Changes for the Better

MITSUBISHI ELECTRIC

CNC
MELDAS AC SPINDLE
MDS-C1-SPA Series

INSTRUCTION MANUAL

IB-1500152A(ENG)

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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-SPA 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

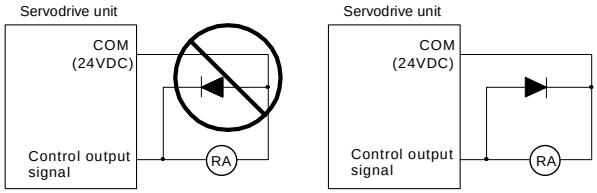
⚠ Correctly and securely perform the wiring. Failure to do so could lead to runaway of the servomotor.

⚠ 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.

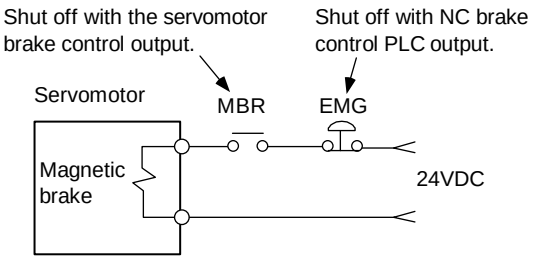
⚠ If a breaker is shared by several power supply units, the breaker may not activate when a short-circuit fault occurs in a small capacity unit. This is dangerous, so never share the breakers.

⚠ 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

Contents for MDS-C1-SPA Series SPECIFICATIONS MANUAL (IB-1500150)

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

Contents for MDS-C1-SPA Series SPECIFICATIONS MANUAL (IB-1500150)

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

1. Installation

1-1 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.

1-1-1 Environmental conditions

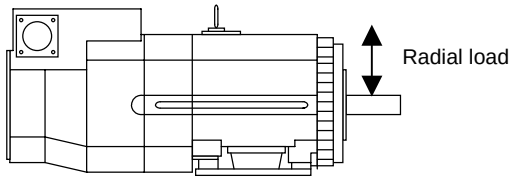
Environment	Conditions
Ambient temperature	0°C to +40°C (with no freezing)
Ambient humidity	90%RH or less (with no dew condensation)
Storage temperature	-20°C to +65°C (with no freezing)
Storage humidity	90%RH or less (with no dew condensation)
Atmosphere	Indoors (Where unit is not subject to direct 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.

1-1-2 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.

1-2 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.

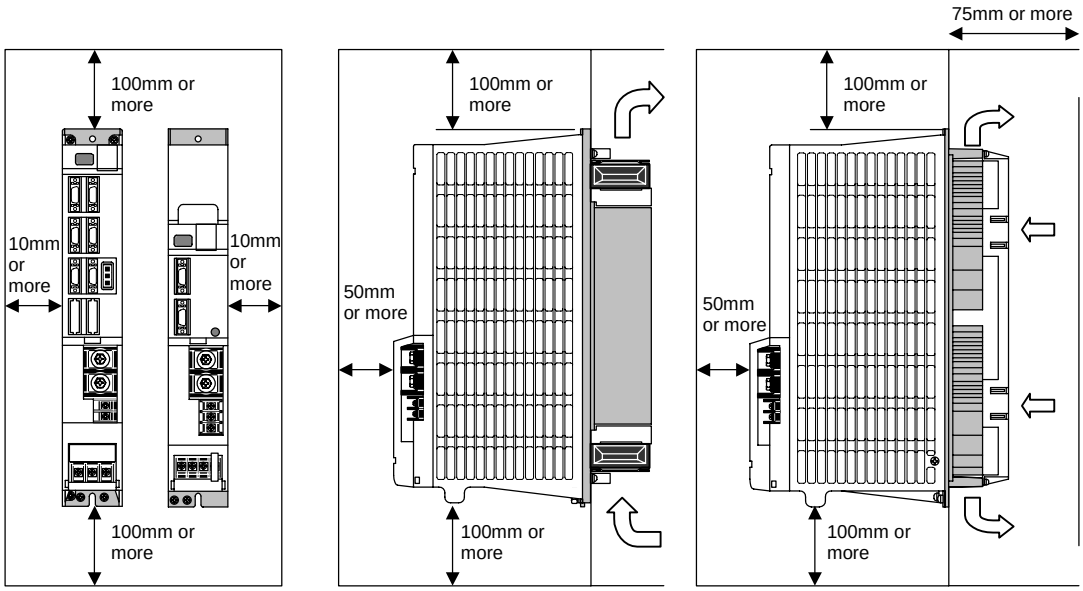
1-2-1 Environmental conditions

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.)

1-2-2 Installation direction and clearance

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

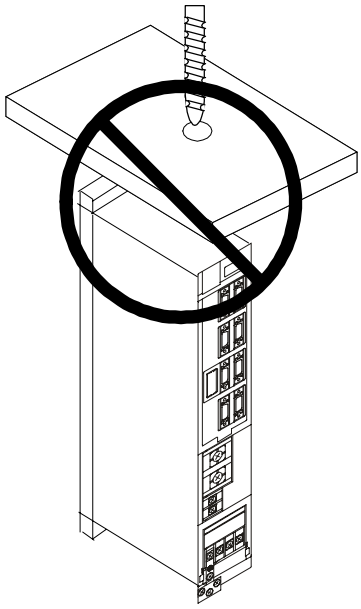


> **⚠ CAUTION**
>
> The ambient temperature condition for the power supply unit or the drive units is 55°C or less. Because heat can easily accumulate in the upper portion of the units, give sufficient consideration to heat dissipation when designing the panel. If required, install a fan in the panel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

1-2-3 Prevention of entering of foreign matter

Treat the cabinet with the following items.

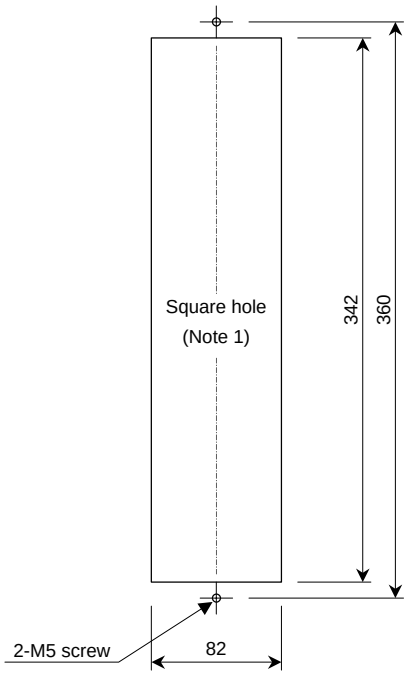
- Make sure that the cable inlet is dust and oil proof by using packing, etc.
- Make sure that the external air does not enter inside by using head radiating holes, etc.
- Close all clearances.
- Securely install door packing.
- If there is a rear cover, always apply packing.
- Oil will tend to accumulate 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).



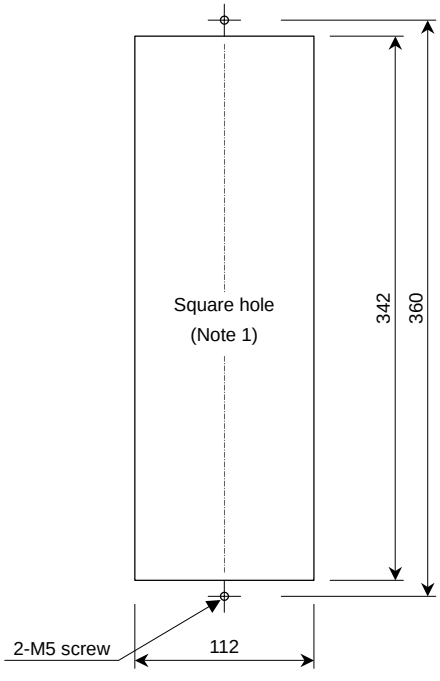
1-2-4 Panel installation hole work drawings (Panel cut drawings)

Prepare a square hole to match the unit width.

