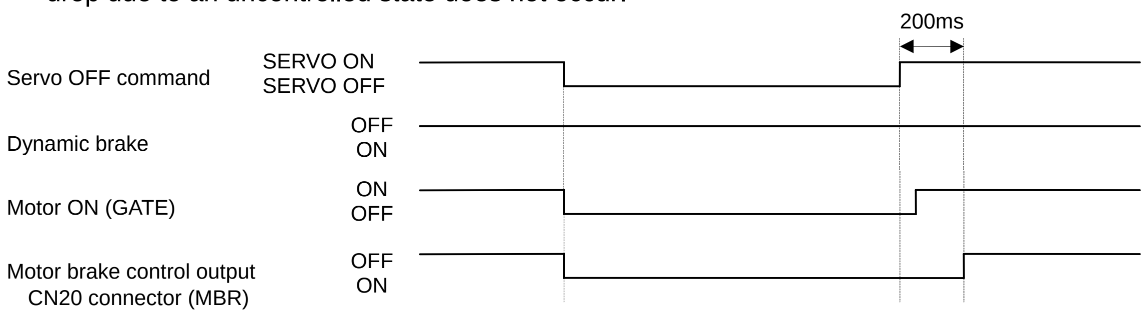
The motor brake control output (CN20: MBR) releases the magnetic brake in the sequences in the following drawing when canceling the emergency stop. The brake is released after the start of the power ON to the servomotor.



Motor brake control sequences when an emergency stop is canceled

(2) 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.



Motor brake control sequences when a servo OFF command is output

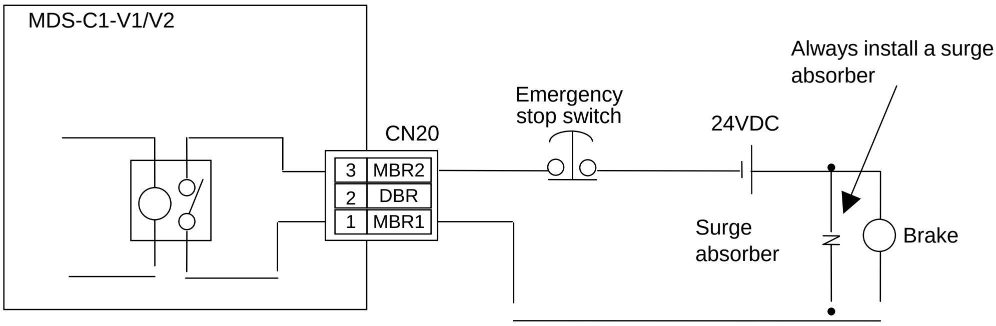
⚠ CAUTION	1. The vertical axis drop prevention control only is performed during an emergency stop (including alarms and power failures). It is not performed when a servo OFF command is input. 2. A servo OFF command is required at both axes in order to perform a motor brake control output (MBR) at 2-axis drive unit.

(3) 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 "4-5 Setting for emergency stop" for details on the operation sequences for each stop method.

(4) Motor brake control connector (CN20) output circuit

As shown in the illustration below, an external power supply circuit is controlled by the CN20 connector output. Dynamic brake unit is controlled simultaneously for large-capacity drive unit (MDS-C1-V1-110/150). Refer to "2-6-2 Dynamic brake unit wiring" for details.



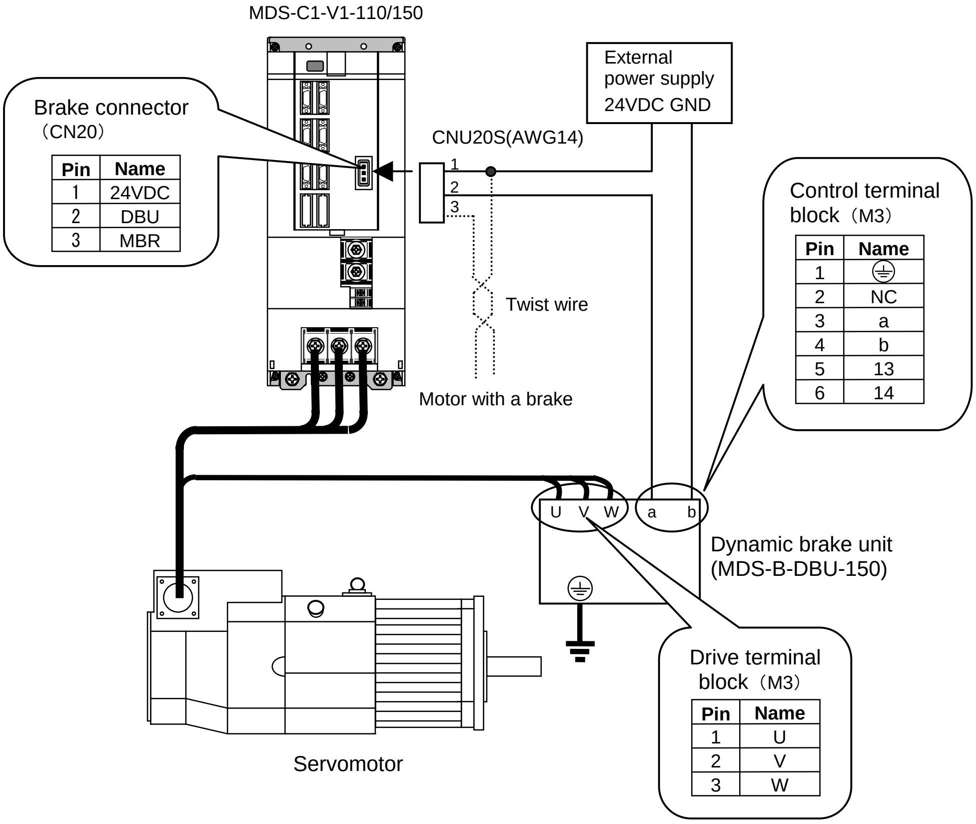
（Unit internal relay specification: 5A 30Vdc/8A 250Vac）

⚠ **CAUTION**	1. Always install a surge absorber near the motor's brake terminal to eliminate noise and protect the contacts. 2. The brakes cannot be released just by connecting the CN20 and motor brake terminal. 24VDC must be supplied.

POINT	To ensure safety in an emergency, make sure that the magnetic brakes are applied in sequence with the emergency stop switch.

2-6-2 Dynamic brake unit wiring

The 11kW and larger servo drive unit does not have built-in dynamic brakes. Always install a dynamic brake unit.
The 9kW and smaller servo drive unit has built-in dynamic brakes.



⚠ CAUTION	Correct wire the dynamic brake unit to the servo drive unit. Do not use for applications other than emergencies (normal braking, etc.). The internal resistor could heat up, and lead to fires or faults.

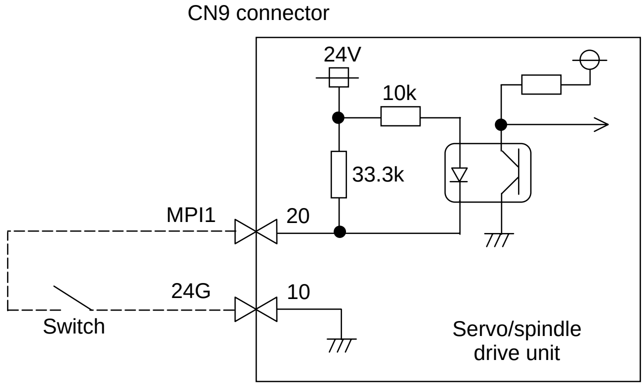
POINT	When you use a servomotor with a brake, please wire (between 1pin and 3pin) of CN20 connector.

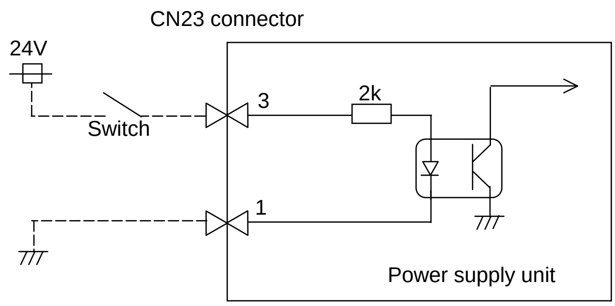
2-7 Peripheral control wiring

2-7-1 Input/output circuit wiring

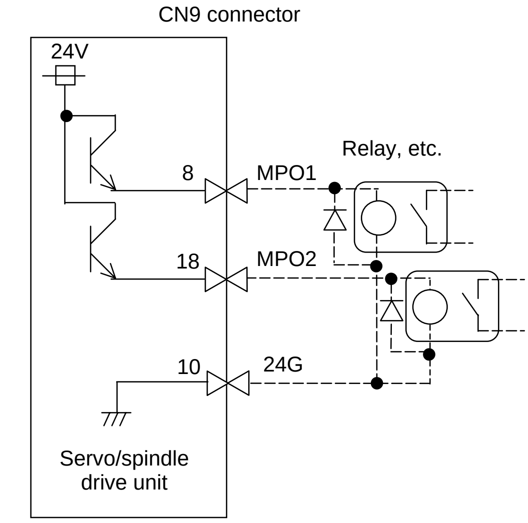
The input/output circuit to control the external signal such as external emergency stop input and relay changeover signal output is wired.
The input/output circuit for each unit is as follows.

Input circuit





Output circuit



The part indicated by the "– – – –" must be prepared by the user.

	Input condition
Switch ON	18VDC to 25.2VDC 9mA or more
Switch OFF	4VDC or less 2mA or less

	Output condition
Output voltage	24VDC ±5%
Tolerable output current Io	50mA or less

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

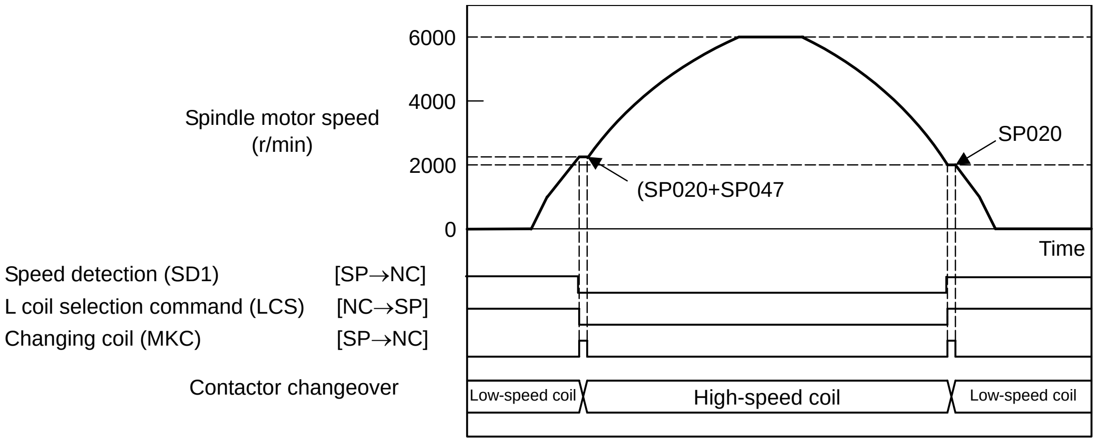
Interface name	Selection example
For digital input signal (CN23,CN9)	Use a minute signal switch which is stably contacted and operated even with low voltage or current <Example> OMRON: G2A, G6B type, MY type, LY type
For digital output signal (CN9)	Use a compact relay operated with rating of 24VDC, 50mA or less. <Example> OMROM: G6B type, MY type

2-7-2 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 or three types (only for MDS-C1-SPM) 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 SP020. 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 SP047 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

No.	Abbrev.	Parameter name	Description	Setting range	Standard value
SP020	SDTS*	Speed detection set value	Set the motor speed of which speed detection 1 output is performed. Usually, the setting value is 10% of SP017 (TSP).	0 to 32767 (r/min)	600
SP047	SDTR*	Speed detection reset value	Set the reset hysteresis width for a speed detection set value defined in SP020 (SDTS).	0 to 1000 (r/min)	30

(2) Protective functions

[1] Base 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 base is shut off during contactor operation time in order to protect the spindle drive unit's main circuit. The base shutoff time is determined by the "Winding changeover base shutoff timer" (SP059) setting. The standard time setting should be used, as a shorter time can cause contactor burn damage.

(Refer to 5-2-2 (4) "Spindle control output 4" Coil changing (bit 6) for details.)

No.	Abbrev.	Parameter name	Description	Setting range	Standard value
SP059	MKT*	Winding changeover base shut-off timer	Set the base shut-off time for contactor switching at coil changeover. Note that the contactor may be damaged with burning if the value of this parameter is too small.	50 to 10000 (ms)	150

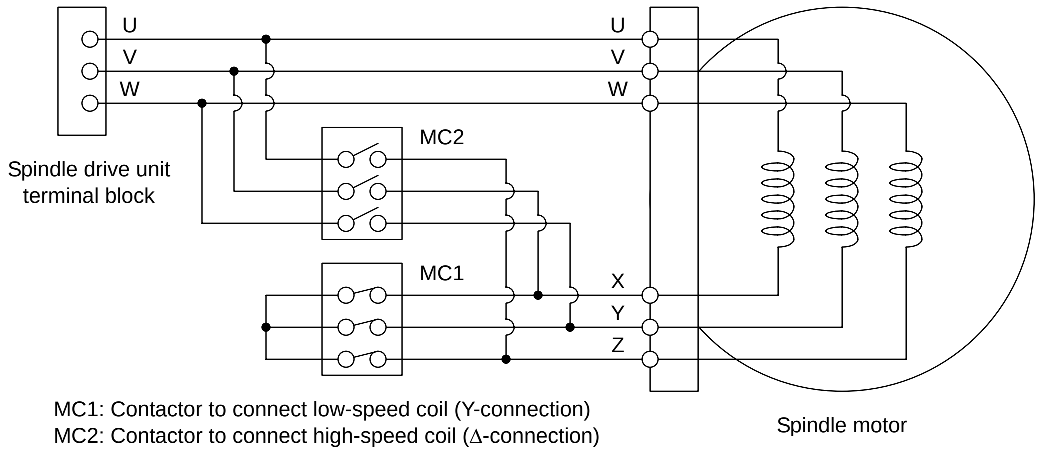
[2] Current limit after coil changeover

Following a coil changeover, the current is limited (SP061) for the period specified by the current limit timer (SV060) 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.

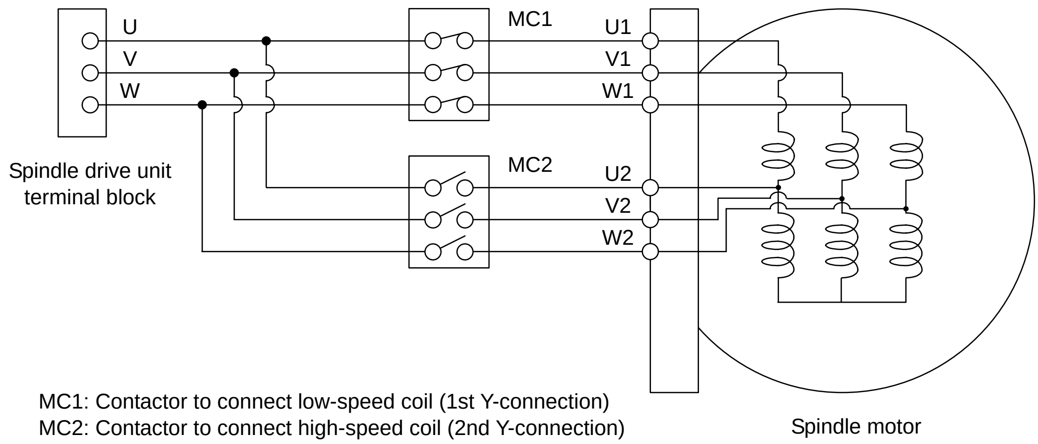
No.	Abbrev.	Parameter name	Description	Setting range	Standard value
SP060	MKT2*	Current limit timer after coil changeover	Set the current limit time to be taken after completion of contactor switching at coil changeover.	0 to 10000 (ms)	500
SP061	MKIL*	Current limit value after coil changeover	Set the current limit value during a period defined in SP060 (MKT2) after completion of contactor switching at coil changeover.	0 to 120 (%)	75

(3) Wiring

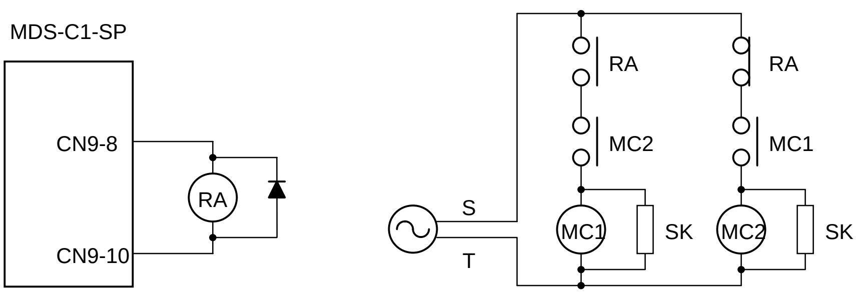
The illustration below shows the 2 types of changeover that occur after a coil changeover, (a) Y (star) – Δ (delta) changeover, and (b) Y (star) – Y (star) changeover. As shown in (c), one of the contactors (MC1 or MC2) is turned ON and the other is turned OFF at all of the coil changeover control circuits.



(a) Y (star) - Δ (delta) changeover circuit



(b) Y (star) - Y (star) changeover circuit



(c) Coil changeover control circuit (common)

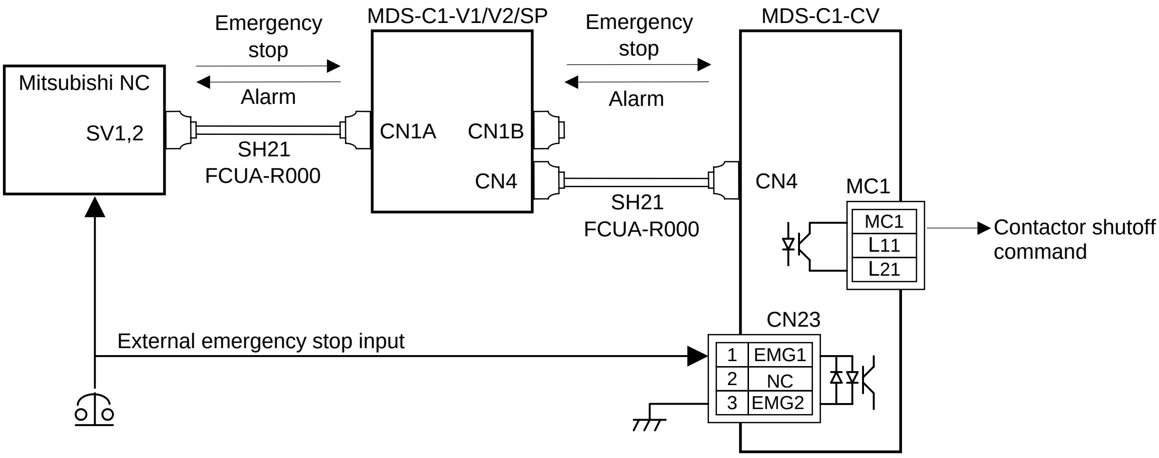
Coil changeover relay control circuit

2-7-3 Wiring of an external emergency stop

(1) External emergency stop setting

Besides the emergency stop input from the NC communication cable (CN1A, CN1B), double-protection when an emergency stop occurs can be provided by directly inputting an external emergency stop to the CN23 connector on the power supply 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 CN23 connector on the power supply unit.

[1] Connection



[2] Setting

When using the external emergency stop, the rotary switch on the front of the power supply unit and the parameter (PTYP) of drive unit that controls the power supply must be set.

- Rotary switch setting: 4
- Parameter setting: Add "0040" to the setting of PTYP (Servo=SV036, Spindle=SP041).

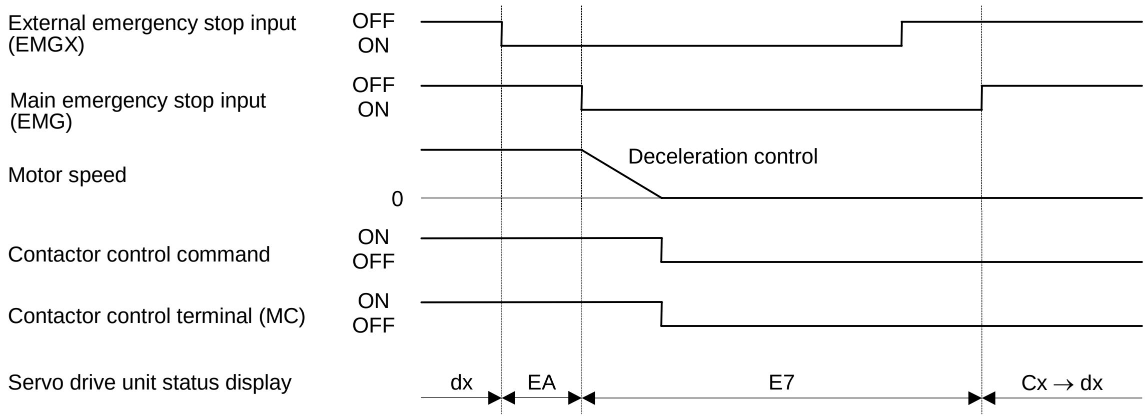
Parameter settings

No.	Abbrevia-tion	Parameter name	Descriptions
SV036 SP041	PTYP	Power supply type	When external emergency stop is validated, 0040 [hex] is added to PTYP for the drive unit connected to the power supply unit.

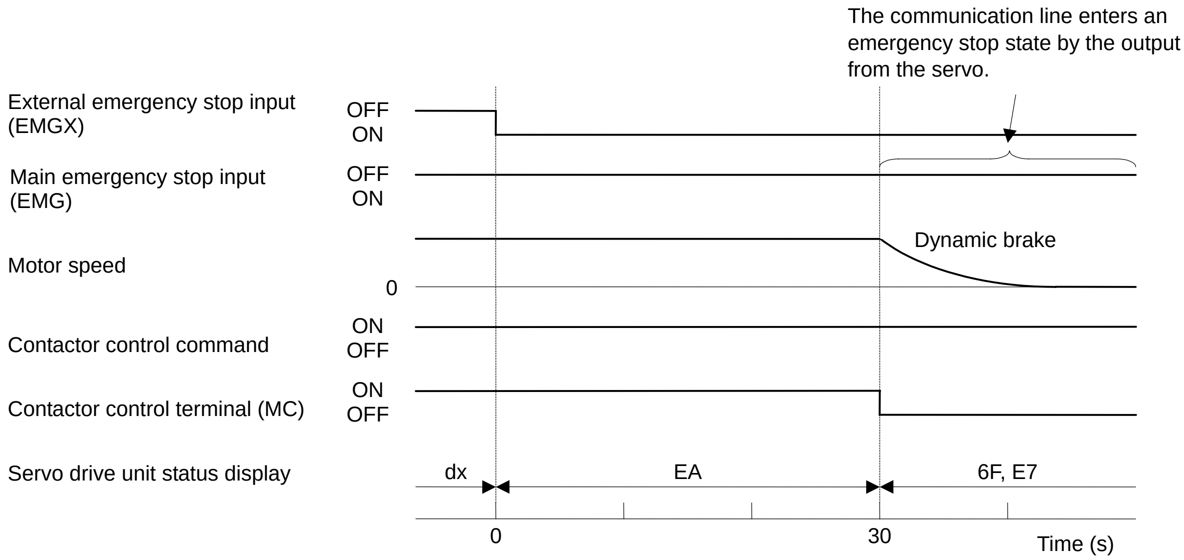
⚠ **CAUTION**	The emergency stop signal input to the CNC side cannot be used as a substitute for the external emergency stop function (CN23).

(2) Operation sequences of CN23 external emergency stop function

If only external emergency stop is input when external emergency stop valid is set in the parameters (the emergency stop is not input in NC), an "In external emergency stop" (warning EA) will be detected. At this time, the system itself does not enter an emergency stop status. (There will be no deceleration control or dynamic brake stop.)
If a contactor shutoff command is not issued from the NC within 30 seconds after the external emergency stop is input, the power supply unit outputs contactor shutoff signal (MC1), and then it shuts off the contactors, and a power supply error (alarm 6F) is detected simultaneously. If the emergency stop is input from NC within 30 seconds, the warning EA replaces the "In NC emergency stop" (warning E7). A normal emergency stop status will result if the contactor shutoff command from the NC are further input.
Ready ON is possible even if CN23, an external emergency stop has been input when the emergency stop is canceled, but an power supply error (alarm 6F) will occur after 30 seconds.



External emergency stop input sequences



When neither a main emergency stop nor contactor shutoff command is input

(3) Example of emergency stop circuit

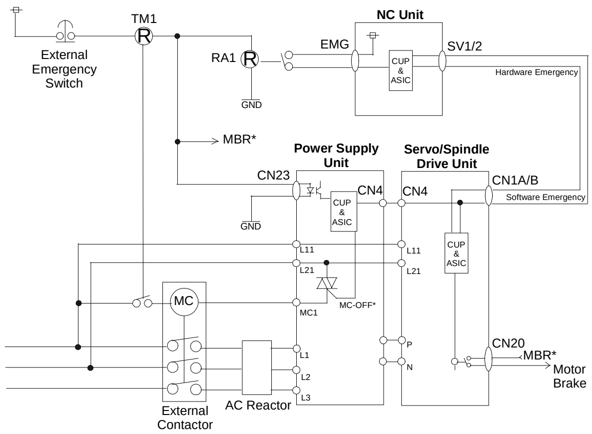
[1] Outline of function

The power supply unit's external emergency stop can be validated by wiring to the CN23 connector, and setting the parameters and rotary switch. If the emergency stop cannot be processed and the external contractor cannot be shut off (due to a fault) by the NC unit, the external contactor can be shut off by the power supply unit instead of the NC. At this time, the spindle motor will coast and the servomotor will stop with the dynamic brakes.
EN60204-1 Category 1 can be basically complied with by inputting the external emergency stop and installing contactor.

⚠ **CAUTION**	1. The power supply unit external emergency stop function is a function that assists the NC emergency stop. 2. It will take 30 seconds for the external contactor to function after the emergency stop is input to CN23. (This time is fixed.)

[2] Outline of function

The emergency stop is a signal used to stop the machine in an emergency. This is connected to the NC unit. Wire to the power supply unit when necessary.
The servo/spindle unit will be decelerated and controlled by the software according to the emergency stop command issued from the NC unit. (The deceleration control depends on a parameter setting.)
The diagram on the right shows an example of the emergency stop circuit (EN60204-1 Category 0 stop) in which an off delay timer (TM1) is installed as a power shutoff method independent from the NC emergency stop input. The required safety category may be high depending on the machine and the Safety Standards may not be met. Thus, always pay special attention when selecting the parts and designing the circuit.



[3] Setting the off delay timer (TM1) time

Set the TM1 operation time so that it functions after it has been confirmed that all axes have stopped. If the set time is too short, the spindle motor will coast to a stop.

$$tm \geq \text{All axes stop time}$$

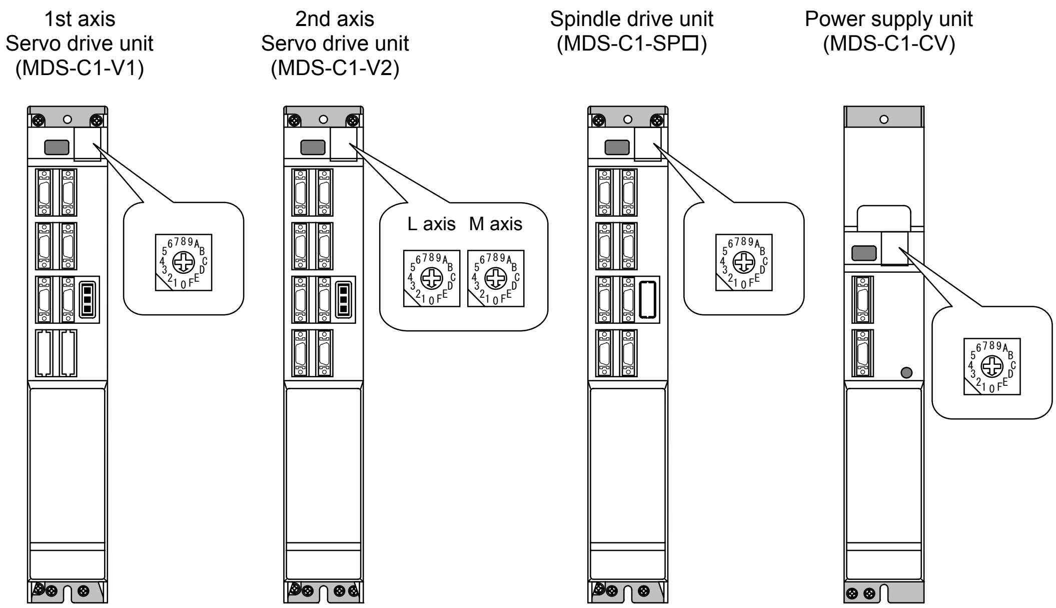
Provide a mechanism that shuts off the power even if the NC system fails.

POINT	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.

3-1 Initial setup

3-1-1 Setting the rotary switch

Before turning on the power, the axis No. must be set with the rotary switch. The rotary switch settings will be validated when the units are turned ON.



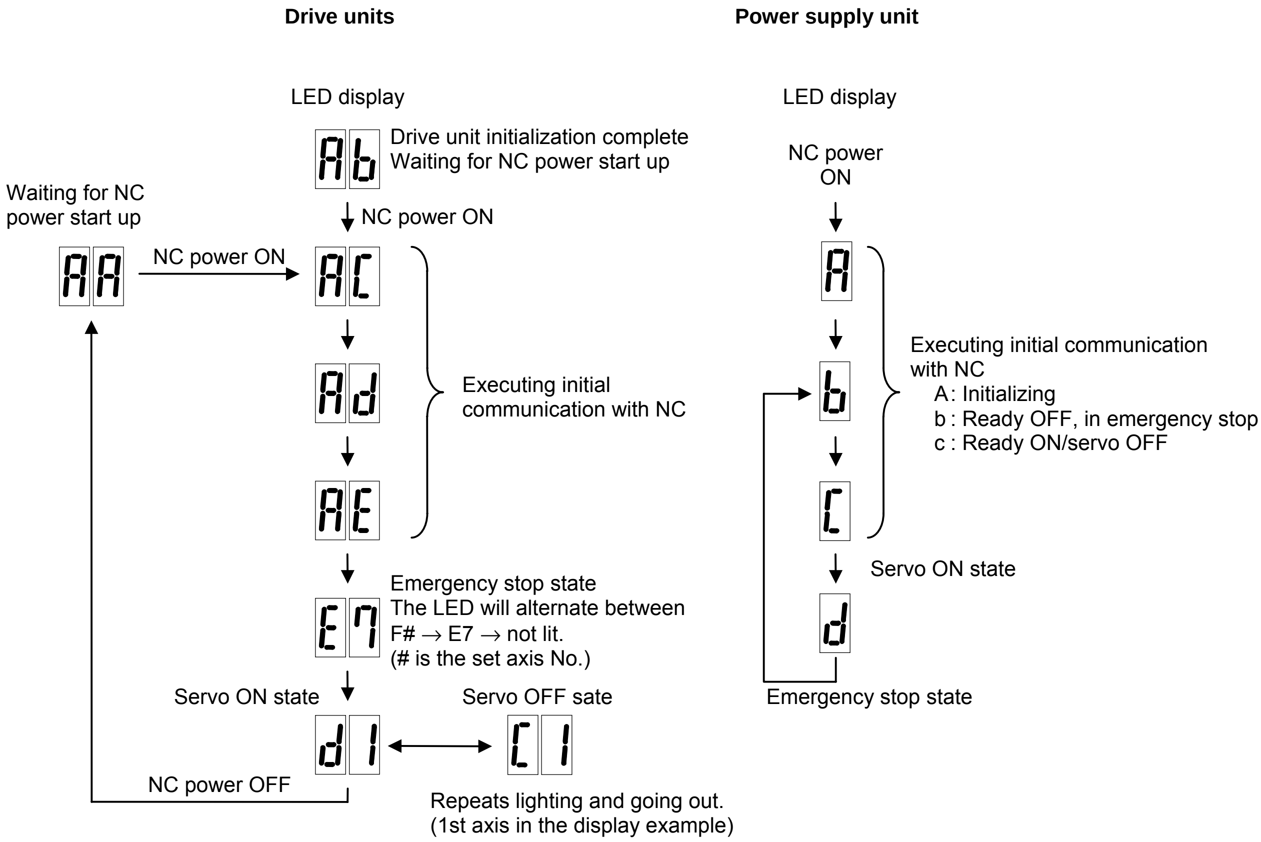
Setting the rotary switch	Details	
	Setting the MDS-C1-V1/V2/SP□	**Setting the MDS-C1-CV**
0	1st axis	External emergency stop invalid
1	2nd axis	Setting prohibited
2	3rd axis	
3	4th axis	
4	5th axis	External emergency stop valid (Used CN23)
5	6th axis	Setting prohibited
6	7th axis	
7	Setting prohibited	
8		
9		
A		
B		
C		
D		
E		
F	Axis not used	

POINT

When an axis that is not used is selected, that axis will not be controlled when the power is turned ON, and "Ab" will remain displayed on the LED. If the power of the axis not in use is disconnected, the NC system's emergency stop cannot be released.

3-1-2 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 "6-1 LED display when alarm or warning occurs" for details on the alarm displays.



⚠ CAUTION Always input emergency stop when starting the servo system.

3-1-3 Servo standard specifications and high-gain specifications

(1) Two-part system compliance

With the MDS-C1-V1/V2 Series, control is possible with the standard servo (MDS-B-V1/V2) control mode and high-gain servo (MDS-B-V14/V24) control mode. When replacing an older model (MDS-B Series) with this series, the servo parameter settings are automatically recognized and the control mode is determined. Thus, the model can be changed from either a standard servo or high-gain servo without changing the servo parameters.
When using the MDS-C1-V1/V2 unit and newly adjusting the machine, select the high-gain specifications. The high-gain specifications are set as the default.

(2) Judging the control mode

Whether the servo drive unit starts up with the standard servo specifications or high-gain servo specifications depends on the servo parameter SV009 to SV012 and SV033/bit8, 9 settings.

Parameter	High-gain	Standard	Standard	High-gain	High-gain
SV009 SV010 SV011 SV012	SV009 = 4096 or more, and SV010 = 4096 or more, and SV011 = 768 or more, and SV012 = 768 or more	Setting that does not satisfy even one of the following conditions: SV009 = 4096 or more SV010 = 4096 or more SV011 = 768 or more SV012 = 768 or more	SV009=* SV010=* SV011=* SV012=*	SV009=* SV010=* SV011=* SV012=*	SV009=* SV010=* SV011=* SV012=*
SV033/bit8	0	0	1	0	1
SV033/bit9	0	0	0	1	1

(Note) * indicates that there are no limits.

(3) Servo monitor unit type display

Whether the system is running with the high-gain servo or standard servo control mode can be confirmed with the unit type displayed on the NC SERVO MONITOR screen.

Unit type	For standard servo specifications	For high-gain servo specifications
MDS-C1-V1-□□□	C1V1s□□□	C1V1-□□□
MDS-C1-V2-□□○○	C1V2s□□○○	C1V2-□□○○
MDS-C1-V1-45S	C1V1s4S	C1V1-4S
MDS-C1-V1-70S	C1V1s7S	C1V1-7S
MDS-C1-V2-3510S	C1V2s3510	C1V2-3510
MDS-C1-V2-3520S	C1V2s3520	C1V2-3520
MDS-C1-V2-4545S	C1V2s4S4S	C1V2-4S4S
MDS-C1-V2-7070S	C1V2s7S7S	C1V2-7S7S
MDS-C1-V2-9090S	C1V2s9S9S	C1V2-9S9S

CAUTION

1. To change the control mode to the high-gain servo specifications after replacing the unit from a standard servo (MDS-B-V1/V2), the parameters must be changed and adjusted for high-gain servo use.
2. If alarm 7F occurs after setting the servo parameters, turn the servo drive unit power ON again.

3-2 Setting the initial parameters for the servo drive unit (High-gain specifications)

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.

3-2-1 Setting the standard parameters

When starting up the system, first set the standard parameters listed in "3-2-2 List of standard parameters for each servomotor". For the parameters shown below, check the machine and servo system specifications and determine the setting value.

(1) Basic specification parameters

[1] When performing absolute position control, set SV017/bit7=1. This may be automatically set by NC system parameter setting, depending on NC model. (Setting on the servo parameter screen is not valid.)

[2] When performing absolute position control with speed and current synchronous control, set SV081/bit4=1 for master and slave axes. Also set SV017/bit7=1.

[3] For HA053N, HA13N, HA23N, HA33N motors, if the connector direction of the motor end detector with motor power connector is 90°, set SV017/bit5=1. If the angle is 180°, use a standard setting (SV017/bit5=0).

Setting basic specification parameters

High-gain specifications

<table>
<tr><th>No.</th><th>Abbrev.</th><th>Parameter name</th><th>Explanation</th></tr>
<tr><td>SV017</td><td>SPEC*</td><td>Servo specification selection 1</td><td>
<table>
<tr><td>F</td><td>E</td><td>D</td><td>C</td><td>B</td><td>A</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td colspan="4">spm</td><td></td><td></td><td>mpt</td><td>mp</td><td>abs</td><td></td><td>vdir</td><td>fdir</td><td>vfb</td><td>seqh</td><td>dfbx</td><td>fdir2</td></tr>
</table>
<table>
<tr><th colspan="2">bit</th><th>Meaning when "0" is set</th><th>Meaning when "1" is set</th></tr>
<tr><td>5</td><td>vdir</td><td>Standard setting</td><td>HA motor (4 pole motor)
Detector installation position 90 degrees (B, D)</td></tr>
<tr><td>7</td><td>abs</td><td>Incremental control</td><td>Absolute position control</td></tr>
</table>
</td></tr>
<tr><td>SV081</td><td>SPEC2*</td><td>Servo specification selction 2</td><td>
<table>
<tr><td>F</td><td>E</td><td>D</td><td>C</td><td>B</td><td>A</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>pabs</td><td></td><td></td><td>rabs</td><td></td></tr>
</table>
<table>
<tr><th colspan="2">bit</th><th>Meaning when "0" is set</th><th>Meaning when "1" is set</th></tr>
<tr><td>4</td><td>pabs</td><td>Normal setting</td><td>Speed/current synchronous control absolute position control</td></tr>
</table>
</td></tr>
</table>

Parameters with an asterisk * in the abbreviation, such as PC1*, are validated with the NC power turned ON again.

POINT	Setting of absolute position control (SV017/bit7) may be set automatically by NC system parameter setting, depending on NC model. In this case, setting on the servo parameter screen is not valid.

(2) Electronic gear related parameters

The setting range of the following parameters, which configure the electronic gears, may be limited according to the combination. Refer to section "3-4 Restrictions on servo control" for details.

High-gain specifications

<table>
<tr><th>No.</th><th>Abbrev.</th><th>Parameter name</th><th>Explanation</th><th>Setting range (Unit)</th></tr>
<tr><td>SV001</td><td>PC1*</td><td>Motor side gear ratio</td><td rowspan="2">Set the motor side and machine side gear ratio.
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 cause an alarm.</td><td>1 to 32767</td></tr>
<tr><td>SV002</td><td>PC2*</td><td>Machine side gear ratio</td><td>1 to 32767</td></tr>
<tr><td>SV018</td><td>PIT*</td><td>Ball screw pitch</td><td>Set the ball screw pitch. Set to "360" for the rotary axis.</td><td>1 to 32767
(mm/rev)</td></tr>
<tr><td rowspan="2">SV019</td><td rowspan="2">RNG1*</td><td rowspan="2">Position detector resolution</td><td>In the case of the semi-closed loop control
Set the same value as SV020 (RNG2). (Refer to the explanation of SV020.)</td><td>1 to 9999
(kp/rev)</td></tr>
<tr><td>In the case of the full-closed loop control
Set the number of pulses per ball screw pitch.
<table>
<tr><th>Detector model name</th><th>Resolution</th><th>SV019 setting</th></tr>
<tr><td>OHE25K-ET, OHA25K-ET</td><td>100,000 (p/rev)</td><td>100</td></tr>
<tr><td>OSE104-ET,OSA104-ET</td><td>100,000 (p/rev)</td><td>100</td></tr>
<tr><td>OSE105-ET,OSA105-ET</td><td>1,000,000 (p/rev)</td><td>1000</td></tr>
<tr><td>Relative position detection scale</td><td>Refer to detector specification manual</td><td>PIT/Resolution (µm)</td></tr>
<tr><td>AT41 (Mitsutoyo)</td><td>1 (µm/p)</td><td>The same as SV018 (PIT)</td></tr>
<tr><td>FME type, FLE type (Futaba)</td><td>Refer to detector specification manual</td><td>PIT/Resolution (µm)</td></tr>
<tr><td>MP type (Mitsubishi Heavy Industries)</td><td>Refer to detector specification manual</td><td>PIT/Resolution (µm)</td></tr>
<tr><td>AT342 (Mitsutoyo)</td><td>0.5 (µm/p)</td><td>Twice as big as SV018 (PIT)</td></tr>
<tr><td>AT343 (Mitsutoyo)</td><td>0.05 (µm/p)</td><td>20 times as big as SV018 (PIT)</td></tr>
<tr><td>AT543 (Mitsutoyo)</td><td>0.05 (µm/p)</td><td>20 times as big as SV018 (PIT)</td></tr>
<tr><td>LC191M (Heidenhain)</td><td>0.1, 0.05 (µm/p)</td><td>PIT/Resolution (µm)</td></tr>
<tr><td>LC491M (Heidenhain)</td><td>0.05 (µm/p)</td><td>PIT/Resolution (µm)</td></tr>
<tr><td>RCN223(Heidenhain)</td><td>8,000,000(p/rev)</td><td>8000</td></tr>
<tr><td>RCN723(Heidenhain)</td><td>8,000,000(p/rev)</td><td>8000</td></tr>
<tr><td>MDS-B-HR</td><td>-</td><td>PIT/scale(µm)</td></tr>
</table></td><td>1 to 3000
(kp/pit)</td></tr>
<tr><td>SV020</td><td>RNG2*</td><td>Speed detector resolution</td><td>Set the number of pulses per one revolution of the motor end detector.
<table>
<tr><th>Detector model name</th><th>SV020 setting</th></tr>
<tr><td>OSE104, OSA104</td><td>100</td></tr>
<tr><td>OSE105, OSA105</td><td>1000</td></tr>
</table></td><td>1 to 9999
(kp/rev)</td></tr>
</table>

Parameters with an asterisk * in the abbreviation, such as PC1*, are validated with the NC power turned ON again.

(3) Detector related parameters

(a) For semi-closed loop control

For control using only the motor end detector, specify the settings shown in the table below. For speed and current synchronous control, refer to section "2-4-3 Connecting the synchronous control system".

Setting for semi-closed loop control

High-gain specifications

<table>
<tr><th>No.</th><th>Abbrev.</th><th>Parameter name</th><th>Explanation</th></tr>
<tr><td>SV025</td><td>MTYP*</td><td>Motor/Detector type</td><td>
<table>
<tr><th colspan="2">bit</th><th>Details</th></tr>
<tr><td>8</td><td rowspan="4">ent</td><td rowspan="8">Set the detector type.
Set the position detector type for "pen", and the speed detector type for "ent". In the case of the semi-closed loop control, set the same value for "pen" and "ent".
<table>
<tr><th>Detector model name</th><th>pen setting</th><th>ent setting</th></tr>
<tr><td>OSE104</td><td>0</td><td>0</td></tr>
<tr><td>OSA104</td><td>1</td><td>1</td></tr>
<tr><td>OSE105, OSA105</td><td>2</td><td>2</td></tr>
</table>
</td></tr>
<tr><td>9</td></tr>
<tr><td>A</td></tr>
<tr><td>B</td></tr>
<tr><td>C</td><td rowspan="4">pen</td></tr>
<tr><td>D</td></tr>
<tr><td>E</td></tr>
<tr><td>F</td></tr>
</table>
</td></tr>
</table>

(b) For full-closed loop control

Some parameter settings must be specified in order to use the machine end detector. These settings are determined by type or the installation conditions of the linear scale and the ball screw end detector.

[1] The SV025/bit8 to B (ent) setting must be specified according to the motor end detector specifications, in the same manner as for semi-closed loop control. For current synchronous control, however, refer to section "2-4-3 Connecting the synchronous control system".
[2] If the polarities of the motor end detector and the machine end detector do not match, specify SV017/bit4=1 setting.
[3] To use AT342, AT343, AT543, LC191M, LC491M, specify SV027/bit6=1 setting.
[4] To use the MP scale, specify SV017/bit8 setting in accordance with the scale specifications. For absolute position control, specify SV017/bit9=1 setting.
[5] For ABZ phase pulse output type relative position detection scale with constant Z-phase detection position without regard to the travel direction, specify SV027/bit6=1 setting. Z-phase detection occurs as follows: Plus-direction travel: Rising edge detection, Minus-direction travel: Falling edge detection
[6] For machine end absolute position control at the rotation axis, specify SV081/bit1=1 setting.
[7] For speed and current synchronous control, refer to "2-4-3 Connecting the synchronous control system".

Setting for full-closed loop control

High-gain specifications

No.	Abbrev.	Parameter name	Explanation
SV017	SPEC*	Servo specification selection	(see bit tables below)
SV025	MTYP*	Motor/Detector type	(see bit tables below)

SV017 SPEC*

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
spm						mpt	mp	abs		vdir	fdir	vfb	seqh	dfbx	fdir2

bit		Meaning when "0" is set	Meaning when "1" is set
4	fdir	Position feedback forward polarity	Position feedback reverse polarity
8	mp	MP scale 360P (2mm pitch)	MP scale 720P (1mm pitch)
9	mpt	MP scale ABS detection NC control	MP scale ABS detection automatic (Standard setting)

SV025 MTYP*

bit		Explanation
8, 9, A, B	ent	Set the detector type. Set the position detector type for “pen”, and the speed detector type for “ent”. In the case of the semi-closed loop control, set the same value for “pen” and “ent”.
C, D, E, F	pen	

Detector model name	pen setting	ent setting
OSE104	0 (Note)	0
OSA104	1 (Note)	1
OSE105, OSA105	2 (Note)	2
	3 (Note)	3
OHE25K-ET,OSE104-ET	4	Setting impossible
OHA25K-ET,OSA104-ET	5	Setting impossible
OSE105-ET, OSA105-ET, RCN223, RCN723 (Heidenhain)	6	Setting impossible
	7	Setting impossible
Relative position detection scale, MP type (Mitsubishi Heavy Industries)	8	Setting impossible
AT41 (Mitsutoyo), FME type, FLE type (Futaba)	9	Setting impossible
AT342, AT343, AT543 (Mitsutoyo), LC191M/491M (Heidenhain), MDS-B-HR	A	Setting impossible
	B	Setting impossible
The setting of the slave axis in the speed/current synchronization control. When the master axis is the semi-closed control.	C	C (Current synchronization)
The setting of the slave axis in the speed/ current synchronization control. When the master axis is the full-closed control. (Current synchronization control is only for MDS-C1-V2.)	D	E (Current synchronization)
	E	Setting impossible
	F	Setting impossible

(Note) Setting for semi-closed loop control

Parameters with an asterisk * in the abbreviation, such as PC1*, are validated with the NC power turned ON again.

Setting for full-closed loop control

High-gain specifications

<table>
<tr><th>No.</th><th>Abbr ev.</th><th>Parameter name</th><th>Explanation</th></tr>
<tr><td>SV027</td><td>SSF1</td><td>Servo function selection 1</td><td>
<table>
<tr><td>F</td><td>E</td><td>D</td><td>C</td><td>B</td><td>A</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td>aflt</td><td>zrn2</td><td colspan="2">afse</td><td colspan="2">ovs</td><td colspan="2">lmc</td><td>omr</td><td>zrn3</td><td colspan="2">vfct</td><td></td><td>upc</td><td colspan="2">vcnt</td></tr>
</table>
<table>
<tr><th colspan="2">bit</th><th>Meaning when "0" is set</th><th>Meaning when "1" is set</th></tr>
<tr><td>6</td><td>zrn3</td><td colspan="2">ABZ phase scale: Set to "1" to fix Z-phase detection edge.
Absolute position scale: Set to "1" in using AT342/343, LC191M/491M.</td></tr>
</table>
</td></tr>
<tr><td>SV081</td><td>SPEC2*</td><td>Servo function selection 2</td><td>
<table>
<tr><td>F</td><td>E</td><td>D</td><td>C</td><td>B</td><td>A</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>pabs</td><td></td><td></td><td>rabs</td><td></td></tr>
</table>
<table>
<tr><th colspan="2">bit</th><th>Meaning when "0" is set</th><th>Meaning when "1" is set</th></tr>
<tr><td>1</td><td>rabs</td><td>Normal setting</td><td>Rotary axis machine end absolute position control</td></tr>
</table>
</td></tr>
</table>

Parameters with an asterisk * in the abbreviation, such as PC1*, are validated with the NC power turned ON again.

(4) Setting the power supply type

Set the drive unit connected to the power supply unit with the CN4 connector. This does not need to be set if the power supply for the axis is not connected with the CN4 connector. (Set "0000".)
If the power supply unit is connected with the spindle drive unit, the parameters do not need to be set on the servo side. When connected to a 2-axis servo drive unit (MDS-C1-V2), set the power supply type for one of the two target axes.

High-gain specifications

No.	Abbrev.	Parameter name	Explanation
SV036	PTYP*	Power supply type	

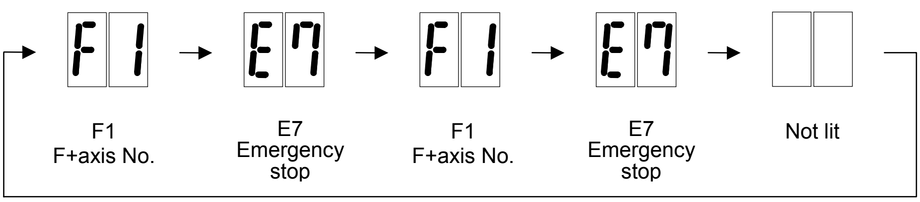
F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
amp				rtyp				ptyp							

bit		Explanation
0, 1, 2, 3, 4, 5, 6, 7	ptyp	When the CN4 connector of the drive unit and the power supply unit are connected, setting below is necessary. To validate the external emergency stop function, add 40h.
8, 9, A, B	rtyp	Set the regenerative resistor type when using MDS-A-CR. Set 0 when using the MDS-C1-CV (power regeneration.)
C, D, E, F	amp	Set "0".

Setting	0x	1x	2x	3x	4x	5x	6x	7x	8x
x0	Not used			CV-300					
x1		CV-110							CR-10
x2			CV-220						CR-15
x3									CR-22
x4	CV-37								CR-37
x5		CV-150			MDS-B-CVE-450	MDS-B-CVE-550			
x6	CV-55		CV-260						CR-55
x7				CV-370					
x8	CV-75								CR-75
x9		CV-185							CR-90

Parameters with an asterisk * in the abbreviation, such as PC1*, are validated with the NC power turned ON again.

If alarm 7F occurs after setting the initial parameters, turn the drive unit power ON again. If the unit's LEDs indicate the following emergency stop state, the unit has started up normally.



Normal LED display when NC power is turned ON (1st axis)

3-2-2 List of standard parameters for each servomotor

(1) HC Series (Standard 2000r/min rating)

High-gain specifications

Parameter		Motor	Standard HC motor 2000 r/min rating										
			HC52	HC 102	HC 152	HC202	HC 352	HC452		HC702		HC902	
No.	Abbrev.	Details / Unit capacity	05	10	20	20	35	45S	45	70S	70	90S	90
SV001	PC1	Motor side gear ratio	---	---	---	---	---	---	---	---	---	---	---
SV002	PC2	Machine side gear ratio	---	---	---	---	---	---	---	---	---	---	---
SV003	PGN1	Position loop gain 1	47	47	47	47	47	47	47	47	47	47	47
SV004	PGN2	Position loop gain 2	0	0	0	0	0	0	0	0	0	0	0
SV005	VGN1	Speed loop gain 1	200	200	200	200	200	200	200	200	200	200	200
SV006	VGN2	Speed loop gain 2	0	0	0	0	0	0	0	0	0	0	0
SV007	VIL	Speed loop delay compensation	0	0	0	0	0	0	0	0	0	0	0
SV008	VIA	Speed loop lead compensation	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364
SV009	IQA	Current loop q axis lead compensation	4096	4096	4096	4096	4096	4096	4096	4096	4096	4096	4096
SV010	IDA	Current loop d axis lead compensation	4096	4096	4096	4096	4096	4096	4096	4096	4096	4096	4096
SV011	IQG	Current loop q axis gain	768	768	768	768	768	768	768	768	768	768	768
SV012	IDG	Current loop d axis gain	768	768	768	768	768	768	768	768	768	768	768
SV013	ILMT	Current limit value	500	500	500	500	500	500	500	500	500	500	500
SV014	ILMTsp	Current limit value in special control	500	500	500	500	500	500	500	500	500	500	500
SV015	FFC	Acceleration rate feed forward gain	0	0	0	0	0	0	0	0	0	0	0
SV016	LMC1	Lost motion compensation 1	0	0	0	0	0	0	0	0	0	0	0
SV017	SPEC	Servo specification selection	0000	0000	0000	0000	0000	1000	0000	1000	0000	1000	0000
SV018	PIT	Ball screw pitch	---	---	---	---	---	---	---	---	---	---	---
SV019	RNG1	Position detector resolution	---	---	---	---	---	---	---	---	---	---	---
SV020	RNG2	Speed detector resolution	---	---	---	---	---	---	---	---	---	---	---
SV021	OLT	Overload detection time constant	60	60	60	60	60	60	60	60	60	60	60
SV022	OLL	Overload detection level	150	150	150	150	150	150	150	150	150	150	150
SV023	OD1	Excessive error detection width during servo ON	6	6	6	6	6	6	6	6	6	6	6
SV024	INP	In-position detection width	50	50	50	50	50	50	50	50	50	50	50
SV025	MTYP	Motor/detector type	xxB0	xxB1	xxB2	xxB3	xxB4	xx95	xxB5	xx96	xxB6	xx97	xxB7
SV026	OD2	Excessive error detection width during servo OFF	6	6	6	6	6	6	6	6	6	6	6
SV027	SSF1	Servo function selection 1	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
SV028			0	0	0	0	0	0	0	0	0	0	0
SV029	VCS	Speed at the change of speed loop gain	0	0	0	0	0	0	0	0	0	0	0
SV030	IVC	Voltage dead time compensation / current bias 1	0	0	0	0	0	0	0	0	0	0	0
SV031	OVS1	Overshooting compensation 1	0	0	0	0	0	0	0	0	0	0	0
SV032	TOF	Torque offset	0	0	0	0	0	0	0	0	0	0	0
SV033	SSF2	Servo function selection 2	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
SV034	SSF3	Servo function selection 3	0003	0003	0003	0003	0003	0003	0003	0003	0003	0003	0003
SV035	SSF4	Servo function selection 4	0000	0000	0040	0040	0040	0040	0040	0040	0040	0000	0000
SV036	PTYP	Power supply type	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
SV037	JL	Load inertia scale	0	0	0	0	0	0	0	0	0	0	0
SV038	FHz1	Notch filter frequency 1	0	0	0	0	0	0	0	0	0	0	0
SV039	LMCD	Lost motion compensation timing	0	0	0	0	0	0	0	0	0	0	0
SV040	LMCT	Lost motion compensation non-sensitive band /current bias 2	0	0	0	10240	10240	10240	10240	10240	10240	10240	10240
SV041	LMC2	Lost motion compensation 2	0	0	0	0	0	0	0	0	0	0	0
SV042	OVS2	Overshooting compensation 2	0	0	0	0	0	0	0	0	0	0	0
SV043	OBS1	Disturbance observer filter frequency	0	0	0	0	0	0	0	0	0	0	0
SV044	OBS2	Disturbance observer gain	0	0	0	0	0	0	0	0	0	0	0
SV045	TRUB	Frictional torque/current bias 3	0	0	0	0	0	0	0	0	0	0	0
SV046	FHz2	Notch filter frequency 2	0	0	0	0	0	0	0	0	0	0	0
SV047	EC	Inductive voltage compensation gain	100	100	100	100	100	100	100	100	100	100	100
SV048	EMGrt	Vertical axis drop prevention time	0	0	0	0	0	0	0	0	0	0	0
SV049	PGN1sp	Position loop gain 1 in spindle synchronous control	15	15	15	15	15	15	15	15	15	15	15
SV050	PGN2sp	Position loop gain 2 in spindle synchronous control	0	0	0	0	0	0	0	0	0	0	0
SV051	DFBT	Dual feedback control time constant	0	0	0	0	0	0	0	0	0	0	0
SV052	DFBN	Dual feedback control non-sensitive band	0	0	0	0	0	0	0	0	0	0	0
SV053	OD3	Excessive error detection width in special control	0	0	0	0	0	0	0	0	0	0	0
SV054	ORE	Overrun detection width in closed loop control	0	0	0	0	0	0	0	0	0	0	0
SV055	EMGx	Max. gate off delay time after emergency stop	0	0	0	0	0	0	0	0	0	0	0
SV056	EMGt	Deceleration time constant at emergency stop	0	0	0	0	0	0	0	0	0	0	0
SV057	SHGC	SHG control gain	0	0	0	0	0	0	0	0	0	0	0
SV058	SHGCsp	SHG control gain in spindle synchronous control	0	0	0	0	0	0	0	0	0	0	0
SV059	TCNV	Collision detection torque estimating gain	0	0	0	0	0	0	0	0	0	0	0
SV060	TLMT	Collision detection level	0	0	0	0	0	0	0	0	0	0	0
SV061	DA1NO	D/A output channel 1 data No.	0	0	0	0	0	0	0	0	0	0	0
SV062	DA2NO	D/A output channel 2 data No.	0	0	0	0	0	0	0	0	0	0	0
SV063	DA1MPY	D/A output channel 1 output scale	0	0	0	0	0	0	0	0	0	0	0
SV064	DA2MPY	D/A output channel 2 output scale	0	0	0	0	0	0	0	0	0	0	0

Parameter			Motor	Standard HC motor 2000 r/min rating										
				HC52	HC102	HC152	HC202	HC352	HC452		HC702		HC902	
No.	Abbrev.	Details	Unit capacity	05	10	20	20	35	45S	45	70S	70	90S	90
SV065	TLC	Tool end compensation spring constant		0	0	0	0	0	0	0	0	0	0	0
		(System parameter area)												
SV081	SPEC2	Servo specification selection 2		0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
SV082	SSF5	Servo function selection 5		0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
SV083	SSF6	Servo function selection 6		0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
SV084	SSF7	Servo function selection 7		0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
SV085	LMCk	Lost motion compensation spring constant		0	0	0	0	0	0	0	0	0	0	0
SV086	LMCc	Lost motion compensation viscous coefficient		0	0	0	0	0	0	0	0	0	0	0
SV087	FHz4	Notch filter frequency 4		0	0	0	0	0	0	0	0	0	0	0
SV088	FHz5	Notch filter frequency 5		0	0	0	0	0	0	0	0	0	0	0
SV089 : SV100				0	0	0	0	0	0	0	0	0	0	0

(2) HC Series (Standard 3000r/min rating)

High-gain specifications

Parameter		Motor	Standard HC motor 3000 r/min rating									
			HC53	HC103	HC153	HC203	HC353		HC453		HC703	
No.	Abbrev.	Details / Unit capacity	05	10	20	35	45S	45	70S	70	90S	90
SV001	PC1	Motor side gear ratio	---	---	---	---	---	---	---	---	---	---
SV002	PC2	Machine side gear ratio	---	---	---	---	---	---	---	---	---	---
SV003	PGN1	Position loop gain 1	47	47	47	47	47	47	47	47	47	47
SV004	PGN2	Position loop gain 2	0	0	0	0	0	0	0	0	0	0
SV005	VGN1	Speed loop gain 1	200	200	200	200	200	200	200	200	200	200
SV006	VGN2	Speed loop gain 2	0	0	0	0	0	0	0	0	0	0
SV007	VIL	Speed loop delay compensation	0	0	0	0	0	0	0	0	0	0
SV008	VIA	Speed loop lead compensation	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364
SV009	IQA	Current loop q axis lead compensation	4096	4096	4096	4096	4096	4096	4096	4096	4096	4096
SV010	IDA	Current loop d axis lead compensation	4096	4096	4096	4096	4096	4096	4096	4096	4096	4096
SV011	IQG	Current loop q axis gain	768	768	768	768	768	768	768	768	768	768
SV012	IDG	Current loop d axis gain	768	768	768	768	768	768	768	768	768	768
SV013	ILMT	Current limit value	500	500	500	500	500	500	500	500	500	500
SV014	ILMTsp	Current limit value in special control	500	500	500	500	500	500	500	500	500	500
SV015	FFC	Acceleration rate feed forward gain	0	0	0	0	0	0	0	0	0	0
SV016	LMC1	Lost motion compensation 1	0	0	0	0	0	0	0	0	0	0
SV017	SPEC	Servo specification selection	0000	0000	0000	0000	1000	0000	1000	0000	1000	0000
SV018	PIT	Ball screw pitch	---	---	---	---	---	---	---	---	---	---
SV019	RNG1	Position detector resolution	---	---	---	---	---	---	---	---	---	---
SV020	RNG2	Speed detector resolution	---	---	---	---	---	---	---	---	---	---
SV021	OLT	Overload detection time constant	60	60	60	60	60	60	60	60	60	60
SV022	OLL	Overload detection level	150	150	150	150	150	150	150	150	150	150
SV023	OD1	Excessive error detection width during servo ON	6	6	6	6	6	6	6	6	6	6
SV024	INP	In-position detection width	50	50	50	50	50	50	50	50	50	50
SV025	MTYP	Motor/detector type	xxC0	xxC1	xxC2	xxC3	xxA4	xxC4	xxA5	xxC5	xxA6	xxC6
SV026	OD2	Excessive error detection width during servo OFF	6	6	6	6	6	6	6	6	6	6
SV027	SSF1	Servo function selection 1	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
SV028			0	0	0	0	0	0	0	0	0	0
SV029	VCS	Speed at the change of speed loop gain	0	0	0	0	0	0	0	0	0	0
SV030	IVC	Voltage dead time compensation / current bias 1	0	0	0	0	0	0	0	0	0	0
SV031	OVS1	Overshooting compensation 1	0	0	0	0	0	0	0	0	0	0
SV032	TOF	Torque offset	0	0	0	0	0	0	0	0	0	0
SV033	SSF2	Servo function selection 2	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
SV034	SSF3	Servo function selection 3	0003	0003	0003	0003	0003	0003	0003	0003	0003	0003
SV035	SSF4	Servo function selection 4	0000	0000	0040	0040	0040	0040	0040	0040	0000	0000
SV036	PTYP	Power supply type	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
SV037	JL	Load inertia scale	0	0	0	0	0	0	0	0	0	0
SV038	FHz1	Notch filter frequency 1	0	0	0	0	0	0	0	0	0	0
SV039	LMCD	Lost motion compensation timing	0	0	0	0	0	0	0	0	0	0
SV040	LMCT	Lost motion compensation non-sensitive band /current bias 2	0	0	0	10240	10240	10240	10240	10240	10240	10240
SV041	LMC2	Lost motion compensation 2	0	0	0	0	0	0	0	0	0	0
SV042	OVS2	Overshooting compensation 2	0	0	0	0	0	0	0	0	0	0
SV043	OBS1	Disturbance observer filter frequency	0	0	0	0	0	0	0	0	0	0
SV044	OBS2	Disturbance observer gain	0	0	0	0	0	0	0	0	0	0
SV045	TRUB	Frictional torque/current bias 3	0	0	0	0	0	0	0	0	0	0
SV046	FHz2	Notch filter frequency 2	0	0	0	0	0	0	0	0	0	0
SV047	EC	Inductive voltage compensation gain	100	100	100	100	100	100	100	100	100	100
SV048	EMGrt	Vertical axis drop prevention time	0	0	0	0	0	0	0	0	0	0
SV049	PGN1sp	Position loop gain 1 in spindle synchronous control	15	15	15	15	15	15	15	15	15	15
SV050	PGN2sp	Position loop gain 2 in spindle synchronous control	0	0	0	0	0	0	0	0	0	0
SV051	DFBT	Dual feedback control time constant	0	0	0	0	0	0	0	0	0	0
SV052	DFBN	Dual feedback control non-sensitive band	0	0	0	0	0	0	0	0	0	0
SV053	OD3	Excessive error detection width in special control	0	0	0	0	0	0	0	0	0	0
SV054	ORE	Overrun detection width in closed loop control	0	0	0	0	0	0	0	0	0	0
SV055	EMGx	Max. gate off delay time after emergency stop	0	0	0	0	0	0	0	0	0	0
SV056	EMGt	Deceleration time constant at emergency stop	0	0	0	0	0	0	0	0	0	0
SV057	SHGC	SHG control gain	0	0	0	0	0	0	0	0	0	0
SV058	SHGCsp	SHG control gain in spindle synchronous control	0	0	0	0	0	0	0	0	0	0
SV059	TCNV	Collision detection torque estimating gain	0	0	0	0	0	0	0	0	0	0
SV060	TLMT	Collision detection level	0	0	0	0	0	0	0	0	0	0
SV061	DA1NO	D/A output channel 1 data No.	0	0	0	0	0	0	0	0	0	0
SV062	DA2NO	D/A output channel 2 data No.	0	0	0	0	0	0	0	0	0	0
SV063	DA1MPY	D/A output channel 1 output scale	0	0	0	0	0	0	0	0	0	0
SV064	DA2MPY	D/A output channel 2 output scale	0	0	0	0	0	0	0	0	0	0
SV065	TLC	Tool end compensation spring constant	0	0	0	0	0	0	0	0	0	0

Parameter No.	Abbrev.	Details	Motor / Unit capacity	Standard HC motor 3000 r/min rating HC53	HC103	HC153	HC203	HC353		HC453		HC703	
				05	10	20	35	45S	45	70S	70	90S	90
		(System parameter area)											
SV081	SPEC2	Servo specification selection 2		0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
SV082	SSF5	Servo function selection 5		0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
SV083	SSF6	Servo function selection 6		0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
SV084	SSF7	Servo function selection 7		0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
SV085	LMCk	Lost motion compensation spring constant		0	0	0	0	0	0	0	0	0	0
SV086	LMCc	Lost motion compensation viscous coefficient		0	0	0	0	0	0	0	0	0	0
SV087	FHz4	Notch filter frequency 4		0	0	0	0	0	0	0	0	0	0
SV088	FHz5	Notch filter frequency 5		0	0	0	0	0	0	0	0	0	0
SV089 : SV100				0	0	0	0	0	0	0	0	0	0

(3) HC Series (Low-inertia)

High-gain specifications

Parameter No.	Abbrev.	Details	Motor / Unit capacity	Low-inertia HC motor HC103R	HC153R	HC203R	HC353R	HC503R
			Unit capacity	10	10	20	35	45
SV001	PC1	Motor side gear ratio		---	---	---	---	---
SV002	PC2	Machine side gear ratio		---	---	---	---	---
SV003	PGN1	Position loop gain 1		33	33	33	33	33
SV004	PGN2	Position loop gain 2		0	0	0	0	0
SV005	VGN1	Speed loop gain 1		15	15	20	40	40
SV006	VGN2	Speed loop gain 2		0	0	0	0	0
SV007	VIL	Speed loop delay compensation		0	0	0	0	0
SV008	VIA	Speed loop lead compensation		1364	1364	1364	1364	1364
SV009	IQA	Current loop q axis lead compensation		4096	4096	4096	4096	4096
SV010	IDA	Current loop d axis lead compensation		4096	4096	4096	4096	4096
SV011	IQG	Current loop q axis gain		256	256	256	256	512
SV012	IDG	Current loop d axis gain		512	512	512	512	512
SV013	ILMT	Current limit value		500	500	500	500	500
SV014	ILMTsp	Current limit value in special control		500	500	500	500	500
SV015	FFC	Acceleration rate feed forward gain		0	0	0	0	0
SV016	LMC1	Lost motion compensation 1		0	0	0	0	0
SV017	SPEC	Servo specification selection		0000	0000	0000	0000	0000
SV018	PIT	Ball screw pitch		---	---	---	---	---
SV019	RNG1	Position detector resolution		---	---	---	---	---
SV020	RNG2	Speed detector resolution		---	---	---	---	---
SV021	OLT	Overload detection time constant		60	60	60	60	60
SV022	OLL	Overload detection level		150	150	150	150	150
SV023	OD1	Excessive error detection width during servo ON		6	6	6	6	6
SV024	INP	In-position detection width		50	50	50	50	50
SV025	MTYP	Motor/detector type		xxE1	xxE2	xxE3	xxE4	xxE5
SV026	OD2	Excessive error detection width during servo OFF		6	6	6	6	6
SV027	SSF1	Servo function selection 1		4000	4000	4000	4000	4000
SV028				0	0	0	0	0
SV029	VCS	Speed at the change of speed loop gain		0	0	0	0	0
SV030	IVC	Voltage dead time compensation / current bias 1		0	0	0	0	0
SV031	OVS1	Overshooting compensation 1		0	0	0	0	0
SV032	TOF	Torque offset		0	0	0	0	0
SV033	SSF2	Servo function selection 2		0200	0200	0200	0200	0200
SV034	SSF3	Servo function selection 3		0000	0000	0000	0000	0000
SV035	SSF4	Servo function selection 4		0000	0000	0000	0000	0000
SV036	PTYP	Power supply type		0000	0000	0000	0000	0000
SV037	JL	Load inertia scale		0	0	0	0	0
SV038	FHz1	Notch filter frequency 1		0	0	0	0	0
SV039	LMCD	Lost motion compensation timing		0	0	0	0	0
SV040	LMCT	Lost motion compensation non-sensitive band /current bias 2		0	0	0	0	0
SV041	LMC2	Lost motion compensation 2		0	0	0	0	0
SV042	OVS2	Overshooting compensation 2		0	0	0	0	0
SV043	OBS1	Disturbance observer filter frequency		0	0	0	0	0
SV044	OBS2	Disturbance observer gain		0	0	0	0	0
SV045	TRUB	Frictional torque/current bias 3		0	0	0	0	0
SV046	FHz2	Notch filter frequency 2		0	0	0	0	0
SV047	EC	Inductive voltage compensation gain		100	100	100	100	100
SV048	EMGrt	Vertical axis drop prevention time		0	0	0	0	0
SV049	PGN1sp	Position loop gain 1 in spindle synchronous control		15	15	15	15	15
SV050	PGN2sp	Position loop gain 2 in spindle synchronous control		0	0	0	0	0
SV051	DFBT	Dual feedback control time constant		0	0	0	0	0
SV052	DFBN	Dual feedback control non-sensitive band		0	0	0	0	0
SV053	OD3	Excessive error detection width in special control		0	0	0	0	0
SV054	ORE	Overrun detection width in closed loop control		0	0	0	0	0
SV055	EMGx	Max. gate off delay time after emergency stop		0	0	0	0	0
SV056	EMGt	Deceleration time constant at emergency stop		0	0	0	0	0
SV057	SHGC	SHG control gain		0	0	0	0	0
SV058	SHGCsp	SHG control gain in spindle synchronous control		0	0	0	0	0
SV059	TCNV	Collision detection torque estimating gain		0	0	0	0	0
SV060	TLMT	Collision detection level		0	0	0	0	0
SV061	DA1NO	D/A output channel 1 data No.		0	0	0	0	0
SV062	DA2NO	D/A output channel 2 data No.		0	0	0	0	0
SV063	DA1MPY	D/A output channel 1 output scale		0	0	0	0	0
SV064	DA2MPY	D/A output channel 2 output scale		0	0	0	0	0
SV065	TLC	Tool end compensation spring constant		0	0	0	0	0

Parameter		Motor		Low-inertia HC motor				
				HC103R	HC153R	HC203R	HC353R	HC503R
No.	Abbrev.	Details	Unit capacity	10	10	20	35	45
		(System parameter area)						
SV081	SPEC2	Servo specification selection 2		0000	0000	0000	0000	0000
SV082	SSF5	Servo function selection 5		0000	0000	0000	0000	0000
SV083	SSF6	Servo function selection 6		0000	0000	0000	0000	0000
SV084	SSF7	Servo function selection 7		0000	0000	0000	0000	0000
SV085	LMCk	Lost motion compensation spring constant		0	0	0	0	0
SV086	LMCc	Lost motion compensation viscous coefficient		0	0	0	0	0
SV087	FHz4	Notch filter frequency 4		0	0	0	0	0
SV088	FHz5	Notch filter frequency 5		0	0	0	0	0
SV089 : SV100				0	0	0	0	0

(4) HA series

High-gain specifications

Parameter		Motor	Small capacity HA motor				Large capacity HA motor	
			HA053N	HA13N	HA23N	HA33N	HA-LF11K2	HA-LF15K2
No.	Abbrev.	Details / Unit capacity	01	01	03	03	110	150
SV001	PC1	Motor side gear ratio	---	---	---	---	---	---
SV002	PC2	Machine side gear ratio	---	---	---	---	---	---
SV003	PGN1	Position loop gain 1	33	33	33	33	33	33
SV004	PGN2	Position loop gain 2	0	0	0	0	0	0
SV005	VGN1	Speed loop gain 1	70	70	100	100	150	150
SV006	VGN2	Speed loop gain 2	0	0	0	0	0	0
SV007	VIL	Speed loop delay compensation	0	0	0	0	0	0
SV008	VIA	Speed loop lead compensation	1364	1364	1364	1364	1364	1364
SV009	IQA	Current loop q axis lead compensation	4096	4096	4096	4096	4096	4096
SV010	IDA	Current loop d axis lead compensation	4096	4096	4096	4096	4096	4096
SV011	IQG	Current loop q axis gain	768	768	768	768	512	512
SV012	IDG	Current loop d axis gain	768	768	768	768	512	512
SV013	ILMT	Current limit value	500	500	500	500	500	500
SV014	ILMTsp	Current limit value in special control	500	500	500	500	500	500
SV015	FFC	Acceleration rate feed forward gain	0	0	0	0	0	0
SV016	LMC1	Lost motion compensation 1	0	0	0	0	0	0
SV017	SPEC	Servo specification selection	0000	0000	0000	0000	0000	0000
SV018	PIT	Ball screw pitch	---	---	---	---	---	---
SV019	RNG1	Position detector resolution	---	---	---	---	---	---
SV020	RNG2	Speed detector resolution	---	---	---	---	---	---
SV021	OLT	Overload detection time constant	60	60	60	60	60	60
SV022	OLL	Overload detection level	150	150	150	150	150	150
SV023	OD1	Excessive error detection width during servo ON	6	6	6	6	6	6
SV024	INP	In-position detection width	50	50	50	50	50	50
SV025	MTYP	Motor/detector type	xx8C	xx8D	xx8E	xx8F	xx2E	xx2F
SV026	OD2	Excessive error detection width during servo OFF	6	6	6	6	6	6
SV027	SSF1	Servo function selection 1	4000	4000	4000	4000	4000	4000
SV028			0	0	0	0	0	0
SV029	VCS	Speed at the change of speed loop gain	0	0	0	0	0	0
SV030	IVC	Voltage dead time compensation / current bias 1	0	0	0	0	0	0
SV031	OVS1	Overshooting compensation 1	0	0	0	0	0	0
SV032	TOF	Torque offset	0	0	0	0	0	0
SV033	SSF2	Servo function selection 2	0000	0000	0000	0000	0000	0000
SV034	SSF3	Servo function selection 3	0000	0000	0000	0000	0000	0000
SV035	SSF4	Servo function selection 4	0000	0000	0000	0000	0000	0000
SV036	PTYP	Power supply type	0000	0000	0000	0000	0000	0000
SV037	JL	Load inertia scale	0	0	0	0	0	0
SV038	FHz1	Notch filter frequency 1	0	0	0	0	0	0
SV039	LMCD	Lost motion compensation timing	0	0	0	0	0	0
SV040	LMCT	Lost motion compensation non-sensitive band /current bias 2	0	0	0	0	0	0
SV041	LMC2	Lost motion compensation 2	0	0	0	0	0	0
SV042	OVS2	Overshooting compensation 2	0	0	0	0	0	0
SV043	OBS1	Disturbance observer filter frequency	0	0	0	0	0	0
SV044	OBS2	Disturbance observer gain	0	0	0	0	0	0
SV045	TRUB	Frictional torque/current bias 3	0	0	0	0	0	0
SV046	FHz2	Notch filter frequency 2	0	0	0	0	0	0
SV047	EC	Inductive voltage compensation gain	100	100	100	100	100	100
SV048	EMGrt	Vertical axis drop prevention time	0	0	0	0	0	0
SV049	PGN1sp	Position loop gain 1 in spindle synchronous control	15	15	15	15	15	15
SV050	PGN2sp	Position loop gain 2 in spindle synchronous control	0	0	0	0	0	0
SV051	DFBT	Dual feedback control time constant	0	0	0	0	0	0
SV052	DFBN	Dual feedback control non-sensitive band	0	0	0	0	0	0
SV053	OD3	Excessive error detection width in special control	0	0	0	0	0	0
SV054	ORE	Overrun detection width in closed loop control	0	0	0	0	0	0
SV055	EMGx	Max. gate off delay time after emergency stop	0	0	0	0	0	0
SV056	EMGt	Deceleration time constant at emergency stop	0	0	0	0	0	0
SV057	SHGC	SHG control gain	0	0	0	0	0	0
SV058	SHGCsp	SHG control gain in spindle synchronous control	0	0	0	0	0	0
SV059	TCNV	Collision detection torque estimating gain	0	0	0	0	0	0
SV060	TLMT	Collision detection level	0	0	0	0	0	0
SV061	DA1NO	D/A output channel 1 data No.	0	0	0	0	0	0
SV062	DA2NO	D/A output channel 2 data No.	0	0	0	0	0	0
SV063	DA1MPY	D/A output channel 1 output scale	0	0	0	0	0	0
SV064	DA2MPY	D/A output channel 2 output scale	0	0	0	0	0	0
SV065	TLC	Tool end compensation spring constant	0	0	0	0	0	0

Parameter No.	Abbrev.	Details	Motor / Unit capacity	Small capacity HA motor HA053N	HA13N	HA23N	HA33N	Large capacity HA motor HA-LF11K2	HA-LF15K2
				01	01	03	03	110	150
		(System parameter area)							
SV081	SPEC2	Servo specification selection 2		0000	0000	0000	0000	0000	0000
SV082	SSF5	Servo function selection 5		0000	0000	0000	0000	0000	0000
SV083	SSF6	Servo function selection 6		0000	0000	0000	0000	0000	0000
SV084	SSF7	Servo function selection 7		0000	0000	0000	0000	0000	0000
SV085	LMCk	Lost motion compensation spring constant		0	0	0	0	0	0
SV086	LMCc	Lost motion compensation viscous coefficient		0	0	0	0	0	0
SV087	FHz4	Notch filter frequency 4		0	0	0	0	0	0
SV088	FHz5	Notch filter frequency 5		0	0	0	0	0	0
SV089 : SV100				0	0	0	0	0	0

(5) HA series (MDS-B-Vx4)

High-gain specifications

Parameter No.	Abbrev.	Details (Motor / Unit capacity)	HA motor 2000 r/min rating HA40N 05	HA80N 10	HA100N 20	HA200N 35	HA300N 45	HA700N 70	HA900N 90
SV001	PC1	Motor side gear ratio	---	---	---	---	---	---	---
SV002	PC2	Machine side gear ratio	---	---	---	---	---	---	---
SV003	PGN1	Position loop gain 1	33	33	33	33	33	25	25
SV004	PGN2	Position loop gain 2	0	0	0	0	0	0	0
SV005	VGN1	Speed loop gain 1	150	150	150	150	150	250	250
SV006	VGN2	Speed loop gain 2	0	0	0	0	0	0	0
SV007	VIL	Speed loop delay compensation	0	0	0	0	0	0	0
SV008	VIA	Speed loop lead compensation	1364	1364	1364	1364	1364	1364	1364
SV009	IQA	Current loop q axis lead compensation	4096	4096	4096	4096	4096	4096	4096
SV010	IDA	Current loop d axis lead compensation	4096	4096	4096	4096	4096	4096	4096
SV011	IQG	Current loop q axis gain	768	768	768	768	768	768	768
SV012	IDG	Current loop d axis gain	768	768	768	768	768	768	768
SV013	ILMT	Current limit value	500	500	500	500	500	500	500
SV014	ILMTsp	Current limit value in special control	500	500	500	500	500	500	500
SV015	FFC	Acceleration rate feed forward gain	0	0	0	0	0	0	0
SV016	LMC1	Lost motion compensation 1	0	0	0	0	0	0	0
SV017	SPEC	Servo specification selection	0000	0000	0000	0000	0000	0000	0000
SV018	PIT	Ball screw pitch	---	---	---	---	---	---	---
SV019	RNG1	Position detector resolution	---	---	---	---	---	---	---
SV020	RNG2	Speed detector resolution	---	---	---	---	---	---	---
SV021	OLT	Overload detection time constant	60	60	60	60	60	60	60
SV022	OLL	Overload detection level	150	150	150	150	150	150	150
SV023	OD1	Excessive error detection width during servo ON	6	6	6	6	6	6	6
SV024	INP	In-position detection width	50	50	50	50	50	50	50
SV025	MTYP	Motor/detector type	xx00	xx01	xx02	xx03	xx04	xx05	xx85
SV026	OD2	Excessive error detection width during servo OFF	6	6	6	6	6	6	6
SV027	SSF1	Servo function selection 1	4000	4000	4000	4000	4000	4000	4000
SV028			0	0	0	0	0	0	0
SV029	VCS	Speed at the change of speed loop gain	0	0	0	0	0	0	0
SV030	IVC	Voltage dead time compensation / current bias 1	0	0	0	0	0	0	0
SV031	OVS1	Overshooting compensation 1	0	0	0	0	0	0	0
SV032	TOF	Torque offset	0	0	0	0	0	0	0
SV033	SSF2	Servo function selection 2	0000	0000	0000	0000	0000	0000	0000
SV034	SSF3	Servo function selection 3	0000	0000	0000	0000	0000	0000	0000
SV035	SSF4	Servo function selection 4	0000	0000	0000	0000	0000	0000	0000
SV036	PTYP	Power supply type	0000	0000	0000	0000	0000	0000	0000
SV037	JL	Load inertia scale	0	0	0	0	0	0	0
SV038	FHz1	Notch filter frequency 1	0	0	0	0	0	0	0
SV039	LMCD	Lost motion compensation timing	0	0	0	0	0	0	0
SV040	LMCT	Lost motion compensation non-sensitive band /current bias 2	0	0	0	0	0	0	0
SV041	LMC2	Lost motion compensation 2	0	0	0	0	0	0	0
SV042	OVS2	Overshooting compensation 2	0	0	0	0	0	0	0
SV043	OBS1	Disturbance observer filter frequency	0	0	0	0	0	0	0
SV044	OBS2	Disturbance observer gain	0	0	0	0	0	0	0
SV045	TRUB	Frictional torque/current bias 3	0	0	0	0	0	0	0
SV046	FHz2	Notch filter frequency 2	0	0	0	0	0	0	0
SV047	EC	Inductive voltage compensation gain	100	100	100	100	100	100	100
SV048	EMGrt	Vertical axis drop prevention time	0	0	0	0	0	0	0
SV049	PGN1sp	Position loop gain 1 in spindle synchronous control	15	15	15	15	15	15	15
SV050	PGN2sp	Position loop gain 2 in spindle synchronous control	0	0	0	0	0	0	0
SV051	DFBT	Dual feedback control time constant	0	0	0	0	0	0	0
SV052	DFBN	Dual feedback control non-sensitive band	0	0	0	0	0	0	0
SV053	OD3	Excessive error detection width in special control	0	0	0	0	0	0	0
SV054	ORE	Overrun detection width in closed loop control	0	0	0	0	0	0	0
SV055	EMGx	Max. gate off delay time after emergency stop	0	0	0	0	0	0	0
SV056	EMGt	Deceleration time constant at emergency stop	0	0	0	0	0	0	0
SV057	SHGC	SHG control gain	0	0	0	0	0	0	0
SV058	SHGCsp	SHG control gain in spindle synchronous control	0	0	0	0	0	0	0
SV059	TCNV	Collision detection torque estimating gain	0	0	0	0	0	0	0
SV060	TLMT	Collision detection level	0	0	0	0	0	0	0
SV061	DA1NO	D/A output channel 1 data No.	0	0	0	0	0	0	0
SV062	DA2NO	D/A output channel 2 data No.	0	0	0	0	0	0	0
SV063	DA1MPY	D/A output channel 1 output scale	0	0	0	0	0	0	0
SV064	DA2MPY	D/A output channel 2 output scale	0	0	0	0	0	0	0
SV065	TLC	Tool end compensation spring constant	0	0	0	0	0	0	0

Parameter			Motor	HA motor 2000 r/min rating						
				HA40N	HA80N	HA100N	HA200N	HA300N	HA700N	HA900N
No.	Abbrev.	Details	Unit capacity	05	10	20	35	45	70	90
		(System parameter area)								
SV081	SPEC2	Servo specification selection 2		0000	0000	0000	0000	0000	0000	0000
SV082	SSF5	Servo function selection 5		0000	0000	0000	0000	0000	0000	0000
SV083	SSF6	Servo function selection 6		0000	0000	0000	0000	0000	0000	0000
SV084	SSF7	Servo function selection 7		0000	0000	0000	0000	0000	0000	0000
SV085	LMCk	Lost motion compensation spring constant		0	0	0	0	0	0	0
SV086	LMCc	Lost motion compensation viscous coefficient		0	0	0	0	0	0	0
SV087	FHz4	Notch filter frequency 4		0	0	0	0	0	0	0
SV088	FHz5	Notch filter frequency 5		0	0	0	0	0	0	0
SV089 : SV100				0	0	0	0	0	0	0

(6) HA series (MDS-B-Vx4)

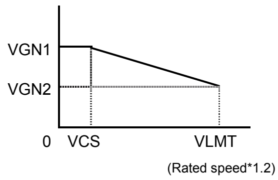
High-gain specifications

Parameter		Motor	HA motor 3000 r/min rating						
			HA43N	HA83N	HA93N	HA103N	HA203N	HA303N	HA703N
No.	Abbrev.	Details / Unit capacity	05	10	20	35	45	70	90
SV001	PC1	Motor side gear ratio	---	---	---	---	---	---	---
SV002	PC2	Machine side gear ratio	---	---	---	---	---	---	---
SV003	PGN1	Position loop gain 1	33	33	33	33	33	33	25
SV004	PGN2	Position loop gain 2	0	0	0	0	0	0	0
SV005	VGN1	Speed loop gain 1	150	150	150	150	150	150	250
SV006	VGN2	Speed loop gain 2	0	0	0	0	0	0	0
SV007	VIL	Speed loop delay compensation	0	0	0	0	0	0	0
SV008	VIA	Speed loop lead compensation	1364	1364	1364	1364	1364	1364	1364
SV009	IQA	Current loop q axis lead compensation	4096	4096	4096	4096	4096	4096	4096
SV010	IDA	Current loop d axis lead compensation	4096	4096	4096	4096	4096	4096	4096
SV011	IQG	Current loop q axis gain	768	768	768	768	768	768	768
SV012	IDG	Current loop d axis gain	768	768	768	768	768	768	768
SV013	ILMT	Current limit value	500	500	500	500	500	500	500
SV014	ILMTsp	Current limit value in special control	500	500	500	500	500	500	500
SV015	FFC	Acceleration rate feed forward gain	0	0	0	0	0	0	0
SV016	LMC1	Lost motion compensation 1	0	0	0	0	0	0	0
SV017	SPEC	Servo specification selection	0000	0000	0000	0000	0000	0000	0000
SV018	PIT	Ball screw pitch	---	---	---	---	---	---	---
SV019	RNG1	Position detector resolution	---	---	---	---	---	---	---
SV020	RNG2	Speed detector resolution	---	---	---	---	---	---	---
SV021	OLT	Overload detection time constant	60	60	60	60	60	60	60
SV022	OLL	Overload detection level	150	150	150	150	150	150	150
SV023	OD1	Excessive error detection width during servo ON	6	6	6	6	6	6	6
SV024	INP	In-position detection width	50	50	50	50	50	50	50
SV025	MTYP	Motor/detector type	xx80	xx81	xx8A	xx82	xx83	xx84	xx85
SV026	OD2	Excessive error detection width during servo OFF	6	6	6	6	6	6	6
SV027	SSF1	Servo function selection 1	4000	4000	4000	4000	4000	4000	4000
SV028			0	0	0	0	0	0	0
SV029	VCS	Speed at the change of speed loop gain	0	0	0	0	0	0	0
SV030	IVC	Voltage dead time compensation / current bias 1	0	0	0	0	0	0	0
SV031	OVS1	Overshooting compensation 1	0	0	0	0	0	0	0
SV032	TOF	Torque offset	0	0	0	0	0	0	0
SV033	SSF2	Servo function selection 2	0000	0000	0000	0000	0000	0000	0000
SV034	SSF3	Servo function selection 3	0000	0000	0000	0000	0000	0000	0000
SV035	SSF4	Servo function selection 4	0000	0000	0000	0000	0000	0000	0000
SV036	PTYP	Power supply type	0000	0000	0000	0000	0000	0000	0000
SV037	JL	Load inertia scale	0	0	0	0	0	0	0
SV038	FHz1	Notch filter frequency 1	0	0	0	0	0	0	0
SV039	LMCD	Lost motion compensation timing	0	0	0	0	0	0	0
SV040	LMCT	Lost motion compensation non-sensitive band /current bias 2	0	0	0	0	0	0	0
SV041	LMC2	Lost motion compensation 2	0	0	0	0	0	0	0
SV042	OVS2	Overshooting compensation 2	0	0	0	0	0	0	0
SV043	OBS1	Disturbance observer filter frequency	0	0	0	0	0	0	0
SV044	OBS2	Disturbance observer gain	0	0	0	0	0	0	0
SV045	TRUB	Frictional torque/current bias 3	0	0	0	0	0	0	0
SV046	FHz2	Notch filter frequency 2	0	0	0	0	0	0	0
SV047	EC	Inductive voltage compensation gain	100	100	100	100	100	100	100
SV048	EMGrt	Vertical axis drop prevention time	0	0	0	0	0	0	0
SV049	PGN1sp	Position loop gain 1 in spindle synchronous control	15	15	15	15	15	15	15
SV050	PGN2sp	Position loop gain 2 in spindle synchronous control	0	0	0	0	0	0	0
SV051	DFBT	Dual feedback control time constant	0	0	0	0	0	0	0
SV052	DFBN	Dual feedback control non-sensitive band	0	0	0	0	0	0	0
SV053	OD3	Excessive error detection width in special control	0	0	0	0	0	0	0
SV054	ORE	Overrun detection width in closed loop control	0	0	0	0	0	0	0
SV055	EMGx	Max. gate off delay time after emergency stop	0	0	0	0	0	0	0
SV056	EMGt	Deceleration time constant at emergency stop	0	0	0	0	0	0	0
SV057	SHGC	SHG control gain	0	0	0	0	0	0	0
SV058	SHGCsp	SHG control gain in spindle synchronous control	0	0	0	0	0	0	0
SV059	TCNV	Collision detection torque estimating gain	0	0	0	0	0	0	0
SV060	TLMT	Collision detection level	0	0	0	0	0	0	0
SV061	DA1NO	D/A output channel 1 data No.	0	0	0	0	0	0	0
SV062	DA2NO	D/A output channel 2 data No.	0	0	0	0	0	0	0
SV063	DA1MPY	D/A output channel 1 output scale	0	0	0	0	0	0	0
SV064	DA2MPY	D/A output channel 2 output scale	0	0	0	0	0	0	0
SV065	TLC	Tool end compensation spring constant	0	0	0	0	0	0	0

Parameter			Motor / Unit capacity	HA motor 3000 r/min rating						
				HA43N	HA83N	HA93N	HA103N	HA203N	HA303N	HA703N
No.	Abbrev.	Details	Unit capacity	05	10	20	35	45	70	90
		(System parameter area)								
SV081	SPEC2	Servo specification selection 2		0000	0000	0000	0000	0000	0000	0000
SV082	SSF5	Servo function selection 5		0000	0000	0000	0000	0000	0000	0000
SV083	SSF6	Servo function selection 6		0000	0000	0000	0000	0000	0000	0000
SV084	SSF7	Servo function selection 7		0000	0000	0000	0000	0000	0000	0000
SV085	LMCk	Lost motion compensation spring constant		0	0	0	0	0	0	0
SV086	LMCc	Lost motion compensation viscous coefficient		0	0	0	0	0	0	0
SV087	FHz4	Notch filter frequency 4		0	0	0	0	0	0	0
SV088	FHz5	Notch filter frequency 5		0	0	0	0	0	0	0
SV089 : SV100				0	0	0	0	0	0	0

3-2-3 Servo parameter list

High-gain specifications

No.	Abbrev.	Parameter name	Explanation	Setting range (Unit)
SV001	PC1*	Motor side gear ratio	Set the motor side and machine side gear ratio. 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 cause an alarm.	1 to 32767
SV002	PC2*	Machine side gear ratio		1 to 32767
SV003	PGN1	Position loop gain 1	Set the position loop gain. The standard setting is "47". The higher the setting value is, the more precisely the command can be followed and the shorter the positioning time gets, however, note that a bigger shock is applied to the machine during acceleration/deceleration. When using the SHG control, also set SV004 (PGN2) and SV057 (SHGC).	1 to 200 (rad/s)
SV004	PGN2	Position loop gain 2	When using the SHG control, also set SV003 (PGN1) and SV057 (SHGC). When not using the SHG control, set to "0".	0 to 999 (rad/s)
SV005	VGN1	Speed loop gain 1	Set the speed loop gain. Set this according to the load inertia size. 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 be 70 to 80% of the value at the time when the vibration stops.	1 to 999
SV006	VGN2	Speed loop gain 2	If the noise is bothersome at high speed during rapid traverse, etc, lower the speed loop gain. As in the right figure, set the speed loop gain of the speed 1.2 times as fast as the motor's rated speed, and use this with SV029 (VCS). When not using, set to "0". 	-1000 to 1000
SV007	VIL	Speed loop delay compensation	Set this when the limit cycle occurs in the full-closed loop, or overshooting occurs in positioning. Select the control method with SV027 (SSF1)/bit1, 0 (vcnt). Normally, use "Changeover type 2". When you set this parameter, make sure to set the torque offset (SV032 (TOF)). When not using, set to "0". No changeover When SV027 (SSF1)/bit1, 0 (vcnt)=00 The delay compensation control is always valid. Changeover type 1 When SV027 (SSF1)/bit1, 0 (vcnt)=01 The delay compensation control works when the command from the NC is "0". Overshooting that occurs during pulse feeding can be suppressed. Changeover type 2 When SV027 (SSF1)/bit1, 0 (vcnt)=10 The delay compensation control works when the command from the NC is "0" and the position droop is "0". Overshooting or the limit cycle that occurs during pulse feeding or positioning can be suppressed.	0 to 32767
SV008	VIA	Speed loop lead compensation	Set the gain of the speed loop integration control. The standard setting is "1364". During the SHG control, the standard setting is "1900". Adjust the value by increasing/decreasing it by about 100 at a time. Raise this value to improve contour tracking precision in high-speed cutting. Lower this value when the position droop vibrates (10 to 20Hz).	1 to 9999
SV009	IQA	Current loop q axis lead compensation	Set the gain of current loop. As this setting is determined by the motor's electrical characteristics, the setting is fixed for each type of motor. Set the standard values for all the parameters depending on each motor type.	1 to 20480
SV010	IDA	Current loop d axis lead compensation		
SV011	IQG	Current loop q axis gain		1 to 8192
SV012	IDG	Current loop d axis gain		

Parameters with an asterisk * in the abbreviation, such as PC1*, are validated with the NC power turned ON again.

High-gain specifications

No.	Abbrev.	Parameter name	Explanation	Setting range (Unit)
SV013	ILMT	Current limit value	Set the normal current (torque) limit value. (Limit values for both + and - direction.) When the value is "500" (a standard setting), the maximum torque is determined by the specification of the motor.	0 to 999 (Stall [rated] current %)
SV014	ILMTsp	Current limit value in special control	Set the current (torque) limit value in a special control (initial absolute position setting, stopper control, etc). (Limit values for both of the + and - directions.) Set to "500" when not using.	0 to 999 (Stall [rated] current %)
SV015	FFC	Acceleration rate feed forward gain	When a relative error in the synchronous control is large, apply this parameter to the axis that is delaying. The standard setting value is "0". For the SHG control, set to "100". To adjust a relative error in acceleration/deceleration, increase the value by 50 to 100 at a time.	0 to 999 (%)
SV016	LMC1	Lost motion compensation 1	Set this when the protrusion (that occurs due to the non-sensitive band by friction, torsion, backlash, etc.) at quadrant change is too large. This compensates the torque at quadrant change. This is valid only when the lost motion compensation (SV027 (SSF1.lmc)) is selected.	
			Type 1: When SV027 (SSF1)/bit9, 8 (lmc)=01 Set the compensation amount based on the motor torque before the quadrant change. The standard setting is "100". Setting to "0" means the compensation amount is zero. Normally, use Type 2.	-1 to 200 (%)
			Type 2: When SV027 (SSF1)/bit9, 8 (lmc)=10 Set the compensation amount based on the stall (rated) current of the motor. The standard setting is double of the friction torque. Setting to "0" means the compensation amount is zero.	-1 to 200 (Stall [rated] current %)
			Type3 When SV082(SSF5)/bit1(lmc3)＝1 Set the compensation amount based on the stall current of the motor. Setting on SV082/bit1(lmc3) has a priority over SV027/bit9,8(lmc)	-1 to 200 (Stall current %)
			When you wish different compensation amount depending on the direction When SV041 (LMC2) is "0", compensate with the value of SV016 (LMC1) in both of the + and -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 won't be performed in the direction of the command.	

Parameters with an asterisk * in the abbreviation, such as PC1*, are validated with the NC power turned ON again.

High-gain specifications

<table>
<tr><th>No.</th><th>Abbrev.</th><th>Parameter name</th><th>Explanation</th><th>Setting range (Unit)</th></tr>
<tr><td>SV017</td><td>SPEC*</td><td>Servo specification selection</td><td>
<table>
<tr><td>F</td><td>E</td><td>D</td><td>C</td><td>B</td><td>A</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td colspan="4">spm</td><td></td><td></td><td>mpt</td><td>mp</td><td>abs</td><td></td><td>vdir</td><td>fdir</td><td>vfb</td><td>seqh</td><td>dfbx</td><td>fdir2</td></tr>
</table>
<table>
<tr><th colspan="2">bit</th><th>Meaning when "0" is set</th><th>Meaning when "1" is set</th></tr>
<tr><td>0</td><td>fdir2</td><td>Speed feedback forward polarity</td><td>Speed feedback reverse polarity</td></tr>
<tr><td>1</td><td>dfbx</td><td>Dual feedback control stop</td><td>Dual feedback control start</td></tr>
<tr><td>2</td><td>seqh</td><td></td><td></td></tr>
<tr><td>3</td><td>vfb</td><td>Speed feedback filter stop</td><td>Speed feedback filter stop (2250Hz)</td></tr>
<tr><td>4</td><td>fdir</td><td>Position feedback forward polarity</td><td>Position feedback reverse polarity</td></tr>
<tr><td>5</td><td>vdir</td><td>Standard setting</td><td>HA motor (4 pole motor)
Detector installation position 90 degrees (B, D)</td></tr>
<tr><td>6</td><td></td><td></td><td></td></tr>
<tr><td>7</td><td>abs</td><td>Incremental control</td><td>Absolute position control</td></tr>
<tr><td>8</td><td>mp</td><td>MP scale 360P (2mm pitch)</td><td>MP scale 720P (1mm pitch)</td></tr>
<tr><td>9</td><td>mpt</td><td>MP scale ABS detection NC control</td><td>MP scale ABS detection automatic (Standard setting)</td></tr>
<tr><td>A</td><td></td><td></td><td></td></tr>
<tr><td>B</td><td></td><td></td><td></td></tr>
<tr><td>C</td><td rowspan="4">spm</td><td colspan="2" rowspan="4">0 : Setting for normal use
1 : When using the S type drive unit (Only in the case of MDS-C1-Vx)
2 to F : Setting probhited</td></tr>
<tr><td>D</td></tr>
<tr><td>E</td></tr>
<tr><td>F</td></tr>
</table>
(Note) Set to "0" for bits with no particular description.</td><td>HEX setting</td></tr>
</table>

Parameters with an asterisk * in the abbreviation, such as PC1*, are validated with the NC power turned ON again.

High-gain specifications

<table>
<tr><th>No.</th><th>Abbrev.</th><th>Parameter name</th><th>Explanation</th><th>Setting range (Unit)</th></tr>
<tr><td>SV018</td><td>PIT*</td><td>Ball screw pitch</td><td>Set the ball screw pitch. Set to "360" for the rotary axis.</td><td>1 to 32767
(mm/rev)</td></tr>
<tr><td rowspan="2">SV019</td><td rowspan="2">RNG1*</td><td rowspan="2">Position detector resolution</td><td>In the case of the semi-closed loop control
Set the same value as SV020 (RNG2).
(Refer to the explanation of SV020.)</td><td>1 to 9999
(kp/rev)</td></tr>
<tr><td>In the case of the full-closed loop control
Set the number of pulses per ball screw pitch.
<table>
<tr><th>Detector model name</th><th>Resolution</th><th>SV019 setting</th></tr>
<tr><td>OHE25K-ET, OHA25K-ET</td><td>100,000 (p/rev)</td><td>100</td></tr>
<tr><td>OSE104-ET,OSA104-ET</td><td>100,000 (p/rev)</td><td>100</td></tr>
<tr><td>OSE105-ET,OSA105-ET</td><td>1,000,000 (p/rev)</td><td>1000</td></tr>
<tr><td>Relative position detection scale</td><td>Refer to detector specification manual</td><td>PIT/Resolution (μm)</td></tr>
<tr><td>AT41 (Mitsutoyo)</td><td>1 (μm/p)</td><td>The same as SV018 (PIT)</td></tr>
<tr><td>FME type, FLE type (Futaba)</td><td>Refer to detector specification manual</td><td>PIT/Resolution (μm)</td></tr>
<tr><td>MP type (Mitsubishi Heavy Industries)</td><td>Refer to detector specification manual</td><td>PIT/Resolution (μm)</td></tr>
<tr><td>AT342 (Mitsutoyo)</td><td>0.5 (μm/p)</td><td>Twice as big as SV018 (PIT)</td></tr>
<tr><td>AT343 (Mitsutoyo)</td><td>0.05 (μm/p)</td><td>20 times as big as SV018 (PIT)</td></tr>
<tr><td>AT543 (Mitsutoyo)</td><td>0.05 (μm/p)</td><td>20 times as big as SV018 (PIT)</td></tr>
<tr><td>LC191M (Heidenhain)</td><td>0.1, 0.05 (μm/p)</td><td>PIT/Resolution (μm)</td></tr>
<tr><td>LC491M (Heidenhain)</td><td>0.05 (μm/p)</td><td>PIT/Resolution (μm)</td></tr>
<tr><td>RCN223(Heidenhain)</td><td>8,000,000(p/rev)</td><td>8000</td></tr>
<tr><td>RCN723(Heidenhain)</td><td>8,000,000(p/rev)</td><td>8000</td></tr>
<tr><td>MDS-B-HR</td><td>-</td><td>PIT/scale(μm)</td></tr>
</table></td><td>1 to 30000
(kp/pit)</td></tr>
<tr><td>SV020</td><td>RNG2*</td><td>Speed detector resolution</td><td>Set the number of pulses per one revolution of the motor end detector.
<table>
<tr><th>Detector model name</th><th>SV020 setting</th></tr>
<tr><td>OSE104, OSA104</td><td>100</td></tr>
<tr><td>OSE105, OSA105</td><td>1000</td></tr>
</table></td><td>1 to 9999
(kp/rev)</td></tr>
<tr><td>SV021</td><td>OLT</td><td>Overload detection time constant</td><td>Set the detection time constant of Overload 1 (Alarm 50).
Set to "60" as a standard. (For machine tool builder adjustment.)</td><td>1 to 999
(s)</td></tr>
<tr><td>SV022</td><td>OLL</td><td>Overload detection level</td><td>Set the current detection level of Overload 1 (Alarm 50) in respect to the stall (rated) current.
Set to "150" as a standard. (For machine tool builder adjustment.)</td><td>110 to 500
(Stall [rated] current %)</td></tr>
<tr><td>SV023</td><td>OD1</td><td>Excessive error detection width during servo ON</td><td>Set the excessive error detection width when servo ON.
<Standard setting value> $OD1=OD2=\dfrac{\text{Rapid traverse rate (mm/min)}}{60 \times PGN1} \div 2$ (mm)
When "0" is set, the excessive error detection will not be performed.</td><td>0 to 32767
(mm)</td></tr>
<tr><td>SV024</td><td>INP</td><td>In-position detection width</td><td>Set the in-position detection width.
Set the accuracy required for the machine.
The lower the setting is, the higher the positioning accuracy gets, however, the cycle time (setting time) becomes longer. The standard setting is "50".</td><td>0 to 32767
(μm)</td></tr>
</table>

Parameters with an asterisk * in the abbreviation, such as PC1*, are validated with the NC power turned ON again.

High-gain specifications

No.	Abbrev.	Parameter name	Explanation
SV025	MTYP*	Motor/Detector type	(see below)

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
pen				ent				mtyp							

bit		Explanation
0–7	mtyp	Set the motor type. Set this along with SV017 (SPEC)/spm.

[1] When SV017/spm=0 (Normal drive unit)

Setting	0x	1x	2x	3x	4x	5x	6x	7x
x0	HA40N		HA50L	HA53L				
x1	HA80N		HA100L	HA103L				
x2	HA100N		HA200L	HA203L				
x3	HA200N		HA300L	HA303L				
x4	HA300N		HA500L	HA503L				
x5	HA700N							
x6	HA900N							
x7			HALH11K2					
x8			HALH15K2					
x9								
xA			HA150L	HA153L				
xB								
xC								
xD								
xE			HALF11K2					
xF			HA-LF15K2					

Setting	8x	9x	Ax	Bx	Cx	Dx	Ex	Fx
x0	HA43N			HC52	HC53			
x1	HA83N			HC102	HC103		HC103R	
x2	HA103N			HC152	HC153		HC153R	
x3	HA203N			HC202	HC203		HC203R	
x4	HA303N			HC352	HC353		HC353R	
x5	HA703N			HC452	HC453		HC503R	
x6				HC702	HC703			
x7				HC902				
x8								
x9								
xA	HA93N							
xB								
xC	HA053N							
xD	HA13N							
xE	HA23N							
xF	HA33N							

[2] When SV017/spm=1 (S type drive unit)

Setting	8x	9x	Ax	Bx	Cx	Dx	Ex	Fx
x0								
x1								
x2								
x3								
x4			HC353					
x5		HC452	HC453					
x6		HC702	HC703					
x7		HC902						
x8								
x9								
xA								
xB								
xC								
xD								
xE								
xF								

Parameters with an asterisk * in the abbreviation, such as PC1*, are validated with the NC power turned ON again.

High-gain specifications

<table>
<tr><th>No.</th><th>Abbrev.</th><th>Parameter name</th><th>Explanation</th><th>Setting range (Unit)</th></tr>
<tr><td>SV025</td><td>MTYP*</td><td>Motor/Detector type</td><td>
<table>
<tr><td>8
9
A
B</td><td>ent</td><td rowspan="2">Set the detector type.
Set the position detector type for "pen", and the speed detector type for "ent". In the case of the semi-closed loop control, set the same value for "pen" and "ent".
<table>
<tr><th>Detector model name</th><th>pen setting</th><th>ent setting</th></tr>
<tr><td>OSE104</td><td>0 (Note)</td><td>0</td></tr>
<tr><td>OSA104</td><td>1 (Note)</td><td>1</td></tr>
<tr><td>OSE105, OSA105</td><td>2 (Note)</td><td>2</td></tr>
<tr><td></td><td>3 (Note)</td><td>3</td></tr>
<tr><td>OHE25K-ET, OSE104-ET</td><td>4</td><td>Setting impossible</td></tr>
<tr><td>OHA25K-ET, OSA104-ET</td><td>5</td><td>Setting impossible</td></tr>
<tr><td>OSE105-ET, OSA105-ET, RCN223, RCN723 (Heidenhain)</td><td>6</td><td>Setting impossible</td></tr>
<tr><td></td><td>7</td><td>Setting impossible</td></tr>
<tr><td>Relative position detection scale, MP type (Mitsubishi Heavy Industries)</td><td>8</td><td>Setting impossible</td></tr>
<tr><td>AT41 (Mitsutoyo), FME type, FLE type (Futaba)</td><td>9</td><td>Setting impossible</td></tr>
<tr><td>AT342, AT343, AT543 (Mitsutoyo), LC191M/491M (Heidenhain), MDS-B-HR</td><td>A</td><td>Setting impossible</td></tr>
<tr><td></td><td>B</td><td>Setting impossible</td></tr>
<tr><td>The setting of the slave axis in the speed/current synchronization control. When the master axis is the semi-closed control.</td><td>C</td><td>C
(Current synchronization)</td></tr>
<tr><td>The setting of the slave axis in the speed/ current synchronization control. When the master axis is the full-closed control.
(Current synchronization control is only for MDS-C1-V2.)</td><td>D</td><td>E
(Current synchronization)</td></tr>
<tr><td></td><td>E</td><td>Setting impossible</td></tr>
<tr><td></td><td>F</td><td>Setting impossible</td></tr>
</table>
(Note) Setting for semi-closed loop control</td></tr>
<tr><td>C
D
E
F</td><td>pen</td></tr>
</table>
</td><td></td></tr>
<tr><td>SV026</td><td>OD2</td><td>Excessive error detection width during servo OFF</td><td>Set the excessive error detection width when servo ON.
For the standard setting, refer to the explanation of SV023 (OD1).
When "0" is set, the excessive error detection will not be performed.</td><td>0 to 32767
(mm)</td></tr>
</table>

Parameters with an asterisk * in the abbreviation, such as PC1*, are validated with the NC power turned ON again.

High-gain specifications

<table>
<tr><th>No.</th><th>Abbrev.</th><th>Parameter name</th><th>Explanation</th><th>Setting range
(Unit)</th></tr>
<tr><td>SV027</td><td>SSF1</td><td>Servo function selection 1</td><td colspan="2">
HEX setting
<table>
<tr><td>F</td><td>E</td><td>D</td><td>C</td><td>B</td><td>A</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td>aflt</td><td>zrn2</td><td colspan="2">afse</td><td colspan="2">ovs</td><td colspan="2">lmc</td><td>omr</td><td>zrn3</td><td colspan="2">vfct</td><td></td><td>upc</td><td colspan="2">vcnt</td></tr>
</table>
<table>
<tr><th colspan="2">bit</th><th>Meaning when "0" is set</th><th>Meaning when "1" is set</th></tr>
<tr><td>0
1</td><td>vcnt</td><td colspan="2">Set the execution changeover type of the speed loop delay compensation.
00: Delay compensation changeover invalid 10: Delay compensation type 2
01: Delay compensation changeover type 1 11: Setting prohibited</td></tr>
<tr><td>2</td><td>upc</td><td>Starting torque compensation invalid</td><td>Starting torque compensation valid</td></tr>
<tr><td>3</td><td></td><td></td><td></td></tr>
<tr><td>4
5</td><td>vfct</td><td colspan="2">Set the number of compensation pulses of the jitter compensation.
00: Jitter compensation invalid 10: Jitter compensation 2 pulses
01: Jitter compensation 1 pulse 11: Jitter compensation 3 pulses</td></tr>
<tr><td>6</td><td>zrn3</td><td colspan="2">ABZ phase scale: Set to "1" to fix Z-phase detection edge.
Absolute position scale: Set to "1" in using AT342/343, LC191M/491M.</td></tr>
<tr><td>7</td><td>omr</td><td>Machine end compensation invalid</td><td>Machine end compensation valid</td></tr>
<tr><td>8
9</td><td>lmc</td><td colspan="2">Set the compensation amount with SV016 (LMC1) and SV041 (LMC2).
00: Lost motion compensation stop 10: Lost motion compensation type 2
01: Lost motion compensation type 1 11: Setting prohibited</td></tr>
<tr><td>A
B</td><td>ovs</td><td colspan="2">Set the compensation amount with SV031 (OVS1) and SV042 (OVS2).
00: Overshooting compensation stop 10: Overshooting compensation type 2
01: Overshooting compensation type 1 11: Overshooting compensation type 3</td></tr>
<tr><td>C
D</td><td>afse</td><td colspan="2">00: Adaptive filter sensitivity standard
11: Adaptive filter sensitivity increase (Set 2bits at a time)</td></tr>
<tr><td>E</td><td>zrn2</td><td colspan="2">Set to "1".</td></tr>
<tr><td>F</td><td>aflt</td><td>Adaptive filter stop</td><td>Adaptive filter start</td></tr>
</table>
(Note) Set to "0" for bits with no particular description.
</td></tr>
<tr><td>SV028</td><td></td><td></td><td>Not used. Set to "0".</td><td>0</td></tr>
<tr><td>SV029</td><td>VCS</td><td>Speed at the change of speed loop gain</td><td>If the noise is bothersome at high speed during rapid traverse, etc, lower the speed loop gain.
Set the speed at which the speed loop gain changes, and use this with SV006 (VGN2). (Refer to SV006)
When not using, set to "0".</td><td>0 to 9999
(r/min)</td></tr>
<tr><td>SV030</td><td colspan="3">The higher order 8bits and lower order 8bits are used for different functions.
"The setting value of SV030" = (Ic x 256) + IVC
<table>
<tr><th>Abbrev.</th><th>Parameter name</th><th>Explanation</th><th>Setting range
(Unit)</th></tr>
<tr><td>IVC
(Low order)</td><td>Voltage dead time compensation</td><td>When 100% is set, the voltage equivalent to the logical non-energized time will be compensated.
When "0" is set, a 100% compensation will be performed.
Adjust in increments of 10% from the default value 100%.
If increased too much, vibration or vibration noise may be generated.</td><td>0 to 255
(%)</td></tr>
<tr><td>Icx
(High order)</td><td>Current bias 1</td><td>Normally set to "0".
Use this in combination with SV040 and the high order 8bits of SV045.</td><td>0 to 127</td></tr>
</table>
</td><td>0 to 32767</td></tr>
</table>

Parameters with an asterisk * in the abbreviation, such as PC1*, are validated with the NC power turned ON again.

High-gain specifications

<table>
<tr><th>No.</th><th>Abbrev.</th><th>Parameter name</th><th>Explanation</th><th>Setting range
(Unit)</th></tr>
<tr><td>SV031</td><td>OVS1</td><td>Overshooting compensation 1</td><td>Set this if overshooting occurs during positioning. This compensates the motor torque during positioning.
This is valid only when the overshooting compensation SV027 (SSF1.ovs) is selected.<hr>Type 1: When SV027 (SSF1)/bitB, A (ovs)=01
Normally use type 3 to provide compatibility with the old method.<hr>Type 2: When SV027 (SSF1)/bitB, A (ovs)=10
Normally use type 3 to provide compatibility with the old method..<hr>Type 3: When SV027 (SSF1)/bitB, A (ovs)=11
Increase the amount in increments of 1%, and find the amount where overshooting does not occur. Also set SV034 (SSF3)/bit F to C (ovsn) when using feed forward control.<hr>When you wish different compensation amount depending on the direction
When SV042 (OVS2) is "0", compensate with the value of SV031 (OVS1) in both of the + and -directions.
If you wish to change 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 won’t be performed in the direction of the command.</td><td>-1 to 100
(Stall [rated] current %)</td></tr>
<tr><td>SV032</td><td>TOF</td><td>Torque offset</td><td>Set the unbalance torque of vertical axis and inclined axis.</td><td>-100 to 100
(Stall [rated] current %)</td></tr>
<tr><td>SV033</td><td>SSF2</td><td>Servo function selection 2</td><td>
<table>
<tr><td>F</td><td>E</td><td>D</td><td>C</td><td>B</td><td>A</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td>hvx</td><td>svx</td><td colspan="3">nfd2</td><td>nf3</td><td colspan="3">nfd1</td><td>zck</td></tr>
</table>
<table>
<tr><th colspan="2">bit</th><th>Meaning when "0" is set</th><th>Meaning when "1" is set</th></tr>
<tr><td>0</td><td>zck</td><td>Z phase check valid (Alarm 42)</td><td>Z phase check invalid</td></tr>
<tr><td>1
2
3</td><td>nfd1</td><td colspan="2">Set the filter depth for Notch filter 1 (SV038).
Value 000 001 010 011 100 101 110 111
Depth (dB) Infntly deep -18.1 -12.0 -8.5 -6.0 -4.1 -2.5 -1.2
Deep← Shallow→</td></tr>
<tr><td>4</td><td>nf3</td><td>Notch filter 3 stop</td><td>Notch filter 3 start (1125Hz)</td></tr>
<tr><td>5
6
7</td><td>nfd2</td><td colspan="2">Set the filter depth of Notch filter 2 (SV046).
Value 000 001 010 011 100 101 110 111
Depth (dB) Infntly deep -18.1 -12.0 -8.5 -6.0 -4.1 -2.5 -1.2
Deep← Shallow→</td></tr>
<tr><td>8</td><td>svx</td><td colspan="2" rowspan="2">Set the performance mode of the servo control. (only for MDS-C1-VX)
00: By current loop gain 10: High gain mode selected
01: MDS-B-Vx compatible mode selected 11: High gain mode selected</td></tr>
<tr><td>9</td><td>hvx</td></tr>
<tr><td>A</td><td></td><td></td><td></td></tr>
<tr><td>B</td><td></td><td></td><td></td></tr>
<tr><td>C</td><td></td><td></td><td></td></tr>
<tr><td>D</td><td></td><td></td><td></td></tr>
<tr><td>E</td><td></td><td></td><td></td></tr>
<tr><td>F</td><td></td><td></td><td></td></tr>
</table>
(Note) Set to "0" for bits with no particular description.</td><td></td></tr>
</table>

Parameters with an asterisk * in the abbreviation, such as PC1*, are validated with the NC power turned ON again.

High-gain specifications

<table>
<tr><th>No.</th><th>Abbrev.</th><th>Parameter name</th><th>Explanation</th><th>Setting range
(Unit)</th></tr>
<tr><td>SV034</td><td>SSF3</td><td>Servo function selection 3</td><td>
<table>
<tr><td>F</td><td>E</td><td>D</td><td>C</td><td>B</td><td>A</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td colspan="4">ovsn</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>has2</td><td>has1</td></tr>
</table>
<table>
<tr><th colspan="2">bit</th><th>Meaning when "0" is set</th><th>Meaning when "1" is set</th></tr>
<tr><td>0</td><td>has1</td><td>Setting for normal use.
(Except for HC)</td><td>HAS control 1 valid
(HC: High acceleration rate support)</td></tr>
<tr><td>1</td><td>has2</td><td>Setting for normal use.
(Except for HC)</td><td>HAS control 2 valid
(HC; Overshooting support)</td></tr>
<tr><td>2</td><td></td><td></td><td></td></tr>
<tr><td>3</td><td></td><td></td><td></td></tr>
<tr><td>4</td><td></td><td></td><td></td></tr>
<tr><td>5</td><td></td><td></td><td></td></tr>
<tr><td>6</td><td></td><td></td><td></td></tr>
<tr><td>7</td><td></td><td></td><td></td></tr>
<tr><td>8</td><td></td><td></td><td></td></tr>
<tr><td>9</td><td></td><td></td><td></td></tr>
<tr><td>A</td><td></td><td></td><td></td></tr>
<tr><td>B</td><td></td><td></td><td></td></tr>
<tr><td>C
D
E
F</td><td>ovsn</td><td colspan="2">Set the non-sensitive band of the overshooting compensation type 3 in increments of 2μm at a time.
In the feed forward control, the non-sensitive band of the model position droop is set, and overshooting of the model is ignored. Set 2μm (0001) as a standard.</td></tr>
</table>
(Note) Set to "0" for bits with no particular description.
</td><td></td></tr>
<tr><td>SV035</td><td>SSF4</td><td>Servo function selection 4</td><td>
<table>
<tr><td>F</td><td>E</td><td>D</td><td>C</td><td>B</td><td>A</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td>clt</td><td colspan="3">clG1</td><td>cl2n</td><td>clet</td><td colspan="2">cltq</td><td></td><td>iup</td><td colspan="6">tdt</td></tr>
</table>
<table>
<tr><th colspan="2">bit</th><th>Meaning when "0" is set</th><th>Meaning when "1" is set</th></tr>
<tr><td>0
1
2
3
4
5</td><td>tdt</td><td colspan="2">Td creation time setting
Set to "0". (For machine tool builder adjustment)</td></tr>
<tr><td>6</td><td>iup</td><td colspan="2">Set to "1" when using any of motors from HC152 to HC702 and from HC153 to HC453.</td></tr>
<tr><td>7</td><td></td><td></td><td></td></tr>
<tr><td>8
9</td><td>Cltq</td><td colspan="2">Set the retracting torque for collision detection in respect to the maximum torque of the motor.
00: 100% 01: 90% 10: 80% (Standard) 11: 70%</td></tr>
<tr><td>A</td><td>clet</td><td>Setting for normal use</td><td>The disturbance torque peak of the latest two seconds is displayed in MPOS of the servo monitor screen.</td></tr>
<tr><td>B</td><td>cl2n</td><td>Collision detection method 2 valid</td><td>Collision detection method 2 invalid</td></tr>
<tr><td>C
D
E</td><td>clG1</td><td colspan="2">Collision detection method 1
Set the collision detection level during cutting feed (G1).
The G1 collision detection level=SV060 × clG1.
When clG1=0, the collision detection method 1 during cutting feed won't function.</td></tr>
<tr><td>F</td><td>clt</td><td>Setting for normal use</td><td>The guide value of the SV059 setting value is displayed in MPOS of the servo monitor screen.</td></tr>
</table>
(Note) Set to "0" for bits with no particular description.
</td><td></td></tr>
</table>

Parameters with an asterisk * in the abbreviation, such as PC1*, are validated with the NC power turned ON again.

High-gain specifications

<table>
<tr><th>No.</th><th>Abbrev.</th><th>Parameter name</th><th>Explanation</th><th>Setting range (Unit)</th></tr>
<tr><td>SV036</td><td>PTYP*</td><td>Power supply type</td><td colspan="2">
HEX setting
<table>
<tr><td>F</td><td>E</td><td>D</td><td>C</td><td>B</td><td>A</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td colspan="4">amp</td><td colspan="4">rtyp</td><td colspan="8">ptyp</td></tr>
</table>
<table>
<tr><th colspan="2">bit</th><th>Explanation</th></tr>
<tr><td>0
1
2
3
4
5
6
7</td><td>ptyp</td><td>When the CN4 connector of the drive unit and the power supply are connected, setting below is necessary.
To validate the external emergency stop function, add 40h.
<table>
<tr><th>Setting</th><th>0x</th><th>1x</th><th>2x</th><th>3x</th><th>4x</th><th>5x</th><th>6x</th><th>7x</th><th>8x</th></tr>
<tr><td>x0</td><td>Not used</td><td></td><td></td><td>CV-300</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>x1</td><td></td><td>CV-110</td><td></td><td></td><td></td><td></td><td></td><td></td><td>CR-10</td></tr>
<tr><td>x2</td><td></td><td></td><td>CV-220</td><td></td><td></td><td></td><td></td><td></td><td>CR-15</td></tr>
<tr><td>x3</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>CR-22</td></tr>
<tr><td>x4</td><td>CV-37</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>CR-37</td></tr>
<tr><td>x5</td><td></td><td>CV-150</td><td></td><td></td><td>MDS-B-CVE-450</td><td>MDS-B-CVE-550</td><td></td><td></td><td></td></tr>
<tr><td>x6</td><td>CV-55</td><td></td><td>CV-260</td><td></td><td></td><td></td><td></td><td></td><td>CR-55</td></tr>
<tr><td>x7</td><td></td><td></td><td></td><td>CV-370</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>x8</td><td>CV-75</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>CR-75</td></tr>
<tr><td>x9</td><td></td><td>CV-185</td><td></td><td></td><td></td><td></td><td></td><td></td><td>CR-90</td></tr>
</table></td></tr>
<tr><td>8
9
A
B</td><td>rtyp</td><td>Set the regenerative resistor type when MDS-A-CR is used.
<table>
<tr><th>Setting</th><th>Regenerative resistor model name</th><th>Resistance value</th><th>Capacity</th></tr>
<tr><td>0</td><td colspan="3">MDS-C1-CV (Setting when using power supply regeneration)</td></tr>
<tr><td>1</td><td>GZG200W260HMJ</td><td>26Ω</td><td>80W</td></tr>
<tr><td>2</td><td>GZG300W130HMJ × 2</td><td>26Ω</td><td>150W</td></tr>
<tr><td>3</td><td>MR-RB30</td><td>13Ω</td><td>300W</td></tr>
<tr><td>4</td><td>MR-RB50</td><td>13Ω</td><td>500W</td></tr>
<tr><td>5</td><td>GZG200W200HMJ × 3</td><td>6.7Ω</td><td>350W</td></tr>
<tr><td>6</td><td>GZG300W200HMJ × 3</td><td>6.7Ω</td><td>500W</td></tr>
<tr><td>7</td><td>R-UNIT-1</td><td>30Ω</td><td>700W</td></tr>
<tr><td>8</td><td>R-UNIT-2</td><td>15Ω</td><td>700W</td></tr>
<tr><td>9</td><td>R-UNIT-3</td><td>15Ω</td><td>2100W</td></tr>
<tr><td>A to F</td><td>No setting</td><td></td><td></td></tr>
</table></td></tr>
<tr><td>C
D
E
F</td><td>amp</td><td>Always set "0".</td></tr>
</table>
</td></tr>
<tr><td>SV037</td><td>JL</td><td>Load inertia scale</td><td>Set "the motor inertia + motor axis conversion load inertia" in respect to the motor inertia.
$SV037(JL) = \frac{Jl+Jm}{Jm} \times 100$ Jm: Motor inertia
Jl: Motor axis conversion load inertia</td><td>0 to 5000
(%)</td></tr>
<tr><td>SV038</td><td>FHz1</td><td>Notch filter frequency 1</td><td>Set the vibration frequency to suppress if machine vibration occurs.
(Valid at 36 or more) When not using, set to "0".</td><td>0 to 9000
(Hz)</td></tr>
</table>

Parameters with an asterisk * in the abbreviation, such as PC1*, are validated with the NC power turned ON again.

High-gain specifications

<table>
<tr><th>No.</th><th>Abbrev.</th><th>Parameter name</th><th>Explanation</th><th>Setting range (Unit)</th></tr>
<tr><td>SV039</td><td>LMCD</td><td>Lost motion compensation timing</td><td>Set this when the lost motion compensation type2 timing doest not match.
Adjust by increasing the value by 10 at a time.</td><td>0 to 2000
(ms)</td></tr>
<tr><td>SV040</td><td colspan="3">For SV040, the hex. value’s higher order 8bits and lower order 8bits are used for different functions.
"Setting value of SV040" = (Icy×256) + LMCT
<table>
<tr><th>Abbrev.</th><th>Parameter name</th><th>Explanation</th><th>Setting range (Unit)</th></tr>
<tr><td>LMCT
(Low order)</td><td>Lost motion compensation non-sensitive band</td><td>Set the non-sensitive band of the lost motion compensation in the feed forward control.
When "0" is set, the actual value that is set is 2µm.
Adjust by increasing by 1µm at a time.</td><td>0 to 100
(µm)</td></tr>
<tr><td>Icy
(High order)</td><td>Current bias 2</td><td>Normally, set to "40" if you use HC202 to HC902, HC203 to HC703.
Use this in combination with SV030 and the high order 8bits of SV045.</td><td>0 to 127</td></tr>
</table></td><td>0 to 32767</td></tr>
<tr><td>SV041</td><td>LMC2</td><td>Lost motion compensation 2</td><td>Set this with SV016 (LMC1) only when you wish to set the lost motion compensation amount to be different depending on the command directions. Set to "0" as a standard.</td><td>-1 to 200
(Stall [rated] current %)</td></tr>
<tr><td>SV042</td><td>OVS2</td><td>Overshooting compensation 2</td><td>Set this with SV031 (OVS1) only when you wish to set the overshooting compensation amount to be different depending on the command directions. Set to "0" as a standard.</td><td>-1 to 100
(Stall [rated] current %)</td></tr>
<tr><td>SV043</td><td>OBS1</td><td>Disturbance observer filter frequency</td><td>Set the disturbance observer filter band. Set to "100" as a standard.
To use the disturbance observer, also set SV037 (JL), SV044 (OBS2) and SV082/bit7 (obshj). When not using, set to "0".</td><td>0 to 1000
(rad/s)</td></tr>
<tr><td>SV044</td><td>OBS2</td><td>Disturbance observer gain</td><td>Set the disturbance observer gain. The standard setting is "100" to "300".
To use the disturbance observer, also set SV037 (JL), SV043 (OBS1) and SV082/bit7 (obshj). When not using, set to "0".</td><td>0 to 500
(%)</td></tr>
<tr><td>SV045</td><td colspan="3">For SV045, the hexadecimal value's higher order 8 bits and lower order 8 bits are used for different functions.
"Setting value of SV045" = (Icy × 256) + LMCT
<table>
<tr><th>Abbrev.</th><th>Parameter name</th><th>Explanation</th><th>Setting range (Unit)</th></tr>
<tr><td>TRUB
(Low order)</td><td>Frictional torque</td><td>When you use the collision detection function, set the frictional torque.</td><td>0 to 100
(Stall [rated] current %)</td></tr>
<tr><td>Ib1
(High order)</td><td>Current bias 3</td><td>Normally set to "0".
Use this in combination with SV030 and the high order 8bits of SV040.</td><td>0 to 127</td></tr>
</table></td><td>0 to 32767</td></tr>
<tr><td>SV046</td><td>FHz2</td><td>Notch filter frequency 2</td><td>Set the vibration frequency to suppress if machine vibration occurs.
(Valid at 36 or more) When not using, set to "0".</td><td>0 to 9000
(Hz)</td></tr>
<tr><td>SV047</td><td>EC</td><td>Inductive voltage compensation gain</td><td>Set the inductive voltage compensation gain. Set to "100" as a standard.
If the current FB peak exceeds the current command peak, lower the gain.</td><td>0 to 200
(%)</td></tr>
<tr><td>SV048</td><td>EMGrt</td><td>Vertical axis drop prevention time</td><td>Input a length of time to prevent the vertical axis from dropping by delaying Ready OFF until the brake works when the emergency stop occurs.
Increase the setting by 100msec at a time and set the value where the axis does not drop.</td><td>0 to 20000
(ms)</td></tr>
<tr><td>SV049</td><td>PGN1sp</td><td>Position loop gain 1 in spindle synchronous control</td><td>Set the position loop gain during the spindle synchronous control (synchronous tapping, synchronous control with spindle/C axis).
Set the same value as the value of the spindle parameter, position loop gain in synchronous control.
When performing the SHG control, set this with SV050 (PGN2sp) and SV058 (SHGCsp).</td><td>1 to 200
(rad/s)</td></tr>
<tr><td>SV050</td><td>PGN2sp</td><td>Position loop gain 2 in spindle synchronous control</td><td>Set this with SV049 (PGN1sp) and SV058 (SHGCsp) if you wish to perform the SHG control in the spindle synchronous control (synchronous tapping, synchronous control with spindle/C axis).
When not performing the SHG control, set to "0".</td><td>0 to 999
(rad/s)</td></tr>
</table>

Parameters with an asterisk * in the abbreviation, such as PC1*, are validated with the NC power turned ON again.

High-gain specifications

No.	Abbrev.	Parameter name	Explanation	Setting range (Unit)
SV051	DFBT	Dual feed back control time constant	Set the control time constant in dual feed back. When "0" is set, the actual value that is set is 1ms. The higher the time constant is, the closer it gets to the semi-closed control, so the limit of the position loop gain is raised.	0 to 9999 (ms)
SV052	DFBN	Dual feedback control non-sensitive band	Set to "0" as a standard. Set the dead zone in the dual feedback control.	0 to 9999 (µm)
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.). If "0" is set, excessive error detection won't be performed.	0 to 32767 (mm)
SV054	ORE	Overrun detection width in closed loop control	Set the overrun detection width in the full-closed loop control. If the gap between the motor end detector and the linear scale (tool end detector) exceeds the value set by this parameter, it is judged to be overrun and Alarm 43 will be detected. When "-1" is set, the alarm detection won't be performed. When "0" is set, overrun is detected with a 2mm width.	-1 to 32767 (mm)
SV055	EMGx	Max. gate off delay time after emergency stop	Set a length of time from the point when the emergency stop is input to the point when READY OFF is compulsorily executed. Normally, set the same value as the absolute value of SV056. In preventing the vertical axis from dropping, the gate off is delayed for the length of time set by SV048 if SV055's value is smaller than that of SV048.	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 a length of time that takes from rapid traverse rate (rapid) to stopping. Normally, set the same value as the rapid traverse acceleration/deceleration time constant. When executing the synchronous operation, put the minus sign to the settings of both of the master axis and slave axis.	-20000 to 20000 (ms)
SV057	SHGC	SHG control gain	When performing the SHG control, set this with S003 (PGN1) and SV004 (PGN2). When not performing the SHG control, set to "0".	0 to 1200 (rad/s)
SV058	SHGCsp	SHG control gain in spindle synchronous control	Set this with SV049 (PGN1sp) and SV050 (PGN2sp) if you wish to perform the SHG control in the synchronous tapping control. When not performing the SHG control, set to "0".	0 to 1200 (rad/s)
SV059	TCNV	Collision detection torque estimating gain	Set the torque estimating gain when using the collision detection function. After setting as SV035/bitF(clt)=1 and performing acceleration/deceleration, set the value displayed in MPOS of the NC servo monitor screen. Set to "0" when not using the collision detection function.	-32768 to 32767

Parameters with an asterisk * in the abbreviation, such as PC1*, are validated with the NC power turned ON again.

High-gain specifications

No.	Abbrev.	Parameter name	Explanation	Setting range (Unit)
SV060	TLMT	Collision detection level	When using the collision detection function, set the collision detection level during the G0 feeding. If "0" is set, none of the collision detection function will work.	0 to 999 (Stall [rated] current %)
SV061	DA1NO	D/A output channel 1 data No.	Input the data number you wish to output to D/A output channel. In the case of MDS-C1-V2, set the axis on the side to which the data will not be output to "-1".	-1 to 127
SV062	DA2NO	D/A output channel 2 data No.		
SV063	DA1MPY	D/A output channel 1 output scale	Set the scale with a 1/256 unit. When "0" is set, output is done with the standard output unit.	-32768 to 32767 (Unit: 1/256)
SV064	DA2MPY	D/A output channel 2 output scale		
SV065	TLC	Tool end compensation spring constant	Set the spring constant of the tool end compensation. In the semi-closed loop control, the tool end compensation amount is calculated with the following equation. Compensation amount= $\frac{F\ (mm/min)^2 \times SV065}{R\ (mm) \times 10^9}$ (μm) When not using, set to "0".	-32768 to 32767
SV066 : SV080		System setting parameter	These parameters are set automatically by the NC system.	

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High-gain specifications

No.	Abbrev.	Parameter name	Explanation
SV081	SPEC2*	Servo specification selection 2	see below
SV082	SSF5	Servo function selection5	see below

SV081 SPEC2* Servo specification selection 2

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
											pabs			rabs	

bit		Meaning when "0" is set	Meaning when "1" is set
0			
1	rabs	Normal setting	Rotary axis machine end absolute position control
2			
3			
4	pabs	Normal setting	Speed/current synchronous control absolute position control
5			
6			
7			
8			
9			
A			
B			
C			
D			
E			
F			

(Note) Set to "0" for bits with no particular description.

SV082 SSF5 Servo function selection5

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
								obshj						lmc3	lmct

bit		Meaning when "0" is set	Meaning when "1" is set
0	lmct	Setting for normal use	Lost motion compensation 3 adjustment time measurement valid
1	lmc3	Lost motion compensation 3 stop	Lost motion compensation 3 start
2			
3			
4			
5			
6			
7	obshj	Normal use	Disturbance observer High-load inertia compatible control
8			
9			
A			
B			
C			
D			
E			
F			

(Note) Set to "0" for bits with no particular description.

Parameters with an asterisk * in the abbreviation, such as PC1*, are validated with the NC power turned ON again.

High-gain specifications

No.	Abbrev.	Parameter name	Explanation	Setting range (Unit)
SV083	SSF6	Servo function selection 6	See bit table below	
SV084	SSF7	Servo function selection 7	See bit table below	

SV083 SSF6 Servo function selection 6

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
									nfd5				nfd4		

bit		Meaning when set to 0	Meaning when set to 1
0			
1	nfd4	Set the filter depth for Notch filter 4 (SV038). Setting value Deep ← → Shallow 000 / 001 / 010 / 011 / 100 / 101 / 110 / 111 Depth (dB) -∞ / -18.1 / -12.0 / -8.5 / -6.0 / -4.1 / -2.5 / -1.2	
2			
3			
4			
5	nfd5	Set the filter depth for Notch filter 5 (SV046). Setting value Deep ← → Shallow 000 / 001 / 010 / 011 / 100 / 101 / 110 / 111 Depth (dB) -∞ / -18.1 / -12.0 / -8.5 / -6.0 / -4.1 / -2.5 / -1.2	
6			
7			
8			
9			
A			
B			
C			
D			
E			
F			

(Note) Set to "0" for bits with no particular description.

SV084 SSF7 Servo function selection 7

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0

bit		Meaning when set to 0	Meaning when set to 1
0			
1			
2			
3			
4			
5			
6			
7			
8			
9			
A			
B			
C			
D			
E			
F			

(Note) Set to "0" for bits with no particular description.

High-gain specifications

No.	Abbrev.	Parameter name	Explanation	Setting range (Unit)
SV085	LMCk	Lost motion compensation spring constant	Set the machine system's spring constant when using lost motion compensation type 3.	0 to 32767
SV086	LMCc	Lost motion compensation viscous coefficient	Set the machine system's viscous coefficient when using lost motion compensation type 3.	0 to 32767
SV087	FHz4	Notch filter frequency 4	Set the vibration frequency to suppress if machine vibration occurs. (Valid at 141 or more) When not using, set to "0". To use this function, set to not "0" (normally "1") when turning the power ON. This function cannot be used with adaptive filter.	0 to 2250 (Hz)
SV088	FHz5	Notch filter frequency 5		0 to 2250 (Hz)
SV089 : SV100			Not used. Set to "0".	0

3-3 Setting the initial parameters for the servo drive unit (Standard specifications)

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.

3-3-1 Setting the standard parameters

When starting up the system, first set the standard parameters listed in "3-3-2 List of standard parameters for each servomotor". For the parameters shown below, check the machine and servo system specifications and determine the setting value.

(1) Basic specification parameters

[1] When performing absolute position control, set SV017/bit7=1. This may be automatically set by NC system parameter setting, depending on NC model. (Setting on the servo parameter screen is not valid.)

[2] For HA053N, HA13N, HA23N, HA33N motors, if the connector direction of the motor end detector with motor power supply connector is 90°, set SV017/bit5=1. If the angle is 180°, use a standard setting (SV017/bit5=0).

Setting basic specification parameters

Standard specifications

<table>
<tr><th>No.</th><th>Abbrev.</th><th>Parameter name</th><th>Explanation</th></tr>
<tr><td>SV017</td><td>SPEC*</td><td>Servo specification selection 1</td><td>
<table>
<tr><td>F</td><td>E</td><td>D</td><td>C</td><td>B</td><td>A</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td colspan="4">spm</td><td></td><td></td><td>mpt</td><td>mp</td><td>abs</td><td></td><td>vdir</td><td>fdir</td><td>vfb</td><td>seqh</td><td>dfbx</td><td></td></tr>
</table>
<table>
<tr><th colspan="2">bit</th><th>Meaning when set to 0</th><th>Meaning when set to 1</th></tr>
<tr><td>5</td><td>vdir</td><td>Standard setting</td><td>HA motor (4 pole motor)
Detector installation position 90 degrees (B, D)</td></tr>
<tr><td>7</td><td>abs</td><td>Incremental control</td><td>Absolute position control</td></tr>
</table>
</td></tr>
</table>

POINT

Setting of absolute position control (SV017/bit7) may be set automatically by NC system parameter setting, depending on NC model. In this case, setting on the servo parameter screen is not valid.

(2) Electronic gear related parameters

The setting range of the following parameters, which configure the electronic gears, may be limited according to the combination. Refer to section "3-4 Restrictions on servo control" for details.

Standard specifications

<table>
<tr><th>No.</th><th>Abbrev.</th><th>Parameter name</th><th>Explanation</th><th>Setting range (Unit)</th></tr>
<tr><td>SV001</td><td>PC1*</td><td>Motor side gear ratio</td><td rowspan="2">Set the motor side and machine side gear ratio.
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 cause an alarm.</td><td>1 to 32767</td></tr>
<tr><td>SV002</td><td>PC2*</td><td>Machine side gear ratio</td><td>1 to 32767</td></tr>
<tr><td>SV018</td><td>PIT*</td><td>Ball screw pitch</td><td>Set the ball screw pitch. Set to “360” for the rotary axis.</td><td>1 to 32767
(mm/rev)</td></tr>
<tr><td rowspan="2">SV019</td><td rowspan="2">RNG1*</td><td rowspan="2">Position detector resolution</td><td>In the case of the semi-closed loop control
Set the same value as SV020 (RNG2). (Refer to the explanation of SV020.)</td><td>1 to 9999
(kp/rev)</td></tr>
<tr><td>In the case of the full-closed loop control
Set the number of pulses per ball screw pitch.
<table>
<tr><th>Detector model name</th><th>Resolution</th><th>SV019 setting</th></tr>
<tr><td>OHE25K-ET, OHA25K-ET</td><td>100,000 (p/rev)</td><td>100</td></tr>
<tr><td>OSE104-ET,OSA104-ET</td><td>100,000 (p/rev)</td><td>100</td></tr>
<tr><td>OSE105-ET,OSA105-ET</td><td>1,000,000 (p/rev)</td><td>1000</td></tr>
<tr><td>Relative position detection scale</td><td>Refer to detector specification manual</td><td>PIT/Resolution (μm)</td></tr>
<tr><td>AT41 (Mitsutoyo)</td><td>1 (μm/p)</td><td>The same as SV018 (PIT)</td></tr>
<tr><td>AT342 (Mitsutoyo)</td><td>0.5 (μm/p)</td><td>Twice as big as SV018 (PIT)</td></tr>
<tr><td>FME type, FLE type (Futaba)</td><td>Refer to detector specification manual</td><td>PIT/Resolution (μm)</td></tr>
<tr><td>MP type (Mitsubishi Heavy Industries)</td><td>Refer to detector specification manual</td><td>PIT/Resolution (μm)</td></tr>
</table></td><td>1 to 9999
(kp/pit)</td></tr>
<tr><td>SV020</td><td>RNG2*</td><td>Speed detector resolution</td><td>Set the number of pulses per one revolution of the motor end detector.
<table>
<tr><th>Detector model name</th><th>SV020 setting</th></tr>
<tr><td>OSE104, OSA104</td><td>100</td></tr>
<tr><td>OSE105, OSA105</td><td>1000</td></tr>
</table></td><td>1 to 9999
(kp/rev)</td></tr>
</table>

Parameters with an asterisk * in the abbreviation, such as PC1*, are validated with the NC power turned ON again.

(3) Detector related parameters

(a) For semi-closed loop control

For control using only the motor end detector, specify the settings shown in the table below. For speed and current synchronous control, refer to section "2-4-3 Connecting the synchronous control system".

Setting for semi-closed loop control

Standard specifications

<table>
<tr><th>No.</th><th>Abbrev.</th><th>Parameter name</th><th>Explanation</th></tr>
<tr><td>SV025</td><td>MTYP*</td><td>Motor/Detector type</td><td>
<table>
<tr><th>bit</th><th></th><th>Details</th></tr>
<tr><td>8</td><td rowspan="4">ent</td><td rowspan="8">Set the detector type.
Set the position detector type for “pen”, and the speed detector type for “ent”. In the case of the semi-closed loop control, set the same value for “pen” and “ent”.
<table>
<tr><th>Detector model</th><th>pen setting</th><th>ent setting</th></tr>
<tr><td>OSE104</td><td>0</td><td>0</td></tr>
<tr><td>OSA104</td><td>1</td><td>1</td></tr>
<tr><td>OSE105, OSA105</td><td>2</td><td>2</td></tr>
</table></td></tr>
<tr><td>9</td></tr>
<tr><td>A</td></tr>
<tr><td>B</td></tr>
<tr><td>C</td><td rowspan="4">pen</td></tr>
<tr><td>D</td></tr>
<tr><td>E</td></tr>
<tr><td>F</td></tr>
</table>
</td></tr>
</table>

Parameters with an asterisk * in the abbreviation, such as PC1*, are validated with the NC power turned ON again.

(b) For full-closed loop control

Some parameter settings must be specified in order to use the machine end detector. These settings are determined by type or the installation conditions of the linear scale and the ball screw end detector.

[1] The SV025/bit8 to B (ent) setting must be specified according to the motor end detector specifications, in the same manner as for semi-closed loop control. For current synchronous control, however, refer to section "2-4-3 Connecting the synchronous control system".

[2] If the polarities of the motor end detector and the machine end detector do not match, specify SV017/bit4=1 setting.

[3] To use AT342, specify SV027/bit6=1 setting.

[4] To use the MP scale, specify SV017/bit8 setting in accordance with the scale specifications. For absolute position control, specify SV017/bit9=1 setting.

[5] For ABZ phase pulse output type relative position detection scale with constant Z-phase detection position without regard to the travel direction, specify SV027/bit6=1 setting. Z-phase detection occurs as follows: Plus-direction travel: Rising edge detection, Minus-direction travel: Falling edge detection

[6] For machine end absolute position control at the rotation axis, specify SV081/bit1=1 setting.

[7] For speed and current synchronous control, refer to "2-4-3 Connecting the synchronous control system".

Setting for full-closed loop control

Standard specifications

No.	Abbrev.	Parameter name	Explanation
SV017	SPEC*	Servo specification selection	

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
						mpt	mp	abs		vdir	fdir	spwv	seqh	dfbx	

bit		Meaning when set to 0	Meaning when set to 1
4	fdir	Position feedback forward polarity	Position feedback reverse polarity
8	mp	MP scale 360P (2mm pitch)	MP scale 720P (1mm pitch)
9	mpt	MP scale ABS detection NC control	MP scale ABS detection automatic (Standard swetting)

SV025	MTYP*	Motor/Detector type	

bit		Explanation
8, 9, A, B	ent	Set the detector type. Set the position detector type for “pen”, and the speed detector type for “ent”. In the case of the semi-closed loop control, set the same value for “pen” and “ent”.
C, D, E, F	pen	

Detector model name	pen setting	ent setting
OSE104	0 (Note)	0
OSA104	1 (Note)	1
OSE105, OSA105	2 (Note)	2
	3 (Note)	3
OHE25K-ET,OSE104-ET	4	Setting impossible
OHA25K-ET,OSA104-ET	5	Setting impossible
OSE105-ET,OSA105-ET	6	Setting impossible
	7	Setting impossible
Relative position detection scale, MP type (Mitsubishi Heavy Industries)	8	Setting impossible
AT41 (Mitsutoyo), FME type, FLE type (Futaba)	9	Setting impossible
AT342 (Mitsutoyo)	A	Setting impossible
	B	Setting impossible
The setting of the slave axis in the speed/current synchronization control. When the master axis is the semi-closed control.	C	C (Current synchronization)
	D	Setting impossible
	E	Setting impossible
	F	Setting impossible

(Note) Setting for semi-closed loop control

SV027	SSF1	Servo function selection 2	

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
aflt	zrn2	afse		ovs		lmc			zrn3	vfct			upc	vcnt	

bit		Meaning when set to 0	Meaning when set to 1
6	zrn3	ABZ scale: Set to "1" to fix Z-phase detection edge. Absolute position scale: Set to "1" in using AT342.	

Parameters with an asterisk * in the abbreviation, such as PC1*, are validated with the NC power turned ON again.

(4) Setting the power supply type

Set the drive unit connected to the power supply unit with the CN4 connector. This does not need to be set if the power supply for the axis is not connected with the CN4 connector. (Set "0000".)
If the power supply unit is connected with the spindle drive unit, the parameters do not need to be set on the servo side. When connected to a 2-axis servo drive unit (MDS-C1-V2), set the power supply type for one of the two target axes.

Setting power supply type

Standard specifications

No.	Abbrev.	Parameter name	Explanation
SV036	PTYP*	Power supply type	

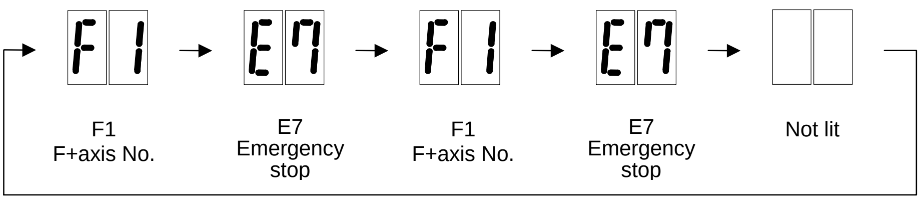
F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
amp				rtyp				ptyp							

bit		Explanation
0 1 2 3 4 5 6 7	ptyp	When the CN4 connector of the drive unit and the power supply are connected, setting below is necessary. To validate the external emergency stop function, add 40h.
8 9 A B	rtyp	Set the regenerative resistor type when MDS-A-CR is used. Set "0" when using MDS-C1-CV (power supply regeneration).
C D E F	amp	Always set "0".

Setting	0x	1x	2x	3x	4x	5x	6x	7x	8x
x0	Not used			CV-300					
x1		CV-110							CR-10
x2			CV-220						CR-15
x3									CR-22
x4	CV-37								CR-37
x5		CV-150			MDS-B-CVE-450	MDS-B-CVE-550			
x6	CV-55		CV-260						CR-55
x7				CV-370					
x8	CV-75								CR-75
x9		CV-185							CR-90

Parameters with an asterisk * in the abbreviation, such as PC1*, are validated with the NC power turned ON again.

If alarm 7F occurs after setting the initial parameters, turn the drive unit power ON again. If the unit's LEDs indicate the following emergency stop state, the unit has started up normally.



Normal LED display when NC power is turned ON (1st axis)

3-3-2 List of standard parameters for each servomotor

(1) HC series (Standard 2000 r/min rating)

Standard specifications

Parameter \ Motor				Standard HC motor 2000 r/min rating							
				HC52	HC102	HC152	HC202	HC352	HC452	HC702	HC902
No.	Abbrev.	Details	Unit capacity	05	10	20	20	35	45	70	90
SV001	PC1	Motor side gear ratio		---	---	---	---	---	---	---	---
SV002	PC2	Machine side gear ratio		---	---	---	---	---	---	---	---
SV003	PGN1	Position loop gain 1		33	33	33	33	33	33	33	33
SV004	PGN2	Position loop gain 2		0	0	0	0	0	0	0	0
SV005	VGN1	Speed loop gain 1		100	100	100	100	100	100	150	150
SV006	VGN2	Speed loop gain 2		0	0	0	0	0	0	0	0
SV007	VIL	Speed loop delay compensation		0	0	0	0	0	0	0	0
SV008	VIA	Speed loop lead compensation		1364	1364	1364	1364	1364	1364	1364	1364
SV009	IQA	Current loop q axis lead compensation		2048	2048	2048	2048	2048	2048	2048	2048
SV010	IDA	Current loop d axis lead compensation		2048	2048	2048	2048	2048	2048	2048	2048
SV011	IQG	Current loop q axis gain		512	512	512	256	256	256	200	200
SV012	IDG	Current loop d axis gain		512	512	512	512	512	512	256	256
SV013	ILMT	Current limit value		500	500	500	500	500	500	500	500
SV014	ILMTsp	Current limit value in special control		500	500	500	500	500	500	500	500
SV015	FFC	Acceleration rate feed forward gain		0	0	0	0	0	0	0	0
SV016	LMC1	Lost motion compensation 1		0	0	0	0	0	0	0	0
SV017	SPEC	Servo specifications selection 1		0000	0000	0000	0000	0000	0000	0000	0000
SV018	PIT	Ball screw pitch		---	---	---	---	---	---	---	---
SV019	RNG1	Position detector resolution		---	---	---	---	---	---	---	---
SV020	RNG2	Speed detector resolution		---	---	---	---	---	---	---	---
SV021	OLT	Overload detection time constant		60	60	60	60	60	60	60	60
SV022	OLL	Overload detection level		150	150	150	150	150	150	150	150
SV023	OD1	Excessive error detection width during servo ON		6	6	6	6	6	6	6	6
SV024	INP	In-position detection width		50	50	50	50	50	50	50	50
SV025	MTYP	Motor/detector type		xxB0	xxB1	xxB2	xxB3	xxB4	xxB5	xxB6	xxB7
SV026	OD2	Excessive error detection width during servo OFF		6	6	6	6	6	6	6	6
SV027	SSF1	Servo function selection 1		4000	4000	4000	4000	4000	4000	4000	4000
SV028				0	0	0	0	0	0	0	0
SV029	VCS	Speed at the change of speed loop gain		0	0	0	0	0	0	0	0
SV030	IVC	Voltage dead time compensation / current bias 1		0	0	0	0	0	0	0	0
SV031	OVS1	Overshooting compensation 1		0	0	0	0	0	0	0	0
SV032	TOF	Torque offset		0	0	0	0	0	0	0	0
SV033	SSF2	Servo function selection 2		0000	0000	0000	0000	0000	0000	0000	0000
SV034	SSF3	Servo function selection 3		0003	0003	0003	0003	0003	0003	0003	0003
SV035	SSF4	Servo function selection 4		0000	0000	0040	0040	0040	0040	0040	0000
SV036	PTYP	Power supply type		0000	0000	0000	0000	0000	0000	0000	0000
SV037	JL	Load inertia scale		0	0	0	0	0	0	0	0
SV038	FHz1	Notch filter frequency 1		0	0	0	0	0	0	0	0
SV039	LMCD	Lost motion compensation timing		0	0	0	0	0	0	0	0
SV040	LMCT	Lost motion compensation non-sensitive band /current bias 2		0	0	0	10240	10240	10240	10240	10240
SV041	LMC2	Lost motion compensation 2		0	0	0	0	0	0	0	0
SV042	OVS2	Overshooting compensation 2		0	0	0	0	0	0	0	0
SV043	OBS1	Disturbance observer filter frequency		0	0	0	0	0	0	0	0
SV044	OBS2	Disturbance observer gain		0	0	0	0	0	0	0	0
SV045	TRUB	Frictional torque/current bias 3		0	0	0	0	0	0	0	0
SV046				0	0	0	0	0	0	0	0
SV047	EC	Inductive voltage compensation gain		100	100	100	100	100	100	100	100
SV048	EMGrt	Vertical axis drop prevention time		0	0	0	0	0	0	0	0
SV049	PGN1sp	Position loop gain 1 in spindle synchronous control		15	15	15	15	15	15	15	15
SV050	PGN2sp	Position loop gain 2 in spindle synchronous control		0	0	0	0	0	0	0	0
SV051	DFBT	Dual feedback control time constant		0	0	0	0	0	0	0	0
SV052	DFBN	Dual feedback control non-sensitive band		0	0	0	0	0	0	0	0
SV053	OD3	Excessive error detection width in special control		0	0	0	0	0	0	0	0
SV054	ORE	Overrun detection width in closed loop control		0	0	0	0	0	0	0	0
SV055	EMGx	Max. gate off delay time after emergency stop		0	0	0	0	0	0	0	0
SV056	EMGt	Deceleration time constant at emergency stop		0	0	0	0	0	0	0	0
SV057	SHGC	SHG control gain		0	0	0	0	0	0	0	0
SV058	SHGCsp	SHG control gain in spindle synchronous control		0	0	0	0	0	0	0	0
SV059	TCNV	Collision detection torque estimating gain		0	0	0	0	0	0	0	0
SV060	TLMT	Collision detection level		0	0	0	0	0	0	0	0
SV061	DA1NO	D/A output channel 1 data No.		0	0	0	0	0	0	0	0
SV062	DA2NO	D/A output channel 2 data No.		0	0	0	0	0	0	0	0
SV063	DA1MPY	D/A output channel 1 output scale		0	0	0	0	0	0	0	0
SV064	DA2MPY	D/A output channel 2 output scale		0	0	0	0	0	0	0	0
SV065				0	0	0	0	0	0	0	0

(2) HC series (Standard 3000 r/min rating)

Standard specifications

Parameter			Motor	Standard HC motor 3000 r/min rating						
				HC53	HC103	HC153	HC203	HC353	HC453	HC703
No.	Abbrev.	Details	Unit capacity	05	10	20	35	45	70	90
SV001	PC1	Motor side gear ratio		---	---	---	---	---	---	---
SV002	PC2	Machine side gear ratio		---	---	---	---	---	---	---
SV003	PGN1	Position loop gain 1		33	33	33	33	33	33	33
SV004	PGN2	Position loop gain 2		0	0	0	0	0	0	0
SV005	VGN1	Speed loop gain 1		100	100	100	100	100	100	100
SV006	VGN2	Speed loop gain 2		0	0	0	0	0	0	0
SV007	VIL	Speed loop delay compensation		0	0	0	0	0	0	0
SV008	VIA	Speed loop lead compensation		1364	1364	1364	1364	1364	1364	1364
SV009	IQA	Current loop q axis lead compensation		2048	2048	2048	2048	2048	2048	2048
SV010	IDA	Current loop d axis lead compensation		2048	2048	2048	2048	2048	2048	2048
SV011	IQG	Current loop q axis gain		256	256	256	256	256	256	256
SV012	IDG	Current loop d axis gain		512	512	512	512	512	512	512
SV013	ILMT	Current limit value		500	500	500	500	500	500	500
SV014	ILMTsp	Current limit value in special control		500	500	500	500	500	500	500
SV015	FFC	Acceleration rate feed forward gain		0	0	0	0	0	0	0
SV016	LMC1	Lost motion compensation 1		0	0	0	0	0	0	0
SV017	SPEC	Servo specifications selection 1		0000	0000	0000	0000	0000	0000	0000
SV018	PIT	Ball screw pitch		---	---	---	---	---	---	---
SV019	RNG1	Position detector resolution		---	---	---	---	---	---	---
SV020	RNG2	Speed detector resolution		---	---	---	---	---	---	---
SV021	OLT	Overload detection time constant		60	60	60	60	60	60	60
SV022	OLL	Overload detection level		150	150	150	150	150	150	150
SV023	OD1	Excessive error detection width during servo ON		6	6	6	6	6	6	6
SV024	INP	In-position detection width		50	50	50	50	50	50	50
SV025	MTYP	Motor/detector type		xxC0	xxC1	xxC2	xxC3	xxC4	xxC5	xxC6
SV026	OD2	Excessive error detection width during servo OFF		6	6	6	6	6	6	6
SV027	SSF1	Servo function selection 1		4000	4000	4000	4000	4000	4000	4000
SV028				0	0	0	0	0	0	0
SV029	VCS	Speed at the change of speed loop gain		0	0	0	0	0	0	0
SV030	IVC	Voltage dead time compensation / current bias 1		0	0	0	0	0	0	0
SV031	OVS1	Overshooting compensation 1		0	0	0	0	0	0	0
SV032	TOF	Torque offset		0	0	0	0	0	0	0
SV033	SSF2	Servo function selection 2		0000	0000	0000	0000	0000	0000	0000
SV034	SSF3	Servo function selection 3		0003	0003	0003	0003	0003	0003	0003
SV035	SSF4	Servo function selection 4		0000	0000	0040	0040	0040	0040	0000
SV036	PTYP	Power supply type		0000	0000	0000	0000	0000	0000	0000
SV037	JL	Load inertia scale		0	0	0	0	0	0	0
SV038	FHz1	Notch filter frequency 1		0	0	0	0	0	0	0
SV039	LMCD	Lost motion compensation timing		0	0	0	0	0	0	0
SV040	LMCT	Lost motion compensation non-sensitive band /current bias 2		0	0	0	10240	10240	10240	10240
SV041	LMC2	Lost motion compensation 2		0	0	0	0	0	0	0
SV042	OVS2	Overshooting compensation 2		0	0	0	0	0	0	0
SV043	OBS1	Disturbance observer filter frequency		0	0	0	0	0	0	0
SV044	OBS2	Disturbance observer gain		0	0	0	0	0	0	0
SV045	TRUB	Frictional torque/current bias 3		0	0	0	0	0	0	0
SV046				0	0	0	0	0	0	0
SV047	EC	Inductive voltage compensation gain		100	100	100	100	100	100	100
SV048	EMGrt	Vertical axis drop prevention time		0	0	0	0	0	0	0
SV049	PGN1sp	Position loop gain 1 in spindle synchronous control		15	15	15	15	15	15	15
SV050	PGN2sp	Position loop gain 2 in spindle synchronous control		0	0	0	0	0	0	0
SV051	DFBT	Dual feedback control time constant		0	0	0	0	0	0	0
SV052	DFBN	Dual feedback control non-sensitive band		0	0	0	0	0	0	0
SV053	OD3	Excessive error detection width in special control		0	0	0	0	0	0	0
SV054	IRE	Overrun detection width in closed loop control		0	0	0	0	0	0	0
SV055	EMGx	Max. gate off delay time after emergency stop		0	0	0	0	0	0	0
SV056	EMGt	Deceleration time constant at emergency stop		0	0	0	0	0	0	0
SV057	SHGC	SHG control gain		0	0	0	0	0	0	0
SV058	SHGCsp	SHG control gain in spindle synchronous control		0	0	0	0	0	0	0
SV059	TCNV	Collision detection torque estimating gain		0	0	0	0	0	0	0
SV060	TLMT	Collision detection level		0	0	0	0	0	0	0
SV061	DA1NO	D/A output channel 1 data No.		0	0	0	0	0	0	0
SV062	DA2NO	D/A output channel 2 data No.		0	0	0	0	0	0	0
SV063	DA1MPY	D/A output channel 1 output scale		0	0	0	0	0	0	0
SV064	DA2MPY	D/A output channel 2 output scale		0	0	0	0	0	0	0
SV065				0	0	0	0	0	0	0

(3) HC series (Low-inertia)

Standard specifications

Parameter		Motor		Low-inertia HC motor				
				HC103R	HC153R	HC203R	HC353R	HC503R
No.	Abbrev.	Details	Unit capacity	10	10	20	35	45
SV001	PC1	Motor side gear ratio		---	---	---	---	---
SV002	PC2	Machine side gear ratio		---	---	---	---	---
SV003	PGN1	Position loop gain 1		33	33	33	33	33
SV004	PGN2	Position loop gain 2		0	0	0	0	0
SV005	VGN1	Speed loop gain 1		15	15	20	40	40
SV006	VGN2	Speed loop gain 2		0	0	0	0	0
SV007	VIL	Speed loop delay compensation		0	0	0	0	0
SV008	VIA	Speed loop lead compensation		1364	1364	1364	1364	1364
SV009	IQA	Current loop q axis lead compensation		4096	4096	4096	4096	4096
SV010	IDA	Current loop d axis lead compensation		4096	4096	4096	4096	4096
SV011	IQG	Current loop q axis gain		256	256	256	256	256
SV012	IDG	Current loop d axis gain		512	512	512	512	512
SV013	ILMT	Current limit value		500	500	500	500	500
SV014	ILMTsp	Current limit value in special control		500	500	500	500	500
SV015	FFC	Acceleration rate feed forward gain		0	0	0	0	0
SV016	LMC1	Lost motion compensation 1		0	0	0	0	0
SV017	SPEC	Servo specifications selection 1		0000	0000	0000	0000	0000
SV018	PIT	Ball screw pitch		---	---	---	---	---
SV019	RNG1	Position detector resolution		---	---	---	---	---
SV020	RNG2	Speed detector resolution		---	---	---	---	---
SV021	OLT	Overload detection time constant		60	60	60	60	60
SV022	OLL	Overload detection level		150	150	150	150	150
SV023	OD1	Excessive error detection width during servo ON		6	6	6	6	6
SV024	INP	In-position detection width		50	50	50	50	50
SV025	MTYP	Motor/detector type		xxE1	xxE2	xxE3	xxE4	xxE5
SV026	OD2	Excessive error detection width during servo OFF		6	6	6	6	6
SV027	SSF1	Servo function selection 1		4000	4000	4000	4000	4000
SV028				0	0	0	0	0
SV029	VCS	Speed at the change of speed loop gain		0	0	0	0	0
SV030	IVC	Voltage dead time compensation / current bias 1		0	0	0	0	0
SV031	OVS1	Overshooting compensation 1		0	0	0	0	0
SV032	TOF	Torque offset		0	0	0	0	0
SV033	SSF2	Servo function selection 2		0000	0000	0000	0000	0000
SV034	SSF3	Servo function selection 3		0000	0000	0000	0000	0000
SV035	SSF4	Servo function selection 4		0000	0000	0000	0000	0000
SV036	PTYP	Power supply type		0000	0000	0000	0000	0000
SV037	JL	Load inertia scale		0	0	0	0	0
SV038	FHz1	Notch filter frequency 1		0	0	0	0	0
SV039	LMCD	Lost motion compensation timing		0	0	0	0	0
SV040	LMCT	Lost motion compensation non-sensitive band /current bias 2		0	0	0	0	0
SV041	LMC2	Lost motion compensation 2		0	0	0	0	0
SV042	OVS2	Overshooting compensation 2		0	0	0	0	0
SV043	OBS1	Disturbance observer filter frequency		0	0	0	0	0
SV044	OBS2	Disturbance observer gain		0	0	0	0	0
SV045	TRUB	Frictional torque/current bias 3		0	0	0	0	0
SV046				0	0	0	0	0
SV047	EC	Inductive voltage compensation gain		100	100	100	100	100
SV048	EMGrt	Vertical axis drop prevention time		0	0	0	0	0
SV049	PGN1sp	Position loop gain 1 in spindle synchronous control		15	15	15	15	15
SV050	PGN2sp	Position loop gain 2 in spindle synchronous control		0	0	0	0	0
SV051	DFBT	Dual feedback control time constant		0	0	0	0	0
SV052	DFBN	Dual feedback control non-sensitive band		0	0	0	0	0
SV053	OD3	Excessive error detection width in special control		0	0	0	0	0
SV054	IRE	Overrun detection width in closed loop control		0	0	0	0	0
SV055	EMGx	Max. gate off delay time after emergency stop		0	0	0	0	0
SV056	EMGt	Deceleration time constant at emergency stop		0	0	0	0	0
SV057	SHGC	SHG control gain		0	0	0	0	0
SV058	SHGCsp	SHG control gain in spindle synchronous control		0	0	0	0	0
SV059	TCNV	Collision detection torque estimating gain		0	0	0	0	0
SV060	TLMT	Collision detection level		0	0	0	0	0
SV061	DA1NO	D/A output channel 1 data No.		0	0	0	0	0
SV062	DA2NO	D/A output channel 2 data No.		0	0	0	0	0
SV063	DA1MPY	D/A output channel 1 output scale		0	0	0	0	0
SV064	DA2MPY	D/A output channel 2 output scale		0	0	0	0	0
SV065				0	0	0	0	0

(4) HA series (Standard 2000 r/min rating)

Standard specifications

Parameter		Motor	Standard HA motor 2000 r/min rating						
			HA40N	HA80N	HA100N	HA200N	HA300N	HA700N	HA900N
No.	Abbrev.	Details / Unit capacity	05	10	20	35	45	70	90
SV001	PC1	Motor side gear ratio	---	---	---	---	---	---	---
SV002	PC2	Machine side gear ratio	---	---	---	---	---	---	---
SV003	PGN1	Position loop gain 1	33	33	33	33	33	25	25
SV004	PGN2	Position loop gain 2	0	0	0	0	0	0	0
SV005	VGN1	Speed loop gain 1	150	150	150	150	150	250	250
SV006	VGN2	Speed loop gain 2	0	0	0	0	0	0	0
SV007	VIL	Speed loop delay compensation	0	0	0	0	0	0	0
SV008	VIA	Speed loop lead compensation	1364	1364	1364	1364	1364	1364	1364
SV009	IQA	Current loop q axis lead compensation	2048	2048	2048	2048	2048	2048	2048
SV010	IDA	Current loop d axis lead compensation	2048	2048	2048	2048	2048	2048	2048
SV011	IQG	Current loop q axis gain	512	512	256	256	256	200	200
SV012	IDG	Current loop d axis gain	512	512	512	512	512	256	256
SV013	ILMT	Current limit value	500	500	500	500	500	500	500
SV014	ILMTsp	Current limit value in special control	500	500	500	500	500	500	500
SV015	FFC	Acceleration rate feed forward gain	0	0	0	0	0	0	0
SV016	LMC1	Lost motion compensation 1	0	0	0	0	0	0	0
SV017	SPEC	Servo specifications selection 1	0000	0000	0000	0000	0000	0000	0000
SV018	PIT	Ball screw pitch	---	---	---	---	---	---	---
SV019	RNG1	Position detector resolution	---	---	---	---	---	---	---
SV020	RNG2	Speed detector resolution	---	---	---	---	---	---	---
SV021	OLT	Overload detection time constant	60	60	60	60	60	60	60
SV022	OLL	Overload detection level	150	150	150	150	150	150	150
SV023	OD1	Excessive error detection width during servo ON	6	6	6	6	6	6	6
SV024	INP	In-position detection width	50	50	50	50	50	50	50
SV025	MTYP	Motor/detector type	xx00	xx01	xx02	xx03	xx04	xx05	xx06
SV026	OD2	Excessive error detection width during servo OFF	6	6	6	6	6	6	6
SV027	SSF1	Servo function selection 1	4000	4000	4000	4000	4000	4000	4000
SV028			0	0	0	0	0	0	0
SV029	VCS	Speed at the change of speed loop gain	0	0	0	0	0	0	0
SV030	IVC	Voltage dead time compensation / current bias 1	0	0	0	0	0	0	0
SV031	OVS1	Overshooting compensation 1	0	0	0	0	0	0	0
SV032	TOF	Torque offset	0	0	0	0	0	0	0
SV033	SSF2	Servo function selection 2	0000	0000	0000	0000	0000	0000	0000
SV034	SSF3	Servo function selection 3	0000	0000	0000	0000	0000	0000	0000
SV035	SSF4	Servo function selection 4	0000	0000	0000	0000	0000	0000	0000
SV036	PTYP	Power supply type	0000	0000	0000	0000	0000	0000	0000
SV037	JL	Load inertia scale	0	0	0	0	0	0	0
SV038	FHz1	Notch filter frequency 1	0	0	0	0	0	0	0
SV039	LMCD	Lost motion compensation timing	0	0	0	0	0	0	0
SV040	LMCT	Lost motion compensation non-sensitive band /current bias 2	0	0	0	0	0	0	0
SV041	LMC2	Lost motion compensation 2	0	0	0	0	0	0	0
SV042	OVS2	Overshooting compensation 2	0	0	0	0	0	0	0
SV043	OBS1	Disturbance observer filter frequency	0	0	0	0	0	0	0
SV044	OBS2	Disturbance observer gain	0	0	0	0	0	0	0
SV045	TRUB	Frictional torque/current bias 3	0	0	0	0	0	0	0
SV046			0	0	0	0	0	0	0
SV047	EC	Inductive voltage compensation gain	100	100	100	100	100	100	100
SV048	EMGrt	Vertical axis drop prevention time	0	0	0	0	0	0	0
SV049	PGN1sp	Position loop gain 1 in spindle synchronous control	15	15	15	15	15	15	15
SV050	PGN2sp	Position loop gain 2 in spindle synchronous control	0	0	0	0	0	0	0
SV051	DFBT	Dual feedback control time constant	0	0	0	0	0	0	0
SV052	DFBN	Dual feedback control non-sensitive band	0	0	0	0	0	0	0
SV053	OD3	Excessive error detection width in special control	0	0	0	0	0	0	0
SV054	IRE	Overrun detection width in closed loop control	0	0	0	0	0	0	0
SV055	EMGx	Max. gate off delay time after emergency stop	0	0	0	0	0	0	0
SV056	EMGt	Deceleration time constant at emergency stop	0	0	0	0	0	0	0
SV057	SHGC	SHG control gain	0	0	0	0	0	0	0
SV058	SHGCsp	SHG control gain in spindle synchronous control	0	0	0	0	0	0	0
SV059	TCNV	Collision detection torque estimating gain	0	0	0	0	0	0	0
SV060	TLMT	Collision detection level	0	0	0	0	0	0	0
SV061	DA1NO	D/A output channel 1 data No.	0	0	0	0	0	0	0
SV062	DA2NO	D/A output channel 2 data No.	0	0	0	0	0	0	0
SV063	DA1MPY	D/A output channel 1 output scale	0	0	0	0	0	0	0
SV064	DA2MPY	D/A output channel 2 output scale	0	0	0	0	0	0	0
SV065			0	0	0	0	0	0	0

(5) HA series (Standard 3000 r/min rating)

Standard specifications

Parameter / Motor				Standard HA motor 3000 r/min rating						
				HA43N	HA83N	HA93N	HA103N	HA203N	HA303N	HA703N
No.	Abbrev.	Details	Unit capacity	05	10	20	35	45	70	90
SV001	PC1	Motor side gear ratio		---	---	---	---	---	---	---
SV002	PC2	Machine side gear ratio		---	---	---	---	---	---	---
SV003	PGN1	Position loop gain 1		33	33	33	33	33	33	25
SV004	PGN2	Position loop gain 2		0	0	0	0	0	0	0
SV005	VGN1	Speed loop gain 1		150	150	150	150	150	150	250
SV006	VGN2	Speed loop gain 2		0	0	0	0	0	0	0
SV007	VIL	Speed loop delay compensation		0	0	0	0	0	0	0
SV008	VIA	Speed loop lead compensation		1364	1364	1364	1364	1364	1364	1364
SV009	IQA	Current loop q axis lead compensation		2048	2048	2048	2048	2048	2048	2048
SV010	IDA	Current loop d axis lead compensation		2048	2048	2048	2048	2048	2048	2048
SV011	IQG	Current loop q axis gain		256	256	256	256	256	256	200
SV012	IDG	Current loop d axis gain		512	512	512	512	512	512	256
SV013	ILMT	Current limit value		500	500	500	500	500	500	500
SV014	ILMTsp	Current limit value in special control		500	500	500	500	500	500	500
SV015	FFC	Acceleration rate feed forward gain		0	0	0	0	0	0	0
SV016	LMC1	Lost motion compensation 1		0	0	0	0	0	0	0
SV017	SPEC	Servo specifications selection 1		0000	0000	0000	0000	0000	0000	0000
SV018	PIT	Ball screw pitch		---	---	---	---	---	---	---
SV019	RNG1	Position detector resolution		---	---	---	---	---	---	---
SV020	RNG2	Speed detector resolution		---	---	---	---	---	---	---
SV021	OLT	Overload detection time constant		60	60	60	60	60	60	60
SV022	OLL	Overload detection level		150	150	150	150	150	150	150
SV023	OD1	Excessive error detection width during servo ON		6	6	6	6	6	6	6
SV024	INP	In-position detection width		50	50	50	50	50	50	50
SV025	MTYP	Motor/detector type		xx80	xx81	xx8A	xx82	xx83	xx84	xx85
SV026	OD2	Excessive error detection width during servo OFF		6	6	6	6	6	6	6
SV027	SSF1	Servo function selection 1		4000	4000	4000	4000	4000	4000	4000
SV028				0	0	0	0	0	0	0
SV029	VCS	Speed at the change of speed loop gain		0	0	0	0	0	0	0
SV030	IVC	Voltage dead time compensation / current bias 1		0	0	0	0	0	0	0
SV031	OVS1	Overshooting compensation 1		0	0	0	0	0	0	0
SV032	TOF	Torque offset		0	0	0	0	0	0	0
SV033	SSF2	Servo function selection 2		0000	0000	0000	0000	0000	0000	0000
SV034	SSF3	Servo function selection 3		0000	0000	0000	0000	0000	0000	0000
SV035	SSF4	Servo function selection 4		0000	0000	0000	0000	0000	0000	0000
SV036	PTYP	Power supply type		0000	0000	0000	0000	0000	0000	0000
SV037	JL	Load inertia scale		0	0	0	0	0	0	0
SV038	FHz1	Notch filter frequency 1		0	0	0	0	0	0	0
SV039	LMCD	Lost motion compensation timing		0	0	0	0	0	0	0
SV040	LMCT	Lost motion compensation non-sensitive band /current bias 2		0	0	0	0	0	0	0
SV041	LMC2	Lost motion compensation 2		0	0	0	0	0	0	0
SV042	OVS2	Overshooting compensation 2		0	0	0	0	0	0	0
SV043	OBS1	Disturbance observer filter frequency		0	0	0	0	0	0	0
SV044	OBS2	Disturbance observer gain		0	0	0	0	0	0	0
SV045	TRUB	Frictional torque/current bias 3		0	0	0	0	0	0	0
SV046				0	0	0	0	0	0	0
SV047	EC	Inductive voltage compensation gain		100	100	100	100	100	100	100
SV048	EMGrt	Vertical axis drop prevention time		0	0	0	0	0	0	0
SV049	PGN1sp	Position loop gain 1 in spindle synchronous control		15	15	15	15	15	15	15
SV050	PGN2sp	Position loop gain 2 in spindle synchronous control		0	0	0	0	0	0	0
SV051	DFBT	Dual feedback control time constant		0	0	0	0	0	0	0
SV052	DFBN	Dual feedback control non-sensitive band		0	0	0	0	0	0	0
SV053	OD3	Excessive error detection width in special control		0	0	0	0	0	0	0
SV054	IRE	Overrun detection width in closed loop control		0	0	0	0	0	0	0
SV055	EMGx	Max. gate off delay time after emergency stop		0	0	0	0	0	0	0
SV056	EMGt	Deceleration time constant at emergency stop		0	0	0	0	0	0	0
SV057	SHGC	SHG control gain		0	0	0	0	0	0	0
SV058	SHGCsp	SHG control gain in spindle synchronous control		0	0	0	0	0	0	0
SV059	TCNV	Collision detection torque estimating gain		0	0	0	0	0	0	0
SV060	TLMT	Collision detection level		0	0	0	0	0	0	0
SV061	DA1NO	D/A output channel 1 data No.		0	0	0	0	0	0	0
SV062	DA2NO	D/A output channel 2 data No.		0	0	0	0	0	0	0
SV063	DA1MPY	D/A output channel 1 output scale		0	0	0	0	0	0	0
SV064	DA2MPY	D/A output channel 2 output scale		0	0	0	0	0	0	0
SV065				0	0	0	0	0	0	0

(6) HA series (Low-inertia 2000 r/min rating)

Standard specifications

Parameter No.	Abbrev.	Details	HA50L (05)	HA100L (10)	HA150L (10)	HA200L (20)	HA300L (35)	HA500L (45)	HA-LH11K2 (110)	HA-LH15K2 (150)
		Motor: Low-inertia HA motor 2000 r/min rating / Unit capacity								
SV001	PC1	Motor side gear ratio	---	---	---	---	---	---	---	---
SV002	PC2	Machine side gear ratio	---	---	---	---	---	---	---	---
SV003	PGN1	Position loop gain 1	33	33	33	33	33	33	33	33
SV004	PGN2	Position loop gain 2	0	0	0	0	0	0	0	0
SV005	VGN1	Speed loop gain 1	30	30	30	30	30	50	150	150
SV006	VGN2	Speed loop gain 2	0	0	0	0	0	0	0	0
SV007	VIL	Speed loop delay compensation	0	0	0	0	0	0	0	0
SV008	VIA	Speed loop lead compensation	1364	1364	1364	1364	1364	1364	1364	1364
SV009	IQA	Current loop q axis lead compensation	2048	2048	2048	2048	2048	2048	2048	2048
SV010	IDA	Current loop d axis lead compensation	2048	2048	2048	2048	2048	2048	2048	2048
SV011	IQG	Current loop q axis gain	512	512	512	512	256	256	512	512
SV012	IDG	Current loop d axis gain	512	512	512	512	512	512	512	512
SV013	ILMT	Current limit value	500	500	500	500	500	500	500	500
SV014	ILMTsp	Current limit value in special control	500	500	500	500	500	500	500	500
SV015	FFC	Acceleration rate feed forward gain	0	0	0	0	0	0	0	0
SV016	LMC1	Lost motion compensation 1	0	0	0	0	0	0	0	0
SV017	SPEC	Servo specifications selection 1	0000	0000	0000	0000	0000	0000	0000	0000
SV018	PIT	Ball screw pitch	---	---	---	---	---	---	---	---
SV019	RNG1	Position detector resolution	---	---	---	---	---	---	---	---
SV020	RNG2	Speed detector resolution	---	---	---	---	---	---	---	---
SV021	OLT	Overload detection time constant	60	60	60	60	60	60	60	3
SV022	OLL	Overload detection level	150	150	150	150	150	150	150	150
SV023	OD1	Excessive error detection width during servo ON	6	6	6	6	6	6	6	6
SV024	INP	In-position detection width	50	50	50	50	50	50	50	50
SV025	MTYP	Motor/detector type	xx20	xx21	xx2A	xx22	xx23	xx24	xx27	xx28
SV026	OD2	Excessive error detection width during servo OFF	6	6	6	6	6	6	6	6
SV027	SSF1	Servo function selection 1	4000	4000	4000	4000	4000	4000	4000	4000
SV028			0	0	0	0	0	0	0	0
SV029	VCS	Speed at the change of speed loop gain	0	0	0	0	0	0	0	0
SV030	IVC	Voltage dead time compensation / current bias 1	0	0	0	0	0	0	0	0
SV031	OVS1	Overshooting compensation 1	0	0	0	0	0	0	0	0
SV032	TOF	Torque offset	0	0	0	0	0	0	0	0
SV033	SSF2	Servo function selection 2	0000	0000	0000	0000	0000	0000	0000	0000
SV034	SSF3	Servo function selection 3	0000	0000	0000	0000	0000	0000	0000	0000
SV035	SSF4	Servo function selection 4	0000	0000	0000	0000	0000	0000	0000	0000
SV036	PTYP	Power supply type	0000	0000	0000	0000	0000	0000	0000	0000
SV037	JL	Load inertia scale	0	0	0	0	0	0	0	0
SV038	FHz1	Notch filter frequency 1	0	0	0	0	0	0	0	0
SV039	LMCD	Lost motion compensation timing	0	0	0	0	0	0	0	0
SV040	LMCT	Lost motion compensation non-sensitive band /current bias 2	0	0	0	0	0	0	0	0
SV041	LMC2	Lost motion compensation 2	0	0	0	0	0	0	0	0
SV042	OVS2	Overshooting compensation 2	0	0	0	0	0	0	0	0
SV043	OBS1	Disturbance observer filter frequency	0	0	0	0	0	0	0	0
SV044	OBS2	Disturbance observer gain	0	0	0	0	0	0	0	0
SV045	TRUB	Frictional torque/current bias 3	0	0	0	0	0	0	0	0
SV046			0	0	0	0	0	0	0	0
SV047	EC	Inductive voltage compensation gain	100	100	100	100	100	100	100	100
SV048	EMGrt	Vertical axis drop prevention time	0	0	0	0	0	0	0	0
SV049	PGN1sp	Position loop gain 1 in spindle synchronous control	15	15	15	15	15	15	15	15
SV050	PGN2sp	Position loop gain 2 in spindle synchronous control	0	0	0	0	0	0	0	0
SV051	DFBT	Dual feedback control time constant	0	0	0	0	0	0	0	0
SV052	DFBN	Dual feedback control non-sensitive band	0	0	0	0	0	0	0	0
SV053	OD3	Excessive error detection width in special control	0	0	0	0	0	0	0	0
SV054	IRE	Overrun detection width in closed loop control	0	0	0	0	0	0	0	0
SV055	EMGx	Max. gate off delay time after emergency stop	0	0	0	0	0	0	0	0
SV056	EMGt	Deceleration time constant at emergency stop	0	0	0	0	0	0	0	0
SV057	SHGC	SHG control gain	0	0	0	0	0	0	0	0
SV058	SHGCsp	SHG control gain in spindle synchronous control	0	0	0	0	0	0	0	0
SV059	TCNV	Collision detection torque estimating gain	0	0	0	0	0	0	0	0
SV060	TLMT	Collision detection level	0	0	0	0	0	0	0	0
SV061	DA1NO	D/A output channel 1 data No.	0	0	0	0	0	0	0	0
SV062	DA2NO	D/A output channel 2 data No.	0	0	0	0	0	0	0	0
SV063	DA1MPY	D/A output channel 1 output scale	0	0	0	0	0	0	0	0
SV064	DA2MPY	D/A output channel 2 output scale	0	0	0	0	0	0	0	0
SV065			0	0	0	0	0	0	0	0

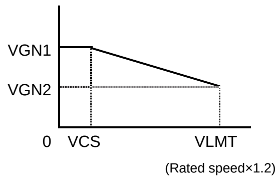
(7) HA series (Small capacity, Low-inertia 3000 r/min rating)

Standard specifications

Parameter			Motor	Small capacity HA motor				Low-inertia HA motor 3000 r/min rating					
				HA053A	HA13N	HA23N	HA33N	HA53L	HA103L	HA153L	HA203L	HA303L	HA503L
No.	Abbrev.	Details	Unit capacity	01	01	03	03	10	20	20	35	45	70
SV001	PC1	Motor side gear ratio		---	---	---	---	---	---	---	---	---	---
SV002	PC2	Machine side gear ratio		---	---	---	---	---	---	---	---	---	---
SV003	PGN1	Position loop gain 1		33	33	33	33	33	33	33	33	33	33
SV004	PGN2	Position loop gain 2		0	0	0	0	0	0	0	0	0	0
SV005	VGN1	Speed loop gain 1		70	70	100	100	30	30	30	30	30	50
SV006	VGN2	Speed loop gain 2		0	0	0	0	0	0	0	0	0	0
SV007	VIL	Speed loop delay compensation		0	0	0	0	0	0	0	0	0	0
SV008	VIA	Speed loop lead compensation		1364	1364	1364	1364	1364	1364	1364	1364	1364	1364
SV009	IQA	Current loop q axis lead compensation		2048	2048	2048	2048	2048	2048	2048	2048	2048	2048
SV010	IDA	Current loop d axis lead compensation		2048	2048	2048	2048	2048	2048	2048	2048	2048	2048
SV011	IQG	Current loop q axis gain		256	256	224	224	512	512	512	512	256	256
SV012	IDG	Current loop d axis gain		256	256	224	224	512	512	512	512	512	512
SV013	ILMT	Current limit value		500	500	500	500	500	500	500	500	500	500
SV014	ILMTsp	Current limit value in special control		500	500	500	500	500	500	500	500	500	500
SV015	FFC	Acceleration rate feed forward gain		0	0	0	0	0	0	0	0	0	0
SV016	LMC1	Lost motion compensation 1		0	0	0	0	0	0	0	0	0	0
SV017	SPEC	Servo specifications selection 1		0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
SV018	PIT	Ball screw pitch		---	---	---	---	---	---	---	---	---	---
SV019	RNG1	Position detector resolution		---	---	---	---	---	---	---	---	---	---
SV020	RNG2	Speed detector resolution		---	---	---	---	---	---	---	---	---	---
SV021	OLT	Overload detection time constant		60	60	60	60	60	60	60	60	60	60
SV022	OLL	Overload detection level		150	150	150	150	150	150	150	150	150	150
SV023	OD1	Excessive error detection width during servo ON		6	6	6	6	6	6	6	6	6	6
SV024	INP	In-position detection width		50	50	50	50	50	50	50	50	50	50
SV025	MTYP	Motor/detector type		xx8C	xx8D	xx8E	xx8F	xx30	xx31	xx3A	xx32	xx33	xx34
SV026	OD2	Excessive error detection width during servo OFF		6	6	6	6	6	6	6	6	6	6
SV027	SSF1	Servo function selection 1		4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
SV028				0	0	0	0	0	0	0	0	0	0
SV029	VCS	Speed at the change of speed loop gain		0	0	0	0	0	0	0	0	0	0
SV030	IVC	Voltage dead time compensation / current bias 1		0	0	0	0	0	0	0	0	0	0
SV031	OVS1	Overshooting compensation 1		0	0	0	0	0	0	0	0	0	0
SV032	TOF	Torque offset		0	0	0	0	0	0	0	0	0	0
SV033	SSF2	Servo function selection 2		0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
SV034	SSF3	Servo function selection 3		0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
SV035	SSF4	Servo function selection 4		0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
SV036	PTYP	Power supply type		0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
SV037	JL	Load inertia scale		0	0	0	0	0	0	0	0	0	0
SV038	FHz1	Notch filter frequency 1		0	0	0	0	0	0	0	0	0	0
SV039	LMCD	Lost motion compensation timing		0	0	0	0	0	0	0	0	0	0
SV040	LMCT	Lost motion compensation non-sensitive band /current bias 2		0	0	0	0	0	0	0	0	0	0
SV041	LMC2	Lost motion compensation 2		0	0	0	0	0	0	0	0	0	0
SV042	OVS2	Overshooting compensation 2		0	0	0	0	0	0	0	0	0	0
SV043	OBS1	Disturbance observer filter frequency		0	0	0	0	0	0	0	0	0	0
SV044	OBS2	Disturbance observer gain		0	0	0	0	0	0	0	0	0	0
SV045	TRUB	Frictional torque/current bias 3		0	0	0	0	0	0	0	0	0	0
SV046				0	0	0	0	0	0	0	0	0	0
SV047	EC	Inductive voltage compensation gain		100	100	100	100	100	100	100	100	100	100
SV048	EMGrt	Vertical axis drop prevention time		0	0	0	0	0	0	0	0	0	0
SV049	PGN1sp	Position loop gain 1 in spindle synchronous control		15	15	15	15	15	15	15	15	15	15
SV050	PGN2sp	Position loop gain 2 in spindle synchronous control		0	0	0	0	0	0	0	0	0	0
SV051	DFBT	Dual feedback control time constant		0	0	0	0	0	0	0	0	0	0
SV052	DFBN	Dual feedback control non-sensitive band		0	0	0	0	0	0	0	0	0	0
SV053	OD3	Excessive error detection width in special control		0	0	0	0	0	0	0	0	0	0
SV054	IRE	Overrun detection width in closed loop control		0	0	0	0	0	0	0	0	0	0
SV055	EMGx	Max. gate off delay time after emergency stop		0	0	0	0	0	0	0	0	0	0
SV056	EMGt	Deceleration time constant at emergency stop		0	0	0	0	0	0	0	0	0	0
SV057	SHGC	SHG control gain		0	0	0	0	0	0	0	0	0	0
SV058	SHGCsp	SHG control gain in spindle synchronous control		0	0	0	0	0	0	0	0	0	0
SV059	TCNV	Collision detection torque estimating gain		0	0	0	0	0	0	0	0	0	0
SV060	TLMT	Collision detection level		0	0	0	0	0	0	0	0	0	0
SV061	DA1NO	D/A output channel 1 data No.		0	0	0	0	0	0	0	0	0	0
SV062	DA2NO	D/A output channel 2 data No.		0	0	0	0	0	0	0	0	0	0
SV063	DA1MPY	D/A output channel 1 output scale		0	0	0	0	0	0	0	0	0	0
SV064	DA2MPY	D/A output channel 2 output scale		0	0	0	0	0	0	0	0	0	0
SV065				0	0	0	0	0	0	0	0	0	0

3-3-3 Servo parameter list

Standard specifications

No.	Abbrev.	Parameter name	Explanation	Setting range (Unit)
SV001	PC1*	Motor side gear ratio	Set the motor side and machine side gear ratio. 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 cause an alarm.	1 to 32767
SV002	PC2*	Machine side gear ratio		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 precisely the command can be followed and the shorter the positioning time gets, however, note that a bigger shock is applied to the machine during acceleration/deceleration. When using the SHG control, also set SV004 (PGN2) and SV057 (SHGC).	1 to 200 (rad/s)
SV004	PGN2	Position loop gain 2	When using the SHG control, also set SV003 (PGN1) and SV057 (SHGC). When not using the SHG control, set to "0".	0 to 999 (rad/s)
SV005	VGN1	Speed loop gain 1	Set the speed loop gain. Set this according to the load inertia size. 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 be 70 to 80% of the value at the time when the vibration stops.	1 to 999
SV006	VGN2	Speed loop gain 2	If the noise is bothersome at high speed during rapid traverse, etc, lower the speed loop gain. As in the right figure, set the speed loop gain of the speed 1.2 times as fast as the motor's rated speed, and use this with SV029 (VCS). When not using, set to "0". 	-1000 to 1000
SV007	VIL	Speed loop delay compensation	Set this when the limit cycle occurs in the full-closed loop, or overshooting occurs in positioning. Select the control method with SV027 (SSF1)/bit1, 0 (vcnt). Normally, use "Changeover type 2". When you set this parameter, make sure to set the torque offset (SV032 (TOF)). When not using, set to "0". No changeover When SV027 (SSF1)/bit1, 0 (vcnt)=00 The delay compensation control is always valid. Changeover type 1 When SV027 (SSF1)/bit1, 0 (vcnt)=01 The delay compensation control works when the command from the NC is "0". Overshooting that occurs during pulse feeding can be suppressed. Changeover type 2 When SV027 (SSF1)/bit1, 0 (vcnt)=10 The delay compensation control works when the command from the NC is "0" and the position droop is "0". Overshooting or the limit cycle that occurs during pulse feeding or positioning can be suppressed.	0 to 32767
SV008	VIA	Speed loop lead compensation	Set the gain of the speed loop integration control. The standard setting is "1364". During the SHG control, the standard setting is "1900". Adjust the value by increasing/decreasing it by about 100 at a time. Raise this value to improve contour tracking precision in high-speed cutting. Lower this value when the position droop vibrates (10 to 20Hz).	1 to 9999
SV009	IQA	Current loop q axis lead compensation	Set the gain of current loop. As this setting is determined by the motor's electrical characteristics, the setting is fixed for each type of motor. Set the standard values for all the parameters depending on each motor type.	1 to 20480
SV010	IDA	Current loop d axis lead compensation		
SV011	IQG	Current loop q axis gain		1 to 2560
SV012	IDG	Current loop d axis gain		

Parameters with an asterisk * in the abbreviation, such as PC1*, are validated with the NC power turned ON again.

Standard specifications

No.	Abbrev.	Parameter name	Explanation	Setting range (Unit)
SV013	ILMT	Current limit value	Set the normal current (torque) limit value. (Limit values for both + and - direction.) When the value is “500” (a standard setting), the maximum torque is determined by the specification of the motor.	0 to 999 (Stall [rated] current %)
SV014	ILMTsp	Current limit value in special control	Set the current (torque) limit value in a special control (initial absolute position setting, stopper control, etc). (Limit values for both of the + and - directions.) Set to “500” when not using.	0 to 999 (Stall [rated] current %)
SV015	FFC	Acceleration rate feed forward gain	When a relative error in the synchronous control is large, apply this parameter to the axis that is delaying. The standard setting value is “0”. For the SHG control, set to “100”. To adjust a relative error in acceleration/deceleration, increase the value by 50 to 100 at a time.	0 to 999 (%)
SV016	LMC1	Lost motion compensation 1	Set this when the protrusion (that occurs due to the non-sensitive band by friction, torsion, backlash, etc) at quadrant change is too large. This compensates the torque at quadrant change. This is valid only when the lost motion compensation (SV027 (SSF1.lmc)) is selected.	
			Type 1: When SV027 (SSF1)/bit9, 8 (lmc)=01 Set the compensation amount based on the motor torque before the quadrant change. The standard setting is “100”. Setting to “0” means the compensation amount is zero. Normally, use Type 2.	-1 to 200 (%)
			Type 2: When SV027 (SSF1)/bit9, 8 (lmc)=10 Set the compensation amount based on the stall (rated) current of the motor. The standard setting is double of the friction torque. Setting to “0” means the compensation amount is zero.	-1 to 200 (Stall [rated] current %)
			When you wish different compensation amount depending on the direction When SV041 (LMC2) is “0”, compensate with the value of SV016 (LMC1) in both of the + and -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 won’t be performed in the direction of the command.	

Parameters with an asterisk * in the abbreviation, such as PC1*, are validated with the NC power turned ON again.

Standard specifications

<table>
<tr><th>No.</th><th>Abbrev.</th><th>Parameter name</th><th>Explanation</th><th>Setting range (Unit)</th></tr>
<tr><td>SV017</td><td>SPEC*</td><td>Servo specification selection</td><td colspan="2">
<table>
<tr><td>F</td><td>E</td><td>D</td><td>C</td><td>B</td><td>A</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td>mpt</td><td>mp</td><td>abs</td><td></td><td>vdir</td><td>fdir</td><td>spwv</td><td>seqh</td><td>dfbx</td><td></td></tr>
</table>
<table>
<tr><th colspan="2">bit</th><th>Meaning when “0” is set</th><th>Meaning when “1” is set</th></tr>
<tr><td>0</td><td></td><td></td><td></td></tr>
<tr><td>1</td><td>dfbx</td><td>Dual feedback control stop</td><td>Dual feedback control start</td></tr>
<tr><td>2</td><td>seqh</td><td>Normal ready ON/servo ON time</td><td>High-speed ready ON/servo ON time</td></tr>
<tr><td>3</td><td>spwv</td><td>Normal mode</td><td>High-gain servo synchronization mode</td></tr>
<tr><td>4</td><td>fdir</td><td>Position feedback forward polarity</td><td>Position feedback reverse polarity</td></tr>
<tr><td>5</td><td>vdir</td><td>Standard setting</td><td>HA motor (4 pole motor)
Detector installation position 90 degrees (B, D)</td></tr>
<tr><td>6</td><td></td><td></td><td></td></tr>
<tr><td>7</td><td>abs</td><td>Incremental control</td><td>Absolute position control</td></tr>
<tr><td>8</td><td>mp</td><td>MP scale 360P (2mm pitch)</td><td>MP scale 720P (1mm pitch)</td></tr>
<tr><td>9</td><td>mpt</td><td>MP scale ABS detection NC control</td><td>MP scale ABS detection automatic (Standard swetting)</td></tr>
<tr><td>A</td><td></td><td></td><td></td></tr>
<tr><td>B</td><td></td><td></td><td></td></tr>
<tr><td>C</td><td></td><td></td><td></td></tr>
<tr><td>D</td><td></td><td></td><td></td></tr>
<tr><td>E</td><td></td><td></td><td></td></tr>
<tr><td>F</td><td></td><td></td><td></td></tr>
</table>
(Note) Set to “0” for bits with no particular description.
</td></tr>
<tr><td>SV018</td><td>PIT*</td><td>Ball screw pitch</td><td>Set the ball screw pitch. Set to “360” for the rotary axis.</td><td>1 to 32767
(mm/rev)</td></tr>
</table>

Parameters with an asterisk * in the abbreviation, such as PC1*, are validated with the NC power turned ON again.

Standard specifications

<table>
<tr><th>No.</th><th>Abbrev.</th><th>Parameter name</th><th>Explanation</th><th>Setting range (Unit)</th></tr>
<tr><td rowspan="2">SV019</td><td rowspan="2">RNG1*</td><td rowspan="2">Position detector resolution</td><td>In the case of the semi-closed loop control
Set the same value as SV020 (RNG2). (Refer to the explanation of SV020.)</td><td>1 to 9999
(kp/rev)</td></tr>
<tr><td>In the case of the full-closed loop control
Set the number of pulses per ball screw pitch.
<table>
<tr><th>Detector model name</th><th>Resolution</th><th>SV019 setting</th></tr>
<tr><td>OHE25K-ET, OHA25K-ET</td><td>100,000 (p/rev)</td><td>100</td></tr>
<tr><td>OSE104-ET,OSA104-ET</td><td>100,000 (p/rev)</td><td>100</td></tr>
<tr><td>OSE105-ET,OSA105-ET</td><td>1,000,000 (p/rev)</td><td>1000</td></tr>
<tr><td>Relative position detection scale</td><td>Refer to detector specification manual</td><td>PIT/Resolution (μm)</td></tr>
<tr><td>AT41 (Mitsutoyo)</td><td>1 (μm/p)</td><td>The same as SV018 (PIT)</td></tr>
<tr><td>AT342 (Mitsutoyo)</td><td>0.5 (μm/p)</td><td>Twice as big as SV018 (PIT)</td></tr>
<tr><td>FME type, FLE type (Futaba)</td><td>Refer to detector specification manual</td><td>PIT/Resolution (μm)</td></tr>
<tr><td>MP type (Mitsubishi Heavy Industries)</td><td>Refer to detector specification manual</td><td>PIT/Resolution (μm)</td></tr>
</table></td><td>1 to 9999
(kp/pit)</td></tr>
<tr><td>SV020</td><td>RNG2*</td><td>Speed detector resolution</td><td>Set the number of pulses per one revolution of the motor end detector.
<table>
<tr><th>Detector model name</th><th>SV020 setting</th></tr>
<tr><td>OSE104, OSA104</td><td>100</td></tr>
<tr><td>OSE105, OSA105</td><td>1000</td></tr>
</table></td><td>1 to 9999
(kp/rev)</td></tr>
<tr><td>SV021</td><td>OLT</td><td>Overload detection time constant</td><td>Set the detection time constant of Overload 1 (Alarm 50).
Set to “60” as a standard. (For machine tool builder adjustment.)</td><td>1 to 999
(s)</td></tr>
<tr><td>SV022</td><td>OLL</td><td>Overload detection level</td><td>Set the current detection level of Overload 1 (Alarm 50) in respect to the stall (rated) current.
Set to “150” as a standard. (For machine tool builder adjustment.)</td><td>110 to 500
(Stall [rated] current %)</td></tr>
<tr><td>SV023</td><td>OD1</td><td>Excessive error detection width during servo ON</td><td>Set the excessive error detection width when servo ON.
<Standard setting value> $OD1=OD2=\dfrac{\text{Rapid traverse rate (mm/min)}}{60 \times PGN1} \div 2$ (mm)
When “0” is set, the excessive error detection will not be performed.</td><td>0 to 32767
(mm)</td></tr>
<tr><td>SV024</td><td>INP</td><td>In-position detection width</td><td>Set the in-position detection width.
Set the accuracy required for the machine.
The lower the setting is, the higher the positioning accuracy gets, however, the cycle time (setting time) becomes longer. The standard setting is “50”.</td><td>0 to 32767
(μm)</td></tr>
</table>

Parameters with an asterisk * in the abbreviation, such as PC1*, are validated with the NC power turned ON again.

Standard specifications

No.	Abbrev.	Parameter name	Explanation
SV025	MTYP*	Motor/Detector type	(see tables below)

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
pen				ent				mtyp							

bit		Explanation
0	mtyp	Set the motor type.
1		
2		
3		
4		
5		
6		
7		

Setting	0x	1x	2x	3x	4x	5x	6x	7x
x0	HA40N		HA50L	HA53L				
x1	HA80N		HA100L	HA103L				
x2	HA100N		HA200L	HA203L				
x3	HA200N		HA300L	HA303L				
x4	HA300N		HA500L	HA503L				
x5	HA700N							
x6	HA900N							
x7			HA-LH11K2					
x8			HA-LH15K2					
x9								
xA			HA150L	HA153L				
xB								
xC								
xD								
xE								
xF								

Setting	8x	9x	Ax	Bx	Cx	Dx	Ex	Fx
x0	HA43N			HC52	H53			
x1	HA83N			HC102	HC103		HC103R	
x2	HA103N			HC152	HC153		HC153R	
x3	HA203N			HC202	HC203		HC203R	
x4	HA303N			HC352	HC353		HC353R	
x5	HA703N			HC452	HC453		HC503R	
x6				HC702	HC703			
x7				HC902				
x8								
x9								
xA	HA93N							
xB								
xC	HA053N							
xD	HA13N							
xE	HA23N							
xF	HA33N							

Parameters with an asterisk * in the abbreviation, such as PC1*, are validated with the NC power turned ON again.