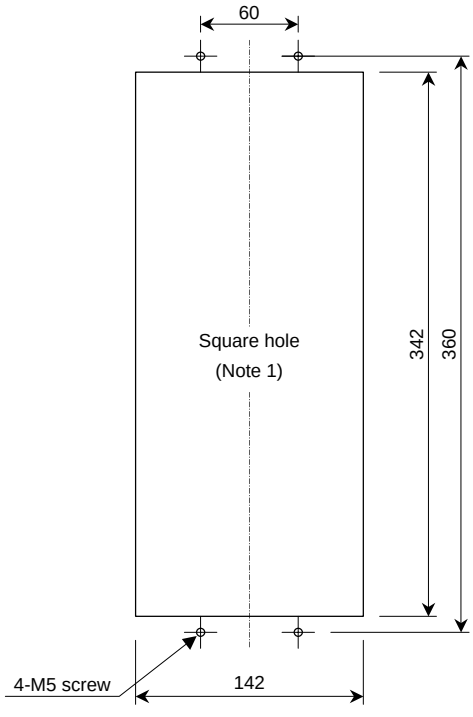
[Unit: mm]



Unit width: 90mm



Unit width: 120mm



Unit width: 150mm

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

1-2-5 Heating value

Each heating value is calculated with the following values.
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			Power supply unit		
Type MDS-C1-	Heating amount [W]		Type MDS-C1-	Heating amount [W]	
	Inside panel	Outside panel		Inside panel	Outside panel
SPA- 55	31	76	**CV- 37**	21	34
SPA- 75	35	102	**CV- 55**	23	42
SPA-110	41	140	**CV- 75**	25	55
SPA-150	48	187	**CV-110**	26	99
SPA-185	62	280	**CV-150**	29	126
SPA-220	65	301	**CV-185**	33	162
SPA-260	80	403	**CV-220**	35	175
SPA-300	98	522	**CV-260**	40	220
			CV-300	46	274
			CV-370	54	346

(Example 1)

When using MDS-C1-CV-185, MDS-C1-SPA[]-185[]

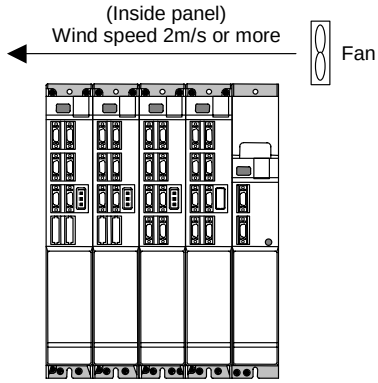
Total heating value = (33+162) + (62+280)
= 537 [W]

Heating value in panel = (33) + (62)
= 95 [W]

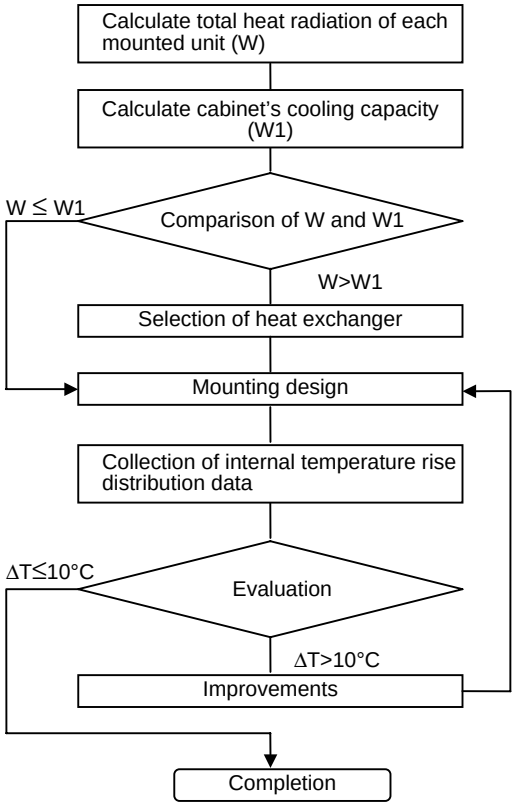
1-2-6 Heat radiation countermeasures

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>

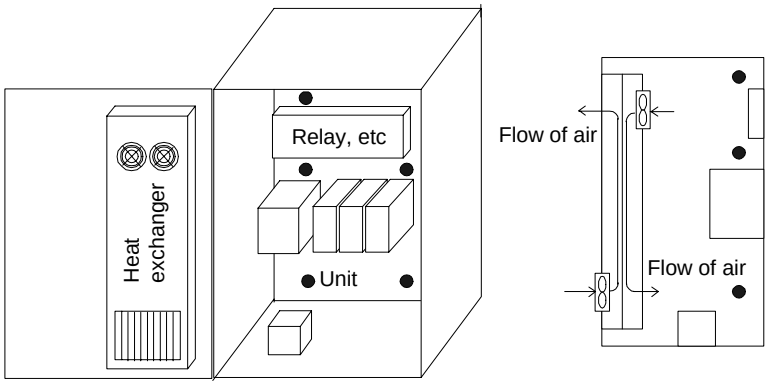
(1) Average temperature in cabinet : T ≤ 55°C
(2) Cabinet peripheral temperature : Ta ≤ 0°C to 45°C
(3) Internal temperature rise value : $\Delta T = T - Ta_{max} = 10°C$

<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) ≤ 10°C
   ΔT_{max} (maximum value) ≤ 15°C
   R (inconsistency) = $(\Delta T_{max} - \Delta T_{min}) \leq 6°C$
   (Evaluate existence of heat spots)

Examples of mounting and temperature measurement positions (reference)

● **Measurement position (example)**

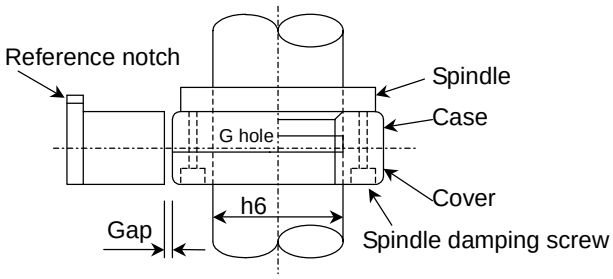


1-3 Installing the spindle detector

1-3-1 Magnetic sensor

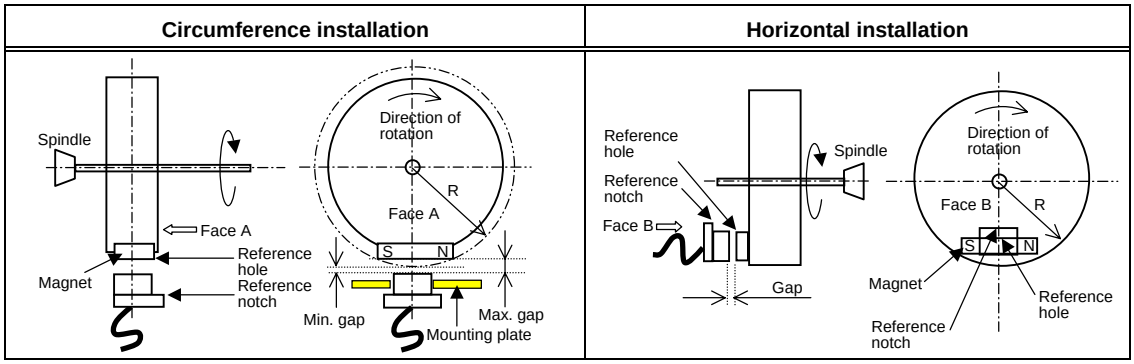
(1) Installing the magnetic sensor

- 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

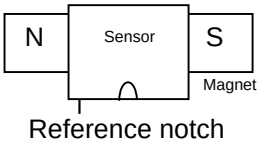
(2) Gap between magnet and sensor

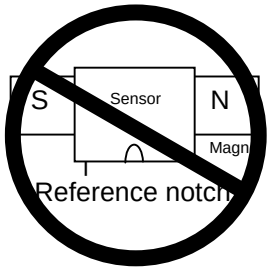


Magnet model	BKO-C1810H03			BKO-C1730H06			BKO-C1730H09	
Installation direction	Circumference installation		Horizontal installation	Circumference installation		Horizontal installation	Circumference installation	
R (Radius) mm	Gap mm			Gap mm			Gap mm	
	Max. value	Min. value		Max. value	Min. value		Max. 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)



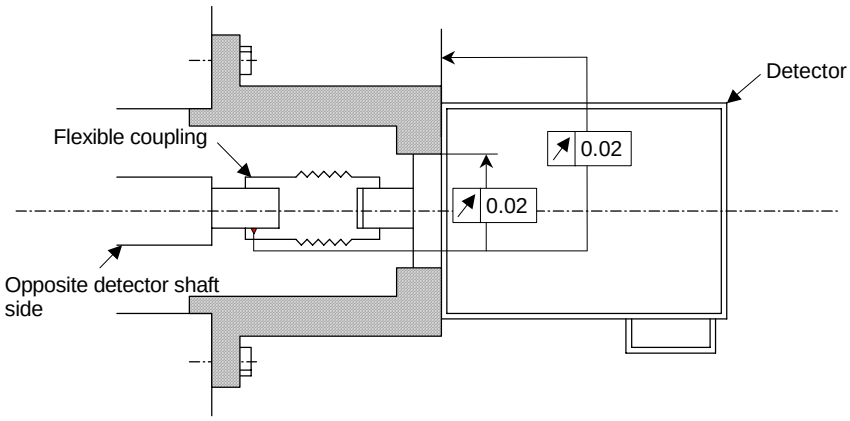


(4) Cautions

[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.