Standard specifications

<table>
<tr><th>No.</th><th>Abbrev.</th><th>Parameter name</th><th>Explanation</th><th>Setting range (Unit)</th></tr>
<tr><td>SV025</td><td>MTYP*</td><td>Motor/Detector type</td><td colspan="2">
<table>
<tr><th colspan="2">bit</th><th>Explanation</th></tr>
<tr><td>8
9
A
B</td><td>ent</td><td rowspan="2">Set the detector type.
Set the position detector type for “pen”, and the speed detector type for “ent”. In the case of the semi-closed loop control, set the same value for “pen” and “ent”.
<table>
<tr><th>Detector model name</th><th>pen setting</th><th>ent setting</th></tr>
<tr><td>OSE104</td><td>0 (Note)</td><td>0</td></tr>
<tr><td>OSA104</td><td>1 (Note)</td><td>1</td></tr>
<tr><td>OSE105, OSA105</td><td>2 (Note)</td><td>2</td></tr>
<tr><td></td><td>3 (Note)</td><td>3</td></tr>
<tr><td>OHE25K-ET, OSE104-ET</td><td>4</td><td>Setting impossible</td></tr>
<tr><td>OHA25K-ET, OSA104-ET</td><td>5</td><td>Setting impossible</td></tr>
<tr><td>OSE105-ET, OSA105-ET</td><td>6</td><td>Setting impossible</td></tr>
<tr><td></td><td>7</td><td>Setting impossible</td></tr>
<tr><td>Relative position detection scale, MP type (Mitsubishi Heavy Industries)</td><td>8</td><td>Setting impossible</td></tr>
<tr><td>AT41 (Mitsutoyo), FME type, FLE type (Futaba)</td><td>9</td><td>Setting impossible</td></tr>
<tr><td>AT342 (Mitsutoyo)</td><td>A</td><td>Setting impossible</td></tr>
<tr><td></td><td>B</td><td>Setting impossible</td></tr>
<tr><td>The setting of the slave axis in the speed/current synchronization control.
When the master axis is the semi-closed control.</td><td>C</td><td>C
(Current synchronization)</td></tr>
<tr><td></td><td>D</td><td>Setting impossible</td></tr>
<tr><td></td><td>E</td><td>Setting impossible</td></tr>
<tr><td></td><td>F</td><td>Setting impossible</td></tr>
</table>
(Note) Setting for semi-closed loop control</td></tr>
<tr><td>C
D
E
F</td><td>pen</td></tr>
</table>
</td></tr>
<tr><td>SV026</td><td>OD2</td><td>Excessive error detection width during servo OFF</td><td>Set the excessive error detection width when servo ON.
For the standard setting, refer to the explanation of SV023 (OD1).
When “0” is set, the excessive error detection will not be performed.</td><td>0 to 32767
(mm)</td></tr>
</table>

Parameters with an asterisk * in the abbreviation, such as PC1*, are validated with the NC power turned ON again.

Standard specifications

<table>
<tr><th>No.</th><th>Abbrev.</th><th>Parameter name</th><th>Explanation</th><th>Setting range (Unit)</th></tr>
<tr><td>SV027</td><td>SSF1</td><td>Servo function selection 1</td><td colspan="2">
<table>
<tr><td>F</td><td>E</td><td>D</td><td>C</td><td>B</td><td>A</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td>aflt</td><td>zrn2</td><td colspan="2">afse</td><td colspan="2">ovs</td><td colspan="2">lmc</td><td></td><td>zrn3</td><td colspan="2">vfct</td><td></td><td>upc</td><td colspan="2">vcnt</td></tr>
</table>
<table>
<tr><th colspan="2">bit</th><th>Meaning when “0” is set</th><th>Meaning when “1” is set</th></tr>
<tr><td>0
1</td><td>vcnt</td><td colspan="2">Set the execution changeover type of the speed loop delay compensation.
00: Delay compensation changeover invalid 10: Delay compensation type 2
01: Delay compensation changeover type 1 11: Setting prohibited</td></tr>
<tr><td>2</td><td>upc</td><td>Starting torque compensation invalid</td><td>Starting torque compensation valid</td></tr>
<tr><td>3</td><td></td><td colspan="2"></td></tr>
<tr><td>4
5</td><td>vfct</td><td colspan="2">Set the number of compensation pulses of the jitter compensation.
00: Jitter compensation invalid 10: Jitter compensation 2 pulses
01: Jitter compensation 1 pulse 11: Jitter compensation 3 pulses</td></tr>
<tr><td>6</td><td>zrn3</td><td colspan="2">ABZ scale: Set to "1" to fix Z-phase detection edge.
Absolute position scale: Set to "1" in using AT342.</td></tr>
<tr><td>7</td><td>omr</td><td>Machine end compensation invalid</td><td>Machine end compensation valid</td></tr>
<tr><td>8
9</td><td>lmc</td><td colspan="2">Set the compensation amount with SV016 (LMC1) and SV041 (LMC2).
00: Lost motion compensation stop 10: Lost motion compensation type 2
01: Lost motion compensation type 1 11: Setting prohibited</td></tr>
<tr><td>A
B</td><td>ovs</td><td colspan="2">Set the compensation amount with SV031 (OVS1) and SV042 (OVS2).
00: Overshooting compensation stop 10: Overshooting compensation type 2
01: Overshooting compensation type 1 11: Setting prohibited</td></tr>
<tr><td>C
D</td><td>afse</td><td colspan="2">00: Adaptive filter sensitivity standard
11: Adaptive filter sensitivity increase (Set 2bits at a time)</td></tr>
<tr><td>E</td><td>zrn2</td><td colspan="2">Set to “1”.</td></tr>
<tr><td>F</td><td>aflt</td><td>Adaptive filter stop</td><td>Adaptive filter start</td></tr>
</table>
(Note) Set to "0" for bits with no particular description.</td></tr>
<tr><td>SV028</td><td></td><td></td><td>Not used. Set to "0".</td><td>0</td></tr>
<tr><td>SV029</td><td>VCS</td><td>Speed at the change of speed loop gain</td><td>If the noise is bothersome at high speed during rapid traverse, etc, lower the speed loop gain.
Set the speed at which the speed loop gain changes, and use this with SV006 (VGN2).
When not using, set to “0”.</td><td>0 to 9999
(r/min)</td></tr>
<tr><td>SV030</td><td colspan="3">The higher order 8bits and lower order 8bits are used for different functions.
“The setting value of SV030” = (Icx × 256) + IVC
<table>
<tr><th>Abbrev.</th><th>Parameter name</th><th>Explanation</th><th>Setting range (Unit)</th></tr>
<tr><td>IVC
(Low order)</td><td>Voltage dead band compensation</td><td>When 100% is set, the voltage equivalent to the logical non-energized time will be compensated.
When “0” is set, a 100% compensation will be performed.
Adjust in increments of 10% from the default value 100%.
If increased too much, vibration or vibration noise may be generated.</td><td>0 to 255
(%)</td></tr>
<tr><td>Icx
(High order)</td><td>Current bias 1</td><td>Normally set to “0”.
Use this in combination with SV040 and the high order 8bits of SV045.</td><td>0 to 127</td></tr>
</table></td><td>0 to 32767</td></tr>
</table>

Parameters with an asterisk * in the abbreviation, such as PC1*, are validated with the NC power turned ON again.

Standard specifications

<table>
<tr><th>No.</th><th>Abbrev.</th><th>Parameter name</th><th>Explanation</th><th>Setting range (Unit)</th></tr>
<tr><td>SV031</td><td>OVS1</td><td>Overshooting compensation 1</td><td>Set this if overshooting occurs during positioning. This compensates the motor torque during positioning.
This is valid only when the overshooting compensation SV027 (SSF1.ovs) is selected.

Type 1: When SV027 (SSF1)/bitB, A (ovs)=01
Set the compensation amount based on the motor's stall current.
This compensates overshooting that occurs during pulse feeding.
Normally, use Type 2.

Type 2: When SV027 (SSF1)/bitB, A (ovs)=10
Set the compensation amount based on the motor's stall current.
Increase by 1% and determine the amount that overshooting doesn't occur.
In Type 2, compensation during the feed forward control during circular cutting won't be performed.

Type 3: When SV027 (SSF1)/bitB, A (ovs)=11
Use this to perform the overshooting compensation during circular cutting or the feed forward control. The setting method is the same in Type 2.

When you wish different compensation amount depending on the direction
When SV042 (OVS2) is "0", compensate with the value of SV031 (OVS1) in both of the + and -directions.
If you wish to change 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 won't be performed in the direction of the command.</td><td>-1 to 100
(Stall [rated] current %)</td></tr>
<tr><td>SV032</td><td>TOF</td><td>Torque offset</td><td>Set the unbalance torque of vertical axis and inclined axis.</td><td>-100 to 100
(Stall [rated] current %)</td></tr>
<tr><td>SV033</td><td>SSF2</td><td>Servo function selection 2</td><td>
<table>
<tr><td>F</td><td>E</td><td>D</td><td>C</td><td>B</td><td>A</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td>hvx</td><td>svx</td><td colspan="4">fhz2</td><td colspan="3">nfd1</td><td>zck</td></tr>
</table>
<table>
<tr><th colspan="2">bit</th><th>Meaning when "0" is set</th><th>Meaning when "1" is set</th></tr>
<tr><td>0</td><td>zck</td><td>Z phase check valid (Alarm 42)</td><td>Z phase check invalid</td></tr>
<tr><td>1
2
3</td><td>nfd1</td><td colspan="2">Set the filter depth for Notch filter 1 (SV038).
Value: 000 / 001 / 010 / 011 / 100 / 101 / 110 / 111
Depth (dB): Infntly deep / -18.1 / -12.0 / -8.5 / -6.0 / -4.1 / -2.5 / -1.2
Deep← Shallow→</td></tr>
<tr><td>4
5
6
7</td><td>fhz2</td><td colspan="2">Set the operation frequency of Notch filter 2
0: Invalid 3: 750Hz 6: 375Hz
1: 2250Hz 4: 563Hz 7: 321Hz
2 : 1125Hz 5: 450Hz 8 to F: 281Hz</td></tr>
<tr><td>8
9</td><td>svx
hvx</td><td colspan="2">Set the performance mode of the servo control. (Only for MDS-C1-Vx)
00: By current loop gain 10: High gain mode selected
01: MDS-B-Vx compatible mode selected 11: High gain mode selected</td></tr>
<tr><td>A</td><td></td><td></td><td></td></tr>
<tr><td>B</td><td></td><td></td><td></td></tr>
<tr><td>C</td><td></td><td></td><td></td></tr>
<tr><td>D</td><td></td><td></td><td></td></tr>
<tr><td>E</td><td></td><td></td><td></td></tr>
<tr><td>F</td><td></td><td></td><td></td></tr>
</table>
(Note) Set to "0" for bits with no particular description.</td><td></td></tr>
</table>

Parameters with an asterisk * in the abbreviation, such as PC1*, are validated with the NC power turned ON again.

Standard specifications

<table>
<tr><th>No.</th><th>Abbrev.</th><th>Parameter name</th><th>Explanation</th><th>Setting range (Unit)</th></tr>
<tr><td>SV034</td><td>SSF3</td><td>Servo function selection 3</td><td>
<table>
<tr><td>F</td><td>E</td><td>D</td><td>C</td><td>B</td><td>A</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td colspan="4">ovsn</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>has2</td><td>has1</td></tr>
</table>
<table>
<tr><th colspan="2">bit</th><th>Meaning when “0” is set</th><th>Meaning when “1” is set</th></tr>
<tr><td>0</td><td>has1</td><td>Setting for normal use.
(Except for HC)</td><td>HAS control 1 valid
(HC: High acceleration rate support)</td></tr>
<tr><td>1</td><td>has2</td><td>Setting for normal use.
(Except for HC)</td><td>HAS control 2 valid
(HC: Overshooting support)</td></tr>
<tr><td>2</td><td></td><td></td><td></td></tr>
<tr><td>3</td><td></td><td></td><td></td></tr>
<tr><td>4</td><td></td><td></td><td></td></tr>
<tr><td>5</td><td></td><td></td><td></td></tr>
<tr><td>6</td><td></td><td></td><td></td></tr>
<tr><td>7</td><td></td><td></td><td></td></tr>
<tr><td>8</td><td></td><td colspan="2"></td></tr>
<tr><td>9</td><td></td><td colspan="2"></td></tr>
<tr><td>A</td><td></td><td colspan="2"></td></tr>
<tr><td>B</td><td></td><td colspan="2"></td></tr>
<tr><td>C
D
E
F</td><td>ovsn</td><td colspan="2">Set the non-sensitive band of the overshooting compensation type 3 in increments of 2µm at a time.
In the feed forward control, the non-sensitive band of the model position droop is set, and overshooting of the model is ignored. Set 2µm (0001) as a standard.</td></tr>
</table>
(Note) Set to “0” for bits with no particular description.
</td><td></td></tr>
<tr><td>SV035</td><td>SSF4</td><td>Servo function selection 4</td><td>
<table>
<tr><td>F</td><td>E</td><td>D</td><td>C</td><td>B</td><td>A</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td>clt</td><td colspan="3">clG1</td><td>cl2n</td><td>clet</td><td colspan="2">cltq</td><td></td><td>iup</td><td colspan="6">tdt</td></tr>
</table>
<table>
<tr><th colspan="2">bit</th><th>Meaning when “0” is set</th><th>Meaning when “1” is set</th></tr>
<tr><td>0
1
2
3
4
5</td><td>tdt</td><td colspan="2">Td creation time setting
Set to “0”. (For machine tool builder adjustment)</td></tr>
<tr><td>6</td><td>iup</td><td colspan="2">Set to “1” when using any of motors from HC152 to HC702 and from HC153 to HC453.</td></tr>
<tr><td>7</td><td>ckab</td><td>Setting for normal use</td><td>No signal 2 (Alarm 21) special detection</td></tr>
<tr><td>8
9</td><td>Cltq</td><td colspan="2">Set the retracting torque for collision detection in respect to the maximum torque of the motor.
00: 100% 01: 90% 10: 80% (Standard) 11: 70%</td></tr>
<tr><td>A</td><td>clet</td><td>Setting for normal use</td><td>The disturbance torque peak of the latest two seconds is displayed in MPOS of the servo monitor screen.</td></tr>
<tr><td>B</td><td>cl2n</td><td>Collision detection method 2 valid</td><td>Collision detection method 2 invalid</td></tr>
<tr><td>C
D
E</td><td>clG1</td><td colspan="2">Collision detection method 1
Set the collision detection level during cutting feed (G1).
The G1 collision detection level=SV060*clG1.
When clG1=0, the collision detection method 1 during cutting feed won’t function.</td></tr>
<tr><td>F</td><td>clt</td><td>Setting for normal use</td><td>The guide value of the SV059 setting value is displayed in MPOS of the servo monitor screen.</td></tr>
</table>
(Note) Set to “0” for bits with no particular description.
</td><td>HEX setting</td></tr>
</table>

Parameters with an asterisk * in the abbreviation, such as PC1*, are validated with the NC power turned ON again.

Standard specifications

No.	Abbrev.	Parameter name	Explanation	Setting range (Unit)
SV036	PTYP*	Power supply type		

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
amp				rtyp				ptyp							

bit		Explanation
0, 1, 2, 3, 4, 5, 6, 7	ptyp	When the CN4 connector of the drive unit and the power supply are connected, setting below is necessary. To validate the external emergency stop function, add 40h.

Setting	0x	1x	2x	3x	4x	5x	6x	7x	8x
x0	Not used			CV-300					
x1		CV-110							CR-10
x2			CV-220						CR-15
x3									CR-22
x4	CV-37								CR-37
x5		CV-150			MDS-B-CVE-450	MDS-B-CVE-550			
x6	CV-55		CV-260						CR-55
x7				CV-370					
x8	CV-75								CR-75
x9		CV-185							CR-90

bit		Explanation
8, 9, A, B	rtyp	Set the regenerative resistor type when MDS-A-CR is used.

Setting	Regenerative resistor model name	Resistance value	Capacity
0	MDS-C1-CV (Setting when using power supply regeneration)		
1	GZG200W260HMJ	26Ω	80W
2	GZG300W130HMJ × 2	26Ω	150W
3	MR-RB30	13Ω	300W
4	MR-RB50	13Ω	500W
5	GZG200W200HMJ × 3	6.7Ω	350W
6	GZG300W200HMJ × 3	6.7Ω	500W
7	R-UNIT-1	30Ω	700W
8	R-UNIT-2	15Ω	700W
9	R-UNIT-3	15Ω	2100W
A to F	No setting		

bit		Explanation
C, D, E, F	amp	Always set "0".

SV037	JL	Load inertia scale	Set "the motor inertia + motor axis conversion load inertia" in respect to the motor inertia. $SV037(JL) = \frac{Jl+Jm}{Jm} \times 100$ Jm Motor inertia Jl Motor axis conversion load inertia	0 to 5000 (%)
SV038	FHz1	Notch filter frequency 1	Set the vibration frequency to suppress if machine vibration occurs. (Valid at 36 or more) When not using, set to "0".	0 to 3000 (Hz)
SV039	LMCD	Lost motion compensation timing	Set this when the lost motion compensation type2 timing doest not match. Adjust by increasing the value by 10 at a time.	0 to 2000 (ms)

Parameters with an asterisk * in the abbreviation, such as PC1*, are validated with the NC power turned ON again.

Standard specifications

<table>
<tr><th>No.</th><th>Abbrev.</th><th>Parameter name</th><th>Explanation</th><th>Setting range (Unit)</th></tr>
<tr><td>SV040</td><td colspan="3">For SV040, the hex. value's higher order 8bits and lower order 8bits are used for different functions.
"Setting value of SV040" = (Icy*256) + LMCT
<table>
<tr><th>Abbrev.</th><th>Parameter name</th><th>Explanation</th><th>Setting range (Unit)</th></tr>
<tr><td>LMCT (Low order)</td><td>Lost motion compensation dead band</td><td>Set the dead band of the lost motion compensation in the feed forward control.
When "0" is set, the actual value that is set is 2   m.
Adjust by increasing by 1   m at a time.</td><td>0 to 100 (μm)</td></tr>
<tr><td>Icy (High order)</td><td>Current bias 2</td><td>Normally, set to "40" if you use HC202 to HC902, HC203 to HC703.
Use this in combination with SV030 and the high order 8bits of SV045.</td><td>0 to 127</td></tr>
</table></td><td>0 to 32767</td></tr>
<tr><td>SV041</td><td>LMC2</td><td>Lost motion compensation 2</td><td>Set this with SV016 (LMC1) only when you wish to set the lost motion compensation amount to be different depending on the command directions.
Set to "0" as a standard.</td><td>-1 to 200 (Stall [rated] current %)</td></tr>
<tr><td>SV042</td><td>OVS2</td><td>Overshooting compensation 2</td><td>Set this with SV031 (OVS1) only when you wish to set the overshooting compensation amount to be different depending on the command directions.
Set to "0" as a standard.</td><td>-1 to 100 (Stall [rated] current %)</td></tr>
<tr><td>SV043</td><td>OBS1</td><td>Disturbance observer filter frequency</td><td>Set the disturbance observer filter band.
Set to "100" as a standard.
To use the disturbance observer, also set SV037 (JL) and SV044 (OBS2).
When not using, set to "0".</td><td>0 to 1000 (rad/s)</td></tr>
<tr><td>SV044</td><td>OBS2</td><td>Disturbance observer gain</td><td>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 not using, set to "0".</td><td>0 to 500 (%)</td></tr>
<tr><td>SV045</td><td colspan="3">For SV045, the hexadecimal value's higher order 8 bits and lower order 8 bits are used for different functions.
"Setting value of SV045" = (Icy × 256) + LMCT
<table>
<tr><th>Abbrev.</th><th>Parameter name</th><th>Explanation</th><th>Setting range (Unit)</th></tr>
<tr><td>TRUB (Low order)</td><td>Frictional torque</td><td>When you use the collision detection function, set the frictional torque.</td><td>0 to 100 (Stall [rated] current %)</td></tr>
<tr><td>Ib1 (High order)</td><td>Current bias 3</td><td>Normally set to "0".
Use this in combination with SV030 and the high order 8bits of SV040.</td><td>0 to 127</td></tr>
</table></td><td>0 to 32767</td></tr>
<tr><td>SV046</td><td></td><td></td><td>Not used. Set to "0".</td><td>0</td></tr>
<tr><td>SV047</td><td>EC</td><td>Inductive voltage compensation gain</td><td>Set the inductive voltage compensation gain.　Set to "100" as a standard.
If the current FB peak exceeds the current command peak, lower the gain.</td><td>0 to 200 (%)</td></tr>
<tr><td>SV048</td><td>EMGrt</td><td>Vertical axis drop prevention time</td><td>Input a length of time to prevent the vertical axis from dropping by delaying Ready OFF until the brake works when the emergency stop occurs.
Increase the setting by 100msec at a time and set the value where the axis does not drop.</td><td>0 to 20000 (ms)</td></tr>
<tr><td>SV049</td><td>PGN1sp</td><td>Position loop gain 1 in spindle synchronous control</td><td>Set the position loop gain during the spindle synchronous control (synchronous tapping, synchronous control with spindle/C axis).
Set the same value as the value of the spindle parameter, position loop gain in synchronous control.
When performing the SHG control, set this with SV050 (PGN2sp) and SV058 (SHGCsp).</td><td>1 to 200 (rad/s)</td></tr>
<tr><td>SV050</td><td>PGN2sp</td><td>Position loop gain 2 in spindle synchronous control</td><td>Set this with SV049 (PGN1sp) and SV058 (SHGCsp) if you wish to perform the SHG control in the spindle synchronous control (synchronous tapping, synchronous control with spindle/C axis).
When not performing the SHG control, set to "0".</td><td>0 to 999 (rad/s)</td></tr>
</table>

Parameters with an asterisk * in the abbreviation, such as PC1*, are validated with the NC power turned ON again.

Standard specifications

No.	Abbrev.	Parameter name	Explanation	Setting range (Unit)
SV051	DFBT	Dual feed back control time constant	Set the control time constant in dual feed back. When “0” is set, the actual value that is set is 1ms. The higher the time constant is, the closer it gets to the semi-closed control, so the limit of the position loop gain is raised.	0 to 9999 (ms)
SV052	DFBN	Dual feedback control dead zone	Set to “0” as a standard. Set the dead zone in the dual feedback control.	0 to 9999 (μm)
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.). If “0” is set, excessive error detection won’t be performed.	0 to 32767 (mm)
SV054	ORE	Overrun detection width in closed loop control	Set the overrun detection width in the full-closed loop control. If the gap between the motor end detector and the linear scale (tool end detector) exceeds the value set by this parameter, it is judged to be overrun and Alarm 43 will be detected. When “-1” is set, the alarm detection won’t be performed. When “0” is set, overrun is detected with a 2mm width.	-1 to 32767 (mm)
SV055	EMGx	Max. gate off delay time after emergency stop	Set a length of time from the point when the emergency stop is input to the point when READY OFF is compulsorily executed. Normally, set the same value as the absolute value of SV056. In preventing the vertical axis from dropping, the gate off is delayed for the length of time set by SV048 if SV055’s value is smaller than that of SV048.	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 a length of time that takes from rapid traverse rate (rapid) to stopping. Normally, set the same value as the rapid traverse acceleration/deceleration time constant. When executing the synchronous operation, put the minus sign to the settings of both of the master axis and slave axis.	-20000 to 20000 (ms)
SV057	SHGC	SHG control gain	When performing the SHG control, set this with S003 (PGN1) and SV004 (PGN2). When not performing the SHG control, set to “0”.	0 to 999 (rad/s)
SV058	SHGCsp	SHG control gain in spindle synchronous control	Set this with SV049 (PGN1sp) and SV050 (PGN2sp) if you wish to perform the SHG control in the synchronous tapping control. When not performing the SHG control, set to “0”.	0 to 999 (rad/s)
SV059	TCNV	Collision detection torque estimating gain	Set the torque estimating gain when using the collision detection function. After setting as SV035/bitF(clt)=1 and performing acceleration/deceleration, set the value displayed in MPOS of the NC servo monitor screen. Set to “0” when not using the collision detection function.	-32768 to 32767
SV060	TLMT	Collision detection level	When using the collision detection function, set the collision detection level during the G0 feeding. If “0” is set, none of the collision detection function will work.	0 to 999 (Stall [rated] current %)
SV061	DA1NO	D/A output channel 1 data No.	Input the data number you wish to output to D/A output channel. In the case of MDS-C1-V2, set the axis on the side to which the data will not be output to “-1”.	-1 to 127
SV062	DA2NO	D/A output channel 2 data No.		
SV063	DA1MPY	D/A output channel 1 output scale	Set the scale with a 1/256 unit. When “0” is set, output is done with the standard output unit.	-32768 to 32767 (Unit: 1/256)
SV064	DA2MPY	D/A output channel 2 output scale		
SV065			Not used. Set to "0".	0

Parameters with an asterisk * in the abbreviation, such as PC1*, are validated with the NC power turned ON again.

3-4 Restrictions on servo control

There may be some restrictions on mechanical specifications and electrical specifications when executing servo controls. Always read this section when designing machines and confirm that no problems exist with the specifications.

3-4-1 Restrictions of electronic gear setting value

The servo drive unit has internal electronic gears. The command value from the NC is converted into a detector resolution unit to carry out position control. The electronic gears are single gear ratios calculated from multiple parameters as shown below, and each value (ELG1, ELG2) must be 32767 or less.

If the value overflows, the initial parameter error (alarm 37) or error parameter No. 101 (2301 with M60S/E60 Series NC) will be output.

If an alarm occurs, the mechanical specifications and electrical specifications (such as resolution of the detector) must be revised so that the electronic gears are within the specifications range.

(1) For semi-closed loop control

$$\text{Reduced fraction of } \frac{\mathrm{ELG1}}{\mathrm{ELG2}} = \frac{\mathrm{PC2} \times \mathrm{RNG1}}{\mathrm{PC1} \times \mathrm{PIT} \times \mathrm{IUNIT}} \text{ (reduced fraction)}$$

IUNIT = 2/NC command unit (μm)
1μm : IUNIT = 2, 0.1μm : IUNIT = 20

When the above is calculated, the following conditions must be satisfied.
ELG1 $\leq$ 32767
ELG2 $\leq$ 32767

(2) For full-closed loop control

$$\text{Reduced fraction of } \frac{\mathrm{PGNX}}{\mathrm{PGNY}} = \frac{\mathrm{PC2} \times \mathrm{RNG2} \times \mathrm{PGN1}}{\mathrm{PC1} \times \mathrm{RNG1} \times 30} \text{ (reduced fraction)}$$

When the above is calculated, the following conditions must be satisfied.
PGNX $\leq$ 32767
PGNY $\leq$ 32767

And,

$$\text{Reduced fraction of } \frac{\mathrm{PGNXsp}}{\mathrm{PGNYsp}} = \frac{\mathrm{PC2} \times \mathrm{RNG2} \times \mathrm{PGN1sp}}{\mathrm{PC1} \times \mathrm{RNG1} \times 30} \text{ (reduced fraction)}$$

When the above is calculated, the following conditions must be satisfied.
PGNXsp $\leq$ 32767
PGNYsp $\leq$ 32767

POINT	If the electronic gears overflow, the alarm 37 or error parameter No. 101 (2301 with M60S/E60 series NC) will be output.

3-4-2 Restrictions on absolute position control

When executing absolute position control, the following conditions must be satisfied. If not satisfied, mechanical specifications and electrical specifications (such as resolution of the detector) must be revised.
When executing incremental control, there are no particular restrictions on servo control. (Confirm with the NC system side specifications.)

(1) For linear axis

The following conditions, Condition 1 and 2, must be satisfied simultaneously.

(Condition 1)

$$\text{Length of stroke} \leq \frac{2147}{\text{IUNIT}} \ [\text{m}]$$

IUNIT = 2/NC command unit (μm)
1μm : IUNIT = 2, 0.1μm : IUNIT = 20

(Condition 2)
(a) For semi-closed loop control

$$\text{Length of stroke} \leq 2147 \times \frac{\text{PC1} \times \text{PIT}}{\text{PC2} \times \text{RNG2}} \ [\text{m}]$$

(b) For full-closed loop control

$$\text{Length of stroke} \leq 2147 \times \frac{\text{PIT}}{\text{RNG1}} \ [\text{m}]$$

(Note) Even during the full-closed loop control, when the MP scale is used, restrictions are applied with the condition (a), as well.

(2) For rotary axis

The following conditions must be satisfied.

$$\text{PC2} \leq \frac{2147000}{\text{RNG2}} \times \text{PC1}$$

3-5 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.

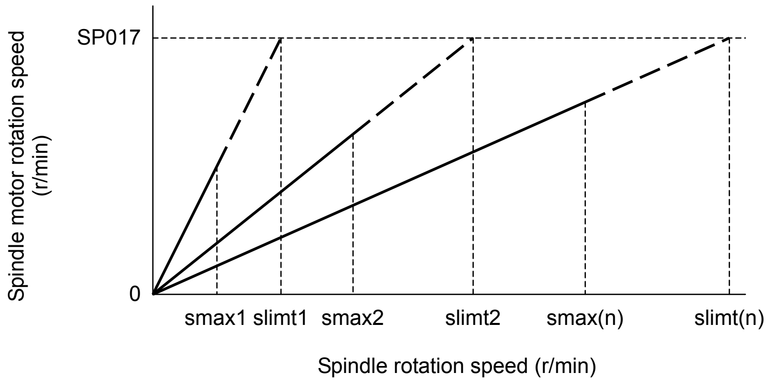
3-5-1 Spindle specification parameters

The configuration of these parameters depends on the NC, so refer to each NC Instruction Manual. The following table shows the configuration of the M60S and E60 Series NC.

M60S Series No.	Abbrev.	Parameter name	Details	Setting range (Unit)
3001 3002 3003 3004	slimit 1 2 3 4	Limit rotation speed	Set spindle rotation speed for maximum motor rotation speed with gears 00, 01, 10, 11. (Set the spindle speed for the S analog output 10V.)	0 to 99999 (r/min)
3005 3006 3007 3008	smax 1 2 3 4	Maximum rotation speed	Set maximum spindle rotation speed with gears 00, 01, 10, 11. Set to slimt ≥ smax. By comparing the S command value and the value of gear 1 to 4, a spindle gear shift command will be output automatically.	0 to 99999 (r/min)
3009 3010 3011 3012	ssift 1 2 3 4	Shift rotation speed	Set spindle speed for gear shifting with gears 00, 01, 10, 11. (Note) Setting too large value may cause a gear nicks when changing gears.	0 to 32767 (r/min)
3013 3014 3015 3016	stap 1 2 3 4	Tap rotation speed	Set maximum spindle rotation speed during tap cycle with gears 00, 01, 10, 11.	0 to 99999 (r/min)
3017 3018 3019 3020	stapt 1 2 3 4	Tap time constant	Set time constants for constant inclination synchronous tap cycles for gears 00, 01, 10, 11 (linear acceleration/deceleration pattern).	1 to 5000 (ms)

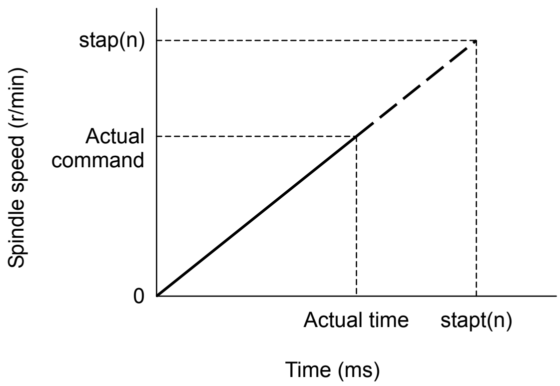
<Relation of spindle limit rotation speed and spindle maximum rotation speed>

The spindle rotation speed which can be attained at the spindle motor's maximum rotation speed is set for the limit rotation speed (slimt). This value is obtained by multiplying the gear ratio on the spindle motor maximum rotation speed (SP017). 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.



<Relation of tap time constant and actual acceleration/deceleration time constant>
(For constant inclination synchronous tap cycle)

Set the acceleration time up to the tap rotation speed (stap) in the tap time constant (stapt). Acceleration/deceleration is carried out at the same inclination for all speed commands. Up to four values can be set for gear changeover.



M60S Series No.	Abbrev.	Parameter name	Details	Setting range (Unit)
3021	sori	Orientation rotation speed	Set the spindle orientation rotation speed. Set the rotation speed for when the spindle rotates at the constant rotation speed.	0 to 32767 (r/min)
3022	sgear	Encoder gear ratio	Set the gear ratio of the spindle to the spindle end detector when the spindle end detector feed back is directly input to NC.	0: 1/1 1: 1/2 2: 1/4 3: 1/8
3023	smini	Minimum rotation speed	Set the minimum rotation speed of the spindle. If an S command instructs the rotation speed below this setting, the spindle rotates at the minimum rotation speed set by this parameter.	0 to 32767 (r/min)
3024	sout*	Spindle connection	Set the type of the spindle to be connected. 0: No connection with the spindle 1: Serial connection (bus) 2 to 5: Analog output	0 to 5
3025	enc-on	Spindle end detector	Set the spindle end detector connection destination. 0: No connection 1: NC 2: Drive unit	0 to 2
3026	cs_ori	Selection of coil in orientation mode	0: Perform orientation using the coil selected when the orientation command is issued. 1: Use coil L whenever the orientation command is issued.	0/1
3027	cs_syn	Selection of coil in spindle synchronous mode	0: The coil H/L is selected by the actual spindle motor rotation speed (calculated from commanded rotation speed) when spindle synchronous control starts. (The coil is not switched during synchronous control. The control is carried out with the coil selected at start.) If the actual spindle motor rotation speed is less than SP020, the coil L is selected, and if more than the value, the coil H is selected. 1: Use coil H whenever the spindle synchronous command is issued.	0/1
3028	sprcmm	L system tap cycle spindle forward run/ reverse run M command	Set the M code of the spindle forward run/reverse run command. High-order three digits: The spindle forward run command's M code is set. Low-order three digits: The spindle reverse run command's M code is set.	0 to 999999
3029	tapsel	Asynchronous tap gear selection	Specify whether to use the tap rotation speed or maximum rotation speed for the gear that is selected when an asynchronous tap command is issued. 0: Tap rotation speed 1: Maximum rotation speed This parameter is valid only when the M-function synchronous tap cycle enable parameter (#1272 ext08/bit1) is ON.	0/1
3030			Not used. Set to "0".	0
3031	smcp_no *	Drive unit I/F channel No. (spindle)	Using a 4-digit number, set the drive unit interface channel No. and which axis in that channel is to be used when connecting a spindle drive unit. High-order two digits : Drive unit interface channel No. Low-order two digits : Axis No. When using the conventional fixed layout, set all axes to "0000". Set "0000" when using an analog spindle.	0000 0101 to 0107 0201 to 0207
3032			Not used. Set to "0".	0

Parameters with an asterisk * in the abbreviation, such as sout*, are validated with the NC power turned ON again.

M60S Series No.	Abbrev.	Parameter name	Details	Setting range (Unit)
3037 3038 3039 3040	taps 21 22 23 24	Synchronous tap switching spindle speed 2	Set the spindle rotation speed at which the step-2 acceleration/deceleration time constant is to be switched at gear 00, 01, 10, or 11.	0 to 99999 (r/min)
3041 3042 3043 3044	tapt 21 22 23 24	Synchronous tap switching time constant 2	Set the time constant to reach synchronous tap switching spindle rotation speed 2 (taps 21 to 24) at gear 00, 01, 10, or 11.	1 to 5000 (ms)
3045 3046 3047 3048	tapt 31 32 33 34	Synchronous tap switching time constant 3	Set the time constant to reach the maximum rotation speed (smax 1 to 4) at gear 00, 01, 10, or 11.	1 to 5000 (ms)
3049	spt	Spindle synchronization acceleration/ deceleration time constant	Set the acceleration/deceleration time constant for when the spindle synchronization command's rotation speed changes during spindle synchronous control.	0 to 9999 (ms)
3050	sprlv	Spindle synchro-nization rotation speed attainment level	The spindle rotation speed synchronization complete signal will turn ON when the difference of the reference spindle and synchronous spindle actual rotation speeds is less than the level set for the synchronous spindle rotation speed command value during spindle synchronous control.	0 to 4095 (pulse) (1 pulse = 0.088°)
3051	spplv	Spindle phase synchronization attainment level	The spindle phase synchronization complete signal will turn ON when the phase difference of the reference spindle and synchronous spindle is less than the set level during spindle phase synchronization control.	0 to 4095 (pulse) (1 pulse = 0.088°)
3052	spplr	Spindle motor spindle relative polarity	Set the spindle motor and spindle's relative polarity. Spindle CW rotation at motor CW rotation: Positive polarity Spindle CCW rotation at motor CW rotation: Negative polarity	0: Positive polarity 1: Negative polarity
3053	sppst	Spindle end detector Z -phase position	Set the deviation amount from the spindle's reference position to the spindle end detector's Z phase. The deviation amount is obtained using the clockwise direction looking from the front of the spindle as the positive direction.	0 to 359999 (1/1000°)
3054	sptc1	Spindle synchro-nization multi-step acceleration/ deceleration changeover speed 1	Set the spindle speed for changing the 1st step's acceleration/deceleration time constant.	0 to 99999 (r/min)
3055	sptc2	Spindle synchro-nization multi-step acceleration/ deceleration changeover speed 2	Set the spindle speed for changing the 2nd step's acceleration/deceleration time constant.	0 to 99999 (r/min)
3056	sptc3	Spindle synchro-nization multi-step acceleration/ deceleration changeover speed 3	Set the spindle speed for changing the 3rd step's acceleration/deceleration time constant.	0 to 99999 (r/min)
3057	sptc4	Spindle synchro-nization multi-step acceleration/ deceleration changeover speed 4	Set the spindle speed for changing the 4th step's acceleration/deceleration time constant.	0 to 99999 (r/min)
3058	sptc5	Spindle synchro-nization multi-step acceleration/ deceleration changeover speed 5	Set the spindle speed for changing the 5th step's acceleration/deceleration time constant.	0 to 99999 (r/min)

M60S Series No.	Abbrev.	Parameter name	Details	Setting range (Unit)
3059	sptc6	Spindle synchro-nization multi-step acceleration/ deceleration changeover speed 6	Set the spindle speed for changing the 6th step's acceleration/deceleration time constant.	0 to 99999 (r/min)
3060	sptc7	Spindle synchro-nization multi-step acceleration/ deceleration changeover speed 7	Set the spindle speed for changing the 7th step's acceleration/deceleration time constant.	0 to 99999 (r/min)
3061	spdiv1	Magnification for time constant changeover speed 1	Set the acceleration/deceleration time constant between the spindle synchronization multi-step acceleration/deceleration changeover speed 1 (sptc1) to the spindle synchronization multi-step acceleration/ deceleration changeover speed 2 (sptc2) as a magnification in respect to the spindle synchronization acceleration/deceleration time constant (spt).	0 to 127
3062	spdiv2	Magnification for time constant changeover speed 2	Set the acceleration/deceleration time constant between the spindle synchronization multi-step acceleration/deceleration changeover speed 2 (sptc2) to the spindle synchronization multi-step acceleration/deceleration changeover speed 3 (sptc3) as a magnification in respect to the spindle synchronization acceleration/deceleration time constant (spt).	0 to 127
3063	spdiv3	Magnification for time constant changeover speed 3	Set the acceleration/deceleration time constant between the spindle synchronization multi-step acceleration/deceleration changeover speed 3 (sptc3) to the spindle synchronization multi-step acceleration/deceleration changeover speed 4 (sptc4) as a magnification in respect to the spindle synchronization acceleration/deceleration time constant (spt).	0 to 127
3064	spdiv4	Magnification for time constant changeover speed 4	Set the acceleration/deceleration time constant between the spindle synchronization multi-step acceleration/deceleration changeover speed 4 (sptc4) to the spindle synchronization multi-step acceleration/deceleration changeover speed 5 (sptc5) as a magnification in respect to the spindle synchronization acceleration/deceleration time constant (spt).	0 to 127
3065	spdiv5	Magnification for time constant changeover speed 5	Set the acceleration/deceleration time constant between the spindle synchronization multi-step acceleration/deceleration changeover speed 5 (sptc5) to the spindle synchronization multi-step acceleration/deceleration changeover speed 6 (sptc6) as a magnification in respect to the spindle synchronization acceleration/deceleration time constant (spt).	0 to 127
3066	spdiv6	Magnification for time constant changeover speed 6	Set the acceleration/deceleration time constant between the spindle synchronization multi-step acceleration/deceleration changeover speed 6 (sptc6) to the spindle synchronization multi-step acceleration/deceleration changeover speed 7 (sptc7) as a magnification in respect to the spindle synchronization acceleration/deceleration time constant (spt).	0 to 127
3067	spdiv7	Magnification for time constant changeover speed 7	Set the acceleration/deceleration time constant for the spindle synchronization multi-step acceleration/ deceleration changeover speed 7 (sptc7) and higher as a magnification in respect to the spindle synchronization acceleration/deceleration time constant (spt).	0 to 127
3068	symtm1	Phase synchronization start confirmation time	Set the time to confirm that synchronization is attained before phase synchronization control is started. When "0" is set, the time will be 2 seconds. When "100" or less is set, the time will be 100ms.	0 to 9999 (ms)
3069	symtm2	Phase synchronization end confirmation time	Set the time to wait for phase synchronization control to end as the time for the rotation speed to reach the attainment range. When "0" is set, the time will be 2 seconds. When "100" or less is set, the time will be 100ms.	0 to 9999 (ms)
3070	syprt	Phase synchronization speed	Set the fluctuation amount to change the synchronous spindle rotation speed during phase synchronization control as the command speed and rate. When "0" is set, the amount will be 100%.	0 to 100 (%)
3071		(Not used.)	Not used. Set to "0".	0
3072		(Not used.)	Not used. Set to "0".	0

3-5-2 List of 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.

No.	Abbr.	Parameter name	Details	Setting range (Unit)	Standard setting
SP001	PGM	Magnetic sensor, motor PLG orientation position loop gain	**<For MDS-C1-SP/SPH/SPM>** The orientation time will be shorter when the value is increased, and the servo rigidity will increase. On the other hand, the vibration will increase, and the machine will sway easily.	0 to 1000 (0.1 rad/s)	100
			<For MDS-C1-SPX/SPHX> Not used. Set "0".	0	0
SP002	PGE	Encoder orientation position loop gain	**<For MDS-C1-SP/SPH/SPM>** The orientation time will be shorter when the value is increased, and the servo rigidity will increase. On the other hand, the vibration will increase, and the machine will sway easily. **<For MDS-C1-SPX/SPHX>** Set the position loop gain for spindle end PLG orientation.	0 to 1000 (0.1 rad/s)	100
SP003	PGC	Position gain during C-axis non-cutting	Set the position loop gain for the C-axis non-cutting mode. During non-cutting (rapid traverse, etc.) with the C axis control, this position loop gain setting is valid.	0 to 100 (rad/s)	15
SP004	OINP	Orientation in-position width	Set the position error range in which an orientation completion signal is output.	1 to 2880 (1/16°)	16
SP005	OSP*	Orientation mode speed clamp value	Set the motor speed limit value to be used when the speed loop is changed to the position loop in orientation mode. When this parameter is set to "0", SP017 (TSP) becomes the limit value.	0 to 32767 (r/min)	0
SP006	CSP	Orientation mode deceleration rate	As the set value is larger, the orientation time becomes shorter. However, the machine becomes likely to overshoot.	1 to 1000	20
SP007	OPST	Position shift amount for orientation	Set the stop position for orientation. (1) Motor PLG and spindle end detector Set a value obtained by dividing 360° by 4096. (2) Magnetic sensor orientation Divide -5°C to +5° by 1024, and set 0° as "0".	(1) 0 to 4095 (2) -512 to 512	0
SP008			Not used. Set "0".	0	0
SP009	PGT	Synchronous tap position loop gain	Set the spindle position loop gain for synchronous tapping.	1 to 100 (rad/s)	15
SP010	PGS	Spindle synchronization position loop gain	Set the spindle position loop gain for spindle synchronization.	1 to 100 (rad/s)	15
SP011			Not used. Set "0".	0	0
SP012			Not used. Set "0".	0	0
SP013			Not used. Set "0".	0	0
SP014			Not used. Set "0".	0	0
SP015			Not used. Set "0".	0	0
SP016			Not used. Set "0".	0	0

Parameters with an asterisk * in the abbreviation, such as OSP*, are validated with the NC power turned ON again.

No.	Abbr.	Parameter name	Details	Setting range (Unit)	Standard setting
SP017	TSP*	Maximum motor speed	Set the maximum spindle motor speed.	1 to 32767 (r/min)	6000
SP018	ZSP*	Motor zero speed	Set the motor speed for which zero-speed output is performed.	1 to 1000 (r/min)	50
SP019	CSN1*	Speed cushion 1	Set the time constant for a speed command from "0" to the maximum speed. (This parameter is invalid during position loop control.)	1 to 32767 (10 ms)	30
SP020	SDTS*	Speed detection set value	Set the motor speed for which speed detection output is performed. Usually, the setting value is 10% of SP017 (TSP).	0 to 32767 (r/min)	600
SP021	TLM1	Torque limit 1	Set the torque limit rate for torque limit signal 001.	0 to 120 (%)	10
SP022	VGNP1*	Speed loop gain proportional term under speed control	Set the speed loop proportional gain in speed control mode. When the gain is increased, response is improved but vibration and sound become larger.	0 to 1000	63
SP023	VGNI1*	Speed loop gain integral term under speed control	Set the speed loop integral gain in speed control mode. Normally, this is set so that the ratio in respect to SP022 (VGNP1) is approximately constant.	0 to 1000	60
SP024			Not used. Set "0".	0	0
SP025	GRA1*	Spindle gear teeth count 1	Set the number of gear teeth of the spindle corresponding to gear 000.	1 to 32767	1
SP026	GRA2*	Spindle gear teeth count 2	Set the number of gear teeth of the spindle corresponding to gear 001.	1 to 32767	1
SP027	GRA3*	Spindle gear teeth count 3	Set the number of gear teeth of the spindle corresponding to gear 010.	1 to 32767	1
SP028	GRA4*	Spindle gear teeth count 4	Set the number of gear teeth of the spindle corresponding to gear 011.	1 to 32767	1
SP029	GRB1*	Motor shaft gear teeth count 1	Set the number of gear teeth of the motor shaft corresponding to gear 000.	1 to 32767	1
SP030	GRB2*	Motor shaft gear teeth count 2	Set the number of gear teeth of the motor shaft corresponding to gear 001.	1 to 32767	1
SP031	GRB3*	Motor shaft gear teeth count 3	Set the number of gear teeth of the motor shaft corresponding to gear 010.	1 to 32767	1
SP032	GRB4*	Motor shaft gear teeth count 4	Set the number of gear teeth of the motor shaft corresponding to gear 011.	1 to 32767	1

Parameters with an asterisk * in the abbreviation, such as OSP*, are validated with the NC power turned ON again.

No.	Abbr.	Parameter name	Details
SP033	SFNC1*	Spindle function 1	

<For MDS-C1-SP/SPH>

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
poff	hzs		ront			pycal	pychg	pyst	pyoff				sftk	dflt	1a2m

bit		Meaning when set to 0	Meaning when set to 1	Standard
0	1a2m	1 drive unit 2 motor function: Invalid	1 drive unit 2 motor function: Valid	0
1	dflt	Default motor: Main	Default motor: Sub	0
2	sftk	Without SF-TK card	With SF-TK card	0
3				0
4				0
5				0
6	pyoff	This is used by Mitsubishi. Set to "0" unless particularly designated.		0
7	pyst			0
8	pychg			0
9	pycal	(Conventional specifications)	High-speed rate deceleration method valid for minimum excitation rate	0
A				0
B				0
C	ront	Normal ready ON	High-speed ready ON	0
D				0
E	hzs	Gate OFF by high-cycle zero speed invalid	Gate OFF by high-cycle zero speed valid	0
F	poff	Contactor hold at NC power OFF invalid	Contactor hold at NC power OFF valid	0

(Note 1) bits 0, 1 and 2 are invalid for SPH.

(Note 2) Set 0 if there is no particular explanation for the bit.

<For MDS-C1-SPX/SPHX>

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
poff	hzs	sfnc1	ront			pycal	pychg	pyst	pyoff						

bit		Meaning when set to 0	Meaning when set to 1	Standard
0				0
1				0
2				0
3				0
4				0
5				0
6	pyoff	This is used by Mitsubishi. Set to "0" unless particularly designated.		0
7	pyst			0
8	pychg			0
9	pycal	(Conventional specifications)	High-speed rate deceleration method valid for minimum excitation rate	0
A				0
B				0
C	ront	Normal ready ON	High-speed ready ON	0
D	sfnc1	MDS-B-PJEX connection invalid	MDS-B-PJEX connection valid	1
E	hzs	Gate OFF by high-cycle zero speed invalid	Gate OFF by high-cycle zero speed valid	0
F	poff	Contactor hold at NC power OFF invalid	Contactor hold at NC power OFF valid	0

(Note) Set 0 if there is no particular explanation for the bit.

Parameters with an asterisk * in the abbreviation, such as OSP*, are validated with the NC power turned ON again.

No.	Abbr.	Parameter name	Details
SP033	SFNC1*	Spindle function 1	**<For MDS-C1-SPM>** (see bit tables below)

<For MDS-C1-SPM>

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
poff			ront												

bit		Meaning when set to 0	Meaning when set to 1	Standard
0				0
1				0
2				0
3				0
4				0
5				0
6				0
7				0
8				0
9				0
A				0
B				0
C	ront	Normal ready ON	High-speed ready ON	0
D				0
E				0
F	poff	Contactor hold at NC power OFF invalid	Contactor hold at NC power OFF valid	0

(Note) Set 0 if there is no particular explanation for the bit.

Parameters with an asterisk * in the abbreviation, such as OSP*, are validated with the NC power turned ON again.

No.	Abbr.	Parameter name	Details
SP034	SFNC2*	Spindle function 2	

<For MDS-C1-SP/SPH/SPX/SPHX>

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
												mkc2	mkch	invm	mtsl

bit		Meaning when set to 0	Meaning when set to 1	Standard
0	mtsl	Special motor constant invalid	Special motor constant setting valid	0
1	invm	A general-purpose motor FV control invalid	A general-purpose motor FV control valid	0
2	mkch	Coil switch function invalid	Coil switch function valid	0
3	mkc2	Coil switch function 2 invalid	Coil switch function 2 valid (Turns ON simultaneously with bit2)	0
4				0
5				0
6				0
7				0
8				0
9				0
A				0
B				0
C				0
D				0
E				0
F				0

(Note 1) To validate bit3, NC side needs to be prepared.
(Note 2) Set 0 if there is no particular explanation for the bit.

<For MDS-C1-SPM>

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
												mkc2	mkch	mk3c	mtsl

bit		Meaning when set to 0	Meaning when set to 1	Standard
0	mtsl	Special motor constant invalid	Special motor constant setting valid	0
1	mk3c	3-step coil switch function invalid	3-step coil switch function valid	0
2	mkch	Coil switch function invalid	Coil switch function valid	0
3	mkc2	Coil switch function 2 invalid	Coil switch function 2 valid (Turns ON simultaneously with bit2)	0
4				0
5				0
6				0
7				0
8				0
9				0
A				0
B				0
C				0
D				0
E				0
F				0

(Note 1) To validate bit3, NC side needs to be prepared.
(Note 2) Set 0 if there is no particular explanation for the bit.

Parameters with an asterisk * in the abbreviation, such as OSP*, are validated with the NC power turned ON again.

No.	Abbr.	Parameter name	Details
SP035	SFNC3*	Spindle function 3	See bit tables below

<For MDS-C1-SP/SPH/SPX/SPHX>

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
												lbsd	hbsd	lwid	hwid

bit		Meaning when set to 0	Meaning when set to 1	Standard
0	hwid	H-coil wide-range constant output invalid	H-coil wide-range constant output valid	0
1	lwid	L-coil wide-range constant output invalid	L-coil wide-range constant output valid	0
2	hbsd	H-coil base slide invalid	H-coil base slide valid	0
3	lbsd	L-coil base slide invalid	L-coil base slide valid	0
4				0
5				0
6				0
7				0
8				0
9				0
A				0
B				0
C				0
D				0
E				0
F				0

(Note) Set 0 if there is no particular explanation for the bit.

<For MDS-C1-SPM>

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
													mwid	lwid	hwid

bit		Meaning when set to 0	Meaning when set to 1	Standard
0	hwid	H coil output characteristic change invalid	H coil output characteristic change valid	0
1	lwid	L coil output characteristic change invalid	L coil output characteristic change valid	0
2	mwid	M coil output characteristic change invalid	M coil output characteristic change valid	0
3				0
4				0
5				0
6				0
7				0
8				0
9				0
A				0
B				0
C				0
D				0
E				0
F				0

(Note) Set 0 if there is no particular explanation for the bit.

Parameters with an asterisk * in the abbreviation, such as OSP*, are validated with the NC power turned ON again.

<table>
<tr><th>No.</th><th>Abbr.</th><th>Parameter name</th><th>Details</th></tr>
<tr><td>SP036</td><td>SFNC4*</td><td>Spindle function 4</td><td>

<For MDS-C1-SP>

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
						dslm	dssm			enc2	enc1	mag2	mag1	plg2	plg1

bit		Meaning when set to 0	Meaning when set to 1	Standard
0	plg1	PLG of motor 1 valid	PLG of motor 1 invalid	0
1	plg2	PLG of motor 2 valid	PLG of motor 2 invalid	0
2	mag1	MAG of motor 1 valid	MAG of motor 1 invalid	0
3	mag2	MAG of motor 2 valid	MAG of motor 2 invalid	0
4	enc1	ENC of motor 1 valid	ENC of motor 1 invalid	0
5	enc2	ENC of motor 2 valid	ENC of motor 2 invalid	0
6				0
7				0
8	dssm	Speedometer output valid	Speedometer output invalid	0
9	dslm	Load meter output valid	Load meter output invalid	0
A				0
B				0
C				0
D				0
E				0
F				0

(Note) Set 0 if there is no particular explanation for the bit.

<For MDS-C1-SPH/SPX/SPHX/SPM>

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0

bit		Meaning when set to 0	Meaning when set to 1	Standard
0				0
1				0
2				0
3				0
4				0
5				0
6				0
7				0
8				0
9				0
A				0
B				0
C				0
D				0
E				0
F				0

(Note) Set 0 if there is no particular explanation for the bit.

</td></tr>
</table>

Parameters with an asterisk * in the abbreviation, such as OSP*, are validated with the NC power turned ON again.

No.	Abbr.	Parameter name	Details
SP037	SFNC5*	Spindle function 5	(see below)

<For MDS-C1-SP/SPH>

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
splg	dplg	ospcl			noplg	nsno	nosg						plgo	mago	enco

bit		Meaning when set to 0	Meaning when set to 1	Standard
0	enco	Encoder orientation invalid	Encoder orientation valid	0
1	mago	Magnetic sensor orientation invalid	Magnetic sensor orientation valid	0
2	plgo	PLG orientation invalid	PLG orientation valid	0
3				0
4				0
5				0
6				0
7				0
8	nosg	No-signal detection type (Always monitoring)	No-signal detection valid only in position loop or orientation-mode	0
9	nsno	No-signal detection valid	No-signal detection invalid	0
A	noplg	Constant monitor of PLG-Z phase no-signal invalid	Constant monitor of PLG-Z phase no-signal valid	0
B				0
C				0
D	ospcl	Orientation speed clamp motor speed setting	Orientation speed clamp spindle speed setting	0
E	dplg	This is used by Mitsubishi. Set to "0" unless particularly designated.		0
F	splg			0

(Note 1) For bit0 to 2, do not set two bits or more to "1" at the same time.
(Note 2) BitD is valid only when MDS-C1-SPH is used.
(Note 3) Set 0 if there is no particular explanation for the bit.

<For MDS-C1-SPX/SPHX>

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
															enco

bit		Meaning when set to 0	Meaning when set to 1	Standard
0	enco	Spindle end PLG orientation invalid	Spindle end PLG orientation valid	0
1				0
2				0
3				0
4				0
5				0
6				0
7				0
8				0
9				0
A				0
B				0
C				0
D				0
E				0
F				0

(Note) Set 0 if there is no particular explanation for the bit.

Parameters with an asterisk * in the abbreviation, such as OSP*, are validated with the NC power turned ON again.

No.	Abbr.	Parameter name	Details
SP037	SFNC5*	Spindle function 5	**<For MDS-C1-SPM>** (see bit table below)

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
						nsno	nosg						plgo		enco

bit		Meaning when set to 0	Meaning when set to 1	Standard
0	enco	Encoder orientation invalid	Encoder orientation valid	0
1				0
2	plgo	PLG orientation invalid	PLG orientation valid	0
3				0
4				0
5				0
6				0
7				0
8	nosg	No-signal detection type (Always monitoring)	Monitoring only in position loop or orientation-mode	0
9	nsno	No-signal detection valid	No-signal detection invalid	0
A				0
B				0
C				0
D				0
E				0
F				0

(Note 1) For bit0 to 2, do not set two bits or more to "1" at the same time.

(Note 2) Set 0 if there is no particular explanation for the bit.

Parameters with an asterisk * in the abbreviation, such as OSP*, are validated with the NC power turned ON again.

No.	Abbr.	Parameter name	Details
SP038	SFNC6*	Spindle function 6	See below

<For MDS-C1-SP/SPH>

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
oplp	lmx	iqsv	XFzs	dcsn	lmnp	pl80	sdt2	vfbs	orm	adin		plg2	pftm		alty

bit		Meaning when set to 0	Meaning when set to 1	Standard
0	alty	Deceleration stop during special alarm invalid	Deceleration stop during special alarm valid	0
1				0
2	pftm	Encoder feedback serial communication invalid	Encoder feedback serial communication valid	0
3	plg2	Semi-closed pulse output signal ×2 invalid	Semi-closed pulse output signal ×2 valid	0
4				0
5	adin	Interpolation during thread cutting invalid	Interpolation during thread cutting valid	0
6	orm	Orientation start memo invalid	Orientation start memo valid	0
7	vfbs	This is used by Mitsubishi. Set to "0" unless particularly designated.		0
8	sdt2	(Follows SP038/bitC setting)	Set output 2 to 2nd speed detection output	0
9	pl80	MHE90K detector's 180 wave PLG	180 wave PLG other than MHE90K	0
A	lmnp	This is used by Mitsubishi. Set to "0" unless particularly designated.		0
B	dcsn	Dual cushion during acceleration/ deceleration valid	Dual cushion during acceleration/ deceleration invalid	0
C	XFzs	Set output 2 to MP scale low (L) speed mode	Set output 2 to zero speed output	0
D	Iqsv	This is used by Mitsubishi. Set to "0" unless particularly designated		0
E	lmx			0
F	oplp	Open loop operation invalid	Open loop operation valid	0

(Note) Set 0 if there is no particular explanation for the bit.

<For MDS-C1-SPX/SPHX>

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
oplp	lmx	iqsv	XFzs	dcsn			sdt2	vfbs				plg2	pftm		alty

bit		Meaning when set to 0	Meaning when set to 1	Standard
0	alty	Deceleration stop during special alarm invalid	Deceleration stop during special alarm valid	0
1				0
2	pftm	Encoder feedback serial communication invalid	Encoder feedback serial communication valid	0
3	plg2	Semi-closed pulse output signal ×2 invalid	Semi-closed pulse output signal ×2 valid	0
4				0
5				0
6				0
7	vfbs	This is used by Mitsubishi. Set to "0" unless particularly designated.		0
8	sdt2	(Follows SP038/bitC setting)	Set output 2 to 2nd speed detection output	0
9				0
A				0
B	dcsn	Dual cushion during acceleration/ deceleration valid	Dual cushion during acceleration/ deceleration invalid	0
C	XFzs	Set output 2 to MP scale low (L) speed mode	Set output 2 to zero speed output	0
D	Iqsv	This is used by Mitsubishi. Set to "0" unless particularly designated		0
E	lmx			0
F	oplp	Open loop operation invalid	Open loop operation valid	0

(Note) Set 0 if there is no particular explanation for the bit.

Parameters with an asterisk * in the abbreviation, such as OSP*, are validated with the NC power turned ON again

No.	Abbr.	Parameter name	Details
SP038	SFNC6*	Spindle function 6	**<For MDS-C1-SPM>** (see bit layout and table below)

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
			XFzs			pl80	sdt2	vfbs	orm		tdn	plg2	pftm		alty

bit		Meaning when set to 0	Meaning when set to 1	Standard
0	alty	Deceleration stop during special alarm invalid	Deceleration stop during special alarm valid	0
1				0
2	pftm	Encoder feedback serial communication invalid	Encoder feedback serial communication valid	0
3	plg2	Semi-closed pulse output signal ×2 invalid	Semi-closed pulse output signal ×2 valid	0
4	tdn	This is used by Mitsubishi. Set to "0" unless particularly designated.		0
5				0
6	orm	Orientation start memo invalid	Orientation start memo valid	0
7	vfbs	This is used by Mitsubishi. Set to "0" unless particularly designated.		0
8	sdt2	(Follows SP038/bitC setting)	Set output 2 to 2nd speed detection output	0
9	pl80	MHE90K detector's 180 wave PLG	180 wave PLG other than MHE90K	0
A				0
B				0
C	XFzs	Set output 2 to MP scale low (L) speed mode	Set output 2 to zero speed output	0
D				0
E				0
F				0

(Note) Set 0 if there is no particular explanation for the bit.

Parameters with an asterisk * in the abbreviation, such as OSP*, are validated with the NC power turned ON again.

<table>
<tr><th>No.</th><th>Abbr.</th><th>Parameter name</th><th>Details</th><th>Setting range (Unit)</th><th>Standard setting</th></tr>
<tr><td>SP039</td><td>ATYP*</td><td>Drive unit type</td><td>Set the spindle drive unit's capacity type.
(HEX setting)
<table>
<tr><th>Setting</th><th>Unit capacity</th><th>Setting</th><th>Unit capacity</th></tr>
<tr><td>0000</td><td>---</td><td>0010</td><td>MDS-B-SP-550</td></tr>
<tr><td>0001</td><td>MDS-C1-SP-075</td><td>0011</td><td>---</td></tr>
<tr><td>0002</td><td>MDS-C1-SP-15</td><td>0012</td><td>---</td></tr>
<tr><td>0003</td><td>MDS-C1-SP-22</td><td>0013</td><td>---</td></tr>
<tr><td>0004</td><td>MDS-C1-SP-37</td><td>0014</td><td>---</td></tr>
<tr><td>0005</td><td>MDS-C1-SP-55</td><td>0015</td><td>---</td></tr>
<tr><td>0006</td><td>MDS-C1-SP-75</td><td>0016</td><td>---</td></tr>
<tr><td>0007</td><td>MDS-C1-SP-110</td><td>0017</td><td>---</td></tr>
<tr><td>0008</td><td>MDS-C1-SP-150</td><td>0018</td><td>---</td></tr>
<tr><td>0009</td><td>MDS-C1-SP-185</td><td>0019</td><td>---</td></tr>
<tr><td>000A</td><td>MDS-C1-SP-220</td><td>001A</td><td>---</td></tr>
<tr><td>000B</td><td>MDS-C1-SP-260</td><td>001B</td><td>---</td></tr>
<tr><td>000C</td><td>MDS-C1-SP-300</td><td>001C</td><td>---</td></tr>
<tr><td>000D</td><td>MDS-B-SP-370</td><td>001D</td><td>---</td></tr>
<tr><td>000E</td><td>MDS-B-SP-450</td><td>001E</td><td>---</td></tr>
<tr><td>000F</td><td>MDS-C1-SP-04</td><td>001F</td><td>---</td></tr>
</table>
</td><td>0000 to FFFF</td><td>0000</td></tr>
<tr><td>SP040</td><td>MTYP*</td><td>Motor type</td><td>This parameter is valid when SP034 (SFNC2)/bit0 is set to "0". (Old type of motor)
Set the appropriate motor number from the standard motors listed below.
(HEX setting)
<table>
<tr><th>Setting</th><th>Motor name</th><th>Maximum speed</th><th>Corresponding drive unit</th></tr>
<tr><td>0000</td><td>---</td><td>---</td><td>---</td></tr>
<tr><td>0001</td><td>SJ-2.2A</td><td>10000 r/min</td><td>MDS-C1-SP-22</td></tr>
<tr><td>0002</td><td>SJ-3.7A</td><td>10000 r/min</td><td>MDS-C1-SP-37</td></tr>
<tr><td>0003</td><td>SJ-5.5A</td><td>8000 r/min</td><td>MDS-C1-SP-55</td></tr>
<tr><td>0004</td><td>SJ-7.5A</td><td>8000 r/min</td><td>MDS-C1-SP-75</td></tr>
<tr><td>0005</td><td>SJ-11A</td><td>6000 r/min</td><td>MDS-C1-SP-110</td></tr>
<tr><td>0006</td><td>SJ-15A</td><td>6000 r/min</td><td>MDS-C1-SP-150</td></tr>
<tr><td>0007</td><td>SJ-18.5A</td><td>6000 r/min</td><td>MDS-C1-SP-185</td></tr>
<tr><td>0008</td><td>SJ-22A</td><td>4500 r/min</td><td>MDS-C1-SP-220</td></tr>
<tr><td>0009</td><td>SJ-26A</td><td>4500 r/min</td><td>MDS-C1-SP-260</td></tr>
<tr><td>000A</td><td>SJ-30A</td><td>4500 r/min</td><td>MDS-C1-SP-300</td></tr>
<tr><td>000B</td><td>---</td><td>---</td><td>---</td></tr>
<tr><td>000C</td><td>---</td><td>---</td><td>---</td></tr>
<tr><td>000D</td><td>---</td><td>---</td><td>---</td></tr>
<tr><td>000E</td><td>---</td><td>---</td><td>---</td></tr>
<tr><td>000F</td><td>---</td><td>---</td><td>---</td></tr>
<tr><td>0010</td><td>---</td><td>---</td><td>---</td></tr>
<tr><td>0011</td><td>SJ-N0.75A</td><td>10000 r/min</td><td>MDS-C1-SP-075</td></tr>
<tr><td>0012</td><td>SJ-N1.5A</td><td>10000 r/min</td><td>MDS-C1-SP-15</td></tr>
<tr><td>0013</td><td>SJ-N2.2A</td><td>10000 r/min</td><td>MDS-C1-SP-22</td></tr>
<tr><td>0014</td><td>SJ-N3.7A</td><td>10000 r/min</td><td>MDS-C1-SP-37</td></tr>
<tr><td>0015</td><td>SJ-N5.5A</td><td>8000 r/min</td><td>MDS-C1-SP-55</td></tr>
<tr><td>0016</td><td>SJ-N7.5A</td><td>8000 r/min</td><td>MDS-C1-SP-75</td></tr>
<tr><td>0017</td><td>---</td><td>---</td><td>---</td></tr>
<tr><td>0018</td><td>---</td><td>---</td><td>---</td></tr>
<tr><td>0019</td><td>---</td><td>---</td><td>---</td></tr>
<tr><td>001A</td><td>---</td><td>---</td><td>---</td></tr>
<tr><td>001B</td><td>---</td><td>---</td><td>---</td></tr>
<tr><td>001C</td><td>---</td><td>---</td><td>---</td></tr>
<tr><td>001D</td><td>---</td><td>---</td><td>---</td></tr>
<tr><td>001E</td><td>---</td><td>---</td><td>---</td></tr>
<tr><td>001F</td><td>---</td><td>---</td><td>---</td></tr>
</table>
</td><td>0000 to FFFF</td><td>0000</td></tr>
</table>

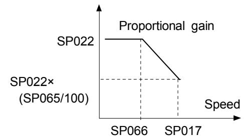
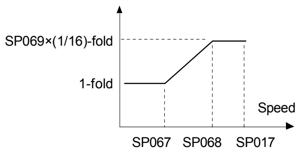
Parameters with an asterisk * in the abbreviation, such as OSP*, are validated with the NC power turned ON again.

<table>
<tr><th>No.</th><th>Abbr.</th><th>Parameter name</th><th>Details</th><th>Setting range (Unit)</th><th>Standard setting</th></tr>
<tr><td>SP041</td><td>PTYP*</td><td>Power supply type</td><td colspan="3">
<table>
<tr><td>F</td><td>E</td><td>D</td><td>C</td><td>B</td><td>A</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td colspan="4">amp</td><td colspan="4">rtyp</td><td colspan="8">ptyp</td></tr>
</table>
<table>
<tr><th colspan="2">bit</th><th>Explanation</th></tr>
<tr><td>0
1
2
3
4
5
6
7</td><td>ptyp</td><td>When the CN4 connector of the drive unit and the power supply are connected, setting below is necessary.
To validate the external emergency stop function, add 40h.
<table>
<tr><th>Setting</th><th>0x</th><th>1x</th><th>2x</th><th>3x</th><th>4x</th><th>5x</th><th>6x</th><th>7x</th><th>8x</th></tr>
<tr><td>x0</td><td>Not used</td><td></td><td></td><td>CV-300</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>x1</td><td></td><td>CV-110</td><td></td><td></td><td></td><td></td><td></td><td></td><td>CR-10</td></tr>
<tr><td>x2</td><td></td><td></td><td>CV-220</td><td></td><td></td><td></td><td></td><td></td><td>CR-15</td></tr>
<tr><td>x3</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>CR-22</td></tr>
<tr><td>x4</td><td>CV-37</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>CR-37</td></tr>
<tr><td>x5</td><td></td><td>CV-150</td><td></td><td></td><td>MDS-B-CVE-450</td><td>MDS-B-CVE-550</td><td></td><td></td><td></td></tr>
<tr><td>x6</td><td>CV-55</td><td></td><td>CV-260</td><td></td><td></td><td></td><td></td><td></td><td>CR-55</td></tr>
<tr><td>x7</td><td></td><td></td><td></td><td>CV-370</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>x8</td><td>CV-75</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>CR-75</td></tr>
<tr><td>x9</td><td></td><td>CV-185</td><td></td><td></td><td></td><td></td><td></td><td></td><td>CR-90</td></tr>
</table></td></tr>
<tr><td>8
9
A
B</td><td>rtyp</td><td>Set the regenerative resistor type when MDS-A-CR is used.
<table>
<tr><th>Setting</th><th>Regenerative resistor model name</th><th>Resistance value</th><th>Capacity</th></tr>
<tr><td>0</td><td colspan="3">MDS-C1-CV (Setting when using power supply regeneration)</td></tr>
<tr><td>1</td><td>GZG200W260HMJ (Note)</td><td>26Ω</td><td>80W</td></tr>
<tr><td>2</td><td>GZG300W130HMJ×2</td><td>26Ω</td><td>150W</td></tr>
<tr><td>3</td><td>MR-RB30</td><td>13Ω</td><td>300W</td></tr>
<tr><td>4</td><td>MR-RB50</td><td>13Ω</td><td>500W</td></tr>
<tr><td>5</td><td>GZG200W200HMJ×3</td><td>6.7Ω</td><td>350W</td></tr>
<tr><td>6</td><td>GZG300W200HMJ×3</td><td>6.7Ω</td><td>500W</td></tr>
<tr><td>7</td><td>R-UNIT-1</td><td>30Ω</td><td>700W</td></tr>
<tr><td>8</td><td>R-UNIT-2</td><td>15Ω</td><td>700W</td></tr>
<tr><td>9</td><td>R-UNIT-3</td><td>15Ω</td><td>2100W</td></tr>
<tr><td>A~F</td><td>No setting</td><td></td><td></td></tr>
</table></td></tr>
<tr><td>C
D
E
F</td><td>amp</td><td>Always set to "0".</td></tr>
</table>
(Note) When MDS-B-SP-370, 450 or 550 is used, set "0" even if power regeneration type is applied.
</td></tr>
<tr><td>SP042</td><td>CRNG*</td><td>C-axis detector range</td><td><For MDS-C1-SP/SPH/SPM>
This parameter is used to set the C-axis detector range.
Set "0" for this parameter.
"2" is used by Mitsubishi for testing.
<For MDS-C1-SPX/SPHX>
Set the number of pulses for the spindle end PLG.
"4" = 128, "5" = 256, "6" = 512, "8" = 180</td><td>0 to 8</td><td>0</td></tr>
<tr><td>SP043</td><td>TRNG*</td><td>Synchronous tapping, spindle synchronous detector range</td><td>This parameter is used to set the synchronous tapping or spindle synchronous detector range.
Set "0" for this parameter.</td><td>0 to 7</td><td>0</td></tr>
</table>

Parameters with an asterisk * in the abbreviation, such as OSP*, are validated with the NC power turned ON again.

No.	Abbr.	Parameter name	Details	Setting range (Unit)	Standard setting
SP044	TRANS*	NC communication frequency	Set a frequency of data communication with NC.	0 to 32767	Standard: 0 Special: 1028
SP045	CSNT	Dual cushion timer	Set the cycle to add the increment values in the dual cushion process. When this setting value is increased, the dual cushion will increase, and the changes in the speed during acceleration/deceleration will become gradual.	0 to 1000 (ms)	0
SP046	CSN2*	Speed command dual cushion	For an acceleration/deceleration time constant defined in SP019 (CSN1) , this parameter is used to provide smooth movement only at the start of acceleration/deceleration. As the value of this parameter is smaller, it moves smoother but the acceleration/deceleration time becomes longer. To make this parameter invalid, set "0".	0 to 1000	0
SP047	SDTR*	Speed detection reset value	Set the reset hysteresis width for a speed detection set value defined in SP020 (SDTS).	0 to 1000 (r/min)	30
SP048	SUT*	Speed reach range	Set the speed deviation rate with respect to the commanded speed for output of the speed reach signal.	0 to 100 (%)	15
SP049	TLM2	Torque limit 2	Set the torque limit rate for the torque limit signal 010.	0 to 120 (%)	20
SP050	TLM3	Torque limit 3	Set the torque limit rate for the torque limit signal 011.	0 to 120 (%)	30
SP051	TLM4	Torque limit 4	Set the torque limit rate for the torque limit signal 100.	0 to 120 (%)	40
SP052	TLM5	Torque limit 5	Set the torque limit rate for the torque limit signal 101.	0 to 120 (%)	50
SP053	TLM6	Torque limit 6	Set the torque limit rate for the torque limit signal 110.	0 to 120 (%)	60
SP054	TLM7	Torque limit 7	Set the torque limit rate for the torque limit signal 111.	0 to 120 (%)	70
SP055	SETM*	Excessive speed deviation timer	Set the timer value until the excessive speed deviation alarm is output. The value of this parameter should be longer than the acceleration/deceleration time.	0 to 160 (s)	12
SP056	PYVR	Variable excitation (min value)	Set the minimum value of the variable excitation rate. Select a smaller value when gear noise is too high.	0 to 100 (%)	50
SP057	STOD*	Constant → transition judgment value	Set the value for judging when changing the speed command from a constant to acceleration/deceleration. When "0" is set, judge the speed with 12 r/min.	0 to 50 (r/min)	0
SP058	SDT2*	Speed detection setting value 2	Set the motor speed for carry out speed detection 2 output.	0 to 32767 (r/min)	0
SP059	MKT*	Winding changeover base shut-off timer	Set the base shut-off time for contactor switching at coil changeover. Note that the contactor may be damaged with burning if the value of this parameter is too small.	50 to 10000 (ms)	150
SP060	MKT2*	Current limit timer after coil changeover	Set the current limit time to be taken after completion of contactor switching at coil changeover.	0 to 10000 (ms)	500
SP061	MKIL*	Current limit value after coil changeover	Set the current limit value during a period defined in SP060 (MKT2) after completion of contactor switching at coil changeover.	0 to 120 (%)	75
SP062			Not used. Set to "0".	0	0
SP063	OLT*	Overload alarm detection time	Set the time constant for detection of the motor overload alarm. (For machine tool builder adjustment)	0 to 1000 (s)	60
SP064	OLL*	Overload alarm detection level	Set the detection level of the motor overload alarm. (For machine tool builder adjustment)	0 to 120 (%)	110
SP065	VCGN1*	Target value of variable speed loop proportional gain	Set the magnification of speed loop proportional gain with respect to SP022 (VGNP1) at the maximum motor speed defined in SP017 (TSP).	0 to 100 (%)	100

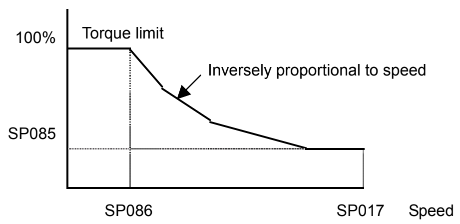
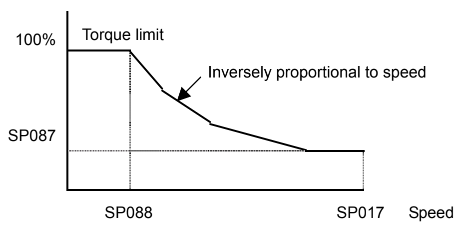
Parameters with an asterisk * in the abbreviation, such as OSP*, are validated with the NC power turned ON again.

<table>
<tr><th>No.</th><th>Abbr.</th><th>Parameter name</th><th>Details</th><th>Setting range (Unit)</th><th>Standard setting</th></tr>
<tr><td>SP066</td><td>VCSN1*</td><td>Change starting speed of variable speed loop proportional gain</td><td>Set the speed when the speed loop proportional gain change starts.

</td><td>0 to 32767
(r/min)</td><td>0</td></tr>
<tr><td>SP067</td><td>VIGWA*</td><td>Change starting speed of variable current loop gain</td><td>Set the speed where the current loop gain change starts.</td><td>0 to 32767
(r/min)</td><td>0</td></tr>
<tr><td>SP068</td><td>VIGWB*</td><td>Change ending speed of variable current loop gain</td><td>Set the speed where the current loop gain change ends.</td><td>0 to 32767
(r/min)</td><td>0</td></tr>
<tr><td>SP069</td><td>VIGN*</td><td>Target value of variable current loop gain</td><td>Set the magnification of current loop gain (torque component and excitation component) for a change ending speed defined in SP068 (VIGWB).
When this parameter is set to "0", the magnification is 1.

<table>
<tr><th rowspan="2">SP017 (TSP)
Maximum motor speed</th><th colspan="3">Setting value</th></tr>
<tr><th>SP067
(VIGWA)</th><th>SP068
(VIGWB)</th><th>SP069
(VIGN)</th></tr>
<tr><td>0 to 6000</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>6001 to 8000</td><td>5000</td><td>8000</td><td>45</td></tr>
<tr><td>8001 or more</td><td>5000</td><td>10000</td><td>64</td></tr>
</table></td><td>0 to 32767
(1/16-fold)</td><td>0</td></tr>
<tr><td>SP070</td><td>FHz</td><td>Machine resonance suppression filter frequency</td><td>When machine vibration occurs in speed and position control, set the frequency of the required vibration suppression.
Note that a value of 100Hz or more is set.
Set to "0" when not used.</td><td>0 to 3000 (Hz)</td><td>0</td></tr>
<tr><td>SP071</td><td>VR2WA*</td><td>Fixed control constant</td><td>Set by Mitsubishi. Set "0" unless designated in particular.</td><td>0</td><td>0</td></tr>
<tr><td>SP072</td><td>VR2WB*</td><td>Fixed control constant</td><td>Set by Mitsubishi. Set "0" unless designated in particular.</td><td>0</td><td>0</td></tr>
<tr><td>SP073</td><td>VR2GN*</td><td>Fixed control constant</td><td>Set by Mitsubishi. Set "0" unless designated in particular.</td><td>0</td><td>0</td></tr>
<tr><td>SP074</td><td>IGDEC*</td><td>Fixed control constant</td><td>Set by Mitsubishi. Set "0" unless designated in particular.</td><td>0</td><td>0</td></tr>
</table>

Parameters with an asterisk * in the abbreviation, such as OSP*, are validated with the NC power turned ON again.

<table>
<tr><th>No.</th><th>Abbr.</th><th>Parameter name</th><th>Details</th><th>Setting range (Unit)</th><th>Standard setting</th></tr>
<tr><td>SP075</td><td>R2KWS</td><td>Fixed control constant</td><td colspan="3">
<table>
<tr><td>F</td><td>E</td><td>D</td><td>C</td><td>B</td><td>A</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td>r2iro</td><td>r2ini</td><td></td><td></td><td></td><td>r2am</td><td>r2lm</td><td>r2dm</td><td>no51</td><td>r2ch</td></tr>
</table>
<table>
<tr><th colspan="2">bit</th><th>Meaning when set to 0</th><th>Meaning when set to 1</th><th>Standard</th></tr>
<tr><td>0</td><td>r2ch</td><td colspan="2" rowspan="5">Set by Mitsubishi. Set "0" unless designated in particular.</td><td>0</td></tr>
<tr><td>1</td><td>no51</td><td>0</td></tr>
<tr><td>2</td><td>r2dm</td><td>0</td></tr>
<tr><td>3</td><td>r2lm</td><td>0</td></tr>
<tr><td>4</td><td>r2am</td><td>0</td></tr>
<tr><td>5</td><td></td><td></td><td></td><td>0</td></tr>
<tr><td>6</td><td></td><td></td><td></td><td>0</td></tr>
<tr><td>7</td><td></td><td></td><td></td><td>0</td></tr>
<tr><td>8</td><td>r2ini</td><td colspan="2">Set by Mitsubishi. Set "0" unless designated in particular.</td><td>0</td></tr>
<tr><td>9</td><td>r2iro</td><td colspan="2">Set by Mitsubishi. Set "0" unless designated in particular.</td><td>0</td></tr>
<tr><td>A</td><td></td><td></td><td></td><td>0</td></tr>
<tr><td>B</td><td></td><td></td><td></td><td>0</td></tr>
<tr><td>C</td><td></td><td></td><td></td><td>0</td></tr>
<tr><td>D</td><td></td><td></td><td></td><td>0</td></tr>
<tr><td>E</td><td></td><td></td><td></td><td>0</td></tr>
<tr><td>F</td><td></td><td></td><td></td><td>0</td></tr>
</table>
(Note) Set 0 if there is no particular explanation for the bit.
</td></tr>
<tr><td>SP076</td><td>FONS</td><td>Machine resonance suppression filter operation speed</td><td>When the vibration increases in motor stop (ex. in orientation stop) when the machine vibration suppression filter is operated by SP070, operate the machine vibration suppression filter at a speed of this parameter or more.
When set to "0", this is validated for all speeds.</td><td>0 to 32767
(r/min)</td><td>0</td></tr>
<tr><td>SP077</td><td>TDSL*</td><td>Fixed control constant</td><td>Set by Mitsubishi.
Set "14" unless designated in particular.</td><td>14</td><td>14</td></tr>
<tr><td>SP078</td><td>FPWM*</td><td>Fixed control constant</td><td>Set by Mitsubishi. Set "0" unless designated in particular.</td><td>0</td><td>0</td></tr>
<tr><td>SP079</td><td>ILMT*</td><td>Fixed control constant</td><td>Set by Mitsubishi. Set "0" unless designated in particular.</td><td>0</td><td>0</td></tr>
<tr><td>SP080</td><td></td><td></td><td>Not used. Set "0".</td><td>0</td><td>0</td></tr>
<tr><td>SP081</td><td>LMCA</td><td>Fixed control constant</td><td>Set by Mitsubishi.
Set "14" unless designated in particular.</td><td>14</td><td>14</td></tr>
<tr><td>SP082</td><td>LMCB</td><td>Fixed control constant</td><td>Set by Mitsubishi. Set "0" unless designated in particular.</td><td>0</td><td>0</td></tr>
<tr><td>SP083</td><td></td><td>Fixed control constant</td><td>Set by Mitsubishi. Set "0" unless designated in particular.</td><td>0</td><td>0</td></tr>
<tr><td>SP084</td><td></td><td></td><td>Not used. Set "0".</td><td>0</td><td>0</td></tr>
</table>

Parameters with an asterisk * in the abbreviation, such as OSP*, are validated with the NC power turned ON again.

<table>
<tr><th>No.</th><th>Abbr.</th><th>Parameter name</th><th>Details</th><th>Setting range (Unit)</th><th>Standard setting</th></tr>
<tr><td rowspan="2">SP085</td><td rowspan="2">AIQM*</td><td rowspan="2">Target value of variable torque limit magnification at acceleration</td><td>< For MDS-C1-SPH>
Set the minimum value of variable torque limit at acceleration.</td><td>0 to 150
(%)</td><td>0</td></tr>
<tr><td>< For MDS-C1-SP/SPX/SPHX/SPM >
Not used. Set "0".</td><td>0</td><td>0</td></tr>
<tr><td rowspan="2">SP086</td><td rowspan="2">AIQN*</td><td rowspan="2">Speed for starting change of variable torque limit magnification at acceleration</td><td><For MDS-C1-SPH>
Set the speed where the torque limit value at acceleration starts to change.
</td><td>0 to 32767
(r/min)</td><td>0</td></tr>
<tr><td>< For MDS-C1-SP/SPX/SPHX/SPM>
Not used. Set "0".</td><td>0</td><td>0</td></tr>
<tr><td>SP087</td><td>DIQM*</td><td>Target value of variable torque limit magnification at deceleration</td><td>Set the minimum value of variable torque limit at deceleration.</td><td>0 to 150 (%)</td><td>75</td></tr>
<tr><td>SP088</td><td>DIQN*</td><td>Speed for starting change of variable torque limit magnification at deceleration</td><td>Set the speed where the torque limit value at deceleration starts to change.
</td><td>0 to 32767
(r/min)</td><td>3000</td></tr>
<tr><td>SP089</td><td></td><td></td><td>Not used. Set "0".</td><td>0</td><td>0</td></tr>
<tr><td>SP090</td><td></td><td></td><td>Not used. Set "0".</td><td>0</td><td>0</td></tr>
<tr><td>SP091</td><td>OFSN</td><td>Offset compensation during motor PLG forward run</td><td>Set the PLG offset for forward run.
Normally "0" is set.</td><td>-2048 to 2047
(-1mV)</td><td>0</td></tr>
<tr><td>SP092</td><td>OFSI</td><td>Offset compensation during motor PLG reverse run</td><td>Set the PLG offset for reverse run.
Normally "0" is set.</td><td>-2048 to 2047
(-1mV)</td><td>0</td></tr>
<tr><td>SP093</td><td>ORE*</td><td>Tolerable pulse check error</td><td>Set this when detecting the pulse detector's pulse mistakes. (Valid only for full close control.)</td><td>0 to 32767</td><td>0</td></tr>
<tr><td>SP094</td><td>LMAV*</td><td>Load meter output filter</td><td>Set the filter time constant of load meter output.
When "0" is set, a filter time constant is set to 100ms.</td><td>0 to 32767
(2ms)</td><td>0</td></tr>
<tr><td>SP095</td><td>VFAV*</td><td>Fixed control constant</td><td>Set by Mitsubishi. Set "0" unless designated in particular.</td><td>0</td><td>0</td></tr>
<tr><td>SP096</td><td>EGAR*</td><td>Encoder gear ratio</td><td>Set the gear ratio between the spindle end and the detector end (except for the motor PLG) as indicated below.
<table>
<tr><th>Setting value</th><th>Gear ratio (deceleration)</th></tr>
<tr><td>0</td><td>1 : 1</td></tr>
<tr><td>1</td><td>1 : 1/2</td></tr>
<tr><td>2</td><td>1 : 1/4</td></tr>
<tr><td>3</td><td>1 : 1/8</td></tr>
<tr><td>4</td><td>1 : 1/16</td></tr>
</table>
<table>
<tr><th>Setting value</th><th>Gear ratio (acceleration)</th></tr>
<tr><td>-1</td><td>1 : 2</td></tr>
<tr><td>-2</td><td>1 : 4</td></tr>
<tr><td>-3</td><td>1 : 3</td></tr>
</table></td><td>-3 to 4</td><td>0</td></tr>
</table>

Parameters with an asterisk * in the abbreviation, such as OSP*, are validated with the NC power turned ON again.

No.	Abbr.	Parameter name	Details	Setting range (Unit)	Standard setting
SP097	SPECO*	Orientation specification			

<For MDS-C1-SP>

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
ostp	orze	ksft	gchg		ips2	zdir		vg8x	mdir	fdir	oscl	pyfx	dmin	odi2	odi1

<table>
<tr><th colspan="2">bit</th><th>Meaning when set to 0</th><th>Meaning when set to 1</th><th>Standard</th></tr>
<tr><td>0</td><td>odi1</td><td colspan="2" rowspan="2">Orientation rotation direction, C-axis control zero point return direction (only SPX, SPHX)
00: Previous (the direction in which the motor has so far rotated under speed control)
01: Forward rotation
10: Backward rotation 11: Prohibited</td><td>0</td></tr>
<tr><td>1</td><td>odi2</td><td>0</td></tr>
<tr><td>2</td><td>dmin</td><td>Orientation completion advance invalid</td><td>Orientation completion advance valid</td><td>0</td></tr>
<tr><td>3</td><td>pyfx</td><td>Excitation min. (50%) during orientation servo lock invalid</td><td>Excitation min. (50%) during orientation servo lock valid</td><td>0</td></tr>
<tr><td>4</td><td>oscl</td><td>Indexing speed clamp invalid</td><td>Indexing speed clamp valid</td><td>0</td></tr>
<tr><td>5</td><td>fdir</td><td>Spindle end detector polarity: +</td><td>Spindle end detector polarity: –</td><td>0</td></tr>
<tr><td>6</td><td>mdir</td><td>Magnetic sensor polarity: +</td><td>Magnetic sensor polarity: –</td><td>0</td></tr>
<tr><td>7</td><td>vg8x</td><td>Speed gain *1/8 during torque limit valid</td><td>Speed gain *1/8 during torque limit invalid</td><td>0</td></tr>
<tr><td>8</td><td></td><td></td><td></td><td>0</td></tr>
<tr><td>9</td><td>zdir</td><td colspan="2">This is used by Mitsubishi. Set to "0" unless particularly designated.</td><td>0</td></tr>
<tr><td>A</td><td>ips2</td><td>2nd orientation completion invalid</td><td>2nd orientation completion valid</td><td>0</td></tr>
<tr><td>B</td><td></td><td></td><td></td><td>0</td></tr>
<tr><td>C</td><td>gchg</td><td>Gain changeover during orientation invalid</td><td>Gain changeover during orientation valid</td><td>0</td></tr>
<tr><td>D</td><td>ksft</td><td>Orientation virtual target shift invalid</td><td>Orientation virtual target shift valid</td><td>0</td></tr>
<tr><td>E</td><td>orze</td><td colspan="2" rowspan="2">This is used by Mitsubishi.
Set to "0" unless particularly designated.</td><td>0</td></tr>
<tr><td>F</td><td>ostp</td><td>0</td></tr>
</table>

(Note 1) Set 0 if there is no particular explanation for the bit.

<For MDS-C1-SPH>

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
ostp	orze	ksft	gchg	tlmp	ips2	zdir	tlet	vg8x	mdir	fdir	oscl	pyfx	dmin	odi2	odi1

<table>
<tr><th colspan="2">bit</th><th>Meaning when set to 0</th><th>Meaning when set to 1</th><th>Standard</th></tr>
<tr><td>0</td><td>odi1</td><td colspan="2" rowspan="2">Orientation rotation direction
00: Previous (the direction in which the motor has so far rotated under speed control)
01: Forward rotation
10: Backward rotation 11: Prohibited</td><td>0</td></tr>
<tr><td>1</td><td>odi2</td><td>0</td></tr>
<tr><td>2</td><td>dmin</td><td>Orientation completion advance invalid</td><td>Orientation completion advance valid</td><td>0</td></tr>
<tr><td>3</td><td>pyfx</td><td>Excitation min. (50%) during orientation servo lock invalid</td><td>Excitation min. (50%) during orientation servo lock valid</td><td>0</td></tr>
<tr><td>4</td><td>oscl</td><td>Indexing speed clamp invalid</td><td>Indexing speed clamp valid</td><td>0</td></tr>
<tr><td>5</td><td>fdir</td><td>Spindle end detector polarity: +</td><td>Spindle end detector polarity: –</td><td>0</td></tr>
<tr><td>6</td><td>mdir</td><td>Magnetic sensor polarity: +</td><td>Magnetic sensor polarity: –</td><td>0</td></tr>
<tr><td>7</td><td>vg8x</td><td>Speed gain *1/8 during torque limit valid</td><td>Speed gain *1/8 during torque limit invalid</td><td>0</td></tr>
<tr><td>8</td><td>tlet</td><td>Turret indexing invalid</td><td>Turret indexing valid</td><td>0</td></tr>
<tr><td>9</td><td>zdir</td><td colspan="2">This is used by Mitsubishi. Set to "0" unless particularly designated.</td><td>0</td></tr>
<tr><td>A</td><td>ips2</td><td>2nd orientation completion invalid</td><td>2nd orientation completion valid</td><td>0</td></tr>
<tr><td>B</td><td>tlmp</td><td>Turret indexing 1-deg unit</td><td>Turret indexing 0.1-deg unit</td><td>0</td></tr>
<tr><td>C</td><td>gchg</td><td>Gain changeover during orientation invalid</td><td>Gain changeover during orientation valid</td><td>0</td></tr>
<tr><td>D</td><td>ksft</td><td>Orientation virtual target shift invalid</td><td>Orientation virtual target shift valid</td><td>0</td></tr>
<tr><td>E</td><td>orze</td><td colspan="2" rowspan="2">This is used by Mitsubishi.
Set to "0" unless particularly designated.</td><td>0</td></tr>
<tr><td>F</td><td>ostp</td><td>0</td></tr>
</table>

Parameters with an asterisk * in the abbreviation, such as OSP*, are validated with the NC power turned ON again.

<table>
<tr><th colspan="2" rowspan="2"></th><th colspan="2">Orientation completion advance (SP097/bit2)</th></tr>
<tr><th>0 (Invalid)</th><th>1 (Valid)</th></tr>
<tr><td rowspan="2">2nd orientation completion signal (SP097/bitA)</td><td>0 (Invalid)</td><td rowspan="2">In SP004 (OINP) width:
Orientation completion signal (ORCF)
Control output 4/bit4=1
2nd orientation completion signal (ORF2)
Control output 4/bitF=Invalid</td><td>In SP004 (OINP) width:
Orientation completion signal (ORCF)
Control output 4/bit4=1
2nd orientation completion signal (ORF2)
Control output 4/bitF=Invalid</td></tr>
<tr><td>1 (Valid)</td><td>In SP101 (DINP) width:
Orientation completion signal (ORCF)
Control output 4/bit4=1
In SP004 (OINP) width:
2nd orientation completion signal (ORF2)
Control output 4/bitF=1</td></tr>
</table>

No.	Abbr.	Parameter name	Details	Setting range (Unit)	Standard setting
SP097	SPECO*	Orientation specification	Continued from previous page (see below)		

Continued from previous page

<For MDS-C1-SPX/SPHX>

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
ostp	orze	ksft	gchg		ips2	zdir		vg8x		fdir	oscl	pyfx	dmin	odi2	odi1

bit		Meaning when set to 0	Meaning when set to 1	Standard
0	odi1	Orientation rotation direction, C-axis control zero point return direction (only SPX, SPHX) 00: Previous (the direction in which the motor has so far rotated under speed control) 01: Forward rotation 10: Backward rotation 11: Prohibited		0
1	odi2			0
2	dmin	Orientation completion advance invalid	Orientation completion advance valid	0
3	pyfx	Excitation min. (50%) during orientation servo lock invalid	Excitation min. (50%) during orientation servo lock valid	0
4	oscl	Indexing speed clamp invalid	Indexing speed clamp valid	0
5	fdir	Spindle end detector polarity: +	Spindle end detector polarity: –	0
6				0
7	vg8x	Speed gain *1/8 during torque limit valid	Speed gain *1/8 during torque limit invalid	0
8				0
9	zdir	This is used by Mitsubishi. Set to "0" unless particularly designated.		0
A	ips2	2nd orientation completion invalid	2nd orientation completion valid	0
B				0
C	gchg	Gain changeover during orientation invalid	Gain changeover during orientation valid	0
D	ksft	Orientation virtual target shift invalid	Orientation virtual target shift valid	0
E	orze	This is used by Mitsubishi. Set to "0" unless particularly designated.		0
F	ostp			0

(Note 1) Set 0 if there is no particular explanation for the bit.

<For MDS-C1-SPM>

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
ostp	orze	ksft	gchg		ips2			vg8x		fdir	oscl		dmin	odi2	odi1

bit		Meaning when set to 0	Meaning when set to 1	Standard
0	odi1	Orientation rotation direction 00: Previous (the direction in which the motor has so far rotated under speed control) 01: Forward rotation 10: Backward rotation 11: Prohibited		0
1	odi2			0
2	dmin	Orientation completion advance invalid	Orientation completion advance valid	0
3				0
4	oscl	Indexing speed clamp invalid	Indexing speed clamp valid	0
5	fdir	Spindle end detector polarity: +	Spindle end detector polarity: –	0
6				0
7	vg8x	Speed gain *1/8 during torque limit valid	Speed gain *1/8 during torque limit invalid	0
8				0
9				0
A	ips2	2nd orientation completion invalid	2nd orientation completion valid	0
B				0
C	gchg	Gain changeover during orientation invalid	Gain changeover during orientation valid	0
D	ksft	Orientation virtual target shift invalid	Orientation virtual target shift valid	0
E	orze	This is used by Mitsubishi. Set to "0" unless particularly designated.		0
F	ostp			0

(Note 1) Set 0 if there is no particular explanation for the bit.

Parameters with an asterisk * in the abbreviation, such as OSP*, are validated with the NC power turned ON again.

No.	Abbr.	Parameter name	Details	Setting range (Unit)	Standard setting
SP098	VGOP*	Speed loop gain proportional term in orientation control mode	Set the speed loop proportional gain in orientation control mode. When the gain is increased, rigidity is improved in the orientation stop but vibration and sound become larger.	0 to 1000	63
SP099	VGOI*	Orientation control mode speed loop gain integral term	Set the speed loop integral gain in orientation control mode.	0 to 1000	60
SP100	VGOD*	Orientation control mode speed loop gain delay advance term	Set a loop gain delay advance gain in orientation control mode. When this parameter is set to "0", PI control is applied.	0 to 1000	15
SP101	DINP*	Orientation advance in-position width	When using the orientation completed advance function, set the in-position width that is larger than the normal in-position width defined in SP004 (OINP).	1 to 2880 (1/16 deg)	16
SP102	OODR*	Excessive error value in orientation control mode	Set the excessive error detection width in orientation control mode.	0 to 32767 (1/4 pulse) (1 pulse= 0.088 deg)	32767
SP103	FTM*	Index positioning completion OFF time timer	Set the time for forcedly turn OFF the index positioning completion signal (different from the orientation completion signal) after the leading edge of the indexing start signal.	0 to 10000 (ms)	200
SP104	TLOR*	Torque limit value after orientation completed l	Set the torque limit value after orientation completed. If the external torque limit signal is input, the torque limit value set by this parameter is made invalid.	0 to 120 (%)	100
SP105	IQGO*	Current loop gain magnification 1 in orientation control mode	Set the magnification for current loop gain (torque component) at orientation completion.	1 to 1000 (%)	100
SP106	IDGO*	Current loop gain magnification 2 in orientation control mode	Set the magnification for current loop gain (excitation component) at orientation completion.	1 to 1000 (%)	100
SP107	CSP2	Deceleration rate 2 in orientation control mode	Set the deceleration rate in orientation mode corresponding to the gear 001. When this parameter is set to "0", same as SP006 (CSP).	0 to 1000	0
SP108	CSP3	Deceleration rate 3 in orientation control mode	Set the deceleration rate in orientation mode corresponding to the gear 010. When this parameter is set to "0", same as SP006 (CSP).	0 to 1000	0
SP109	CSP4	Deceleration rate 4 in orientation control mode	Set the deceleration rate in orientation mode corresponding to the gear 011. When this parameter is set to "0", same as SP006 (CSP).	0 to 1000	0
SP110	WCML	Turret indexing control Command magnification	**<For MDS-C1-SPH>** Specify the gear ratio for the motor axis and the turret axis.	0 to 32767 (fold)	0
			<For MDS-C1-SP/SPX/SPHX/SPM> Not used. Set "0".	0	0
SP111	WDEL	Turret indexing control Deceleration magnification	**<For MDS-C1-SPH>** Specify the deceleration rate for turret indexing control.	0 to 32767 (1/256-fold)	0
			<For MDS-C1-SP/SPX/SPHX/SPM> Not used. Set "0".	0	0
SP112	WCLP	Turret indexing control Clamp speed	**<For MDS-C1-SPH>** Specify the clamp speed for the turret axis end.	0 to 32767 (r/min)	0
			<For MDS-C1-SP/SPX/SPHX/SPM> Not used. Set "0".	0	0
SP113	WINP	Turret indexing control In-position width	**<For MDS-C1-SPH>** Specify the in-position detection range for turret indexing control.	0 to 32767 (0.088deg)	0
			<For MDS-C1-SP/SPX/SPHX/SPM> Not used. Set "0".	0	0

Parameters with an asterisk * in the abbreviation, such as OSP*, are validated with the NC power turned ON again.

No.	Abbr.	Parameter name	Details	Setting range (Unit)	Standard setting
SP114	OPER	Orientation control pulse miss check value	An alarm "5C" will occur if the pulse miss value at the orientation stop exceeds this setting value. (Note that this is invalid when set to "0".) In this parameter, set the value to fulfill the following conditions. SP114 setting value > 1.5 × SP004 (orientation in-position width)	0 to 32767 (360 deg/4096)	0
SP115	OSP2	Orientation control speed clamp value 2	When the orientation clamp speed is changed by the control input, this parameter setting will be used instead of SP005: OSP. Indexing speed clamp valid This parameter is used when (SP097: SPEC0/bit4 = 1).	0 to 32767 (r/min)	0
SP116	OPYVR	Minimum excitation value after changeover (2nd minimum excitation rate)	Set the minimum excitation rate when position control input or external input is selected.	0 to 100 (%)	0
SP117	ORUT	Fixed control constant	Set by Mitsubishi. Set "0" unless designated in particular.	0	0
SP118	ORCT	Orientation control number of retry times	Set the number of times to retry when an orientation or feedback error occurs. The warning (A9) is issued while retrying orientation, and an alarm (5C) is issued when the set number of times is exceeded.	0 to 100 (time)	0
SP119	MPGH	Orientation control position loop gain H coil magnification	Set the compensation magnification of the orientation position loop gain for the H coil. H coil orientation position loop gain = SP001 (or SP002) × SP119/256 When set to "0", will become the same as SP001 or SP002.	0 to 2560 (1/256-fold)	0
SP120	MPGL	Orientation control position loop gain L coil magnification	Set the compensation magnification of the orientation position loop gain for the L coil. L coil orientation position loop gain = SP001 (or SP002) × SP120/256 When set to "0", will become the same as SP001 or SP002.	0 to 2560 (1/256-fold)	0
SP121	MPCSH	Orientation deceleration rate H coil magnification	Set the compensation magnification of the orientation deceleration rate for the H coil. Orientation deceleration rate for the H coil = SP006 × SP121/256 When set to "0", will become the same as SP006.	0 to 2560 (1/256-fold)	0
SP122	MPCSL	Orientation deceleration rate L coil magnification	Set the compensation magnification of the orientation deceleration rate for the L coil. Orientation deceleration rate for the L coil = SP006 × SP122/256 When set to "0", will become the same as SP006.	0 to 2560 (1/256-fold)	0
SP123	MGD0	Magnetic sensor output peak value	This parameter is used for adjusting the operation during magnetic sensor orientation. Set the peak value of the magnetic sensor output. If the gap between the sensor and magnet is small, set a large value. If the gap is large, set a small value.	1 to 10000	Standard magnet=542 Compact magnet=500
SP124	MGD1	Magnetic sensor linear zone width	This parameter is used for adjusting the operation during magnetic sensor orientation. Set the width of the magnetic sensor linear zone. If the installation radius of the magnet is large, set a small value.	1 to 10000	Standard magnet=768 Compact magnet=440
SP125	MGD2	Magnetic sensor changeover point	This parameter is used for adjusting the operation during magnetic sensor orientation. Set the distance from the target stop point for changing the position feedback to magnetic sensor output. Normally, a value that is approx. half of SP124 (MGDI) is set.	1 to 10000	Standard magnet=384 Compact magnet=220

Parameters with an asterisk * in the abbreviation, such as OSP*, are validated with the NC power turned ON again.

No.	Abbr.	Parameter name	Details	Setting range (Unit)	Standard setting
SP126	MPGM	Orientation position loop gain M coil magnification	**<For MDS-C1-SPM>** Set the compensation magnification of the orientation position loop gain for the M coil. M coil orientation position loop gain = SP001 (or SP002) × SP119/256 When set to "0", will become the same as SP001 or SP002.	0 to 2560 (1/256-fold)	0
			<For MDS-C1-SP/SPH/SPX/SPHX> Not used. Set "0".	0	0
SP127	MPCSM	Orientation deceleration rate M coil magnification	**<For MDS-C1-SPM>** Set the compensation magnification of the orientation deceleration rate for the M coil. Orientation deceleration rate for the M coil = SP006 × SP121/256 When set to "0", will become the same as SP006.	0 to 2560 (1/256-fld)	0
			<For MDS-C1-SP/SPX/SPHX/SPM> Not used. Set "0".	0	0
SP128	OXKPM	After orientation completion, Position loop gain magnification (M coil)	**<For MDS-C1-SPM>** Set the switched M coil position loop gain magnification after orientation when gain switching is enabled (SP097: SPEC0/bitC=1).	0 to 2560 (1/256-fold)	0
			<For MDS-C1-SP/SPX/SPHX/SPM> Not used. Set "0".	0	0

Parameters with an asterisk * in the abbreviation, such as OSP*, are validated with the NC power turned ON again.

No.	Abbr.	Parameter name	Details
SP129	SPECC*	C-axis specifications	

<For MDS-C1-SP/SPH/SPX/SPHX>

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
zrtn	ptyp	fb9x	zrtd	zrn2		zdir	ztyp	vg8x		fdir		phos	rtrn	adin	fclx

bit		Meaning when set to 0	Meaning when set to 1	Standard
0	fclx	Closed loop	Semi-closed loop (Gear 1 : 1 only)	0
1	adin	Interpolation A/D compensation invalid	Interpolation A/D compensation valid	0
2	rtrn	Position monitor during ready OFF invalid	Position monitor during ready OFF valid	1
3	phos	High-gain servo synchronous compensation invalid	High-gain servo synchronous compensation valid	0
4				0
5	fdir	Position detector polarity (+)	Position detector polarity (-)	0
6				0
7	vg8x	Speed gain × 1/8 during torque limit valid	Speed gain × 1/8 during torque limit invalid	0
8	ztyp	Z-phase type: Normal start up	Z-phase type: Start up only	0
9	zdir	Z-phase rising polarity (+)	Z-phase rising polarity (-)	0
A				0
B	zrn2	This is used by Mitsubishi. Set to "0" unless particularly designated.		0
C	zrtd			0
D	fb9x	Speed feedback, Standard (PLG)	Speed feedback 90,000 pulse detector	0
E	ptyp	Position control switch type: After zero point return	Position control switch type: After deceleration stop	0
F	zrtn	Zero point return direction: CCW	Zero point return direction: CW	0

(Note 1) bits 5, D and F are invalid for SPX and SPHX. Set the direction with SP097.

(Note 2) Set 0 if there is no particular explanation for the bit.

<For MDS-C1-SPM>

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
zrtn	ptyp	fb9x	zrtd	zrn2		zdir	ztyp	vg8x		fdir		phos	rtrn		fclx

bit		Meaning when set to 0	Meaning when set to 1	Standard
0	fclx	Closed loop	Semi-closed loop (Gear 1 : 1 only)	0
1				0
2	rtrn	Position monitor during ready OFF invalid	Position monitor during ready OFF valid	0
3	phos	High-gain servo synchronous compensation invalid	High-gain servo synchronous compensation valid	1
4				0
5	fdir	Position detector polarity (+)	Position detector polarity (-)	0
6				0
7	vg8x	Speed gain × 1/8 during torque limit valid	Speed gain × 1/8 during torque limit invalid	0
8	ztyp	Z-phase type: Normal start up	Z-phase type: Start up only	0
9	zdir	Z-phase rising polarity (+)	Z-phase rising polarity (-)	0
A				0
B	zrn2	This is used by Mitsubishi. Set to "0" unless particularly designated.		0
C	zrtd			0
D	fb9x	Speed feedback, Standard (PLG)	Speed feedback 90,000 pulse detector	0
E	ptyp	Position control switch type: After zero point return	Position control switch type: After deceleration stop	0
F	zrtn	Zero point return direction: CCW	Zero point return direction: CW	0

(Note) Set 0 if there is no particular explanation for the bit.

Parameters with an asterisk * in the abbreviation, such as OSP*, are validated with the NC power turned ON again.

No.	Abbr.	Parameter name	Details	Setting range (Unit)	Standard setting
SP130	PGC1	First position loop gain for cutting control on C-axis	Set the position loop gain when the first gain is selected for C axis cutting.	1 to 100 (rad/s)	15
SP131	PGC2	Second position loop gain for cutting control on C-axis	Set the position loop gain when the second gain is selected for C axis cutting.	1 to 100 (rad/s)	15
SP132	PGC3	Third position loop gain for cutting control on C-axis	Set the position loop gain when the third gain is selected for C-axis cutting.	1 to 100 (rad/s)	15
SP133	PGC4	Stop position loop gain for cutting control on C-axis	Set the position loop gain for stopping when carrying out C-axis cutting control.	1 to 100 (rad/s)	15
SP134	VGCP0*	C-axis non-cutting control speed loop gain proportional item	Set the speed loop proportional gain in C-axis non-cutting control mode.	0 to 5000	63
SP135	VGCI0*	C-axis non-cutting control speed loop gain integral item	Set the speed loop integral gain in C-axis non-cutting control mode.	0 to 5000	60
SP136	VGCD0*	C-axis non-cutting control speed loop gain delay advance item	Set the speed loop delay advance gain in C-axis non-cutting control mode. When this parameter is set to "0", PI control is exercised.	0 to 5000	15
SP137	VGCP1*	First speed loop gain proportional item for C-axis cutting control	Set the speed loop proportional gain when the first gain is selected for C-axis cutting control.	0 to 5000	63
SP138	VGCI1*	First speed loop gain integral item for cutting control on C-axis	Set the speed loop integral gain when the first gain is selected for C-axis cutting control.	0 to 5000	60
SP139	VGCD1*	First speed loop gain delay advance item for cutting control on C-axis	Set the speed loop delay advance gain when the first gain is selected for curing on the C-axis cutting control. When this parameter is set to "0", PI control is applied.	0 to 5000	15
SP140	VGCP2*	Second speed loop gain proportional item for cutting control on C-axis	Set the speed loop proportional gain when the second gain is selected for C-axis cutting control.	0 to 5000	63
SP141	VGCI2*	Second speed loop gain integral item for cutting control on C-axis	Set the speed loop integral gain when the second gain is selected for C-axis cutting control.	0 to 5000	60
SP142	VGCD2*	Second speed loop gain delay advance item for cutting control on C-axis	Set the speed loop delay advance gain when the second gain is selected for C-axis cutting. When this parameter is set to "0", PI control is applied.	0 to 5000	15
SP143	VGCP3*	Third speed loop gain proportional item for cutting control on C-axis	Set the speed loop proportional gain when the third gain is selected for C-axis cutting control.	0 to 5000	63
SP144	VGCI3*	Third speed loop gain integral item for cutting control on C-axis	Set the speed loop integral gain when the third gain is selected for C-axis cutting control.	0 to 5000	60
SP145	VGCD3*	Third speed loop gain delay advance item for cutting on C-axis	Set the speed loop delay advance gain when the third gain is selected for C-axis cutting control. When this parameter is set to "0", PI control is applied.	0 to 5000	15
SP146	VGCP4*	Speed loop gain proportional item for stop of cutting on C-axis	Set the speed loop proportional gain when C-axis cutting is stopped.	0 to 5000	63
SP147	VGCI4*	Speed loop gain integral item for stop of cutting on C-axis	Set the speed loop integral gain when C-axis cutting is stopped.	0 to 5000	60
SP148	VGCD4*	Speed loop gain delay advance item for stop of cutting on C-axis	Set the speed loop delay advance gain when C-axis cutting is stopped. When this parameter is set to "0", PI control is applied.	0 to 5000	15
SP149	CZRN	C-axis control zero point return speed	This parameter is valid when SP129 (SPECC)/bitE is set to "0". Set the zero point return speed used when the speed loop changes to the position loop.	1 to 500 (r/min)	50

Parameters with an asterisk * in the abbreviation, such as OSP*, are validated with the NC power turned ON again.

No.	Abbr.	Parameter name	Details	Setting range (Unit)	Standard setting
SP150	CPDT	C-axis control zero point return deceleration point	This parameter is valid when SP129 (SPECC)/bitE is set to "0". Set the deceleration rate where the machine starts to decelerate when it returns to the target stop point during C-axis zero point return. When the machine tends to overshoot at the stop point, set the smaller value.	1 to 10000	1
SP151	CPSTL	C-axis zero point return shift amount (low byte)	This parameter is valid when SPECC (SP129)/bitE is set to "0". Set the C-axis zero point position. (HEX setting)	00000000 to FFFFFFFF Only for SPX 00000000 to 00057E3F (1/1000 deg)	0000
SP152	CPSTH	C-axis zero point return shift amount (high byte)			0000
SP153	CINP	C-axis control in-position width	Set the position error range for outputting the in-position signal during C-axis control. (HEX setting)	0000 to FFFF (1/1000 deg)	03E8
SP154	CODRL*	Excessive error width on C-axis control (low byte)	Set the excessive error width on the C-axis control. (HEX setting)	00000000 to FFFFFFFF (1/1000 deg)	D4C0
SP155	CODRH*	Excessive error width on C-axis control (high byte)			0001
SP156	OVSH	C-axis control overshoot compensation	Set this to prevent overshooting when shifting from movement to stopping with C-axis control. (Set this referring to the load meter display when overshooting occurred.)	0 to 1000 (0.1%)	0
SP157			Not used. Set to "0".	0	0
SP158			Not used. Set to "0".	0	0
SP159	CPY0	C-axis non-cutting control variable excitation ratio	Set the minimum value of variable excitation ratio for non-cutting control on the C-axis.	0 to 100 (%)	50
SP160	CPY1	C-axis cutting control variable excitation ratio	Set the minimum variable excitation ratio for cutting control on the C-axis.	0 to 100 (%)	100
SP161	IQGC0*	Current loop gain magnification 1 for non-cutting control on C-axis	Set the magnification of current loop gain (torque component) for C-axis non-cutting control.	1 to 1000 (%)	100
SP162	IDGC0*	Current loop gain magnification 2 for non-cutting control on C-axis	Set the magnification of current loop gain (excitation component) for C-axis non-cutting control.	1 to 1000 (%)	100
SP163	IQGC1*	Current loop gain magnification 1 for cutting control on C-axis	Set the magnification of current loop gain (torque component) for C-axis cutting control.	1 to 1000 (%)	100
SP164	IDGC1*	Current loop gain magnification 2 for cutting control on C-axis	Set the magnification of current loop gain (excitation component) for C-axis cutting control.	1 to 1000 (%)	100
SP165	PG2C	C-axis control position loop gain 2	Set the second position loop gain when high-gain control is carried out for control of the C-axis. This parameter is applied to all the operation modes of C-axis control. When this function is not used, assign "0".	0 to 999 (rad/s)	0
SP166	PG3C	C-axis control position loop gain 3	Set the third position loop gain when high-gain control is carried out for control of the C-axis. This parameter is applied to all the operation modes of C-axis control. When this function is not used, assign "0".	0 to 999 (rad/s)	0
SP167	PGU*	Position loop gain for increased spindle holding force	Set the position loop gain for when the disturbance observer is valid.	0 to 999 (rad/s)	15
SP168	VGUP*	Speed loop gain proportional item for increased spindle holding force	Set the speed loop gain proportional item for when the disturbance observer is valid.	0 to 5000	63
SP169	VGUI*	Speed loop gain integral item for increased spindle holding force	Set the speed loop gain integral item for when the disturbance observer is valid.	0 to 5000	60

Parameters with an asterisk * in the abbreviation, such as OSP*, are validated with the NC power turned ON again.

No.	Abbr.	Parameter name	Details	Setting range (Unit)	Standard setting
SP170	VGUD*	Speed loop gain delay advance item for increased spindle holding force	Set the speed loop gain delay advance item for when the disturbance observer is valid.	0 to 5000	15
SP171			Not used. Set "0".	0	0
SP172			Not used. Set "0".	0	0
SP173			Not used. Set "0".	0	0
SP174			Not used. Set "0".	0	0
SP175			Not used. Set "0".	0	0
SP176	ZGOF	Gate OFF delay time after zero speed detection	<For MDS-C1-SP/SPH/SPX/SPHX> Set the time until gate OFF after zero speed (ZS) is detected at speed control.	0 to 1000 (10ms)	0
			< For MDS-C1-SPM> Not used. Set "0".	0	0

Parameters with an asterisk * in the abbreviation, such as OSP*, are validated with the NC power turned ON again.

No.	Abbr.	Parameter name	Details
SP177	SPECS*	Spindle synchronous specifications	

<For MDS-C1-SP/SPH/SPX/SPHX>

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
		odx8					phos			fdir		pyfx	rtrn	adin	fclx

bit		Meaning when set to 0	Meaning when set to 1	Standard
0	fclx	Closed loop	Semi-closed loop	0
1	adin	Interpolation A/D compensation invalid	Interpolation A/D compensation valid	0
2	rtrn	Position monitor during ready OFF invalid	Position monitor during ready OFF valid	0
3	pyfx	Normal excitation	Position loop excitation fixed (strong)	0
4				0
5	fdir	Position detector direction (positive direction)	Position detector direction (negative direction)	0
6				0
7				0
8	phos	High-gain servo synchronous compensation invalid	High-gain servo synchronous compensation valid	0
9				0
A				0
B				0
C				0
D	odx8	Excessive error detection width normal	Magnification of excessive error detection width × 8 times valid	0
E				0
F				0

(Note 1) bits 5, D and F are invalid for SPX and SPHX. Set the direction with SP097.
(Note 2) Set 0 if there is no particular explanation for the bit.

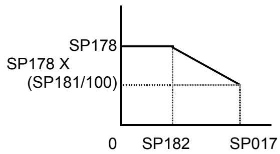
<For MDS-C1-SPM>

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
		odx8					phos			fdir		mach			fclx

bit		Meaning when set to 0	Meaning when set to 1	Standard
0	fclx	Closed loop	Semi-closed loop	0
1				0
2				0
3	mach	Automatic coil changeover during spindle synchronization invalid	Automatic coil changeover during spindle synchronization valid	0
4				0
5	fdir	Position detector direction (positive direction)	Position detector direction (negative direction)	0
6				0
7				0
8	phos	High-gain servo synchronous compensation invalid	High-gain servo synchronous compensation valid	1
9				0
A				0
B				0
C				0
D	odx8	Excessive error detection width normal	Magnification of excessive error detection width × 8 times valid	0
E				0
F				0

(Note) Set 0 if there is no particular explanation for the bit.

Parameters with an asterisk * in the abbreviation, such as OSP*, are validated with the NC power turned ON again.

No.	Abbr.	Parameter name	Details	Setting range (Unit)	Standard setting
SP178	VGSP*	Spindle synchronous control speed loop gain proportional term	Set the speed loop proportional gain in spindle synchronous control mode.	0 to 1000	63
SP179	VGSI*	Spindle synchronous control speed loop gain integral term	Set the speed loop integral gain in spindle synchronous control mode.	0 to 1000	60
SP180	VGSD*	Spindle synchronous control speed loop gain delay advance term	Set the speed loop delay advance gain in spindle synchronous control mode. When this parameter is set to "0", PI control is applied.	0 to 1000	15
SP181	VCGS*	Spindle synchronous control Target value of variable speed loop proportional gain	Set the magnification of speed loop proportional gain with respect to SP178 (VGSP) at the maximum speed defined in SP017 (TSP) in spindle synchronous control mode.	0 to 100 (%)	100
SP182	VCSS*	Spindle synchronous control Change starting speed of variable speed loop proportional gain	Set the speed when the speed loop proportional gain change starts in the spindle synchronous control mode. 	0 to 32767 (r/min)	0
SP183	SYNV	Spindle synchronous control Sync matching speed	For changeover from the speed loop to the position loop in the spindle synchronous control mode, set a speed command error range for output of the synchronous speed matching signal.	0 to 1000 (r/min)	20
SP184			Not used. Set "0".	0	0
SP185	SINP	Spindle synchronous control In-position width	Set the position error range for output of the in-position signal in the spindle synchronous control mode.	1 to 2880 (1/16 deg)	16
SP186	SODR*	Spindle synchronous control Excessive error width	Set the excessive error width in the spindle synchronous control mode.	0 to 32767 (pulse) (1 pulse = 0.088 deg)	32767
SP187	IQGS*	Spindle synchronous control Current loop gain magnification1	Set the magnification of current loop gain (torque component) in the spindle synchronous control mode.	1 to 1000 (%)	100
SP188	IDGS*	Spindle synchronous control Current loop gain magnification 2	Set the magnification of current loop gain (excitation component) in the spindle synchronous control mode.	1 to 1000 (%)	10
SP189	PG2S	Spindle synchronous control Position loop gain 2	Set the second position loop gain when high-gain control is carried out in the spindle synchronous control mode. When this parameter function is not used, set to "0".	0 to 999 (rad/s)	0
SP190	PG3S	Spindle synchronous control Position loop gain 3	Set the third position loop gain when high-gain control is carried out in the spindle synchronous control mode. When this parameter function is not used, set to "0".	0 to 999 (rad/s)	0
SP191			Not used. Set "0".	0	0
SP192			Not used. Set "0".	0	0

Parameters with an asterisk * in the abbreviation, such as OSP*, are validated with the NC power turned ON again.

No.	Abbr.	Parameter name	Details
SP193	SPECT*	Synchronized tapping specifications	See below

<For MDS-C1-SP/SPH/SPX/SPHX>

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
zrtn	ptyp	od8x					phos			fdir	cdir	pyfx	rtrn	adin	fclx

bit		Meaning when set to 0	Meaning when set to 1	Standard
0	fclx	Closed loop	Semi-closed loop (Gear 1 : 1 only)	0
1	adin	Interpolation A/D compensation invalid	Interpolation A/D compensation valid	0
2	rtrn	Position monitor during ready OFF invalid	Position monitor during ready OFF valid	0
3	pyfx	Normal excitation	Position loop excitation fixed (strong)	0
4	cdir	Command polarity (+)	Command polarity (–)	0
5	fdir	Position detector polarity (+)	Position detector polarity (–)	0
6				0
7				0
8	phos	High-gain servo synchronous compensation invalid	High-gain servo synchronous compensation valid	1
9				0
A				0
B				0
C				0
D	od8x	Magnification of excessive error width × 8 times invalid	Magnification of excessive error width × 8 times valid	0
E	ptyp	Position control switch type: After zero point return	Position control switch type: After deceleration stop	0
F	zrtn	Zero point return direction: CCW	Zero point return direction: CW	0

(Note) Set 0 if there is no particular explanation for the bit.

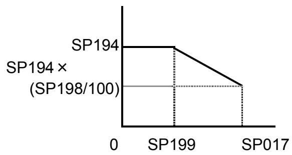
<For MDS-C1-SPM>

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
zrtn	ptyp	od8x					phos			fdir	cdir		rtrn		fclx

bit		Meaning when set to 0	Meaning when set to 1	Standard
0	fclx	Closed loop	Semi-closed loop (Gear 1 : 1 only)	0
1				0
2	rtrn	Position monitor during ready OFF invalid	Position monitor during ready OFF valid	0
3	pyfx			0
4	cdir	Command polarity (+)	Command polarity (–)	0
5	fdir	Position detector polarity (+)	Position detector polarity (–)	0
6				0
7				0
8	phos	High-gain servo synchronous compensation invalid	High-gain servo synchronous compensation valid	1
9				0
A				0
B				0
C				0
D	od8x	Magnification of excessive error width × 8 times invalid	Magnification of excessive error width × 8 times valid	0
E	ptyp	Position control switch type: After zero point return	Position control switch type: After deceleration stop	0
F	zrtn	Zero point return direction: CCW	Zero point return direction: CW	0

(Note) Set 0 if there is no particular explanation for the bit.

Parameters with an asterisk * in the abbreviation, such as OSP*, are validated with the NC power turned ON again.

No.	Abbr.	Parameter name	Details	Setting range (Unit)	Standard setting
SP194	VGTP*	Synchronized tapping control speed loop gain proportional term	Set the speed loop proportional gain in synchronized tapping control mode.	0 to 1000	63
SP195	VGTI*	Synchronized tapping control speed loop gain integral term	Set the speed loop integral gain in synchronized tapping control mode.	0 to 1000	60
SP196	VGTD*	Synchronized tapping control speed loop gain delay advance term	Set the speed loop delay advance gain in synchronized tapping control mode. When this parameter is set to "0", PI control is applied.	0 to 1000	15
SP197		Fixed control constant	Set by Mitsubishi. Set "0" unless designated in particular.	0	0
SP198	VCGT*	Synchronized tapping control target value of variable speed loop proportional gain	Set the magnification of speed loop proportional gain with respect to SP194 (VGTP) at the maximum motor speed defined in SP017 (TSP) in synchronized tapping control mode.	0 to 100 (%)	100
SP199	VCST*	Synchronized tapping control change starting speed of variable speed loop proportional gain	Set the speed where the speed loop proportional gain change starts during synchronized tapping control. 	0 to 32767 (r/min)	0
SP200	FFCI*	Synchronized tapping control acceleration feed forward gain (gear 1)	Set the acceleration feed forward gain for selection of gear 000 during synchronized tapping control. This parameter should be used when an error of relative position to Z-axis servo is large.	0 to 1000 (%)	0
SP201	FFC2*	Synchronized tapping control acceleration feed forward gain (gear 2)	Set the acceleration feed forward gain for selection of gear 001 during synchronized tapping control.	0 to 1000 (%)	0
SP202	FFC3*	Synchronized tapping control acceleration feed forward gain (gear 3)	Set the acceleration feed forward gain for selection of gear 010 during synchronized tapping control.	0 to 1000 (%)	0
SP203	FFC4*	Synchronized tapping control acceleration feed forward gain (gear 4)	Set the acceleration feed forward gain for selection of gear 011 during synchronized tapping control.	0 to 1000 (%)	0
SP204	THOD	Fixed control constant	Set by Mitsubishi. Set "0" unless designated in particular.	0	0
SP205	ZCHS	PLG Z-phase automatic adjustment	<For MDS-C1-SPM> This validates the PLG Z-phase automatic adjustment function	0 to 1	0 → 1
			<For MDS-C1-SP/SPH/SPX/SPHX> Not used. Set to "0".	0	0
SP206	GCK*	Fixed control constant	Set by Mitsubishi. Set "0" unless designated in particular.	0	0
SP207	GDL*	Fixed control constant	Set by Mitsubishi. Set "0" unless designated in particular.	0	0
SP208	W2	Fixed control constant	Set by Mitsubishi. Set "0" unless designated in particular.	0	0
SP209			Not used. Set to "0".	0	0
SP210			Not used. Set to "0".	0	0
SP211			Not used. Set to "0".	0	0
SP212			Not used. Set to "0".	0	0

Parameters with an asterisk * in the abbreviation, such as OSP*, are validated with the NC power turned ON again.

No.	Abbr.	Parameter name	Details	Setting range (Unit)	Standard setting
SP213	LPF	Low path filter	<For MDS-C1-SP/SPH/SPM> Set to reduce the noise generated from the spindle motor Set the band of the low path filter	0 to 2250 (rad/s)	0
			<For MDS-C1-SPX/SPHX> Not used. Set to "0".	0	0
SP214	TZRN	Synchronized tapping control zero point return speed	This parameter is valid when SP193 (SPECT)/bit E is set to "0". Set the zero point return speed used when the speed loop changes to the position loop.	0 to 500 (r/min)	50
SP215	TPDT	Synchronized tapping control zero point return deceleration rate	This parameter is valid when SP193 (SPECT)/bit E is set to "0". Set the deceleration rate where the machine starts to decelerate when it returns to the target stop point during synchronized tapping zero point return. When the machine tends to overshoot at the stop point set a smaller value.	0 to 10000 (pulse)	1
SP216	TPST	Synchronized tapping control zero point return shift amount	This parameter is valid when SP193 (SPECT)/bit E is set to "0". Set the synchronized tapping zero point position.	0 to 4095	0
SP217	TINP	Synchronized tapping control in-position width	Set the position error range for output of the in-position during synchronized tapping control.	1 to 2880 (1/16 deg)	16
SP218	TODR*	Synchronized tapping control excessive error width	Set the excessive error width during synchronized tapping.	0 to 32767 (pulse) (1 pulse = 0.088 deg)	32767
SP219	IQGT*	Synchronized tapping control current loop gain magnification 1	Set the magnification of current loop gain (torque component) during synchronized tapping control.	1 to 1000 (%)	100
SP220	IDGT*	Synchronized tapping control current loop gain magnification 2	Set the magnification of current loop gain (excitation component) during synchronized tapping control.	1 to 1000 (%)	100
SP221	PG2T	Synchronized tapping control position loop gain 2	Set the second position loop gain when high-gain control is applied during synchronized tapping control. When this parameter is not used, set to "0".	0 to 999 (rad/s)	0
SP222	PG3T	Synchronized tapping control position loop gain 3	Set the third position loop gain when high-gain control is applied during synchronized tapping control. When this parameter is not used, set to "0".	0 to 999 (rad/s)	0
SP223	SPDV	Speed monitor speed	Set the spindle limit speed in the door open state. (Invalid when 0 is set.) If the spindle end speed exceeds this setting value when the door is open, the speed monitor error (5E) will occur.	0 to 800 (r/min)	0
SP224	SPDF	Speed monitor time	Set the time (continuous) to detect alarms. (Detected instantly when 0 is set.)	0 to 2813 (3.5 ms)	0
SP225	OXKPH	Position loop gain magnification after orientation completed (H coil)	If gain changeover is valid (SP097: SPEC0/bitC=1) during orientation control, set the magnification of each gain changed to after orientation completed.	0 to 2560 (1/256-fold)	0
SP226	OXKPL	Position loop gain magnification after orientation completed (L coil)		0 to 2560 (1/256-fold)	0
SP227	OXVKP	Speed loop proportional gain magnification after orientation completed		0 to 2560 (1/256-fold)	0
SP228	OXVKI	Speed loop cumulative gain magnification after orientation completed		0 to 2560 (1/256-fold)	0

Parameters with an asterisk * in the abbreviation, such as OSP*, are validated with the NC power turned ON again.

No.	Abbr.	Parameter name	Details	Setting range (Unit)	Standard setting
SP229	OXSFT	Orientation virtual target shift amount	Set the amount to shift the target position when orientation virtual target position is valid (SP097: SPEC0/bitD=1).	0 to 2048 (360 deg/4096)	0
SP230	WIH	Iron loss compensation value	<For MDS-C1-SPH> Set the ratio of iron loss to all losses when temperature compensation considering iron loss is valid.	0 to 100 (%)	0
			<For MDS-C1-SP/SPX/SPHX/SPM> Not used. Set "0".	0	0
SP231	OL2T	Overload 2 time constant	<For MDS-C1-SPH> Set the primary-delay time constant to detect overload 2	0 to 60 (min)	0
			<For MDS-C1-SP/SPX/SPHX/SPM> Not used. Set "0".	0	0
SP232			Not used. Set "0".	0	0
SP233	JL*	Disturbance observer Load inertia rate	Set "the motor inertia + motor axis conversion load inertia" in respect to the motor inertia. SV037 (JL) = $\frac{Jl + Jm}{Jm} \times 100$ Jm : Motor inertia Jl : Motor axis conversion load inertia	0 to 5000 (%)	0
SP234	OBS1*	Disturbance observer low path filter frequency	Set the frequency of the low path filter for when the disturbance observer is valid.	0 to 1000 (rad/s)	0
SP235	OBS2*	Disturbance observer gain	Set the gain for the disturbance observer.	0 to 500 (%)	0
SP236	OBS3	Fixed control constant	Set by Mitsubishi. Set "0" unless designated in particular.	0	0
SP237	KSCP*	Spindle speed overrun judgment value	<For MDS-C1-SPM> The following value is judgment value for spindle speed overrun (alarm 3E). The speed command + SP237 × 0.125 [r/min]	0 to 32767 (r/min)	0
			<For MDS-C1-SP/SPH/SPX/SPHX> Not used. Set "0".	0	0
SP238	SE2R	Speed excessive deflection 2 detection range	<For MDS-C1-SPM> The following value is judgment value for speed excessive deflection 2 (alarm 3F). The speed command × SP238 / 100 [r/min]	0 to 100 (%)	0
			<For MDS-C1-SP/SPH/SPX/SPHX> Not used. Set "0".	0	0
SP239	SE2T	Speed excessive deflection 2 detection time	<For MDS-C1-SPM> Set the continuous detection time for speed excessive deflection 2 (alarm 3F).	0 to 3000	0
			<For MDS-C1-SP/SPH/SPX/SPHX> Not used. Set "0".	0	0
SP240	EXHS	PLG automatic adjustment (PJEX)	<For MDS-C1-SPX/SPHX> This validates the automatic adjustment function for the PLG connected to the MDS-B-PJEX.	0 to 1	0 → 1
			<For MDS-C1-SP/SPH/SPM> Not used. Set "0".	0	0
SP241	EXBIT	Spindle monitor changeover	<For MDS-C1-SPX/SPHX> This changes the spindle drive unit type, serial NO. and software version display. "0" Displays the details for the spindle drive unit. "1" Displays the details for the detector converter.	0 to 1	0
			<For MDS-C1-SP/SPH/SPM> Not used. Set "0".	0	0
SP242	Vavx	Fixed control constant	Set by Mitsubishi. Set "0" unless designated in particular.	0	0
SP243	UTTM	Fixed control constant	Set by Mitsubishi. Set "0" unless designated in particular.	0	0
SP244	OPLP	Fixed control constant	Set by Mitsubishi. Set "0" unless designated in particular.		

Parameters with an asterisk * in the abbreviation, such as OSP*, are validated with the NC power turned ON again.

No.	Abbr.	Parameter name	Details	Setting range (Unit)	Standard setting
SP245	PGHS	PLG automatic adjustment	<For MDS-C1-SP/SPH/SPM> This validates the automatic adjustment function for the PLG.	0 to 1	0 → 1
			<For MDS-C1-SPX/SPHX> Not used. Set "0".	0	0
SP246	TEST	Fixed control constant	Set by Mitsubishi. Set "0" unless designated in particular.	0	0
SP247			Not used. Set "0".	0	0
SP248			Not used. Set "0".	0	0
SP249	SMO	Speed meter speed	Set the motor rotation speed when the speed meter 10V is output. When set to "0", this parameter becomes the same as SP017 (TSP).	0 to 32767 (r/min)	0
SP250	LMO	Load meter voltage	Set the voltage when the load meter 120% is output. When set to "0", this becomes 10V.	0 to 10 (V)	0
SP251			Not used. Set "0".	0	0
SP252			Not used. Set "0".	0	0
SP253	DA1NO	D/A output channel 1 data number	Set the output data number for channel 1 of the D/A output function. When set to "0", the output is speedometer.	-32768 to 32767	0
SP254	DA2NO	D/A output channel 2 data number	Set the output data number for channel 2 of the D/A output function. When set to "0", the output is speedometer.	-32768 to 32767	0
SP255	DA1MPY	DA output channel 1 magnification	Set the data magnification for channel 1 of the D/A output function. The output magnification is the setting value divided by 256. When set to "0", the output magnification becomes 1-fold, in the same manner as when "256" is set.	-32768 to 32767 (1/256-fold)	0
SP256	DA2MPY	DA output channel 2 magnification	Set the data magnification for channel 2 of the D/A output function. The output magnification is the setting value divided by 256. When set to "0", the output magnification becomes 1-fold, in the same manner as when "256" is set.	-32768 to 32767 (1/256-fold)	0

Parameters with an asterisk * in the abbreviation, such as OSP*, are validated with the NC power turned ON again.

<For MDS-C1-SP/SPH/SPX/SPHX>

No.	Abbr.	Parameter name	Details	Setting range (Unit)	Standard setting
SP257 to SP320		Motor constant (H coil)	This parameter is valid only in the following two conditional cases: (a) In case that SP034 (SFNC2)/bit0=1 and SP034 (SFNC2)/bit2=0 Set the motor constants when using a special motor, not described in the SP040 (MTYP) explanation and when not using the coil changeover motor. (b) In case that SP034 (SFNC2)/bit0=1 and SP034 (SFNC2)/bit2=1 Set the motor constant of the H coil of the coil changeover motor. **(Note)** It is not allowed for the user to change the setting. (HEX setting)	0000 to FFFF	0000
SP321 to SP384		Motor constant (L coil)	This parameter is valid only in the following conditional case: (a) In case that SP034 (SFNC2)/bit0=1 and SP034 (SFNC2)/bit2=1 Set the motor constant of the L coil of the coil changeover motor. **(Note)** It is not allowed for the user to change the setting. (HEX setting)	0000 to FFFF	0000

All motor constant parameters are validated with the NC power turned ON again.

<For MDS-C1-SPM>

No.	Abbr.	Parameter name	Details	Setting range (Unit)	Standard setting
SP257 to SP296 SP312 to SP320		Motor constant (H coil)	This parameter is valid only in the following two conditional cases: (a) In case that SP034 (SFNC2)/bit0=1 and SP034 (SFNC2)/bit2=0 Set the motor constants when using a special motor, not described in the SP040 (MTYP) explanation and when not using the coil changeover motor. (b) In case that SP034 (SFNC2)/bit0=1 and SP034 (SFNC2)/bit2=1 Set the motor constant of the H coil of the coil changeover motor. **(Note)** It is not allowed for the user to change the setting. (HEX setting)	0000 to FFFF	0000
SP297 to SP311 SP363 to SP375		Motor constant (M coil)	This parameter is valid only in the following conditional case: (a) In case that SP034 (SFNC2)/bit0=1 and SP034 (SFNC2)/bit2=1 Set the motor constant of the M coil of the coil changeover motor. **(Note)** It is not allowed for the user to change the setting. (HEX setting)	0000 to FFFF	0000
SP321 to SP362 SP376 to SP384		Motor constant (L coil)	This parameter is valid only in the following conditional case: (a) In case that SP034 (SFNC2)/bit0=1 and SP034 (SFNC2)/bit2=1 Set the motor constant of the L coil of the coil changeover motor. **(Note)** It is not allowed for the user to change the setting. (HEX setting)	0000 to FFFF	0000

All motor constant parameters are validated with the NC power turned ON again.

3-6 Initial adjustment of the spindle PLG

3-6-1 Adjusting the PLG installation

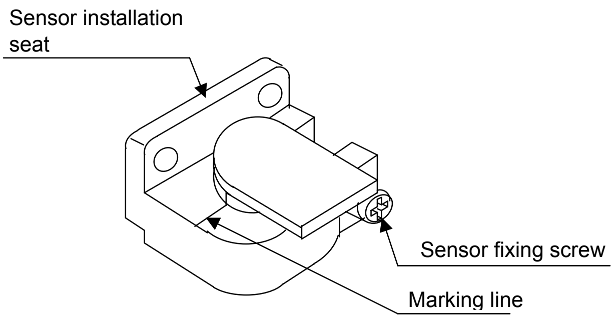
The PLG (spindle motor speed detector) mounted on the Mitsubishi framed spindle motor is shipped from Mitsubishi in the adjusted state. If there are no particular problems, carry out automatic adjustment "3-6-2 Automatic adjustment of Z phase" and "3-6-3 Automatic adjustment of motor end PLG" according to the spindle system.
When using the spindle end PLG for simple C-axis control or the built-in spindle, the PLG detector is installed by the user, so the PLG sensor's gap and output signal must be adjusted with the following procedures. After installing and adjusting these, carry out automatic adjustment of the PLG according to each system.
Install the PLG and then adjust following the procedures on the right. The output signal waveform can be retrieved from the check terminal on the PCB. Measure the waveform with an oscilloscope. The A/B phase output signal and the Z phase pulse width can be adjusted with the volume (VR1 to VR5) on the PCB. (The pulse width has been adjusted at shipment, and normally does not need to be adjusted.)

(1) Checking the gap
⇩
(2) Adjusting the gap
⇩
(3) Checking the A and B phase output signal
⇩
(4) Adjusting the A and B phase output signal
⇩
(5) Checking the Z phase pulse width
⇩
(6) Adjusting the Z phase pulse width
⇩
(7) Checking the Z phase and A phase difference
⇩
(8) Adjusting the Z phase and A phase difference

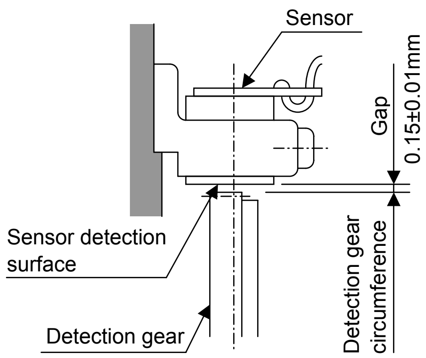
Flow of PLG installation and adjustment

(1) Checking the gap

Check that the gap between the sensor detection surface and detection gear circumference is within 0.15±0.01mm as shown below. The gap is adjusted before shipment, but an error could occur due to the effect of the dimensional difference of the notched fitting section provided for installation, or the dimensional difference of the detection gears' outer diameter. If deviated from the above range, adjust the gap following the section "(2) Adjusting the gap".



Sensor section



Gap with detection gear

(2) Adjusting the gap

[1] Confirm that the detection gears are not rotating. The sensor could be damaged if the gap is adjusted while the gears are rotating.
[2] Loosen the sensor fixing screw with the sensor fixed on the sensor installation seat.
[3] Using a clearance gauge, adjust so that the gap between the sensor detection surface and the detection gears' circumference is 0.15±0.01mm.
[4] The sensor can be moved up and down or turned when the sensor fixing screw is loosened. Position the rotating direction to match the marking line drawn on the sensor and installation seat.
[5] When done adjusting the gap, apply a locking agent on the sensor fixing screw, and then fix the sensor.
[6] After fixing the sensor, check the gap again. If operation is carried out with an excessively small gap, the sensor and gears could contact, and the sensor could be damaged.
[7] Faults could occur if an excessive external force is applied or if the sensor detection surface is damaged.

(3) Checking the A phase and B phase output signal

Check the output signal waveform by measuring the signals of the check terminals on the PCB with the DC range of the synchroscope.

A phase output signal........ Across A-G
B phase output signal........ Across B-G

The PLG reference speed when confirming the output signal waveform differs according to the number of output pulses. Refer to the following table for the reference speed for each number of pulses. If operation is not possible at the reference speed, operate at a low speed within the range in which the waveform can be confirmed.

Check terminal function

Check terminal	Signal name
A	A phase
B	B phase
Z	Z phase
G	Ground

Reference speed for A and B phase output signal confirmation

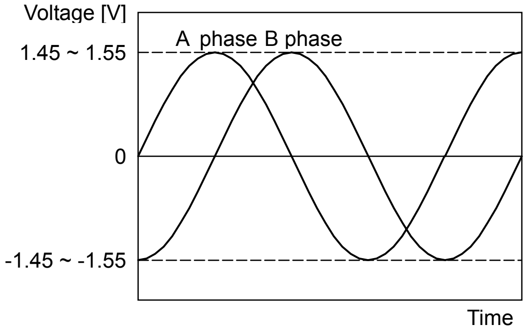
Number of detection gear teeth	Number of A and B phase pulses	Reference speed for signal confirmation
128	128	3600 r/min
180	180	2500 r/min
256	256	1800 r/min
512	512	1200 r/min

The output signal waveform is confirmed when the motor is run in the forward direction and reverse direction. The rotation directions are defined below.

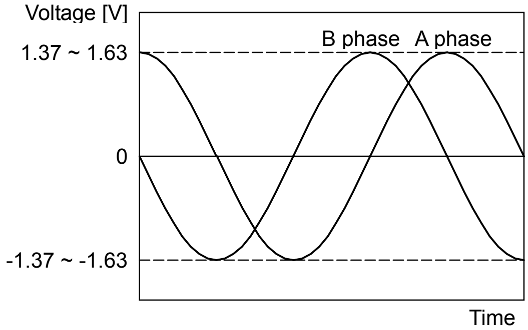
During forward run ... When the detection gears are rotating in the clockwise direction looking from the sensor lead side.

During reverse run ... When the detection gears are rotating in the counterclockwise direction looking from the sensor lead side.

The normal A and B phase output signal waveform when running at the reference speed is shown below. If the output signal waveform is not as shown below, refer to the next section "(4) Adjusting the A and B phase output signal" and adjust.



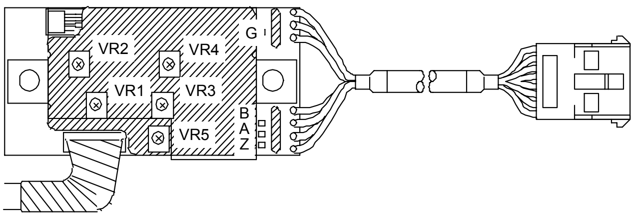
A phase/B phase output signal waveform during forward run



A phase/B phase output signal waveform during reverse run

(4) Adjusting the A phase and B phase output signal

[1] Set the drive unit in the open loop operation state. (Set the spindle parameter SP038/bitF to "1" and turn the NC power ON again.) There are cases when sudden speed changes cannot be followed during open loop operation, so gradually change the speed command.
[2] Forward run the motor and rotate the PLG at the reference speed.
[3] Using the PCB volume VR1 to VR4, adjust so that the A phase and B phase signals are within the specified range. If the correct waveform cannot be attained even after adjusting with VR1 to VR4, adjust the gap again.
[4] Reverse run the motor and rotate the PLG at the reference speed.
[5] Adjust the output waveform by adjusting VR1 to VR4 in the same manner.



PCB section

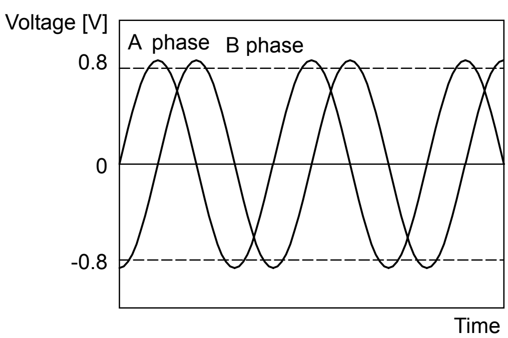
Volume function

Check terminal	Signal name
VR1	A phase offset adjustment
VR2	A phase gain adjustment
VR3	B phase offset adjustment
VR4	B phase gain adjustment
VR5	Z phase pulse width adjustment (Already adjusted before shipment)

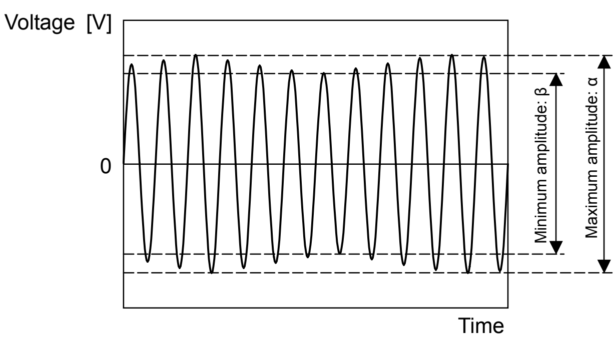
[6] Set the drive unit to the closed loop operation state (normal operation).
[7] Run the motor at the maximum speed, and confirm that the A phase and B phase output voltage peak value is larger than 0.8V on both the plus side and minus side during both forward run and reverse run.
[8] Run the motor at the reference speed, and confirm that the A phase and B phase output signal envelope is 0.4V or less.
The envelope is calculated by the expression below.

(Envelope) = (Maximum amplitude α) - (Minimum amplitude β)

[9] If the envelope is larger than the designated value, the deflection of the detection gears' outer diameter may be large, so check the deflection.



Example of A phase/B phase signal waveform during forward run at maximum speed



Definition of envelope

(5) Confirming the Z phase pulse width

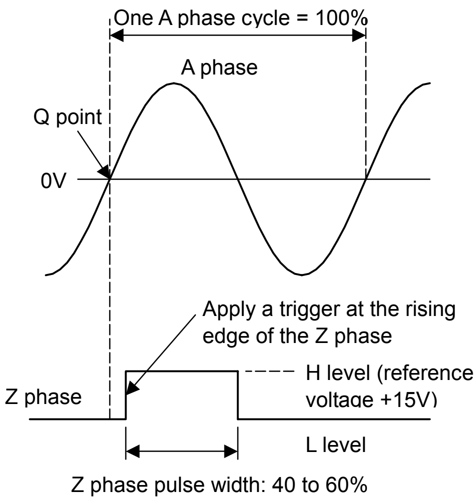
Check the output signal waveform by measuring the signals of the check terminals on the PCB with the DC range of the synchroscope.

A phase output signal........ Across A-G
Z phase output signal........ Across Z-G

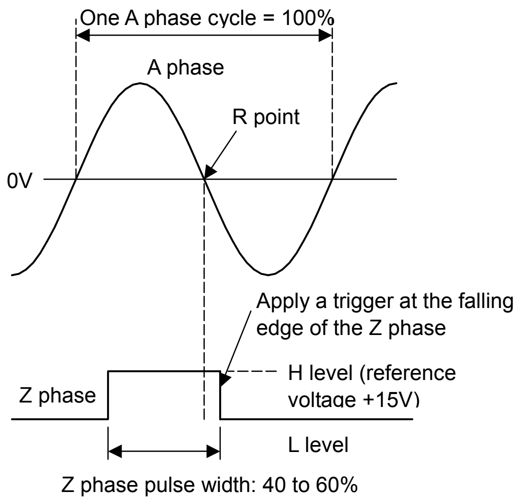
The output signal waveform is confirmed during motor forward run and reverse run. Set the synchroscope as follows to measure the waveform during each run direction.

During forward run .... Apply a trigger at the rising edge of the Z phase output signal
During reverse run .... Apply a trigger at the falling edge of the Z phase output signal

Confirm that the Z phase pulse width (time that the Z phase signal is at the "H" level = approx. 15V) is 40% or more and 60% or less, when one cycle of the A phase signal is calculated as 100%. The normal Z phase output signal waveform when run at the reference speed is shown below. If the output signal waveform is not as shown below, refer to the next section "(6) Adjusting the Z phase pulse width" and adjust.
The Z phase pulse width has been adjusted at shipment, with a combination of the sensor section and PCB section having the same serial No. Thus, it normally does not need to be adjusted. If a sensor section and PCB section having different serial numbers must be used, causing the Z phase pulse width to deviate from the specified range, carry out the adjustment.



A phase/Z phase output signal waveform during forward run



A phase/Z phase output signal waveform during reverse run

(6) Adjusting the Z phase pulse width

The Z phase pulse width can be adjusted with potentiometer VR5 on the PCB. VR5 is fixed after it has been tested and adjusted to match the sensor section and PCB section having the same serial No., so do not turn it unless a sensor section and PCB section with different serial numbers must be used.

(7) Checking the Z phase and A phase difference

Check the output signal waveform by measuring the signals of the check terminals on the PCB with the DC range of the synchroscope.

A phase output signal........ Across A-G
Z phase output signal........ Across Z-G

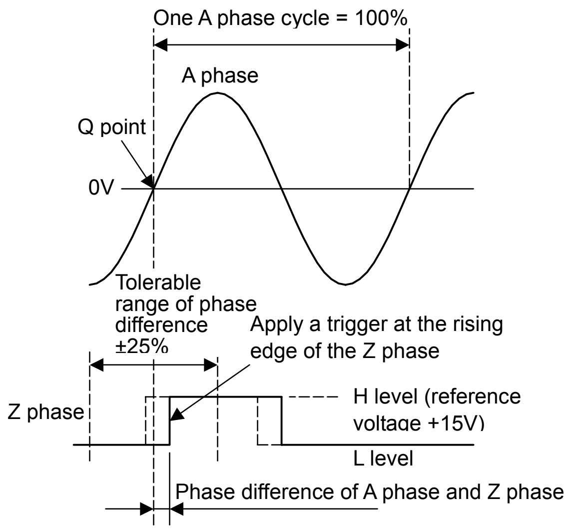
The output signal waveform is confirmed during motor forward run and reverse run. Set the synchroscope as follows to measure the waveform during each run direction.

During forward run .... Apply a trigger at the rising edge of the Z phase output signal
During reverse run .... Apply a trigger at the falling edge of the Z phase output signal

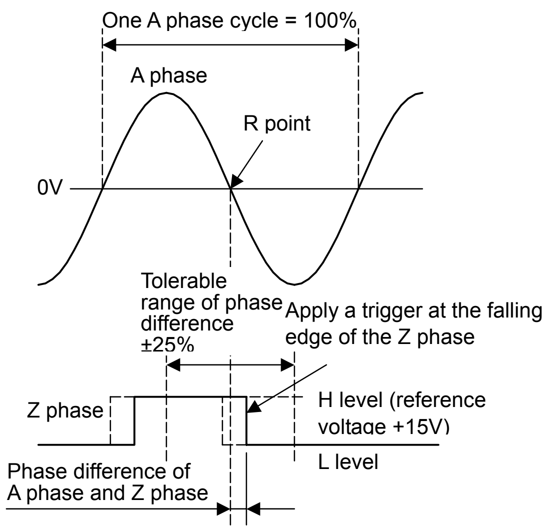
The phase difference for the Z phase signal and A phase signal is defined as follows.

During forward run .... Time difference between Z phase output signal rising edge and A phase output signal zero point (Q point)
During reverse run .... Time difference between Z phase output signal falling edge and A phase output signal's 1/2 cycle point (R point)

Confirm that the phase difference between the Z phase to the A phase is within ±25% during both forward and reverse run when one cycle of the A phase signal is calculated as100%. If the output signal waveform is not as shown below, refer to the next section "(8) Adjusting the Z phase and A phase difference" and adjust.



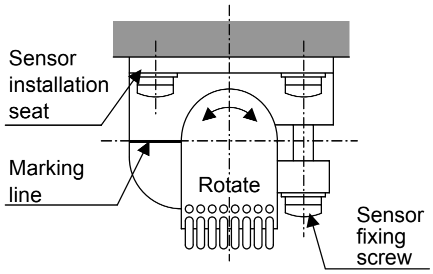
Confirming the Z phase signal phase difference during forward run



Confirming the Z phase signal phase difference during reverse run

(8) Adjusting the Z phase and A phase difference

[1] Stop the motor, and make sure that the detection gears are not rotating. The sensor could be damaged if adjustments are carried out while the gears are rotating.
[2] Using a clearance gauge, adjust so that the gap between the sensor direction surface and the detection gears' circumference is 0.15±0.01mm, and loosen the sensor fixing screw.
[3] The phase difference of the Z phase to the A phase can be adjusted by rotating the sensor as shown on the right. At this time, rotate the sensor a little bit while using the marking lines on the sensor and installation seat as a guide.
[4] Tighten the sensor fixing screw so that the sensor does not move, and confirm that the gap between the sensor detection surface and detection gears' circumference is 0.15 ± 0.01mm. Then, rotate the gears and confirm the phase difference as explained above.
[5] When the phase difference is within the tolerable range, apply a locking agent on the sensor fixing screw, and then fix the sensor. Check the gap again after fixing the sensor.



Adjusting the Z phase difference

Always carry out the initial automatic adjustment when starting the spindle system up for the first time or when the spindle drive unit has been replaced.

[1]MDS-C1-SPM : "3-6-2 Z-phase automatic adjustment" + "3-6-3 Motor end PLG automatic adjustment"
[2]MDS-C1-SP/SPH : "3-6-3 Motor end PLG automatic adjustment"
[3]MDS-C1-SPX/SPHX : "3-6-4 Spindle end PLG automatic adjustment"

3-6-2 Z phase automatic adjustment

Z-phase automatic adjustment is a function that automatically adjusts the relative position of the IPM spindle motor pole and the PLG Z-phase pulse signal input into the spindle drive unit. The adjustment data is saved in the drive unit, and is used to control the motor the next time the power is turned ON.
The motor cannot be started without completing this adjustment (alarm 16 will be detected), so always carry out this adjustment when starting up the spindle system, when the spindle motor has been replaced, when the PLG has been replaced or adjusted, or when the spindle drive unit has been replaced.

<Adjustment methods>

[1] If SP205 is set to 1, change it to 0, and reboot the NC power. If it is already set to 0, go to step [2].
[2] If the SP205 setting is 0, change it to 1.
[3] Input forward run start. The spindle motor will automatically rotate at the adjustment speed (two stages for Z-phase pulse detection and pole position detection). (The control output 4/bitD is changed to 1 on the NC spindle monitor screen from startup until a restart occurs. In the same manner, the control input 3/bit8 or bit9 status of 1 is established after the forward run start input, and "D" is displayed for the drive unit until automatic adjustment is completed.)
[4] The adjustment results will be calculated and the operation will automatically stop approx. 90 seconds after forward run is started (may vary according to pole position). (When automatic adjustment is completed, the drive unit display at the NC spindle monitor screen changes from "D" to "C". Even though the motor is stopped while "D" is displayed, automatic adjustment is in progress. Be sure to wait until "C" displays.)
[5] Turn forward run OFF. (The adjustment data will be saved.)
[6] Reboot the NC power.

No.	Abbr.	Parameter name	Details	Setting range (Unit)	Standard setting
SP205	ZCHS	PLG Z-phase automatic adjustment	<For MDS-C1-SPM> This validates the PLG Z-phase automatic adjustment function	0 to 1	0 → 1

POINT

1. If the NC power is turned ON when SP205 is set to 1, the adjustment data saved in the drive unit will be used for control.
2. To readjust, or to turn the start OFF during the automatic adjustment when "D" is displayed for the drive unit (see step [4] above), specify another SP205=0 setting to restart the NC, then perform the above procedure, beginning from step [2].
3. If operation is started without completing the adjustment, alarm 16 will occur.

⚠ CAUTION

1. The motor will automatically rotate at the adjustment speed during Z-phase automatic adjustment. Do not touch the rotating sections as this is hazardous.
2. Complete PLG adjustment before starting this adjustment. (Built-in motor)
3. Keep the spindle load inertia and friction load as small as possible when using this function. (The maximum inertia is approx. 5-fold the motor inertia.)

3-6-3 Motor end PLG automatic adjustment

Motor end PLG automatic adjustment is a function that automatically adjusts the gain and offset of the spindle motor built-in PLG's A and B phase sine wave signals which are input into the spindle drive unit. The adjustment data is saved in the drive unit, and is used to control the motor the next time the power is turned ON.

Always carry out this adjustment when starting up the spindle system, when the spindle motor has been replaced, when the PLG has been replaced or adjusted, or when the spindle drive unit has been replaced. This function is used to improve the accuracy of the position data.

When using the IPM motor (MDS-C1-SPM), complete the "3-6-1 Z-phase automatic adjustment" before starting this adjustment.

<Adjustment methods>

[1] If SP245 is set to 1, change it to 0, and turn the NC power ON again. If it is already set to 0, go to step [2].
[2] If the SP245 setting is 0, change it to 1.
[3] Input forward run start. The spindle motor will automatically rotate at the adjustment speed (two stages for offset adjustment and gain adjustment). (The control input 3/bit8 or bit9 is changed to 1 after the forward run start input, and "D" is displayed for the drive unit until automatic adjustment is completed. For C1-SPM, a control output 4/bitD status of 1 is established on the NC spindle monitor screen from startup until a restart occurs.)
[4] The adjustment results will be calculated and the operation will automatically stop several seconds after forward run is started. (When automatic adjustment is completed, the drive unit display at the NC spindle monitor screen changes from "D" to "C". Even though the motor is stopped while "D" is displayed, automatic adjustment is in progress. Be sure to wait until "C" displays.)
[5] Turn forward run OFF. (The adjustment data will be saved.)
[6] Turn the NC power ON again.

After completing the PLG adjustment, carry out trial operation, and confirm that there is no abnormal noise (knocking or scratching noise) during forward run or reverse run.

No.	Abbr.	Parameter name	Details	Setting range (Unit)	Standard setting
SP245	PGHS	PLG automatic adjustment	<For MDS-C1-SP/SPH/SPM> This validates the automatic adjustment function for the PLG	0 to 1	0 → 1

POINT

1. If the NC power is turned ON when SP245 is set to 1, the adjustment data saved in the drive unit will be used for control.
2. To readjust, or to turn the start OFF during the automatic adjustment (when "D" is displayed for the drive unit (see step [4] above)), specify another SP205=0 setting to restart the NC, then perform the above procedure, beginning from step [2].

⚠ CAUTION

1. The motor will automatically rotate at the adjustment speed during PLG automatic adjustment. Do not touch the rotating sections as this is hazardous.
2. Complete PLG adjustment before starting this adjustment. (Built-in motor)

3-6-4 Spindle end PLG automatic adjustment

Spindle end PLG automatic adjustment is a function that automatically adjusts the gain and offset of the A and B phase sine wave signals of the spindle end PLG used for C axis control which are input into the detector converter (MDS-B-PJEX) used in the MDS-C1- SPX/SPHX unit. The adjustment data is saved in the detector converter, and is used to control the motor the next time the power is turned ON.
Always carry out this adjustment when starting up the spindle system, when the spindle motor has been replaced, when the PLG has been replaced or readjusted, or when the detector converter has been replaced. This function is used to improve the accuracy of the position data.

<Adjustment methods>

[1] If SP240 is set to 1, change it to 0, and turn the NC power ON again. If it is already set to 0, go to step [2].
[2] If the SP240 setting is 0, change it to 1.
[3] Input forward run start. The spindle motor will automatically rotate at the adjustment speed (two stages for offset adjustment and gain adjustment). (The control input 3/bit8 or bit9 is changed to 1 after the forward run start input, and "D" is displayed for the drive unit until automatic adjustment is completed.)
[4] The adjustment results will be calculated and the operation will automatically stop several seconds after forward run is started. (When automatic adjustment is completed, the drive unit display at the NC spindle monitor screen changes from "D" to "C". Even though the motor is stopped while "D" is displayed, automatic adjustment is in progress. Be sure to wait until "C" displays.)
[5] Turn forward run OFF. (The adjustment data will be saved.)
[6] Turn the NC power ON again.

No.	Abbr.	Parameter name	Details	Setting range (Unit)	Standard setting
SP240	EXHS	PLG automatic adjustment (PJEX)	<For MDS-C1-SPX/SPHX> This validates the automatic adjustment function for the PLG connected to the MDS-B-PJEX.	0 to 1	0 → 1

POINT

1. If the NC power is turned ON when SP240 is set to 1, the adjustment data saved in the detector converter (MDS-B-PJEX) will be used for control.
2. To readjust, or to turn the start OFF during the automatic adjustment when "D" is displayed for the drive unit (see step [4] above), specify another SP205=0 setting to restart the NC, then perform the above procedure, beginning from step [2].

⚠ CAUTION

1. The motor will automatically rotate at the adjustment speed during PLG automatic adjustment. Do not touch the rotating sections as this is hazardous.
2. Complete PLG adjustment before starting this adjustment.

⚠ CAUTION	"Chapter 4 Servo adjustment" explains the methods when controlling with the high-gain specifications.

4-1 D/A output specifications for servo drive unit

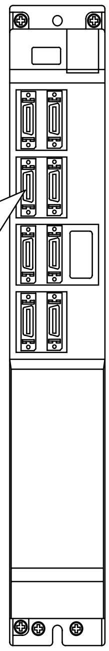
The MDS-C1-V1/V2 servo drive unit has a function to D/A output the various control data.
The servo adjustment data required for setting the servo parameters to match the machine can be D/A output. Measure using a hi-coder, oscilloscope, etc.

4-1-1 D/A output specifications

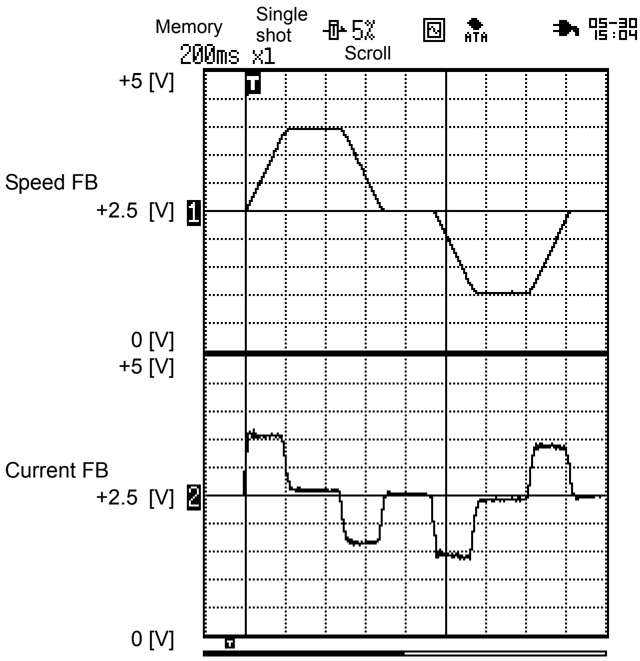
Item	Explanation
No. of channels	2ch
Output cycle	888µs (min. value)
Output precision	8bit
Output voltage range	0V to 2.5V (zero) to +5V
Output magnification setting	±1/256 to ±128-fold
Output pin	CN9 connector MO1 = Pin 9 MO2 = Pin 19 GND = Pins 1, 11
Function	Phase current feedback output function L axis U phase current FB : Pin 7 L axis V phase current FB : Pin 17 M axis U phase current FB : Pin 6 M axis V phase current FB : Pin 16
Others	The D/A output for the 2-axis unit (MDS-C1-V2) is also 2ch. When using the 2-axis unit, set -1 for the output data (SV061, 62) of the axis that is not to be measured.

CN9 connector

Pin	Name	Pin	Name
1	LG	11	LG
2		12	
3		13	
4		14	
5		15	
6	MUIFB	16	MVIFB
7	LUIFB	17	LVIFB
8		18	
9	MO1	19	MO2
10		20	



With the MDS-C1-V1/V2 Series, there is a 2.5V offset voltage (2.5V when data is 0), so the zero level position must be adjusted on the hi-corder side.



Example of D/A output waveform

4-1-2 Output data settings

No.	Abbrev.	Parameter name	Explanation
SV061	DA1NO	D/A output channel 1 data No.	Input the No. of the data to be output to each D/A output channel.
SV062	DA2NO	D/A output channel 2 data No.	

No.	Output data	Original data unit	Output magnification standard setting value (SV063, SV064)	Output unit for standard setting	Output cycle
-1	D/A output not selected	For 2-axis drive unit (MDS-C1-V2). Set the parameters to another axis in the drive unit that is not D/A output.			
0	ch1: Speed feedback	r/min	13 (2000r/min)	1000r/min/V	3.55ms
			9 (3000r/min)	1500r/min/V	3.55ms
	ch2: Current command	Stall %	131	Stall 100%/V	3.55ms
1	Current command	Stall %	131	Stall 100%/V	3.55ms
2	-				
3	Current feedback	Stall %	131	Stall 100%/V	3.55ms
4	-				
5	-				
6	Position droop	NC display unit/2	328 (Display unit = 1μm)	10μm/0.5V	3.55ms
7	-				
8	Feedrate (FΔT)	(NC disiplay unit/2)/ Communication cycle	55 (1μm, 3.5ms)	1000 (mm/min)/0.5V	3.55ms
9	-				
10	Position command	NC display unit/2	328 (Display unit = 1μm)	10μm/0.5V	3.55ms
11	-				
12	Position feedback	NC display unit/2	328 (Display unit = 1μm)	10μm/0.5V	3.55ms
13	-				
14	Collision detection estimated torque	Stall %	131	Stall 100%/V	3.55ms
15	Collision detection disturbance torque	Stall %	131	Stall 100%/V	3.55ms
64	Current command (high-speed)	Internal unit	8 (adjustments required)	-	888μs
65	Current feedback (high-speed)	Internal unit	8 (adjustments required)	-	888μs
77	Estimated disturbance torque	Internal unit	8 (adjustments required)	-	888μs
125	Test output saw tooth wave	0V to 5V	0 (256)	Cycle: 227.5ms	888μs
126	Test output oblong wave	0V to 5V	0 (256)	Cycle 1.7ms	888μs
127	Test output 2.5V (data 0)	2.5V	0 (256)	-	888μs

4-1-3 Setting the output magnification

Normally, set the standard setting value for the output scale (SV063, SV064). When "0" is set, the magnification will be the same as "256".

$$\text{DATA} \times \frac{\text{SV063}}{256} \times \frac{5\text{ [V]}}{256\text{ (8 bit)}} + 2.5\text{ [V] (Offset)} = \text{Output voltage [V]}$$

(Example) To output current FB with stall 100%/V unit (SV061=3, SV063=131)

$$100 \times \frac{131}{256} \times \frac{5}{256} + 2.5 = 3.499\text{ [V]}$$

No.	Abbrev.	Parameter name	Explanation	Setting range
SV063	DA1MPY	D/A output channel 1 output scale	Set the output magnification with a 1/256 unit. When "0" is set, the magnification will be the same as "256".	-32768 to 32767 (1/256-fold)
SV064	DA2MPY	D/A output channel 2 output scale		

4-2 Gain adjustment

4-2-1 Current loop gain

No.	Abbrev.	Parameter name	Explanation	Setting range
SV009	IQA	Current loop q axis lead compensation	Set the gain of current loop. As this setting is determined by the motor's electrical characteristics, the setting is fixed for each type of motor. Set the standard values for all the parameters depending on each motor type.	1 to 20480
SV010	IDA	Current loop d axis lead compensation		
SV011	IQG	Current loop q axis gain		1 to 8192
SV012	IDG	Current loop d axis gain		

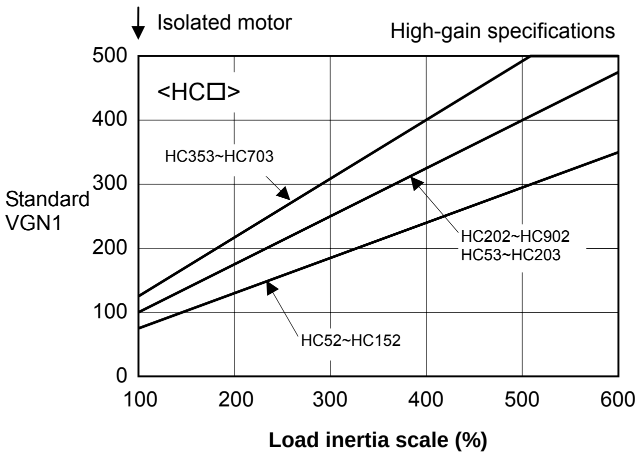
4-2-2 Speed loop gain

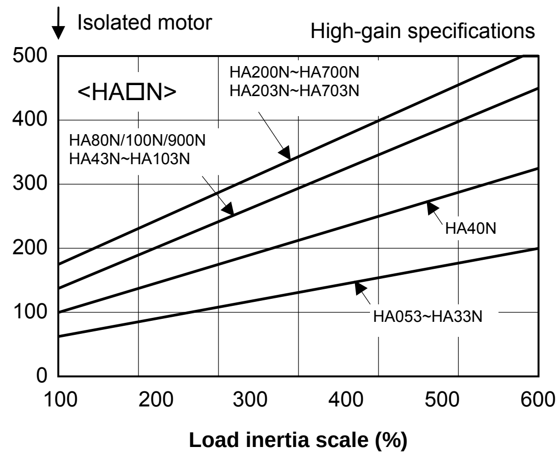
(1) Setting the speed loop gain

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 table and set the standard VGN1 according to the size of the entire load inertia (motor and machine load inertia).

[2] If the standard speed gain 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>

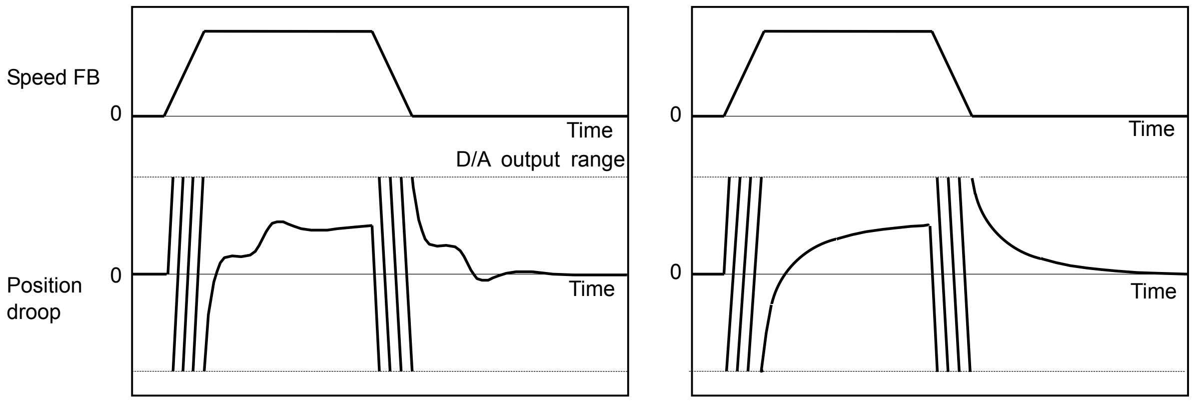
Machine resonance is occurring if the shaft makes abnormal sounds when operating or stopping, and a fine vibration can be felt when the machine is touched while stopped. Machine resonance occurs because the servo control responsiveness includes the machine resonance points. (Speed control resonance points 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 "4-3-2 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.

No.	Abbrev.	Parameter name	Explanation	Setting range
SV005	VGN1	Speed loop gain 1	Set the speed loop gain. Set this according to the load inertia size. 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%.	1 to 999

POINT	The final VGN1 setting value is 70 to 80% of the maximum value at which the machine does not resonate. Suppressing the resonance with the vibration suppression function and increasing the VGN1 setting is effective for adjusting the servo later.

(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.)



Vibration waveform with lead compensation control **Adjusted position droop waveform**

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.

No.	Abbrev.	Parameter name	Explanation	Setting range
SV008	VIA	Speed loop lead compensation	Set the gain of the speed loop integration control. The standard setting is "1364". During the SHG control, the standard setting is "1900". Adjust the value by increasing/decreasing it by about 100 at a time. Raise this value to improve contour tracking precision in high-speed cutting. Lower this value when the position droop vibrates (10 to 20Hz).	1 to 9999

POINT	Position droop vibration of 10Hz or less is not leading compensation control vibration. The position loop gain must be adjusted.

4-2-3 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. 47 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. To adjust the SHG control, gradually raise the gain from a setting where 1/2 of a normal control PGN1 where vibration did not occur was set in PGN1. 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.)

No.	Abbrev.	Parameter name	Explanation	Setting range
SV003	PGN1	Position loop gain 1	Set the position loop gain. The standard setting is "47". The higher the setting value is, the more precisely the command can be followed and the shorter the positioning time gets, however, note that a bigger shock is applied to the machine during acceleration/deceleration. When using the SHG control, also set SV004 (PGN2) and SV057 (SHGC).	1 to 200 (rad/s)
SV004	PGN2	Position loop gain 2	Set 0. (For SHG control)	0 to 999
SV057	SHGC	SHG control gain	Set 0. (For SHG control)	0 to 1200

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.

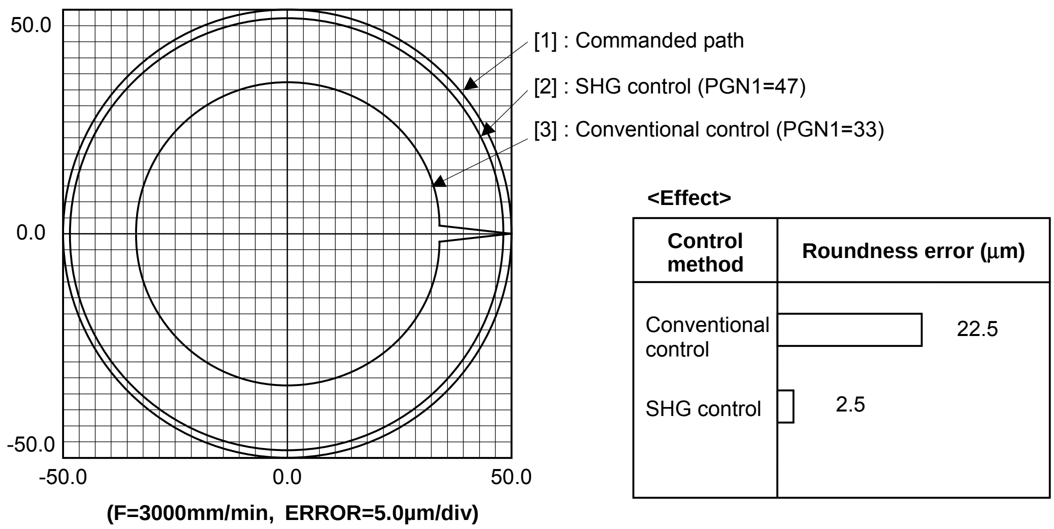
No.	Abbrev.	Parameter name	Explanation		Setting range
SV049	PGN1sp	Position loop gain 1 in spindle synchronous control	Set 15 as a standard.	Set the same parameter as the position loop gain for the spindle synchronous control.	1 to 200 (rad/s)
SV050	PGN2sp	Position loop gain 2 in spindle synchronous control	Set 0 as a standard. (For SHG control)		0 to 999
SV058	SHGCsp	SHG control gain in spindle synchronous control	Set 0 as a standard. (For SHG control)		0 to 1200

⚠ **CAUTION**	Always set the same value for the position loop gain between the spindle and servo synchronous axes.

(3) SHG control (option function)

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.

$$\text{PGN1} : \text{PGN2} : \text{SHGC} = 1 : \frac{8}{3} : 6$$

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.

No.	Abbrev.	Parameter name	Setting ratio	Setting example					Explanation	Setting range
SV003 (SV049)	PGN1 (PGN1sp)	Position loop gain 1	1	23	26	33	38	47	Always set with a combination of these three parameters.	1 to 200
SV004 (SV050)	PGN2 (PGN2sp)	Position loop gain 2	$\frac{8}{3}$	62	70	86	102	125		0 to 999
SV057 (SV058)	SHGC (SHGCsp)	SHG control gain	6	140	160	187	225	281		0 to 999
SV008	VIA	Speed loop lead compensation	Set 1900 as a standard for SHG control.							1 to 9999
SV015	FFC	Acceleration rate feed forward gain	Set 100 as a standard for SHG control.							0 to 999

POINT

The SHG control is an optional function. If the option is not set in the CNC, the alarm 37 (at power ON) or warning E4, Error Parameter No. 104 (2304 for M60S/E60 Series CNC) will be output.

4-3 Characteristics improvement

4-3-1 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.

(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 no 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∆T can be reduced.
(Adjustment) Set 1 (step) for the acceleration/deceleration time constant and carry out cutting feed reciprocation operation with no 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 current command value when adjusting acceleration/deceleration time constant

Motor model	Max. current command value	Motor model	Max. current command value	Motor model	Max. current command value
HC52	Within 388%	**HA053N**	Within 240%	**HA40N**	Within 400%
HC102	Within 340%	**HA13N**	Within 240%	**HA80N**	Within 365%
HC152	Within 380%	**HA23N**	Within 230%	**HA100N**	Within 260%
HC202	Within 275%	**HA33N**	Within 230%	**HA200N**	Within 225%
HC352	Within 251%			**HA300N**	Within 200%
HC452	Within 189%	**HA-LF11K2**	Within 215%	**HA700N**	Within 205%
HC702	Within 221%	**HA-LF15K2**	Within 240%	**HA900N**	Within 220%
HC902	Within 228%				
		HC452*	Within 242%	**HA43N**	Within 295%
HC53	Within 264%	**HC702***	Within 248%	**HA83N**	Within 275%
HC103	Within 257%	**HC902***	Within 228%	**HA103N**	Within 245%
HC153	Within 266%			**HA203N**	Within 210%
HC203	Within 257%	**HC353***	Within 242%	**HA303N**	Within 180%
HC353	Within 230%	**HC453***	Within 248%	**HA703N**	Within 180%
HC453	Within 177%	**HC703***	Within 228%		
HC703	Within 189%				

(Note) The motor indicated with an asterisk indicates the combination with the S-type drive unit.

(3) Adjusting the in-position width

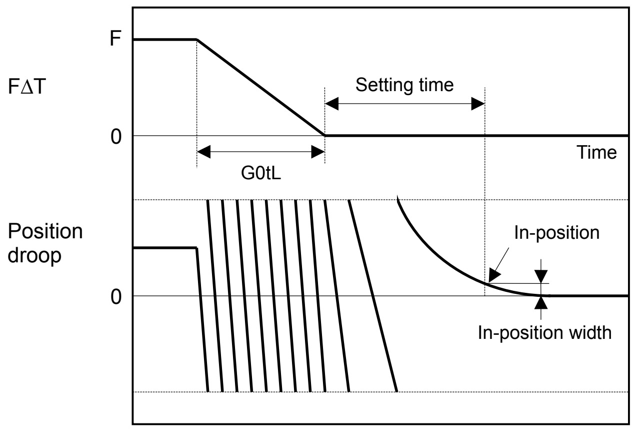
Because there is a response delay in the servomotor drive due to position loop control, a "settling time" is also required for the motor to actually stop after the command speed from the CNC reaches 0.
The movement command in the next block is generally started after it is confirmed that the machine 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.

No.	Abbrev.	Parameter name	Explanation	Setting range
SV024	INP	In-position detection width	Set the in-position detection width. Set the accuracy required for the machine. The lower the setting is, the higher the positioning accuracy gets, however, the cycle time (setting time) becomes longer. The standard setting is "50".	0 to 32767 (µm)

POINT The in-position width setting and confirmation availability depend on the CNC parameters.

(4) Adjusting the settling time

The settling time is the time required for the position droop to enter the in-position width after the feed command (FΔT) from the CNC reaches 0.
The settling time can be shortened by raising the position loop gain or using SHG control. However, a sufficient response (sufficiently large VGN1 setting) for the speed loop is required to carry out stable control.
The settling time during normal control when the CNC is set to linear acceleration/ deceleration can be calculated using the following equation. During SHG control, estimate the settling time by multiplying PGN1 by $\sqrt{2}$.



$$\text{Settling time (ms)} = -\frac{10^3}{\text{PGN1}} \cdot \ln\left\{\frac{\text{INP}}{\dfrac{F \times 10^6}{60 \times \text{G0tL} \times \text{PGN1}^2} \times \left[1 - \exp\left(\dfrac{\text{PGN1} \times \text{G0tL}}{10^3}\right)\right]}\right\}$$

PGN1 : Position loop gain1 (SV003) (rad/s)
F : Rapid traverse rate (mm/min)
G0tL : Rapid traverse linear acceleration/deceleration time constant (ms)
INP : In-position width (SV024) (µm)

4-3-2 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 "4-2-2 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.

POINT	Suppress the vibration using the vibration suppression functions, and maintain the speed loop gain (SV005: VGN1) as high as possible.

(1) Notch filter

This servo drive unit mounts 5 notch filters. Measure the resonance frequency with 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.

<table>
<tr><th>No.</th><th>Abbrev.</th><th>Parameter name</th><th>Explanation</th><th>Setting range</th></tr>
<tr><td>SV033</td><td>SSF2</td><td>Servo function selection 2</td><td colspan="2">
<table>
<tr><td>F</td><td>E</td><td>D</td><td>C</td><td>B</td><td>A</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td>hvx</td><td>svx</td><td colspan="3">nfd2</td><td>nf3</td><td colspan="3">nfd1</td><td>zck</td></tr>
</table>
<table>
<tr><th colspan="2">bit</th><th>Meaning when "0" is set</th><th>Meaning when "1" is set</th></tr>
<tr><td>1
2
3</td><td>nfd1</td><td colspan="2">Set the filter depth for Notch filter 1 (SV038).
Value 000 001 010 011 100 101 110 111
Depth (dB) Infntly deep -18.1 -12.0 -8.5 -6.0 -4.1 -2.5 -1.2
Deep← Shallow→</td></tr>
<tr><td>4</td><td>nf3</td><td>Notch filter 3 stop</td><td>Notch filter 3 start (1125Hz)</td></tr>
<tr><td>5
6
7</td><td>nfd2</td><td colspan="2">Set the filter depth of Notch filter 2 (SV046).
Value 000 001 010 011 100 101 110 111
Depth (dB) Infntly deep -18.1 -12.0 -8.5 -6.0 -4.1 -2.5 -1.2
Deep← Shallow→</td></tr>
</table>
</td></tr>
<tr><td>SV038</td><td>FHz1</td><td>Notch filter frequency 1</td><td>Set the vibration frequency to suppress if machine vibration occurs.
(Valid at 36 or more) When not using, set to "0".</td><td>0 to 9000 (Hz)</td></tr>
<tr><td>SV046</td><td>FHz2</td><td>Notch filter frequency 2</td><td>Set the vibration frequency to suppress if machine vibration occurs.
(Valid at 36 or more) When not using, set to "0".</td><td>0 to 9000 (Hz)</td></tr>
<tr><td>SV083</td><td>SSF6</td><td>Servo function selection 6</td><td colspan="2">
<table>
<tr><td>F</td><td>E</td><td>D</td><td>C</td><td>B</td><td>A</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td>hvx</td><td>svx</td><td colspan="3">nfd2</td><td>nf3</td><td colspan="3">nfd1</td><td>zck</td></tr>
</table>
<table>
<tr><th colspan="2">bit</th><th>Meaning when "0" is set</th><th>Meaning when "1" is set</th></tr>
<tr><td>1
2
3</td><td>nfd4</td><td colspan="2">Set the filter depth for Notch filter 4 (SV038).
Value 000 001 010 011 100 101 110 111
Depth (dB) -∞ -18.1 -12.0 -8.5 -6.0 -4.1 -2.5 -1.2
Deep← Shallow→</td></tr>
<tr><td>5
6
7</td><td>nfd5</td><td colspan="2">Set the filter depth for Notch filter 5 (SV046).
Value 000 001 010 011 100 101 110 111
Depth (dB) -∞ -18.1 -12.0 -8.5 -6.0 -4.1 -2.5 -1.2
Deep← Shallow→</td></tr>
</table>
</td></tr>
<tr><td>SV087</td><td>FHz4</td><td>Notch filter frequency 4</td><td rowspan="2">Set the vibration frequency to suppress if machine vibration occurs.
(Valid at 141 or more) When not using, set to "0".
To use this function, set to not "0" (normally "1") when turning the power ON. This function cannot be used with adaptive filter.</td><td>0 to 2250 (Hz)</td></tr>
<tr><td>SV088</td><td>FHz5</td><td>Notch filter frequency 5</td><td>0 to 2250 (Hz)</td></tr>
</table>

(2) 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.

(3) Adaptive filter

The servo drive unit detects the machine resonance point and automatically sets the filter constant. Even if the ball screw and table position relation changes causing the resonance point to change, the filter will track these changes. If the sensitivity to detect the vibration is insufficient and the effect of the filter is not apparent, increase the sensitivity (SV027/bitC, D). The filter coefficient is recalculated when the power is turned ON again, so vibration may occur temporarily.
Notch filter 4 and notch filter 5 cannot be used together.

No.	Abbrev.	Parameter name	Explanation
SV027	SSF1	Servo function selection 1	(see below)

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
aflt	zrn2	afse		ovs		lmc		omr	zrn3	vfct			upc	vcnt	

<Jitter compensation> Removal of vibration when motor is stopped

bit		Explanation	
4 5	vfct	Set the number of compensation pulses of the jitter compensation. 00: Jitter compensation invalid 01: Jitter compensation 1 pulse	 10: Jitter compensation 2 pulses 11: Jitter compensation 3 pulses

<Adaptive filter>

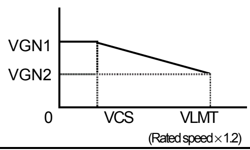
bit		Meaning when "0" is set	Meaning when "1" is set
C D	afse	00: Adaptive filter sensitivity standard 11: Adaptive filter sensitivity increase (Set 2bits at a time)	
E	zrn2	Set to "1".	
F	aflt	Adaptive filter stop	Adaptive filter start

POINT

Jitter compensation vibration suppression is only effective when the motor is stopped.

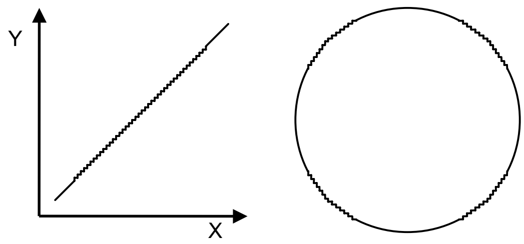
(4) Variable speed loop gain control

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.

No.	Abbrev.	Parameter name	Explanation	Setting range
SV005	VGN1	Speed loop gain 1	Set the speed loop gain. Set this according to the load inertia size. 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 be 70 to 80% of the value at the time when the vibration stops.	1 to 999
SV006	VGN2	Speed loop gain 2	If the noise is bothersome at high speed during rapid traverse, etc, lower the speed loop gain. As in the right figure, set the speed loop gain of the speed 1.2 times as fast as the motor's rated speed, and use this with SV029 (VCS). When not using, set to "0". 	-1000 to 1000
SV029	VCS	Speed at the change of speed loop gain	If the noise is bothersome at high speed during rapid traverse, etc, lower the speed loop gain. Set the speed at which the speed loop gain changes, and use this with SV006 (VGN2). (Refer to SV006.) When not using, set to "0".	0 to 9999 (r/min)

4-3-3 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 "4-2-2 (1) Setting the speed loop gain")

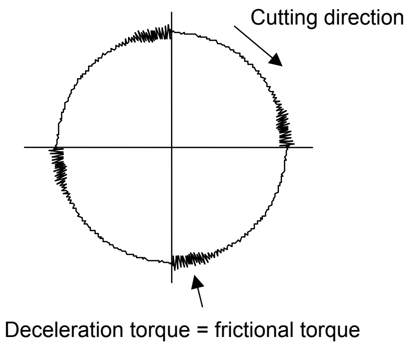
(2) Adjusting the speed loop leading compensation (VIA)

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 "4-2-2 (2) Setting the speed loop leading compensation")

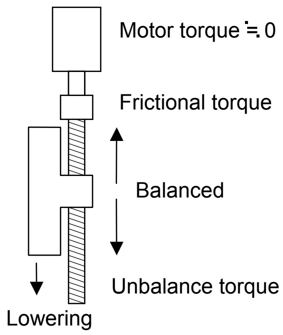
No.	Abbrev.	Parameter name	Explanation	Setting range
SV005	VGN1	Speed loop gain 1	Set the speed loop gain. Set this according to the load inertia size. The higher the setting value is, the more accurate the control will be, however, vibration tends to occur. If vibration occurs, adjust by lowering by 20 to 30%. The value should be determined to be 70 to 80% of the value at the time when the vibration stops.	1 to 999
SV008	VIA	Speed loop lead compensation	Set the gain of the speed loop integration control. The standard setting is "1364". During the SHG control, the standard setting is "1900". Adjust the value by increasing/decreasing it by about 100 at a time. Raise this value to improve contour tracking precision in high-speed cutting. Lower this value when the position droop vibrates (10 to 20Hz).	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.



For circle cutting



For unbalance torque

No.	Abbrev.	Parameter name	Explanation	Setting range
SV030	IVC	Voltage dead time compensation	When 100% is set, the voltage equivalent to the logical non-energized time will be compensated. When "0" is set, a 100% compensation will be performed. Adjust in increments of 10% from the default value 100%. If increased too much, vibration or vibration noise may be generated.	0 to 200 (%)

(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] Set SV082/bit7=1.
[2] Adjust VGN1 to the value where vibration does not occur, and then lower it 10 to 20%.
[3] Set the load inertia scale (SV037: JL) with a percentage in respect to the motor inertia of the total load inertia.
(Refer to next page for measuring the motor shaft conversion load inertia ratio.)
[4] 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.
[5] 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.

<table>
<tr><th>No.</th><th>Abbrev.</th><th>Parameter name</th><th>Explanation</th><th>Setting range</th></tr>
<tr><td>SV037</td><td>JL</td><td>Load inertia scale</td><td>Set "the motor inertia + motor axis conversion load inertia" in respect to the motor inertia.
$SV037\ (JL) = \frac{Jl + Jm}{Jm} \times 100$
Jm : Motor inertia
Jl : Motor axis conversion load inertia</td><td>0 to 5000
(%)</td></tr>
<tr><td>SV043</td><td>OBS1</td><td>Disturbance observer filter frequency</td><td>Set the disturbance observer filter band.
Set to "100" as a standard.
To use the disturbance observer, also set SV037 (JL) and SV044 (OBS2).
When not using, set to "0".</td><td>0 to 1000
(rad/s)</td></tr>
<tr><td>SV044</td><td>OBS2</td><td>Disturbance observer gain</td><td>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 not using, set to "0".</td><td>0 to 500
(%)</td></tr>
<tr><td>SV082</td><td>SSF5</td><td>Servo function selection5</td><td colspan="2">
<table>
<tr><td>F</td><td>E</td><td>D</td><td>C</td><td>B</td><td>A</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>obshj</td><td></td><td></td><td></td><td></td><td></td><td>lmc3</td><td>lmct</td></tr>
</table>
<table>
<tr><th colspan="2">bit</th><th>Meaning when "0" is set</th><th>Meaning when "1" is set</th></tr>
<tr><td>7</td><td>obshj</td><td>Normal use</td><td>Disturbance observer
High-load inertia compatible control</td></tr>
</table>
</td></tr>
</table>

POINT

1. The estimated disturbance torque can be output to the D/A output even if the disturbance observer gain is zero (OBS2 = 0), and the disturbance observer is not functioning.
2. Sections where the machine is not moving smoothly can be estimated as the disturbance.
3. The lost motion compensation must be readjusted when the disturbance observer is started.
4. SV082/bit7 is the characteristics improvement function when load inertia is large. SV082/bit7 can be set when load inertia is small, also.

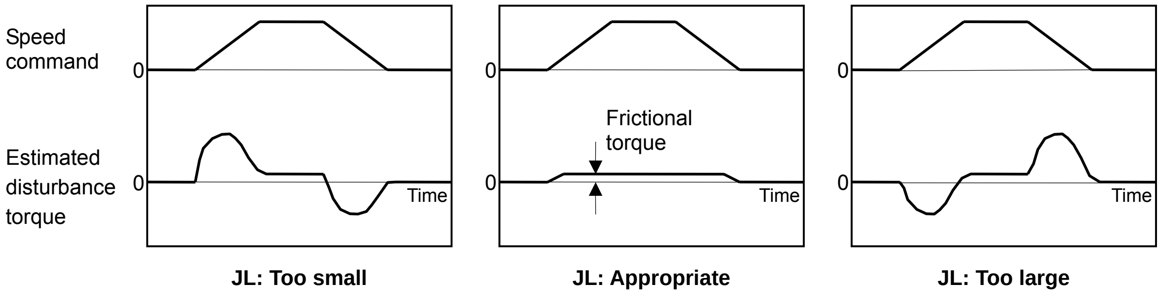
<Measuring the load inertia>

If the load inertia is not clear, it can be estimated with the following method.

[1] Set the torque offset (SV032: TOF) for the unbalance torque. (Refer to "4-3-5 (1) Unbalance torque and frictional torque".)

[2] Set JL = 100, OBS1 = 600 and OBS2 =0, and reciprocate the axis within the range that it can be moved smoothly. Set the acceleration/deceleration time constant so that the acceleration/deceleration torque is larger than the stall (rated) torque (100% or more).

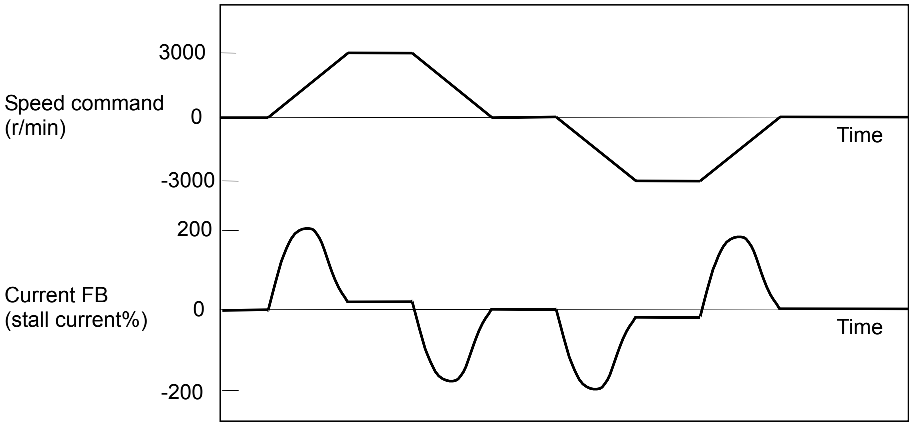
[3] Measure the estimated disturbance torque with the D/A output, and raise JL until the disturbance torque during acceleration/deceleration is small (until it cannot be observed). Even if the torque offset is set and JL is an appropriate value, if the axis has a large friction, the frictional torque will remain in the estimated disturbance torque. Judge the JL setting value, with frictional torque remaining, as the machine's load inertia scale as shown below.



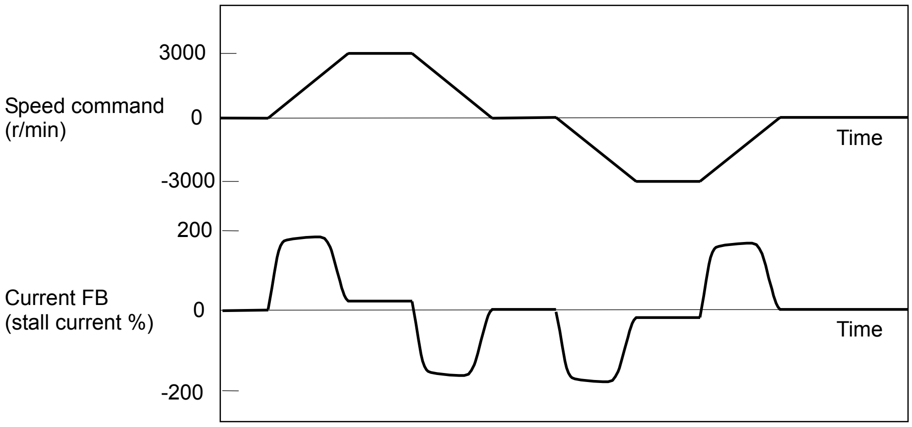
4-3-4 Improvement of characteristics during acceleration/deceleration

(1) SHG control (option function)

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 "4-2-3 Position loop gain" for details on setting SHG control.



Acceleration/deceleration characteristics during conventional control



Acceleration/deceleration characteristics during SHG control

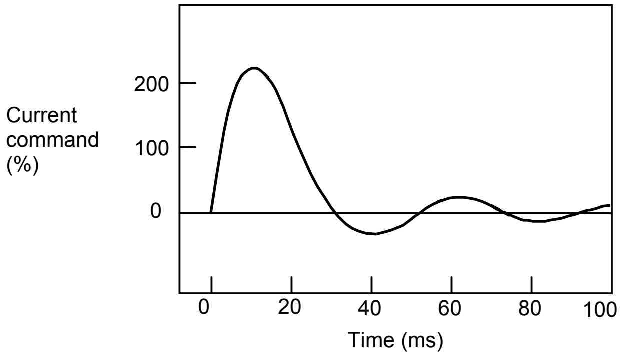
No.	Abbrev.	Parameter name	Setting ratio	Setting example					Explanation	Setting range
SV003 (SV049)	PGN1 (PGN1sp)	Position loop gain 1	1	23	26	33	38	47	Always set with a combination of these three parameters.	1 to 200
SV004 (SV050)	PGN2 (PGN2sp)	Position loop gain 2	$\frac{8}{3}$	62	70	86	102	125		0 to 999
SV057 (SV058)	SHGC (SHGCsp)	SHG control gain	6	140	160	187	225	281		0 to 1200
SV008	VIA	Speed loop lead compensation	Set 1900 as a standard value during SHG control.							1 to 9999
SV015	FFC	Acceleration rate feed forward gain	Set 100 as a standard value during SHG control.							0 to 999

POINT

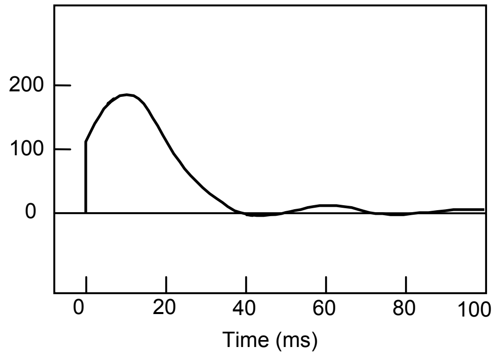
SHG control is an option function. If the option is not set in the NC, alarm 37 (at power ON), or warning E4 and error parameter No. 104 (2304 for M60S/E60 Series NC) will be output.

(2) 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.



No FFC setting



With 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).

No.	Abbrev.	Parameter name	Explanation	Setting range
SV015	FFC	Acceleration rate feed forward gain	When a relative error in the synchronous control is large, apply this parameter to the axis that is delaying. The standard setting value is "0". For the SHG control, set to "100". To adjust a relative error in acceleration/deceleration, increase the value by 50 to 100 at a time.	0 to 999 (%)

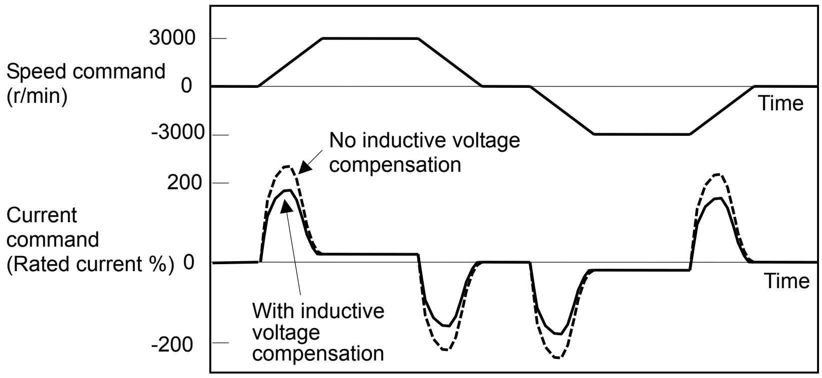
POINT Overshooting occurs easily when a value above the standard value is set during SHG control.

(3) 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>

1. While accelerating/decelerating at rapid traverse, adjust the inductive voltage compensation gain (SV047: EC) so that the current FB peak is a few % smaller than the current command peak.



Inductive voltage compensation

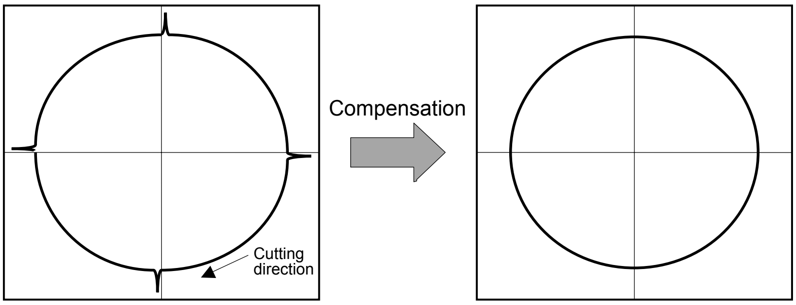
No.	Abbrev.	Parameter name	Explanation	Setting range
SV047	EC	Inductive voltage compensation gain	Set the inductive voltage compensation gain. Set to "100" as a standard. If the current FB peak exceeds the current command peak, lower the gain.	0 to 200 (%)

POINT

If the current FB peak becomes larger than the current command peak (over compensation), an overcurrent (alarm 3A) will occur easily. Note that over compensation will occur easily if the load inertia is large.

4-3-5 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.



Circle cutting path before compensation **Circle cutting path after compensation**

DBB: Double Ball Bar

The following three compensation types are available for lost motion compensation (LMC compensation).