1-3-2 Spindle side detector

When coupling the spindle side detector with spindle, a flexible coupling should be used to couple the spindle side 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 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.

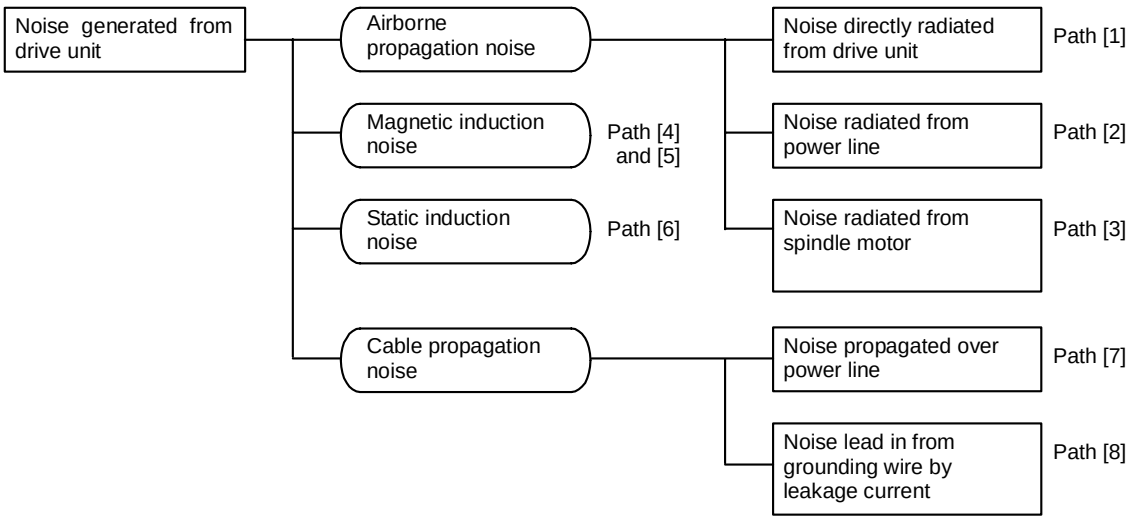
(2) Propagation noise measures

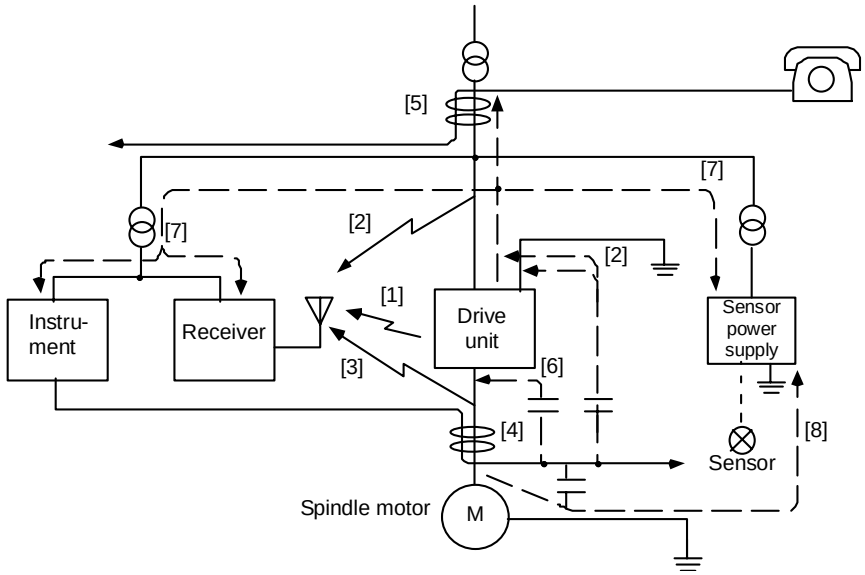
Take the following measures when noise generating devices are installed and the power supply unit or drive unit could malfunction.

- 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.

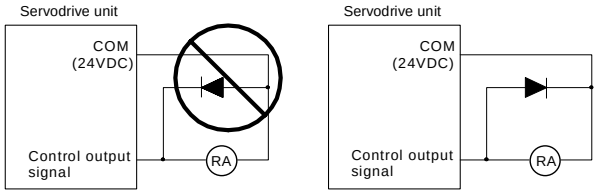
2. Wiring and Connection

⚠ 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 spindle motor.
4. Wire the drive units and 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

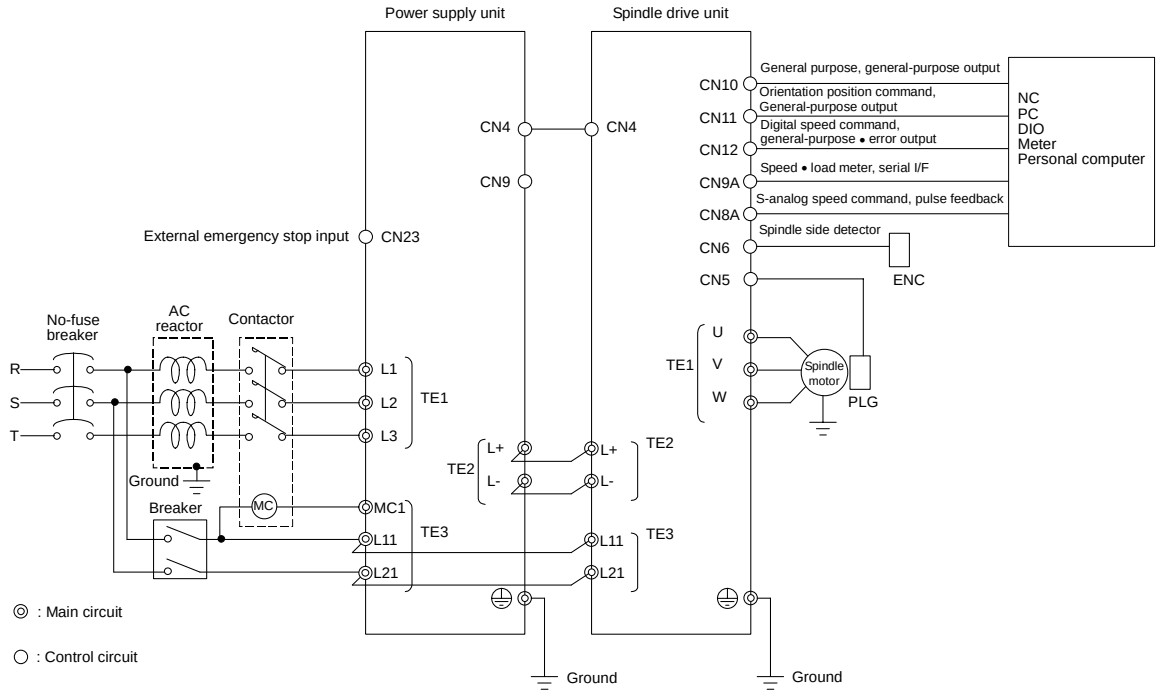
1. Correctly and securely perform the wiring. Failure to do so could result in runaway of the spindle motor or injury.
2. Do not mistake the terminal connections.
   Failure to observe this item could lead to ruptures or damage, etc.
3. Do not mistake the polarity (+ , -). Failure to observe this item 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 general-purpose output 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 spindle motor.
7. Do not modify this unit.
8. The half-pitch connector (CN10, 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 Connection diagram

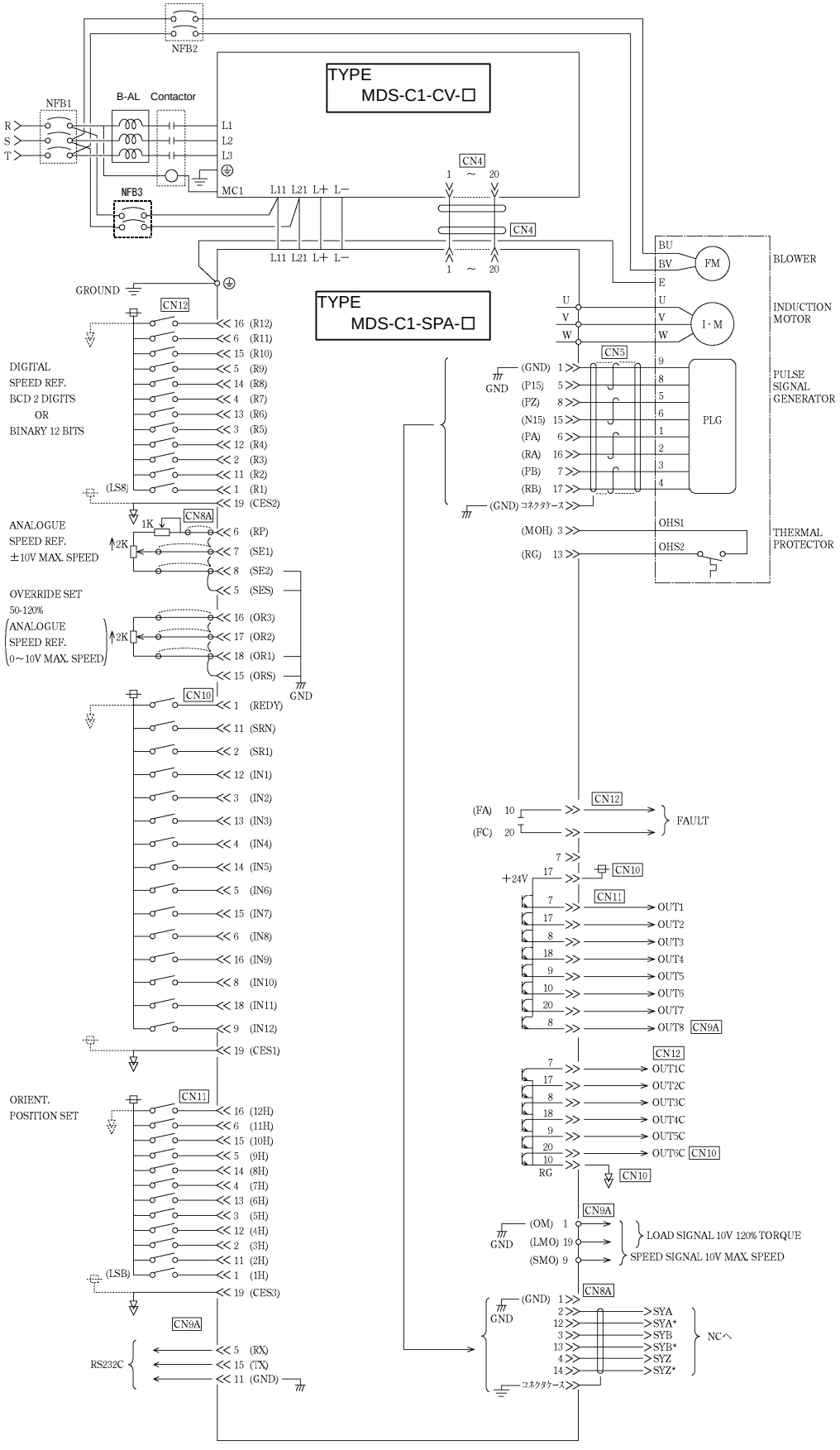
2-1-1 Part system connection diagram



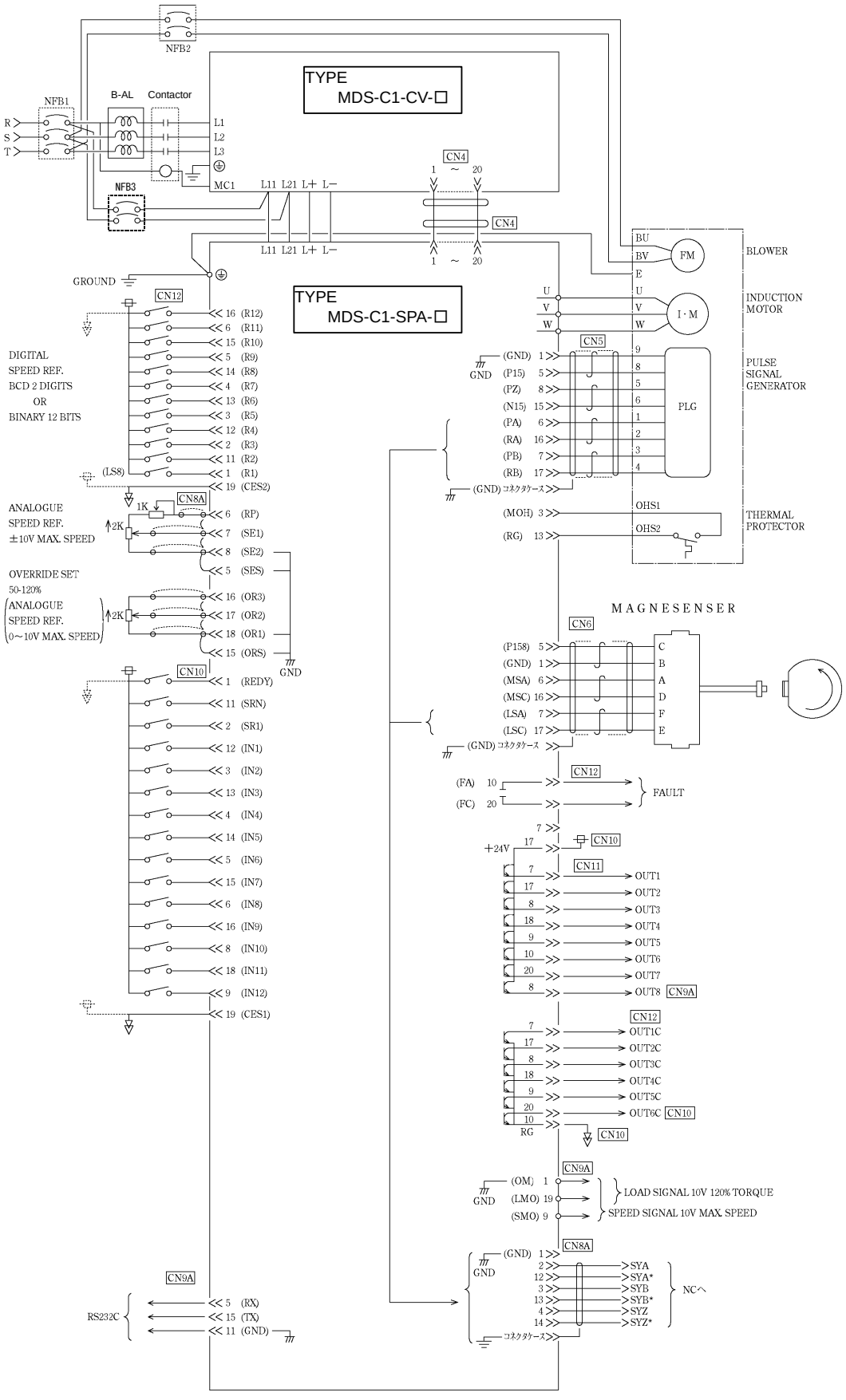
(Note 1) The connection method will differ according to the used motor.
(Note 2) The main circuit (◎) and control circuit (○) are safely separated.