[1] LMC compensation type 1
This is a backward compatible (for older models) compensation type. Either type 2 or type 3 should be used on new models.

[2] LMC compensation type 2
Performs servo internal PI control response delay compensation for the frictional torque reversing condition that occurs during servo reverse travel. Reverse response delay is compensated with adding the torque command set by parameter when a speed and direction change occurs.
LMC compensation type 2 adjustments should be performed with reference to the following items.
(1) Unbalance torque and frictional torque
(2) LMC compensation type 2 setting and adjustment
(3) Lost motion compensation timing adjustment
(4) Adjustment at feed forward control

[3] 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 end roundness measurement.
LMC compensation type 3 adjustments should be performed with reference to the following items.
(1) Unbalance torque and frictional torque
(2) LMC compensation type 3 setting and adjustment

(1) 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.

$$\text{Unbalance torque (\%)} = \frac{(\text{+ feed load current \%}) + (\text{- feed load current \%})}{2}$$

$$\text{Frictional torque (\%)} = \frac{\left|(\text{+ feed load current \%}) - (\text{- feed load current \%})\right|}{2}$$

(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.

$$\text{Unbalance torque (\%)} = \frac{(-55) + (-25)}{2} = -40\%$$

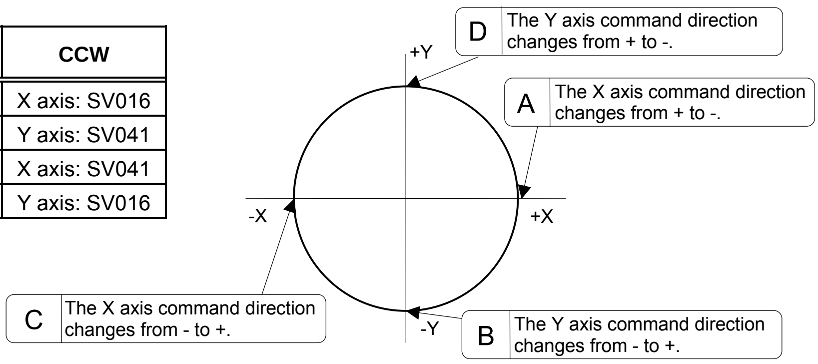
$$\text{Friction torque (\%)} = \frac{\left|(-55) - (-25)\right|}{2} = 15\%$$

(2) Setting and adjusting LMC compensation type 2

<Setting method>

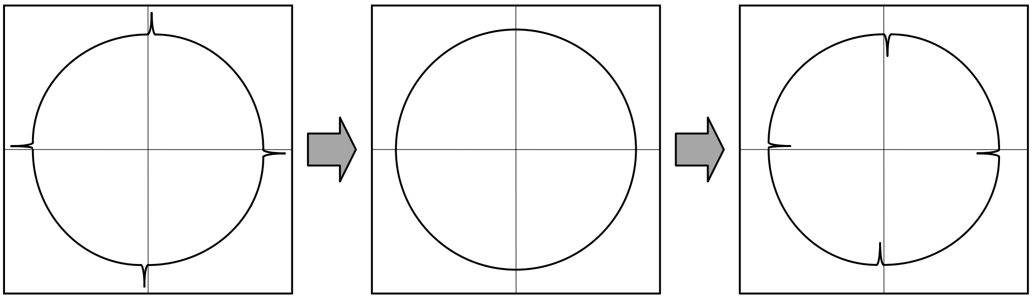
[1] Set the servo function selection 1 (SV027)/bit 9. (The LMC compensation type 2 will start).
[2] Set unbalance torque to the torque offset (SV032).
[3] Set a value double the friction torque to the lost motion compensation 1 (SV016). The SV016 setting value will be used for compensation in the positive and negative directions when the lost motion compensation 2 (SV041) is 0.
[4] Set 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.

Compensation point	CW	CCW
A	X axis: SV041	X axis: SV016
B	Y axis: SV016	Y axis: SV041
C	X axis: SV016	X axis: SV041
D	Y axis: SV041	Y axis: SV016



<Adjustment method>

Perform the final adjustment, carrying out the NC sampling measurement (DBB measurement) or actual cutting. If the compensation amount is insufficient, increase LMC1 or LMC2 by 5% at a time. Note that if the setting is too high, biting may occur.



Compensation 0 **Optimum** **Too high**

No.	Abbrev.	Parameter name	Explanation	Setting range
SV016	LMC1	Lost motion compensation 1	Set the compensation amount based on the stall (rated) current of the motor. The standard setting is double of the friction torque. Setting to "0" means the compensation amount is zero.	-1 to 200 (Stall [rated] current %)
SV041	LMC2	Lost motion compensation 2	Set this with SV016 (LMC1) only when you wish to set the lost motion compensation amount to be different depending on the command directions. Set to "0" as a standard.	-1 to 200 (Stall [rated] current %)
SV032	TOF	Torque offset	This setting is specified when using lost motion compensation. Set the unbalance torque of vertical axis and inclined axis.	-100 to 100 (Stall [rated] current %)
SV027	SSF1	Servo function selection 1	(see bit tables below)	

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
aflt	zrn2	afse		ovs		lmc		omr	zrn3	vfct			upc	vcnt	

bit		Meaning when "0" is set	Meaning when "1" is set
8	lmc	Set the compensation amount with SV016 (LMC1) and SV041 (LMC2).	
9		00: Lost motion compensation stop	10: Lost motion compensation type 2
		01: Lost motion compensation type 1	11: Setting prohibited

POINT

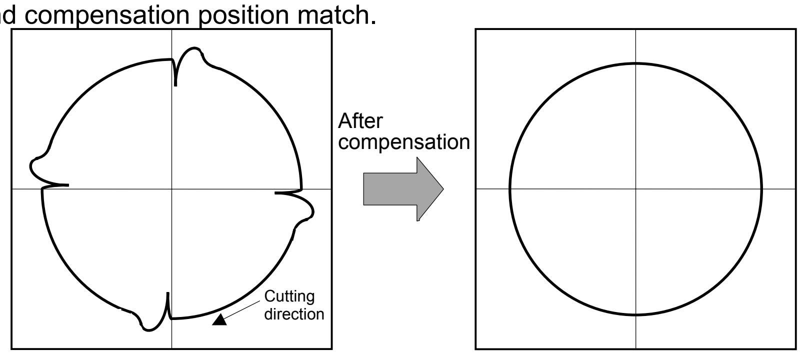
1. Set SV082/bit1=0 when using LMC compensation type 2.
2. When either parameter SV016: LMC1 or SV041: LMC2 is set to 0, the same amount of compensation is carried out in both the positive and negative direction with the setting value of the other parameter (the parameter not set to 0).
3. When the protrusion amount varies according to direction, use LMC2 to adjust it. For compensation in one direction only, set "-1" at the parameter (LMC1 or LMC2) for the direction in which compensation is prohibited.
4. Even if a TOF is set, the motor's torque output characteristics and the load current displayed at the NC servo monitor will remain unchanged. Only the LMC compensation is affected.
5. The value set based on the friction torque is the standard value for LMC compensation. The optimum compensation value changes with the cutting conditions (cutting speed, cutting radius, blade type, workpiece material, etc.). Be sure to ultimately make test cuts matching the target cutting and determine the compensation amount.

(3) Adjusting the lost motion compensation timing

If the speed loop gain has been lowered from the standard setting value because the machine rigidity is low or because machine resonance occurs easily, or when cutting at high speeds, the quadrant protrusion may appear later than the quadrant changeover point on the servo control. In this case, suppress the quadrant protrusion by setting the lost motion compensation timing (SV039: LMCD) to delay the LMC compensation.

<Adjustment method>

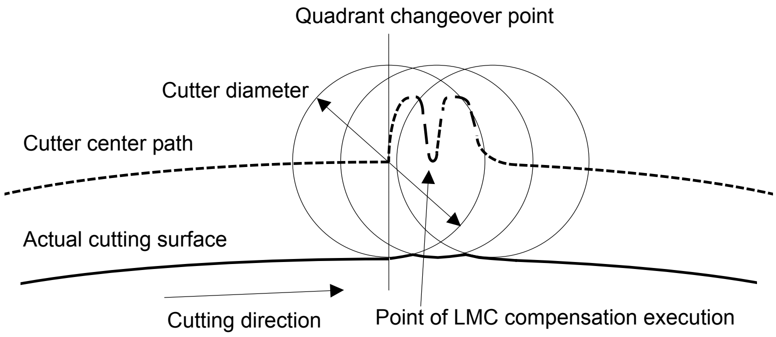
If a delay occurs in the quadrant protrusion in the circle or arc cutting as shown below in respect to the cutting direction when CNC sampling measurement (DBB measurement) or actual cutting is carried out, and the compensation appears before the protrusion position, set the lost motion compensation timing (SV039: LMCD).
While measuring the arc path, increase LMCD by 10 ms at a time, to find the timing that the protrusion and compensation position match.



Before timing delay compensation **After timing delay compensation**

No.	Abbrev.	Parameter name	Explanation	Setting range
SV039	LMCD	Lost motion compensation timing	Set this when the lost motion compensation timing does not match. Adjust while increasing the value by 10 at a time.	0 to 2000 (ms)

When the LMCD is gradually raised, a two-peaked contour may occur at the motor FB position DBB measurement. However, due to the influence of the cutter diameter in cutting such as end milling, the actual cutting surface becomes smooth.
Because satisfactory cutting can be achieved even if this two-peaked contour occurs, consider the point where the protrusion becomes the smallest and finest possible without over compensating (bite-in) as the optimum setting.



(4) Adjusting for feed forward control

In LMC compensation, a model position considering the position loop gain is calculated based on the position command sent from the CNC, and compensation is carried out when the feed changes to that direction. When the CNC carries out feed forward (fwd) control, overshooting equivalent to the operation fraction unit occurs in the position commands, and the timing of the model position direction change may be mistaken. As a result, the LMC compensation timing may deviate, or compensation may be carried out twice or more.
If feed forward control is carried out and the compensation does not operate correctly, adjust with the non-sensitive band (SV040 (LMCT)) during feed forward control. In this non-sensitive band control, the overshooting set with LMCT is ignored during feed forward control. Instead the model position direction change point is correctly recognized to correctly compensate LMC.
This parameter is meaningless when feed forward control is not being carried out.

<Adjustment method>

If the compensation timing deviates during feed forward control, increase the LMCT setting by 1µm at a time.
Note that 2µm are set even when the LMCT is set to 0.

No.	Abbrev.	Parameter name	Explanation	Setting range
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, the actual value that is set is 2µm. Adjust by increasing by 1µm at a time.	0 to 100 (µm)

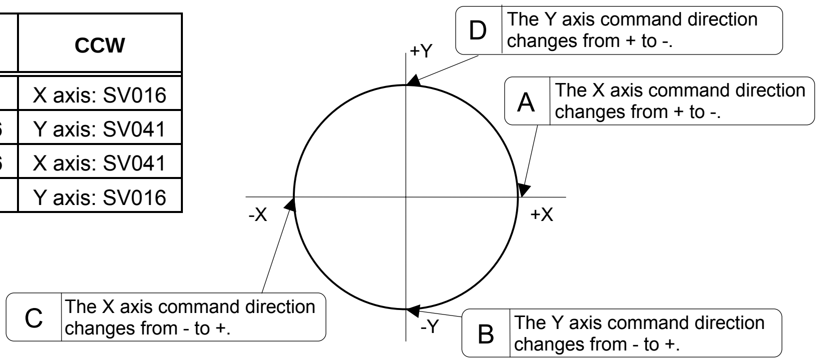
(5) Setting and adjusting LMC compensation type 3

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 viscosity component is 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 performing a machine end roundness measurement such as a DDB measurement, etc.

<Adjustment method>

[1] Set the bit1=1 to servo function selection 5 (SV082). (The LMC compensation type 3 will start).
[2] 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.
[3] Set the initial value, 1000 to the lost motion compensation viscous coefficient (SV086).
[4] Perform a roundness measurement at such speed as radius R=100mm and feedrate F=1000mm/min and adjust SV016 value.
[5] 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.

Compensation point	CW	CCW
A	X axis: SV041	X axis: SV016
B	Y axis: SV016	Y axis: SV041
C	X axis: SV016	X axis: SV041
D	Y axis: SV041	Y axis: SV016



[6] 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 reducing it gradually to have minimum quadrant protrusion.
[7] After adjusting SV086, verify its accuracy by performing roundness measurement at low speed again.

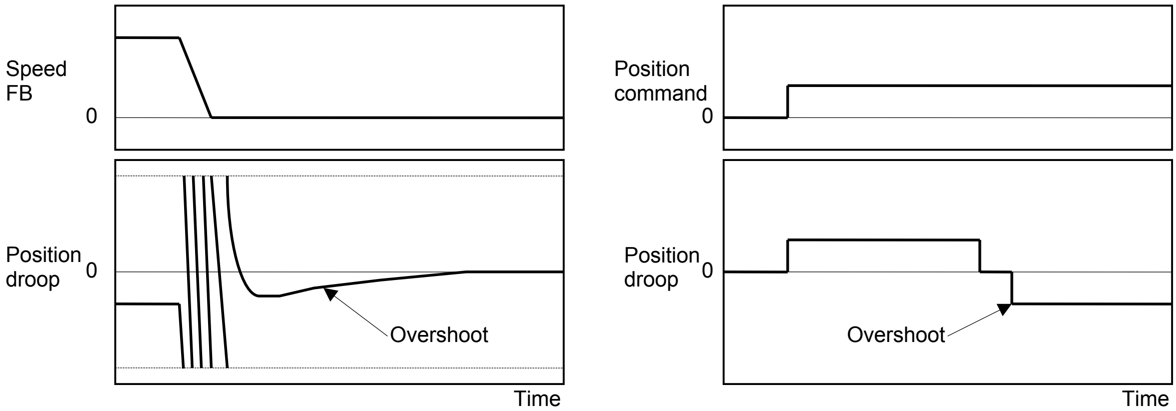
POINT

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).

<table>
<tr><th>No.</th><th>Abbrev.</th><th>Parameter name</th><th>Explanation</th><th>Setting range</th></tr>
<tr><td>SV027</td><td>SSF1</td><td>Servo function selection 1</td><td>
<table>
<tr><td>F</td><td>E</td><td>D</td><td>C</td><td>B</td><td>A</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td>aflt</td><td>zrn2</td><td colspan="2">afse</td><td colspan="2">ovs</td><td colspan="2">lmc</td><td>omr</td><td>zrn3</td><td colspan="2">vfct</td><td></td><td>upc</td><td colspan="2">vcnt</td></tr>
</table>
<table>
<tr><th colspan="2">bit</th><th>Meaning when "0" is set</th><th>Meaning when "1" is set</th></tr>
<tr><td>8
9</td><td>lmc</td><td colspan="2">Set the compensation amount with SV016 (LMC1) and SV041 (LMC2).
00: Lost motion compensation stop 10: Lost motion compensation type 2
01: Lost motion compensation type 1 11: Setting prohibited</td></tr>
</table>
</td><td></td></tr>
<tr><td>SV016</td><td>LMC1</td><td>Lost motion compensation 1</td><td>Set the compensation amount based on the stall (rated) current of the motor. The standard setting is double of the friction torque. Setting to "0" means the compensation amount is zero.</td><td>-1 to 200
(Stall [rated] current %)</td></tr>
<tr><td>SV041</td><td>LMC2</td><td>Lost motion compensation 2</td><td>Set this with SV016 (LMC1) only when you wish to set the lost motion compensation amount to be different depending on the command directions.
Set to "0" as a standard.</td><td>-1 to 200
(Stall [rated] current %)</td></tr>
<tr><td>SV082</td><td>SSF5</td><td>Servo function selection5</td><td>
<table>
<tr><td>F</td><td>E</td><td>D</td><td>C</td><td>B</td><td>A</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>obshj</td><td></td><td></td><td></td><td></td><td></td><td>lmc3</td><td>lmct</td></tr>
</table>
<table>
<tr><th colspan="2">bit</th><th>Meaning when "0" is set</th><th>Meaning when "1" is set</th></tr>
<tr><td>1</td><td>lmc3</td><td>Lost motion compensation 3 stop</td><td>Lost motion compensation 3 start</td></tr>
</table>
</td><td></td></tr>
<tr><td>SV086</td><td>LMCc</td><td>Lost motion compensation viscous coefficient</td><td>Set the machine system's viscous coefficient when using lost motion compensation type 3.</td><td>0 to 32767</td></tr>
</table>

4-3-6 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
[2] Machine system friction: Overshooting will occur mainly during one pulse feed
Either phenomenon can be confirmed by measuring the position droop.



[1] Overshooting during rapid traverse settling **[2] Overshooting during pulse feed**

(1) Overshooting compensation (OVS compensation)

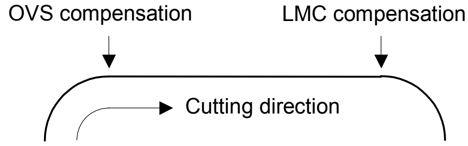
In OVS compensation, the overshooting is suppressed by subtracting the torque command set in the parameters when the motor stops. There are three types of OVS compensation. Type 3 is the standard method. (Types 1 and 2 are for compatibility with older models, and thus explanations have been omitted.)
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

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).

<table>
<tr><th>No.</th><th>Abbrev.</th><th>Parameter name</th><th>Explanation</th><th>Setting range</th></tr>
<tr><td>SV031</td><td>OVS1</td><td>Overshooting compensation 1</td><td>Increase in increments of 1%, and find the value where overshooting does not occur. The value is set in both the ± directions when OVS2 is set to 0.</td><td>-1 to 100
(Stall [rated] current %)</td></tr>
<tr><td>SV042</td><td>OVS2</td><td>Overshooting compensation 2</td><td>Set to "0" as a standard.
Set this to change the compensation amount according to the direction.</td><td>-1 to 100
(Stall [rated] current %)</td></tr>
<tr><td>SV027</td><td>SSF1</td><td>Servo function selection 1</td><td colspan="2">
<table>
<tr><td>F</td><td>E</td><td>D</td><td>C</td><td>B</td><td>A</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td>aflt</td><td>zrn2</td><td colspan="2">afse</td><td colspan="2">ovs</td><td colspan="2">lmc</td><td>omr</td><td>zrn3</td><td colspan="2">vfct</td><td></td><td>upc</td><td colspan="2">vcnt</td></tr>
</table>
<table>
<tr><th colspan="2">bit</th><th>Meaning when "0" is set</th><th>Meaning when "1" is set</th></tr>
<tr><td>A
B</td><td>ovs</td><td colspan="2">Set the compensation amount with SV031 (OVS1) and SV042 (OVS2).
00: Overshooting compensation stop 10: Overshooting compensation type 2
01: Overshooting compensation type1 11: Overshooting compensation type 3</td></tr>
</table>
</td></tr>
<tr><td>SV034</td><td>SSF3</td><td>Servo function selection 3</td><td colspan="2">
<table>
<tr><td>F</td><td>E</td><td>D</td><td>C</td><td>B</td><td>A</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td colspan="4">ovsn</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>has2</td><td>has1</td></tr>
</table>
<table>
<tr><th colspan="2">bit</th><th>Explanation</th></tr>
<tr><td>C
D
E
F</td><td>ovsn</td><td>Set the non-sensitive band of the overshooting compensation type 3 in increments of 2µm at a time.
In the feed forward control, the non-sensitive band of the model position droop is set, and overshooting of the model is ignored. Set to the standard 2µm (0001).</td></tr>
</table>
</td></tr>
</table>

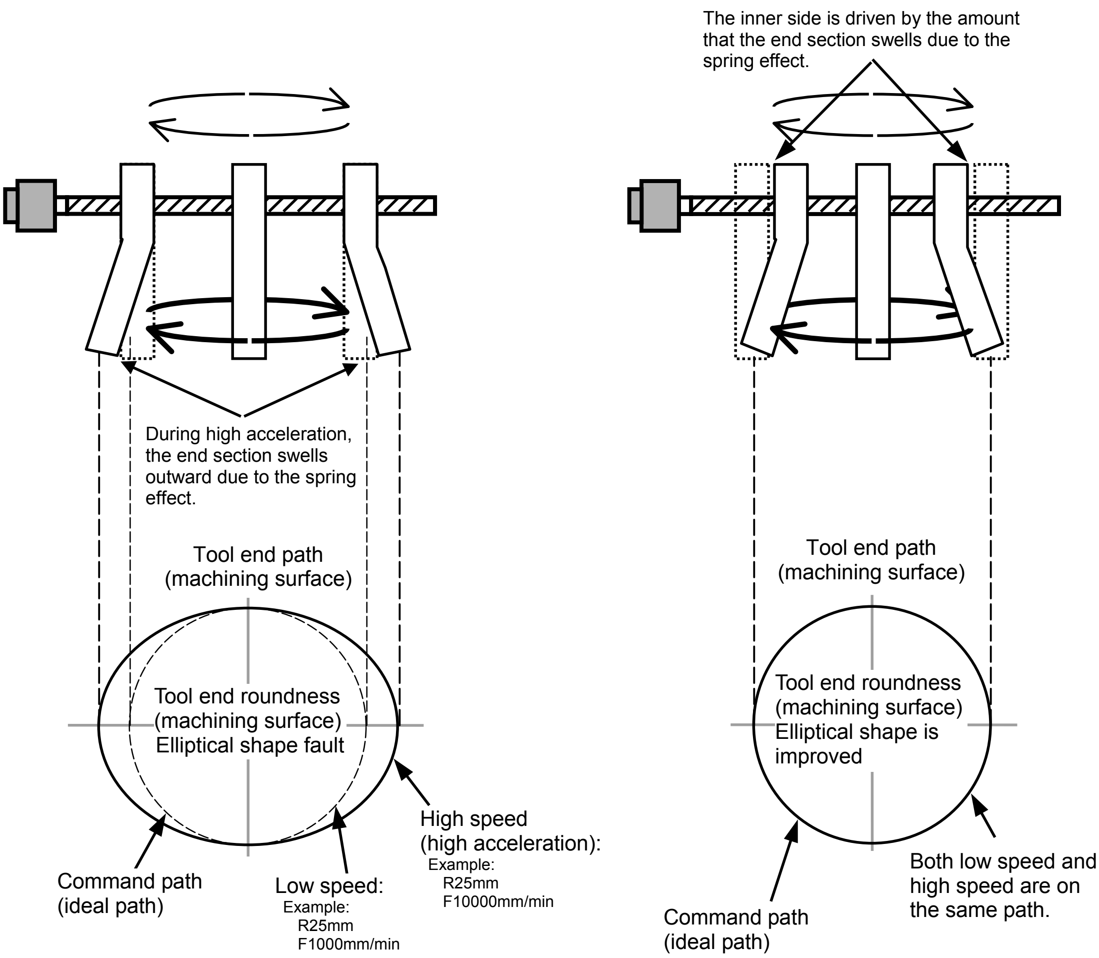
POINT

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).

4-3-7 Improvement of the interpolation control path

(1) Tool end compensation

The tool end compensation function compensates the shape of the tool end during high-speed and high-speed acceleration/deceleration. The spring effect from the tool (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 tool (shaft) 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 tool end compensation function compensates the motor end position according to the acceleration size, so the tool end position is always controlled to the commanded position.



Without tool end compensation **With tool end compensation**

POINT	1. Always evaluate the roundness accuracy at the tool end. 2. Adjust the parameter after adjusting the roundness accuracy at the motor end.

<Adjustment methods>

[1] Confirm that the motor end circle accuracy measured with the NC sampling function is appropriate.

[2] In this state, measure the tool end low-speed and high-speed circle path without tool end compensation. The difference of the high-speed circle path and low-speed circle path is the amount that path has swelled 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.

$$\text{SV065} = \frac{\text{Compensation amount [μm]} \times \text{radius R [mm]} \times 10^9}{(\text{command speed F [mm/min]})^2}$$

[3] Set SV027/bit7 to 1, and 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 tool end compensation

	When using grid encoder	When using DBB measurement	Acceleration
Low speed (reference circle)	R=25 [mm], F=500 [mm/min]	R=100 [mm], F=1000 [mm/min]	0.00028G
High-speed (when adjusting compensation amount)	R=25 [mm], F=10000 [mm/min]	R=100 [mm], F=20000 [mm/min]	0.11G

<table>
<tr><th>No.</th><th>Abbrev.</th><th>Parameter name</th><th>Explanation</th><th>Setting range</th></tr>
<tr><td>SV027</td><td>SSF1</td><td>Servo function selection 1</td><td colspan="2">
<table>
<tr><td>F</td><td>E</td><td>D</td><td>C</td><td>B</td><td>A</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td>aflt</td><td>zrn2</td><td colspan="2">afse</td><td colspan="2">ovs</td><td colspan="2">lmc</td><td>omr</td><td>zrn3</td><td colspan="2">vfct</td><td></td><td>upc</td><td colspan="2">vcnt</td></tr>
</table>
<table>
<tr><th colspan="2">bit</th><th>Meaning when "0" is set</th><th>Meaning when "1" is set</th></tr>
<tr><td>7</td><td>omr</td><td>Tool end compensation invalid</td><td>Tool end compensation valid</td></tr>
</table>
</td></tr>
<tr><td>SV065</td><td>TLC</td><td>Tool end compensation spring constant</td><td>Set the spring constant of the tool end compensation.
In the semi-closed loop control, the tool end compensation amount is calculated with the following equation.
$\text{Compensation amount} = \frac{\text{Commanded speed F (mm/min)}^2 \times \text{SV065}}{\text{Radius R (mm)} \times 10^9}$ (μm)
When not using, set to "0".</td><td>-32768 to 32767</td></tr>
</table>

POINT

1. To confirm the machine's spring element, adjust the electrical end roundness, and then tool end roundness while changing the cutting speed. Confirm that the error increases with the speed.
2. The electrical end roundness will have an error on the inner side when tool end compensation is used.

CAUTION

If an excessive value is set in the tool end compensation spring constant (SV065), the machine could vibrate when stopping, resulting in a dangerous state.

4-4 Adjustment during full closed loop control

4-4-1 Outline

(1) Full closed loop control

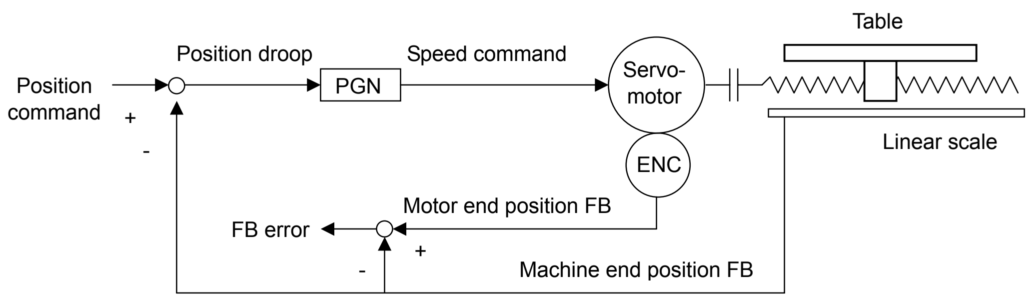
The servo control is all closed loop control using the detector's feedback. "Full closed loop control" is the system that directly detects the machine position using a linear scale, whereas the general "semi-closed loop" is the one that detects the motor end position.
In a machine that drives a table 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, which is the tool end, 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 tool end position feedback (FB) detected with the linear scale is used for the position control. However, the motor end 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.



Overrun detection control

No.	Abbrev.	Parameter name	Explanation	Setting range
SV054	ORE	Overrun detection width in closed loop control	Set the overrun detection width in the full-closed loop control. If the gap between the motor end detector and the linear scale (tool end detector) exceeds the value set by this parameter, it is judged to be overrun and Alarm 43 will be detected. When "-1" is set, the alarm detection won't be performed. When "0" is set, overrun is detected with a 2mm width.	-1 to 32767 (mm)

4-4-2 Speed loop delay compensation

Generally, the tool end position follows the operation later than the motor end position. With full closed loop position loop control, the tool end position is used for position feedback, so the motor end position could advance too far and cause the tool end position to overshoot easily. Speed loop delay compensation suppresses overshooting by weakening the speed loop PI control (weakening advance 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 "4-3-5 (1) 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.

<table>
<tr><th>No.</th><th>Abbrev.</th><th>Parameter name</th><th>Explanation</th><th>Setting range</th></tr>
<tr><td>SV007</td><td>VIL</td><td>Speed loop delay compensation</td><td>Set this when the limit cycle occurs in the full-closed loop, or overshooting occurs in positioning.
Select the control method with SV027 (SSF1)/bit1, 0 (vcnt).
Normally, use "Changeover type 2".
When you set this parameter, make sure to set the torque offset SV032 (TOF). When not using, set to "0".

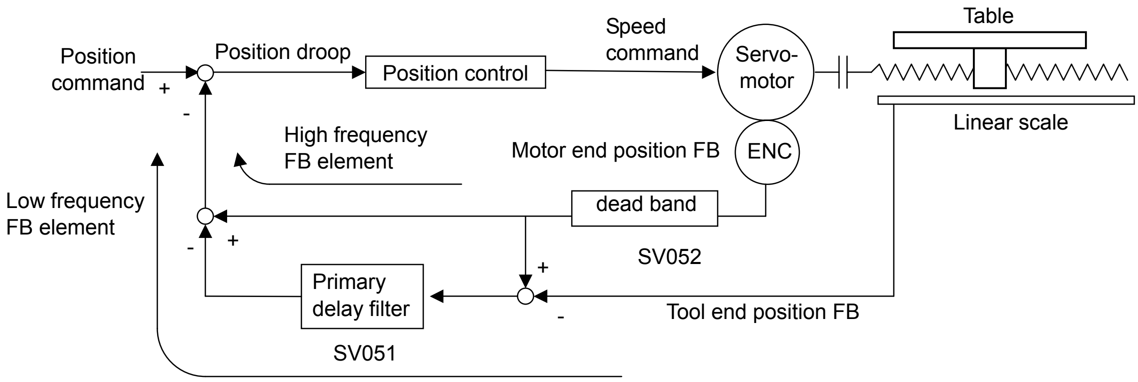
Changeover type 2 When SV027 (SSF1)/ bit1, 0 (vcnt)=10
The delay compensation control works when the command from the NC is "0" and the position droop is "0". Overshooting or the limit cycle that occurs during pulse feeding or positioning can be suppressed.</td><td>0 to 32767</td></tr>
<tr><td>SV032</td><td>TOF</td><td>Torque offset</td><td>Set the unbalance torque of vertical axis and inclined axis.</td><td>-100 to 100
(Stall [rated] current %)</td></tr>
<tr><td>SV027</td><td>SSF1</td><td>Servo function selection 1</td><td>
<table>
<tr><td>F</td><td>E</td><td>D</td><td>C</td><td>B</td><td>A</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td>aflt</td><td>zrn2</td><td colspan="2">afse</td><td colspan="2">ovs</td><td colspan="2">lmc</td><td>omr</td><td>zrn3</td><td colspan="2">vfct</td><td></td><td>upc</td><td colspan="2">vcnt</td></tr>
</table>
<table>
<tr><th colspan="2">bit</th><th>Meaning when "0" is set</th><th>Meaning when "1" is set</th></tr>
<tr><td>0
1</td><td>vcnt</td><td colspan="2">Set the execution changeover type of the speed loop delay compensation.
00: Delay compensation changeover invalid
01: Delay compensation changeover type 1
10: Delay compensation changeover type 2
11: Setting prohibited</td></tr>
</table>
</td><td></td></tr>
</table>

CAUTION The position droop will remain if SV007 is set too high.

4-4-3 Dual feedback control (Optional function)

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 end detector in ranges with high acceleration to enable stable control. In ranges with low acceleration, use position feedback with the tool end detector (scale). This will make it possible to increase the position loop gain.



Dual feedback control

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 tool end detector(scale, etc.). In addition, the positioning time will increase as the primary delay filter time constant increases.

POINT

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.
3. Dual feedback control is an optional function. If the option is not set in the NC, alarm 37 (at power ON), or warning E4 and error parameter No. 103 (2303 for M60S/E60 Series NC) will be output.

<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 overshooting does not occur.
[3] For the final setting value, set a value 1.5 to 2-fold the value adjusted in 3.

<table>
<tr><th>No.</th><th>Abbrev.</th><th>Parameter name</th><th>Explanation</th><th>Setting range</th></tr>
<tr><td>SV017</td><td>SPEC*</td><td>Servo specification selection</td><td colspan="2">
<table>
<tr><td>F</td><td>E</td><td>D</td><td>C</td><td>B</td><td>A</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td colspan="4">spm</td><td></td><td></td><td>mpt</td><td>mp</td><td>abs</td><td></td><td>vdir</td><td>fdir</td><td>vfb</td><td>seqh</td><td>dfbx</td><td>fdir2</td></tr>
</table>
<table>
<tr><td colspan="2">bit</td><td>Meaning when "0" is set</td><td>Meaning when "1" is set</td></tr>
<tr><td>1</td><td>dfbx</td><td>Dual feedback control stop</td><td>Dual feedback control start</td></tr>
</table>
</td></tr>
<tr><td>SV051</td><td>DFBT</td><td>Dual feedback control time constant</td><td>Set the control time constant in dual feed back.
When "0" is set, the actual value that is set is 1ms.
The higher the time constant is, the closer it gets to the semi-closed control, so the limit of the position loop gain is raised.</td><td>0 to 9999
(ms)</td></tr>
<tr><td>SV052</td><td>DFBN</td><td>Dual feedback control non-sensitive band</td><td>Set the non-sensitive band in the dual feedback control.
Set to "0" as a standard.</td><td>0 to 9999
(μm)</td></tr>
</table>

4-5 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 servo alarm was detected

4-5-1 Deceleration control

With the MDS-C1-V1/V2 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>

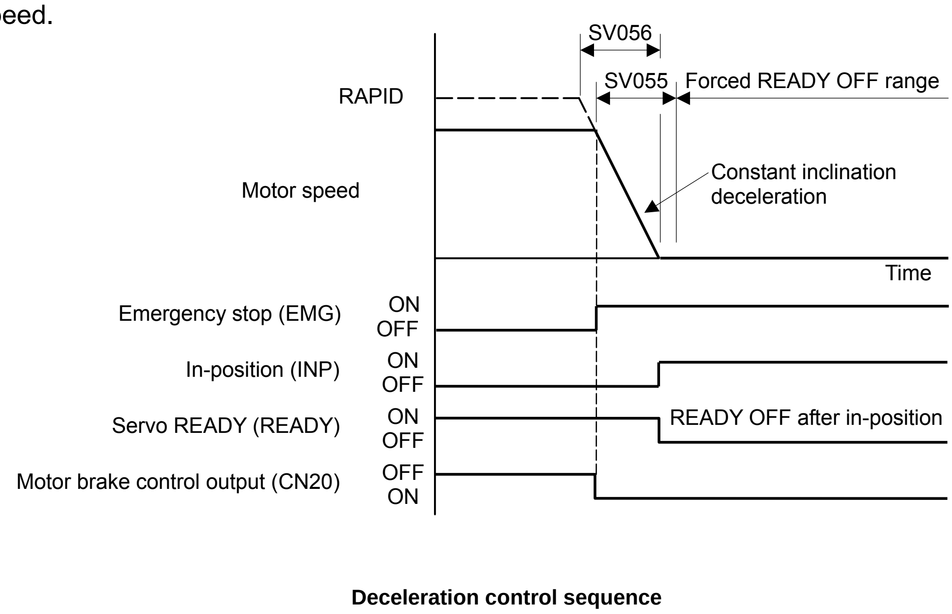
When the load inertia is large, deceleration stop can be executed at a shorter time than the dynamic brakes.
(The stop time for the normal acceleration/deceleration time constants will be achieved.)

(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.
If linear acceleration/deceleration is selected for rapid traverse, the same value as the acceleration/deceleration time constant (G0tL) will be the standard value. If another acceleration/deceleration pattern is selected, set rapid traverse to linear acceleration/deceleration and adjust to a suitable acceleration/deceleration time constant. Use that value as the standard value.

<Operation>

When an emergency stop occurs, the motor will decelerate at the same inclination from each speed.



Deceleration control sequence

No.	Abbrev.	Parameter name	Explanation	Setting range
SV055	EMGx	Max. gate off delay time after emergency stop	Set a length of time from the point when the emergency stop is input to the point when READY OFF is compulsorily executed. Normally, set the same value as the absolute value of SV056. In preventing the vertical axis from dropping, the gate off is delayed for the length of time set in SV048 if SV055's value is smaller than that of SV048.	0 to 20000 (ms)
SV056	EMGt	Deceleration time constant at emergency stop	In the vertical axis drop prevention time control, set the time constant used for the deceleration control at emergency stop. Set a length of time that takes from rapid traverse rate (rapid) to stopping. Normally, set the same value as the rapid traverse acceleration/deceleration time constant. When executing the synchronous operation, put the minus sign to the settings of both of the master axis and slave axis.	-20000 to 20000 (ms)

(2) Deceleration control stop distance

The stopping distance LEMG 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.

$$L_{EMG} = \frac{F}{PGN1 \times 60} + \frac{1}{2} \times \frac{F}{60} \times \frac{F \times EMGt}{rapid \times 1000} \quad \text{(mm)}$$

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)

POINT

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 overtravel point (stroke end point) may be exceeded.
Take care as the axis could collide with the tool end.

4-5-2 Vertical axis drop prevention control

(1) 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 minimum delay time at which the axis does not drop.

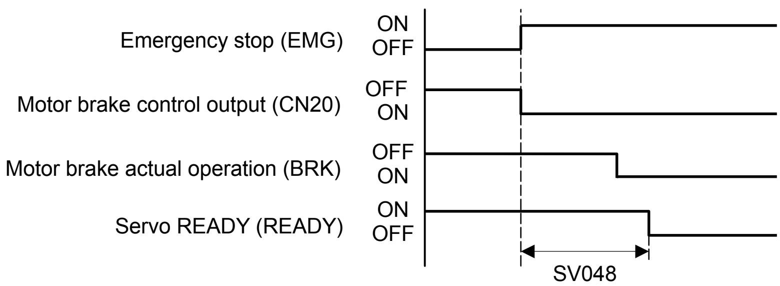
[2] Set the same value as the adjusted vertical axis drop prevention time (SV048) for the max. gate off delay time after emergency stop (SV055).

[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-C1-V2 (2-axis 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 = Same value as that axis' rapid traverse acceleration/deceleration time constant

[5] Set the spindle parameter SP033/bitF=1 when the converter that supplies PN power to the vertical axis is controlled by the spindle amplifier.

[6] If the converter that supplies PN power to the vertical axis is controlled by a different servo amplifier, set the servo parameter setting for that axis as well. (Same as item [4] above).



Vertical axis drop prevention control sequence

⚠ **CAUTION**

1. Always set deceleration control when using the vertical axis drop prevention control setting.
2. Configure so that the power supply unit is controlled directly by the servo drive unit which controls the spindle drive unit or 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.

Servo parameter

No.	Abbrev.	Parameter name	Explanation	Setting range
SV048	EMGrt	Vertical axis drop prevention time	Input a length of time to prevent the vertical axis from dropping by delaying Ready OFF until the brake works when the emergency stop occurs. Increase the setting by 100ms at a time and set the value where the axis does not drop.	0 to 20000 (ms)
SV055	EMGx	Max. gate off delay time after emergency stop	Set a length of time from the point when the emergency stop is input to the point when READY OFF is compulsorily executed. Normally, set the same value as the absolute value of SV056. In preventing the vertical axis from dropping, the gate off is delayed for the length of time set in SV048 if SV055's value is smaller than that of SV048.	0 to 20000 (ms)
SV056	EMGt	Deceleration time constant at emergency stop	In the vertical axis drop prevention time control, set the time constant used for the deceleration control at emergency stop. Set a length of time that takes from rapid traverse rate (rapid) to stopping. Normally, set the same value as the rapid traverse acceleration/deceleration time constant. When executing the synchronous operation, put the minus sign to the settings of both of the master axis and slave axis.	-20000 to 20000 (ms)

Spindle parameter

<table>
<tr><th>No.</th><th>Abbrev.</th><th>Parameter name</th><th>Explanation</th><th>Setting range</th></tr>
<tr><td>SP033</td><td>SFNC1*</td><td>Spindle function 1</td><td>
<table>
<tr><td>F</td><td>E</td><td>D</td><td>C</td><td>B</td><td>A</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td>poff</td><td>hzs</td><td></td><td>ront</td><td></td><td></td><td>pycal</td><td>pychg</td><td>pyst</td><td>pyoff</td><td></td><td></td><td></td><td>sftk</td><td>dflt</td><td>1a2m</td></tr>
</table>
<table>
<tr><th colspan="2">bit</th><th>Meaning when "0" is set</th><th>Meaning when "1" is set</th></tr>
<tr><td>F</td><td>poff</td><td>Contactor hold at NC power OFF invalid</td><td>Contactor hold at NC power OFF valid</td></tr>
</table>
</td><td></td></tr>
</table>

POINT

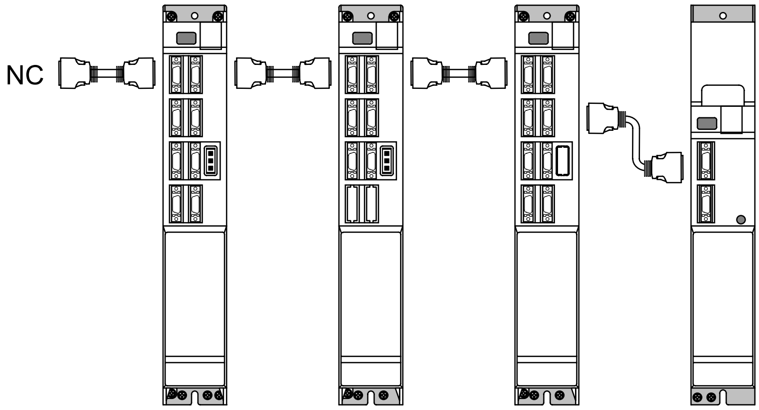
1. SV048 and SV055 are set for each axis, but when using MDS-C1-V2 (2-axis drive unit), the two axes are simultaneously controlled with the larger setting value for the two axes.
2. If an alarm, for which dynamic brake stopping is designated, occurs with the axis for which vertical axis drop prevention control is active, the function will not activate.
3. A drop amount of several μm to several 10μm will remain due to brake play.

CAUTION

1. Do not set the vertical axis drop prevention time longer than required. The servo control and brakes could collide, resulting in an overload alarm or drive unit damage. There is no problem if the overlapping time is within 100ms.
2. Vertical axis drop prevention control (including deceleration control) longer than 100ms will not be guaranteed during a power failure. The operation will change to dynamic brakes.
3. If only SV048 and SV055 are set, and SV056 is set to 0, the deceleration stop will be a stepped stop and could result in collision with the machine.

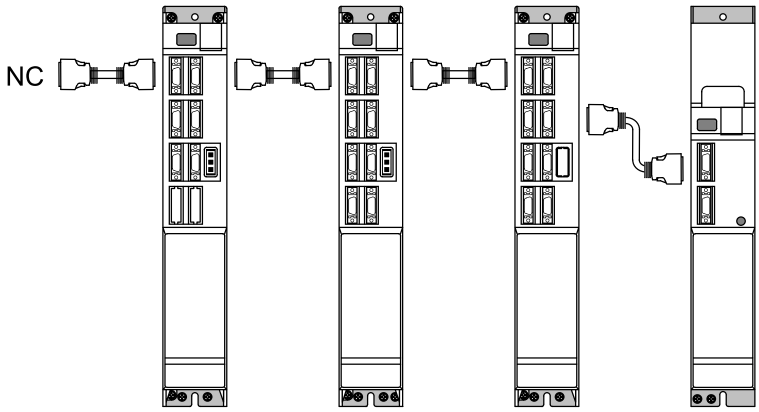
<Outline of system configurations and corresponding parameter settings>

[1] Spindle controls power supply, vertical axis is a 1-axis unit (vertical axis: Z axis)



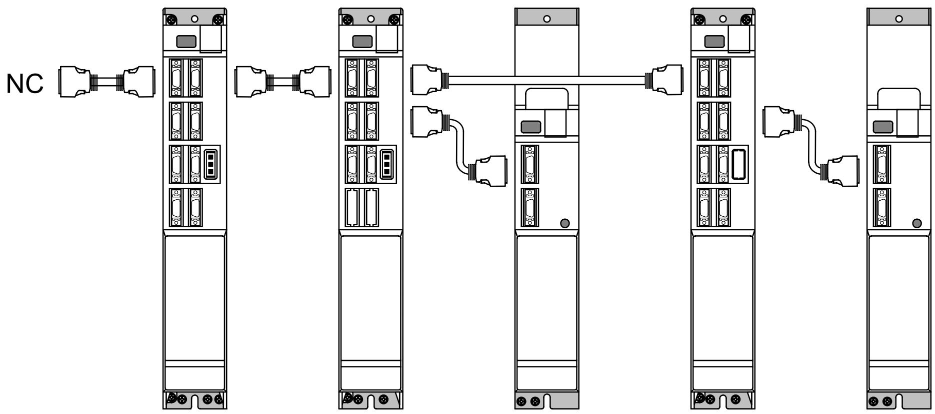
Parameter \ Axis	X axis	Y axis	Z axis (Vertical axis)	Spindle
	MDS-C1-V2		**MDS-C1-V1**	**MDS-C1-SP**
SV048	-	-	Set by adjustment	Spindle parameter SP033/bitF=1
SV055	-	-	Same value as SV048	
SV056	-	-	Same value as Z axis rapid traverse time constant	

[2] Spindle controls power supply, vertical axis is a 2-axis unit (vertical axis: Z axis)



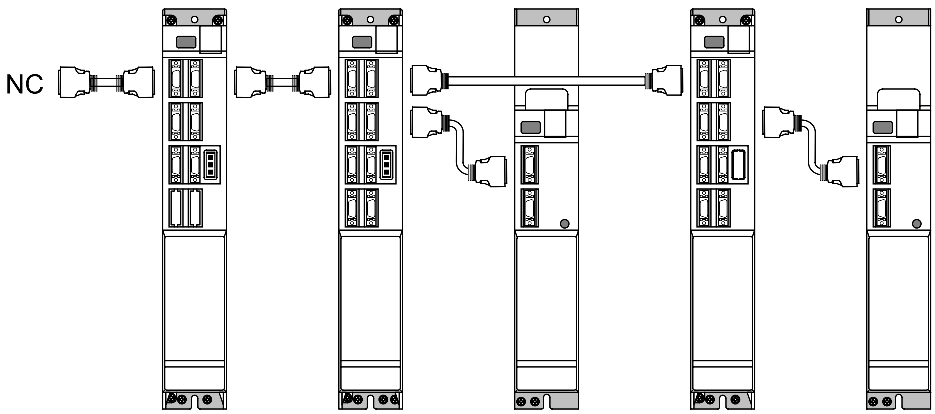
Parameter \ Axis	X axis	Y axis	Z axis (Vertical axis)	Spindle
	MDS-C1-V1	**MDS-C1-V2**		**MDS-C1-SP**
SV048	-	Same value as Z axis →	Set by adjustment	Spindle parameter SP033/bitF=1
SV055	-	Same value as Z axis →	Same value as SV048	
SV056	-	Same value as Y axis rapid traverse time constant	Same value as Z axis rapid traverse time constant	

[3] Servo controls power supply, vertical axis is a 1-axis unit (vertical axis: Z axis)



Axis / Parameter	X axis	Y axis	Z axis (Vertical axis)	Spindle
	MDS-C1-V2		MDS-C1-V1	MDS-C1-SP
SV048	-	-	Set by adjustment	No spindle parameter setting required
SV055	-	-	Same value as SV048	
SV056	-	-	Same value as Z axis rapid traverse time constant	

[4] Servo controls power supply, vertical axis is a 2-axis unit (vertical axis: Z axis)



Axis / Parameter	X axis	Y axis	Z axis (Vertical axis)	Spindle
	MDS-C1-V1	MDS-C1-V2		MDS-C1-SP
SV048	-	Same value as Z axis →	Set by adjustment	No spindle parameter setting required
SV055	-	Same value as Z axis →	Same value as SV048	
SV056	-	Same value as Y axis rapid traverse time constant	Same value as Z axis rapid traverse time constant	

4-6 Protective functions

4-6-1 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-C1 Series Specifications Manual (BNP-C3040).

No.	Abbrev.	Parameter name	Explanation	Setting range
SV021	OLT	Overload detection time constant	Set the detection time constant of Overload 1 (Alarm 50). Set to "60" as a standard. (For machine tool builder adjustment.)	1 to 999 (s)
SV022	OLL	Overload detection level	Set the current detection level of Overload 1 (Alarm 50) in respect to the stall (rated) current. Set to "150" as a standard. (For machine tool builder adjustment.)	110 to 500 (Stall [rated] current %)

4-6-2 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.

No.	Abbrev.	Parameter name	Explanation	Setting range
SV023	OD1	Excessive error detection width during servo ON	Set the excessive error detection width when servo ON. <Standard setting value> $\mathrm{OD1}=\mathrm{OD2}=\dfrac{\text{Rapid traverse rate (mm/min)}}{60 \times \mathrm{PGN1}} \div 2\ \text{(mm)}$ When "0" is set, the excessive error detection will not be performed.	0 to 32767 (mm)
SV026	OD2	Excessive error detection width during servo OFF	Set the excessive error detection width when servo ON. For the standard setting, refer to the explanation of SV023 (OD1). When "0" is set, the excessive error detection will not be performed.	0 to 32767 (mm)
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.). If "0" is set, excessive error detection won't be performed.	0 to 32767 (mm)

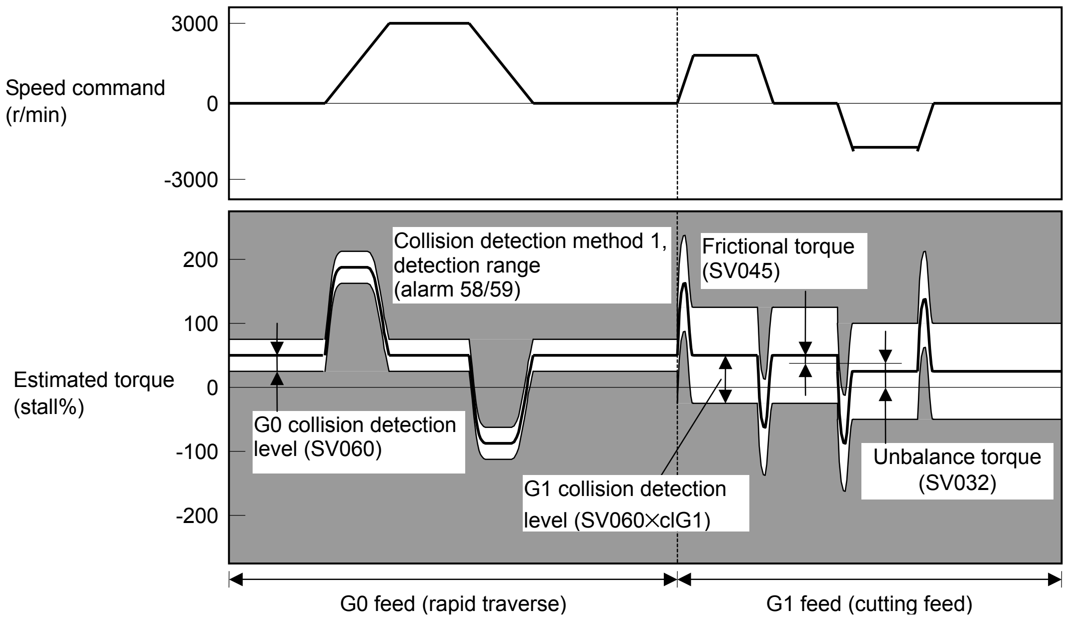
4-6-3 Collision detection

Collision detection 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.

	Collision detection level setting parameter	Detected alarm
During rapid traverse (During G0 feed)	SV060	Alarm 58
During cutting feed (During G1 feed)	SV060 × c1G1 (SV035)	Alarm 59



Alarm detection range for collision detection method 1

⚠ **CAUTION**	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/bitF (SSF4.c12n) to 1 to ignore collision detection method 2.

POINT

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 resolution following the detector replacement, or in the detector loop gain (PGN) or position control system. (closed loop control and semi-closed loop has been changed).

<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 "4-3-5 (1) 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.

$$\text{Frictional torque (\%)} = \left| \frac{(+\text{ feed load current \%}) - (-\text{ feed load current \%})}{2} \right|$$

[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 MPOS 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. When SV035: SSF4.clet (bitA) is set to 1, the estimated disturbance torque peak value for the latest two seconds will appear at MPOS. 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).

<table>
<tr><th>No.</th><th>Abbrev.</th><th>Parameter name</th><th>Explanation</th><th>Setting range</th></tr>
<tr><td>SV032</td><td>TOF</td><td>Torque offset</td><td>Set the unbalance torque of vertical axis and inclined axis.</td><td>-100 to 100
(Stall current %)</td></tr>
<tr><td>SV035</td><td>SSF4</td><td>Servo function selection 4</td><td colspan="2">
<table>
<tr><td>F</td><td>E</td><td>D</td><td>C</td><td>B</td><td>A</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td>clt</td><td colspan="3">clG1</td><td>cl2n</td><td>clet</td><td colspan="2">cltq</td><td></td><td>iup</td><td colspan="6">tdt</td></tr>
</table>
<table>
<tr><th colspan="2">bit</th><th>Meaning when "0" is set</th><th>Meaning when "1" is set</th></tr>
<tr><td>8
9</td><td>cltq</td><td colspan="2">Set the retracting torque for collision detection in respect to the maximum torque of the motor.
00 : 100%   01 : 90%   10 : 80% (Standard)   11 : 70%</td></tr>
<tr><td>A</td><td>clet</td><td>Setting for normal use</td><td>The disturbance torque peak of the latest two seconds is displayed in MPOS of the servo monitor screen.</td></tr>
<tr><td>B</td><td>cl2n</td><td>Collision detection method 2 valid</td><td>Collision detection method 2 invalid</td></tr>
<tr><td>C
D
E</td><td>clG1</td><td colspan="2">Collision detection method 1
Set the collision detection level during cutting feed (G1).
The G1 collision detection level=SV060 × clG1.
When clG1=0, the collision detection method 1 during cutting feed won’t function.</td></tr>
<tr><td>F</td><td>clt</td><td>Setting for normal use</td><td>The guide value of the SV059 setting value is displayed in MPOS of the servo monitor screen.</td></tr>
</table>
</td></tr>
<tr><td>SV045</td><td>TRUB
(Low order)</td><td>Frictional torque</td><td>When you use the collision detection function, set the frictional torque.</td><td>0 to 100
(Stall current %)</td></tr>
<tr><td>SV059</td><td>TCNV</td><td>Collision detection torque estimating gain</td><td>Set the torque estimating gain when using the collision detection function.
After setting as SV035/bitF(clt)=1 and performing acceleration/deceleration, set the value displayed in MPOS of the NC servo monitor screen.
Set to "0" when not using the collision detection function.</td><td>-32768 to 32767</td></tr>
<tr><td>SV060</td><td>TLMT</td><td>Collision detection level</td><td>When using the collision detection function, set the collision detection level during the G0 feeding.
If "0" is set, none of the collision detection function will work.</td><td>0 to 999
(Stall current %)</td></tr>
</table>

5. Spindle Adjustment

5-1 D/A output specifications for spindle drive unit

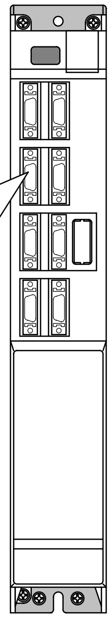
The MDS-C1-SP/SPH/SPX/SPHX/SPM spindle drive unit has a function to D/A output each control data. The spindle adjustment data required to set the spindle parameters matching the machine can be D/A output. The data can be measured with a hi-corder or oscilloscope, etc.

5-1-1 D/A output specifications

Item	Explanation
No. of channels	2ch
Output cycle	444µs (min. value)
Output precision	8bit
Output voltage range	0V to +5V (zero) to +10V, 0V to +10V for meter output
Output magnification setting	±1/256 to ±128-fold
Output pin	CN9 connector MO1 = Pin 9 MO2 = Pin 19 GND = Pin 1
Function	Phase current feedback output function U phase current FB : Pin 7 V phase current FB : Pin 17

CN9 connector

Pin	Name	Pin	Name
1	LG	11	
2		12	
3		13	
4		14	
5		15	
6		16	
7	UIFB	17	VIFB
8		18	
9	MO1	19	MO2
10		20	



5-1-2 Setting the output data

No.	Abbr.	Parameter name	Explanation
SP253	DA1NO	D/A output channel 1 data No.	Input the No. of the data to be output to each D/A output channel.
SP254	DA2NO	D/A output channel 2 data No.	

No.	Output data	Original data unit	Output magnification standard setting value (SP255, SP256)	Output unit for standard setting	Output cycle
0	ch1: Speedometer output	10V=max. speed (Zero=0V)	0	Depends on maximum speed	3.55ms
	ch2: Load meter output	10V=120% load (Zero=0V)	0	30-minute rating 12%/V	3.55ms
1	–				
2	Current command	Rated 100%=4096	8	30-minute rating 20%/V	3.55ms
3	Current feedback	Rated 100%=4096	8	30-minute rating 20%/V	3.55ms
4	Speed feedback	r/min	13	500rpm/V	3.55ms
5	–				
6	Position droop (lower order 16bit)	0.001deg=64	10 (10.24)	0.01deg/V	888µs
7	Position droop (higher order 16bit)	1deg=(64000÷65536)	671	10deg/V	888µs
8	Feedrate (FΔT) (lower order 16bit)	0.001deg=64	173 (at 3.5ms communication)	10deg/min/V	888µs
9	Feedrate (FΔT) (higher order 16bit)	1deg=(64000÷65536)	629 (at 3.5ms communication)	500rpm/V	888µs
10	Position command (lower order 16bit)	0.001deg=64	10 (10.24)	0.01deg/V	888µs
11	Position command (higher order 16bit)	1deg=(64000÷65536)	19 (18.64)	360deg/V	888µs
12	Position FB (lower order 16bit)	0.001deg=64	10 (10.24)	0.01deg/V	888µs
13	Position FB (higher order 16bit)	1deg=(64000÷65536)	19 (18.64)	360deg/V	888µs
80	Control input 1	HEX	Bit correspondence		3.55ms
81	Control input 2				
82	Control input 3				
83	Control input 4				
84	Control output 1				
85	Control output 2				
86	Control output 3				
87	Control output 4				

5-1-3 Setting the output magnification

(1) Meter output (Data No. 0)

With meter output, the output channel is fixed, and the output voltage range is 0 to 10V in the positive range. Set the magnification with the following parameters. Also, low path filter can be set on the load meter output.

No.	Abbr.	Parameter name	Details	Setting range	Standard
SP017	TSP*	Maximum motor speed	Set the maximum spindle motor speed. When SP249=0, the motor speed will be the motor rotation speed at the speedometer 10V output.	1 to 32767 (r/min)	6000
SP094	LMAV*	Load meter output filter	Set the filter time constant of load meter output. When "0" is set, a filter time constant is set to 100ms.	0 to 32767 (2ms)	0
SP249	SMO	Speedometer speed	Set the motor rotation speed when the speedometer 10V is output. When set to "0", this parameter becomes the same as SP017 (TSP).	0 to 32767 (r/min)	0
SP250	LMO	Load meter voltage	Set the voltage when the load meter 120% is output. When set to "0", this becomes 10V.	0 to 10 (V)	0

(2) Internal data output (Data No. 1 to 13)

Normally, the standard setting value is set for the output magnification (SP255, SP256). When "0" is set, the magnification will be the same as "256".

$$\text{DATA} \times \frac{\text{SP255}}{256} \times \frac{10\ [\text{V}]}{256\ (8\ \text{bit})} + 5\ [\text{V}]\ (\text{offset}) = \text{Output voltage [V]}$$

(Example) To output current FB at a 30-minute stall rating 20%/V unit (SP253=3, SP255=8)

$$819.2 \times \frac{8}{256} \times \frac{10}{256} + 5 = 6\ [\text{V}]$$

No.	Abbr.	Parameter name	Details	Setting range	Standard
SP255	DA1MPY	DA output channel 1 magnification	Set the output magnification with a 1/256 unit. When "0" is set, the magnification will be the same as "256".	-32768 to 32767 (1/256-fold)	0
SP256	DA2MPY	DA output channel 2 magnification			0

(3) Control signal output (Data No. 80 to 87)

A hexadecimal display is converted into a decimal and output. The method of calculating the magnification is the same as (2). The status cannot be output for each bit, so output the status for all 16 bits.

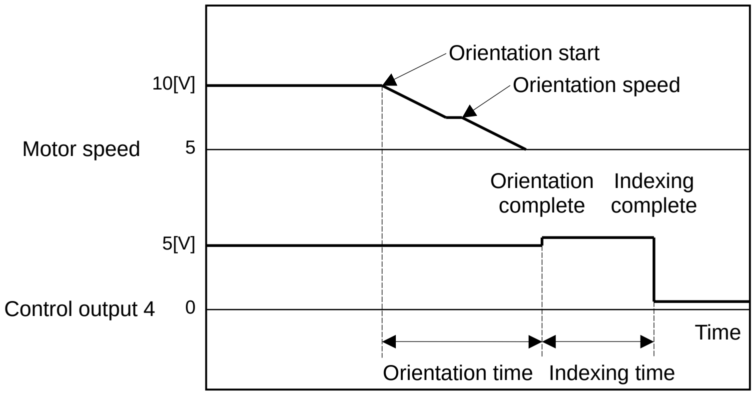
(Example) Orientation indexing control

With orientation indexing control, the following operations of the "Control output 4" can be observed as shown on the right:

bit4: Orientation completed

bit7: Indexing positioning completed

Note that the weight of the D/A output differs for each bit.



Orientation indexing control sequence output

5-2 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.

5-2-1 Spindle control input (NC to SP)

(1) Spindle control input 1

Name	Details
Spindle control input 1	

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
G1				MAC	TL3	TL2	TL1	ALMR	PRM					SRV	RDY

bit		Details
0	RDY	READY ON command
1	SRV	Servo ON command
2		
3		
4		
5		
6	PRM	Parameter conversion command
7	ALMR	Drive unit alarm reset command
8	TL1	Torque limit 1
9	TL2	Torque limit 2
A	TL3	Torque limit 3
B	MAC	Pole position detection check command (only for MDS-C1-SPM)
C		
D		
E		
F	G1	Cutting

bit0. READY ON command (RDY)

This signal is input when preparations to rotate the motor are completed. The forward run and reverse run commands will not be accepted even if input before this signal turns ON.

bit1. Servo ON command (SRV)

This is input for position control, excluding orientation. If this signal is not ON, position control will not be executed even if the spindle control mode selection command's combination indicates the position control mode.

bit6. Parameter conversion command (PRM)

This is started when the spindle parameters are converted on the NC screen.

bit7. Drive unit alarm reset command (ALMR)

This turns ON while NC reset is input. Spindle alarms that can be reset with NR are reset.

bit8. Torque limit 1 (TL1)
bit9. Torque limit 2 (TL2)
bitA. Torque limit 3 (TL3)

This signal is used to temporarily reduce the spindle motor's output torque such as when clamping the spindle motor on the machine side. The torque limit is designated in percentage using the motor's short-time rating as 100%.

Set the SP021, SP049 to SP054 torque limit value with a combination of TL1 to 3.

TL3	TL2	TL1	Torque limit value
0	0	1	SP021
0	1	0	SP049
0	1	1	SP050
1	0	0	SP051
1	0	1	SP052
1	1	0	SP053
1	1	1	SP054

Related spindle parameters

No.	Abbr.	Parameter name	Details	Setting range	Standard
SP021	TLM1	Torque limit 1	Set the torque limit rate for the torque limit signal 001.	0 to 120(%)	10
SP049	TLM2	Torque limit 2	Set the torque limit rate for the torque limit signal 010.	0 to 120(%)	20
SP050	TLM3	Torque limit 3	Set the torque limit rate for the torque limit signal 011.	0 to 120(%)	30
SP051	TLM4	Torque limit 4	Set the torque limit rate for the torque limit signal 100.	0 to 120(%)	40
SP052	TLM5	Torque limit 5	Set the torque limit rate for the torque limit signal 101.	0 to 120(%)	50
SP053	TLM6	Torque limit 6	Set the torque limit rate for the torque limit signal 110.	0 to 120(%)	60
SP054	TLM7	Torque limit 7	Set the torque limit rate for the torque limit signal 111.	0 to 120(%)	70

bitB. Pole position check command (MAC) (only for MDS-C1-SPM)

When requesting pole position check from NC, pole position check is performed by turning ON this signal. However, the pole position check is not performed when the check has already completed (control output 1/bitB=1). When SP207≠0 is set, it stars automatically on the spindle drive unit side.

bitF. Cutting (G1)

This signal is used to determine whether cutting is taking place or not during C-axis control.

(2) Spindle control input 2

<table>
<tr><th>Name</th><th>Details</th></tr>
<tr><td>Spindle control input 2</td><td>
<table>
<tr><td>F</td><td>E</td><td>D</td><td>C</td><td>B</td><td>A</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td></td><td>DAR</td><td></td><td>PAR</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>
</table>
<table>
<tr><th colspan="2">bit</th><th>Details</th></tr>
<tr><td>0</td><td></td><td></td></tr>
<tr><td>1</td><td></td><td></td></tr>
<tr><td>2</td><td></td><td></td></tr>
<tr><td>3</td><td></td><td></td></tr>
<tr><td>4</td><td></td><td></td></tr>
<tr><td>5</td><td></td><td></td></tr>
<tr><td>6</td><td></td><td></td></tr>
<tr><td>7</td><td></td><td></td></tr>
<tr><td>8</td><td></td><td></td></tr>
<tr><td>9</td><td></td><td></td></tr>
<tr><td>A</td><td></td><td></td></tr>
<tr><td>B</td><td></td><td></td></tr>
<tr><td>C</td><td>PAR</td><td>PS alarm history clear</td></tr>
<tr><td>D</td><td></td><td></td></tr>
<tr><td>E</td><td>DAR</td><td>Alarm history clear</td></tr>
<tr><td>F</td><td></td><td></td></tr>
</table>
</td></tr>
</table>

bitC. PS alarm history clear（PAR）

This signal turns ON when clearing alarm history for power supply.

bitE. Alarm history delete（DAR）

This signal turns ON when clearing alarm history for driver.

(3) Spindle control input 3

<table>
<tr><th>Name</th><th>Details</th></tr>
<tr><td>Spindle control input 3</td><td>

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
PCHG	MS	LCS	ORC	WRI	WRN	SRI	SRN		GR2	GR1	SC5	SC4	SC3	SC2	SC1

bit		Details
0	SC1	Spindle control mode selection command 1
1	SC2	Spindle control mode selection command 2
2	SC3	Spindle control mode selection command 3
3	SC4	Spindle control mode selection command 4
4	SC5	Spindle control mode selection command 5
5	GR1	Gear selection command 1
6	GR2	Gear selection command 2
7		
8	SRN	Forward run start command
9	SRI	Reverse run start command
A	WRN	Indexing forward run command
B	WRI	Indexing reverse run command
C	ORC	Orientation start command
D	LCS	L coil selection command (When using coil changeover motor)
E	MS	<<For MDS-C1-SP>> Sub-motor selection command (for 1-drive unit 2-motor changeover)
	MCS	<<For MDS-C1-SPM>> M coil selection command (when using coil changeover motor)
F	PCHG	Position changeover mode selection

</td></tr>
</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)
bit3. Spindle control mode selection command 4 (SC4)
bit4. Spindle control mode selection command 5 (SC5)

SC5	SC4	SC3	SC2	SC1	Control mode
0	0	0	*	*	Speed control
0	0	1	*	*	
0	1	0	*	*	Synchronous tap control
0	1	1	0	0	C-axis control, No. 1 gain selection
0	1	1	0	1	C-axis control, No. 2 gain selection
0	1	1	1	0	C-axis control, No. 3 gain selection
0	1	1	1	1	Setting prohibited
1	0	0	*	*	Spindle synchronous control
1	0	1	*	*	Setting prohibited
1	1	0	*	*	
1	1	1	*	*	

(Note) The asterisk indicates 1 or 0.

bit5. Gear selection command 1 (GR1)
bit6. Gear selection command 2 (GR2)

This selects the number of spindle gear stages required to carry out orientation operation or various position control operation.

GR2	GR1	Gear ratio
0	0	SP025, SP029
0	1	SP026, SP030
1	0	SP027, SP031
1	1	SP028, SP032

Related spindle parameters

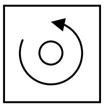
No.	Abbr.	Parameter name	Details	Setting range	Standard setting
SP025	GRA1*	Spindle gear teeth count 1	Set the number of gear teeth of the spindle corresponding to gear 000.	1 to 32767	1
SP026	GRA2*	Spindle gear teeth count 2	Set the number of gear teeth of the spindle corresponding to gear 001.	1 to 32767	1
SP027	GRA3*	Spindle gear teeth count 3	Set the number of gear teeth of the spindle corresponding to gear 010.	1 to 32767	1
SP028	GRA4*	Spindle gear teeth count 4	Set the number of gear teeth of the spindle corresponding to gear 011.	1 to 32767	1
SP029	GRB1*	Motor shaft gear teeth count 1	Set the number of gear teeth of the motor shaft corresponding to gear 000.	1 to 32767	1
SP030	GRB2*	Motor shaft gear teeth count 2	Set the number of gear teeth of the motor shaft corresponding to gear 001.	1 to 32767	1
SP031	GRB3*	Motor shaft gear teeth count 3	Set the number of gear teeth of the motor shaft corresponding to gear 010.	1 to 32767	1
SP032	GRB4*	Motor shaft gear teeth count 4	Set the number of gear teeth of the motor shaft corresponding to gear 011.	1 to 32767	1

bit8. Forward run start command (SRN)

This is an operation command. The speed command must also be designated to rotate the motor. If the orientation command is input, the orientation operation will have the priority.

SRN	Explanation
1 (ON)	The motor rotates in the counterclockwise direction (CCW) looking from the shaft at the commanded speed.
0 (OFF)	The motor decelerates to a stop. After stopping, the drive unit's power module turns OFF.

Spindle motor rotation direction



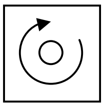
Counterclockwise direction

bit9. Reverse run start command (SRI)

This is an operation command. The speed command must also be designated to rotate the motor. If the orientation command is input, the orientation operation will have the priority.

SRN	Explanation
1 (ON)	The motor rotates in the clockwise direction (CW) looking from the shaft at the commanded speed.
0 (OFF)	The motor decelerates to a stop. After stopping, the drive unit's power module turns OFF.

Spindle motor rotation direction



Clockwise direction

bitA. Indexing forward run command (WRN)
bitB. Indexing reverse run command (WRI)

This is valid when the orientation start command is ON.

WRI	WRN	Explanation
1 (ON)	**1 (ON)**	Setting prohibited.
0 (OFF)	**1 (ON)**	Indexing is carried out in the counterclockwise (CCW) direction looking from the motor end.
1 (ON)	**0 (OFF)**	Indexing is carried out in the clockwise (CW) direction looking from the motor end.
0 (OFF)	**0 (OFF)**	Indexing is not carried out.

bitC. Orientation start command (ORC)

This signal is used to start orientation. Orientation has a priority when the orientation start command is input.

ORC	Explanation
1 (ON)	Orientation starts regardless of the run command (SRN, SRI).
0 (OFF)	When a run command (SRN, SRI) is selected, the rotation starts again at the commanded speed.

bitD. L coil selection command (LCS)

This command is input to select the coil method for changing the coil. Note that coil changeover is not possible when orientation is commanded. The coil is fixed when the orientation command is input.

LCS	Explanation
1 (ON)	The low-speed command is selected.
0 (OFF)	The high-speed command is selected.

<<For MDS-C1-SP>>

bitE. Sub-motor selection command (MS)

This command input signal is used to select sub-motor when changing over 1-drive unit 2-motor (spindle motor/general purpose motor).

MS	Explanation
1 (ON)	Sub-motor is selected.
0 (OFF)	Main-motor is selected.

<<For MDS-C1-SPM>>

bitE. M coil selection command (MCS)

This command is input to select medium-speed coil when using the medium-speed coil.

MCS	Explanation
1 (ON)	Medium-speed command is selected.
0 (OFF)	High-speed command is selected.

bitF. Position changeover mode selection (PCHG)

This command is input to select changeover operation from speed control to position control (synchronous tap control, C-axis control and spindle synchronous control.)

PCHG	Explanation
1 (ON)	No zero point return is selected.
0 (OFF)	With zero point return is selected.

(4) Spindle control input 4

Name	Details
Spindle control input 4	(see bit tables below)

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
TLUP			OSPC	PYVC											

bit		Details
0		
1		
2		
3		
4		
5		
6		
7		
8		
9		
A		
B	PYVC	Minimum excitation rate changeover request
C	OSPC	Orientation speed changeover request
D		
E		
F	TLUP	Spindle holding force up

bitB. Minimum excitation rate changeover request (PYVC)

This command selects the minimum excitation rate of weak excitation control.
When SP033/bit8=1, the minimum excitation rate changes over from SP056 to SP116 by turning ON this signal.

Related spindle parameters

No.	Abbr.	Parameter name	Details	Setting range	Standard
SP056	PYVR	Variable excitation (min value)	Set the minimum value of the variable excitation rate. Select a smaller value when gear noise is too high. Lager value is more effective on impact response.	0 to 100 (%)	50
SP116	OPYVR	Minimum excitation value after changeover (2nd minimum excitation rate)	Set the minimum excitation rate when position control input or external input is selected.	0 to 100 (%)	0

bitC. Orientation speed changeover request (OSPC)

This command selects clamp speed for the orientation changeover operation.
When the orientation is started with control input 3/bitC(ORC)=1, the clamp speed changes over from SP005 to SP115 by turning ON this signal.

Related spindle parameters

No.	Abbr.	Parameter name	Details	Setting range	Standard
SP005	OSP*	Orientation mode speed clamp value	Set the motor speed limit value to be used when the speed loop is changed to the position loop in orientation mode. When this parameter is set to "0", SP017 (TSP) becomes the limit value.	0 to 32767 (r/min)	0
SP115	OSP2	Orientation control speed clamp value 2	When the orientation clamp speed is changed by the control input, this parameter setting will be used instead of SP005: OSP. Indexing speed clamp valid This parameter is used when (SP097: SPEC0/bit4 = 1).	0 to 32767 (r/min)	0

bitF. Spindle holding force up (TLUP)

The disturbance observer starts, and the servo rigidity increases. Refer to "5-3-5 (3) Disturbance observer" for details.

5-2-2 Spindle control output (SP to NC)

(1) Spindle control output 1

Name	Details
Spindle control output 1	

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
CL	INP	ZFIN		MAO	TL3A	TL2A	TL1A	ALM	PRMA		WRN			SON	RON

bit		Details
0	RON	In READY ON
1	SON	In servo ON
2		
3		
4	WRN	In drive unit warning
5		
6	PRMA	In parameter conversion
7	ALM	In drive unit alarm
8	TL1A	In torque limit 1 signal input
9	TL2A	In torque limit 2 signal input
A	TL3A	In torque limit 3 signal input
B	MAO	Magnetic pole position checked (Only for MDS-C1-SPM)
C		
D	ZFIN	Z-phase passed
E	INP	In position loop in-position
F	CL	Limiting current

bit0. In READY ON (RON)

When the READY ON signal is input from the NC, if there is no abnormality, this signal turns on in approx. one second. If the start signal (forward run, reverse run, orientation) is turned ON while this signal is ON, the motor will start rotating. If an alarm occurs in the spindle drive unit, this signal will turn OFF. If the READY ON signal from the NC turns OFF while the spindle motor is rotating, the motor will decelerate to a stop, but this signal will remain ON until the motor stops.

bit1. In servo ON (SON)

This signal turns ON after position control is switched when performing position control except for the orientation.

bit4. In drive unit warning (WRN)

This signal turns ON when a warning is occurring in the spindle drive unit.

bit6. In parameter conversion (PRMA)

The parameters sent from the NC are converted into effective parameters for spindle control.

bit7. In drive unit alarm (ALM)

This signal turns ON when an alarm is occurring in the spindle drive unit.

bit8. In torque limit 1 signal input (TL1A)
bit9. In torque limit 2 signal input (TL2A)
bitA. In torque limit 3 signal input (TL3A)

The respective signal turns ON when the torque limit signal 1 to 3 is input.

bitB. Magnetic pole position checked (MAO)

This signal turns ON when magnetic pole position is checked.

bitD. Z-phase passed (ZFIN)

This signal turns ON when the Z-phase is passed for the first time after servo ON during position control.

bitE. In position loop in-position (INP)

During position loop control, this signal turns ON if the position droop drops below the value set with SP153 (CINP) during C-axis control, SP185 (SINP) during spindle synchronous control, and SP217 (TINP) during synchronous tap control.

Related spindle parameters

No.	Abbr.	Parameter name	Details	Setting range	Standard
SP153	CINP	C-axis control in-position width	Set the position error range for outputting the in-position signal during C-axis control. (HEX setting)	0000 to FFFF (1/1000deg)	03E8
SP185	SINP	Spindle synchronous control In-position width	Set the position error range for output of the in-position signal in the spindle synchronous control mode.	1 to 2880 (1/16deg)	16
SP217	TINP	Synchronized tapping control in-position width	Set the position error range for output of the in-position during synchronized tapping control.	1 to 2880 (1/16deg)	16

bitF. Limiting current (CL)

This signal turns ON if a load higher than the spindle's excessive load withstand level is applied during spindle motor rotation. This may also turn ON during motor acceleration/deceleration.

(2) Spindle control output 2

Name	Details
Spindle control output 2	(see tables below)

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
	DARA		PARA												

bit		Details
0		
1		
2		
3		
4		
5		
6		
7		
8		
9		
A		
B		
C	PARA	In PS alarm history clear
D		
E	DARA	In alarm history in clear
F		

bitC. In PS alarm history clear (PARA)

This signal turns ON while clearing power supply alarm history.

bitE. In alarm history clear (DARA)

This signal turns ON while clearing drive alarm history.

(3) Spindle control output 3

Name	Details
Spindle control output 3	(see bit layout and bit details below)

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
		LCSA	ORCA	WRIA	WRNA	SRIA	SRNA		GR2A	GR1A	SC5A	SC4A	SC3A	SC2A	SC1A

bit		Details
0	SC1A	Inputting spindle control mode selection command 1 signal
1	SC2A	Inputting spindle control mode selection command 2 signal
2	SC3A	Inputting spindle control mode selection command 3 signal
3	SC4A	Inputting spindle control mode selection command 4 signal
4	SC5A	Inputting spindle control mode selection command 5 signal
5	GR1A	Inputting gear selection command 1 signal
6	GR2A	Inputting gear selection command 2 signal
7		
8	SRNA	Motor in forward run
9	SRIA	Motor in reverse run
A	WRNA	In forward run indexing
B	WRIA	In reverse run indexing
C	ORCA	In orientation start command signal
D	LCSA	L coil selected (when using the coil changeover motor)
E	MSA	<<For MDS-C1-SP>> In sub-motor selection (for 1-drive unit 2-motor changeover)
	MCSA	<<For MDS-C1-SPM>> In M coil selection (when using coil changeover motor)
F		

bit0. Inputting spindle control mode selection command 1 signal (SC1A)
bit1. Inputting spindle control mode selection command 2 signal (SC2A)
bit2. Inputting spindle control mode selection command 3 signal (SC3A)
bit3. Inputting spindle control mode selection command 4 signal (SC4A)
bit4. Inputting spindle control mode selection command 5 signal (SC5A)

The respective signal turns ON when the spindle control mode selection command 1 to 5 is input.

bit5. Inputting gear selection command 1 signal (GR1A)
bit6. Inputting gear selection command 2 signal (GR2A)

The respective signal turns ON when the gear selection command 1 or 2 is input.

bit8. Motor in forward run (SRNA)

This signal turns ON while the start signal is input and the motor is rotating in the CCW direction looking from the motor shaft. This signal may turn ON and OFF if the motor speed is several r/min or less.

bit9. Motor in reverse run (SRIA)

This signal turns ON while the start signal is input and the motor is rotating in the CW direction looking from the motor shaft. This signal may turn ON and OFF if the motor speed is several r/min or less.

bitA. In forward run indexing (WRNA)
bitB. In reverse run indexing (WRIA)

The corresponding output signal turns ON while forward run indexing (WRN) or reverse run indexing (WRI) is input to the spindle drive unit.

bitC. In orientation start command signal (ORCA)

This signal turns ON while the orientation start command (ORC) is input to the spindle drive unit.

bit D. L coil selected (LCSA)

This signal turns ON while the L coil selection signal (LCA) is input to the spindle drive unit.

<<For MDS-C1-SP>>
bitE. In sub-motor selection (MSA)

This signal turns ON when selecting sub-motor with 1-drive unit 2-motor specification.

<<For MDS-C1-SPM>>
bitE. In M coil selection (MCSA)

This signal turns ON when selecting medium-speed coil in case of using the medium-speed coil.

(4) Spindle control output 4

Name	Details
Spindle control output 4	

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
ORF2	TLUA	ATA	OSPA	PYVA		SD2	MTC	WRCF	MKC	SYSA	ORCF	ZS	US	SD1	CD

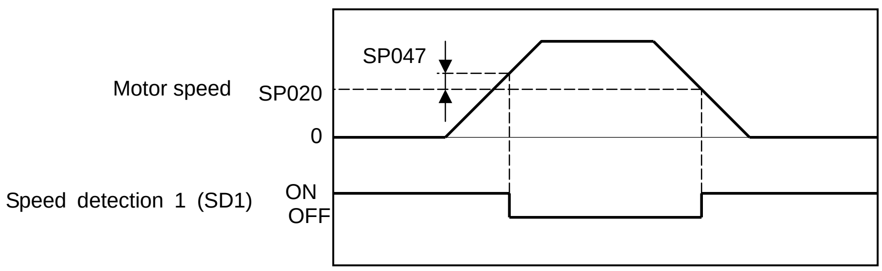
bit		Details
0	CD	Current detection
1	SD1	Speed detection 1
2	US	Up-to-speed
3	ZS	Zero speed
4	ORCF	Orientation complete
5	SYSA	Synchronous speed match
6	MKC	Changing coil
7	WRCF	Index positioning completed
8	MTC	In changeover (for 1-drive unit 2-motor changeover)
9	SD2	Speed detection 2
A		
B	PYVA	In minimum weak excitation value changeover
C	OSPA	Orientation speed changeover state
D	ATA	In automatic adjustment (only for MDS-C1-SPM)
E	TLUA	Spindle holding force increased
F	ORF2	2nd orientation completed

bit0. Current detection (CD)

This signal turns ON when the start signal (forward run, reverse run, orientation) is ON, and the current flowing to the motor is approx. 110% or more of the rating. (The motor output (current) guarantee value is 120% of the rating.)

bit1. Speed detection 1 (SD1)

This signal turns ON when the motor speed drops below the value set with parameter SP020 (SDTS). The ON to OFF hysteresis width is set with parameter SP047 (SDTR). This signal turns ON when the motor's speed is less than the set speed regardless of the input signal state.



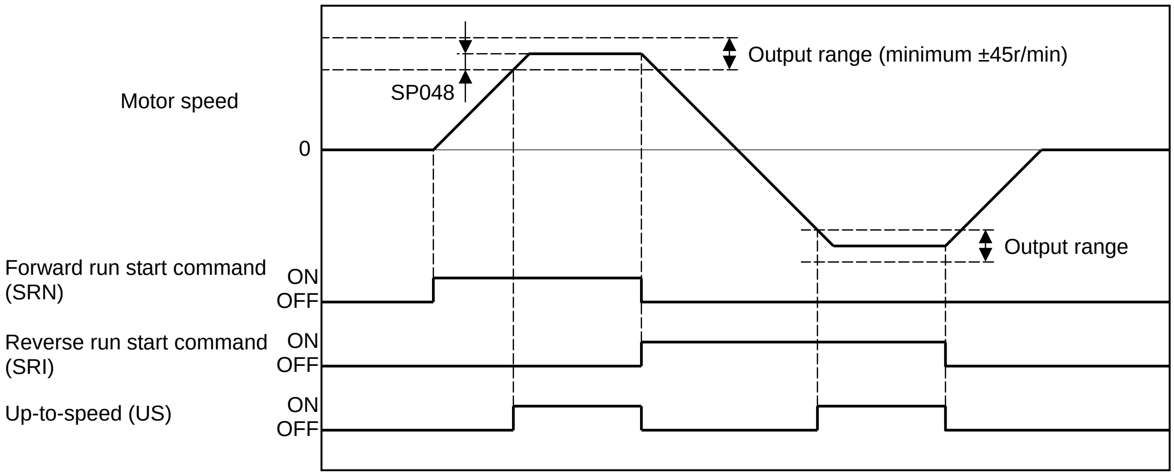
Speed detection 1 (SD1) sequence

Related spindle parameters

No.	Abbr.	Parameter name	Details	Setting range	Standard
SP020	SDTS*	Speed detection set value	Set the motor speed for which speed detection output is performed. Usually, the setting value is 10% of SP017 (TSP).	0 to 32767 (r/min)	600
SP047	SDTR*	Speed detection reset value	Set the reset hysteresis width for a speed detection set value defined in SP020 (SDTS).	0 to 1000 (r/min)	30

bit2. Up-to-speed (US)

This signal turns ON when the start command signal (forward run, reverse run) is ON, and the motor speed has reached a range of ±15% (standard value) of the speed command value. This signal turns OFF when the start command signal turns OFF. The up-to-speed output range can be set with the parameter SP048 (SUT). Even though the setting value is small, the output will be ±45r/min. Pay attention when speed command value is small.



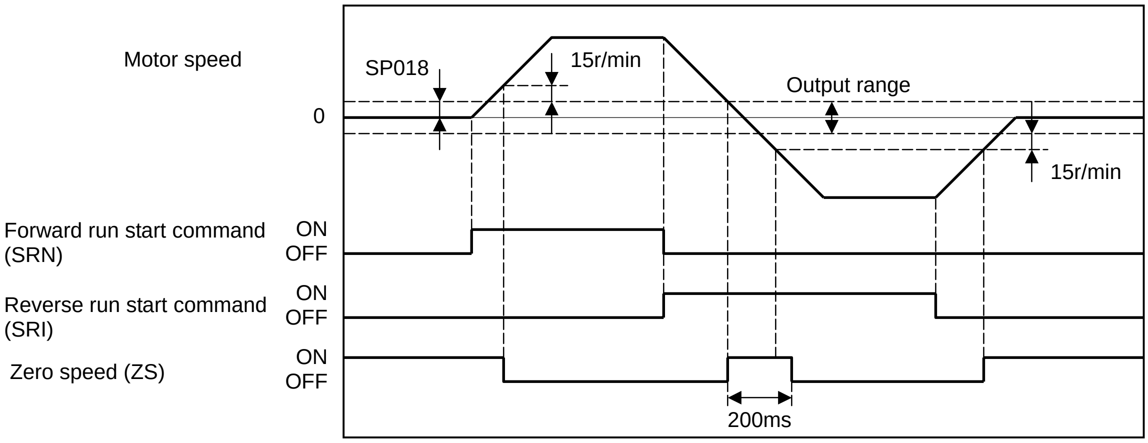
Up-to-speed (US) sequence

Related spindle parameter

No.	Abbr.	Parameter name	Details	Setting range	Standard
SP048	SUT*	Speed reach range	Set the speed deviation rate with respect to the commanded speed for output of the speed reach signal.	0 to 100 (%)	15

bit3. Zero speed (ZS)

Regardless of the input signal state, this signal turns ON when the motor speed drops below the value set with parameter SP018 (ZSP). Once this signal turns ON, it will not turn OFF for at least 200ms. When switching ON to OFF, hysteresis width is 15r/min. Note that if the parameter SP018 (ZSP) setting value is too small (approx. 10r/min or less), this signal may not be output even if the motor is stopped.



Zero speed (ZS) sequence

Related spindle parameter

No.	Abbr.	Parameter name	Details	Setting range	Standard
SP018	ZSP*	Motor zero speed	Set the motor speed for which zero-speed output is performed.	1 to 1000 (r/min)	50

bit4. Orientation complete (ORCA)

This signal turns ON when the orientation command is input, and the spindle position is reached the set range (within the in-position range) in respect to the target stop position. This signal turns OFF when orientation is completed and the spindle position deviates from the in-position range, but it will turn ON again when the spindle position enters the in-position range again. If the orientation command is turned OFF, this signal will turn OFF even if the spindle position is within the in-position range. The in-position range can be set with parameter SP004 (OINP).

Related spindle parameter

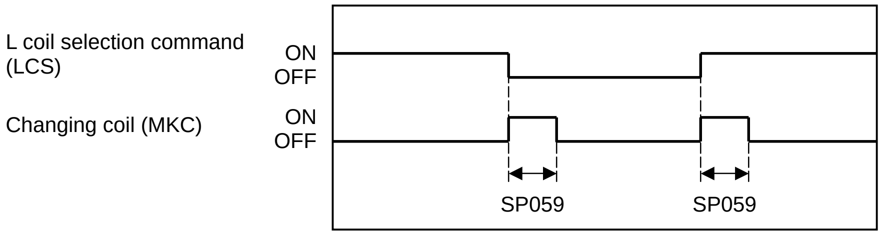
No.	Abbr.	Parameter name	Details	Setting range	Standard
SP004	OINP	Orientation in-position width	Set the position error range in which an orientation completion signal is output.	1 to 2880 (1/16deg)	16

bit5. Synchronous speed match (SYSA)

This signal turns ON during spindle synchronous control, when the mode can be changed from the speed operation mode to the spindle synchronous operation mode.

bit6. Changing coil (MKC)

When using the coil changeover motor, this signal turns ON for the time set in parameter SP059 (MKT) when the L coil selection command is turned ON or OFF. The coil is not changed when the orientation command is input, so this signal will not turn ON even if the L coil selection signal is turned ON or OFF. During orientation control, this signal will turn ON when the orientation command turns OFF and the coil changeover operation takes place. Do not turn the start signal ON or OFF while this signal is ON.



Changing coil (MKC) sequence

Related spindle parameter

No.	Abbr.	Parameter name	Details	Setting range	Standard
SP059	MKT*	Winding changeover base shut-off timer	Set the base shut-off time for contactor switching at coil changeover. Note that the contactor may be damaged with burning if the value of this parameter is too small.	50 to 10000 (ms)	150

bit7. Index positioning completed (WRCF)

This signal turns ON during indexing operation when the spindle position reaches the in-position range in respect to the target stop position. Once this signal turns ON it will remain ON regardless of the spindle position until the orientation signal turns OFF or the next indexing operation signal is input.

This signal will turn OFF for the time set with parameter SP103 (FTM) when the indexing operation signal is input even if the current stop point and the next indexing position are in the in-position range.

Related spindle parameter

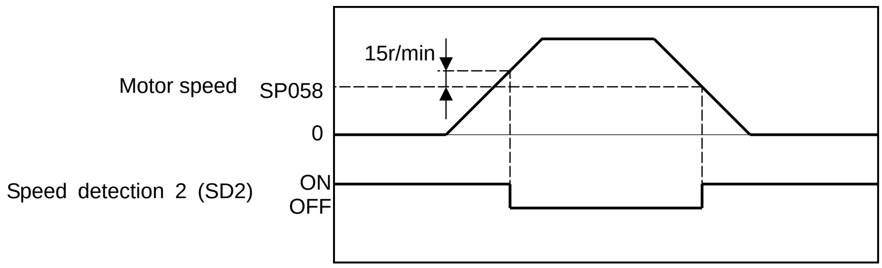
No.	Abbr.	Parameter name	Details	Setting range	Standard
SP103	FTM*	Index positioning completion OFF time timer	Set the time for forcedly turn OFF the index positioning completion signal (different from the orientation completion signal) after the leading edge of the indexing start signal.	0 to 10000 (ms)	200

bit8. In 1-drive unit 2-motor changeover (MTC)

This signal turns ON during motor changeover with 1-drive unit 2-motor specification.

bit9. Speed detection 2 (SD2)

This signal turns ON when the motor speed drops below the value set with parameter SP058 (SDT2). The ON to OFF hysteresis width is fixed at 15r/min. This signal turns ON when the motor speed drops below the set speed regardless of the input signal state.



Speed detection 2 (SD2) sequence

Related spindle parameter

No.	Abbr.	Parameter name	Details	Setting range	Standard
SP058	SDT2*	Speed detection setting value 2	Set the motor speed for carry out speed detection 2 output.	0 to 32767 (r/min)	0

bitB. In minimum weak excitation value changeover (PYDA)

This signal turns ON in response to minimum excitation changeover request (control input 4/bitB).

bitC. Orientation speed changeover state (OSPA)

This signal turns ON in response to orientation speed (control input 4/bitB).

bitD. In automatic adjustment (ATA)

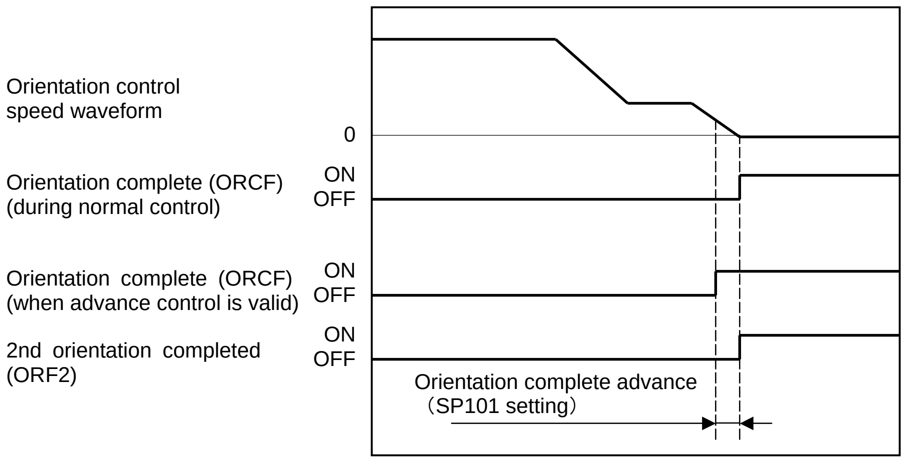
This signal turns ON while the spindle is starting during Z-phase automatic adjustment of the PLG with MDS-C1-SPM.

bitE. Spindle holding force increased (TLUA)

This signal turns ON while the spindle holding force up (TLUP) signal is input.

bitF. 2nd orientation complete (ORF2)

When orientation complete advance is valid, this signal turns ON as in-position width determined by required SP004 is reached.



Sequence of 2nd orientation completed (ORF2)

Related spindle parameters

No.	Abbr.	Parameter name	Details	Setting range	Standard
SP004	OINP	Orientation in-position width	Set the position error range in which an orientation completion signal is output.	1 to 2880 (1/16deg)	16
SP101	DINP*	Orientation advance in-position width	When using the orientation completed advance function, set the in-position width that is larger than the normal in-position width defined in SP004 (OINP).	1 to 2880 (1/16deg)	16
SP097	SPECO*	Orientation specification	(see below)		

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
ostp	orze	ksft	gchg		ips2	zdir		vg8x	mdir	fdir	oscl	pyfx	dmin	odi2	odi1

bit		Meaning when set to 0	Meaning when set to 1	Standard
2	dmin	Orientation completion advance invalid	Orientation completion advance valid	0
A	ips2	2nd orientation completion invalid	2nd orientation completion valid	0

5-3 Adjustment procedures for each control

5-3-1 Basic adjustments

(1) Items to check during trial operation

[1] Directly couple the motor and machine, and check the control status during machine run-in.
[2] Check that the command speed and actual speed match.
If the speeds do not match, check spindle parameters again.
(Especially check SP017, SP034, SP040 and SP257 to SP384.)
[3] Check the NC parameters Slimit1 to 4, Smax 1 to 4, and Smini.
[4] Is the rotation smooth?
[5] Is there any abnormal noise?
[6] Are there any abnormal odors?
[7] Has the bearing temperature risen abnormally?

(2) Adjusting the spindle rotation speed

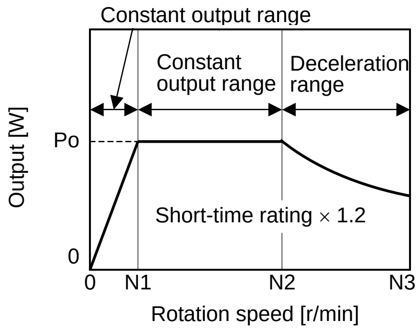
The rotation speed is received as digital signals from the NC, and thus does not need to be adjusted. If the spindle rotation speed does not match the commanded value due to a dimensional error, such as the pulley diameter, adjust the parameters with the following method.

[1] Set the spindle specification parameter slimit.
Slimit = SP017 × (deceleration rate between motor and spindle)
[2] Set the S command to half of the maximum spindle rotation speed, and then measure the spindle rotation speed.
If the speeds do not match, change the Slimit value in small increments until the speed matches.
[3] Set the S command to the maximum spindle rotation speed, and check whether the spindle rotation speed matches.
[4] In machines involving gear changeover, etc., change the gears, and then adjust with steps [1] to [3] above.

5-3-2 Adjusting the acceleration/deceleration operation

(1) Calculating the theoretical acceleration/deceleration time

Each theoretical acceleration/deceleration time is calculated for each output range based on the spindle motor output characteristics as shown on the right. Note that the load torque (friction torque, etc.) is 0 in this calculation expression, so the acceleration/deceleration time can be known as a rough guide, but this calculation result differs from the acceleration/deceleration time of the actual machine.



Output characteristics for acceleration/deceleration

(a) Maximum motor output during acceleration/deceleration: Po

During acceleration/deceleration operation, the motor can output at 120% of the short-time rating. Thus, the motor output Po in the constant output range during acceleration/deceleration follows the expression below.

Po = (Short-time rated output) × 1.2 [W]

(b) Total load inertia: J_{all}

The inertia of the total load which is accelerated and decelerated follows the expression below.

J_{all} = (Motor inertia) + (motor shaft conversion load inertia) [kg•m²] (Caution 1)

The acceleration/deceleration time until the rotation speed "N" to be required is calculated for each motor output range as shown below, using the values obtained in (a) and (b).

(c) Acceleration/deceleration time for constant torque range: t1···0 to N [r/min] (0≤N≤N1)
(For N>N1, apply N=N1 and also calculate t2 or t3.)

$$t1 = \frac{1.097 \times 10^{-2} \times J_{all} \times N1 \times N}{Po} \quad [s] \quad \text{(Caution 1)}$$

(d) Acceleration/deceleration time for constant output range: t2···N1 to N [r/min] (N1<N≤N2)
(For N>N2, apply N=N2 and also calculate t3.)

$$t2 = \frac{1.097 \times 10^{-2} \times J_{all} \times (N^2 - N1^2)}{2 \times Po} \quad [s] \quad \text{(Caution 1)}$$

(e) Acceleration/deceleration time in deceleration output range: t3···N2 to N [r/min] (N2<N≤N3)

$$t3 = \frac{1.097 \times 10^{-2} \times J_{all} \times (N^3 - N2^3)}{3 \times Po \times N2} \quad [s] \quad \text{(Caution 1)}$$

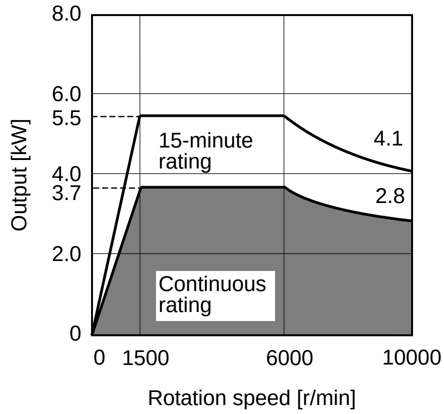
Based on the above expressions, the acceleration/deceleration time: t from 0 to N3 [r/min] is:

t = t1 + t2 + t3 [s] (Caution 2)

⚠ **CAUTION**	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.)

[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 0.059 [kg・m2], and when the motor shaft conversion load inertia is 0.2 [kg•m^2].



Spindle motor characteristics

Po = (Short-time rated output) x 1.2
= 5500 x 1.2 = 6600 [W]

J_{all} = (Motor inertia) + (load inertia)
= 0.0148 + 0.05 =0.0648 [kg・m^2]

$$t1 = \frac{1.097 \times 10^{-2} \times J_{all} \times N1^2}{Po} = \frac{1.097 \times 10^{-2} \times 0.0648 \times 1500^2}{6600} = 0.242\ [s]$$

$$t2 = \frac{1.097 \times 10^{-2} \times J_{all} \times (N2^2 - N1^2)}{2 \times Po} = \frac{1.097 \times 10^{-2} \times 0.0648 \times (6000^2 - 1500^2)}{2 \times 6600} = 1.818\ [s]$$

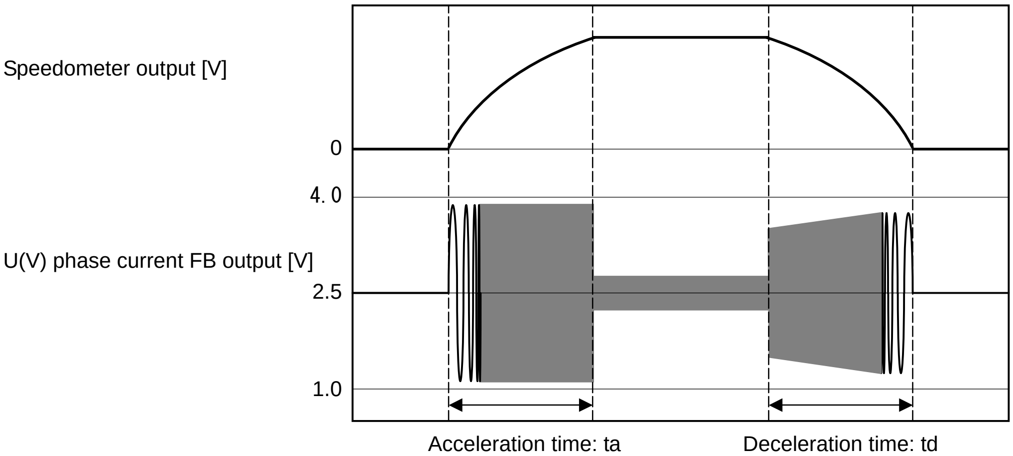
$$t3 = \frac{1.097 \times 10^{-2} \times J_{all} \times (N3^3 - N2^3)}{3 \times Po \times N2} = \frac{1.097 \times 10^{-2} \times 0.0648 \times (10000^3 - 6000^3)}{3 \times 6600 \times 6000} = 4.691\ [s]$$

Thus,

t = t1 + t2 + t3 = 0.242 + 1.818 + 4.691 = 6.751 [s]

(2) Measuring the acceleration/deceleration waveforms

Measure the acceleration/deceleration waveforms by using the spindle drive unit's D/A output function and check if theoretical acceleration/deceleration time is within ±15%. Refer to "5-1 D/A output specifications for spindle drive unit" for details on D/A output functions.
Phase current FB output can be measured by the waveform for either U or V phase FB.