2-1-2 Detailed connection diagram

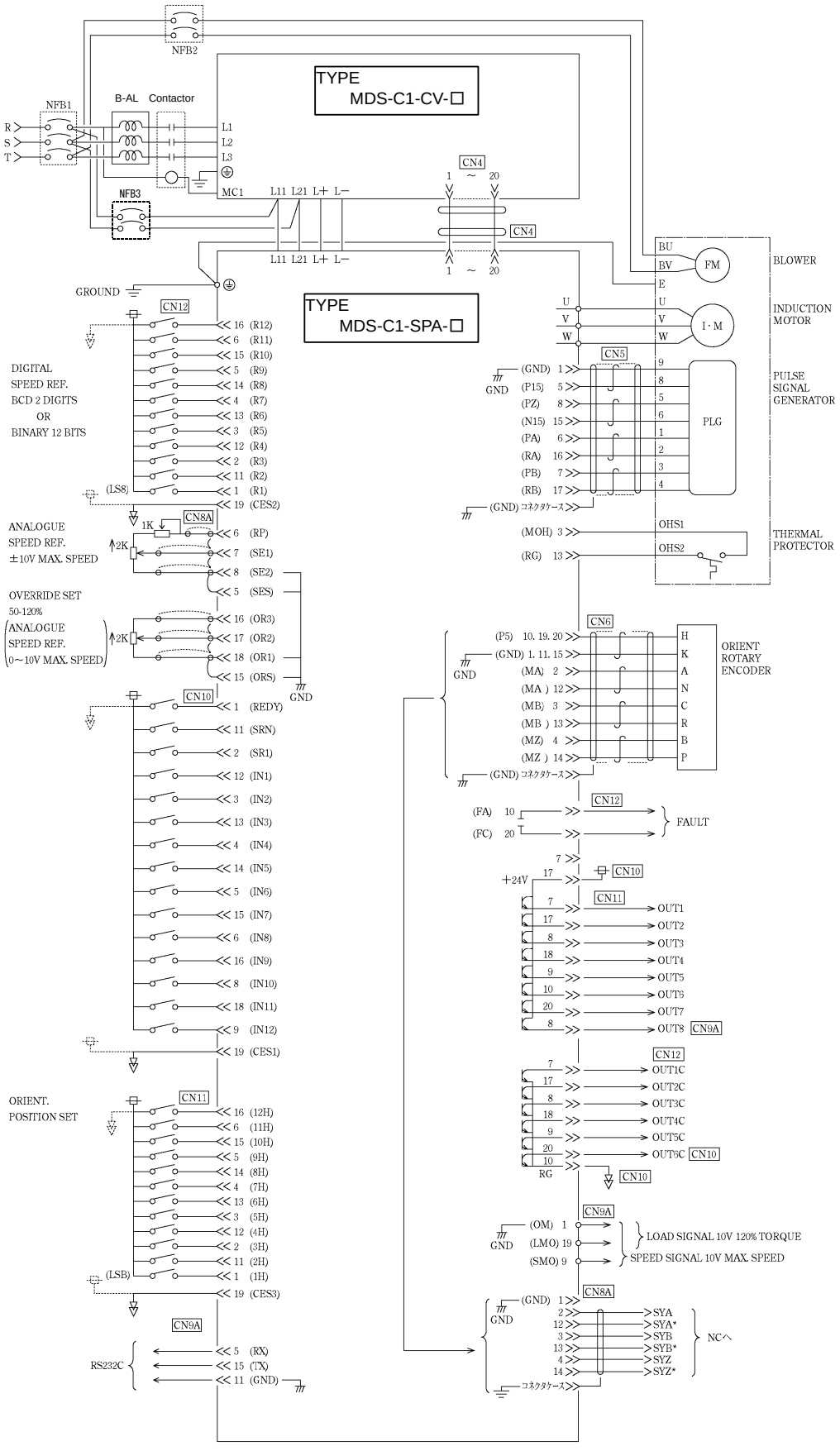
(1) With no orientation / When using motor built-in encoder orientation



(2) When using magnetic sensor orientation



(3) When using encoder orientation



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

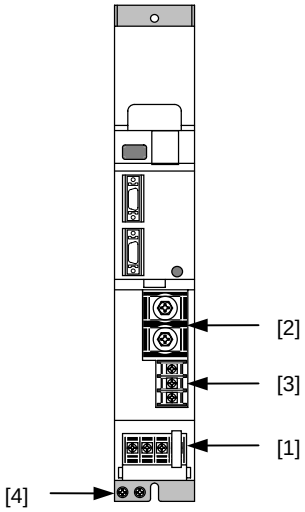
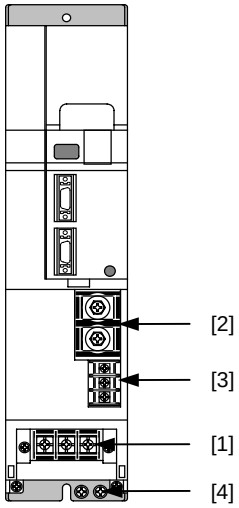
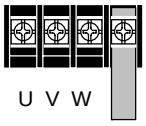
1. Always use one AC reactor per power supply unit. Failure to observe this could lead to unit damage.
2. When sharing a breaker for several power supply units, of a short-circuit fault occurs in a small capacity unit, the breaker could trip. This can be hazardous, so do not share the breaker.
3. Be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

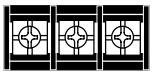
2-2-2 Connector pin assignment

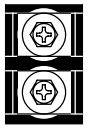
⚠ CAUTION Do not apply a voltage other than that specified in Instruction Manual on each terminal. Failure to observe this item could lead to rupture or damage, etc.

(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> 

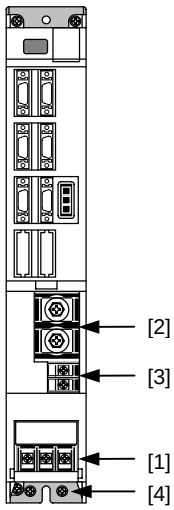
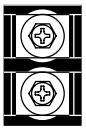
<table>
<tr><th>Compatible unit</th><th>CV-37 to 75</th></tr>
<tr><td>Screw size</td><td>M4</td></tr>
<tr><td>Tightening torque</td><td>1.6Nm</td></tr>
</table></td><td> 

<table>
<tr><th>Compatible unit</th><th>CV-110 to 185</th><th>CV-220 to 370</th></tr>
<tr><td>Screw size</td><td>M5</td><td>M8</td></tr>
<tr><td>Tightening torque</td><td>3.37Nm</td><td>13.2Nm</td></tr>
</table></td></tr>
<tr><td>[2]</td><td>TE2</td><td colspan="2"> 

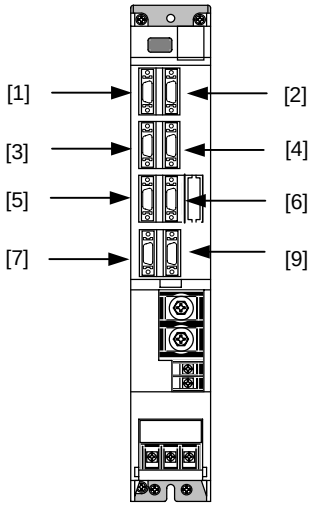
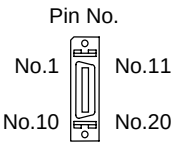
<table>
<tr><th>Compatible unit</th><th>CV-37 to 370</th></tr>
<tr><td>Screw size</td><td>M6</td></tr>
<tr><td>Tightening torque</td><td>5.0Nm</td></tr>
</table></td></tr>
<tr><td>[3]</td><td>TE3</td><td colspan="2"> 

<table>
<tr><th>Compatible unit</th><th>CV-37 to 75</th><th>CV-110 to 370</th></tr>
<tr><td>Screw size</td><td>M4</td><td>M4</td></tr>
<tr><td>Tightening torque</td><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><td>Screw size</td><td>M4</td></tr>
<tr><td>Tightening torque</td><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><td>Screw size</td><td>M5</td><td>M8</td></tr>
<tr><td>Tightening torque</td><td>3.37Nm</td><td>13.2Nm</td></tr>
</table></td></tr>
</table>

Spindle drive unit

<table>
<tr><th colspan="3">Unit / Terminal</th><th>MDS-C1-SPA-55 to 300</th></tr>
<tr><td colspan="3">Terminal position</td><td> 
</td></tr>
<tr><td rowspan="4">Terminal specification/Pin assignment</td><td rowspan="2">[1]</td><td rowspan="2">TE1</td><td> 
U V W</td></tr>
<tr><td><table>
<tr><th>MDS-C1-SPA-</th><th>55 to 185</th><th>220 to 300</th></tr>
<tr><td>Screw size</td><td>M5</td><td>M8</td></tr>
<tr><td>Tightening torque</td><td>3.2Nm</td><td>13.2Nm</td></tr>
</table></td></tr>
<tr><td>[2]</td><td>TE2</td><td> 
L+
L-
<table>
<tr><th>Compatible unit</th><th>All capacity</th></tr>
<tr><td>Screw size</td><td>M6</td></tr>
<tr><td>Tightening torque</td><td>5.0Nm</td></tr>
</table></td></tr>
<tr><td>[3]</td><td>TE3</td><td> 
L11
L21
<table>
<tr><th>Compatible unit</th><th>All capacity</th></tr>
<tr><td>Screw size</td><td>M4</td></tr>
<tr><td>Tightening torque</td><td>2.0Nm</td></tr>
</table></td></tr>
<tr><td>[4]</td><td>⏚</td><td>The PE screw size is the same as TE1.</td></tr>
</table>

(2) Control circuit connector

Unit / Terminal	MDS-C1-SPA-55 to 300
Connector position	
[1] CN11 [2] CN12 [3] CN9A [4] CN4 [5] CN5 [6] CN6 [7] CN10 [8] CN8A	

Connector specifications

[5] CN5

Pin assignment			
1	GND	11	GND
2	RD	12	RD*
3	MOH	13	RG
4	SD	14	SD*
5	P15	15	N15
6	PA	16	RA
7	PB	17	RB
8	PZ	18	-
9	P24	19	-
10	-	20	-

[6] CN6

Pin assignment			
1	GND	11	GND
2	MA	12	MA*
3	MB	13	MB*
4	MZ	14	MZ*
5	P15B	15	GND
6	MSA	16	MSC
7	LSA	17	LSC
8	-	18	-
9	-	19	P5
10	P5	20	P5

[9] CN8A

Pin assignment			
1	GND	11	GND
2	SYA	12	SYA*
3	SYB	13	SYB*
4	SYZ	14	SYZ*
5	SES	15	ORS
6	RP	16	OR3
7	SE1	17	OR2
8	SE2	18	OR1
9	-	19	-
10	-	20	-

[3] CN9A

Pin assignment			
1	GND	11	GND
2	DR	12	DX
3	CLK	13	FSX
4	P5	14	-
5	RX	15	TX
6	-	16	-
7	IU	17	IV
8	OUT8	18	P5
9	SM0	19	LM0
10	-	20	-

[7] CN10

Pin assignment			
1	REDY	11	SRN
2	SRI	12	IN1
3	IN2	13	IN3
4	IN4	14	IN5
5	IN6	15	IN7
6	IN8	16	IN9
7	-	17	+24V
8	IN10	18	IN11
9	IN12	19	CES1
10	RG	20	OUT6C

[1] CN11

Pin assignment			
1	1H	11	2H
2	3H	12	4H
3	5H	13	6H
4	7H	14	8H
5	9H	15	10H
6	11H	16	12H
7	OUT1	17	OUT2
8	OUT3	18	OUT4
9	OUT5	19	CES3
10	OUT6	20	OUT7

[2] CN12

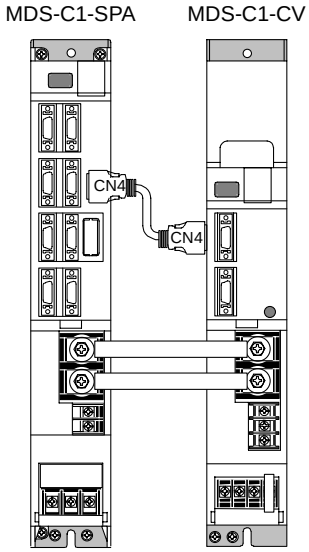
Pin assignment			
1	R1	11	R2
2	R3	12	R4
3	R5	13	R6
4	R7	14	R8
5	R9	15	R10
6	R11	16	R12
7	OUT1C	17	OUT2C
8	OUT3C	18	OUT4C
9	OUT5C	19	CES2
10	FA	20	FC

2-3 Drive unit connection

In this section, the connection between the spindle drive unit and power supply unit is shown. There is space between units in the following diagram to make clearly understandable. However, actually, install the drive units so that the space between the drive units is within 3cm.

POINT	Even if two or more spindle drive units are used, keep the setting of the spindle drive unit's rotary switch to "0". This switch has no relation to the axis No.

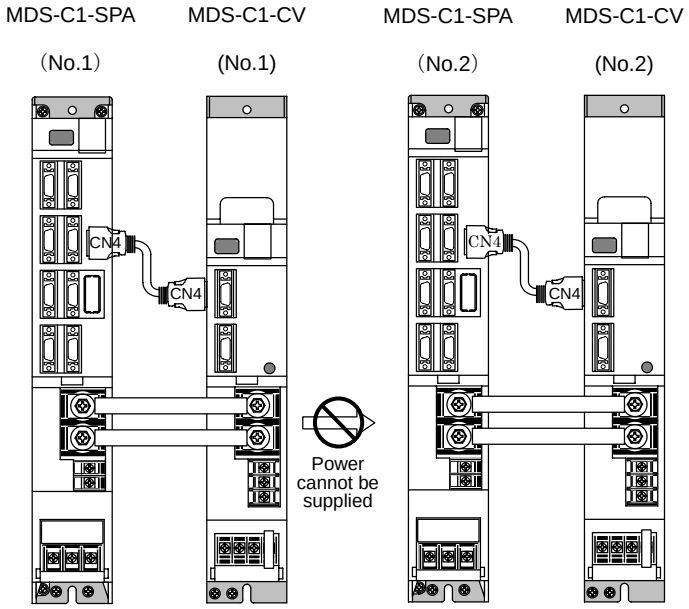
(1) When using one power supply unit for one spindle drive unit



Connection when using one power supply unit

(2) When using two power supply units and connecting one spindle drive unit with each power supply unit

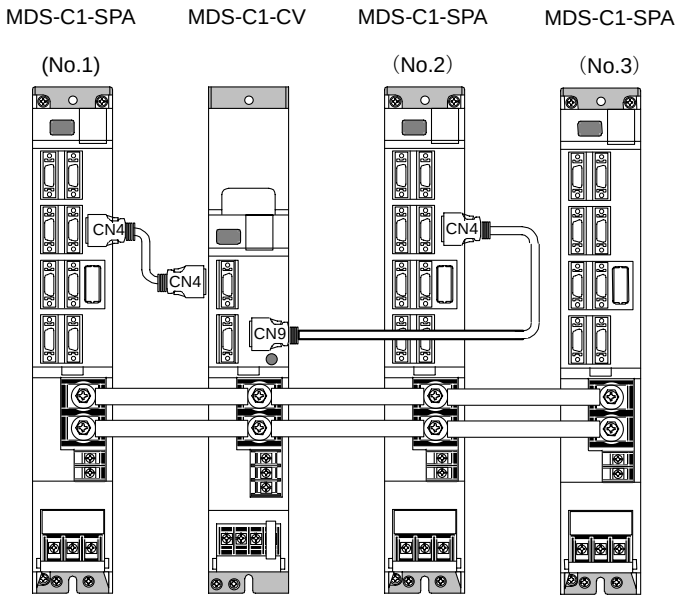
Two or more power supply units may be required if the spindle drive unit capacity is large in a machine applying two spindles specification. Make sure that the powers (L+, L-) of both power supply units are supplied to only one spindle drive unit connected with each power supply, and do not connect each other's powers.



Connections when using two power supply units

(3) When connecting two or more spindle drive units with one power supply unit

Connect units according to the following cautions.



Connections when sharing one power supply

(Note 1) Connecting power supply unit and spindle drive unit.
Connect C1-CV CN4 and C1-SPA (No. 1) CN4 to C1-CV CN9 and C1-SPA (No.2) CN4. If C1-SPA is connected with three or more axes, leave CN4 for C1-SPA (No. 3) and following open.
Note that the C1-CV can be controlled (READY ON/OFF, alarm display, etc.) only by the spindle drive unit connected to C1-CV CN4.

(Note 2) Make sure that the machine ready complete input turns ON and OFF simultaneously for all the spindle drive units. Do not allow the signal to turn ON and OFF for only one spindle drive unit.

(Note 3) When turning the machine ready complete input OFF during an emergency stop, always have all the spindle drive units output the zero speed signal before turning the signal OFF.

(Note 4) If an alarm occurs in one of the spindle drive units, turn OFF the machine ready complete input OFF for all the spindle drive units.