Acceleration/deceleration waveforms of spindle motor

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

1. 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.
2. Conduct "3-5 Initial adjustment of spindle PLG" beforehand.

(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 speed cushion 1 (SP019). When the acceleration time is 10s or less, use the standard value 30 (300ms).
Alarm can be avoided by adjusting excessive speed deviation timer (SP055). 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.

No.	Abbr.	Parameter name	Details	Setting range	Standard
SP019	CSN1*	Speed cushion 1	Set the time constant for a speed command from "0" to the maximum speed. (This parameter is invalid during position loop control.)	1 to 32767 (10ms)	30
SP055	SETM*	Excessive speed deviation timer	Set the timer value until the excessive speed deviation alarm is output. The value of this parameter should be longer than the acceleration/deceleration time.	0 to 60 (s)	12

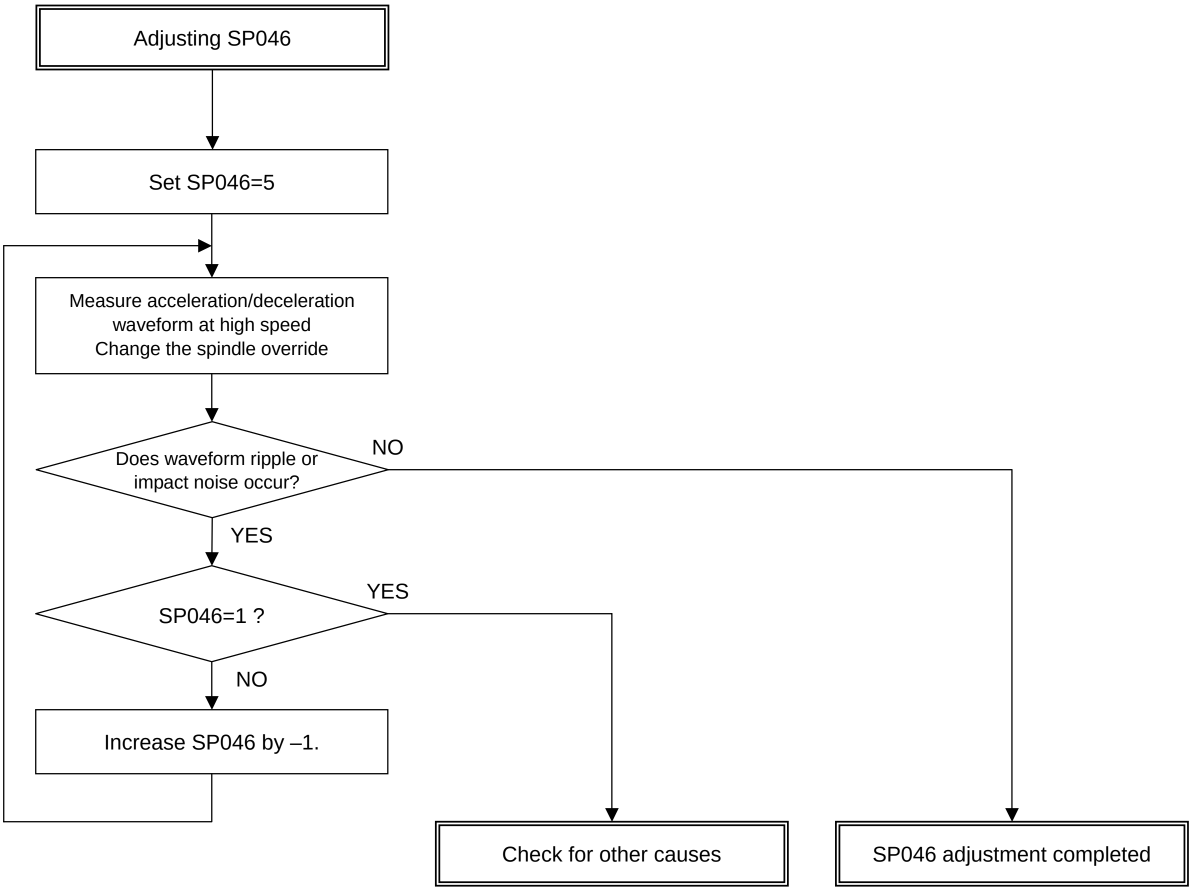
(4) Adjustment when machine system vibration (noise) is generated

When machine components such as gears produce vibration and noise, a machine resonance suppressing filter (notch filter) can be set to eliminate the vibration. At the SP070 parameter, specify the frequency of the vibration to be eliminated. This filter is enabled during all positioning control modes, including speed control, orientation control, and synchronous tap control. If vibration is generated or increased by setting this filter at low speeds, set a machine resonance suppressing filter activation speed (SP076) to prevent the vibration.
When noise from the spindle motor seems excessive, a low-pass filter (SP213) can be set to reduce the noise level. The low-pass filter frequency should be set as high as possible, as a low frequency setting can impair spindle control.

No.	Abbr.	Parameter name	Details	Setting range	Standard
SP070	FHz	Machine resonance suppression filter frequency	When machine vibration occurs in speed and position control, set the frequency of the required vibration suppression. Note that a value of 100Hz or more is set. Set to "0" when not used.	0 to 3000 (Hz)	0
SP076	FONS	Machine resonance suppression filter operation speed	When the vibration increases in motor stop (ex. in orientation stop) when the machine vibration suppression filter is operated by SP070, operate the machine vibration suppression filter at a speed of this parameter or more. When set to "0", this is validated for all speeds.	0 to 32767 (r/min)	0
SP213	LPF	Low path filter	<For MDS-C1-SP/SPH/SPM> Set to reduce the noise generated from the spindle motor Set the band of the low path filter	0 to 2250 (rad/s)	0
			<For MDS-C1-SPX/SPHX> Not used. Set to "0".	0	0

(5) Adjusting speed command dual-cushion

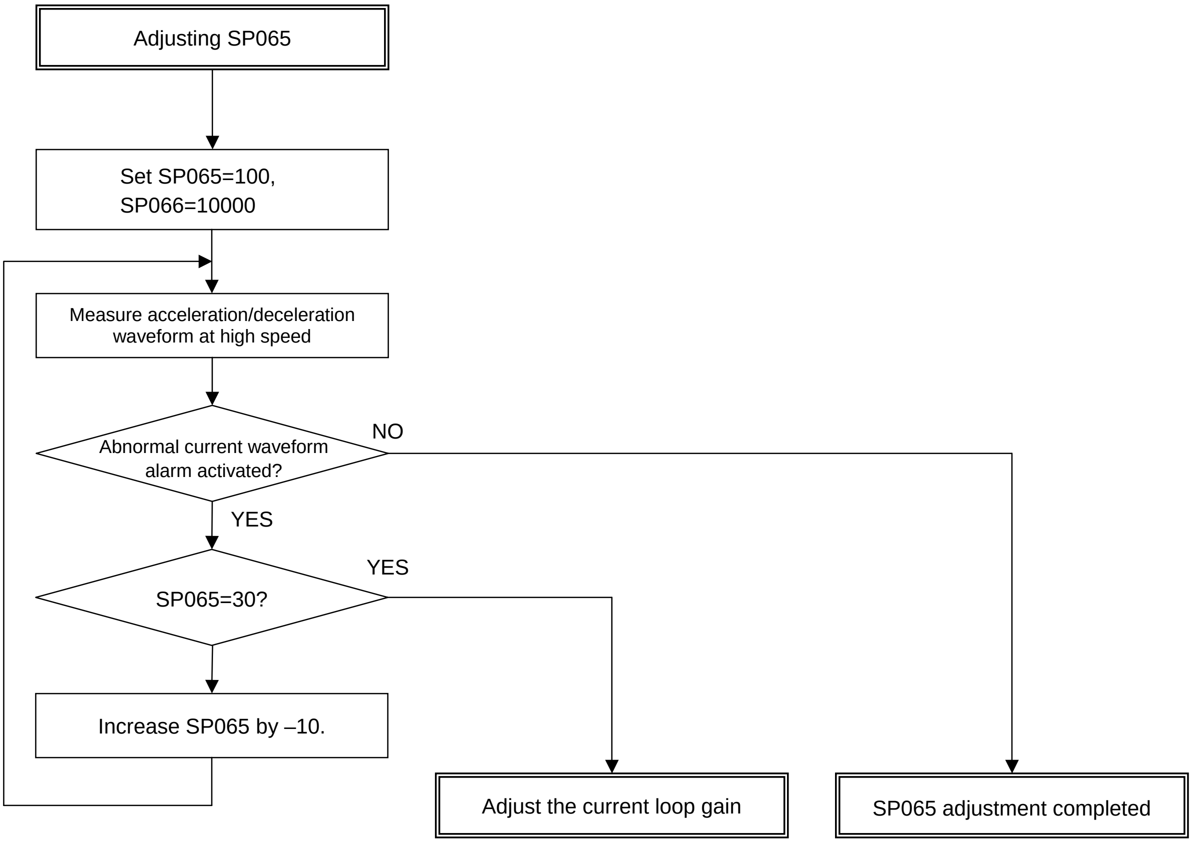
When a deceleration start causes rippling in the phase current FB waveform, or when a spindle override change causes gear impact noise, the speed command dual-cushion (SP046) setting should be adjusted. The smaller the SP046 setting value, the longer the acceleration/deceleration time. Therefore, set SP046 value as high as possible, while observing the phase current FB waveform, or while listening to the impact noise. (Setting upper limit = 5)

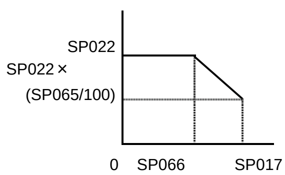


No.	Abbr.	Parameter name	Details	Setting range	Standard
SP046	CSN2*	Speed command dual cushion	For an acceleration/deceleration time constant defined in SP019 (CSN1) , this parameter is used to provide smooth movement only at the start of acceleration/deceleration. As the value of this parameter is smaller, it moves smoother but the acceleration/deceleration time becomes longer. To make this parameter invalid, set "0".	0 to 1000	0

(6) Adjusting speed loop gain

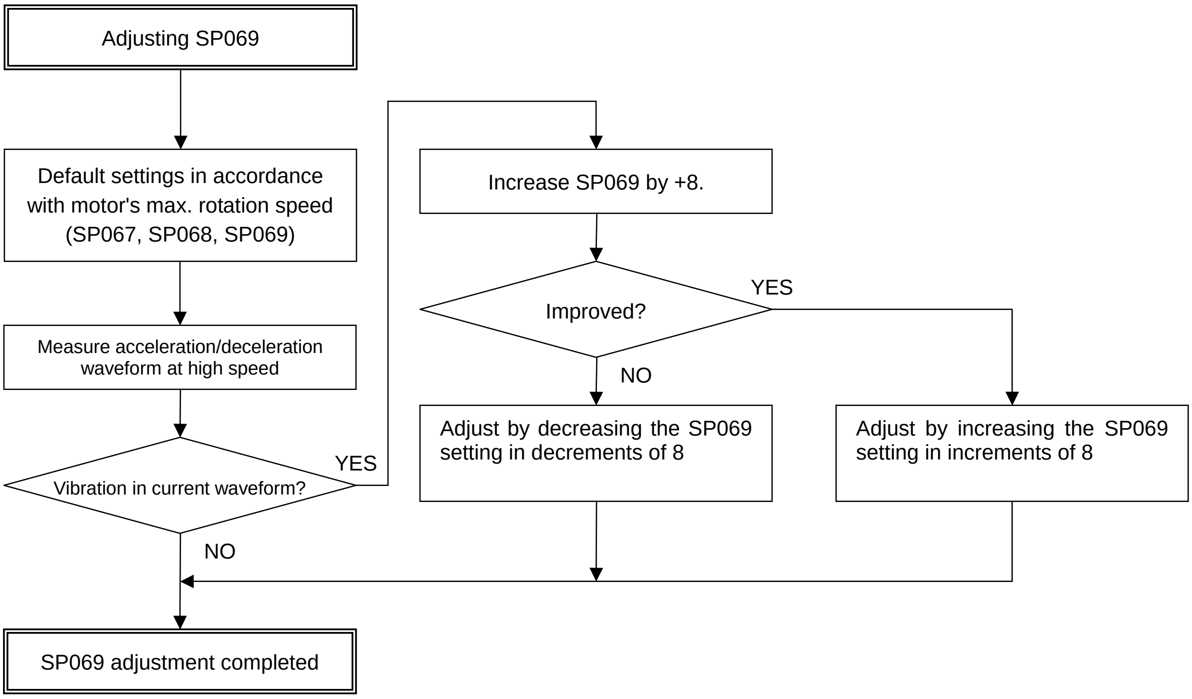
The speed loop gain adjustment is made to improve the high-speed range characteristics for speeds of 10,000r/min and higher. Use only the motor-specific standard settings for the basic parameters (SP022, SP023).
If the problems shown below occur during constant-speed operation at a speed of 10,000r/min or higher, adjust the target value of variable speed loop proportional gain (SP065) and the change starting speed of variable speed loop proportional gain (SP066) parameter settings.
1) A swell or spike appears in the current waveform
2) An overvoltage condition (alarm 32) occurs
If the maximum speed is 10,000 r/min or less, or if no improvement is seen after adjusting the speed loop gain, then adjust the current loop gain.

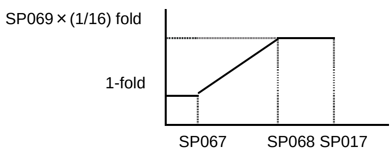


No.	Abbr.	Parameter name	Details	Setting range	Standard
SP022	VGNP1*	Speed loop gain proportional term under speed control	Basically, use standard setting value set for each motor.	0 to 1000	63
SP023	VGMI1*	Speed loop gain integral term under speed control		0 to 1000	60
SP065	VCGN1*	Target value of variable speed loop proportional gain	Set the magnification of speed loop proportional gain with respect to SP022 (VGNP1) at the maximum motor speed defined in SP017 (TSP).	0 to 100 (%)	100
SP066	VCSN1*	Change starting speed of variable speed loop proportional gain	Set the speed when the speed loop proportional gain change starts. Set 10,000 normally. 	0 to 32767 (r/min)	0

(7) Adjusting current loop gain

Although the default setting value is usually appropriate, an adjustment may be required if slight vibration occurs at high spindle motor rotating. In such cases, adjust the target value of variable current loop gain (SP069) parameter setting while observing the current waveform in the high-speed range. Adjust until the output waveform to the spindle motor stabilizes.
Set the change starting/ending speed of variable current loop gain (SP067 and SP068) parameters in accordance with the motor's maximum rotation speed.



<table>
<tr><th>No.</th><th>Abbr.</th><th>Parameter name</th><th>Details</th><th>Setting range</th><th>Standard</th></tr>
<tr><td>SP067</td><td>VIGWA*</td><td>Change starting speed of variable current loop gain</td><td>Set the speed where the current loop gain change starts.</td><td>0 to 32767
(r/min)</td><td>0</td></tr>
<tr><td>SP068</td><td>VIGWB*</td><td>Change ending speed of variable current loop gain</td><td>Set the speed where the current loop gain change ends.</td><td>0 to 32767
(r/min)</td><td>0</td></tr>
<tr><td>SP069</td><td>VIGN*</td><td>Target value of variable
current loop gain</td><td>Set the magnification of current loop gain (torque component and excitation component) for a change ending speed defined in SP068 (VIGWB).
When this parameter is set to "0", the magnification is 1.


<table>
<tr><th>SP017(TSP)
Maximum motor speed</th><th colspan="3">Setting value</th></tr>
<tr><th></th><th>SP067
(VIGWA)</th><th>SP068
(VIGWB)</th><th>SP069
(VIGN)</th></tr>
<tr><td>0 to 6000</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>6001 to 8000</td><td>5000</td><td>8000</td><td>45</td></tr>
<tr><td>8001 or more</td><td>5000</td><td>10000</td><td>64</td></tr>
</table></td><td>0 to 32767
(1/16-fold)</td><td>0</td></tr>
</table>

(8) Adjusting excitation rate

If the motor noise is excessive during constant-speed operation, adjust the variable excitation (SP056) value downward in decrements of 10 from the standard setting of 50 (setting lower limit = 25). The SP033/bit9 parameter setting is an effective way to reduce noise for high-speed operation only (it lowers the excitation rate for high-speed operation only).

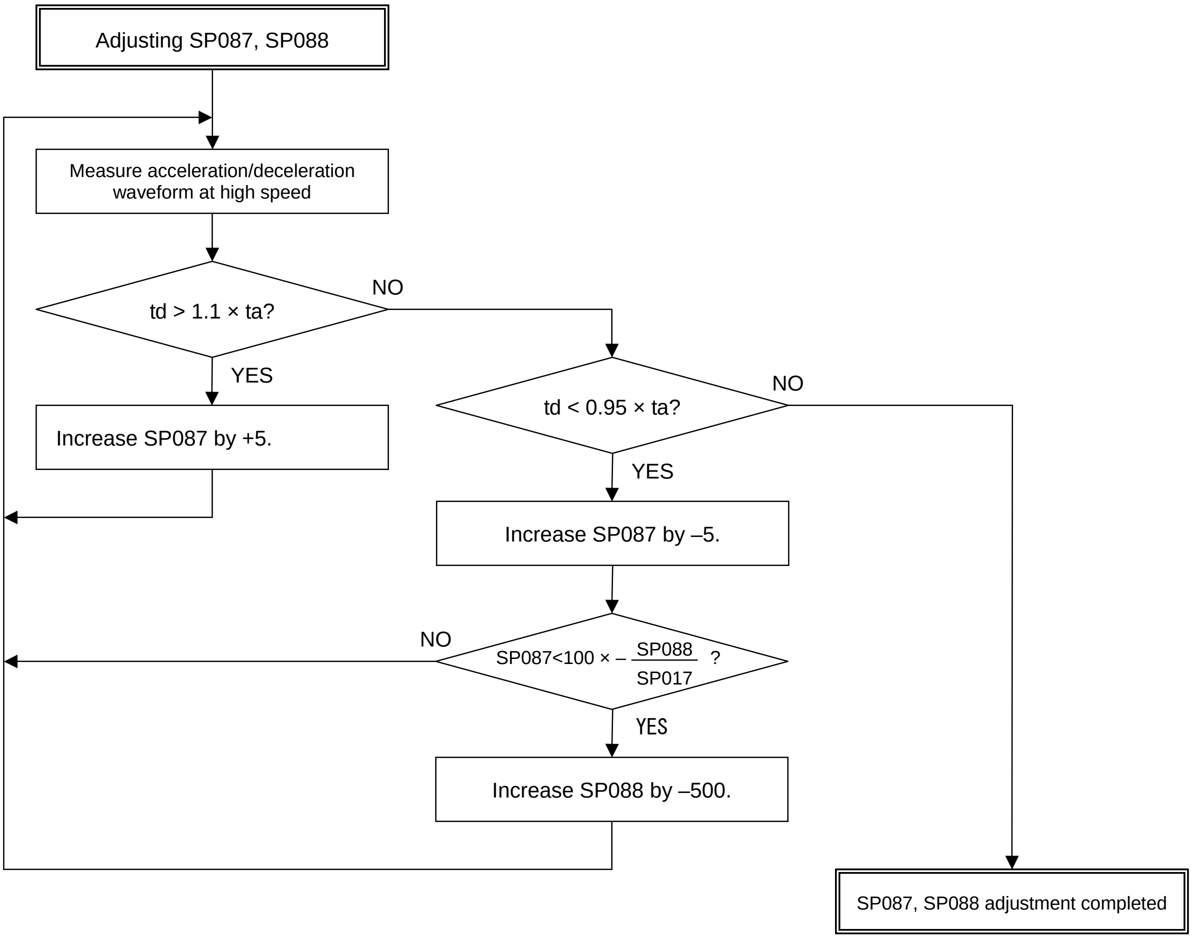
No.	Abbr.	Parameter name	Details	Setting range	Standard
SP056	PYVR	Variable excitation (min value)	Set the minimum value of the variable excitation rate. Select a smaller value when gear noise is too high. Larger value is more effective on impact response.	0 to 100 (%)	50
SP033	SFNC1*	Spindle function 1	<For MDS-C1-SP/SPH/SPX/SPHX>		

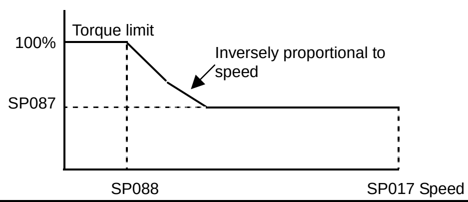
F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
poff	hzs		ront			pycal	pychg	pyst	pyoff				sftk	dflt	1a2m

bit		Meaning when set to 0	Meaning when set to 1	Standard
9	pycal	(Conventional specifications)	High-speed rate deceleration method valid for minimum excitation rate	0

(9) Adjusting deceleration time

When the deceleration time "td" is significantly different from the acceleration time "ta" (td < 0.95 × ta, 1.1 × 1a < td) and no problem with the acceleration time, adjust the deceleration time by changing the target value of variable torque limit magnification at deceleration (SP087) setting. In cases, however, where the variable torque characteristic cannot be lowered to the SP087 level, adjust by changing the speed for starting change of variable torque limit magnification at deceleration (SP088) setting.



No.	Abbr.	Parameter name	Details	Setting range	Standard
SP087	DIQM*	Target value of variable torque limit magnification at deceleration	Set the minimum value of variable torque limit at deceleration.	0 to 150 (%)	75
SP088	DIQN*	Speed for starting change of variable torque limit magnification at deceleration	Set the speed where the torque limit value at deceleration starts to change. 	0 to 32767 (r/min)	3000

5-3-3 Adjusting the orientation control

(1) Confirming the default parameters

Set the default parameters for each detector used in orientation control.

(a) Motor PLG

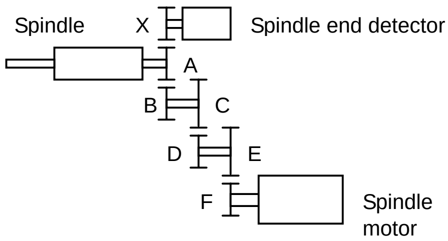
Motor PLG orientation is possible only when the spindle and motor are coupled, or when they are coupled 1:1 with gears (timing belt). The SP025 (GRA1) to SP032 (GRB4) parameters can be set only to 1. The PLG with Z-phase must be mounted on the motor to be used.

(b) Spindle end detector

An accurate gear ratio (pulley ratio) is required from the motor shaft to the spindle end detector rotary axis.
Make sure that the correct number of gear teeth is set in SP025 (GRA1) to SP032 (GRB4).

SP025 to SP028=A × C × E
SP029 to SP032=B × D × F

Set the gear ratio (A:X) between the spindle and spindle end detector in SP096 (EGAR).



Spindle configuration when using spindle end detector

No.	Abbr.	Parameter name	Details	Setting range	Standard
SP096	EGAR*	Encoder gear ratio	Set the gear ratio between the spindle end and the detector end (except for the motor PLG) as indicated below.	-3 to 4	0

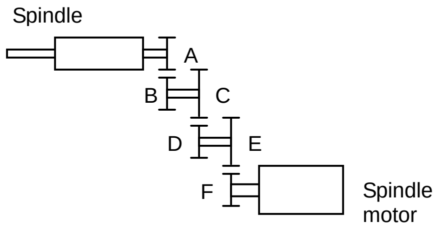
Setting value	Gear ratio (deceleration)	Setting value	Gear ratio (acceleration)
0	1 : 1	-1	1 : 2
1	1 : 1/2	-2	1 : 4
2	1 : 1/4	-3	1 : 3
3	1 : 1/8		
4	1 : 1/16		

(c) Magnetic sensor

An accurate gear ratio (pulley ratio) is required from the motor shaft to the detector rotary axis. Make sure that the correct number of gear teeth is set in SP025 (GRA1) to SP032 (GRB1).

SP025 to SP028=A × C × E
SP029 to SP032=B × D × F

The SP123 (MGD0) to SP125 (MGD2) parameters are set as shown below according to the magnetic sensor type.



Spindle configuration when using magnetic sensor

<table>
<tr><th rowspan="2">Type</th><th rowspan="2">Magnetic sensor type</th><th colspan="3">Parameter setting</th></tr>
<tr><th>SP123 (MGD0)</th><th>SP124 (MGD1)</th><th>SP125 (MGD2)</th></tr>
<tr><td>Standard</td><td>MAGNETIC SENSOR BKO-C1810H01-3</td><td rowspan="2">542</td><td rowspan="2">768</td><td rowspan="2">384</td></tr>
<tr><td>High-speed standard</td><td>MAGNETIC SENSOR BKO-C1730H01.2.6</td></tr>
<tr><td>High-speed compact</td><td>MAGNETIC SENSOR BKO-C1730H01.2.9</td><td rowspan="5">500</td><td rowspan="5">440</td><td rowspan="5">220</td></tr>
<tr><td rowspan="4">High-speed ring type</td><td>MAGNETIC SENSOR BKO-C1730H01.2.41</td></tr>
<tr><td>MAGNETIC SENSOR BKO-C1730H01.2.42</td></tr>
<tr><td>MAGNETIC SENSOR BKO-C1730H01.2.43</td></tr>
<tr><td>MAGNETIC SENSOR BKO-C1730H01.2.44</td></tr>
</table>

POINT

When using the magnetic sensor, orientation control cannot be carried out with a machine having a gear ratio between the spindle motor and spindle exceeding 1:31.

The default orientation control parameters for each detector are as shown below. Confirm that these parameters are correctly set according to the machine specifications.

No.	Abbr.	Parameter name	Default parameter settings for detector in use		
			(a) Motor PLG	(b) Spindle end detector	(c) Magnetic sensor
SP001	PGM	Magnetic sensor and motor PLG orientation position loop gain	100	-	100
SP002	PGE	Encoder orientation position loop gain	-	100	-
SP004	OINP	Orientation in-position width	16	16	16
SP005	OSP*	Orientation mode speed clamp value	0	0	0
SP006	CSP	Orientation mode deceleration rate	20	20	20
SP007	OPST	In-position shift amount for orientation	0	0	0
SP025	GRA1*	Spindle gear teeth count 1	1	*	*
SP026	GRA2*	Spindle gear teeth count 2	1	*	*
SP027	GRA3*	Spindle gear teeth count 3	1	*	*
SP028	GRA4*	Spindle gear teeth count 4	1	*	*
SP029	GRB1*	Motor shaft gear teeth count 1	1	*	*
SP030	GRB2*	Motor shaft gear teeth count 2	1	*	*
SP031	GRB3*	Motor shaft gear teeth count 3	1	*	*
SP032	GRB4*	Motor shaft gear teeth count 4	1	*	*
SP037	SFNC5*	Spindle function 5	0004	0001	0002
SP096	EGAR*	Encoder gear ratio	-	*	-
SP097	SPECO*	Orientation specification	0000	0000	0000
SP098	VGOP*	Speed loop gain proportional term in orientation mode	63	63	63
SP099	VGOI*	Speed loop gain integral term in orientation mode	60	60	60
SP100	VGOD*	Speed loop gain delay advance term in orientation mode	15	15	15
SP101	DINP*	Orientation advance in-position width	16	16	16
SP102	OODR*	Excessive error value in orientation mode	32767	32767	32767
SP103	FTM*	Index positioning completion OFF time timer	200	200	200
SP104	TLOR*	Torque limit value after orientation completed	100	100	100
SP105	IQGO*	Current loop gain magnification 1 in orientation mode	100	100	100
SP106	IDGO*	Current loop gain magnification 2 in orientation mode	100	100	100
SP107	CSP2	Deceleration rate 2 in orientation mode	0	0	0
SP108	CSP3	Deceleration rate 3 in orientation mode	0	0	0
SP109	CSP4	Deceleration rate 4 in orientation mode	0	0	0
SP114	OPER	Orientation pulse miss check value	0	0	0
SP115	OSP2	Orientation control speed clamp value 2	0	0	0
SP116	OPYVR	Minimum excitation value after changeover (2nd minimum excitation rate)	0	0	0
SP117	ORUT	Fixed control constant	0	0	0
SP118	ORCT	Orientation control number of retry times	0	0	0
SP119	MPGH	Orientation control position loop gain H coil magnification	0	0	0
SP120	MPGL	Orientation control position loop gain L coil magnification	0	0	0
SP121	MPCSH	Orientation deceleration rate H coil magnification	0	0	0
SP122	MPCSL	Orientation deceleration rate L coil magnification	0	0	0
SP123	MGD0	Magnetic sensor output peak value	-	-	Standard: 542 Small type: 500
SP124	MGD1	Magnetic sensor linear zone width	-	-	Standard: 768 Small type: 440
SP125	MGD2	Magnetic sensor changeover point	-	-	Standard: 384 Small type: 220

(Note 1) *: Set according to machine specifications, -: Setting irrelevant
(Note 2) Parameters with an asterisk in the Abbrev. column (such as OSP*) are validated when the NC power is turned ON again.

No.	Abbr.	Parameter name	Default parameter settings for detector in use		
			(a) Motor PLG	(b) Spindle detector	(c) Magnetic sensor
SP126	MPGM	Orientation position loop gain M coil magnification	0	0	0
SP127	MPCSM	Orientation deceleration rate M coil magnification	0	0	0
SP128	OXKPM	After orientation completion, Position loop gain magnification (M coil)	0	0	0
SP225	OXKPH	Position loop gain magnification after orientation completed (H coil)	0	0	0
SP226	OXKPL	Position loop gain magnification after orientation completed (L coil)	0	0	0
SP227	OXVKP	Speed loop proportional gain magnification after orientation completed	0	0	0
SP228	OXVKI	Speed loop cumulative gain magnification after orientation completed	0	0	0

(Note 1) *: Set according to machine specifications, -: Setting irrelevant
(Note 2) Parameters with an asterisk in the Abbrev. column (such as OSP*) are validated when the NC power is turned ON again.

(2) Adjusting the orientation deceleration control

[1] Polarity setting of sensor

Input the orientation command (ORC) when the machine is in the normal state. Confirm that the operation stops at one point and the orientation complete signal (ORCF) turns ON even when the operation is unstable. If the excessive error alarm (alarm 52) occurs, or if the operation does not stop and repeats forward/reverse run at a low-speed when using the magnetic sensor orientation specifications, change the value for SP097/bit5 or bit6. If the excessive error alarm occurs even after changing this value, carry out step [3].

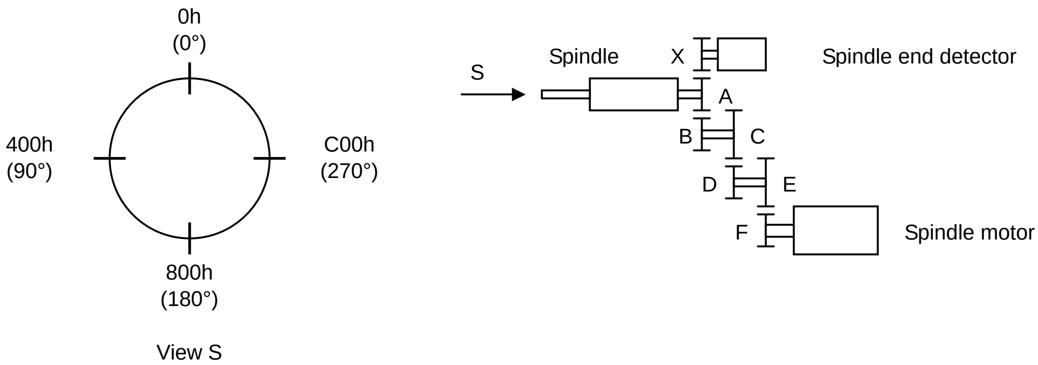
No.	Abbr.	Parameter name	Details
SP097	SPECO*	Orientation specification	(see bit tables below)

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
ostp	orze	ksft	gchg		ips2	zdir		vg8x	mdir	fdir	Oscl	pyfx	dmin	odi2	odi1

bit		Meaning when set to 0	Meaning when set to 1	Standard
5	fdir	Spindle end detector polarity: +	Spindle end detector polarity: –	0
6	mdir	Magnetic sensor polarity: +	Magnetic sensor polarity: –	0

[2] Adjustment of orientation stop position

Next, adjust the in-position shift amount for orientation control: SP007 (OPST) so that the axis stops at the target stop point. If the stop position command data is input from the spindle end detector, or from an external source during motor PLG orientation, the operation will stop according to the given data as shown in the drawing below regardless of the detector's mounting direction. The 0° position shown below is the position shifted by SP007 (OPST).



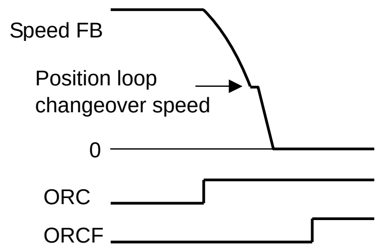
Orientation stop position

(Note) The external stop position command data is read in at the rising edge of the orientation start, so always change the value before inputting the orientation start command. Any changes to the value will be invalid if made after orientation has started.

No.	Abbr.	Parameter name	Details	Setting range	Standard
SP007	OPST	In-position shift amount for orientation	Set the stop position for orientation. (1) Motor PLG, spindle end detector: Set the value by dividing 360° by 4096. (2) Magnetic sensor: Divide –5° to +5° by 1024 and put 0° for 0.	(1) 0 to 4095 (2) -512 to 512	0

[3] Adjustment of position loop gain deceleration rate

Adjust the orientation time and vibration. Refer to the following table and adjust the parameters according to the apparent state. When using the motor PLG and magnetic sensor, adjust the position loop gain with SP001 (PGM). When using the spindle end detector, adjust SP002 (PGE). Adjust SP006 (CSP) after adjusting SP001 and PS002. When performing coil change over, each coil can be adjusted individually. (Refer to the next page.)



Adjusting the orientation control

State	Parameter adjustment	
	SP001/SP002	SP006
The operation overshoots when stopping	Decrease the setting value	Decrease the setting value
The orientation time is long	Increase the setting value	Increase the setting value
Hunting occurs when stopping	Decrease the setting value	Do not change the setting value
An excessive error alarm occurs	Decrease the setting value	Decrease the setting value

To adjust the shortest orientation time for each gear, adjust deceleration rate for each gear by SP107 (CSP2) to SP109 (CSP4) in the same manner. If an excessive error alarm occurs when the gear ratio is 1:10 or more, and the state is not improved with the above adjustments, adjust the speed clamp value (SP005) as described later.

No.	Abbr.	Parameter name	Details	Setting range	Standard
SP001	PGM	Magnetic sensor, motor PLG orientation position loop gain	The orientation time will be shorter when the value is increased, and the servo rigidity will increase. On the other hand, the vibration will increase, and the machine will sway easily.	0 to1000 (0.1rad/s)	100
SP002	PGE	Encoder orientation position loop gain	<For MDS-C1-SP/SPH/SPM> The orientation time will be shorter when the value is increased, and the servo rigidity will increase. On the other hand, the vibration will increase, and the machine will sway easily.	0 to 1000 (0.1rad/s)	100
			<For MDS-C1-SPX/SPHX> Set the position loop gain for spindle end PLG orientation.		
SP006	CSP	Orientation mode deceleration rate	As the set value is larger, the orientation time becomes shorter. However, the machine becomes likely to overshoot.	1 to 1000	20
SP107	CSP2	Deceleration rate 2 in orientation control mode	Set the deceleration rate in orientation mode corresponding to the gear 001. When this parameter is set to "0", same as SP006 (CSP).	0 to 1000	0
SP108	CSP3	Deceleration rate 3 in orientation control mode	Set the deceleration rate in orientation mode corresponding to the gear 010. When this parameter is set to "0", same as SP006 (CSP).	0 to 1000	0
SP109	CSP4	Deceleration rate 4 in orientation control mode	Set the deceleration rate in orientation mode corresponding to the gear 011. When this parameter is set to "0", same as SP006 (CSP).	0 to 1000	0

POINT

On machines with large spindle-to-motor gear ratios, it may not be possible to achieve the desired results by adjusting the SP001, SP002, and SP006 parameters, due to internal clamping. When clamped, the parameter settings can be changed, but control remains unchanged.

[4] Position loop gain and deceleration rate adjustment at coil changeovers

When using a coil changeover motor, the position loop gain and deceleration rate can be set for each coil.

- **Coil-specific orientation control position loop gain**

Compensation magnification values are set for each coil by the SP119, SP120 and SP126 settings, relative to each coil's SP001 or SP002 position loop gain reference value. If a "0" is set, the SP001 (SP002) setting is adopted.

$$\text{Effective position loop gain (H-coil)} = \text{SP001 (SP002)} \times \frac{\text{SP119}}{256}$$

$$\text{Effective position loop gain (L-coil)} = \text{SP001 (SP002)} \times \frac{\text{SP120}}{256}$$

<<Only for MDS-C1-SPM>>

$$\text{Effective position loop gain (M-coil)} = \text{SP001 (SP002)} \times \frac{\text{SP126}}{256}$$

No.	Abbr.	Parameter name	Details	Setting range	Standard
SP119	MPGH	Orientation control position loop gain H coil magnification	Set the compensation magnification of the orientation position loop gain for the H coil.	0 to 2560 (1/256-fold)	0
SP120	MPGL	Orientation control position loop gain L coil magnification	Set the compensation magnification of the orientation position loop gain for the L coil.	0 to 2560 (1/256-fold)	0
SP126	MPGM	Orientation position loop gain M coil magnification	<For MDS-C1-SPM> Set the compensation magnification of the orientation position loop gain for the M coil.	0 to 2560 (1/256-fold)	0

- **Coil-specific orientation control deceleration rate**

Compensation magnification values are specified for each coil by the SP121, SP122 and SP127 settings, relative to each coil's SP006 deceleration rate reference value. If a "0" is set, the SP006 setting is adopted.

$$\text{Effective deceleration rate (H coil)} = \text{SP006} \times \frac{\text{SP121}}{256}$$

$$\text{Effective deceleration rate (L coil)} = \text{SP006} \times \frac{\text{SP122}}{256}$$

<<Only for MDS-C1-SPM>>

$$\text{Effective deceleration rate (M coil)} = \text{SP006} \times \frac{\text{SP127}}{256}$$

No.	Abbr.	Parameter name	Details	Setting range	Standard
SP121	MPCSH	Orientation deceleration rate H coil magnification	Set the compensation magnification of the orientation deceleration rate for the H coil.	0 to 2560 (1/256-fold)	0
SP122	MPCSL	Orientation deceleration rate L coil magnification	Set the compensation magnification of the orientation deceleration rate for the L coil.	0 to 2560 (1/256-fold)	0
SP127	MPCSM	Orientation deceleration rate M coil magnification	<For MDS-C1-SPM> Set the compensation magnification of the orientation deceleration rate for the M coil.	0 to 2560 (1/256-fold)	0

[5] Speed clamp value adjustment

The orientation control mode's position loop control changing speed is determined automatically, based on the position loop gain, the deceleration rate, and the gear ratio, etc. A changing speed that is too high can be limited by the orientation mode changing speed limit value (SP005) setting. A change to the orientation motor speed clamp value 2 (SP115) occurs at control input 4/bitC.

No.	Abbr.	Parameter name	Details	Setting range	Standard
SP005	OSP*	Orientation mode speed clamp value	Set the motor speed limit value to be used when the speed loop is changed to the position loop in orientation mode. When this parameter is set to "0", SP017 (TSP) becomes the limit value.	0 to 32767 (r/min)	0
SP115	OSP2	Orientation control speed clamp value 2	When the orientation clamp speed is changed by the control input, this parameter setting will be used instead of SP005: OSP. Indexing speed clamp valid This parameter is used when (SP097: SPEC0/bit4 = 1).	0 to 32767 (r/min)	0

For MDS-C1-SPH, SP037/bitD=1 setting can be used to set a clamp speed that is the same as the spindle end speed. At gear changes, too, the spindle speed is clamped at the same speed. The clamp speed parameter is the same as that used to set the motor speed.

No.	Abbr.	Parameter name	Details	Setting range	Standard
SP037	SFNC5*	Spindle function 5	(see bit tables below)		

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
splg	dplg	ospcl			noplg	nsno	nosg						plgo	mago	enco

bit		Meaning when set to 0	Meaning when set to 1	Standard
D	ospcl	Orientation speed clamp motor speed setting	Orientation speed clamp spindle speed setting	0

(Note) bitD is valid only for MDS-C1-SPH.

(3) Adjustments during orientation stop

[1] Position loop gain adjustment

Stop position accuracy can be improved by increasing the post-orientation servo rigidity. To increase the post-orientation position loop gain, enable a gain change by the SP097/bitC parameter setting, then set the desired position loop gain magnification. A separate position loop gain (other than that used during deceleration) can be set for operation that begins from the orientation completed ON status that follows orientation deceleration control.

The effective position loop gain values for each coil are calculated using the formulas shown below. If a magnification setting of "0" is set, a "256" setting is adopted.

$$\text{Effective position loop gain (H coil)} = \text{SP001 (SP002)} \times \frac{\text{SP119}}{256} \times \frac{\text{SP225}}{256}$$

$$\text{Effective position loop gain (L coil)} = \text{SP001 (SP002)} \times \frac{\text{SP120}}{256} \times \frac{\text{SP226}}{256}$$

<<Only for MDS-C1-SPM>>

$$\text{Effective position loop gain (M coil)} = \text{SP001 (SP002)} \times \frac{\text{SP126}}{256} \times \frac{\text{SP128}}{256}$$

<table>
<tr><th>No.</th><th>Abbr.</th><th>Parameter name</th><th>Details</th><th>Setting range</th><th>Standard</th></tr>
<tr><td>SP001</td><td>PGM</td><td>Magnetic sensor, motor PLG orientation position loop gain</td><td>The orientation time will be shorter when the value is increased, and the servo rigidity will increase. On the other hand, the vibration will increase, and the machine will sway easily.</td><td>0 to1000
(0.1rad/s)</td><td>100</td></tr>
<tr><td>SP002</td><td>PGE</td><td>Encoder orientation position loop gain</td><td><For MDS-C1-SP/SPH/SPM>
The orientation time will be shorter when the value is increased, and the servo rigidity will increase. On the other hand, the vibration will increase, and the machine will sway easily.

<For MDS-C1-SPX/SPHX>
Set the position loop gain for spindle end PLG orientation.</td><td>0 to 1000
(0.1rad/s)</td><td>100</td></tr>
<tr><td>SP097</td><td>SPECO*</td><td>Orientation specification</td><td colspan="3">
<table>
<tr><td>F</td><td>E</td><td>D</td><td>C</td><td>B</td><td>A</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td>ostp</td><td>orze</td><td>ksft</td><td>gchg</td><td></td><td>ips2</td><td>zdir</td><td></td><td>vg8x</td><td>mdir</td><td>fdir</td><td>oscl</td><td>pyfx</td><td>dmin</td><td>odi2</td><td>odi1</td></tr>
</table>
<table>
<tr><th colspan="2">bit</th><th>Meaning when set to 0</th><th>Meaning when set to 1</th><th>Standard</th></tr>
<tr><td>C</td><td>gchg</td><td>Gain changeover during orientation invalid</td><td>Gain changeover during orientation valid</td><td>0</td></tr>
</table>
</td></tr>
<tr><td>SP225</td><td>OXKPH</td><td>Position loop gain magnification after orientation completed
(H coil)</td><td>If gain changeover is valid (SP097: SPEC0/bitC=1) during orientation, set the position loop gain magnification (H coil) changed to after orientation completed.</td><td>0 to 2560
(1/256-fold)</td><td>0</td></tr>
<tr><td>SP226</td><td>OXKPL</td><td>Position loop gain magnification after orientation completed (L coil)</td><td>If gain changeover is valid (SP097: SPEC0/bitC=1) during orientation, set the position loop gain magnification (L coil) changed to after orientation complete.</td><td>0 to 2560
(1/256-fold)</td><td>0</td></tr>
<tr><td>SP128</td><td>OXKPM</td><td>After orientation completion, Position loop gain magnification
(M coil)</td><td><For MDS-C1-SPM>
Set the switched M coil position loop gain magnification after orientation when gain switching is enabled (SP097: SPEC0/ bitC=1).</td><td>0 to 2560
(1/256-fold)</td><td>0</td></tr>
</table>

[2] Speed loop gain adjustment

In the same manner as for the position loop gain, a speed loop gain can be set separately from the one used during deceleration for a operation that begins from the orientation completed ON status, following orientation deceleration control. Although the servo lock rigidity can be improved by increasing the speed loop gain during stop, vibration tends to be generated.

To change the post-orientation speed loop gain, enable a gain change by SP097/bitC=1 parameter setting, then set the desired speed loop proportional gain magnification and integral gain magnification. The proportional and integral gains should be increased at the same rate, and should be decreased if vibration occurs.

The effective speed loop gains are common to all coils, and are calculated using the formulas shown below. If a magnification setting of "0" is set, a "256" setting is adopted.

$$\text{Effective speed loop proportional gain} = \text{SP098} \times \frac{\text{SP227}}{256}$$

$$\text{Effective speed loop integral gain} = \text{SP099} \times \frac{\text{SP228}}{256}$$

No.	Abbr.	Parameter name	Details	Setting range	Standard
SP098	VGOP*	Speed loop gain proportional term in orientation control mode	Set the speed loop proportional gain in orientation control mode. When the gain is increased, rigidity is improved in the orientation stop but vibration and sound become larger.	0 to 1000	63
SP099	VGOI*	Orientation control mode speed loop gain integral term	Set the speed loop integral gain in orientation control mode.	0 to 1000	60
SP227	OXVKP	Speed loop proportional gain magnification after orientation completed	If gain changeover is valid (SP097: SPEC0/bitC=1) during orientation control, set the magnification of each gain changed to after orientation completed.	0 to 2560 (1/256-fold)	0
SP228	OXVKI	Speed loop cumulative gain magnification after orientation completed		0 to 2560 (1/256-fold)	0

[3] Speed loop delay compensation adjustment

This adjustment selects the delay compensation control used at normal orientation stops for tool changes, etc. Because the full-closed loop control used by the spindle end detector, etc., is prone to overshooting at stops, the speed loop gain delay advance term (SP100) value is adjusted upward.

SP100 value that is too high, however, will result in stop position inconsistency, particularly on high-friction machines. In cases where stop position accuracy is required on spindles with high frictional torques, set SP100=0, and select PI control.

<Examples of using PI control>

- Positioning a workpiece with a lathe
- A machine that indexes a 5-plane machining attachment

No.	Abbr.	Parameter name	Details	Setting range	Standard
SP100	VGOD*	Orientation control mode speed loop gain delay advance term	Set a loop gain delay advance gain in orientation control mode. When this parameter is set to "0", PI control is applied.	0 to 1000	15

POINT

When forward and reverse run stop positions differ even with PI control, machine's backlash may be large. In such cases, accuracy can be improved by setting orientation positioning direction as one direction only (unidirectional). (Refer to spindle parameter SP097/bit0, 1)

[4] Torque limit adjustment

The torque during post-orientation stops is limited by the parameter shown below. In case of performing a mechanical lock at orientation stops, be sure to lower the torque limit value to avoid interference between the spindle motor and the machine.

If a torque limit is commanded by a spindle control input 1 even during an orientation stop, however, the torque limit will be applied.

No.	Abbr.	Parameter name	Details	Setting range	Standard
SP104	TLOR*	Torque limit value after orientation completed l	Set the torque limit value after orientation completed. If the external torque limit signal is input, the torque limit value set by this parameter is made invalid.	0 to 120 (%)	100

⚠CAUTION

In case of locking the spindle mechanically at orientation stops, be sure to enter a torque limit to restrict the motor's output torque. (Recommended torque limit: 10% or less)

(4) Setting orientation positioning accuracy check

The positioning accuracy at orientation control is checked by the parameters shown below. An error is detected if the positioning pulse error amount from the reference position (Z-phase) exceeds the orientation control pulse miss check value (SP114). When an error is detected, the spindle continues rotating until the next reference position is detected, and a positioning retry then occurs. The "A9" warning is activated during the positioning retry, and the "5C" alarm is activated if the number of retries exceeds the number of orientation retry times (SP118).

No.	Abbr.	Parameter name	Details	Setting range	Standard
SP114	OPER	Orientation control pulse miss check value	An alarm "5C" will occur if the pulse miss value at the orientation stop exceeds this setting value. (Note that this is invalid when set to "0".) In this parameter, set the value to fulfill the following conditions. SP114 setting value > 1.5 × SP004 (orientation in-position width)	0 to 32767 (360deg /4096)	0
SP118	ORCT	Orientation control number of retry times	Set the number of times to retry when an orientation or feedback error occurs. The warning (A9) is issued while retrying orientation, and an alarm (5C) is issued when the set number of times is exceeded.	0 to 100 (time)	0

(5) Troubleshooting

[1] Orientation does not take place (motor keeps rotating)

	Cause	Investigation item	Remedy	Remarks
1	Parameter setting values are incorrect	The orientation detector and parameter do not match. SP037 (SFNC5) Motor PLG............................. 4 Spindle end detector .... 1 Magnetic sensor.................... 2	Correctly set SP037 (SFNC5).	
2	The specification are not correct	Motor PLG orientation is attempted with standard motor instead of motor with Z phase.	Change to a motor having a PLG-built-in motor with Z phase.	For motor PLG orientation
3	Incorrect wiring	The connector pin numbers are incorrect, The inserted connector number is incorrect. The cable is disconnected.	Correct the wiring. Replace the cable.	

[2] The motor overtravels and stops. (The motor sways when stopping.)

	Cause	Investigation item	Remedy	Remarks
1	Parameter setting values are incorrect	The gear ratio parameters: SP025 (GRA1) to SP032 (GRB4) are incorrect.	Correctly set SP025 (GRA1) to SP032 (GRB4).	
		The phenomenon is improved when the deceleration rate for orientation parameter SP006 (CSP) is halved.	Readjust SP006 (CSP)	This also applies to: SP107 (CSP2) SP108 (CSP3) SP109 (CSP4) SP121 (MPCSH) SP122 (MPCSL)
		The phenomenon is improved when the position loop gain parameters SP001 (PGM) and SP002 (PGE) are halved.	Readjust SP001 (PGM), SP002 (PGE).	This also applies to: SP119 (MPGH) SP120 (MPGL)
		The orientation stop direction is set to one direction (CCW or CW).	Set the SP097 (SPECO) /bit 0, 1 to "0".	

[3] The stopping position deviates.

	Cause	Investigation item	Remedy	Remarks
1	Mechanical cause	The stopping position is not deviated with the encoder axis.	There is backlash or slipping, etc., between the spindle and encoder. The gear ratio between the spindle and encoder is not 1:1 or 1:2.	For spindle end detector orientation
			There is backlash or slipping between the spindle and motor. The gear ratio between the spindle and motor is not 1:1.	For motor PLG orientation
2	Noise	The position detector's cable is relayed with a terminal block (connector), etc.	Do not relay the cable.	
		The position detector cable's shield is not treated properly.	Properly treat the shield.	
		The peeled section of signal wire at the position detector cable's connector section is large. (A large section is not covered by the shield.)	Keep the peeled section to 3cm or less when possible. Keep the peeled section as far away from the power cable as possible.	
3	The magnetic sensor installation direction is incorrect	Check the relation of the magnet and sensor installation.	Correct the relation of the magnet and sensor installation.	For magnetic sensor orientation.

[4] The stopping position does not change even when the position shift parameter is changed.

	Cause	Investigation item	Remedy	Remarks
1	Parameter setting values are incorrect	The position shift was changed to 2048 when the gear ratio between the spindle and encoder was 1:2 (one encoder rotation at two spindle rotations).	If the gear ratio on the left is established between the spindle and encoder, the position shift amount for one spindle rotation is 2048 instead of 4096.	

[5] The machine vibrates when stopping.

	Cause	Investigation item	Remedy	Remarks
1	Parameter setting values are incorrect	The gear ratio parameters SP025 (GRA1) to SP032 (GRB4) are incorrect.	Correctly set SP025 (GRA1) to SP032 (GRB4).	
2	The orientation adjustment is faulty	The vibration frequency is several Hz.	Decrease the position loop gain parameters SP001 (PGM) and SP002 (PGE). Increase the current loop gain for orientation parameters SP105 (IQGO) and SP106 (IDGO).	
		The vibration frequency is 10Hz or more.	Decrease the speed loop gain for orientation parameters SP098 (VGOP) and SP099 (VGOI). Decrease the current loop gain for orientation parameters SP105 (IQGO) and SP106 (IDGO).	

[6] The orientation complete signal is not output

	Cause	Investigation item	Remedy	Remarks
1	The machine's load is heavy	The in-position parameter SP004 (OINP) is too small.	Review the in-position range, and increase SP004 (OINP).	
		State is improved if delay compensation control is stopped during orientation stopping. (State is improved when changed to PI control).	Review the values set for the speed loop gain for orientation parameters SP098 (VGOP), SP099 (VGOI) and SP100 (VGOD).	
2	Carry out the items for [1] Orientation does not take place (motor keeps rotating).			

5-3-4 Adjusting the synchronous tap control

(1) Confirming the default parameters

Confirm that the parameters are correctly set according to the machine specifications. Pay special attention to the following points.

(a) Position loop gain

The position loop gain must be the same as the servo axis used for interpolation control during synchronous tap control.

Position loop gain for synchronous tap control SP009 = SV049
Position loop gain 2 for synchronous tap control SP221 = SV050
Position loop gain 3 for synchronous tap control SP222 = SV058

(b) High-gain servo synchronous compensation

The synchronous tap control specifications SP193/bit8 must be set according to the specification of the servo drive unit used for interpolation control during synchronous tap control.

Synchronous compensation valid = High-gain servo :
MDS-C1-V1/V2 (for high-gain setting), MDS-B-V14/V24
Synchronous compensation invalid = Standard servo :
MDS-C1-V1/V2 (for standard setting), MDS-B-V1/V2, MDS-B-SVJ2

<Spindle parameters>

No.	Abbrev.	Parameter name	Unit	Setting range	Standard value
SP009	PGT	Synchronized tapping Position loop gain	rad/s	1 to 100	15
SP193	SPECT*	Synchronized tapping specifications (The standard value is set according to the servo drive for interpolation control.)	HEX	0000 to FFFF	Standard: 0000 High-gain: 0100
SP194	VGTP*	Synchronized tapping speed loop gain proportional term		0 to 1000	63
SP195	VGTI*	Synchronized tapping speed loop gain integral term		0 to 1000	60
SP196	VGTD*	Synchronized tapping speed loop gain delay advance term		0 to 1000	15
SP197		Fixed control constant		0	0
SP198	VCGT*	Synchronized tapping target value of variable speed loop proportional gain	%	0 to 100	100
SP199	VCST*	Synchronized tapping change starting speed of variable speed loop proportional gain	r/min	0 to 32767	0
SP200	FFC1*	Synchronized tapping acceleration feed forward gain (gear 1)	%	0 to 1000	0
SP201	FFC2*	Synchronized tapping acceleration feed forward gain (gear 2)	%	0 to 1000	0
SP202	FFC3*	Synchronized tapping acceleration feed forward gain (gear 3)	%	0 to 1000	0
SP203	FFC4*	Synchronized tapping acceleration feed forward gain (gear 4)	%	0 to 1000	0
SP214	TZRN	Synchronized tapping zero point return speed	r/min	0 to 500	50
SP215	TPDT	Synchronized tapping zero point return deceleration rate	pulse	0 to 10000	1
SP216	TPST	Synchronized tapping zero point return shift amount		0 to 4095	0
SP217	TINP	Synchronized tapping in-position width	1/16 deg	1 to 2880	16
SP218	TODR*	Synchronized tapping excessive error width (1pulse=0.088deg)	pulse	0 to 32767	32767
SP219	IQGT*	Synchronized tapping current loop gain magnification 1	%	0 to 1000	100
SP220	IDGT*	Synchronized tapping current loop gain magnification 2	%	0 to 1000	100
SP221	PG2T	Synchronized tapping position loop gain 2	rad/s	0 to 999	0
SP222	PG3T	Synchronized tapping position loop gain 3	rad/s	0 to 999	0

<Servo parameters>

No.	Abbrev.	Parameter name	Unit	Setting range	Standard value
SV049	PGN1sp	Position loop gain 1 in spindle synchronous control	rad/s	1 to 200	15
SV050	PGN2sp	Position loop gain 2 in spindle synchronous control	rad/s	0 to 999	0
SV058	SHGCsp	SHG control gain in spindle synchronous control	rad/s	0 to 1200	0

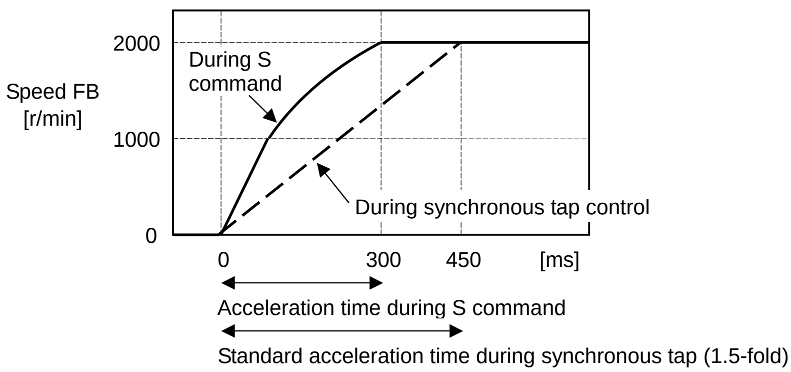
POINT

Always adjust the synchronous tap control after adjusting the operation and acceleration/deceleration time with the speed command, and adjusting the servo axis controlled in synchronization with the spindle during synchronous tap control.

(2) Adjusting the acceleration/deceleration time constant

Synchronous tap synchronizes the operation with the servo. Generally, the spindle takes longer to accelerate and decelerate, so the acceleration/deceleration time constant is determined on the spindle side. Measure the acceleration time for the S command, and set a value 1.5-fold that as the standard value.

If the spindle maximum rotation speed is 2000r/min during synchronous tap operation, first carry out 2000r/min acceleration/deceleration with the S command as shown below. Then, measure the total acceleration/deceleration time in a linear, 2-step or 3-step state. The time constant for synchronous tap operation is 450ms which is 1.5-fold 300ms.



Measuring the acceleration time during S command

POINT	When carrying out synchronous tap operation with a motor capable of coil changeover, either the high-speed coil or low-speed coil is used. Fix the coil being used, and measure the acceleration time by issuing the S command in this case.

(3) Synchronous tap trial operation

Carry out trial operation after setting the parameters. Carry out dry operation without tapping or a workpiece, and confirm the amount that the spindle moves in respect to the servo axis. If an alarm occurs when there is no load, check the cause with the following table.

Troubleshooting for synchronous tap trial operation

Fault	Cause	Remedy
Excessive error alarm occurs (ALM52)	The synchronous tap detector direction is set in reverse.	Check the SP193/bit5 setting. 0 = Forward run, 1 = Reverse run
	The motor cannot follow because the tap time constant is too short.	Readjust the tap time constant. Set a value double the value for the S command.
Overcurrent alarm occurs (ALM32)	The motor cannot follow because the tap time constant is too short.	Readjust the tap time constant. Set a value double the value for the S command.
	The speed loop gain is too high for synchronous tap control (Is there vibration when changing to synchronous control?)	The SP194 setting value is too large. Set 100% as the standard.
	The current loop gain is too high during synchronous tap control.	The SP219, SP220 setting value is too large. Set 100% as the standard.
The spindle rotation movement amount does not match the command	The closed loop and semi-closed loop settings for spindle control are incorrect.	Check which detector's FB is being used. Spindle ENC = full closed loop: SP193/bit0 =0 Motor PLG = semi-closed loop: SP193/bit0 =1
	The gear ratio setting is incorrect.	Check the machine gear ratio. Number of gear teeth on spindle side : SP025 to SP028 Number of gear teeth on motor side : SP029 to SP032

(4) Adjusting the parameters

Adjust the following parameters while measuring the synchronous error between the servo and spindle. The servo axis speed loop gain is valid for all control, so adjust the speed loop gain only on the spindle side. Adjust mainly the lost motion compensation parameters on the servo side. When these have already been adjusted when measuring the roundness, etc., they do not need to be adjusted again. If the acceleration/deceleration is delayed for one of the axes, set the acceleration feed forward gain for the delayed axis to compensate the synchronous delay.

Spindle adjustment parameters

No.	Abbr.	Parameter name	Details	Setting range	Standard
SP194	VGTP*	Synchronized tapping control speed loop gain proportional term	Set the speed loop proportional gain in synchronized tapping mode.	0 to 1000	63
SP195	VGTI*	Synchronized tapping control speed loop gain integral term	Set the speed loop integral gain in synchronized tapping mode.	0 to 1000	60
SP200	FFCI*	Synchronized tapping control acceleration feed forward gain (gear 1)	Set the acceleration feed forward gain for selection of gear 000 during synchronized tapping. This parameter should be used when an error of relative position to Z-axis servo is large.	0 to 1000 (%)	0
SP201	FFC2*	(Gear 2)			0
SP202	FFC3*	(Gear 3)			0
SP203	FFC4*	(Gear 4)			0

Spindle adjustment parameters

<table>
<tr><th>No.</th><th>Abbr.</th><th>Parameter name</th><th>Details</th><th>Setting range</th></tr>
<tr><td>SV027</td><td>SSF1</td><td>Servo function selection 1</td><td colspan="2">
<table>
<tr><td>F</td><td>E</td><td>D</td><td>C</td><td>B</td><td>A</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td>aflt</td><td>zrn2</td><td colspan="2">afse</td><td colspan="2">ovs</td><td colspan="2">lmc</td><td>omr</td><td>zrn3</td><td colspan="2">vfct</td><td></td><td>upc</td><td colspan="2">vcnt</td></tr>
</table>
<table>
<tr><th colspan="2">bit</th><th>Meaning when set to 0</th><th>Meaning when set to 1</th></tr>
<tr><td>8</td><td rowspan="2">lmc</td><td colspan="2" rowspan="2">Set the compensation amount with SV016 (LMC1) and SV041 (LMC2).
00: Lost motion compensation stop　10: Lost motion compensation type 2
01: Lost motion compensation type 1　11: Setting prohibited</td></tr>
<tr><td>9</td></tr>
</table>
</td></tr>
<tr><td>SV016</td><td>LMC1</td><td>Lost motion compensation 1</td><td>Set the compensation amount based on the stall (rated) current of the motor. The standard setting is double of the friction torque. Setting to "0" means the compensation amount is zero.</td><td>-1 to 200 (Stall [rated] current %)</td></tr>
<tr><td>SV041</td><td>LMC2</td><td>Lost motion compensation 2</td><td>Set this with SV016 (LMC1) only when you wish to set the lost motion compensation amount to be different depending on the command directions. Normally, set to "0".</td><td>-1 to 200 (Stall [rated] current %)</td></tr>
<tr><td>SV015</td><td>FFC</td><td>Acceleration rate feed forward gain</td><td>When a relative error in the synchronous control is large, apply this parameter to the axis that is delaying. The standard setting value is "0". For the SHG control, set to "100".
To adjust a relative error in acceleration/deceleration, increase the value by 50 to 100 at a time.</td><td>0 to 999 (%)</td></tr>
</table>

POINT

1. Stop the machine error compensation function (backlash compensation, pitch error compensation, etc.) when measuring the synchronous error.
2. The servo's speed loop gain has an effect on all control, so do not adjust it for synchronous tap. The spindle parameters are dedicated for synchronous tap control, so improve the synchronization accuracy by adjusting the spindle parameters when possible.

CAUTION

The above spindle parameters adjusted when adjusting the synchronous tap are all validated when the NC power is turned ON again.

(5) Synchronous tap cutting operation

After adjusting the parameters, mount the tap and workpiece, and carry out actual cutting. Various elements affect the tap cutting. Even if the synchronous accuracy (electrical accuracy) is good up to this point, it may not enable cutting with a sufficient accuracy. Check the items in the following table and improve the cutting accuracy.

Investigation items for improving cutting accuracy

Investigation item	Remedy
1. The cutting chip discharge is poor (cutting chips get caught)	Use a spiral tape (recommended) with good cutting chip discharge performance
	Adjust the cutting speed to an appropriate value
2. The tap cutting performance is poor	Replace the tap
3. The tap hole diameter is too large	Set the tap hole diameter to an appropriate size
4. The spindle PLG waveform adjustment is insufficient	Readjust the offset and gain
5. The servo axis backlash compensation amount is incorrect	Adjust the backlash compensation amount
6. The servo axis pitch error compensation amount is incorrect	Adjust the pitch error compensation amount
7. The acceleration/deceleration time constant is short	Increase the acceleration/deceleration time constant to improve the accuracy
8. The tap depth is too deep for the tap diameter	Set the tap depth to up to 3-times the tap diameter
9. The spindle center deviates	Check the tap mounting state
10. The spindle backlash is too large	Improve the machine side
11. The spindle load inertia is too large (3-times or more)	Try using fixed position loop excitation (SP193/bit3 = 1) Note that vibration noise will be generated easily
12. The cutting load is large (50% or more)	The tap hole is too small → Check the tap mounting state
	The spindle center deviates → Check the tap mounting state
	The tap cutting performance is poor → Replace the tap
	Try using fixed position loop excitation (SP193/bit3 = 1)

If the tap breaks, investigate the following items.

Investigation items when tap breaks

Investigation item	Remedy
1. The program's screw pitch and tap pitch do not match.	Set the program to the tap.
2. The tap center deviation is large	Check the accuracy of the spindle and the tap mounting state
3. The tap hole is too shallow	Drill the tap hole to an appropriate depth
4. The tap hole is too small	Drill the tap hole to an appropriate size

5-3-5 Adjusting the C-axis control

(1) Confirming the default parameters

Confirm that the parameters are correctly set according to the machine specifications. When carrying out interpolation control with the servo axis, set the following parameters according to the servo axis specifications.

(a) Position loop gain

When carrying out interpolation control with the servo axis using C-axis control, the C-axis control and position loop gain for each mode must be set to match the servo axis used for interpolation control. During C-axis control in this case, the operation is always controlled with the same position loop gain.

C-axis non-cutting position loop gain	SP003 = SV003
First position loop gain for cutting on C-axis	SP130 = SV003
Second position loop gain for cutting on C-axis	SP131 = SV003
Third position loop gain for cutting on C-axis	SP132 = SV003
Stop position loop gain for cutting on C-axis	SP133 = SV003
C-axis position loop gain 2	SP165 = SV004
C-axis position loop gain 3	SP166 = SV057

(b) High-gain servo synchronous compensation

Set C-axis control specification SP129/bit3 according to the specifications of the servo drive unit used for interpolation control with C-axis control.

Synchronous compensation valid = High-gain servo:
MDS-C1-V1/V2 (for high-gain setting), MDS-B-V14/V24

Synchronous compensation invalid = Standard servo:
MDS-C1-V1/V2 (for standard setting), MDS-B-V1/V2, MDS-B-SVJ2

(2) Gain parameters

The position loop gain and speed loop gain can be set according to each control state. Note that when using SHG control for C-axis control, or when carrying out interpolation control with the servo axis, the same value must be set in the position loop gain (SP003, SP130, SP131, SP132, SP133) for each control state.

Gain parameter settings for C-axis control

Parameter \ Control state	During non-cutting (rapid traverse)	No.1 gain selection for cutting control	No.2 gain selection for cutting control	No.3 gain selection for cutting control	When cutting is stopped
Speed loop proportional gain	SP134	SP137	SP140	SP143	SP146
Speed loop integral gain	SP135	SP138	SP141	SP144	SP147
Speed loop delay compensation	SP136	SP139	SP142	SP145	SP148
Position loop gain	SP003	SP130	SP131	SP132	SP133
Position loop gain 2	SP165				
Position loop gain 3	SP166				

POINT

In order to perform C-axis interpolation with the servo axis, the position loop gain settings for each C-axis control mode must match that of the servo axis where interpolation occurs. If the servo axis is performing SHG control, the SP165 and SP166 settings apply to all control modes. Therefore, the position loop gain values for each control mode (SP003, SP130, SP131, SP132 and SP133) must be the same as the position loop gain (SV003) for all the servo axes.

< Spindle parameters>

No.	Abbr.	Parameter name	Unit	Setting range	Standard value
SP003	PGC0	C-axis non-cutting position loop gain	rad/s	1 to 100	15
SP129	SPECC*	C-axis specifications (The standard value is set according to the servo drive for interpolation control.)	HEX	0000 to FFFF	Standard: 0000 High-gain: 0008
SP130	PGC1	First position loop gain for cutting on C-axis	rad/s	1 to 100	15
SP131	PGC2	Second position loop gain for cutting on C-axis	rad/s	1 to 100	15
SP132	PGC3	Third position loop gain for cutting on C-axis	rad/s	1 to 100	15
SP133	PGC4	Stop position loop gain for cutting on C-axis	rad/s	1 to 100	15
SP134	VGCP0*	C-axis non-cutting speed loop gain proportional item		0 to 5000	63
SP135	VGCI0*	C-axis non-cutting speed loop gain integral item		0 to 5000	60
SP136	VGCD0*	C-axis non-cutting speed loop gain delay advance item		0 to 5000	15
SP137	VGCP1*	First speed loop gain proportional item for C-axis cutting		0 to 5000	63
SP138	VGCI1*	First speed loop gain integral item for cutting on C-axis		0 to 5000	60
SP139	VGCD1*	First speed loop gain delay advance item for cutting on C-axis		0 to 5000	15
SP140	VGCP2*	Second speed loop gain proportional item for cutting on C-axis		0 to 5000	63
SP141	VGCI2*	Second speed loop gain integral item for cutting on C-axis		0 to 5000	60
SP142	VGCD2*	Second speed loop gain delay advance item for cutting on C-axis		0 to 5000	15
SP143	VGCP3*	Third speed loop gain proportional item for cutting on C-axis		0 to 5000	63
SP144	VGCI3*	Third speed loop gain integral item for cutting on C-axis		0 to 5000	60
SP145	VGCD3*	Third speed loop gain delay advance item for cutting on C-axis		0 to 5000	15
SP146	VGCP4*	Speed loop gain proportional item for stop of cutting on C-axis		0 to 5000	63
SP147	VGCI4*	Speed loop gain integral item for stop of cutting on C-axis		0 to 5000	60
SP148	VGCD4*	Speed loop gain delay advance item for stop of cutting on C-axis		0 to 5000	15
SP149	CZRN	C-axis zero point return speed	r/min	1 to 500	50
SP150	CPDT	C-axis zero point return deceleration point		1 to 1000	1
SP151	CPSTL	C-axis zero point return shift amount (low byte)	1/1000 deg (HEX)	00000000 to FFFFFFFF	0000
SP152	CPSTH	C-axis zero point return shift amount (high byte)			0000
SP153	CINP	C-axis in-position width	1/1000 deg (HEX)	0000 to FFFF	03E8
SP154	CODRL*	Excessive error width on C-axis (low byte)	1/1000 deg (HEX)	00000000 to FFFFFFFF	D4C0
SP155	CODRH*	Excessive error width on C-axis (high byte)			0001
SP156	OVSH	C-axis overshoot compensation	0.1%	0 to 1000	0
SP159	CPY0	C-axis non-cutting variable excitation ratio	%	0 to 100	50
SP160	CPY1	C-axis cutting variable excitation ratio	%	0 to 100	100
SP161	IQGC0*	Current loop gain magnification 1 for non-cutting on C-axis	%	1 to 1000	100
SP162	IDGC0*	Current loop gain magnification 2 for non-cutting on C-axis	%	1 to 1000	100
SP163	IQGC1*	Current loop gain magnification 1 for cutting on C-axis	%	1 to 1000	100
SP164	IDGC1*	Current loop gain magnification 2 for cutting on C-axis	%	1 to 1000	100
SP165	PG2C	C-axis position loop gain 2	rad/s	0 to 999	0
SP166	PG3C	C-axis position loop gain 3	rad/s	0 to 999	0

<Servo parameters>

No.	Abbr.	Parameter name	Unit	Setting range	Standard value
SV003	PGN1	Position loop gain 1	rad/s	1 to 200	33
SV004	PGN2	Position loop gain 2	rad/s	0 to 999	0
SV057	SHGC	SHG control gain	rad/s	0 to 1200	0

(3) Disturbance observer

The disturbance observer estimates the disturbance torque and compensates accordingly, thereby minimizing cutting time disturbance, frictional resistance, and torsion vibration. It is also effective in suppressing vibration that is caused by speed advance compensation control.
The disturbance observer function is enabled in all control modes (not just the C-axis control) during a spindle control input 4/bitF=1 (increased spindle hold force). The position loop gain and speed loop gain settings are set separately during disturbance observer operation.

<Setting method>

[1] Calculate the inertia for all axes including the spindle motor, then set the motor inertia rate as the disturbance observer load inertia rate (SP233) value.
[2] Set the disturbance observer low path filter frequency (SP234) to the observer filter band (observer pole) value to suppress the estimated high-frequency disturbance and vibration. The standard setting is "100".
[3] Set the disturbance observer gain (SP235) to the observer gain value. This activates the disturbance observer function. Begin with a setting of "100", then, if no vibration occurs, increase the setting value in increments of "50" to increase the compensation efficacy.
[4] If the disturbance observer setting facilitates vibration, decrease the speed loop gain proportional item for increased spindle holding force (SP168) and the speed loop gain integral item for increased spindle holding force (SP169) values by 10 to 20% at the same rate.
[5] Although the position loop gain can be set individually by the position loop gain for increased spindle holding force (SP167) setting during disturbance observer operation, it should be set to the same value as the other settings if the interpolation servo axis is performing SHG control.

No.	Abbr.	Parameter name	Details	Setting range	Standard
SP167	PGU*	Position loop gain for increased spindle holding force	Set the position loop gain for when the disturbance observer is valid.	0 to 100 (rad/s)	15
SP168	VGUP*	Speed loop gain proportional item for increased spindle holding force	Set the speed loop gain proportional item for when the disturbance observer is valid.	0 to 5000	63
SP169	VGUI*	Speed loop gain integral item for increased spindle holding force	Set the speed loop gain integral item for when the disturbance observer is valid.	0 to 5000	60
SP170	VGUD*	Speed loop gain delay advance item for increased spindle holding force	Set the speed loop gain delay advance item for when the disturbance observer is valid.	0 to 5000	15
SP233	JL*	Disturbance observer Load inertia rate	Set "the motor inertia + motor axis conversion load inertia" in respect to the motor inertia. SP233 (JL) $= \frac{Jl + Jm}{Jm} \times 100$ Jm : Motor inertia Jl : Motor axis conversion load inertia	0 to 5000 (%)	0
SP234	OBS1*	Disturbance observer low path filter frequency	Set the frequency of the low path filter for when the disturbance observer is valid.	0 to 1000 (rad/s)	0
SP235	OBS2*	Disturbance observer gain	Set the gain for the disturbance observer.	0 to 500 (%)	0

POINT Disturbance observer control is valid in all control modes during a spindle control input 4/bitF.

5-3-6 Adjusting the spindle synchronous control

(1) Confirming the default parameters

Confirm that the parameters are correctly set according to the machine specifications. The parameters are set with the following conditions for spindles used for synchronous control.

(a) Position loop gain

The same value must be set for the spindle drive units used for synchronous control.

Spindle synchronous position loop gain : SP010
Spindle synchronous position loop gain 2 : SP189
Spindle synchronous position loop gain 3 : SP190

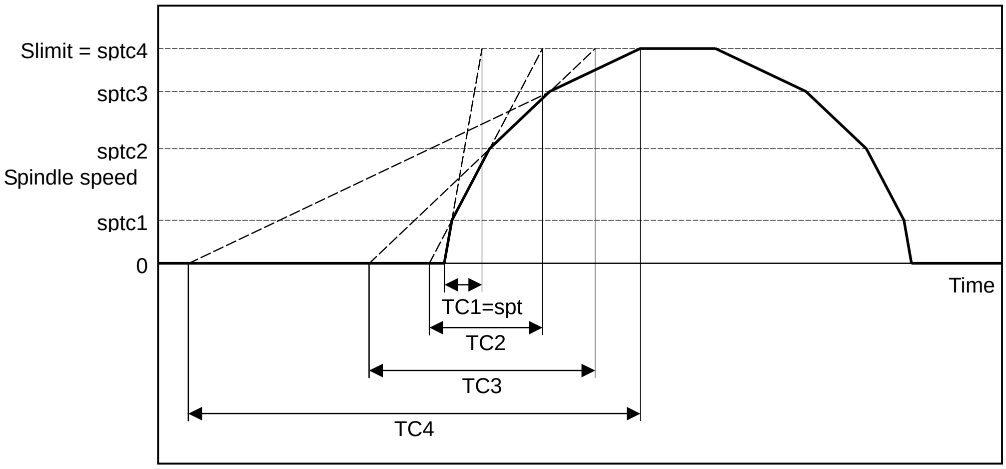
<Spindle parameters>

No.	Abbr.	Parameter name	Unit	Setting range	Standard value
SP010	PGS	Spindle synchronization position loop gain	rad/s	1 to 100	15
SP177	SPECS*	Spindle synchronous specifications	HEX	0000 to FFFF	0000
SP178	VGSP*	Spindle synchronous speed loop gain proportional term		0 to 1000	63
SP179	VGSI*	Spindle synchronous speed loop gain integral term		0 to 1000	60
SP180	VGSD*	Spindle synchronous speed loop gain delay advance term		0 to 1000	15
SP181	VCGS*	Spindle synchronous Target value of variable speed loop proportional gain	%	0 to 100	100
SP182	VCSS*	Spindle synchronous Change starting speed of variable speed loop proportional gain	r/min	0 to 32767	0
SP183	SYNV	Spindle synchronous Sync matching speed	r/min	0 to 1000	20
SP185	SINP	Spindle synchronous In-position width	1/16 deg	1 to 2880	16
SP186	SODR*	Spindle synchronous Excessive error width (1pulse=0.088deg)	pulse	0 to 32767	32767
SP187	IQGS*	Spindle synchronous Current loop gain magnification 1	%	0 to 1000	100
SP188	IDGS*	Spindle synchronous Current loop gain magnification 2	%	0 to 1000	100
SP189	PG2S	Spindle synchronous Position loop gain 2	rad/s	0 to 999	0
SP190	PG3S	Spindle synchronous Position loop gain 3	rad/s	0 to 999	0

(2) Setting the multi-step acceleration/deceleration time constant

For acceleration/deceleration control during spindle synchronous control, the acceleration/deceleration time constant can be set up to eight steps according to the spindle rotation speed.
The acceleration/deceleration time constant (acceleration time from 0 to limit rotation speed slimit) for each step is set as shown below based on the time constant set for the first step.

1st stage acceleration/deceleration time constant : TC1 = spt
2nd stage acceleration/deceleration time constant : TC2 = spt × spdiv1
3rd stage acceleration/deceleration time constant : TC3 = spt × spdiv2
4th stage acceleration/deceleration time constant : TC4 = spt × spdiv3
5th stage acceleration/deceleration time constant : TC5 = spt × spdiv4
6th stage acceleration/deceleration time constant : TC6 = spt × spdiv5
7th stage acceleration/deceleration time constant : TC7 = spt × spdiv6
8th stage acceleration/deceleration time constant : TC8 = spt × spdiv7



Multi-step acceleration/deceleration control for spindle synchronous control (for 4-step setting)

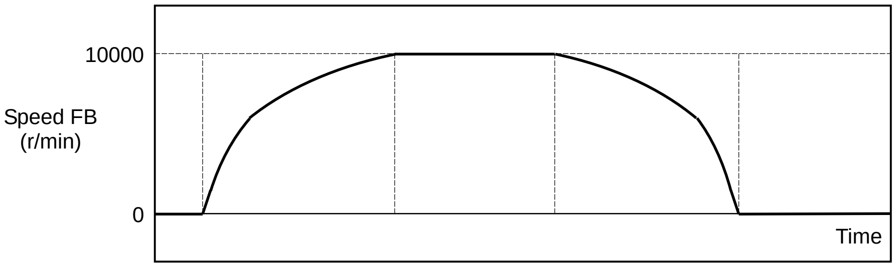
<Spindle specification parameters>

No.	Abbr.	Parameter name	Details	Setting range
3049	spt	Spindle synchronization acceleration/deceleration time constant	Set the acceleration/deceleration time constant for when the spindle synchronization command's rotation speed changes during spindle synchronous control.	0 to 9999 (ms)
3054	sptc1	Spindle synchronization multi-step acceleration/deceleration changeover speed 1	Set the spindle speed for changing the Nth step's acceleration/deceleration time constant.	0 to 99999 (r/min)
3055	sptc2	Spindle synchronization multi-step acceleration/deceleration changeover speed 2		
3056	sptc3	Spindle synchronization multi-step acceleration/deceleration changeover speed 3		
3057	sptc4	Spindle synchronization multi-step acceleration/deceleration changeover speed 4		
3058	sptc5	Spindle synchronization multi-step acceleration/deceleration changeover speed 5		
3059	sptc6	Spindle synchronization multi-step acceleration/deceleration changeover speed 6		
3060	sptc7	Spindle synchronization multi-step acceleration/deceleration changeover speed 7		

No.	Abbr.	Parameter name	Details	Setting range
3061	spdiv1	Magnification for time constant changeover speed 1	Set the acceleration/deceleration time constant in the spindle synchronization multi-step acceleration/deceleration changeover speed sptc (N) to sptc (N+1) range. Set the time that the spindle speed accelerates from 0 to slmit as a magnification in respect to the spindle synchronization acceleration/deceleration time constant (spt). When spdiv7 is set, the range is sptc7 to slimit.	0 to 127
3062	spdiv2	Magnification for time constant changeover speed 2		
3063	spdiv3	Magnification for time constant changeover speed 3		
3064	spdiv4	Magnification for time constant changeover speed 4		
3065	spdiv5	Magnification for time constant changeover speed 5		
3066	spdiv6	Magnification for time constant changeover speed 6		
3067	spdiv7	Magnification for time constant changeover speed 7		

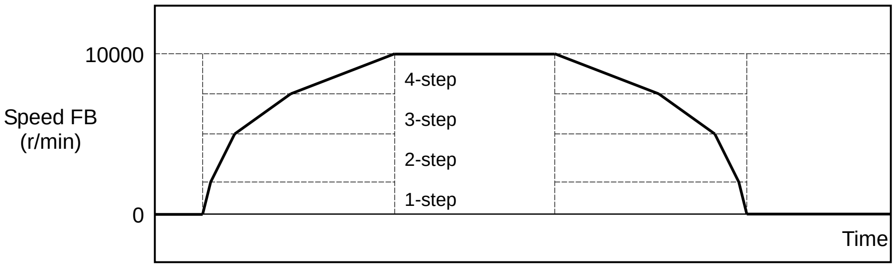
(3) Adjusting the multi-step acceleration/deceleration time constants

[1] Measure the acceleration/deceleration waveform to the spindle's maximum rotation speed using S command operation. (No. 1 spindle, No. 2 spindle)



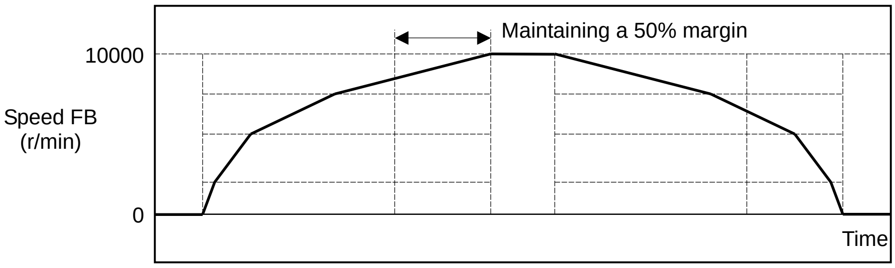
Example of spindle acceleration/deceleration waveform

[2] Calculate the multi-step acceleration/deceleration pattern based on the acceleration/ deceleration waveform for the spindle with a long acceleration/deceleration time.



Calculation of multi-step acceleration/deceleration

[3] Set the actual acceleration/deceleration time constant in the parameters while maintaining a 50% margin from each time constant calculated in step [2].



Setting the multi-step acceleration/deceleration parameters

[4] Try spindle synchronous acceleration/deceleration operation with the actual machine, and confirm that the speed is accelerated or decelerated at 50% or less of the load meter value. If the load meter value exceeds 50%, adjust the time constant again.

6-1 Points of caution and confirmation

If an error occurs in the servo drive unit or spindle 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>

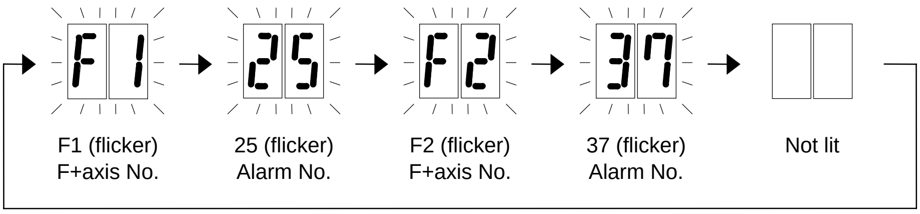
[1] What is the alarm code display?
[2] Can the error or trouble be repeated? (Check alarm history)
[3] Is the motor and servo drive unit temperature and ambient temperature normal?
[4] Are the servo drive unit, control unit and motor grounded?
[5] Was the unit accelerating, decelerating or running at 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?

⚠ **CAUTION**	1. This power supply 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 at the PN terminal (TE2). Do not touch the terminal block in this state. 2. Before replacing the unit, etc., always confirm that there is no voltage at the PN terminal (TE2) 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 or power supply unit as the unit could be damaged.

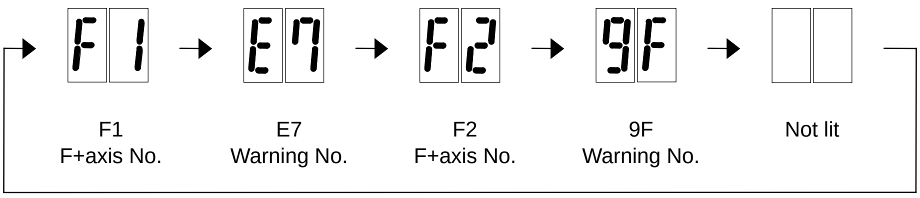
6-1-1 LED display when alarm or warning occurs

(1) Servo and spindle drive unit

The axis No. and alarm/warning No. alternate on the display. The display flickers when an alarm occurs.



LED display during servo alarm or spindle alarm



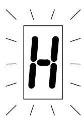
LED display during servo warning or spindle warning

Numbers displayed on LED

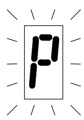
No.	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
LED display	0	1	2	3	4	5	6	7	8	9	A	b	C	d	E	F

(2) Power supply unit

The alarm/warning No. is converted into a symbol and displayed. Refer to section "6-2-1 List of alarms" and "6-2-2 List of warnings" for details. The display flickers when an alarm or a warning occurs.


Alarm 71 (flicker)

LED display during power supply alarm


Warning E9 (flicker)

LED display during power supply warning

6-2 Protective functions list of units

6-2-1 List of alarms

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.

Drive unit alarm

No.	Alarm name	SV	SP	Alarm details	Reset
11	Axis selection error	■	/	The axis No. selection switch setting is incorrect.	AR
12	Memory error 1	■	■	A CPU or internal memory error was detected during the self-check at power ON.	AR
13	Software processing error 1	●	●	The software process was not completed within the specified time. (CPU1)	PR
14	Software processing error 2	○	/	The software process was not completed within the specified time. (CPU2)	PR
16	Magnetic pole position detection error		■	Creation of the initial magnetic pole, required for motor control, was not completed.	PR
17	A/D converter error	■	■	An error was detected in the A/D converter for current FB detection.	PR
18	Motor side detector, initial communication error	■	/	Initial communication with the motor end detector was not possible.	PR
19	Synchronous control/detector communication error	●	/	Initial communication with the master axis motor end detector was not possible when the closed current command synchronous control was set. Or, the communication was cut off.	PR
1A	Machine side detector, initial communication error	■	/	Initial communication with the linear scale or ball screw end detector was not possible.	PR
1B	Machine side detector, CPU error 1	■	/	A CPU initial error was detected with the linear scale or ball screw end detector.	PR
1C	Machine side detector, EEPROM/LED abnormality	●	/	An error was detected in the data stored in the memory with the linear scale. Or, LED deterioration was detected with the linear scale.	PR
1D	Machine side detector, data error	●	/	A data error was detected with the linear scale or ball screw end detector.	PR
1E	Machine side detector, memory error	●	/	An internal memory error was detected with the linear scale.	PR
1F	Machine side detector, communication error	●	/	An error was detected in the communication data with the linear scale or ball screw end detector. Or, the communication was cut off.	PR

(Note 1) Motor stopping method applied when self-axis drive unit alarm occurs is indicated in SV for servo and in SP for spindle.
(Note 2) Servo (SV) alarm stopping method
○: Deceleration control (when SV048, SV055 or SV056 is set)
●: Dynamic brake stop
■: Initial error (while motor is stopped)
(Note 3) Spindle (SP) alarm stopping method
○: Deceleration control (when SP038/bit0=1 is set)
●: Coast to a stop
■: Initial error (while motor is stopped)

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.

Drive unit alarm

No.	Alarm name	SV	SP	Alarm details	Reset
20	Motor side detector, No signal 1	/	○	A PLG Z-phase no signal was detected.	PR
21	Machine side detector, No signal 2	●	○	The pulse-type linear scale or ball screw end detector's ABZ-phase no signal was detected with the servo, or the encoder no-signal was detected with the spindle.	PR
23	Excessive speed deflection 1		●	A difference of 50r/min or more between the speed command and speed feedback continued for longer than the set time.	PR
25	Absolute position lost	■	/	The backup voltage in the absolute position detector dropped causing the absolute position to be lost.	AR
26	Unusable axis error	■	/	A power module error is occurring with the axis for which the axis No. selection switch is set to "F" (not used axis).	PR
27	Machine side detector, CPU error 2	●	/	A CPU error was detected with the linear scale.	PR
28	Machine side detector, overspeed	●	/	A speed exceeding the specified maximum speed was detected with the linear scale.	PR
29	Machine side detector, absolute position data error	●	/	An error was detected in the absolute position data detection circuit with the linear scale.	PR
2A	Machine side detector, incremental position data error	●	/	An error was detected in the relative position data detection circuit with the linear scale.	PR
2B	Motor side detector, CPU error 1	■	/	A CPU initial error was detected with the motor end detector or linear scale in the linear servo system.	PR
2C	Motor side detector, EEPROM/LED error	●	/	Deterioration of the LEDs was detected with the motor end detector. Or, an error in the data stored in the memory was detected with the linear scale in the linear servo system.	PR
2D	Motor side detector, data error	●	/	A data error was detected with the motor end detector or linear scale in the linear servo system.	PR
2F	Motor side detector, communication error	●	/	A communication data error was detected with the motor end detector or linear scale for the linear servo. Or, communication was cut off.	PR
31	Overspeed	○	●	A rotation speed exceeding the motor's tolerable rotation speed was detected.	PR
32	Power module overcurrent	●	●	The power module's overcurrent protection function activated.	PR
34	Communication or CRC error between NC and drive unit	○	○	An error was detected in the data received from the NC.	PR
35	NC command error	○	○	The movement command data received from the NC was excessive.	PR
36	Communication or transmission error between NC and drive unit	○	○	Communication from the NC was cut off.	PR
37	Initial parameter error	■	■	An illegal parameter was detected in the parameters received from the NC at NC power ON.	PR
38	Communication or protocol error 1 between NC and drive unit	○	○	An error was detected in the communication frame received from the NC.	PR
39	Communication or protocol error 2 between NC and drive unit	○	○	An error was detected in the axis information data received from the NC.	PR
3A	Overcurrent	●	●	An excessive current was detected in the motor drive current.	PR
3B	Power module overheat	●	●	The power module's temperature protection function activated.	PR
3D	Spindle speed lock	/	●	Even when the maximum torque was commanded, the motor speed does not increase to 45r/min or more.	PR
3E	Spindle speed overrun	/	●	1. A state in which the motor's speed feedback exceeded the speed command and accelerated was detected. 2. Even though the speed command is 0 (including when stopped during position control), motor rotation exceeding the parameter setting value was detected.	PR
3F	Speed excessive deflection 2	/	●	During constant speed operation, the difference between the speed command and speed feedback exceeded the set amount and set time.	PR

(Note 1) Motor stopping method applied when self-axis drive unit alarm occurs is indicated in SV for servo and in SP for spindle.
(Note 2) Servo (SV) alarm stopping method
○: Deceleration control (when SV048, SV055 or SV056 is set)
●: Dynamic brake stop
■: Initial error (while motor is stopped)
(Note 3) Spindle (SP) alarm stopping method
○: Deceleration control (when SP038/bit0=1 is set)
●: Coast to a stop
■: Initial error (while motor is stopped)

Drive unit alarm

No.	Alarm name	SV	SP	Alarm details	Reset
40	Detector changeover unit, changeover error	/	●	During 1-drive unit 2-motor control, an error was detected in the motor changeover signal received form the detector changeover unit.	PR
41	Detector changeover unit, communication error	/	●	During 1-drive unit 2-motor control, an error was detected in the communication with the detector changeover unit.	PR
42	Feedback error 1	●	●	With the servo, pulse-type position detector feedback signal error was detected. With the spindle, a PLG feedback signal error was detected.	PR
43	Feedback error 2	●	●	With the servo, an excessive error was detected in the position data for the motor side detector and machine side detector. With the spindle, an error was detected in the encoder feedback signal.	PR
44	C-axis changeover alarm	/	●	When using the coil changeover control motor, the mode was changed to C-axis control while the high-speed coil was selected.	NR
46	Motor overheat	○	○	The temperature protection function in the motor or detector activated.	NR
4E	NC command mode error		●	A spindle control mode selection exceeding the specifications was input.	NR
50	Overload 1	○	●	The overload detection level reached 100% or more. The motor or drive unit is in the overload state.	NR
51	Overload 2	●	●	With the servo, a current command exceeding 95% of the unit's maximum current continued for one second or more. With the spindle, a load exceeding the continuous rating continued for 30 minutes or more.	NR
52	Excessive error 1	○	○	With the servo, the difference of the motor's actual position at servo ON and the theoretical position exceeded the setting value. With the spindle, the difference of the position command and position feedback exceeded the setting value.	NR
53	Excessive error 2	●	/	The difference of the motor's actual position at servo OFF and the theoretical position exceeded the setting value.	NR
54	Excessive error 3	○	/	The motor current was not detected when the excessive error 1 alarm occurred.	NR
58	Collision detection 1 G0	○	/	When the collision detection function is valid, the disturbance torque exceeded the collision detection value during rapid traverse (G0).	NR
59	Collision detection 1 G1	○	/	When the collision detection function is valid, the disturbance torque exceeded the collision detection level during cutting feed (G1).	NR
5A	Collision detection 2	○	/	When the collision detection function is valid, the command torque reached the motor's maximum torque.	NR
5C	Orientation feedback error	/	●	After orientation was completed, the command and feedback error exceeded the parameter setting.	PR

(Note 1) Motor stopping method applied when self-axis drive unit alarm occurs is indicated in SV for servo and in SP for spindle.
(Note 2) Servo (SV) alarm stopping method
○: Deceleration control (when SV048, SV055 or SV056 is set)
●: Dynamic brake stop
■: Initial error (while motor is stopped)
(Note 3) Spindle (SP) alarm stopping method
○: Deceleration control (when SP038/bit0=1 is set)
●: Coast to a stop
■: Initial error (while motor is stopped)

Power supply alarm

No.	LED display	Alarm name	CV	CR	Alarm details	Reset
60	0	Instantaneous power failure	●	●	A drop in the 24VDC power was detected.	PR
61	1	Power module overcurrent	●	●	The power module's overcurrent protection function activated.	PR
62	2	Frequency error	●	●	The input power frequency exceeded the specified range.	PR
63	3	Auxiliary regeneration error	●	●	The auxiliary regenerative transistor is still ON.	PR
65	5	Rush relay error	●	●	The rush resistance short-circuit relay does not turn ON.	PR
67	7	Phase failure	●	●	There is a phase failure in the input power.	PR
68	8	Watch dog	●	●	The system is not operating normally.	AR
69	9	Ground fault	●	●	The motor power cable is contacting FG (ground).	PR
6A	A	External contactor melting	●	●	The external contactor's contact has melted.	PR
6B	b	Rush relay melted	●	●	The rush resistance short-circuit relay does not turn OFF.	PR
6C	C	Main circuit error	●	●	An abnormality was detected in the main circuit capacitor's charging operation.	PR
6D	d	Parameter error	●	●	The power supply unit's capacity is not appropriate for the regenerative resistor type set with the parameters.	PR
6E	E	Memory error	●	●	An error was detected in the internal memory.	AR
6F	F	Power supply error	●	●	The power supply is not connected, or an error was detected in the power supply's A/D converter. This is detected simultaneously if another power supply alarm occurs.	AR
71	H	Instantaneous power failure/ external emergency stop	●	●	An instantaneous power failure occurred.	NR
73	J	Over-regeneration	●	●	The over-regeneration detection level exceeded 100%. The regenerative resistor is in the overload state.	PR
74	t	Regenerative resistor overheat	●	●	The temperature protection function in the regenerative resistor activated.	PR
75	L	Overvoltage	●	●	The main circuit PN bus voltage exceeded the tolerable value.	NR
76	N	External emergency stop setting error	●	●	The rotary switch setting for the external emergency stop does not match the parameter setting.	AR
77	n	Power module overheat	●	●	The power module's temperature protection function activated.	AR

(Note 1) If a power supply alarm (60 to 77) occurs, all servos will stop with the dynamic brakes, and all spindles will be stop with the 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.

Drive unit alarm

No.	Alarm name	SV	SP	Alarm details	Reset
7F	Power reboot request	■		A mismatch in the program mode selection was detected. Turn the drive unit power ON again.	PR
88	Watch dog	●	●	The system is not operating normally.	AR
89	Detector converter unit 2 connection error	●	●	With the servo, an error was detected in the connection with the analog output linear scale for the MDS-B-HR unit. With the spindle, initial communication with the MDS-B-PJEX was not possible.	PR
8A	Encoder converter unit 2 communication error	●	●	With the servo, an error was detected in the communication with the serial output linear scale for the MDS-B-HR unit. With the spindle, an error was detected in the communication with the MDS-B-PJEX.	PR
8B	Encoder converter unit 2 automatic adjustment error		●	An abnormal signal from the PLG was detected during automatic adjustment of the PLG.	PR
8C	Encoder converter unit 2 judgment error		●	A detector type not within the specifications was detected with the MDS-B-PJEX.	PR
8D	Encoder converter unit 2 CPU error	●	●	With the servo, a CPU error was detected with the MDS-B-HR unit. With the spindle, a CPU error was detected with the MDS-B-PJEX unit.	AR
8E	Encoder converter unit 2 data error	●		A data error was detected with the MDS-B-HR unit.	PR

(Note 1) Motor stopping method applied when self-axis drive unit alarm occurs is indicated in SV for servo and in SP for spindle.

(Note 2) Servo (SV) alarm stopping method
- ○: Deceleration control (when SV048, SV055 or SV056 is set)
- ●: Dynamic brake stop
- ■: Initial error (while motor is stopped)

(Note 3) Spindle (SP) alarm stopping method
- ○: Deceleration control (when SP038/bit0=1 is set)
- ●: Coast to a stop
- ■: Initial error (while motor is stopped)

6-2-2 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.

Drive unit warnings

No.	Alarm name	Warning details	Reset
90	Detector, initial communication error	Initial communication with the absolute position linear scale was not possible.	PR
91	Detector, communication error	An error was detected in the communication with the detector for the absolute position detection system.	*
92	Detector, protocol error	An error was detected in the data for the absolute position detection system.	*
93	Initial absolute position fluctuation	The position data fluctuated when creating the initial absolute position.	PR
96	MP scale feedback error	An excessive deviation was detected in the motor end detector and MP scale feedback data for the MP scale absolute position detection system.	*
97	MP scale offset error	An error was detected in the offset data received from the MP scale for the MP scale absolute position detection system.	PR
9E	Absolute position detector, multi-rotation counter error	An error was detected in the multi-rotation counter for the absolute position detector. The absolute position cannot be compensated.	*
9F	Battery voltage drop	The voltage of the battery supplying to the absolute position detector has dropped. The absolute position data is held.	*
A8	Turret indexing error warning	The commanded turret indexing position shift amount is not within the specified range.	*
A9	Orientation feedback error warn	Retrying during an orientation feedback error.	*
E1	Overload warning	The overload detection level is 80% or more.	*
E3	Absolute position counter warning	A deviation was detected in the absolute position data and absolute position data.	*
E4	Parameter error warning	A parameter exceeding the setting range was set.	*
E6	Control axis removal warning	Control axis removal was commanded.	*
E7	CNC emergency stop	Emergency stop was input from the NC.	*

(Note 1) Servo and spindle motor do not stop when the warning occurs.
(Note 2) 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 SP038/bit 0=1is set.)

Power supply warnings

No.	LED display	Alarm name	CV	CR	Warning details	Reset
E8	o	Auxiliary regeneration frequency over		○	Regeneration at the power supply performance limit is occurring frequently.	*
E9	P	Instantaneous power failure warning	○		An instantaneous power failure occurred.	NR
EA	q	External emergency stop	○		The external emergency stop signal was input.	*
EB	r	Over-regeneration warning	○		The over-regeneration level is 80% or more.	*

(Note) Servo and spindle motor do not stop when the warning occurs.

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.)

6-3 Troubleshooting

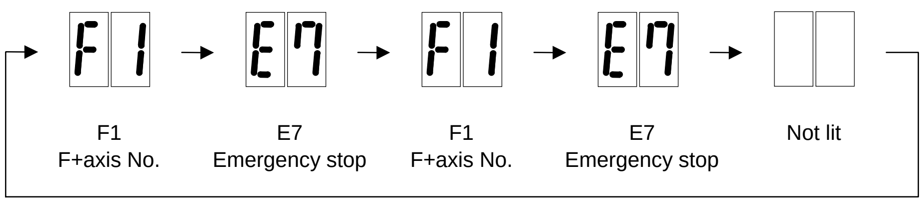
Follow this section to troubleshoot the alarms that occur during start up or while the machine is operating. If the state is not improved with the following investigations, the drive unit may be faulty. Exchange the unit with another unit of the same capacity, and check whether the state is improved.

6-3-1 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.

LED display	Symptom	Cause of occurrence	Investigation method	Remedy
AA	Initial communication with the CNC was not completed correctly.	The drive unit axis No. setting is incorrect.	Is there any other drive unit that has the same axis No. set?	Set correctly.
		The CNC setting is incorrect.	Is the No. of CNC controlled axes correct?	Set correctly.
		Communication with CNC is incorrect.	Is the connector (CN1A, CN1B) disconnected?	Connect correctly.
			Is the cable broken? Check the conductivity with a tester.	Replace the cable.
Ab	Initial communication with the CNC was not carried out.	The axis is not used, the setting is for use inhibiting.	Is the axis setting rotary switch set to "7" to "F"?	Set correctly.
		Communication with CNC is incorrect.	Is the connector (CN1A, CN1B) disconnected?	Connect correctly.
			Is the cable broken? Check the conductivity with a tester	Replace the cable.
12	An error was detected in the unit's memory and IC during the self-diagnosis at power ON.	The CPU peripheral circuit is abnormal.	Check the repeatability.	Replace the unit.
			Check whether there is any abnormality with the unit's surrounding environment, etc.	Improve the surrounding environment.

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)

6-3-2 Troubleshooting for each alarm No.

Alarm No. 11	Axis selection error The axis No. selection switch setting is incorrect.				
	Investigation details	**Investigation results**	**Remedies**	**SV**	**SP**
1	Check the setting of the axis selection switch on the top of the unit.	The same axis No. is set for the L and M axes.	Correctly set the axis No. 0 = No. 1 axis, 1 = No. 2 axis, ...	○	

Alarm No. 12	Memory error 1 A CPU or internal memory error was detected during the self-check at power ON.				
	Investigation details	**Investigation results**	**Remedies**	**SV**	**SP**
1	Refer to "6-3-1 Troubleshooting at power ON".			○	○

Alarm No. 13	Software processing error 1 The software process was not completed within the specified time. (CPU1)				
	Investigation details	**Investigation results**	**Remedies**	**SV**	**SP**
1	Check whether the servo software version was changed recently.	The version was changed.	Try replacing with the drive unit containing the original software version.	○	○
		The version was not changed.	Investigate item 2.		
2	Check the repeatability.	The error is always repeated.	Replace the drive unit.	○	○
		The state returns to normal once, but occurs sometimes thereafter.	Investigate item 3.		
3	Check if there is any abnormality in the unit's ambient environment. (Ex. Ambient temperature, noise, grounding)	No abnormality is found in particular.	Replace the drive unit.	○	○
		An abnormality was found in the ambient environment.	Take remedies according to the causes of the abnormality. Ex. High temperature: Check the cooling fan. Incomplete grounding: Additionally ground.		

Alarm No. 14	Software processing error 2 The software process was not completed within the specified time. (CPU2)				
	Investigation details	**Investigation results**	**Remedies**	**SV**	**SP**
1	Carry out the items for alarm No. 13.			○	○

Alarm No. 16	Magnetic pole position detection error Creation of the initial magnetic pole, required for motor control, was not completed.				
	Investigation details	**Investigation results**	**Remedies**	**SV**	**SP**
1	Was the spindle drive unit replaced?	It was replaced.	Carry out automatic adjustment of the PLG Z-phase.		○
		It was not replaced.	Investigate item 2.		
2	Check the spindle parameters.	SP205 = 0	Carry out automatic adjustment of the PLG Z-phase.		○
		SP205 = 1	Set SP205 to 0, and turn the NC power ON again. Then, carry out automatic adjustment of the PLG Z-phase.		

Alarm No. 17	A/D converter error An error was detected in the A/D converter for current FB detection.				
	Investigation details	**Investigation results**	**Remedies**	**SV**	**SP**
1	Check the repeatability.	The error is always repeated.	Replace the drive unit.	○	○
		The state returns to normal once, but occurs sometimes thereafter.	Investigate item 2.		
2	Check if there is any abnormality in the unit's ambient environment. (Ex. Ambient temperature, noise, grounding)	No abnormality is found in particular.	Replace the drive unit.	○	○
		An abnormality was found in the ambient environment.	Take remedies according to the causes of the abnormality. Ex. High temperature: Check the cooling fan. Incomplete grounding: Additionally ground.		

Alarm No. 18	Motor side detector, initial communication error Initial communication with the motor end detector was not possible.				
	Investigation details	**Investigation results**	**Remedies**	**SV**	**SP**
1	Check the servo parameter (SV025) setting value. OSE104: 0, OSA104: 1 Are all other set to 2? (Excluding slave axis for synchronous control)	The value is not set correctly.	Correctly set SV025.	○	
		The value is set correctly.	Investigate item 2.		
2	Check whether the drive unit connectors (CN2) or detector connectors are disconnected.	The connector is disconnected (or loose).	Correctly install.	○	
		The connector is not disconnected.	Investigate item 3.		
3	Turn the power OFF, and check the detector cable connection with a tester.	There is a connection fault.	Replace the detector cable.	○	
		The connection is normal.	Investigate item 4.		
4	Connect to another normal axis drive unit, and check whether the fault is on the drive unit side or detector side.	The alarm is on the drive unit side.	Replace the drive unit.	○	
		The alarm is on the detector side.	Investigate item 5.		
5	Check if there is any abnormality in the detector's ambient environment. (Ex. Ambient temperature, noise, grounding)	No abnormality is found in particular.	Replace the detector. (With the absolute position system, the zero point must be established.)	○	
		An abnormality was found in the ambient environment.	Take remedies according to the causes of the abnormality. Ex. High temperature: Check the cooling fan. Incomplete grounding: Additionally ground.		

Alarm No. 19	Synchronous control/detector communication error Initial communication with the master axis motor end detector was not possible when the closed current command synchronous control was set. Or, the communication was cut off.				
	Investigation details	**Investigation results**	**Remedies**	**SV**	**SP**
1	Check whether the MDS-B-SD unit CN2B connector is disconnected.	The connector is disconnected.	Correctly connect.	○	
		The connector is not disconnected.	Investigate item 2.		
2	Check the continuity of the cable between the MDS-B-SD unit CN2B and the slave side drive unit CN3.	The cable is disconnected or incorrectly connected.	Replace the cable.	○	
		There is no abnormality in particular.	Try replacing the drive unit or MDS-B-SD unit.		

Alarm No. 1A	Machine side detector, initial communication error Initial communication with the linear scale or ball screw end detector was not possible.				
	Investigation details	**Investigation results**	**Remedies**	**SV**	**SP**
1	Check the servo parameter (SV025.pen) setting value. Are the serial communication parameters set for the pulse-type detector?	The value is not set correctly.	Correctly set SV025.	○	
		The value is set correctly.	Investigate item 2.		
2	Check whether the drive unit connectors (CN3) or detector connectors are disconnected.	The connector is disconnected (or loose).	Correctly install.	○	
		The connector is not disconnected.	Investigate item 3.		
3	Turn the power OFF, and check the detector cable connection with a tester.	There is a connection fault.	Replace the detector cable.	○	
		The connection is normal.	Investigate item 4.		
4	Connect to another normal axis drive unit, and check whether the fault is on the drive unit side or detector side.	The alarm is on the drive unit side.	Replace the drive unit.	○	
		The alarm is on the detector side.	Investigate item 5.		
5	Check if there is any abnormality in the detector's ambient environment. (Ex. Ambient temperature, noise, grounding)	No abnormality is found in particular.	Replace the detector. (With the absolute position system, the zero point must be established.)	○	
		An abnormality was found in the ambient environment.	Take remedies according to the causes of the abnormality. Ex. High temperature: Check the cooling fan. Incomplete grounding: Additionally ground.		

Alarm No. 1B	Machine side detector, CPU error 1 A CPU initial error was detected with the linear scale or ball screw end detector.				
	Investigation details	**Investigation results**	**Remedies**	**SV**	**SP**
1	Connect to another normal axis drive unit, and check whether the fault is on the drive unit side or scale side.	The alarm is on the drive unit side.	Replace the drive unit.	○	
		The alarm is on the detector side.	Investigate item 2.		
2	Check if there is any abnormality in the detector's ambient environment. (Ex. Ambient temperature, noise, grounding)	No abnormality is found in particular.	Replace the detector. (With the absolute position system, the zero point must be established.)	○	
		An abnormality was found in the ambient environment.	Take remedies according to the causes of the abnormality. Ex. High temperature: Check the cooling fan. Incomplete grounding: Additionally ground.		

Alarm No. 1C	Machine side detector, EEPROM/LED abnormality An error was detected in the data stored in the memory by the linear scale. Or, LED deterioration was detected with the linear scale.				
	Investigation details	**Investigation results**	**Remedies**	**SV**	**SP**
1	Check the alarm No. "1B" items.			○	

Alarm No. 1D	Machine side detector, data error A data error was detected with the linear scale or ball screw end detector.				
	Investigation details	**Investigation results**	**Remedies**	**SV**	**SP**
1	Check the alarm No. "1B" items.			○	

Alarm No. 1E	Machine side detector, memory error An internal memory error was detected with the linear scale.				
	Investigation details	**Investigation results**	**Remedies**	**SV**	**SP**
1	Check the alarm No. "1B" items.			○	

Alarm No. 1F	Machine side detector, communication error An error was detected in the communication data with the linear scale or ball screw end detector. Or, the communication was cut off.				
	Investigation details	**Investigation results**	**Remedies**	**SV**	**SP**
1	Check whether the drive unit connectors (CN3) or detector connectors are disconnected.	The connector is disconnected (or loose).	Correctly install.	○	
		The connector is not disconnected.	Investigate item 2.		
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?	The cables are wired near each other. (Noise is entering from the power cable.)	Improve the cable wiring.	○	
		The wires are sufficiently separated.	Investigate item 3.		
3	Is the motor FG wire connected only to the drive unit which drives it? (Is the motor grounded to one point?)	The motor FG wire is grounded on the motor side.	Ground the motor to one point, connecting the wires together on the drive unit side.	○	
		The motor is grounded to one point.	Investigate item 4.		
4	Turn the power OFF, and check the detector cable connection with a tester. (Is the cable shielded?)	There is a connection fault.	Replace the detector cable.	○	
		The connection is normal.	Investigate item 5.		
5	Connect to another normal axis drive unit, and check whether the fault is on the drive unit side or detector side.	The alarm is on the drive unit side.	Replace the drive unit.	○	
		The alarm is on the detector side.	Investigate item 6.		
6	Check if there is any abnormality in the detector's ambient environment. (Ex. Ambient temperature, noise, grounding)	No abnormality is found in particular.	Replace the detector. (With the absolute position system, the zero point must be established.)	○	
		An abnormality was found in the ambient environment.	Take remedies according to the causes of the abnormality. Ex. High temperature: Check the cooling fan. Incomplete grounding: Additionally ground.		

Alarm No. 20	Motor side detector, No signal 1 A PLG Z-phase no signal was detected. An error was detected in the A/B phase output waveform during PLG automatic adjustment.				
	Investigation details	**Investigation results**	**Remedies**	**SV**	**SP**
1	Check whether the drive unit connectors (CN5) or detector connectors are disconnected.	The connector is disconnected (or loose).	Correctly install.		○
		The connector is not disconnected.	Investigate item 2.		
2	Turn the power OFF, and check the detector cable connection with a tester.	There is a connection fault.	Replace the detector cable.		○
		The connection is normal.	Investigate item 3.		
3	Check whether the alarm occurred during PLG automatic adjustment.	The alarm occurred during PLG automatic adjustment.	Investigate item 4.		○
		The alarm occurred during normal operation.	Investigate item 5.		
4	Check the PLG output waveform (A/B phase).	There is a problem. (The A/B phase input voltage is 0.8V or less or 2.2V or higher.)	Adjust the PLG output waveform.		○
		Normal	Investigate item 6.		
5	Check the PLG output waveform (Z-phase).	There is a problem. (The output waveform is 0V even after the gears' Z-phase is passed.)	Investigate item 7.		○
		Normal	Investigate item 6.		
6	Check the occurrence frequency.	Occurs each time.	Replace the drive unit.		○
		Occurs occasionally.	Check whether the cable is disconnected, whether there is a contact fault, or a detector fault.		
7	Check if there is any abnormality in the unit's ambient environment. (Ex. Ambient temperature, noise, grounding)	No abnormality is found in particular.	Replace the PLG detector.		○
		An abnormality was found in the ambient environment.	Take measures according to the error cause. Cable disconnection, contact fault. The sensor is hot during high-load operation. Review the operation, and adjust the Z-phase again.		

Alarm No. 21	Machine side detector, No signal 2 The pulse-type linear scale or ball screw end detector's ABZ-phase no signal was detected with the servo, or the encoder no-signal was detected with the spindle.			

	Investigation details	Investigation results	Remedies	SV	SP
1	Check the servo parameter (SV025. pen) setting value. Are the pulse-type detector parameters set for a serial communication type detector?	The value is not set correctly.	Correctly set SV025.	○	
		The value is set correctly.	Investigate item 3.		
2	Check the spindle parameter (SP037/bit0) settings.	Encoder orientation is not used.	Set SP037/bit0 to 0.		○
		Encoder orientation is used.	Investigate item 3.		
3	Check whether the drive unit connectors (servo: CN3, spindle: CN6) or detector connectors are disconnected.	The connector is disconnected (or loose).	Correctly install.	○	○
		The connector is not disconnected.	Investigate item 4.		
4	Turn the power OFF, and check the detector cable connection with a tester.	There is a connection fault.	Replace the detector cable.	○	○
		The connection is normal.	Investigate item 5.		
5	Connect to another normal axis drive unit, and check whether the fault is on the drive unit side or detector side.	The alarm is on the drive unit side.	Replace the drive unit.	○	○
		The alarm is on the detector side.	Investigate item 6.		
6	Check if there is any abnormality in the detector's ambient environment. (Ex. Ambient temperature, noise, grounding)	No abnormality is found in particular.	Replace the detector. (With the absolute position system, the zero point must be established.)	○	○
		An abnormality was found in the ambient environment.	Take remedies according to the causes of the abnormality. Ex. High temperature: Check the cooling fan. Incomplete grounding: Additionally ground.		

Alarm No. 23	Excessive speed deflection 1 A difference of 50r/min or more between the speed command and speed feedback continued for longer than the set time.			

	Investigation details	Investigation results	Remedies	SV	SP
1	Check the U, V and W wiring between the spindle drive unit and spindle motor.	The wires are not correctly connected.	Correctly connect.		○
		The wires are correctly connected.	Investigate item 2.		
2	Check the settings for SP034, SP040, SP055, and SP257 to SP384.	The correct values are not set.	Correctly set.		○
		The correct values are set.	Investigate item 3.		
3	Measure the acceleration/ deceleration time constants. Measure the time required to reach the reverse run maximum speed from the forward run maximum speed.	12 seconds or more.	Increase the SP055 setting value.		○
		Less than 12 seconds.	Investigate item 4.		
4	Measure the load during cutting.	120% or more.	Reduce the load.		○
		Less than 120%.	Investigate item 5.		
5	Check the PLG output waveform.	There is a problem.	Adjust the PLG output waveform.		○
		Normal.	Replace the drive unit.		

Alarm No. 25	Absolute position lost The backup voltage in the absolute position detector dropped causing the absolute position to be lost.				
	Investigation details	**Investigation results**	**Remedies**	**SV**	**SP**
1	Is warning 9F occurring at the same time?	The warning is occurring.	Investigate item 2.	○	
		The warning is not occurring.	Investigate item 3.		
2	Measure the battery voltage with a tester.	3V or less.	Replace the battery, and establish the zero point.	○	
		3V or more.	Check the NC bus cable connection.		
3	Did alarm 18 occur when the power was turned ON the last time?	Alarm 18 occurred.	Turn the drive unit control power ON again, and establish the zero point.	○	
		Alarm 18 did not occur.	Investigate item 4.		
4	Was the detector cable or battery cable disconnected from the unit for a long time?	The unit was left for a long time. Guide at delivery : 20 hours or more After 5 years : 10 hours or more	Turn the drive unit control power ON again, and establish the zero point.	○	
		The cables were not disconnected.	Investigate item 5.		
5	Check the detector cable or battery cable connection with a tester.	The connection is faulty.	Replace the cable.	○	
		The connection is normal.	Replace the drive unit.		

Alarm No. 26	Unusable axis error A power module error is occurring with the axis for which the axis No. selection switch is set to "F" (not used axis).				
	Investigation details	**Investigation results**	**Remedies**	**SV**	**SP**
1	Check if there is any abnormality in the unit's ambient environment. (Ex. Ambient temperature, noise, grounding)	No abnormality is found in particular.	Replace the drive unit.	○	
		An abnormality was found in the ambient environment.	Take remedies according to the causes of the abnormality. Ex. High temperature: Check the cooling fan. Incomplete grounding: Additionally ground.		

Alarm No. 27	Machine side detector, CPU error 2 A CPU error was detected with the linear scale.				
	Investigation details	**Investigation results**	**Remedies**	**SV**	**SP**
1	Check the alarm No. "1B" items.			○	

Alarm No. 28	Machine side detector, overspeed A speed exceeding the specified maximum speed was detected with the linear scale.				
	Investigation details	**Investigation results**	**Remedies**	**SV**	**SP**
1	Check the linear scale's maximum speed.	The rapid traverse rate is higher than the specified value.	Use within the specified range.	○	
		The rapid traverse rate is less than the specified value.	Investigate item 2.		
2	Check if there is any abnormality in the detector's ambient environment. (Ex. Ambient temperature, noise, grounding)	No abnormality is found in particular.	Replace the linear scale.	○	
		An abnormality was found in the ambient environment.	Take remedies according to the causes of the abnormality. Ex. High temperature: Check the cooling fan. Incomplete grounding: Additionally ground.		

Alarm No. 29	Machine side detector, absolute position data error An error was detected in the absolute position data detection circuit with the linear scale.				
	Investigation details	**Investigation results**	**Remedies**	**SV**	**SP**
1	Check the alarm No. "1B" items.			○	

Alarm No. 2A	Machine side detector, incremental position data error An error was detected in the relative position data detection circuit with the linear scale.				
	Investigation details	**Investigation results**	**Remedies**	**SV**	**SP**
1	Check the alarm No. "1B" items.			○	

Alarm No. 2B	Motor side detector, CPU error 1 A CPU initial error was detected with the motor end detector.				
	Investigation details	**Investigation results**	**Remedies**	**SV**	**SP**
1	Check if there is any abnormality in the detector's ambient environment. (Ex. Ambient temperature, noise, grounding)	No abnormality is found in particular.	Replace the detector. (With the absolute position system, the zero point must be established.)	○	
		An abnormality was found in the ambient environment.	Take remedies according to the causes of the abnormality. Ex. High temperature: Check the cooling fan. Incomplete grounding: Additionally ground.		

Alarm No. 2C	Motor side detector, EEPROM/LED error Deterioration of the LEDs was detected with the motor end detector.				
	Investigation details	**Investigation results**	**Remedies**	**SV**	**SP**
1	Check the alarm No. "2B" items.			○	

Alarm No. 2D	Motor side detector, data error A data error was detected with the motor end detector.				
	Investigation details	**Investigation results**	**Remedies**	**SV**	**SP**
1	Check the alarm No. "2B" items.			○	

Alarm No. 2F	Motor side detector, communication error A communication data error was detected with the motor end detector. Or, communication was cut off.				
	Investigation details	**Investigation results**	**Remedies**	**SV**	**SP**
1	Check whether the drive unit connectors (CN2) or detector connectors are disconnected.	The connector is disconnected (or loose).	Correctly install.	○	
		The connector is not disconnected.	Investigate item 2.		
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?	The cables are wired near each other. (Noise is entering from the power cable.)	Improve the cable wiring.	○	
		The wires are sufficiently separated.	Investigate item 3.		
3	Is the motor FG wire connected only to the drive unit which drives it? (Is the motor grounded to one point?)	The motor FG wire is grounded on the motor side.	Connect together on the drive unit side.	○	
		The motor is grounded to one point.	Investigate item 4.		
4	Turn the power OFF, and check the detector cable connection with a tester. (Is the cable shielded?)	There is a connection fault.	Replace the detector cable.	○	
		The connection is normal.	Investigate item 5.		
5	Connect to another normal axis drive unit, and check whether the fault is on the drive unit side or detector side.	The alarm is on the drive unit side.	Replace the drive unit.	○	
		The alarm is on the detector side.	Investigate item 6.		
6	Check if there is any abnormality in the detector's ambient environment. (Ex. Ambient temperature, noise, grounding)	No abnormality is found in particular.	Replace the detector. (With the absolute position system, the zero point must be established.)	○	
		An abnormality was found in the ambient environment.	Take remedies according to the causes of the abnormality. Ex. High temperature: Check the cooling fan. Incomplete grounding: Additionally ground.		

Alarm No. 31	Overspeed A rotation speed exceeding the motor's tolerable rotation speed was detected.				
	Investigation details	**Investigation results**	**Remedies**	**SV**	**SP**
1	Check the rapid traverse rate (rapid) and motor maximum rotation speed.	The rapid traverse rate is too fast.	Set within the motor's maximum rotation speed.	○	
		The speed is within the motor's maximum rotation speed.	Investigate item 2.		
2	Check the settings for the servo parameters SV001 (PC1), SV002 (PC2), SV018 (PIT) and SV025 (MTYP).	The settings are incorrect.	Correctly set.	○	
		Correctly set.	Investigate item 5.		
3	Confirm the spindle parameter SP017 (TSP) setting.	The setting is incorrect. The alarm is detected at 115% of SP017.	Correctly set.		○
		Correctly set.	Investigate item 4.		
4	Confirm the PLG output waveform.	There is a problem.	Adjust the PLG output waveform.		○
		Normal.	Investigate item 5.		
5	Check whether the speed waveform is overshooting.	The waveform is overshooting.	Increase the acceleration/ deceleration time constant.	○	○
		The waveform is not overshooting.	Check if there is any abnormality in the unit's ambient environment. (Ex.: Ambient temperature, noise, grounding)		

Alarm No. 32	Power module overcurrent The power module's overcurrent protection function activated.				
	Investigation details	**Investigation results**	**Remedies**	**SV**	**SP**
1	Check the repeatability.	The alarm occurs before READY ON. (The drive unit is faulty.)	Check investigation item 2 and following, and remove the cause of the fault. Then replace the drive unit.	○	○
		The alarm occurs after READY ON.	Investigate item 2.		
2	Check the parameter setting. • Motor type	The setting is incorrect. Servo : SV025 Spindle : SP034, SP040, SP257 to SP384	Correctly set.	○	○
		The setting is correct.	Investigate item 3.		
3	Check the parameter settings. • Current loop gain • Speed loop gain	The setting is large compared to the standard value.	Set the standard value.	○	○
		The standard value is set.	Investigate item 4.		
4	Disconnect the UVW phase wiring from the terminal block, and the cannon plug from the motor. Check the insulation with a tester.	The power cable is short-circuited.	Replace the motor's power cable.	○	○
		There is no problem.	Investigate item 5.		
5	Check the insulation between the motor power cable and FG.	The power cable is short-circuited.	Replace the motor's power cable.	○	○
		There is no problem.	Investigate item 6.		
6	Connect the cannon plug, and check the insulation between the power cable and FG.	The motor is short-circuited.	Replace the motor. (With the absolute position system, the zero point must be established.)	○	○
		There is no problem.	Investigate item 7.		
7	Check for any abnormalities in the motor's ambient environment. (Ex.: Ambient temperature, cutting water)	No abnormality is found in particular.	Replace the drive unit.	○	○
		An abnormality was found in the ambient environment.	Replace the motor and improve the motor installation environment. (With the absolute position system, the zero point must be established.)		

Alarm No. 34	Communication or CRC error between NC and drive unit An error was detected in the data received from the NC.				
	Investigation details	**Investigation results**	**Remedies**	**SV**	**SP**
1	Try replacing the terminator or battery unit.	The state is improved.	Replace the cause of the fault.	○	○
		The state is not improved.	Investigate item 2.		
2	Check the NC bus communication cable connection. • Is the cable disconnected? • Is the communication pair cable connected in reverse?	The connection is incorrect.	Replace the cable.	○	○
		There is no problem.	Investigate item 3.		
3	Change the order of the connected drive units. (The rotary switch does not need to be changed.)	The alarm is on the cable connections.	Replace the cable.	○	○
		The alarm is on the unit connections.	Investigate item 4.		
4	Check if there is any abnormality in the unit's ambient environment. (Ex. Ambient temperature, noise, grounding)	No abnormality is found in particular.	Replace the unit.	○	○
		An abnormality was found in the ambient environment.	Take remedies according to the causes of the abnormality. Ex. High temperature: Check the cooling fan. Incomplete grounding: Additionally ground.		

Alarm No. 35	NC command error The movement command data received from the NC was excessive.				
	Investigation details	**Investigation results**	**Remedies**	**SV**	**SP**
1	Is the rapid traverse rate large for using a sub-micron system or rotary axis?	The rapid traverse rate is large.	Check the rapid traverse rate limit.	○	○
		The rate is not especially large.	Look for problems on the NC side, such as not being able to follow up the position FB.		

Alarm No. 36	Communication or transmission error between NC and drive unit Communication from the NC was cut off.				
	Investigation details	**Investigation results**	**Remedies**	**SV**	**SP**
1	Check whether the NC bus communication cable connectors (CN1A, CN1B) are disconnected.	The connector is disconnected (or loose).	Connect correctly.	○	○
		The state is not improved.	Investigate item 2.		
2	Check the NC bus communication cable connection. • Is the cable disconnected? • Is the communication pair cable connected in reverse?	The connection is incorrect.	Replace the cable.	○	○
		There is no problem.	Investigate item 3.		
3	Change the order of the connected drive units. (The rotary switch does not need to be changed.)	The alarm is on the cable connections.	Replace the cable.	○	○
		The alarm is on the unit connections.	Investigate item 4.		
4	Check if there is any abnormality in the unit's ambient environment. (Ex. Ambient temperature, noise, grounding)	No abnormality is found in particular.	Replace the unit.	○	○
		An abnormality was found in the ambient environment.	Take remedies according to the causes of the abnormality. Ex. High temperature: Check the cooling fan. Incomplete grounding: Additionally ground.		

Alarm No. 37	Initial parameter error An illegal parameter was detected in the parameters received from the NC at NC power ON. "S02 initial parameter error ####" is displayed on the NC screen. #### indicates the incorrect parameter No.

	Investigation details	Investigation results	Remedies	SV	SP
1	Check the error parameter No.	SV001 to SV065 (M60S Series: 2201 to 2265) SP001 to SP384 (M60S Series: 3201 to 3584)	Set the value within the designated setting range.	○	○
		SV101 (M60S Series: 2301) The electronic gears are overflowing.	Check SV001, SV002 and SV018.		
		SV102 (M60S Series: 2302) The absolute position detection parameter is valid when OSE104 and OSE105 are connected.	Absolute position control cannot be used. To use, change to an absolute position detector.	○	
		SV104 (M60S Series: 2304) No SHG control operation is provided.	SHG control cannot be used.		
		SV105 (M60S Series: 2305) No adaptive filter option is provided.	The adaptive filter cannot be used.	○	

(Note) Refer to "6-3-4 Parameter numbers at initial parameter error".

Alarm No. 38	Communication or protocol error 1 between NC and drive unit An error was detected in the communication frame received from the NC.

	Investigation details	Investigation results	Remedies	SV	SP
1	Check the alarm No. "34" items.			○	○

Alarm No. 39	Communication or protocol error 2 between NC and drive unit An error was detected in the axis information data received from the NC.

	Investigation details	Investigation results	Remedies	SV	SP
1	Check the alarm No. "34" items.			○	○

Alarm No. 3A	Overcurrent An excessive current was detected in the motor drive current.

	Investigation details	Investigation results	Remedies	SV	SP
1	Check whether vibration is occurring.	Vibration is occurring.	• Set a filter. • Lower the speed loop gain (SV005).	○	
		There is no vibration.	Investigate item 2.		
2	The speed loop gain (SV005) setting is larger than the standard value.	The setting is too large.	Set an appropriate value.	○	
		The setting is approximately the same as the standard value.	Investigate item 3.		
3	Check the current loop gain. (SV009, SV010, SV011, SV012)	The setting is incorrect.	Set the standard value.	○	
		The standard value is set.	Investigate item 4.		
4	Disconnect the UVW phase wiring from the terminal block, and the cannon plug from the motor. Check the insulation with a tester.	The power cable is short-circuited.	Replace the motor power cable.	○	
		There is no problem.	Investigate item 5.		
5	Check the insulation between the motor power cable and FG.	There is a ground fault at the power cable.	Replace the motor power cable.	○	
		There is no problem.	Investigate item 6.		
6	Connect the cannon plug, and check the insulation between the power cable and FG.	There is a ground fault in the motor.	Replace the motor. (With the absolute position system, the zero point must be established.)	○	
		There is no problem.	Investigate item 7.		
7	Check if there is any abnormality in the motor's ambient environment. (Ex. Ambient temperature, cutting water)	No abnormality is found in particular.	Replace the drive unit.	○	
		An abnormality was found in the ambient environment.	Improve the installation environment. (With the absolute position system, the zero point must be established.)		

Alarm No. 3B	Power module overheat The power module's temperature protection function activated.				
	Investigation details	**Investigation results**	**Remedies**	**SV**	**SP**
1	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 or more, and turn the power ON again.	○	○
		The fan did not rotate. Or, an alarm occurred again.	Investigate item 2.		
2	Confirm adhesion of cutting oil or cutting chips, etc. at the fan. Or check if there is any abnormality such as low rotation speed.	Large amounts of cutting oil or cutting chips, etc., are adhered, or the rotation is slow.	Clean or replace the fan.	○	○
		The fan is rotating properly.	Investigate item 3.		
3	Check whether the heat dissipating fins are dirty.	Cutting oil or cutting chips, etc., are adhered, and the fins are clogged.	Clean the fins.	○	○
		The fins are normal.	Investigate item 4.		
4	Measure the drive unit's ambient temperature.	55°C or more	Improve the ventilation and cooling for the power distribution panel.	○	○
		Less than 55°C.	Investigate item 5.		
5	Check if there is any abnormality in the unit's ambient environment. (Ex. Ambient temperature, noise, grounding)	No abnormality is found in particular.	If the alarm occurs even after the unit temperature has dropped, replace the unit.	○	○
		An abnormality was found in the ambient environment.	Take remedies according to the causes of the abnormality. Ex. High temperature: Check the cooling fan. Incomplete grounding: Additionally ground.		

Alarm No. 3D	Spindle speed lock Even when the maximum torque was commanded, the motor speed does not increase to 45r/min or more.				
	Investigation details	**Investigation results**	**Remedies**	**SV**	**SP**
1	Does the alarm occur immediately after the power is turned ON?	Occurs immediately after power is turned ON.	Investigate item 2.		○
		Occurs after normal operation.	Investigate item 5.		
2	Is there any abnormal noise when starting?	There is abnormal noise.	Investigate item 4. (The initial pole estimate may be incorrect.)		○
		There is no abnormal noise.	Investigate item 3.		
3	Check that the PN voltage is supplied to the drive unit. • Is the CHARGE lamp ON?	The voltage is not supplied.	Correctly supply the PN voltage.		○
		Approx. 300V is correctly supplied.	Investigate item 3.		
4	Check the motor power cable (U, V, W phases). (Also check the operation immediately after emergency stop is cancelled.) • The power cable is not connected. • Is the cable connected to the motor for another axis? • Is the contactor between the drive unit and motor OFF? (When using coil changeover specifications.)	The connections are incorrect.	Connect correctly.		○
		The connections are correct.	Investigate item 5.		
5	Check the load value with the spindle monitor, and investigate the machine's load state.	The cutting load is large.	Lower the cutting load.		○
		The cutting load is not large.	Investigate item 6.		
6	Check whether the spindle rotary section is locked with a mechanical lock (C-axis clamp, etc.).	Locked with a mechanical lock.	Remove the cause of the lock.		○
		Not locked with a mechanical lock.	Investigate item 7.		
7	Try replacing the drive unit.	Improved.	Replace the drive unit.		○
		Not improved.	Investigate the motor. (Check the motor type and parameters.)		

Alarm No. 3E	Spindle speed overrun 1. A state in which the motor's speed feedback exceeded the speed command and accelerated was detected. 2. Even though the speed command is 0 (including when stopped during position control), motor rotation exceeding the parameter setting value was detected.				
	Investigation details	**Investigation results**	**Remedies**	**SV**	**SP**
1	Does the alarm occur immediately after the power is turned ON?	Occurs immediately after power is turned ON.	Investigate item 2.		○
		Occurs after normal operation.	Investigate item 3.		
2	Check the motor power cable (U, V, W phases). (Also check the operation immediately after emergency stop is cancelled.) • The power cable is not connected. • Is the cable connected to the motor for another axis? • Is the contactor between the drive unit and motor OFF? (When using coil changeover specifications.)	The connections are incorrect.	Connect correctly.		○
		The connections are correct.	Investigate item 3.		
3	Check whether the spindle rotary section is locked with a mechanical lock (C-axis clamp, etc.).	Locked with a mechanical lock.	Remove the cause of the lock.		○
		Not locked with a mechanical lock.	Investigate item 4.		
4	Try replacing the drive unit.	Improved.	Replace the drive unit.		○
		Not improved.	Investigate the motor. (Check the motor type and parameters.)		

Alarm No. 3F	Speed excessive deflection 2 During constant speed operation, the difference between the speed command and speed feedback exceeded the set amount and set time.				
	Investigation details	**Investigation results**	**Remedies**	**SV**	**SP**
1	Check the load value with the spindle monitor, and investigate the machine's load state.	The cutting load is large.	Lower the cutting load.		○
		The cutting load is not large.	Investigate item 2.		
2	Check whether the spindle rotary section is locked with a mechanical lock (C-axis clamp, etc.).	Locked with a mechanical lock.	Remove the cause of the lock.		○
		Not locked with a mechanical lock.	Investigate item 3.		
3	Try replacing the drive unit.	Improved.	Replace the drive unit.		○
		Not improved.	Investigate the motor. (Check the motor type and parameters.)		

Alarm No. 40	Detector changeover unit, changeover error During 1-drive unit 2-motor control, an error was detected in the motor changeover signal received form the detector changeover unit.				
	Investigation details	**Investigation results**	**Remedies**	**SV**	**SP**
1	Wiggle the FR-TK unit connector by hand to check whether it is disconnected.	The connector is disconnected (or loose).	Correctly install.		○
		The connector is not disconnected.	Investigate item 2.		
2	Check whether the cable connected between the spindle drive unit and FR-TK unit is broken.	The cable is broken.	Replace the cable.		○
		The cable is not broken.	Investigate item 3.		
3	Check if there is any abnormality in the unit's ambient environment. (Ex. Ambient temperature, noise, grounding)	No abnormality is found in particular.	Replace the drive unit.		○
		An abnormality was found in the ambient environment.	Take remedies according to the causes of the abnormality. Ex. High temperature: Check the cooling fan. Incomplete grounding: Additionally ground.		

Alarm No. 41	Detector changeover unit, communication error During 1-drive unit 2-motor control, an error was detected in the communication with the detector changeover unit.				
	Investigation details	**Investigation results**	**Remedies**	**SV**	**SP**
1	Check the alarm No. "40" items.				○

Alarm No. 42	Feedback error 1 With the servo, pulse-type position detector feedback signal error was detected. With the spindle, a PLG feedback signal error was detected.				
	Investigation details	**Investigation results**	**Remedies**	**SV**	**SP**
1	Check whether the drive unit connectors (servo: CN3, spindle: CN6) or detector connectors are disconnected.	The connector is disconnected (or loose).	Correctly install.	○	○
		The connector is not disconnected.	Investigate item 2.		
2	Turn the power OFF, and check the detector cable connection with a tester.	There is a connection fault.	Replace the detector cable.	○	○
		The connection is normal.	Investigate item 3.		
3	Connect to another normal axis drive unit, and check whether the fault is on the drive unit side or detector side.	The alarm is on the drive unit side.	Replace the drive unit.	○	○
		The alarm is on the detector side.	Servo : Investigate item 5. Spindle : Investigate item 4.		
4	Check the PLG output waveform.	There is a problem.	Adjust the PLG output waveform.		○
		Normal	Investigate item 5.		
5	Check if there is any abnormality in the detector's ambient environment. (Ex. Ambient temperature, noise, grounding)	No abnormality is found in particular.	Replace the detector. (With the absolute position system, the zero point must be established.)	○	○
		An abnormality was found in the ambient environment.	Take remedies according to the causes of the abnormality. Ex. High temperature: Check the cooling fan. Incomplete grounding: Additionally ground.		

Alarm No. 43	Feedback error 2 With the servo, an excessive error was detected in the position data for the motor side detector and machine side detector. With the spindle, an error was detected in the encoder feedback signal.				
	Investigation details	**Investigation results**	**Remedies**	**SV**	**SP**
1	Check whether the drive unit connectors or detector connectors are disconnected.	The connector is disconnected (or loose).	Correctly install.	○	
		The connector is not disconnected.	Investigate item 2.		
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?	The cables are wired near each other. (Noise is entering from the power cable.)	Improve the cable wiring.	○	
		The wires are sufficiently separated.	Investigate item 3.		
3	Is the motor FG wire connected only to the drive unit which drives it? (Is the motor grounded to one point?)	The motor FG wire is grounded on the motor side.	Connect together on the drive unit side.	○	
		The motor is grounded to one point.	Investigate item 4.		
4	Turn the power OFF, and check the detector cable connection with a tester. (Is the cable shielded?)	There is a connection fault.	Replace the detector cable.	○	
		The connection is normal.	Investigate item 5.		
5	Connect to another normal axis drive unit, and check whether the fault is on the drive unit side or detector side.	The alarm is on the drive unit side.	Replace the drive unit.	○	
		The alarm is on the detector side.	Investigate item 6.		
6	Check if there is any abnormality in the detector's ambient environment. (Ex. Ambient temperature, noise, grounding)	No abnormality is found in particular.	Replace the detector. (With the absolute position system, the zero point must be established.)	○	
		An abnormality was found in the ambient environment.	Take remedies according to the causes of the abnormality. Ex. High temperature: Check the cooling fan. Incomplete grounding: Additionally ground.		

Alarm No. 44	C-axis changeover alarm When using the coil changeover control motor, the mode was changed to C-axis control while the high-speed coil was selected.				
	Investigation details	**Investigation results**	**Remedies**	**SV**	**SP**
1	Check the coil selected with the spindle control input 3, bitD for the C-axis control command.	High-speed coil is selected (bitD = 0)	Correct the sequence.		○
		Low-speed coil is selected (bitD= 1)	Investigate item 2.		
2	Is coil changeover validated for the special motor specifications?	Coil changeover valid (SP034/bit2 = 1)	Correctly set the parameter.		○
		Coil changeover invalid (SP034/bit2 = 0)	Replace the drive unit.		

Alarm No. 46	Motor overheat The temperature protection function in the motor or detector activated.				
	Investigation details	**Investigation results**	**Remedies**	**SV**	**SP**
1	Check the repeatability.	The alarm occurs before operation.	Investigate item 2.	○	○
		The alarm occurs occasionally after operation is started.	Investigate item 5.		
2	Check whether the drive unit connectors (servo: CN3, spindle: CN6) or detector connectors are disconnected.	The connector is disconnected (or loose).	Correctly install.	○	○
		The connector is not disconnected.	Investigate item 3.		
3	Using a tester, check whether the detector cable is broken.	The cable is broken.	Replace the cable.	○	○
		The cable is not broken.	Servo : Investigate item 4. Spindle : Investigate item 12.		
4	When using MDS-B-HR, is the motor thermal validated even when it is not provided?	SV034/bit2 = 0	Set SP034/bit2 to 1.	○	
		SV034/bit2 = 1	Investigate item 12.		
5	Check the overload % (servo) or load meter (spindle).	The load is large.	Servo : Investigate item 6. Spindle : Investigate item 8.	○	○
		The load is not large.	Investigate item 9.		
6	Is the unbalance torque high?	The constant load torque (friction + unbalance) is 60% or more.	Select the motor so that the constant load torque is 60% or less.	○	
		The constant load torque is less than 60%.	Investigate item 7.		
7	Was the overload alarm (50) forcibly reset by turning the drive unit power OFF?	The alarm was forcibly reset.	Do not turn the drive unit's power OFF when an overload alarm occurs. (The NC power can be turned OFF.)	○	
		The alarm was not forcibly reset.	Investigate item 9.		
8	Check the parameter settings.	There was an incorrect setting.	Correctly set.		○
		The settings are correct.	Investigate item 9.		
9	Measure the motor temperature when the alarm occurs.	Hot.	Investigate item 10.	○	○
		Not hot.	Investigate item 12.		
10	When using a motor with fan, check whether the fan is stopped, or whether it is clogged with dust, etc.	The fan motor was stopped.	Investigate item 11.	○	○
		The motor fan wind flow is poor.	Clean.		
		There is no problem.	Investigate item 12.		
11	Check the fan wiring.	The cable is broken.	Replace the cable.	○	○
		The cable is not broken.	Replace the fan.		
12	Try replacing the drive unit.	Improved.	Replace the drive unit.	○	○
		Not improved.	Replace the motor.		

Alarm No. 4E	NC command mode error A spindle control mode selection outside the specifications was input.				
	Investigation details	**Investigation results**	**Remedies**	**SV**	**SP**
1	Pinpoint where the alarm occurs in the PLC program.	The alarm always occurs at the same position.	Check the NC and PLC program process.		○
		The alarm occurs irregularly.	Investigate item 2.		
2	Does the alarm occur when position control (C-axis, spindle synchronization, synchronous tap) is started?	The alarm occurs during position control.	Check the NC and PLC program process.		○
		The alarm occurs during speed control.	Check the NC and PLC program process. (If the cause cannot be pinpointed, replace the drive unit, and confirm.)		

Alarm No. 50	Overload 1 The overload detection level reached 100% or more. The motor or drive unit is in the overload state.				
	Investigation details	**Investigation results**	**Remedies**	**SV**	**SP**
1	Check the overload parameters. Servo : SV021, SV022 Spindle : SP063, SP064	The standard values (below) are not set. Servo : SV021 = 60, SV022 = 150 Spindle : SV063 = 60, SP064 = 110	Set the standard values.	○	○
		The standard values are set.	Investigate item 2.		
2	Check the overload % (servo) or load meter (spindle).	The load is large.	Servo : Investigate item 3. Spindle : Investigate item 7.	○	○
		The load is not large.	Investigate item 9.		
3	Check whether machine resonance is occurring.	Resonance is occurring.	Adjust the parameters. • Set the notch filter. • Lower VGN1 (SV005).	○	
		Resonance is not occurring.	Investigate item 4.		
4	Check whether the shaft sways when the motor is stopped. (Hunting)	The motor is hunting.	Adjust the parameters. • Increase VGN1 (SV005). • Lower VIA (SV008).	○	
		The motor is not hunting.	Investigate item 5.		
5	Check the brake operation Check the brake relay. Check the connector (CN20) connection.	The motor brakes are not released.	Correct the faulty section.	○	
		The motor brake operation is normal.	Investigate item 6.		
6	Check the load current with the NC Servo Monitor, and investigate the machine load.	The cutting load is large.	Lower the cutting load.	○	
		There is interference with the positioning pin.	When using the positioning pin, turn the servo OFF when stopped.		
		An excessive force is applied from the machine.	Check whether the ball screw is bent, or whether there is a fault in the guide.		
		The machine load is not large.	Investigate item 8.		
7	Check the PLG output waveform.	There is a problem.	Adjust the PLG output waveform.		○
		Normal	Investigate item 8.		
8	Confirm the motor capacity selection again.	The motor performance is insufficient.	Lower the acceleration/deceleration rate or cutting load.	○	○
		The motor performance is sufficient.	Investigate item 9.		
9	Try replacing the drive unit.	Improved.	Replace the drive unit.	○	○
		Not improved.	Replace the motor.		

(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. 51	Overload 2 With the servo, a current command exceeding 95% of the unit's maximum current continued for one second or more. With the spindle, a load exceeding the continuous rating continued for 30 minutes or more.				
	Investigation details	**Investigation results**	**Remedies**	**SV**	**SP**
1	Did the alarm occur immediately after READY ON?	The alarm occurred after ready ON before operation starts.	Investigate item 2.	○	
		The alarm occurred after normal operation.	Investigate item 5.		
2	Check that the PN voltage is supplied to the drive unit. Is the CHARGE lamp ON?	The voltage is not supplied.	Correctly supply the PN voltage.	○	
		Approx. 300V is correctly supplied.	Investigate item 3.		
3	Check the motor power cable (U, V, W phases). The power cable is not connected. Is the cable connected to the motor for another axis?	The connections are incorrect.	Connect correctly.	○	
		The connections are correct.	Investigate item 4.		
4	Check the detector cable connection. Is the cable connected to the motor for another axis?	The connections are incorrect.	Connect correctly.	○	
		The connections are correct.	Investigate item 5.		
5	Check whether the machine has collided.	The machine has collided.	Check the machining program and soft limit settings.	○	
		The machine has not collided.	Investigate item 6.		
6	Check whether the current value on the NC Servo Monitor screen is saturated during acceleration/deceleration.	The current is saturated during acceleration/deceleration.	Increase the acceleration/ deceleration time constant.	○	
		The current value during acceleration/deceleration is appropriate.	Investigate item 7.		
7	Check the detector FB.	The FB signal is abnormal.	Replace the detector. (With the absolute position system, the zero point must be established.)	○	
		The FB signal is normal.	Replace the drive unit.		
8	Check the load meter value.	The load is large.	Lower the load.		○
		The load is not large.	Investigate item 9.		
9	Check the PLG output waveform.	There is a problem.	Adjust the PLG output waveform.		○
		Normal	Replace the drive unit.		

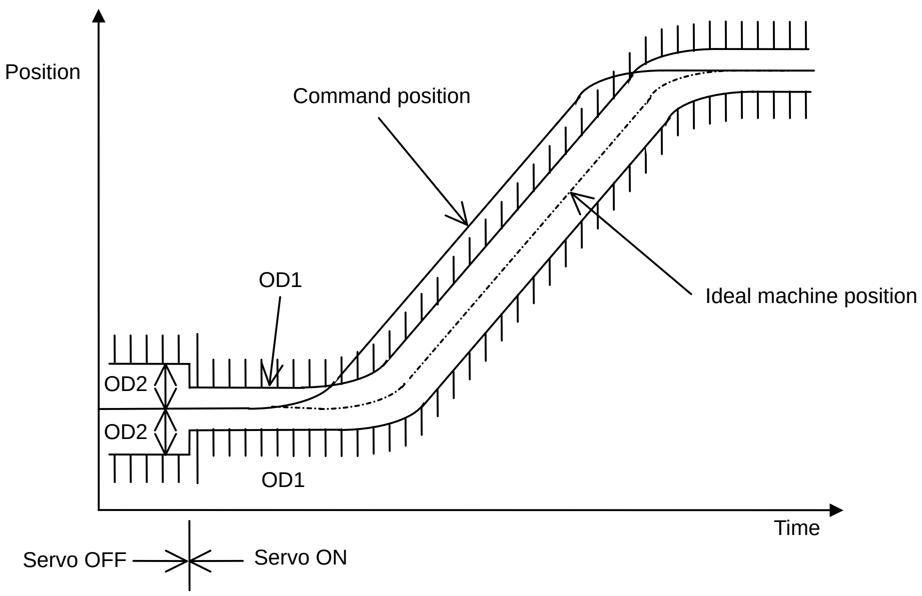
Alarm No. 52	Excessive error 1 The difference between the motor's actual position at servo ON and the theoretical position exceeded the setting value.				
	Investigation details	**Investigation results**	**Remedies**	**SV**	**SP**
1	Check the excessive error detection width. SV023 (Servo) SP102 (Orientation control) SP154, SP155 (C-axis control) SP177/bitD, SP186 (Spindle synchronous control) SP193/bitD, SP218 (Synchronous tap)	The excessive error detection width is too small. Servo standard value: $SV023 = \frac{RAPID}{60 \times PGN1} \div 2$ For the spindle, a value larger than the droop amount: Droop amount = $\frac{\text{Spindle rotation speed} \times \text{No. of pulses}}{60 \times \text{position loop gain}}$	Set appropriate values.	○	○
		Appropriate values are set.	Investigate item 2.		
2	Check the position detector polarity. SV017/bit4 (Servo) SP097/bit5 (Orientation control) SP129/bit5 (C-axis control) SP177/bit5 (Spindle synchronous control) SP193/bit5 (Synchronous tap control)	The polarity is reversed.	Correctly set the parameters.	○	○
		Normal.	Investigate item 3.		
3	Check the alarm No. "51" items.			○	○

Alarm No. 53	Excessive error 2 The difference between the motor's actual position at servo OFF and the theoretical position exceeded the setting value.				
	Investigation details	**Investigation results**	**Remedies**	**SV**	**SP**
1	Check the follow-up function while the NC is in the servo OFF state.	NC parameter (M60S Series) #1064 svof = 0	Investigate item 2.	○	
		NC parameter (M60S Series) #1064 svof = 1	Investigate item 3.		
2	Check whether the axis has moved during servo OFF, and check the motor brake operation.	The axis moved.	Adjust the brakes, etc., so that the axis does not move.	○	
		The axis has not moved.	Investigate item 3.		
3	Check the excessive error detection width. SV026 (Servo)	The excessive error detection width is too small. $SV026 = \frac{RAPID}{60 \times PGN1} \div 2$	Set an appropriate value.	○	
		An appropriate value is set.	Check for problems on the NC side, such as the position FB follow-up control.		

Alarm No. 54	Excessive error 3 The motor current was not detected when the excessive error 1 alarm occurred.				
	Investigation details	**Investigation results**	**Remedies**	**SV**	**SP**
1	Check that the PN voltage is supplied to the drive unit. • Is the CHARGE lamp ON?	The voltage is not supplied.	Correctly supply the PN voltage.	○	
		Approx. 300V is correctly supplied.	Investigate item 2.		
2	Check the motor power cable (U, V, W phases). • The power cable is not connected. • Is the cable connected to the motor for another axis?	The connections are incorrect.	Connect correctly.	○	
		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. 58	Collision detection 1 G0 When the collision detection function is valid, the disturbance torque exceeded the collision detection value during rapid traverse (G0).				
	Investigation details	**Investigation results**	**Remedies**	**SV**	**SP**
1	Check whether the machine has collided.	The machine has collided.	Check the machining program and soft limit settings.	○	
		The machine has not collided.	Increase the detection level (SV060). (The detection level should have an allowance and be set as approx. 1.5-times the maximum disturbance torque.)		

Alarm No. 59	Collision detection 1 G1 When the collision detection function is valid, the disturbance torque exceeded the collision detection level during cutting feed (G1).				
	Investigation details	**Investigation results**	**Remedies**	**SV**	**SP**
1	Check whether the machine has collided.	The machine has collided.	Check the machining program and soft limit settings.	○	
		The machine has not collided.	Increase the detection level (SV035. clG1). (Set the detection level larger than the maximum cutting load.)		

Alarm No. 5A	Collision detection 2 When the collision detection function is valid, the command torque reached the motor's maximum torque.				
	Investigation details	**Investigation results**	**Remedies**	**SV**	**SP**
1	Check whether the machine has collided.	The machine has collided.	Check the machining program and soft limit settings.	○	
		The machine has not collided.	Investigate item 2.		
2	Check whether the current value on the NC Servo Monitor screen is saturated during acceleration/deceleration.	The current is saturated during acceleration/deceleration.	Investigate item 3.	○	
		The current value during acceleration/deceleration is appropriate.	Investigate the cause of the load fluctuation.		
3	Can the acceleration/deceleration time constant be changed?	The constant can be changed.	Increase the acceleration/ deceleration time constant.	○	
		The constant cannot be changed.	Set to ignore collision detection method 2.		

Alarm No. 5C	Orientation feedback error After orientation was completed, the command and feedback error exceeded the parameter setting.				
	Investigation details	**Investigation results**	**Remedies**	**SV**	**SP**
1	Check the PLG cable shield.	The cable is not correctly shielded.	Shield the cable.		○
		The cable is correctly shielded.	Investigate item 2.		
2	Check the PLG cable connection.	The cable is incorrectly connected or broken.	Replace the cable.		○
		Normal	Investigate item 3.		
3	Check the PLG output waveform.	There is a problem.	Adjust the PLG output waveform.		○
		Normal	Replace the drive unit		

Alarm No. 60	Instantaneous power failure A drop in the 24VDC power was detected.				
	Investigation details	**Investigation results**	**Remedies**	**CV**	**CR**
1	Is 24VDC applied on the CN22 connector? Is the voltage low, or does it drop sometimes?	The voltage is not applied.	Investigate item 3.		○
		The voltage is 20.4VDC or less.	Increase the power voltage.		
		The voltage drops below 20.4VDC sometimes.	Investigate item 4.		
		The voltage is correctly applied.	Investigate item 2.		
2	Are the LEDs on the CR unit ON?	The LEDs are not ON.	Replace the unit.		○
		The LEDs are ON.	Investigate item 4.		
3	Check the wiring and power voltage.	The power is abnormal.	Replace the power.		○
		The wiring or connectors are abnormal.	Replace the cable.		
4	Check whether the voltage is dropping because of another load.	A voltage drop is not observed.	Check the wiring.		○
		A voltage drop is observed.	Increase the power capacity.		

Alarm No. 61	Power module overcurrent The power module's overcurrent protection function activated.				
	Investigation details	**Investigation results**	**Remedies**	**CV**	**CR**
1	Check the state of the operation when the alarm occurs, and check the repeatability.	The alarm occurs immediately after 200VAC is supplied and after READY is turned ON.	Replace the unit.	○	
		The alarm occurs frequently during READY ON.	Investigate item 3.		
		The alarm occurs after continuous operation for a long time. The unit is hot.	Investigate item 2.		
2	Check the load state of all motors, and the starting/stopping frequency.	The total load of all motors exceeds the rated capacity of the power supply unit.	Lower the motor load and operation frequency.	○	
		The total does not exceed the capacity.	Investigate item 3.		
3	Check the power capacity.	The power capacity is insufficient.	Increase the power capacity.	○	
		The specified power capacity is secured.	Investigate item 4.		
4	Measure the voltage across wires. • Is the voltage 170V or more even when the motor is accelerating?	The voltage drops to 170V or less occasionally.	Increase the power capacity.	○	
		The difference of the voltage across wires is 10V or more.	Improve the power phase balance.		
		The difference of the voltage across wires is less than 10V.	Investigate item 5.		
5	Measure the power voltage with a synchroscope, and check whether there is any distortion. • Are there any other devices causing the power distortion?	The power voltage is distorted.	Improve the source of the distortion. Install an AC reactor.	○	
		The power voltage waveform is not abnormal.	Investigate item 6.		
6	Check if there is any abnormality in the unit's ambient environment. (Ex. Noise, grounding)	No abnormality is found in particular.	Replace the unit.	○	
		The grounding is incomplete. An alarm will occur easily if another device operates.	Take remedies according to the causes of the abnormality. Ex. Incomplete grounding: Additionally ground. Noise: Noise measures for other devices.		

Alarm No. 62	Frequency error The input power frequency exceeded the specified range.				
	Investigation details	**Investigation results**	**Remedies**	**CV**	**CR**
1	Check the state of the operation when the alarm occurs, and check the repeatability.	The alarm occurs each time immediately after the power is turned ON. Or, the alarm occurs occasionally regardless of the operation state.	Investigate item 2.	○	
		The alarm occurs only while the motor is accelerating/decelerating.	Investigate item 3.		
2	Measure the power voltage waveform during normal operation.	The frequency is deviated from 50Hz±3% or 60Hz±3%.	Review the power facilities.	○	
		The voltage waveform dips at some sections.	Improve the source of the distortion. Install an AC reactor.		
		There is no problem.	Investigate item 4.		
3	Measure the power voltage when the motor is accelerating/decelerating.	The frequency greatly fluctuates during acceleration/deceleration.	Review the power facilities.	○	
		The voltage waveform during deceleration dips in some sections.	Improve the source of the distortion. Install an AC reactor.		
		There is no problem.	Investigate item 4.		
4	Check if there is any abnormality in the unit's ambient environment. (Ex. Noise, grounding)	No abnormality is found in particular.	Replace the unit.	○	
		The grounding is incomplete. An alarm will occur easily if another device operates.	Take remedies according to the causes of the abnormality. Ex. Incomplete grounding: Additionally ground. Noise: Noise measures for other devices.		

Alarm No. 63	Auxiliary regeneration error The auxiliary regenerative transistor is still ON.				
	Investigation details	**Investigation results**	**Remedies**	**CV**	**CR**
1	Check whether the regenerative resistor on the back of the unit is dirty.	Cutting oil or oil mist is adhered on the regenerative resistor.	Take measure to prevent cutting oil and dust from getting on the fins at the back of the unit, and then carry out investigation details 2.		○
		The resistor is not dirty.	Replace the unit.		
2	Using a tester, check the continuity of the terminal block and resistor surface.	There is continuity.	Replace the unit.		○
		The resistance value is ∞.	Clean the resistor or fins.		

Alarm No. 65	Rush relay error The rush resistance short-circuit relay does not turn ON.				
	Investigation details	**Investigation results**	**Remedies**	**CV**	**CR**
1	Check the repeatability.	The alarm occurs each time READY is turned ON.	Replace the unit.		○
		The alarm occurs occasionally.	Investigate item 2.		
2	Check if there is any abnormality in the unit's ambient environment. (Ex. Noise, grounding)	No abnormality is found in particular.	Replace the unit.		○
		The grounding is incomplete. An alarm will occur easily if another device operates.	Take remedies according to the causes of the abnormality. Ex. Incomplete grounding: Additionally ground. Noise: Noise measures for other devices.		

Alarm No. 67	Phase failure There is a phase failure in the input power.				
	Investigation details	**Investigation results**	**Remedies**	**CV**	**CR**
1	Check the voltage for each input phase.	There are phases with no voltage.	Correct the power supply.	○	
		There is no problem.	Investigate item 2.		
2	Check the alarm No. "71" items.			○	

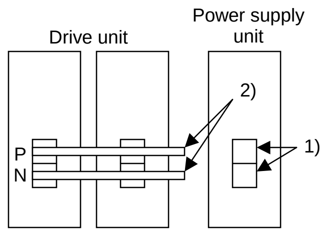
Alarm No. 68	Watch dog The system is not operating normally.				
	Investigation details	**Investigation results**	**Remedies**	**CV**	**CR**
1	Check the repeatability.	The alarm occurs each time READY is turned ON.	Replace the unit.	○	○
		The alarm occurs occasionally.	Investigate item 2.		
2	Check if there is any abnormality in the unit's ambient environment. (Ex. Noise, grounding)	No abnormality is found in particular.	Replace the unit.	○	○
		The grounding is incomplete. An alarm will occur easily if another device operates.	Take remedies according to the causes of the abnormality. Ex. Incomplete grounding: Additionally ground. Noise: Noise measures for other devices.		

Alarm No. 69	Ground fault The motor power cable is contacting FG (ground).				
	Investigation details	**Investigation results**	**Remedies**	**CV**	**CR**
1	Measure the insulation across the U, V, W phase cables for all motors and the ground. (Carry out a megger test.)	100kΩ or less.	The motor or power cable may be ground faulted.	○	○
		100kΩ or more.	Investigate item 2.		
2	Has oil come in contact with the motor or power cable?	Oil has come in contact.	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.	○	○
		Oil has not come in contact.	Investigate item 3.		
3	Measure the insulation again.	1MΩ or less.	Replace the motor or cable.	○	○
		1MΩ or more.	Investigate item 2.		
4	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.)	100kΩ or less.	Replace the drive unit.	○	○
		100kΩ or more.	Replace the power supply unit.		

Alarm No. 6A	External contactor melting The external contactor's contact has melted.				
	Investigation details	**Investigation results**	**Remedies**	**CV**	**CR**
1	Check whether any alarm has occurred on the drive unit side.	An alarm has occurred.	Remove the cause of the alarm on the drive side, and then carry out the investigation details 2.	○	
		An alarm has not occurred.	Investigate item 2.		
2	Check whether the contactor's contact has melted.	The contactor has melted.	Replace the contactor.	○	
		The contactor has not melted.	Investigate item 3.		
3	Check that the contactor excitation wiring is correctly connected from the power supply unit's MC1 terminal.	The connection is correct.	Correctly connect.	○	
		The connection is incorrect.	Replace the power supply unit.		

Alarm No. 6B	Rush relay melted The rush resistance short-circuit relay does not turn OFF.			
	Investigation details	**Investigation results**	**Remedies**	**CV**	**CR**
1	Check whether any alarm has occurred on the drive unit side.	An alarm has occurred.	Remove the cause of the alarm on the drive side, and then carry out the investigation details 2.		○
		An alarm has not occurred.	Investigate item 2.		
2	Check the repeatability.	The alarm occurs each time READY is turned ON.	Replace the unit.		○
		The alarm occurs occasionally.	Investigate item 3.		
3	Check if there is any abnormality in the unit's ambient environment. (Ex. Noise, grounding)	No abnormality is found in particular.	Replace the unit.		○
		The grounding is incomplete. An alarm will occur easily if another device operates.	Take remedies according to the causes of the abnormality. Ex. Incomplete grounding: Additionally ground. Noise: Noise measures for other devices.		

Alarm No. 6C	Main circuit error An abnormality was detected in the main circuit capacitor's charging operation.			
	Investigation details	**Investigation results**	**Remedies**	**CV**	**CR**
1	Check the CHARGE lamp state when the alarm occurs.	The CHARGE lamp remains ON for some time.	Replace the power supply unit.	○	○
		The lamp turns ON instantly, but when the alarm occurs and the contactor turns OFF, the lamp turns OFF immediately.	Investigate item 2.		
		The lamp never turns ON.	Investigate item 2. Then replace the unit.		
2	Disconnect the power supply unit's PN terminal block wiring, and measure the resistance value at 1) and 2) shown below.	1) The power supply unit side is abnormal.	Replace the power supply unit.	○	○
		2) The drive unit side is abnormal.	Disconnect the PN wiring, and then check the drive unit side.		
		1) and 2) are both normal.	Replace the power supply unit.		



Tester measure-ment point	Polarity +	Polarity -	Normal	Abnormal
1)	P	N	Several 100Ω	Short-circuit/∞Ω
	N	P	∞Ω	Several 100Ω
2)	P	N	Several 100Ω	Short-circuit/∞Ω
	N	P	∞Ω	Several 100Ω

Alarm No. 6D	Parameter error The power supply unit's capacity is not appropriate for the regenerative resistor type set with the parameters.			
	Investigation details	**Investigation results**	**Remedies**	**CV**	**CR**
1	Check the parameters (regenerative resistor type) of the drive unit to which the power supply unit's control wire (CN4) is connected. Servo: SV036, Spindle: SP041	SV036 and SP041 setting			○

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
amp				rtyp				ptyp							

rtyp	Regenerative resistor type	CR-10	CR-15	CR-22	CR-37	CR-55	CR-75	CR-90
0	For MDS-C1-CV	×	×	×	×	×	×	×
1	GZG200W260HMJ	○	○	○	○	○	○	○
2	GZG300W130HMJ×2	○	○	○	○	○	○	○
3	MR-RB30	×	×	×	○	○	○	○
4	MR-RB50	×	×	×	○	○	○	○
5	GZG200W200HMJ×3	×	×	×	×	×	○	○
6	GZG300W200HMJ×3	×	×	×	×	×	○	○
7	R-UNIT-1	○	○	○	○	○	○	○
8	R-UNIT-2	×	×	×	○	○	○	○
9	R-UNIT-3	×	×	×	○	○	○	○
A~F	No setting	×	×	×	×	×	×	×
ptyp setting		81	82	83	84	86	88	89

Alarm No. 6E	Memory error An error was detected in the internal memory.				
	Investigation details	**Investigation results**	**Remedies**	**CV**	**CR**
1	Check the repeatability.	The alarm occurs each time READY is turned ON.	Replace the unit.	○	○
		The alarm occurs occasionally.	Investigate item 2.		
2	Check if there is any abnormality in the unit's ambient environment. (Ex. Noise, grounding)	No abnormality is found in particular.	Replace the unit.	○	○
		The grounding is incomplete. An alarm will occur easily if another device operates.	Take remedies according to the causes of the abnormality. Ex. Incomplete grounding: Additionally ground. Noise: Noise measures for other devices.		

Alarm No. 6F	Power supply error The power supply is not connected. An error was detected in the power supply's A/D converter. This is detected simultaneously if another power supply alarm occurs.				
	Investigation details	**Investigation results**	**Remedies**	**CV**	**CR**
1	Check the LED display on the power supply unit.	"F" is flickering.	An A/D converter error has occurred. Carry out the items for alarm No. 6E.	○	○
		Another alarm code is flickering.	Refer to the section for each alarm.		
		"0" is displayed.	Investigate item 2.		
		"F" is displayed.	Investigate item 2.		
		"8" is displayed.	Refer to the section for alarm No.68.		
		"b", "C", "d" is displayed.	Investigate item 3.		
		Something else is displayed.	Refer to the section for alarm No.68.		
2	Check the rotary switch setting.	0 or 4 is set.	Investigate item 3.	○	○
		A value other than the above is set.	Correctly set the rotary switch.		
3	Check the communication cable (CN4) connected with the drive unit.	There is a problem with the wiring or shield.	Replace the cable.	○	○
		There is no problem.	Replace the unit.		

(Note) Alarm 6F is detected at the same time other power supply alarms occur.

Alarm No. 71	Instantaneous power failure/ external emergency stop An instantaneous power failure occurred.				
	Investigation details	**Investigation results**	**Remedies**	**CV**	**CR**
1	Investigate the sequence to check whether the contactor has been turned OFF with an emergency stop button, etc.	The contactor has been turned OFF externally.	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.	○	
		The contactor has not been turned OFF.	Investigate item 2.		
2	Check the repeatability.	The alarm occurs each time READY is turned ON.	Investigate item 3.	○	
		The alarm occurs at a certain operation.	Investigate item 1. If there is no problem, carry out investigation item 3.		
		The alarm occurs occasionally during operation.	Investigate item 4.		
3	Check whether the power input wire and contactor are correctly wired.	The wiring is incorrect.	Correctly connect.	○	
		There is no problem.	Investigate item 4.		
4	Check the power voltage waveform with a synchroscope.	An instantaneous power failure or voltage drop occurs frequently.	Correct the power facility.	○	
		There is no problem.	Replace the unit.		

Alarm No. 73	Over-regeneration The over-regeneration detection level exceeded 100%. The regenerative resistor is in the overload state.				
	Investigation details	**Investigation results**	**Remedies**	**CV**	**CR**
1	Check the alarm occurrence state and regenerative load displayed on the NC Monitor screen while changing the operation mode.	The regenerative load display increases when the power is turned ON and the motor is not rotated.	Check whether the state is affected by power fluctuation, grounding or noise. If there is no problem, replace the unit.	○	○
		The regenerative load display increases each time the motor decelerates, and the alarm occurs.	A-CR : Investigate item 2. C1-CV : Investigate item 4.		
		The regenerative load display increases each time the motor decelerates, but the alarm does not occur when the operation mode is eased.	A-CR : Investigate item 2. C1-CV : Ease the operation mode.		
2	Check whether the parameter (regenerative resistor type) of the drive unit controlling the power supply unit is correct.	The setting is incorrect.	Correctly set. (Refer to the section for alarm No. 6D.)		○
		The setting is correct.	Investigate item 3.		
3	Check the regenerative resistor's state. • Is oil adhered? • Measure the resistance value.	The regenerative resistor is abnormal.	Replace the regenerative resistor.		○
		There is no problem.	Investigate item 4.		
4	Check the alarm No. "75" items.			○	○

Alarm No. 74	Regenerative resistor overheat The temperature protection function in the regenerative resistor activated.				
	Investigation details	**Investigation results**	**Remedies**	**CV**	**CR**
1	Check whether the regenerative resistor is overheated.	The resistor is overheated.	Investigate item 2.		○
		The resistor is not overheated.	Investigate item 3.		
2	Check the alarm history.	Check whether over-regeneration occurred before.	Refer to the section for alarm No.73.		○
		Over-regeneration has not occurred before.	Take measures to dissipate the regenerative resistor's heat. • Improve the ventilation. • Install a fan.		
3	Check the connections of the CN22 (B) connector pins 1 and 2. • Check whether the pins are short-circuited with the resistor's thermal terminal or wire.	The wire is about to break.	Replace the wire.		○
		There is no continuity at the resistor's thermal terminal.	Replace the resistor unit.		
		There is no problem.	Replace the power supply unit.		

Alarm No. 75	Overvoltage The main circuit PN bus voltage exceeded the tolerable value.				
	Investigation details	**Investigation results**	**Remedies**	**CV**	**CR**
1	Check the repeatability.	The alarm occurs each time the motor decelerates.	Investigate item 3.	○	○
		The alarm occurs occasionally.	Investigate item 2.		
2	Check the power supply's alarm history.	Auxiliary regeneration frequency over (E8) occurs just before the overvoltage occurs.	Limit the occurrence of the excessive instantaneous regeneration by not decelerating multiple axes at the same time.	○	○
		Others.	Investigate item 3.		
3	Check the power capacity.	The power capacity is insufficient.	Increase the power capacity.	○	○
		The specified power capacity is secured.	Investigate item 4.		
4	Measure the voltage across wires. • Is the voltage 170V or more even when the motor is accelerating?	The voltage drops to 170V or less occasionally.	Increase the power capacity.	○	○
		The difference of the voltage across wires is 10V or more.	Improve the power phase balance.		
		The difference of the voltage across wires is less than 10V.	Investigate item 5.		
5	Measure the power voltage with a synchroscope, and check whether there is any distortion. • Are there any other devices causing the power distortion?	The power voltage is distorted.	Improve the source of the distortion. Install an AC reactor.	○	○
		The power voltage waveform is not abnormal.	Investigate item 6.		
6	Check if there is any abnormality in the unit's ambient environment. (Ex. Noise, grounding)	No abnormality is found in particular.	Replace the unit.	○	○
		The grounding is incomplete. An alarm will occur easily if another device operates.	Take remedies according to the causes of the abnormality. Ex. Incomplete grounding: Additionally ground. Noise: Noise measures for other devices.		

Alarm No. 76	External emergency stop setting error The rotary switch setting for the external emergency stop does not match the parameter setting.				
	Investigation details	**Investigation results**	**Remedies**	**CV**	**CR**
1	Check the rotary switch settings and parameter settings.	When using external emergency stop: • Add 0040h to the normal setting for SV036 or SP041, and set the power supply's rotary switch to "4".		○	

Alarm No. 77	Power module overheat The power module's temperature protection function activated.				
	Investigation details	**Investigation results**	**Remedies**	**CV**	**CR**
1	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 or more, and turn the power ON again.	○	
		The fan did not rotate. Or, an alarm occurred again.	Investigate item 2.		
2	Confirm that the fan is rotating correctly.	Large amounts of cutting oil or cutting chips, etc., are adhered, or the rotation is slow.	Clean or replace the fan.	○	
		The fan is rotating properly.	Investigate item 3.		
3	Check whether the heat dissipating fins are dirty.	Cutting oil or cutting chips, etc., are adhered, and the fins are clogged.	Clean the fins.	○	
		The fins are normal.	Investigate item 4.		
4	Measure the power supply unit's ambient temperature.	55°C or more	Improve the ventilation and cooling for the power distribution panel.	○	
		Less than 55°C.	Investigate item 5.		
5	Check if there is any abnormality in the unit's ambient environment. (Ex. Ambient temperature, noise, grounding)	No abnormality is found in particular.	If the alarm occurs even after the unit temperature has dropped, replace the unit.	○	
		An abnormality was found in the ambient environment.	Take remedies according to the causes of the abnormality. Ex. High temperature: Check the cooling fan. Incomplete grounding: Additionally ground.		

Alarm No. 7F	Power reboot request A mismatch in the program mode selection was detected. Turn the drive unit power ON again.				
	Investigation details	**Investigation results**	**Remedies**	**SV**	**SP**
1	Were the parameter settings changed? SV009, SV010, SV011, SV012 SV033/bit8, 9	This alarm is detected if the high-gain specification parameters are set when the drive unit is started up with the standard specification software mode, or if the standard specification parameters are set when started up with the high-gain specifications.	Turn the drive unit's control power ON again.	○	

Alarm No. 88	Watch dog The system is not operating normally.				
	Investigation details	**Investigation results**	**Remedies**	**SV**	**SP**
1	Check whether the servo software version was changed recently.	The version was changed.	Replace with a drive unit containing the original software version.	○	○
		The version was not changed.	Investigate item 2.		
2	Check the repeatability.	The alarm is always repeated.	Replace the drive unit.	○	○
		The state is returned to normal once, but then the alarm occurs occasionally.	Investigate item 3.		
3	Check if there is any abnormality in the unit's ambient environment. (Ex. Ambient temperature, noise, grounding)	No abnormality is found in particular.	Replace the drive unit.	○	○
		An abnormality was found in the ambient environment.	Take remedies according to the causes of the abnormality. Ex. High temperature: Check the cooling fan. Incomplete grounding: Additionally ground.		

Alarm No. 89	Encoder converter unit 2, connection error With the servo, an error was detected in the connection with the analog output linear scale for the MDS-B-HR unit. With the spindle, initial communication with the MDS-B-PJEX was not possible.				
	Investigation details	**Investigation results**	**Remedies**	**SV**	**SP**
1	Wiggle the MDS-B-HR/MDS-B-PJEX unit connector (CON3) by hand to check whether it is disconnected.	The connector is disconnected (or loose).	Correctly install.	○	○
		The connector is not disconnected.	Servo : Investigate item 2. Spindle : Investigate item 4.		
2	Check whether the cable between the linear scale and MDS-B-HR is broken.	The cable is broken.	Replace the cable.	○	
		The cable is not broken.	Investigate item 3.		
3	Check if there is any abnormality in the unit's ambient environment. (Ex. Ambient temperature, noise, grounding)	No abnormality is found in particular.	Replace the MDS-B-HR unit.	○	
		An abnormality was found in the ambient environment.	Take remedies according to the causes of the abnormality. Ex. High temperature: Check the cooling fan. Incomplete grounding: Additionally ground.		
4	Check whether the cable between the spindle drive unit and MDS-B-PJEX is broken.	The cable is broken.	Replace the cable.		○
		The cable is not broken.	Investigate item 5.		
5	Check if there is any abnormality in the unit's ambient environment. (Ex. Ambient temperature, noise, grounding)	No abnormality is found in particular.	Replace the drive unit.		○
		An abnormality was found in the ambient environment.	Take remedies according to the causes of the abnormality. Ex. High temperature: Check the cooling fan. Incomplete grounding: Additionally ground.		

Alarm No. 8A	Detection converter unit 2, communication error With the servo, an error was detected in the communication with the serial output linear scale for the MDS-B-HR unit. With the spindle, an error was detected in the communication with the MDS-B-PJEX.				
	Investigation details	**Investigation results**	**Remedies**	**SV**	**SP**
1	Check the alarm No. "89" items.			○	○

Alarm No. 8B	Encoder converter unit 2, automatic adjustment error An abnormal signal from the PLG was detected during automatic adjustment of the PLG.				
	Investigation details	**Investigation results**	**Remedies**	**SV**	**SP**
1	Check whether the MDS-B-PJEX connectors (CN5) or detector connectors are disconnected.	The connector is disconnected (or loose).	Correctly install.		○
		The connector is not disconnected.	Investigate item 2.		
2	Turn the power OFF, and check the detector cable connection with a tester.	There is a connection fault.	Replace the detector cable.		○
		The connection is normal.	Investigate item 3.		
3	Check the PLG output waveform (A/B phase).	There is a problem. (The A/B phase input voltage is 0.8V or less or 2.2V or higher.)	Adjust the PLG output waveform.		○
		Normal	Investigate item 4.		
4	Check the occurrence frequency.	Occurs each time.	Replace the MDS-B-PJEX unit.		○
		Occurs occasionally.	Check whether the cable is disconnected, whether there is a contact fault, or a detector fault.		

Alarm No. 8C	Encoder converter unit 2, judgment error A detector type outside the specifications was detected with the MDS-B-PJEX.				
	Investigation details	**Investigation results**	**Remedies**	**SV**	**SP**
1	Check the spindle parameter SP042. SP042: C-axis control detector range. (Spindle end PLG No. of pulse setting)	The setting was incorrect. "4" : 128 pulses "5" : 256 pulses "6" : 512 pulses "8" : 180 pulses	Set correctly according to the No. of PLG gear teeth.		○
		The setting is correct.	Investigate item 2.		
2	Check if there is any abnormality in the unit's ambient environment. (Ex. Ambient temperature, noise, grounding)	No abnormality is found in particular.	Replace the MDS-B-PJEX.		○
		An abnormality was found in the ambient environment.	Take remedies according to the causes of the abnormality. Ex. High temperature: Check the cooling fan. Incomplete grounding: Additionally ground.		

Alarm No. 8D	Detection converter unit 2, CPU error With the servo, a CPU error was detected with the MDS-B-HR unit. With the spindle, a CPU error was detected with the MDS-B-PJEX unit.				
	Investigation details	**Investigation results**	**Remedies**	**SV**	**SP**
1	Check if there is any abnormality in the detector's ambient environment. (Ex. Ambient temperature, noise, grounding)	No abnormality is found in particular.	Replace the detection converter unit.	○	○
		An abnormality was found in the ambient environment.	Take remedies according to the causes of the abnormality. Ex. High temperature: Check the cooling fan. Incomplete grounding: Additionally ground.		

Alarm No. 8E	Detection converter unit 2, data error A data error was detected with the MDS-B-HR unit.				
	Investigation details	**Investigation results**	**Remedies**	**SV**	**SP**
1	Check whether the cable between the linear scale and MDS-B-HR is broken.	The cable is broken.	Replace the cable.	○	
		The cable is not broken.	Investigate item 2.		
2	Check if there is any abnormality in the unit's ambient environment. (Ex. Ambient temperature, noise, grounding)	No abnormality is found in particular.	Investigate item 3.	○	
		An abnormality was found in the ambient environment.	Take remedies according to the causes of the abnormality. Ex. High temperature: Check the cooling fan. Incomplete grounding: Additionally ground.		
3	Try replacing the MDS-B-HR unit.	The state is improved.	Replace the MDS-B-HR unit.	○	
		The state is not improved.	Replace the linear scale.		

6-3-3 Troubleshooting for each warning No.

Warning No. 90	Detector, initial communication error Initial communication with the absolute position linear scale was not possible.				
	Investigation details	**Investigation results**	**Remedies**	**SV**	**SP**
1	Check the servo parameter (SV025.pen) setting.	The setting is incorrect.	Correctly set SV025.	○	
		The setting is correct.	Investigate item 2.		
2	Check whether the drive unit connector (CN3) and detector connector are disconnected.	The connector is disconnected (loose).	Correctly install.	○	
		The connector is not disconnected.	Investigate item 3.		
3	Turn the power OFF, and check the detector cable connection with a tester.	The connection is faulty.	Replace the detector cable (CN3 side).	○	
		The connection is normal.	Investigate item 4.		
4	Check if there is any abnormality in the tool end detector's ambient environment. (Ex.: Ambient temperature, noise, grounding)	No abnormality is found in particular.	Replace the tool end detector. (With the absolute position system, the zero point must be established.)	○	
		An abnormality was found in the ambient environment.	Take remedies according to the causes of the abnormality. Ex. High temperature: Check the cooling fan. Incomplete grounding: Additionally ground.		

Warning No. 91	Detector, communication error An error was detected in the communication with the detector for the absolute position detection system.				
	Investigation details	**Investigation results**	**Remedies**	**SV**	**SP**
1	Check whether the drive unit connectors (CN3) or detector connectors are disconnected.	The connector is disconnected (or loose).	Correctly install.	○	
		The connector is not disconnected.	Investigate item 2.		
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?	The cables are wired near each other. (Noise is entering from the power cable.)	Improve the cable wiring.	○	
		The wires are sufficiently separated.	Investigate item 3.		
3	Is the motor FG wire connected only to the drive unit which drives it? (Is the motor grounded to one point?)	The motor FG wire is grounded on the motor side.	Ground the motor to one point, connecting the wires together on the drive unit side.	○	
		The motor is grounded to one point.	Investigate item 4.		
4	Turn the power OFF, and check the detector cable connection with a tester. (Is the cable shielded?)	There is a connection fault.	Replace the detector cable.	○	
		The connection is normal.	Investigate item 5.		
5	Connect to another normal axis drive unit, and check whether the fault is on the drive unit side or detector side.	The alarm is on the drive unit side.	Replace the drive unit.	○	
		The alarm is on the detector side.	Investigate item 6.		
6	Check if there is any abnormality in the detector's ambient environment. (Ex. Ambient temperature, noise, grounding)	No abnormality is found in particular.	Replace the detector. (With the absolute position system, the zero point must be established.)	○	
		An abnormality was found in the ambient environment.	Take remedies according to the causes of the abnormality. Ex. High temperature: Check the cooling fan. Incomplete grounding: Additionally ground.		

Warning No. 92	Detector, protocol error An error was detected in the data for the absolute position detection system.				
	Investigation details	**Investigation results**	**Remedies**	**SV**	**SP**
1	Check if there is any abnormality in the detector's ambient environment. (Ex. Ambient temperature, noise, grounding)	No abnormality is found in particular.	Investigate item 2.	○	
		An abnormality was found in the ambient environment.	Take remedies according to the causes of the abnormality. Ex. High temperature: Check the cooling fan. Incomplete grounding: Additionally ground.		
2	Check the repeatability.	Occurs frequently.	Replace the detector.	○	○
		Is not repeated.	Investigate item 1.		

Warning No. 93	Initial absolute position fluctuation The position data fluctuated when creating the initial absolute position.				
	Investigation details	**Investigation results**	**Remedies**	**SV**	**SP**
1	Check the state of the axis when the NC power is turned ON.	The vertical axis or slant axis drops when the NC power is turned ON.	Check the brake operation.	○	
		The axis moves with an external force when the NC power is turned ON.	Make sure that the axis does not move when the power is turned ON.		

Warning No. 96	MP scale feedback error An excessive deviation was detected between the motor end detector and MP scale feedback data for the MP scale absolute position detection system.				
	Investigation details	**Investigation results**	**Remedies**	**SV**	**SP**
1	Check the alarm No. "43" items.			○	

Warning No. 97	MP scale offset error An error was detected in the offset data received from the MP scale for the MP scale absolute position detection system.				
	Investigation details	**Investigation results**	**Remedies**	**SV**	**SP**
1	Check if there is any abnormality in the detector's ambient environment. (Ex. Ambient temperature, noise, grounding)	No abnormality is found in particular.	Investigate item 2.	○	
		An abnormality was found in the ambient environment.	Take remedies according to the causes of the abnormality. Ex. High temperature: Check the cooling fan. Incomplete grounding: Additionally ground.		
2	Check the repeatability.	Occurs frequently.	Replace the detector.	○	○
		Is not repeated.	Investigate item 1.		

Warning No. 9E	Absolute position detector, multi-rotation counter error An error was detected in the multi-rotation counter for the absolute position detector. The absolute position cannot be compensated.				
	Investigation details	**Investigation results**	**Remedies**	**SV**	**SP**
1	Check if there is any abnormality in the detector's ambient environment. (Ex. Ambient temperature, noise, grounding)	No abnormality is found in particular.	Investigate item 2.	○	
		An abnormality was found in the ambient environment.	Take remedies according to the causes of the abnormality. Ex. High temperature: Check the cooling fan. Incomplete grounding: Additionally ground.		
2	Check the repeatability.	Occurs frequently.	Replace the detector.	○	○
		Is not repeated.	Investigate item 1.		

(Note) When this alarm occurs, the absolute position system's zero point must be established.

Warning No. 9F	Battery voltage drop The voltage of the battery supplying to the absolute position detector has dropped. The absolute position data is held.				
	Investigation details	**Investigation results**	**Remedies**	**SV**	**SP**
1	Measure the battery (MDS-A-BT) voltage.	Less than 3V.	Replace the battery unit.	○	
		3V or more.	Investigate item 2.		
2	Check whether the NC bus cable is disconnected.	The cable is disconnected.	Connect correctly.	○	
		There is no problem.	Investigate item 3.		
3	Check whether the battery wire in the detector cable is broken.	The cable is broken.	Replace the cable.	○	
		The cable is not broken.	Investigate item 4.		
4	Try replacing the drive unit.	Improved.	Replace the drive unit.	○	
		Not improved.	Replace the detector. (With the absolute position system, the zero point must be established.)		

(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. A8	Turret indexing error warning The commanded turret indexing position shift amount is outside the specified range.				
	Investigation details	**Investigation results**	**Remedies**	**SV**	**SP**
1	Check the parameters. SP097/bitB = 0 command angle 1° unit SP097/bitB = 1 command angle 0.1° unit	The setting is incorrect.	Correctly set SP097.		○
		The setting is correct.	Investigate item 2.		
2	Pinpoint where the alarm occurs in the PLC program.	The position can be pinpointed.	Check the PLC program process.		○
		The position cannot be pinpointed.	Investigate the details of the NC and PLC program process.		

Warning No. A9	Orientation feedback error warning Retrying during an orientation feedback error.				
	Investigation details	**Investigation results**	**Remedies**	**SV**	**SP**
1	Check the alarm No. "5C" items.				○

Warning No. E1	Overload warning The overload detection level is 80% or more.				
	Investigation details	**Investigation results**	**Remedies**	**SV**	**SP**
1	Check the alarm No. "50" items.			○	○

Warning No. E3	Absolute position counter warning A deviation was detected in the absolute position data and relative position data.				
	Investigation details	**Investigation results**	**Remedies**	**SV**	**SP**
1	Check if there is any abnormality in the detector's ambient environment. (Ex. Ambient temperature, noise, grounding)	No abnormality is found in particular.	Investigate item 2.	○	
		An abnormality was found in the ambient environment.	Take remedies according to the causes of the abnormality. Ex. High temperature: Check the cooling fan. Incomplete grounding: Additionally ground.		
2	Check the repeatability.	Occurs frequently.	Replace the detector.	○	
		Is not repeated.	Investigate item 1.		

(Note) When this alarm occurs, the absolute position system's zero point must be established.

Warning No. E4	Parameter error warning A parameter exceeding the setting range was set. "S51 parameter error ####" is displayed on the NC screen. #### indicates the incorrect parameter No.				
	Investigation details	**Investigation results**	**Remedies**	**SV**	**SP**
1	Check the error parameter No.	SV001 to SV065 (M60S system: 2201 to 2265) SP001 to SP384 (M60S system: 3201 to 3584)	Set the value within the designated setting range.	○	○

Warning No. E6	Control axis removal warning Control axis removal was commanded.				
	Investigation details	**Investigation results**	**Remedies**	**SV**	**SP**
1	The status in which removal of the control axis was commanded from the NC is indicated.			○	

Warning No. E7	NC emergency stop Emergency stop was input from the NC.				
	Investigation details	**Investigation results**	**Remedies**	**SV**	**SP**
1	Check whether NC emergency stop was input.	Emergency stop was input.	The NC is in the emergency stop state. (Normal)	○	○
		Emergency stop was not input.	Investigate item 2.		
2	Check whether an alarm is occurring in another drive unit.	An alarm is occurring in another drive unit.	Reset the alarm in the other drive unit.	○	○
		An alarm is not occurring.	Investigate item 3.		
3	Check the NC communication bus line.	The terminator or battery unit's cable is disconnected.	Correctly connect.	○	○
		The NC communication bus connector (CN1A, CN1B) is loose, or the cable is broken.	Correctly connect the cable.		

Warning No. E8	Auxiliary regeneration frequency over Regeneration at the power supply performance limit is occurring frequently.				
	Investigation details	**Investigation results**	**Remedies**	**CV**	**CR**
1	Check the alarm No. "75" items.				○

Warning No. E9	Instantaneous power failure warning An instantaneous power failure occurred.				
	Investigation details	**Investigation results**	**Remedies**	**CV**	**CR**
1	Check the alarm No. "71" items.			○	

Warning No. EA	External emergency stop The external emergency stop signal was input.				
	Investigation details	**Investigation results**	**Remedies**	**CV**	**CR**
1	Check whether the specifications allow use of the external emergency stop.	Use not allowed.	Invalidate the external emergency stop.	○	
		Use is allowed.	Investigate item 2.		
2	Measure the input voltage of the CN23 connector. (While emergency stop is cancelled.)	24V is input.	Replace the power supply unit.	○	
		24V is not input.	Check whether the external emergency stop cable is broken, or check the external contact operation.		

Warning No. EB	Over-regeneration warning The over-regeneration level is 80% or more.				
	Investigation details	**Investigation results**	**Remedies**	**CV**	**CR**
1	Check the alarm No. "73" items.			○	

6-3-4 Parameter numbers during initial parameter error

If an initial parameter error (alarm 37) occurs, the alarm and the number of the parameter that may have been set exceeding the setting range will appear on the CNC Diagnosis screen. (For M60S, E60 Series NC.)

S02 Initial parameter error ○○○○ □

□ : Axis name

○○○○ : Error parameter

If an error number larger than the servo parameter number is displayed for the servo drive unit (MDS-C1-V1/V2), the alarm is occurring for several related parameters. Refer to the following table, and correctly set the parameters.

Error parameter No.	Details	Related parameters
2269	The CNC setting maximum rapid traverse rate value is incorrect. The CNC system software may be illegal. Turn the power ON again.	NC setting rapid
2271	The CNC setting maximum cutting speed setting value is incorrect. The CNC system software may be illegal. Turn the power ON again.	NC setting clamp
2301	The following settings are overflowing. Electronic gears Position loop gain Speed feedback	SV001, SV002 SV003, SV018 SV019, SV020 SV049
2302	The absolute position parameter is valid when OSE104 and OSE105 are connected.	SV017, SV025
2303	The servo option is not available. The closed loop or dual feedback control function is set.	SV025, SV017
2304	The servo option is not available. The SHG control function is set.	SV057, SV058
2305	The servo option is not available. The adaptive filter function is set.	SV027
2306	The servo option is not available. The MP scale absolute position function is set.	SV017
2308	The valid/invalid setting of the 4th or 5th notch filter is changed from the initial setting.	SV087, SV088

6-3-5 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.

[1] No abnormality is displayed, but the motor does not rotate.

	Investigation item	Investigation results	Remedies
1	Check the wiring around the spindle drive unit. Also check for loosening in the terminal screws and disconnec- tions, etc.	The wiring is incorrect, the screws are loose, or the cables are disconnected.	Correctly wire. Correctly tighten the screws. Replace the cables.
		No particular problems found.	Investigate investigation item 2 and remedy.
2	Check the input voltage.	The voltage is exceeding the specification value.	Restore the power to the correct state.
		The voltage is within the specification value.	Investigate investigation item 3 and remedy.
3	Check all of the spindle parameters.	The correct values are not set.	Set the correct values.
		The correct values are set.	Investigate investigation item 4 and remedy.
4	Check the input signals. • Are the READY, forward run and reverse run signals input? • In particular, the forward run and reverse run signals must be input at least one second after READY is turned ON. • Check whether the forward run and reverse run signals are turned ON simultaneously.	The signals are not input or the sequence is incorrect. The orientation command is input.	Correct the input signals.
		No particular problems found.	Investigate investigation item 5 and remedy.
5	Check the speed command.	The speed command is not input correctly.	Input the correct speed command.
		The speed command is input correctly.	Replace the unit.

[2] No fault is displayed, but the motor only rotates slowly, or a large noise is heard from the motor.

	Investigation item	Investigation results	Remedies
1	Check the U, V and W wiring between the spindle drive unit and motor.	The wires are not connected correctly.	Correctly connect.
		The wires are connected correctly.	Investigate investigation item 2 and remedy.
2	Check the input voltage.	One of the three phases is not within the specification value. No particular problems found.	Restore the power to the correct state. Investigate investigation item 3 and remedy.
3	Check the speed command.	The speed command is not input correctly.	Check the NC and PLC sequence.
		The speed command is input correctly.	Investigate investigation item 4 and remedy.
4	Tug on the connector by hand to check whether the speed detector connector (drive unit side and speed detector side) is loose.	The connector is disconnected (or loose).	Correctly connect the connector.
		The connector is not disconnected (or loose).	Investigate investigation item 5 and remedy.
5	Turn the power OFF, and check the connection of the speed detector cable with a tester.	The connection is faulty or disconnected.	Replace the detector cable. Correct the connection.
		The connection is normal.	Replace the drive unit.

[3] The rotation speed command and actual rotation speed do not match.

	Investigation item	Investigation results	Remedies
1	Check the speed command.	The speed command is not input correctly.	Input the correct speed command.
		The speed command is correct.	Investigate investigation item 2 and remedy.
2	Check whether there is slipping between the motor and spindle. (When connected with a belt or clutch.)	There is slipping.	Repair the machine side.
		No particular problems found.	Investigate investigation item 3 and remedy.
3	Check the spindle parameters (SP017, SP034, SP040, SP257 and following).	The correct values are not set.	Set the correct values.
		The correct values are set.	Replace the drive unit.

[4] The starting time is long or has increased in length.

	Investigation item	Investigation results	Remedies
1	Check whether the friction torque has increased.	The friction torque has increased.	Repair the machine side.
		No particular problems found.	Investigate investigation item 2 and remedy.
2	Manually rotate the motor bearings and check the movement.	The bearings do not rotate smoothly.	Replace the spindle motor.
		The bearings rotate smoothly.	Investigate investigation item 3 and remedy.
3	Check whether the torque limit signal has been input.	The signal has been input.	Do not input this signal.
		The signal is not input.	Replace the drive unit.

[5] The motor stops during cutting.

	Investigation item	Investigation results	Remedies
1	Check the load rate during cutting.	The load meter sways past 120% during cutting.	Reduce the load.
		No particular problems found.	Investigate the same matters as item (4), and remedy.

[6] The vibration and noise (gear noise), etc., are large.

	Investigation item	Investigation results	Remedies
1	Check the machine's dynamic balance. (Coast from the maximum speed.)	The same noise is heard during coasting.	Repair the machine side.
		No particular problems found.	Investigate investigation item 2 and remedy.
2	Check whether there is a resonance point in the machine. (Coast from the maximum speed.)	Vibration and noise increase at a set rotation speed during coasting.	Repair the machine side.
		No particular problems found.	Investigate investigation item 3 and remedy.
3	Check the machine's backlash.	The backlash is great.	Repair the machine side.
		No particular problems found.	Investigate investigation item 4 and remedy.
4	Check the spindle parameter settings. (SP022, SP023, SP056)	Symptoms decrease when setting value is set to approx. half.	Change the setting value. Note that the impact response will drop.
		The symptoms do not change even when the above value is set.	Return the setting values to the original values. Investigate investigation item 5 and remedy.
5	Tug on the connector by hand to check whether the speed detector connector (spindle drive unit side and speed detector side) is loose.	The connector is disconnected (or loose).	Correctly connect the connector.
		The connector is not disconnected (or loose).	Investigate investigation item 6 and remedy.
6	Turn the power OFF, and check the connection of the speed detector cable with a tester.	The connection is faulty or disconnected.	Replace the detector cable. Correct the connection.
		The connection is normal.	Replace the drive unit.

[7] The spindle coasts during deceleration.

	Investigation item	Investigation results	Remedies
1	Check whether there is slipping between the motor and spindle. (When connected with a belt or clutch.)	There is slipping.	Repair the machine side.
		No particular problems found.	Replace the drive unit.

[8] The rotation does not stabilize.

	Investigation item	Investigation results	Remedies
1	Check the spindle parameter settings. (SP022, SP023)	The rotation stabilizes when the settings values are both set to approx. double.	Change the setting value. Note that the gear noise may increase.
		The symptoms do not change even when the above value is set.	Return the setting values to the original values. Investigate investigation item 2 and remedy.
2	Tug on the connector by hand to check whether the speed detector connector (spindle drive unit side and speed detector side) is loose.	The connector is disconnected (or loose).	Correctly connect the connector.
		The connector is not disconnected (or loose).	Investigate investigation item 3 and remedy.
3	Turn the power OFF, and check the connection of the speed detector cable with a tester. (Especially check the shield wiring.)	The connection is faulty or disconnected.	Replace the detector cable. Correct the connection.
		The connection is normal.	Investigate investigation item 4 and remedy.
4	Investigate the wiring and installation environment. • Is the ground correctly connected? • Are there any noise-generating devices near the drive unit?	The grounding is incomplete.	Correctly ground.
		The alarm occurs easily when a specific device operates.	Use noise measures on the device described on the left.
		No particular problems found.	Replace the drive unit.

[9] The speed does not rise above a set level.

	Investigation item	Investigation results	Remedies
1	Check the speed command. Check whether the override input is input from the machine operation panel.	The speed command is not input correctly.	Input the correct speed command.
		The speed command is input correctly.	Investigate investigation item 2 and remedy.
2	Check whether the load has suddenly become heavier.	The load has become heavier.	Repair the machine side.
		No particular problems found.	Investigate investigation item 3 and remedy.
3	Manually rotate the motor bearings and check the movement.	The bearings do not rotate smoothly.	Replace the spindle motor.
		The bearings rotate smoothly.	Investigate investigation item 4 and remedy.
4	Tug on the connector by hand to check whether the speed detector connector (spindle drive unit side and speed detector side) is loose.	The connector is disconnected (or loose).	Correctly connect the connector.
		The connector is not disconnected (or loose).	Investigate investigation item 5 and remedy.
5	Turn the power OFF, and check the connection of the speed detector cable with a tester. (Especially check the shield wiring.)	The connection is faulty or disconnected.	Replace the detector cable. Correct the connection.
		The waveform is normal.	Replace the spindle drive unit.

7. Maintenance

⚠ **WARNING**	1. Before starting maintenance or inspections, turn the main circuit power and control power both OFF. Wait at least ten minutes for the CHARGE lamp to turn OFF, and then using a tester, confirm that the input and output voltage are zero. Failure to observe this could lead to electric shocks. 2. Inspections must be carried out by a qualified technician. Failure to observe this could lead to electric shocks. Contact your nearest Mitsubishi branch or dealer for repairs and part replacement.

⚠ **CAUTION**	1. Never perform a megger test (measure the insulation resistance) of the servo drive unit. Failure to observe this could lead to faults. 2. The user must never disassemble or modify this product.

7-1 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?

7-2 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.

Part name		Standard replacement time	Remarks
Servo drive unit	**Smoothing capacitor**	10 years	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.
	Cooling fan	10,000 to 30,000 hours (2 to 3 years)	
	Battery	10,000 hours	
Servomotor	**Bearings**	20,000 to 30,000 hours	
	Detector	20,000 to 30,000 hours	
	Oil seal, V-ring	5,000 hours	

[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.

7-3 Adding and replacing units and parts

⚠ **CAUTION**	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.

7-3-1 Replacing the drive unit

Replace the unit with the following procedures.

(1) Replacing the servo drive unit

[1] Disconnect the connectors connected to CN1A, CN1B, CN9, CN4, CN2L, CN3L, CN2M, CN3M and CN20.
[2] Disconnect all wires connected to the terminal block: LU, LV, LW, MU, MV, MW, ⏚, L+, L-, L11 and L21.
[3] Remove the two (four) screw fixing the unit onto the control unit. Remove the unit from the control panel.
[4] Install the new unit following the removal procedures in reverse.

(Note) The connector and terminal block names differ for the MDS-C1-V1 unit. (CN2L, CN3L → CN2, CN3 LU, LV, LW → U, V, W)
The CN2M, CN3M connector and MU, MV, MW connectors are not provided.

(2) Replacing the spindle drive unit

[1] Disconnect the connectors connected to CN1A, CN1B, CN9, CN4, CN5, CN6, CN7 and CN8.
[2] Disconnect all wires connected to the terminal block: U, V, W, ⏚, L+, L-, L11 and L21.
[3] Remove the two (four) screw fixing the unit onto the control unit. Remove the unit from the control panel.
[4] Install the new unit following the removal procedures in reverse.

(3) Replacing the power supply unit

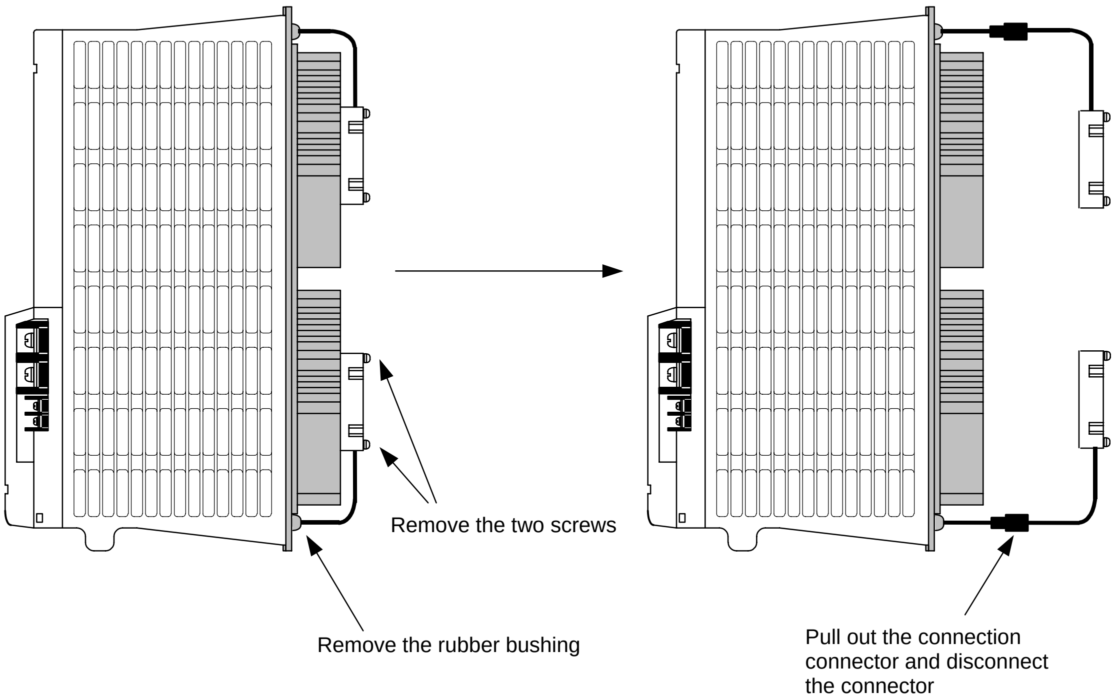
[1] Disconnect the connectors connected to CN4, CN9 and CN23.
[2] Disconnect all wires connected to the terminal block's L1, L2, L3, ⏚, L+, L-, L11, L21 and MC1.
[3] Remove the two (four) screw fixing the unit onto the control unit. Remove the unit from the control panel.
[4] Install the new unit following the removal procedures in reverse.