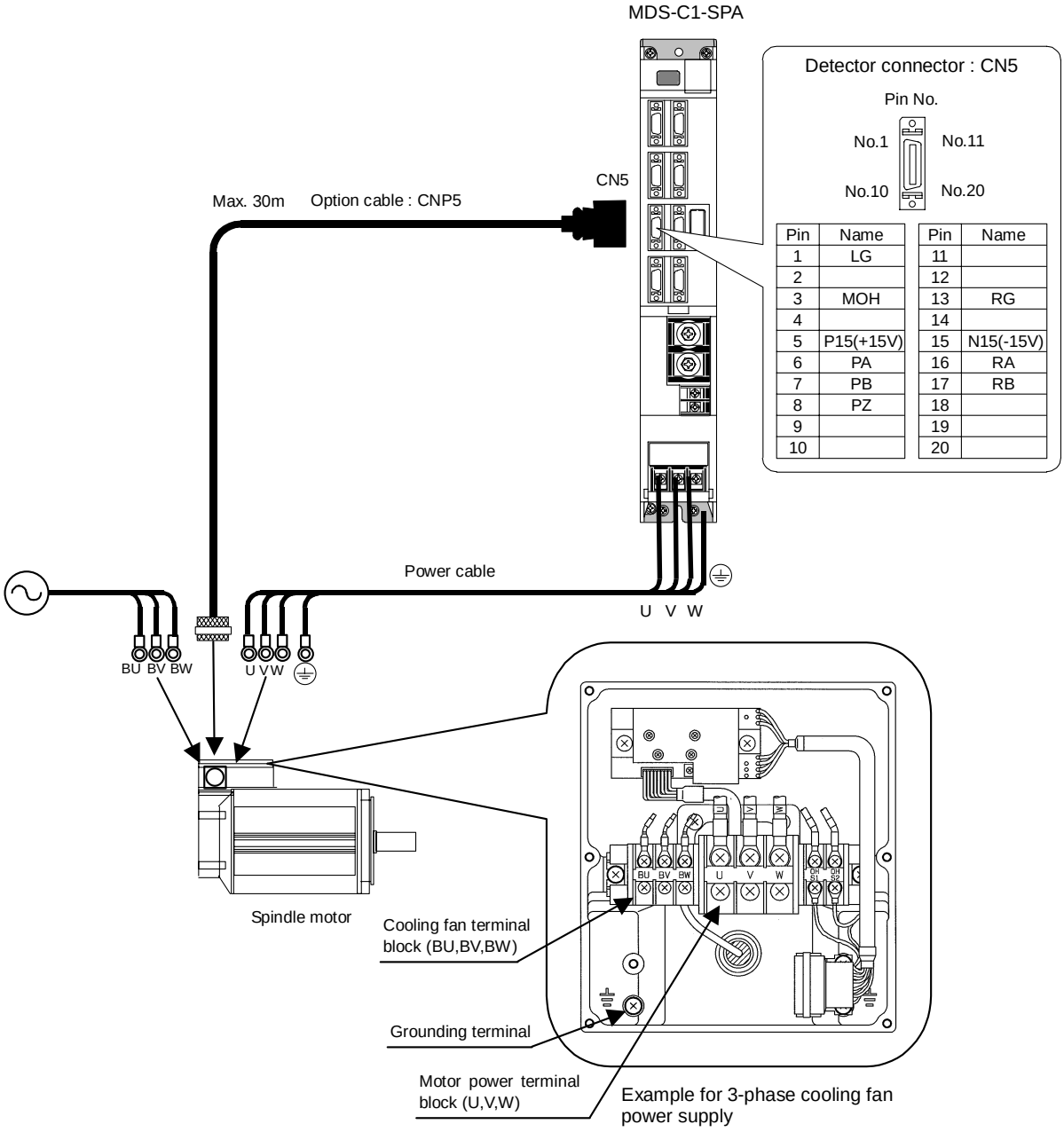
(Note 5) When connecting three or more spindle drive units, install the large-capacity spindle drive units on both sides of the power supply unit.

2-4 Motor and detector connection

2-4-1 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



Detector connector : CN5

Pin No.

No.1 No.11

No.10 No.20

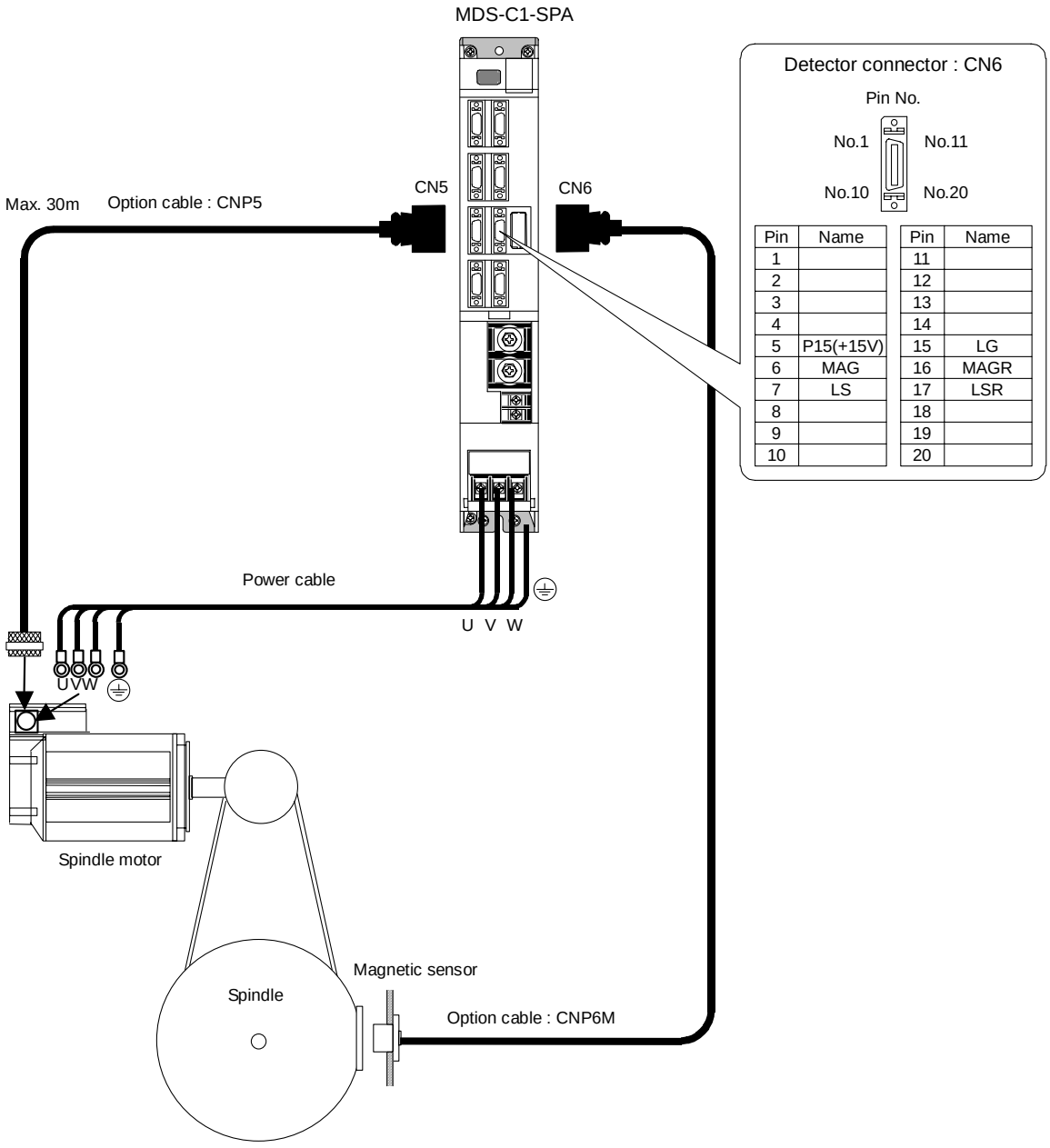
Pin	Name	Pin	Name
1	LG	11	
2		12	
3	MOH	13	RG
4		14	
5	P15(+15V)	15	N15(-15V)
6	PA	16	RA
7	PB	17	RB
8	PZ	18	
9		19	
10		20	

(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.



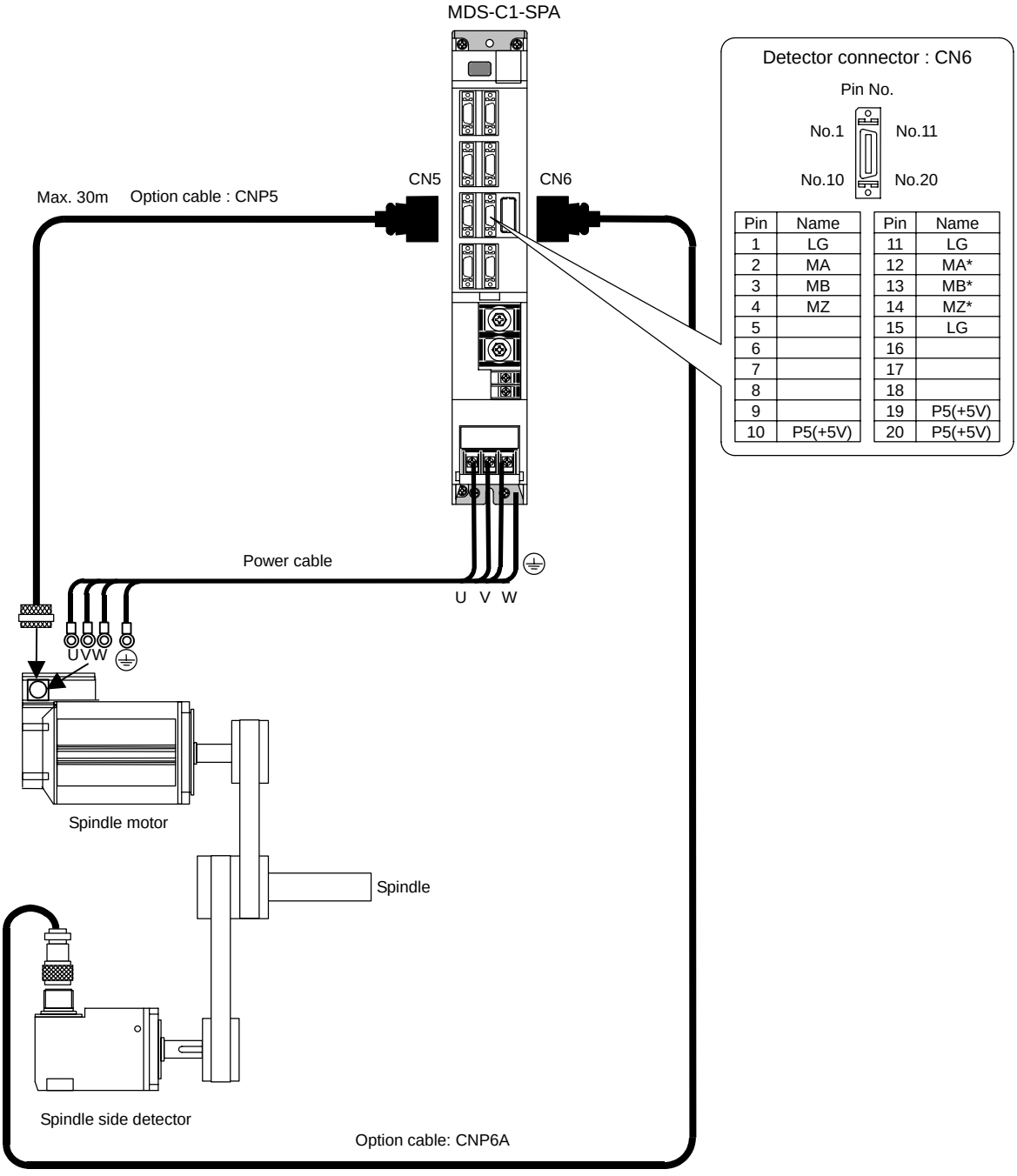
Pin	Name	Pin	Name
1		11	
2		12	
3		13	
4		14	
5	P15(+15V)	15	LG
6	MAG	16	MAGR
7	LS	17	LSR
8		18	
9		19	
10		20	