7-3-2 Replacing the unit fan

Replace the unit fan with the following procedures.

Replacement procedure

[1] Turn the NF for the 200/230VAC input power OFF, and wait for the CHARGE lamp on the power supply unit to turn OFF before removing the unit.
[2] Remove the fan guard from the back of the power supply unit, and remove the two fan mounting screws.
[3] Remove the rubber bushing for the fan power cable, and pull out the connection connector.
[4] Disconnect the connection connector, and replace the fan.



Appendix 1-1 Selection of cable

Appendix 1-1-1 Cable wire and assembly

(1) Cable wire

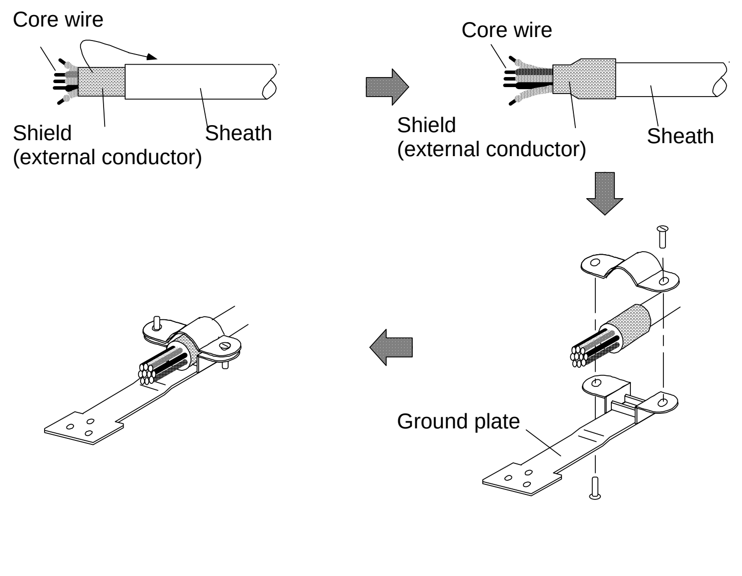
The following shows the specifications and processing of the wire used in each cable. Manufacture the cable using the following recommended wire or equivalent parts.

Recommended wire model (Cannot be directly ordered from Mitsubishi Electric Corp.)	Finished outside diameter	Sheath material	No. of pairs	Wire characteristics					Applica-tion
				Config-uration	Conductor resistance	Withstand voltage	Insulation resistance	Heat resistant temperature	
UL20276 AWG28 10pair	6.1mm	PVC	10	7 strands/ 0.13mm	222Ω/km or less	AC350/ 1min	1MΩ/km or more	80°C	NC unit communi-cation cable
A14B2343 (Note 1)	7.2mm	PVC	6	40 strands/ 0.08mm	105Ω/km or less	AC500/ 1min	1500MΩ/km or more	105°C	Detector cable
TS-91026 (Note 2)	11.6mm	PVC	2 (0.3 mm^2)	60 strands/ 0.08mm	63Ω/km or less	AC750V/ 1min	60MΩ/km or more	60°C	Detector cable (Cable length: 20m or more)
			10 (0.2 mm^2)	40 strands/ 0.08mm	95Ω/km or less				

(Note 1) Junko Co. (Dealer: Toa Denki)
(Note 2) BANDO ELECTRIC WIRE (http: //www.bew.co.jp)

(2) Cable assembly

Assemble the cable as shown in the following drawing, with the cable shield wire securely connected to the ground plate of the connector.



⚠ **CAUTION**	Do not mistake the connection when manufacturing the detector cable. Failure to observe this could lead to faults, runaway or fires.

(3) Cable protection tube (noise countermeasure)

If influence from noise is unavoidable, or further noise resistance is required, selecting a flexible tube and running the signal cable through this tube is effective. This is also an effective countermeasure for preventing the cable sheath from being cut or becoming worn.

A cable clamp (MS3057) is not installed on the detector side, so be particularly careful of broken wires in applications involving bending and vibration.

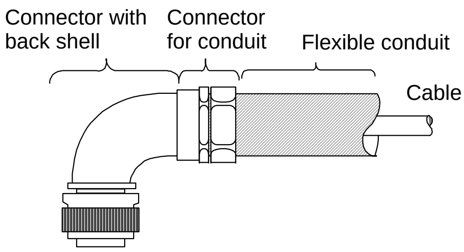
Supplier	Tube	Connector		
		Drive unit side	Installation screws	Motor detector side
Nippon Flex Control Corp.	FBA-4 (FePb wire braid sheath)	RBC-104 (straight) RBC-204 (45°) RBC-304 (90°)	G16 G16 G16	RCC-104-CA2022
DAIWA DENGYO CO., LTD	Hi-flex PT #17 (FePb sheath)	PSG-104 (straight) PLG-17 (90°) PS-17 (straight)	Screw diameter ø26.4 Screw diameter ø26.4 PF1/2	PDC20-17
Sankei Works	Purika Tube PA-2 #17 (FePb sheath)	BC-17 (straight)	Wire tube screws : 15	PDC20-17

(Note) None of the parts in this table can be ordered from Mitsubishi Electric Corp.

Appendix 1-1-2 Flexible conduits

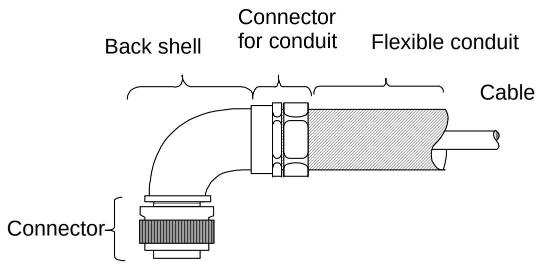
Basically, splash proofing can be ensured if cab-tire cable and connectors with IP65 or higher specifications are used. However, to further improve the oil resistance (chemical resistance to oil), weather resistance (resistance to the environment when used outdoors, etc.), durability, tensile strength, flattening strength, etc., run the cable through a flexible conduit when wiring.
The following shows an example of a flexible conduit. Contact the connector maker for more information.

(1) Method for connecting to a connector with back shell



Application	Applicable motors	Model: DDK Connector (straight)	Model: DDK Connector (angle)	Model: Nippon Flex Connector for conduit	Model: Nippon Flex Flexible conduit
For power	**HA053N, HA13N HA23N, HA33N**	CE05-6A18-12SD-B-BSS	CE05-8A18-12SD-B-BAS	RCC-103CA18	VF-03 (Min. inside diameter: 10.6)
				RCC-104CA18	VF-04 (Min. inside diameter: 14)
	HC52, HC102, HC152 HC53, HC103, HC153 HC103R, HC153R, HC203R	CE05-6A22-23SD-B-BSS	CE05-8A22-23SD-B-BAS	RCC-104CA2022	VF-04 (Min. inside diameter: 14)
				RCC-106CA2022	VF-06 (Min. inside diameter: 19)
	HC202, HC352, HC452 HC203, HC353 HC353R, HC503R	CE05-6A24-10SD-B-BSS	CE05-8A24-10SD-B-BAS	RCC-106CA2428	VF-06 (Min. inside diameter: 19)
				RCC-108CA2428	VF-08 (Min. inside diameter: 24.4)
	HC702, HC902 HC453, HC703	CE05-6A32-17SD-B-BSS	CE05-8A32-17SD-B-BAS	RCC108CA32	VF-08 (Min. inside diameter: 24.4)
				RCC110CA32	VF-10 (Min. inside diameter: 33.0)

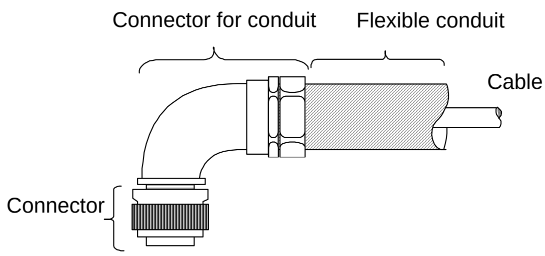
(Note) None of the parts in this table can be ordered from Mitsubishi Electric Corp.



Appli-cation	Applicable motors	Model			
		DDK		Nippon Flex	
		Connector/back shell (straight)	Connector/back shell (angle)	Connector for conduit	Flexible conduit
For brake	HA053NB to HA33NB HC202B to HC902B HC203B to HC703B	Select according to section "(2) Method for connecting to the connector main body".			
For detector	HA053N to HA33N HC52 to HC902, HC53 to HC703 HC103R to HC503R HA-LF11K2-S8, HA-LF15K2-S8	Connector MS3106A22-14S (D190) Back shell CE02-22BS-S	Connector MS3106A22-14S (D190) Back shell CE-22BA-S	RCC-104CA2022	VF-04 (Min. Inside diameter: 14)
				RCC-106CA2022	VF-06 (Min. Inside diameter: 19)

(Note) None of the parts in this table can be ordered from Mitsubishi Electric Corp.

(2) Method for connecting to the connector main body



Appli-cation	Applicable motors	Model		
		DDK	DAIWA DENGYO	
		Connector (straight)	Connector for conduit	Flexible conduit
For power	HA053N, HA13N HA23N, HA33N	CE05-6A18-12SD-B	MSA-12-18 (Straight) MAA-12-18 (Angle)	FCV12 (Min. inside diameter: 12.3)
			MSA-16-18 (Straight) MAA-16-18 (Angle)	FCV16 (Min. inside diameter: 15.8)
	HC52, HC102, HC152 HC53, HC103, HC153 HC103R, HC153R, HC203R	CE05-6A22-23SD-B	MSA-16-22 (Straight) MAA-16-22 (Angle)	FCV16 (Min. inside diameter: 15.8)
			MSA-22-22 (Straight) MAA-22-22 (Angle)	FCV22 (Min. inside diameter: 20.8)
	HC202, HC352, HC452 HC203, HC353 HC353R, HC503R	CE05-6A24-10SD-B	MSA-22-24 (Straight) MAA-22-24 (Angle)	FCV22 (Min. inside diameter: 20.8)
			MSA-28-24 (Straight) MAA-28-24 (Angle)	FCV28 (Min. inside diameter: 26.4)
	HC702, HC902 HC453, HC703	CE05-6A32-17SD-B	Please contact to a maker.	FCV36 (Min. inside diameter: 35.0)
For brake	HA053NB to HA33NB HC202B to HC902B HC203B to HC703B	MS3106A10SL-4S (D190)	MSA-10-10 (Straight) MAA-10-10 (Angle)	FCV10 (Min. inside diameter: 10.0)
For detector	HA053N to HA33N HC52 to HC902, HC53 to HC703 HC103R to HC503R HA-LF11K2-S8, HA-LF15K2-S8	MS3106A22-14S (D190)	MSA-16-22 (Straight) MAA-16-22 (Angle)	FCV16 (Min. inside diameter: 15.8)
			MSA-22-22 (Straight) MAA-22-22 (Angle)	FCV22 (Min. inside diameter: 20.8)

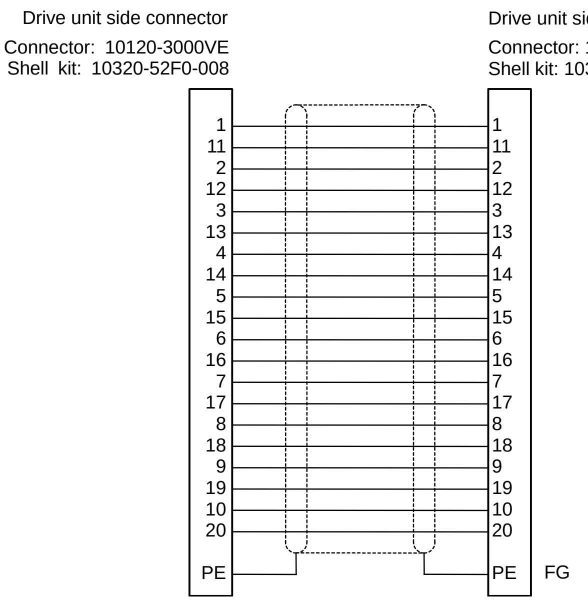
(Note) None of the parts in this table can be ordered from Mitsubishi Electric Corp.

Appendix 1-2 Cable connection diagram

⚠ CAUTION	1. Do not mistake the connection when manufacturing the detector cable. Failure to observe this could lead to faults, runaway or fires. 2. Do not connect anything to pins unless otherwise particularly specified when manufacturing a cable. (Leave OPEN) 3. Contact Mitsubishi when manufacturing a cable longer than 30m.

(1) NC bus cable

<SH21 cable connection diagram>



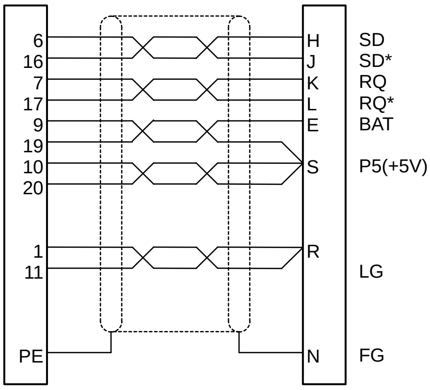
(2) Servo detector cable

<CNV12/CNV13 cable connection diagram> The connection differs according to the cable length.

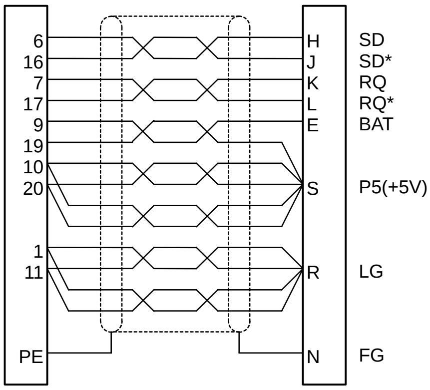
Servo drive unit side connector
Connector: 10120-3000VE
(One-touch type lock)
Shell kit: 10320-52F0-008
(Screw-type lock)
Shell kit: 10320-52A0-008

Servomotor detector side/
Ball screw end detector side connector
<For general environment>
Plug: MS3106B22-14S (Straight)
MS3108B22-14S (Angle)
Clamp: MS3057-12A

<IP65 compatible>
Plug:
MS3106A22-14S(D190)
Straight back shell:
CE02-22BS-S (Straight)
CE-22BA-S (Angle)
Clamp: CE3057-12A-3

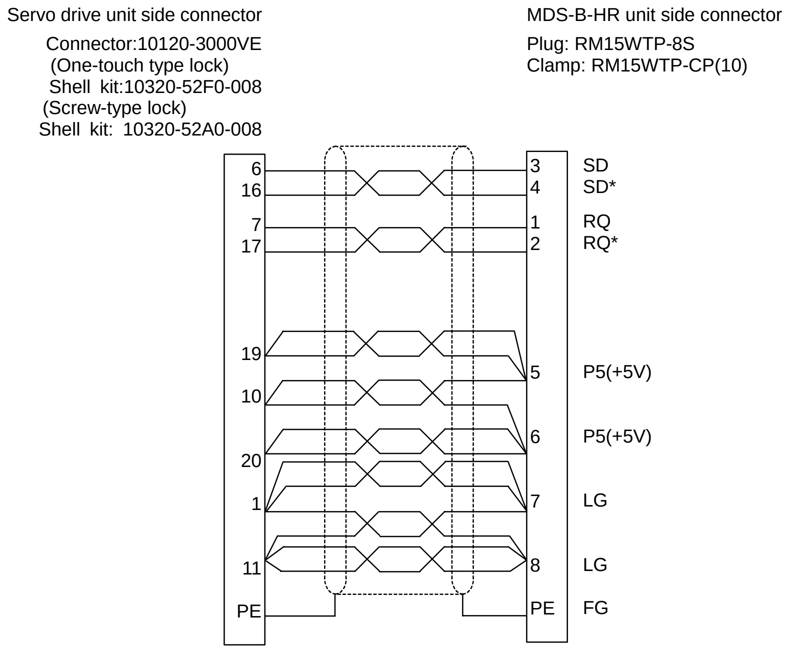


<For 20m or less>



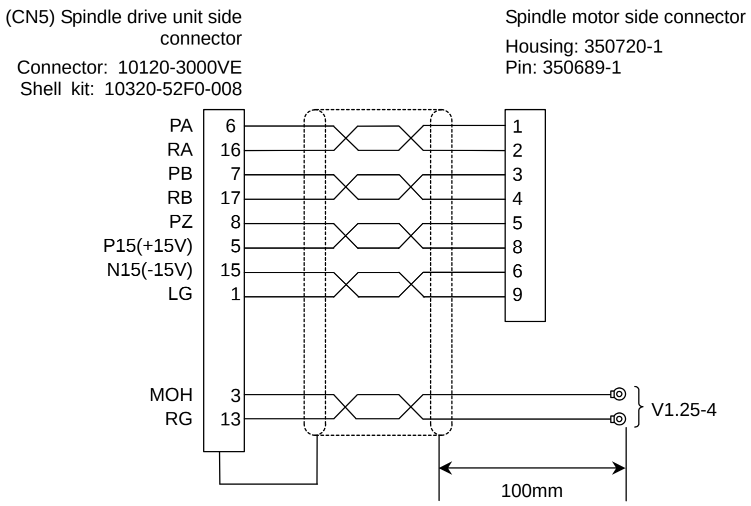
<For 20m to 30m>

<CNL3H1,CNL3H2,CNL3H1-S,CNL3H2-S cable connection diagram>

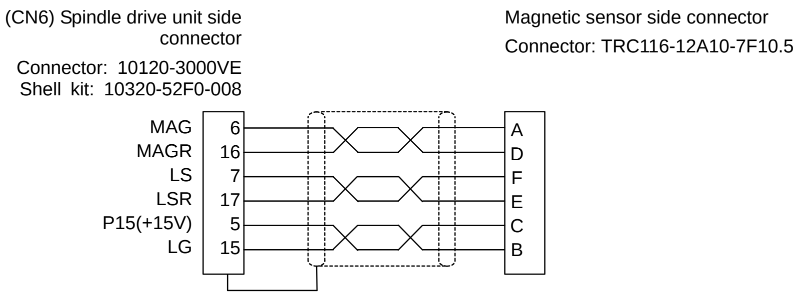


(3) Spindle detector cable

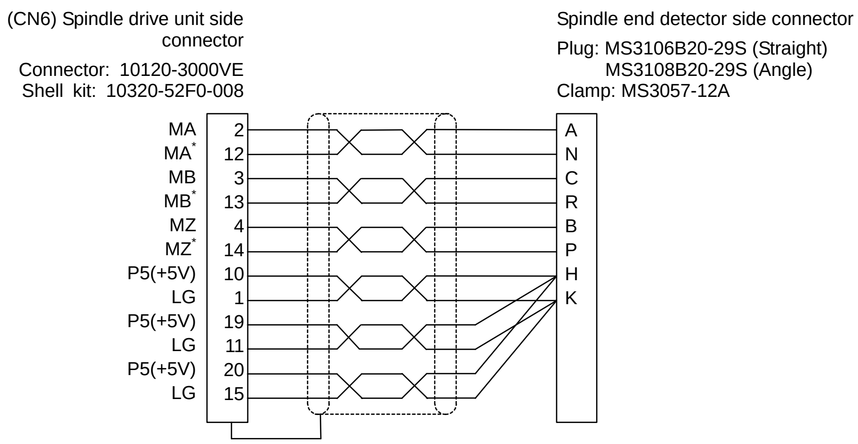
<CNP5 cable connection diagram>



<CNP6M cable connection diagram>

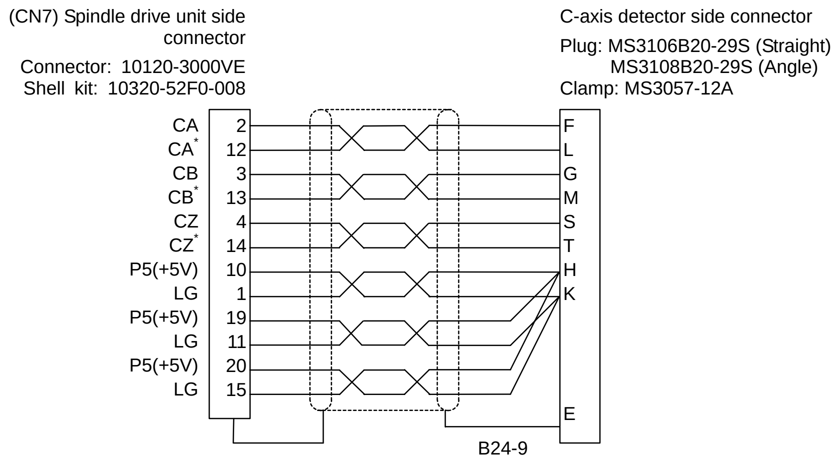


<CNP6A cable connection diagram>

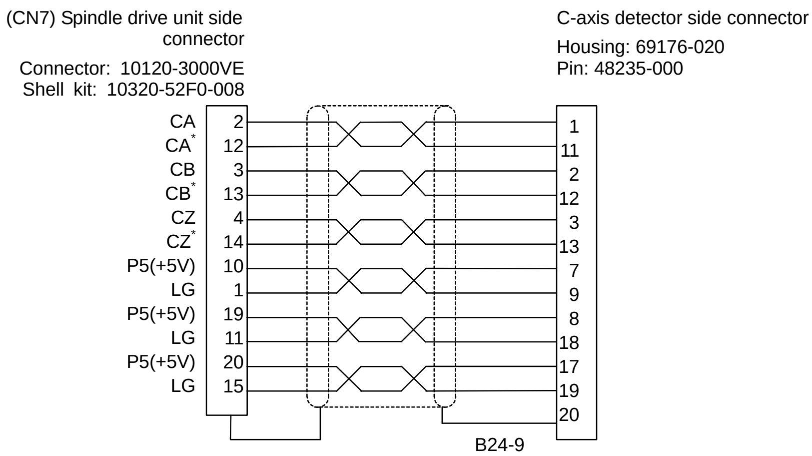


⚠ CAUTION The shield of the spindle detector cable is not connected to the "FG" (earth). Do not connect the cable shield to the earth by clamping the cable, etc.

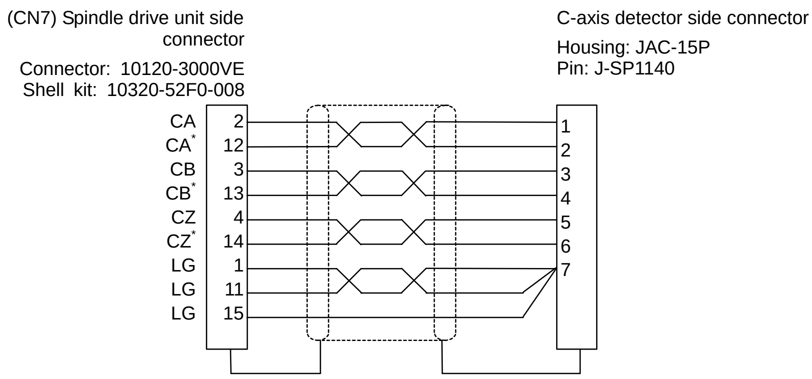
<CNP7A cable connection diagram>



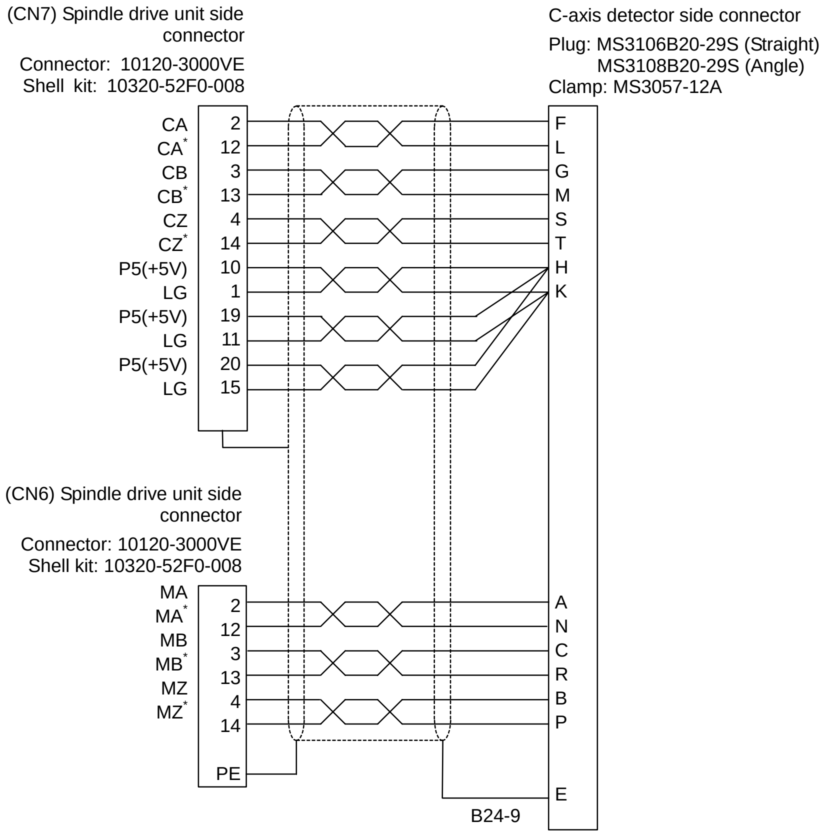
<CNP7B cable connection diagram>



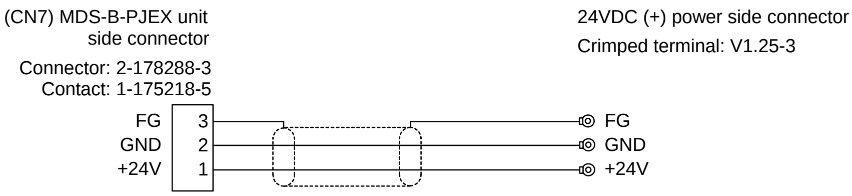
<CNP7H cable connection diagram>



<CNP67A cable connection diagram>



<FCUA-R220 cable connection diagram>

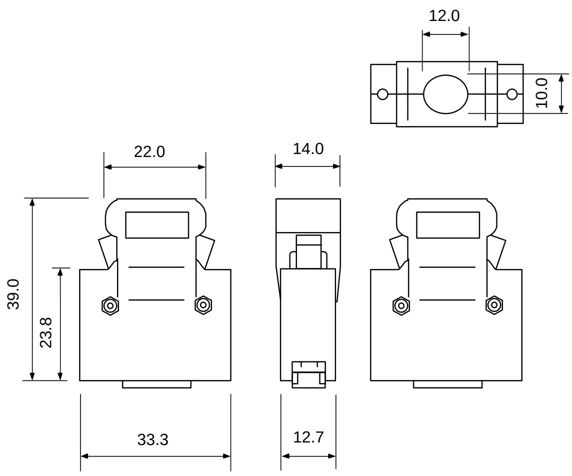


Appendix 1-3 Connector outline dimension drawings

Connector for CN2 Servo drive unit

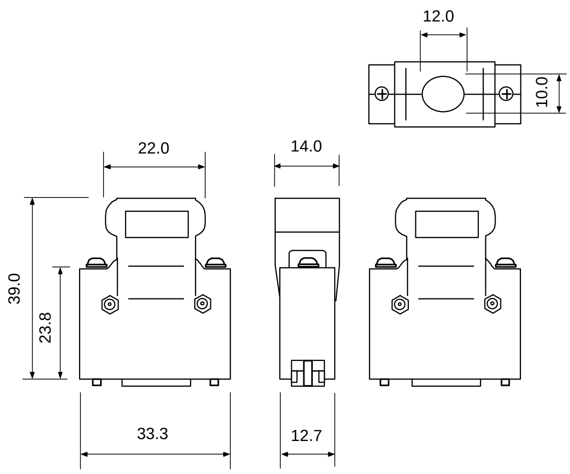
Manufacturer: 3M (Ltd.)
<Type>
Connector: 10120-3000VE
Shell kit: 10320-52F0-008

[Unit: mm]



Manufacturer: 3M (Ltd.)
<Type>
Connector: 10120-3000VE
Shell kit: 10320-52A0-008

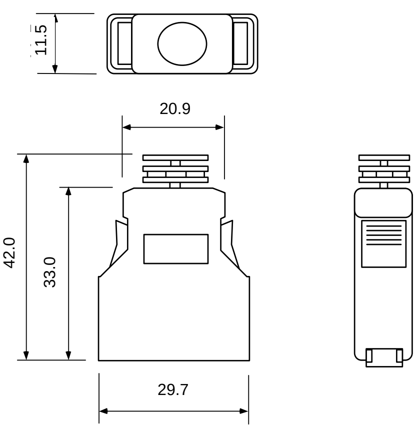
[Unit: mm]



Manufacturer: 3M (Ltd.)
<Type>
Connector: 10120-6000EL
Shell kit: 10320-3210-000

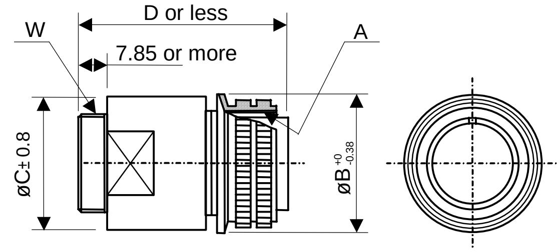
Because this connector is an integrated molding part of the cable, it is not an option setting in the connector set.
The terminal connector (A-TM) also has the same outline.

[Unit: mm]



Connectors for detector and motor power (IP67 and EN standard compatible)

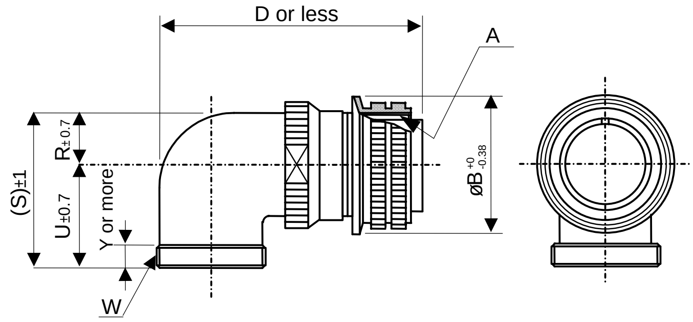
Straight plug
Manufacturer: DDK (Ltd.)



[Unit: mm]

Type	A	B $^{+0}_{-0.38}$	C±0.8	D or less	W
CE05-6A18-12SD-B-BSS	$1^1/_8$-18UNEF-2B	34.13	32.1	57	1-20UNEF-2A
CE05-6A22-23SD-B-BSS	$1^3/_8$-18UNEF-2B	40.48	38.3	61	$1^3/_{16}$-18UNEF-2A
CE05-6A24-10SD-B-BSS	$1^1/_2$-18UNEF-2B	43.63	42.0	68	$1^7/_{16}$-18UNEF-2A
CE05-6A32-17SD-B-BSS	2-18UNS-2B	56.33	54.2	79	$1^3/_4$-18UNS-2A

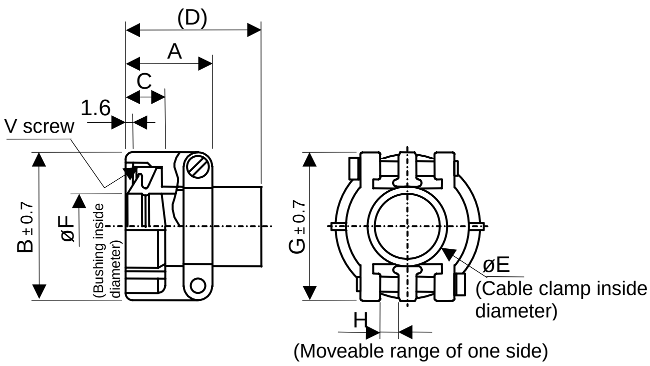
Angle plug
Manufacturer: DDK (Ltd.)



[Unit: mm]

Type	A	B $^{+0}_{-0.38}$	D or less	W	R±0.7	U±0.7	(S) ±1	Y or more
CE05-8A18-12SD-B-BAS	$1^1/_8$-18UNEF-2B	34.13	69.5	1-20UNEF-2A	13.2	30.2	43.4	7.5
CE05-8A22-23SD-B-BAS	$1^3/_8$-18UNEF-2B	40.48	75.5	$1^3/_{16}$-18UNEF-2A	16.3	33.3	49.6	7.5
CE05-8A24-10SD-B-BAS	$1^1/_2$-18UNEF-2B	43.63	86.3	$1^7/_{16}$-18UNEF-2A	18.2	36.5	54.7	7.5
CE05-8A32-17SD-B-BAS	2-18UNS-2B	56.33	93.5	$1^3/_4$-18UNS-2A	24.6	44.5	61.9	8.5

Cable clamp
Manufacturer: DDK (Ltd.)

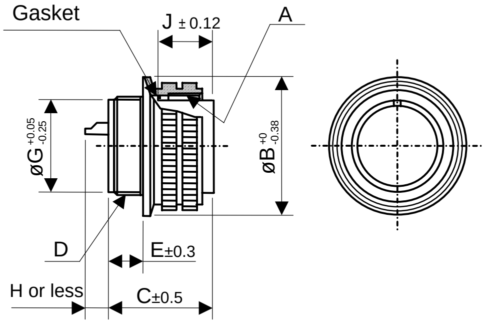


[Unit: mm]

Type	Shell size	Total length A	Outside dia. B	Effective screw length C	D	E	F	G	H	Installation screw V	Bushing	Compliant cable
CE3057-10A-2 (D265)	18	23.8	30.1	10.3	41.3	15.9	11	31.7	3.2	1-20UNEF-2B	CE3420-10-2	ø8.5 to ø11
CE3057-12A-2 (D265)	20	23.8	35	10.3	41.3	19	13	37.3	4	$1^3/_{16}$-18UNEF-2B	CE3420-12-2	ø9.5 to ø13
CE3057-12A-3 (D265)	22						10				CE3420-12-3	ø6.8 to ø10
CE3057-16A-2 (D265)	24	26.2	42.1	10.3	41.3	23.8	15.5	42.9	4.8	$1^7/_{16}$-18UNEF-2B	CE3420-16-2	ø13 to ø15.5
CE3057-20A-1 (D265)	32	27.8	51.6	11.9	43.0	31.7	23.8	51.6	6.3	$1^3/_4$-18UNS-2B	CE3420-20-1	ø22 to ø23.8

Connectors for detector, motor power and brake (IP67 and EN standard compatible)

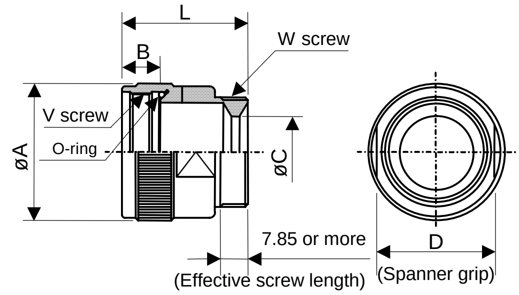
Straight plug
Manufacturer: DDK (Ltd.)



[Unit: mm]

Type	A	B	C±0.5	D	E±0.3	G	J±0.12
MS3106A10SL-4S (D190)	$^5/_8$-24UNEF-2B	22.22	23.3	$^9/_{16}$-24UNEF-2A	7.5	12.5	13.49
MS3106A22-14S (D190)	$1^3/_8$-18UNEF-2B	40.48	34.11	$1^1/_4$-18UNEF-2A	12.15	29.9	18.26

Straight back shell
Manufacturer: DDK (Ltd.)

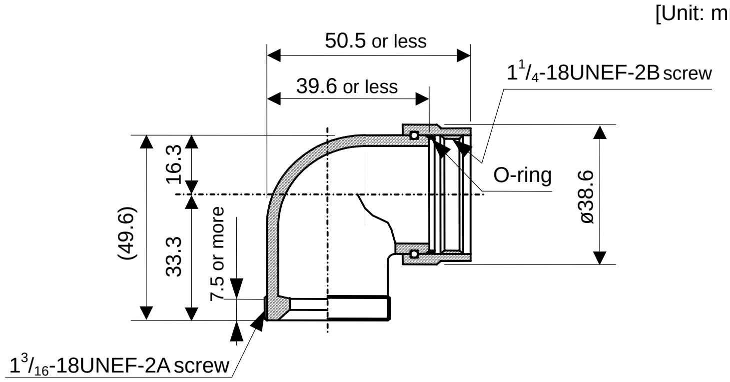


[Unit: mm]

Type	L	A	B	C	D	V	W
CE02-22BS-S	35	36.5	10.9	17.8	32.4	$1^1/_4$-18UNEF-2B	$1^3/_{16}$-18UNEF-2A

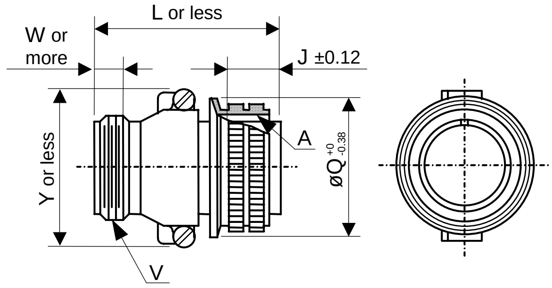
Angle back shell
Manufacturer: DDK (Ltd.)
Type: CE-22BA-S

[Unit: mm]



Connectors for detector, motor power and brake (for general environment)

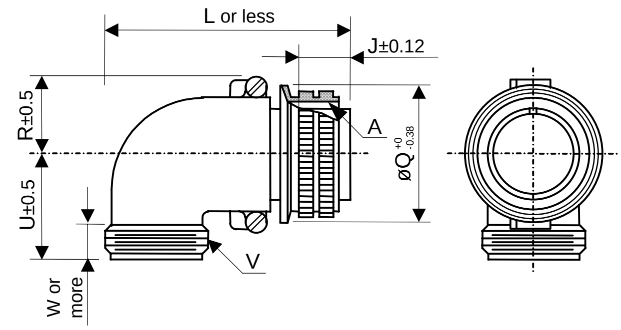
Straight plug
Manufacturer: DDK (Ltd.)



[Unit: mm]

Type	Coupling screw A	Length of coupling section J±0.12	Total length L or less	Connection nut outside diameter øQ $^{+0}_{-0.38}$	Cable clamp installation screw V	Effective screw length W or more	Max. width Y or less
MS3106B18-12S	1$^{1}/_{8}$-18UNEF	18.26	52.37	34.13	1-20UNEF	9.53	42
MS3106B22-14S **MS3106B22-23S**	1$^{3}/_{8}$-18UNEF	18.26	55.57	40.48	1$^{3}/_{16}$-18UNEF	9.53	50
MS3106B24-10S	1$^{1}/_{2}$-18UNEF	18.26	58.72	43.63	1$^{7}/_{16}$-18UNEF	9.53	53
MS3106B32-17S	2-18UNS	18.26	61.92	56.33	1$^{3}/_{4}$-18UNS	11.13	66

Angle plug
Manufacturer: DDK (Ltd.)

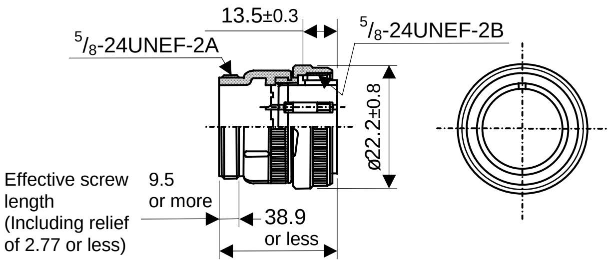


[Unit: mm]

Type	Coupling screw A	Length of coupling section J±0.12	Total length L or less	Connection nut outside diameter øQ	R±0.5	U±0.5	Cable clamp installation screw V	Effective screw length W or more
MS3108B18-12S	1$^{1}/_{8}$-18UNEF	18.26	68.27	34.13 $^{+0}_{-0.38}$	20.5	30.2	1-20UNEF	9.53
MS3108B22-14S **MS3108B22-23S**	1$^{3}/_{8}$-18UNEF	18.26	76.98	40.48	24.1	33.3	1$^{3}/_{16}$-18UNEF	9.53
MS3108B24-10S	1$^{1}/_{2}$-18UNEF	18.26	86.51	43.63	25.6	36.5	1$^{7}/_{16}$-18UNEF	9.53
MS3108B32-17S	2-18UNS	18.26	95.25	56.33	32.8	44.4	1$^{3}/_{4}$-18UNS	11.13

Straight plug
Manufacturer:
Japan Aviation Electronics (Ltd.)
Type: MS3106B10SL-4S

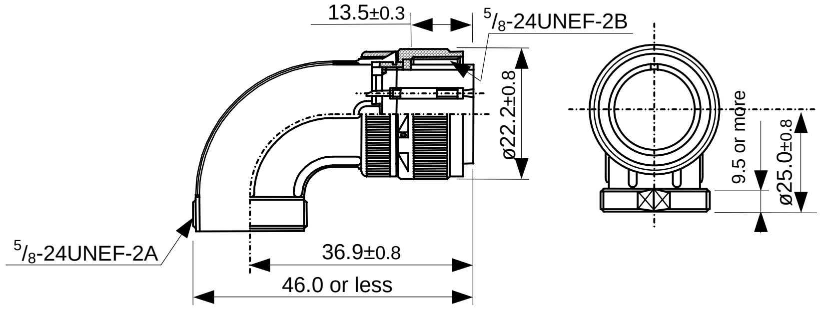
[Unit: mm]



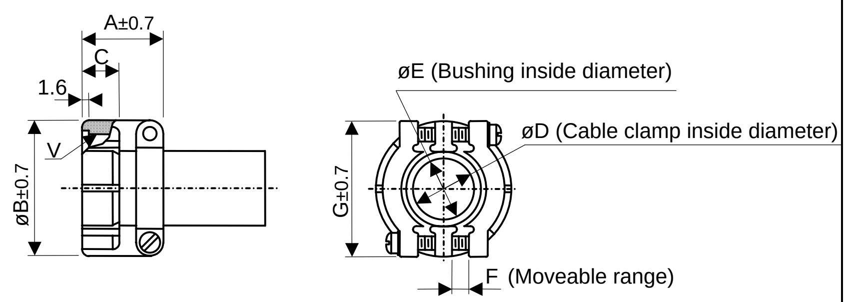
Connectors for detector, motor power and brake (for general environment)

Angle plug
Manufacturer:
Japan Aviation Electronics (Ltd.)
Type: MS3108B10SL-4S

[Unit: mm]



Cable clamp
Manufacturer: DDK (Ltd.)



[Unit: mm]

Type	Shell size	Total length A±0.7	Outside diameter øB±0.7	Effective screw length C	øD	øE	F	G±0.7	Installation screw V	Bushing
MS3057-4A	10SL, 12S	20.6	20.6	10.3	7.9	5.6	1.6	22.2	5/8-24UNEF	AN3420-4
MS3057-10A	18	23.8	30.1	10.3	15.9	14.3	3.2	31.7	1-20UNEF	AN3420-10
MS3057-12A	20, 22	23.8	35.0	10.3	19.0	15.9	4.0	37.3	1 3/16-18UNEF	AN3420-12
MS3057-16A	24, 28	26.2	42.1	10.3	23.8	19.1	4.8	42.9	1 7/16-18UNEF	AN3420-16
MS3057-20A	32	27.8	51.6	11.9	43	31.7	6.3	51.6	1 3/4-18UNEF	AN3420-20

Appendix 2. Compliance to EC Directives

Appendix 2-1 Compliance to EC Directives

Appendix 2-1-1 European EC Directives

In the EU Community, the attachment of a CE mark (CE marking) is mandatory to indicate that the basic safety conditions of the Machine Directives (issued Jan. 1995), EMC Directives (issued Jan. 1996) and the Low-voltage Directives (issued Jan. 1997) are satisfied. The machines and devices in which the servo and spindle drive are assembled are the targets for CE marking.

(1) Compliance to EMC Directives

The servo and spindle drive are components designed to be used in combination with a machine or device. These are not directly targeted by the Directives, but a CE mark must be attached to machines and devices in which these components are assembled. The next section "EMC Installation Guidelines", which explains the unit installation and control panel manufacturing method, etc., has been prepared to make compliance to the EMC Directives easier.

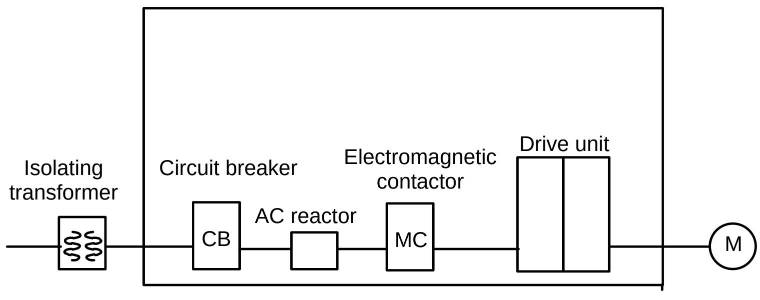
(2) Compliance to Low-voltage Directives

The MDS-C1 Series units are targeted for the Low-voltage Directives. An excerpt of the precautions given in this specification is given below. Please read this section thoroughly before starting use.
A Self-Declaration Document has been prepared for the EMC Directives and Low-voltage Directives. Contact Mitsubishi or your dealer when required.

Appendix 2-1-2 Cautions for EC Directive compliance

Use the Low-voltage Directive compatible parts for the servo/spindle drive and servo/spindle motor. In addition to the items described in this instruction manual, observe the items described below.

(1) Configuration



Use a type B (AC/DC detectable type) breaker

(2) Environment

Use the units under an Overvoltage Protection Category III and Pollution Class of 2 or less environment as stipulated in IEC60664.
Install the servo/spindle drive unit in a control panel having a structure (IP54 or higher) in which water, oil, carbon or dust cannot enter.

Drive unit

	During operation	Storage	During transportation
Ambient temperature	0°C to 55°C	-15°C to 70°C	-15°C to 70°C
Humidity	90%RH or less	90%RH or less	90%RH or less
Altitude	1000m or less	1000m or less	10000m or less

Motor

	During operation	Storage	During transportation
Ambient temperature	0°C to 40°C	-15°C to 70°C	-15°C to 70°C
Humidity	80%RH or less	90%RH or less	90%RH or less
Altitude	1000m or less	1000m or less	10000m or less

(3) Power supply

[1] If a control power supply of the drive unit is 200V, use the power supply under an Overvoltage Protection Category II as stipulated in IEC60664. In that case, insert a star-connection isolation transformer that is compliant with EN or IEC Standard into the primary input power supply of the drive unit.

[2] Do not omit the circuit breaker and electromagnetic contactor.

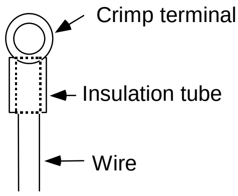
(4) Earthing

[1] To prevent electric shocks, always connect the servo/spindle drive unit protective earth (PE) terminal (terminal with ⏚ mark) to the protective earth (PE) on the control panel.

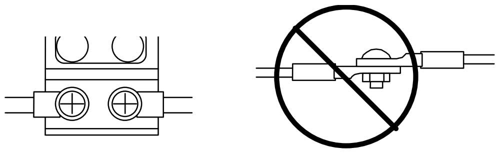
[2] When connecting the earthing wire to the protective earth (PE) terminal, do not tighten the wire terminals together. Always connect one wire to one terminal.

(5) Wiring

[1] Always use crimp terminals with insulation tubes so that the connected wire does not contact the neighboring terminals.



[2] Do not connect the wires directly.



(6) Selecting the wire size for EC Directive compliance

To comply with the EC Directives, select the wire size from the following table using each drive unit's capacity as a reference.

The wire types are as follow.

PVC : Polyvinyl chloride
EPR : Ethylene polypropylene
SIR : Silicon rubber

[1] MDS-C1-CV (L1, L2, L3, PE) (The unit sizes are all mm^2)

Type (MDS-C1-)		CV-37	CV-55	CV-75	CV-110	CV-150	CV-185	CV-220	CV-260	CV-300	CV-370
Wire	PVC	2.5	2.5	4	6	10	16	25	35	50	70
	EPR	1.5	2.5	4	6	10	16	25	35	35	50
	SIR	1.0	1.5	2.5	4	6	10	16	16	25	25
Terminal screw size		M4			M5			M8			

[2] MDS-C1-SP (U, V, W, PE)

Type (MDS-C1-)		SP-04	SP-075	SP-15	SP-22	SP-37	SP-55	SP-75	SP-110	SP-150	SP-185	SP-220	SP-260	SP-300
Wire	PVC	1.0	1.0	1.0	1.0	1.5	2.5	4	6	10	16	25	35	70
	EPR	1.0	1.0	1.0	1.0	1.5	2.5	4	6	10	16	25	35	50
	SIR	1.0	1.0	1.0	1.0	1.0	1.0	2.5	4	6	10	10	16	25
Terminal screw size		M4					M5					M8		

[3] MDS-C1-V1/V2 (U, V, W, PE)

Type (MDS-C1-)		V1-01	V1-03	V1-05	V1-10	V1-20	V1-35	V1-45	V1-70	V1-90	V1-110	V1-150
Wire	PVC	1.0	1.0	1.0	1.0	1.5	2.5	4	6	10	25	35
	EPR	1.0	1.0	1.0	1.0	1.0	1.5	4	6	10	16	25
	SIR	1.0	1.0	1.0	1.0	1.0	1.0	2.5	2.5	4	10	16
Terminal screw size		M4					M5				M8	

[4] Wire size for L11 and L21 link bar
Select a $1.5mm^2$ wire or larger regardless of the capacity. (This also applies to the wire between NFB-L11 and L21.)

[5] Wire size for L+ and L- link bar (For unified sizes)

Type (MDS-C1-)		CV-37	CV-55	CV-75	CV-110	CV-150	CV-185	CV-220	CV-260	CV-300	CV-370
Wire	PVC	2.5	2.5	6	10	16	25	35	50	70	-
	EPR	1.5	2.5	4	10	16	25	35	35	70	70
	SIR	1.0	1.5	2.5	4	10	10	16	25	35	35
Terminal screw size		M6									

* The wire sizes in the above table comply with EN60204 under the following conditions.
  - Ambient temperature 40°C
  - Wire laid along wall or in open cable tray

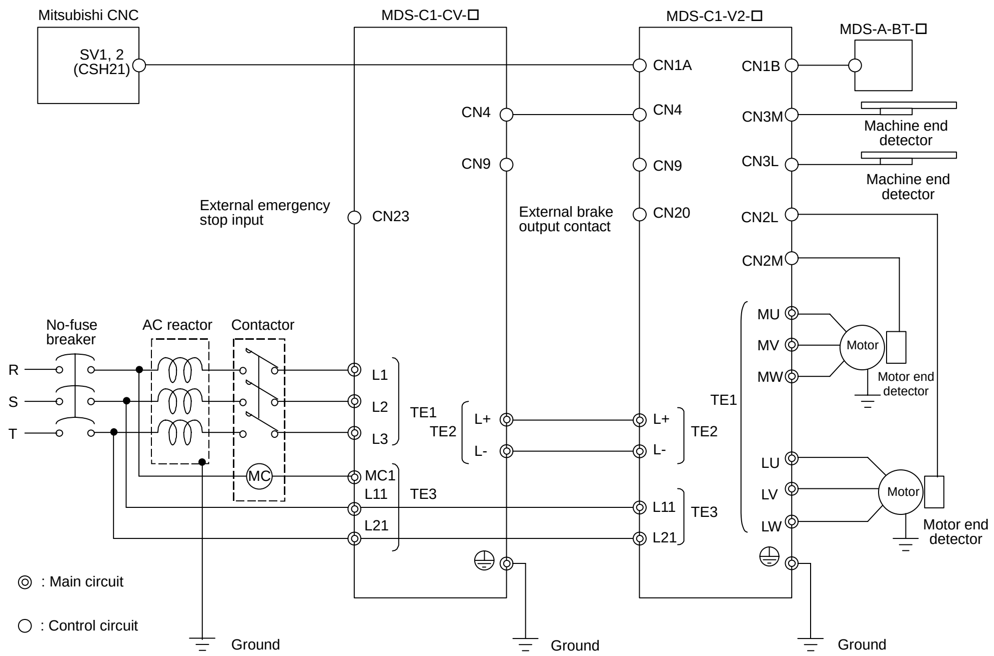
When using under other conditions, refer to EN60204 Appendix 5 and Appended Material C.

(7) Peripheral devices

[1] Use EN/IEC Standards compliant parts for the no-fuse breaker and contactor.

(8) Miscellaneous

[1] Refer to "MDS-C1 INSTRUCTION MANUAL" for methods on complying with the EMC Directives.
[2] Ground the facility according to each country's requirements.
[3] The control circuit connector (○) is safely separated from the main circuit (◎).
[4] Inspect the appearance before installing the unit. Carry out a performance inspection of the final unit, and save the inspection records.



Appendix 3-1 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.
These contents are the same as the EMC INSTALLATION GUIDELINES (BNP-B8582-45).
For measures for CNC, refer to "EMC INSTALLATION GUIDELINES" (BNP-B2230).

Appendix 3-2 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

Class	Name	Details	Generic Standard	Standards for determining test and measurement
Emission	Radiated noise	Electromagnetic noise radiated through the air	EN61000-6-4 EN61800-3 (Industrial environment)	EN55011
	Conductive noise	Electromagnetic noise discharged from power line		
Immunity	Static electricity electrical discharge	**Example)** Withstand level of discharge of electricity charged in a human body.	EN61000-6-2 EN61800-3 (Industrial environment)	IEC61000-4-2
	Radiated magnetic field	**Example)** Simulation of immunity from digital wireless transmitters		IEC61000-4-3
	Burst immunity	**Example)** Withstand level of noise from relays or connecting/disconnecting live wires		IEC61000-4-4
	Conductive immunity	**Example)** Withstand level of noise entering through power line, etc.		IEC61000-4-6
	Power supply frequency field	**Example)** 50/60Hz power frequency noise		IEC61000-4-8
	Power dip (fluctuation)	**Example)** Power voltage drop withstand level		IEC61000-4-11
	Surge	**Example)** Withstand level of noise caused by lightning		IEC61000-4-5

Appendix 3-3 EMC measures

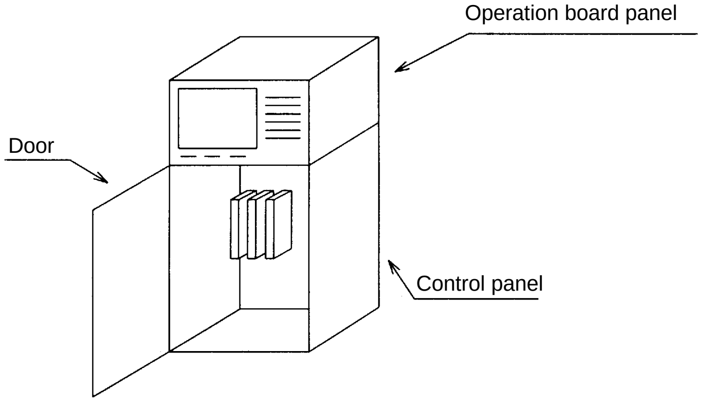
The main items relating to EMC measures include the following.
[1] Store the device in an electrically sealed metal panel.
[2] Earth all conductors that are floating electrically. (Lower the impedance.)
[3] Wire the power line away from the signal wire.
[4] Use shielded wires for the cables wired outside 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 3-4 Measures for panel structure

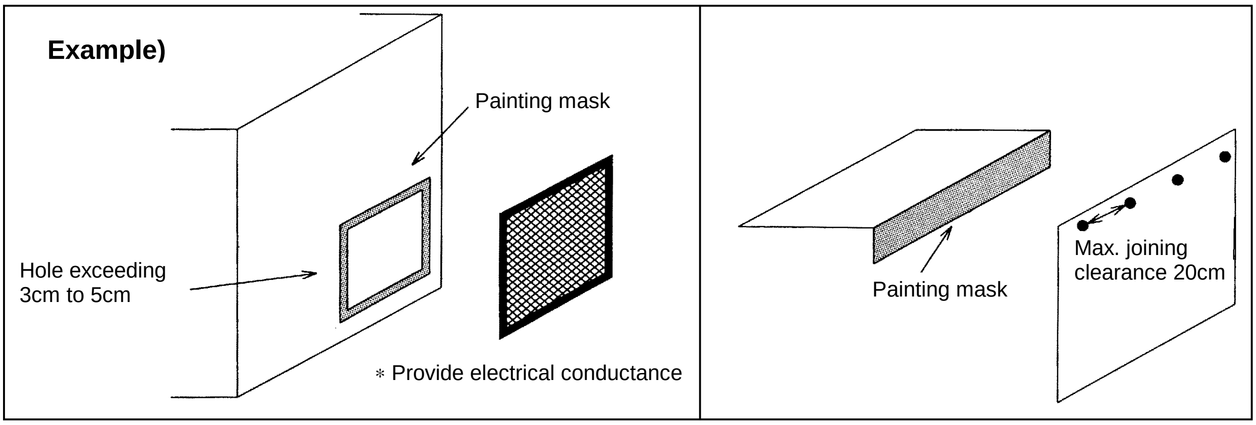
The design of the panel is a very important factor for the EMC measures, so take the following measures into consideration.



Appendix 3-4-1 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.

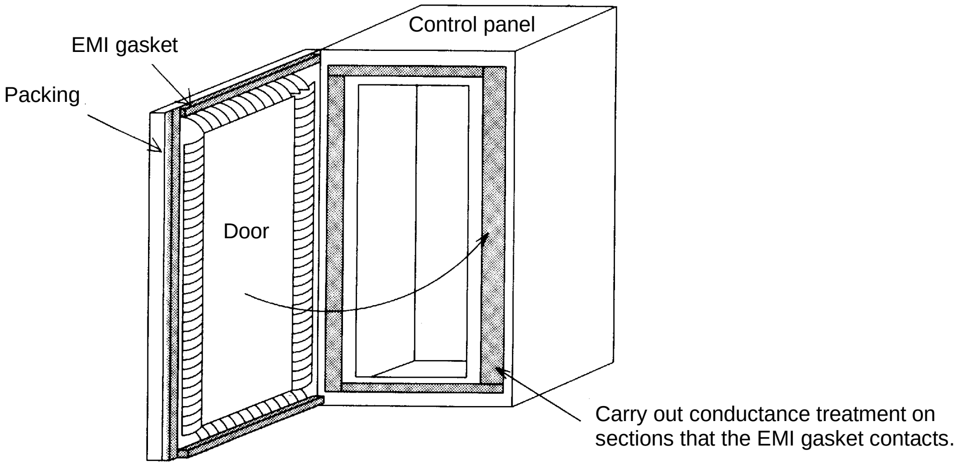
Example)



Appendix 3-4-2 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.

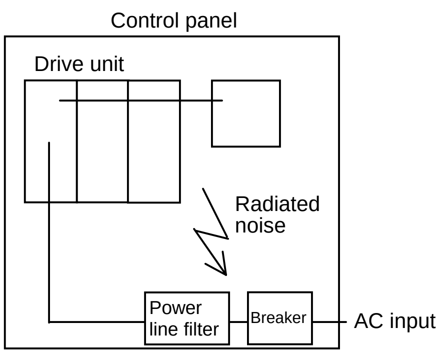
Appendix 3-4-3 Measures for operation board panel

[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.

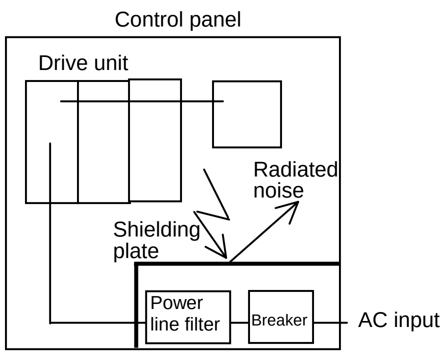
Refer to the "EMC INSTALLATION GUIDELINES" BNP-B2230 for the NC for more details.

Appendix 3-4-4 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.



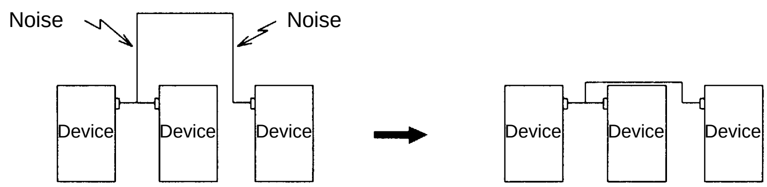
Use a metal plate, etc., for the shielding partition. Make sure not to create a clearance.

Appendix 3-5 Measures for various cables

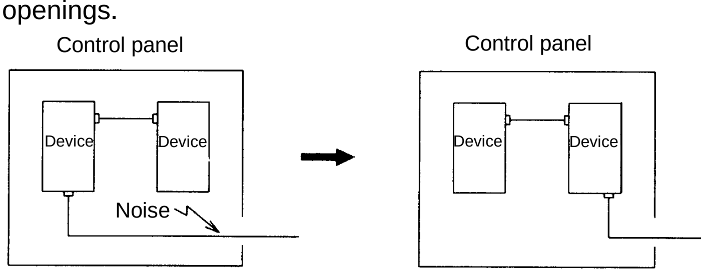
The various cables act as antennas for the noise and discharge the noise externally. Thus appropriate treatment is required to avoid the noise.
The wiring between the drive unit and motor act as an extremely powerful noise source, so apply the following measures.

Appendix 3-5-1 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 3-5-2 Measures for shield treatment

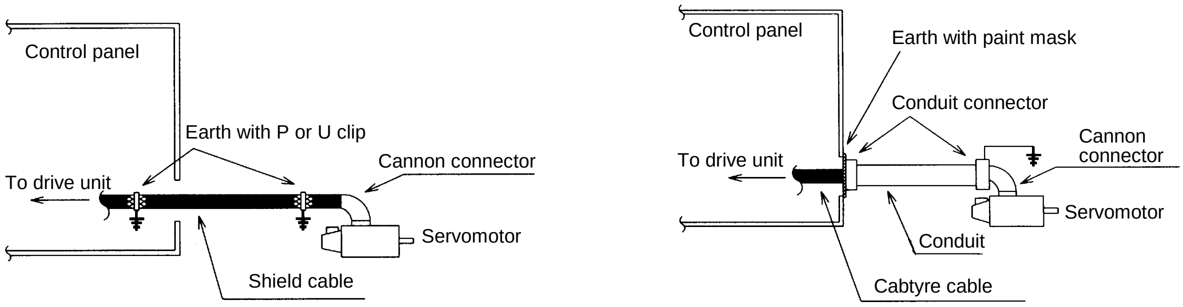
Common items

Use of shield clamp fittings is recommended for treating the shields. The fittings are available as options, so order as required. (Refer to section "Appendix 7-6-1 Shield clamp fitting".)
Clamp the shield at a position within 10cm from the panel lead out port.

POINT

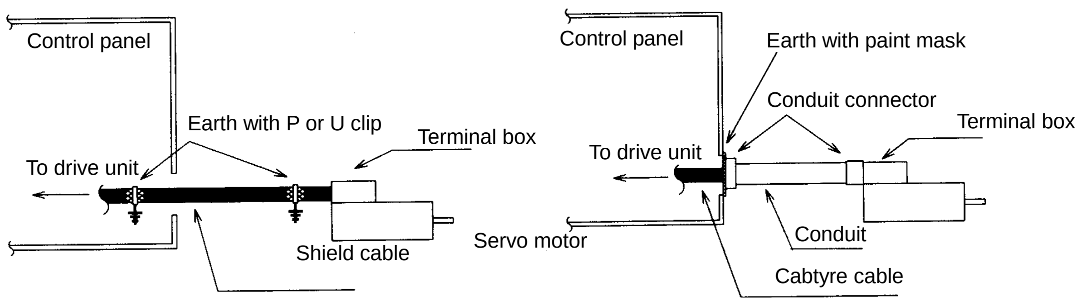
1. When leading the cables, including the grounding wire (FG), outside of the panel, clamp the cables near the panel outlet (recommendation: within 10cm).
2. When using a metal duct or conduit, the cables do not need to be clamped near the panel outlet.
3. When leading cables not having shields outside the panel, follow the instructions given for each cable. (Installation of a ferrite core, etc., may be required.)

Appendix 3-5-3 Servo/spindle motor power cable



Using shield cable **Using conduit**

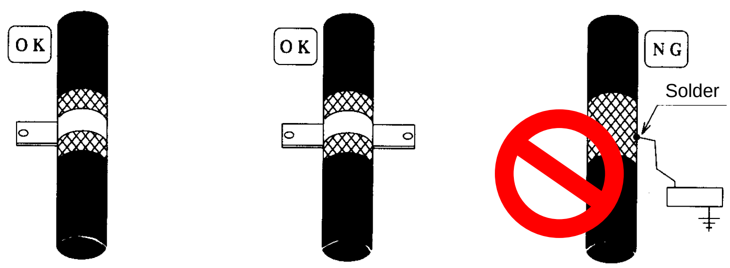
Power cable for servo motor



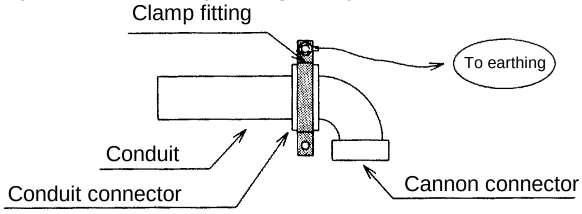
Using shield cable **Using conduit**

Power cable for spindle motor

[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.

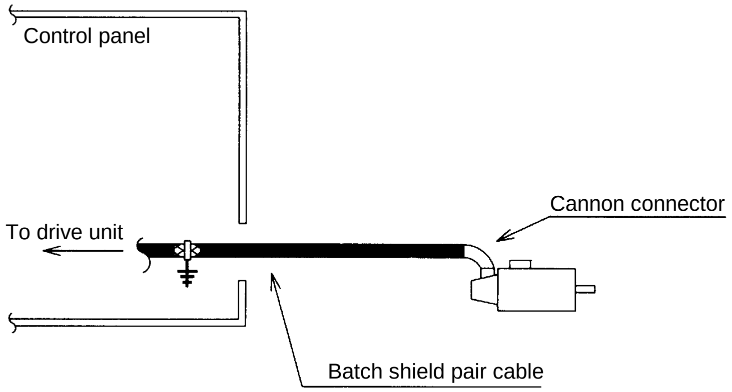


[5] When not using a shield cable for the power cable, use a conventional cabtyre cable. Use a metal conduit outside the cable.
[6] Earth the power cable on the control panel side at the contact surface of the conduit connector and control panel. (Mask the side wall of the control panel with paint.)
[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 3-5-4 Servo motor feedback cable

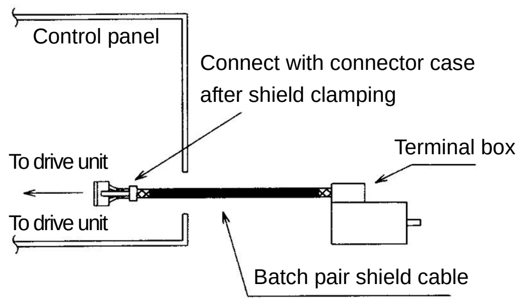
Use a conventional batch shield pair cable for feed back cable of the servo motor to earth on NC side (inside the control panel.)

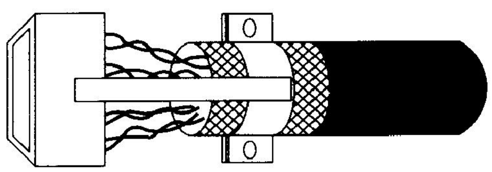


Feed back cable for servomotor

Appendix 3-5-5 Spindle motor feedback cable

Use a conventional batch shield cable for feedback cable of the spindle motor.





Spindle amp side connector (this figure shows when cover is removed)

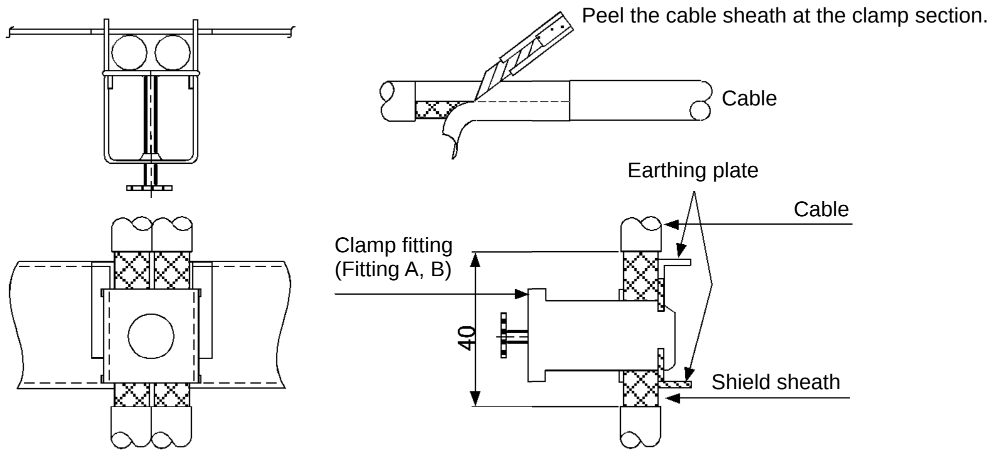
(Note) Shield of the spindle motor feedback cable is not FG. Do not earth.

Feed back cable for spindle motor

Appendix 3-6 EMC countermeasure parts

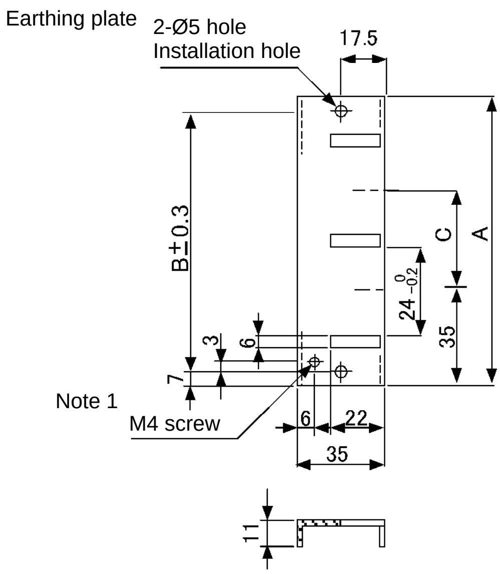
Appendix 3-6-1 Shield clamp fitting

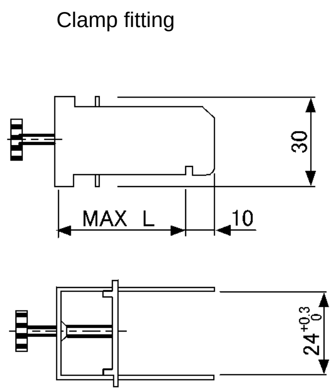
The effect can be enhanced by connecting the cable directly to the earthing plate.
Install an earthing plate near each panel's outlet (within 10cm), and press the cable against the earthing plate with the clamp fitting.
If the cables are thin, several can be bundled and clamped together.
Securely earth the earthing plate with the frame ground. Install directly on the cabinet or connect with an earthing wire.
Contact Mitsubishi if the earthing plate and clamp fitting set (AERSBAN-☐ SET) is required.



View of clamp section

• **Outline drawing**





[Unit: mm]

(Note 1) Screw hole for wiring to earthing plate in cabinet.
(Note 2) The earthing plate thickness is 1.6mm.

	A	B	C	Enclosed fittings
AERSBAN-DSET	100	86	30	Clamp fitting A × 2
AERSBAN-ESET	70	56	-	Clamp fitting B × 1

	L
Clamp fitting A	70
Clamp fitting B	45

⚠ Caution	Shield of spindle detector cable is not connected to FG (earth). Do not earth the cable shield with cable clamp, etc.

Appendix 3-6-2 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.

Recommended ferrite core

TDK ZCAT Series

Shape and dimensions

ZCAT type

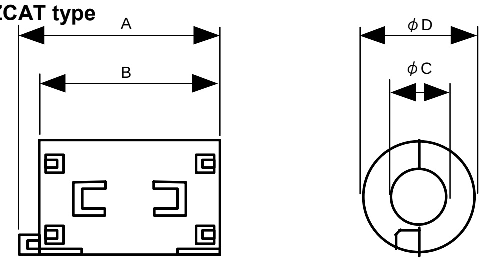


Fig.1

ZCAT-A type

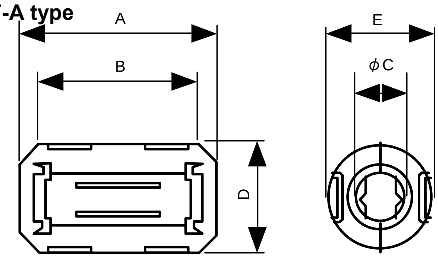


Fig.2

ZCAT-B type

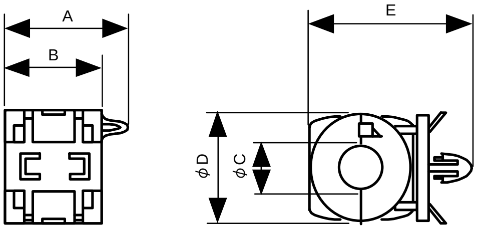


Fig.3

ZCAT-C type

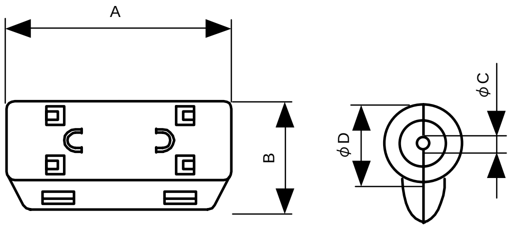


Fig.4

[Unit: mm]

Part name	Fig.	A	B	C	D	E	Applicable cable outline	Weight	Recommended ferrite core
ZCAT3035-1330 (-BK)*1	1	39	34	13	30	---	13 max.	63	○
ZCAT2035-0930-M (-BK)	2	35	29	13	23.5	22	10 to 13	29	
ZCAT2017-0930-M (-BK)	3	21	17	9	20	28.5	9 max.	12	
ZCAT2749-0430-M (-BK)	4	49	27	4.5	19.5	---	4.5 max.	26	

*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 3-6-3 Power line filter

(1) Power line filter for 200V

HF3000A-TM Series for 200V

■ **Features**

- 3-phase 3-wire type (250V series, 500V series)
- Compliant with noise standards German Official Notice Vfg243, EU Standards EN55011 (Class B)
- Effective for use with IGBT inverter and MOS-FET inverter.
- Easy mounting with terminal block structure, and outstanding reliability.

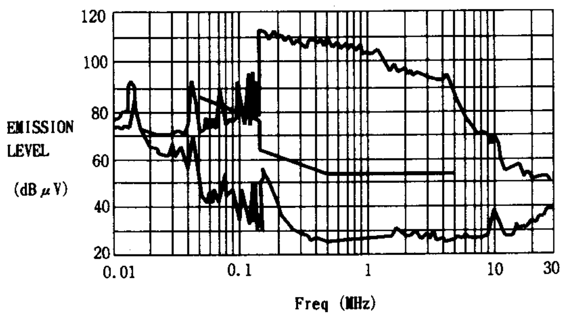
■ **Application**

- Products which must clear noise standards German Official Notice Vfg243 and EU Standards EN55011 (Class B).
- For input of power converter using advanced high-speed power device such as IGBT MOS-FET.

■ **Specifications (250V series)**

Part name	HF3005A -TM	HF3010A -TM	HF3015A -TM	HF3020A -TM	HF3030A -TM	HF3040A -TM	HF3050A -TM	HF3060A -TM	HF3080A -TM	HF3100A -TM	HF3150A -TM
Rated voltage	250VAC										
Rated current	5A	10A	15A	20A	30A	40A	50A	60A	80A	100A	150A
Leakage current	1.5mA MAX 250VAC 60Hz										

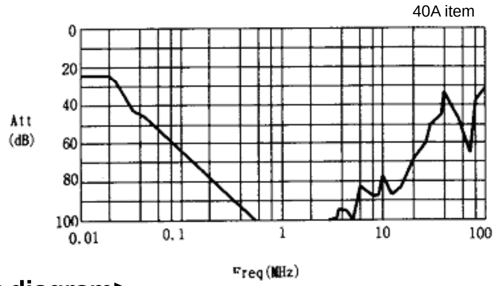
<Example of measuring voltage at noise terminal> ... Measured with IGBT inverter



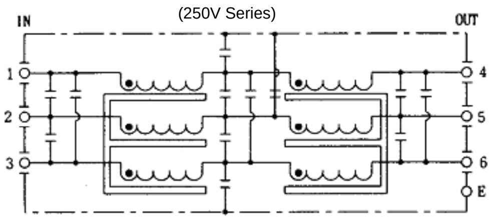
German Official Notice Vfg243 measurement data

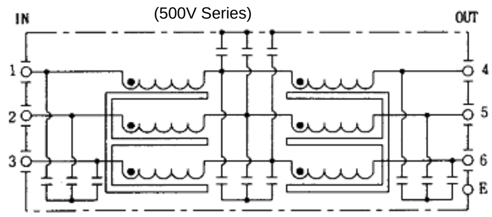
EU Standards EN55011 (Class B) measurement data

<Typical characteristics>

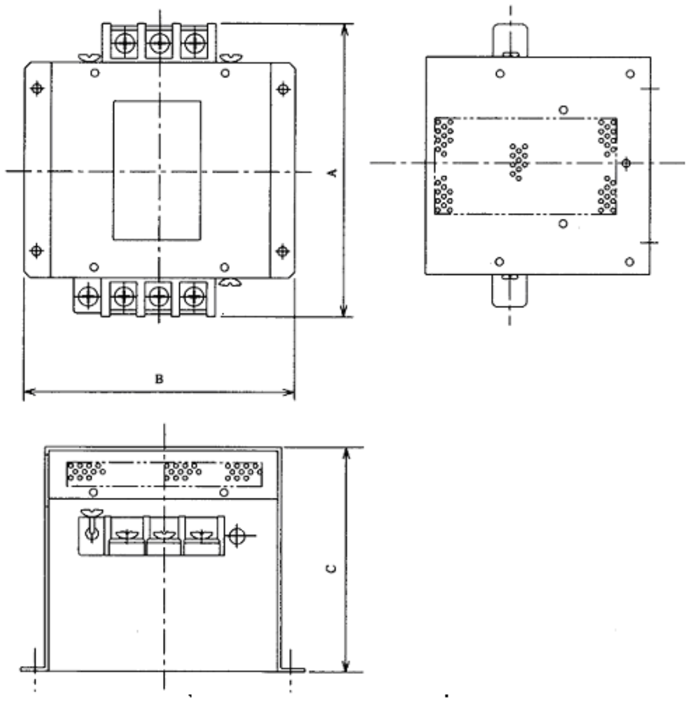


<Circuit diagram>





<Outline dimensions>



[Unit: mm]

Model	Dimension		
	A	B	C
HF3005A-TM	180	170	130
HF3010A-TM			
HF3015A-TM			
HF3020A-TM			
HF3030A-TM	260	155	140
HF3040A-TM			
HF3050A-TM	290	190	170
HF3060A-TM			230
HF3080A-TM	405	220	210
HF3100A-TM			
HF3150A-TM	570	230	

MX13 Series 3-phase high attenuation noise filter for 200V

■ Features

- Perfect for mounting inside control panel:
  New shape with uniform height and depth dimensions
- Easy mounting and maintenance work:
  Terminals are centrally located on the front
- Complaint with NC servo and AC servo noise:
  High attenuation of 40dB at 150KHz
- Safety Standards:
  UL1283, CSA22.2 No.8, EN133200
- Patent and design registration pending

■ Specifications

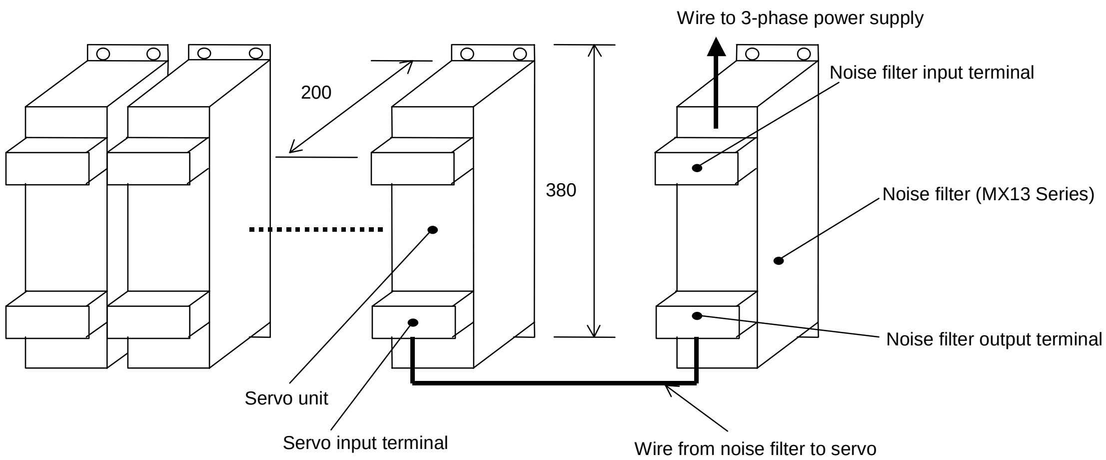
	Item \ Type	MX13030	MX13050	MX13100	MX13150
1	Rated voltage (AC)	3-phase 250VAC (50/60Hz)			
2	Rated current (AC)	30A	50A	100A	150A
3	Test voltage (AC for one minute across terminal and case)	2500VAC (100mA) at 25°C, 70% RH			
4	Insulation resistance (500VDC across terminal and case)	100MΩ min. at 25°C, 70% RH			
5	Leakage current (250V, 60Hz)	3.5 mA max.		8 mA max.	
6	DC resistance	30 mΩ max.	11 mΩ max.	5.5 mΩ max.	3.5 mΩ max.
7	Temperature rise	30°C max			
8	Working ambient temperature	–25°C to +85°C			
9	Working ambient humidity	30% to 95% RH (non condensing)			
10	Storage ambient temperature	–40°C to +85°C			
11	Storage ambient humidity	10% to 95% RH (non condensing)			
12	Weight (typ)	2.8kg	3.9kg	11.5kg	16kg

(Note) This is the value at Ta≤50°C.
Refer to the following output derating for Ta>50°C.

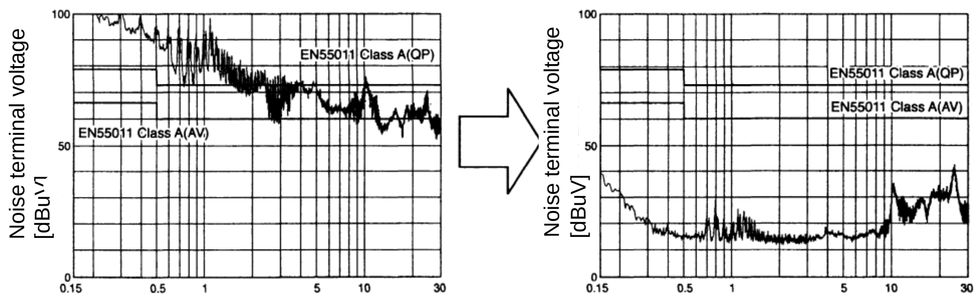
Contact: Densei-lambda Co., Ltd. Telephone: 03-3447-4411 (+81-3-3447-4411)
Fax: 03-3447-7784 (+81-3-3447-7784)
http://www.densei-lambda.com

■ Example of using MX13 Series

This is a noise filter with the same dimensions as the MDS-D/DH series drive unit depth (200mm) and height (380mm).
This unit can be laid out easily in the device by arraigning 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.



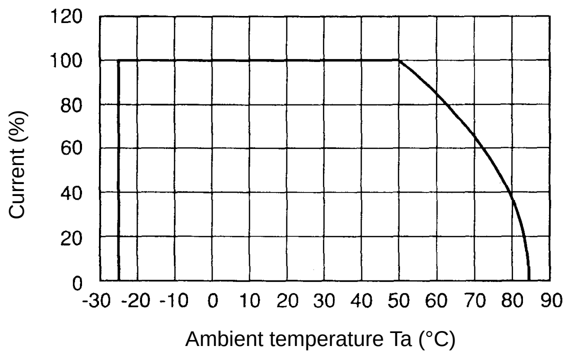
■ Example of noise terminal voltage attenuation



EMI data for independent control panel (with six-axis servo unit mounted)

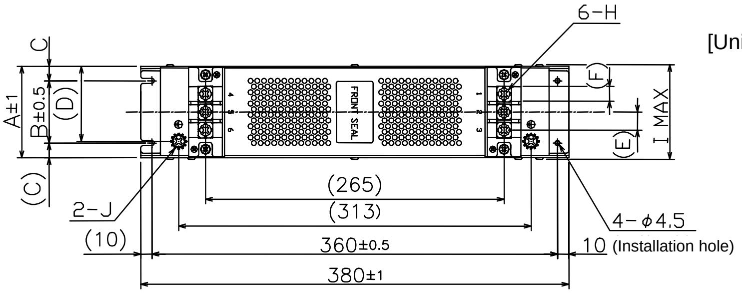
EMI data for control panel + noise filter (MX13030)

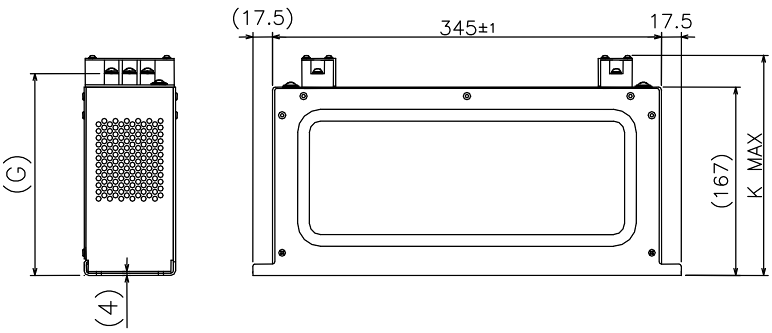
■ Output derating



■ Outline dimension drawings

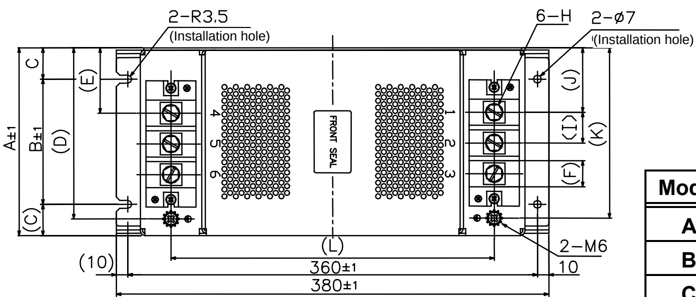
- MX13030, MX13050

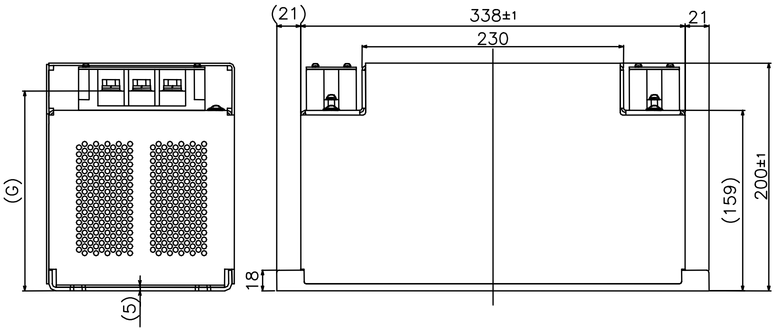




Model	MX13030	MX13050
A	66	81
B	45	55
C	10.5	13
D	50	67
E	13	16
F	10	13
G	177	179
H	M4 screw	M6 screw
I	70	85
J	M4 screw	M6 screw
K	195	200

- MX13100, MX13150





Model	MX13100	MX13150
A	130	165
B	90	110
C	20	27.5
D	115	150.5
E	37.5	57.5
F	18	23
G	174	176
H	M6 screw	M8 screw
I	21	27
J	37.5	56.5
K	115	149.5
L	276	284

Appendix 3-6-4 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.

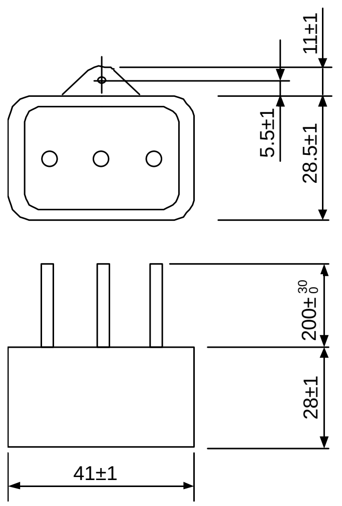
(1) 200V Surge protector

200V R·A·V BYZ Series

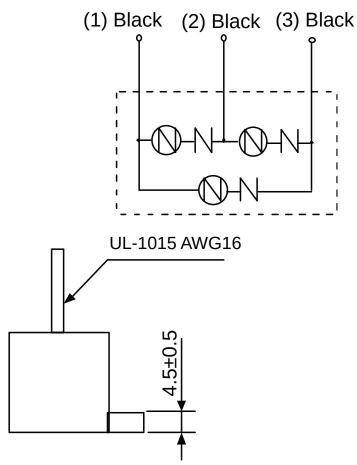
Part name	Circuit voltage 50/60Hz	Maximum tolerable circuit voltage	Clamp voltage	Surge withstand level 8/20 μS	Surge withstand voltage 1.2/50 μS	Electrostatic capacity	Service temperature
RAV-781BYZ-2	3AC 250V	300V	783V±10%	2500A	20kV	75pF	-20 to 70°C

(Note) Refer to the manufacturer's catalog for details on the surge protector's characteristics and specifications.

Outline dimension drawings



Circuit diagram



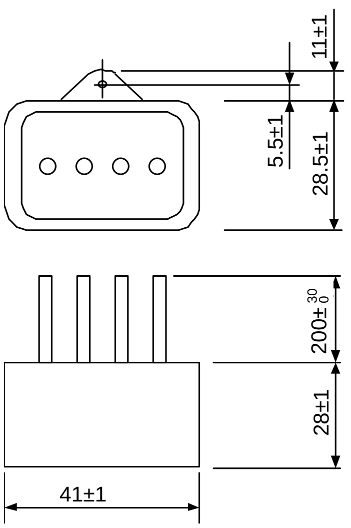
[Unit: mm]

200V R·A·V BXZ Series

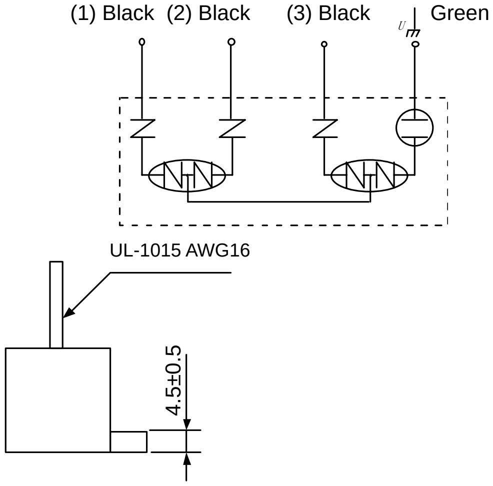
Part name	Circuit voltage 50/60Hz	Maximum tolerable circuit voltage	Clamp voltage	Surge withstand level 8/20 μS	Surge withstand voltage 1.2/50 μS	Electrostatic capacity	Service temperature
RAV-781BXZ-4	3AC 250V	300V	1700V±10%	2500A	2kV	75pF	-20 to 70°C

(Note) Refer to the manufacturer's catalog for details on the surge protector's characteristics and specifications.

Outline dimension drawings



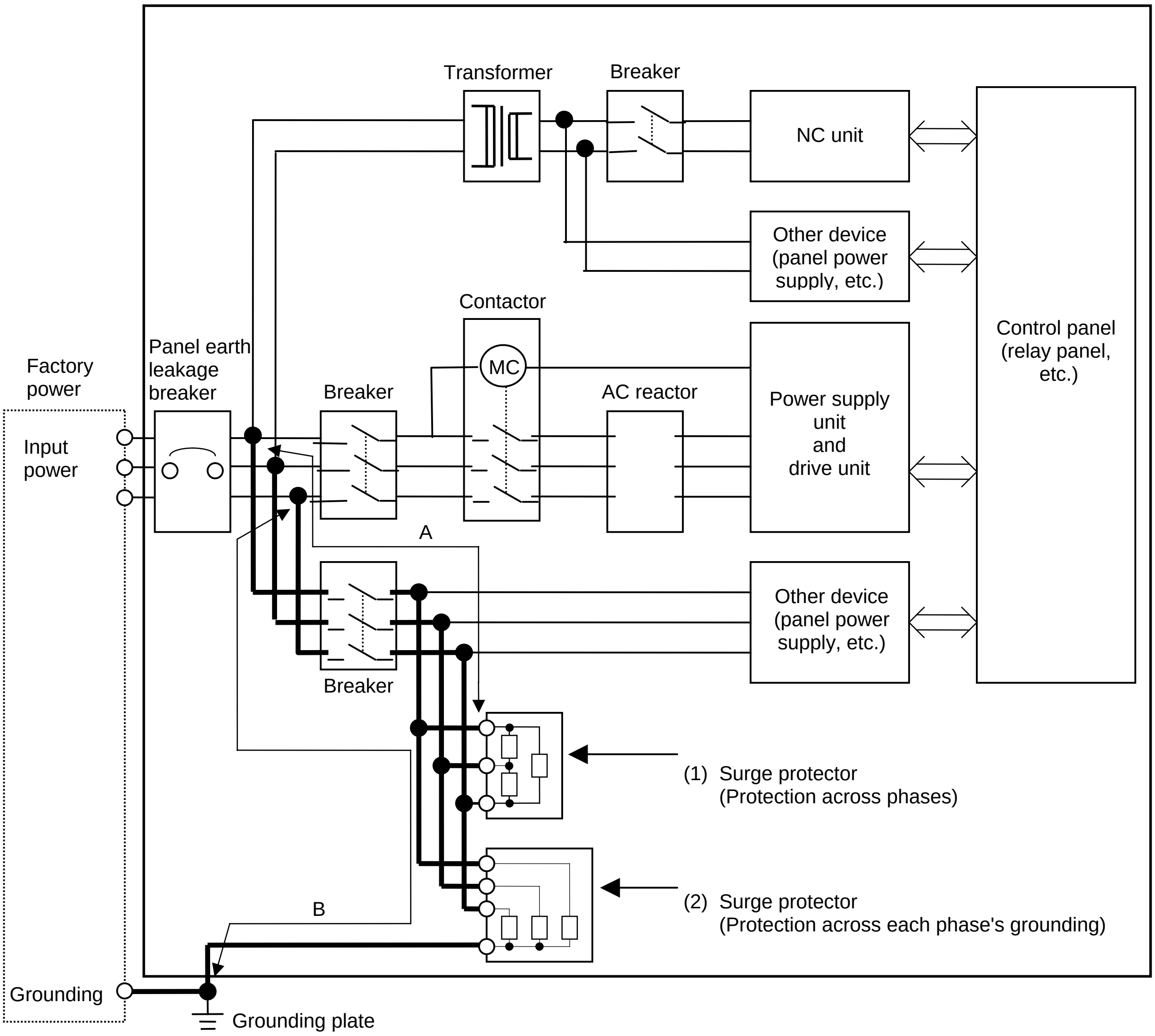
Circuit diagram



[Unit: mm]

(2) 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 protection breaker in the stage before the surge protector. Note that almost no current flows to the surge protector during normal use, so a breaker installed as the circuit protection for another device can be used for the surge protector.



Installing the surge absorber

⚠ CAUTION	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.

Appendix 4-1 Servo/spindle drive unit circuit categories based on higher harmonic suppression countermeasure guidelines

Refer to the following table and calculate the circuit category (conversion coefficient) and the power capacity based on higher harmonic suppression countermeasure guidelines.

Circuit category

Name	Model	Circuit category	Circuit type	Conversion coefficient
AC servo drive unit	**TRS Series**	3	3-phase bridge (smoothing capacitor) with no reactor	K31 = 3.4
	MR-S1/S2/S3 **MR-S11/12 Series**	3	3-phase bridge (smoothing capacitor) with no reactor	K31 = 3.4
	MDS-A-SVJ **MDS-B-SJV2** **MR-J2-CT Series**	3	3-phase bridge (smoothing capacitor) with no reactor	K31 = 3.4
	MDS-A-V1/V2 **MDS-B-V1/V14/V2/V24** **MDS-C1-V1/V2 Series**	3	3-phase bridge (smoothing capacitor) with AC reactor	K32 = 1.8
AC spindle drive unit	**SFJ/SGJ Series**	3	3-phase bridge (smoothing capacitor) with no reactor	K31 = 3.4
	MDS-A-SPJ **MDS-B-SPJ2 Series**	3	3-phase bridge (smoothing capacitor) with no reactor	K31 = 3.4
	MDS-A-CSP-370/450	3	3-phase bridge (smoothing capacitor) with no reactor	K31 = 3.4
	MDS-A-SP/SPA **MDS-B-SP/SPA/SPH/SPM/SPX** **MDS-C1-SP/SPH/SPM/SPX Series**	3	3-phase bridge (smoothing capacitor) with no AC reactor	K32 = 1.8

Usage conditions: The power supply unit (MDS-A/B/C1-CV Series) applies when using the AC reactor (B-AL Series). When using the MDS-A-CR Series, calculate using the conversion coefficient K31 = 3.4 (no reactor).

Power facility capacity

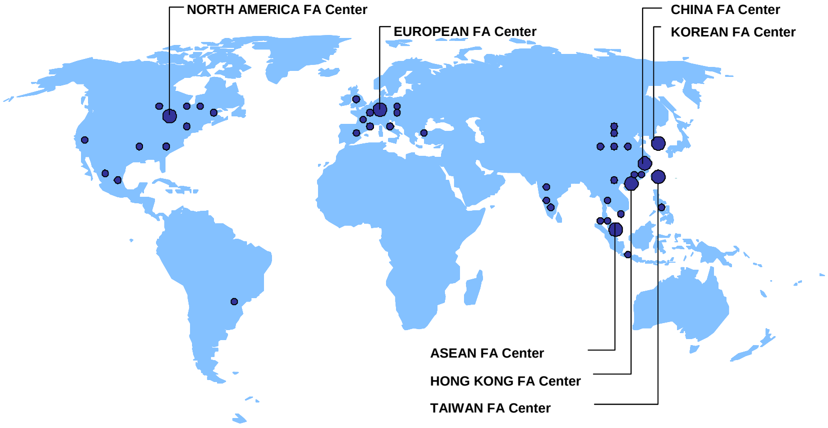
Type	Rated capacity [kVA]	Type	Rated capacity [kVA]	Type	Rated capacity [kVA]
MDS-A/B/C1-SP-37	4.61	MDS-A/B/C1-V1-03	0.6	MDS-A/B/C1-V2-0503	1.6
MDS-A/B/C1-SP-55	6.77	MDS-A/B/C1-V1-05	1.0	MDS-A/B/C1-V2-0505	2.0
MDS-A/B/C1-SP-75	9.07	MDS-A/B/C1-V1-10	1.6	MDS-B/C1-V2-1003	2.2
MDS-A/B/C1-SP-110	13.1	MDS-A/B/C1-V1-20	2.7	MDS-A/B/C1-V2-1005	2.6
MDS-A/B/C1-SP-150	17.6	MDS-A/B/C1-V1-35	4.7	MDS-A/B/C1-V2-1010	3.2
MDS-A/B/C1-SP-185	21.8	MDS-A/B/C1-V1-45	5.9	MDS-A/B/C1-V2-2010	4.3
MDS-A/B/C1-SP-220	25.9	MDS-A/B/C1-V1-70	9.0	MDS-A/B/C1-V2-2020	5.4
MDS-A/B/C1-SP-260	30.0	MDS-A/B/C1-V1-90	11.5	MDS-A/B/C1-V2-3510	6.3
MDS-A/B/C1-SP-300	34.7			MDS-A/B/C1-V2-3520	7.4
MDS-B-SP-370	42.8			MDS-A/B/C1-V2-3535	9.4
MDS-B-SP-450	52.1			MDS-A/B/C1-V2-4520	8.6
MDS-B-SP-550	63.7			MDS-A/B/C1-V2-4535	10.6
				MDS-C1-V2-4545	11.8
				MDS-C1-V2-7070	18.0

SP: Including SPA/SPH/SPM/SPX V1: Including V14 V2: Including V24

Revision History

Date of revision	Manual No.	Revision details
June. 2004	BNP-B2365*	First edition created.
Mar. 2004	BNP-B2365A	• Connection of power supply was fully revised. • Wiring of the motor brake was fully revised. • Peripheral control wiring was fully revised. • "Setup" was fully revised. • D/A output specifications for spindle drive unit were revised. • Spindle control signal was revised. • Adjusting the acceleration/deceleration operation was revised. • Adjusting the orientation control was revised. • Adjusting the C-axis control was revised. • List of alarms was revised. • List of warnings was revised. • Miswrite is corrected.
Feb. 2006	BNP-B2365B	• Adjusting the acceleration/deceleration operation was revised. • Troubleshooting "3B" and "77" were revised. • Miswrite is corrected.

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.

Duplication Prohibited

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