⚠ CAUTION

1. The shield of spindle detector cable is not FG. Do not ground.
2. The magnetic sensor orientation is not available with a machine having a gear ratio between the motor and spindle exceeding 1:31.

(3) Connecting the spindle side 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.

2-5 Connection of power supply

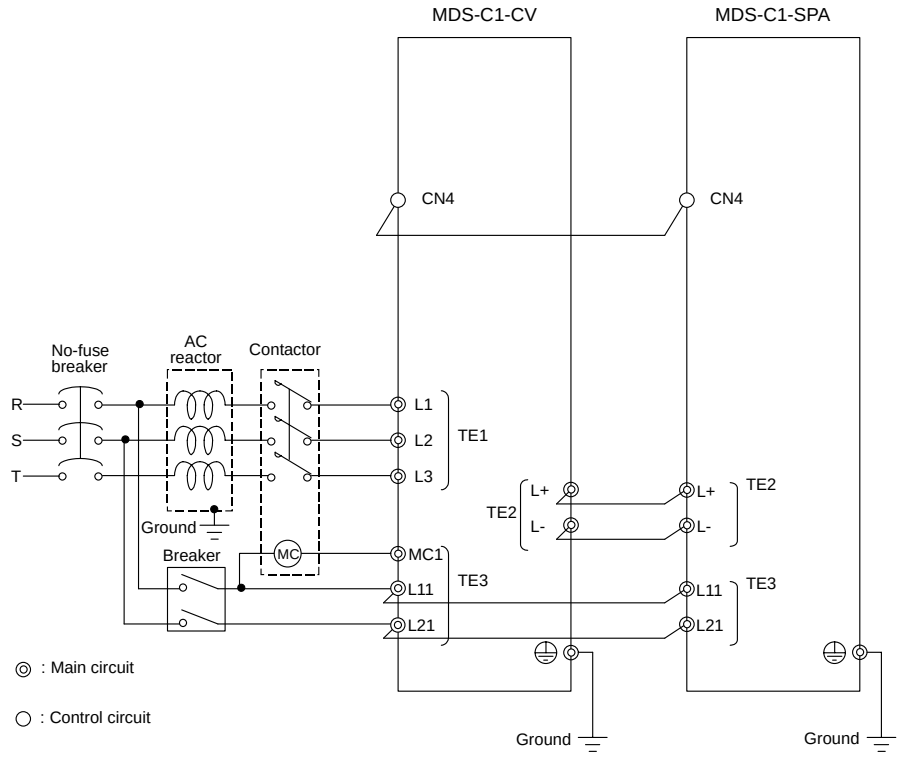
⚠ CAUTION

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 units so that the distance between power supply unit and spindle drive unit will be 3cm or less.

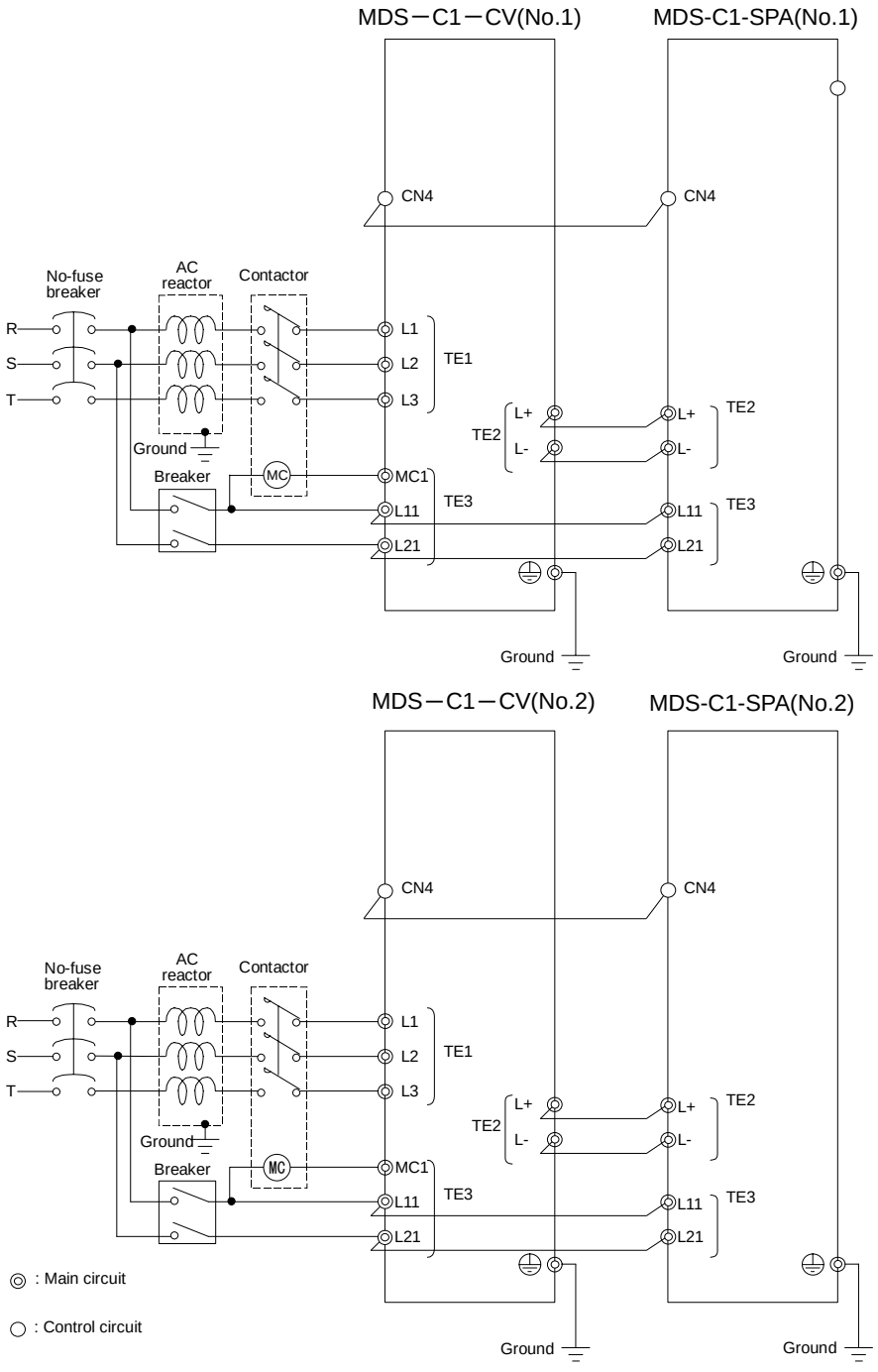


⚠ CAUTION

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.

(2) When using two power supply units, and connecting one spindle drive unit with each power supply unit

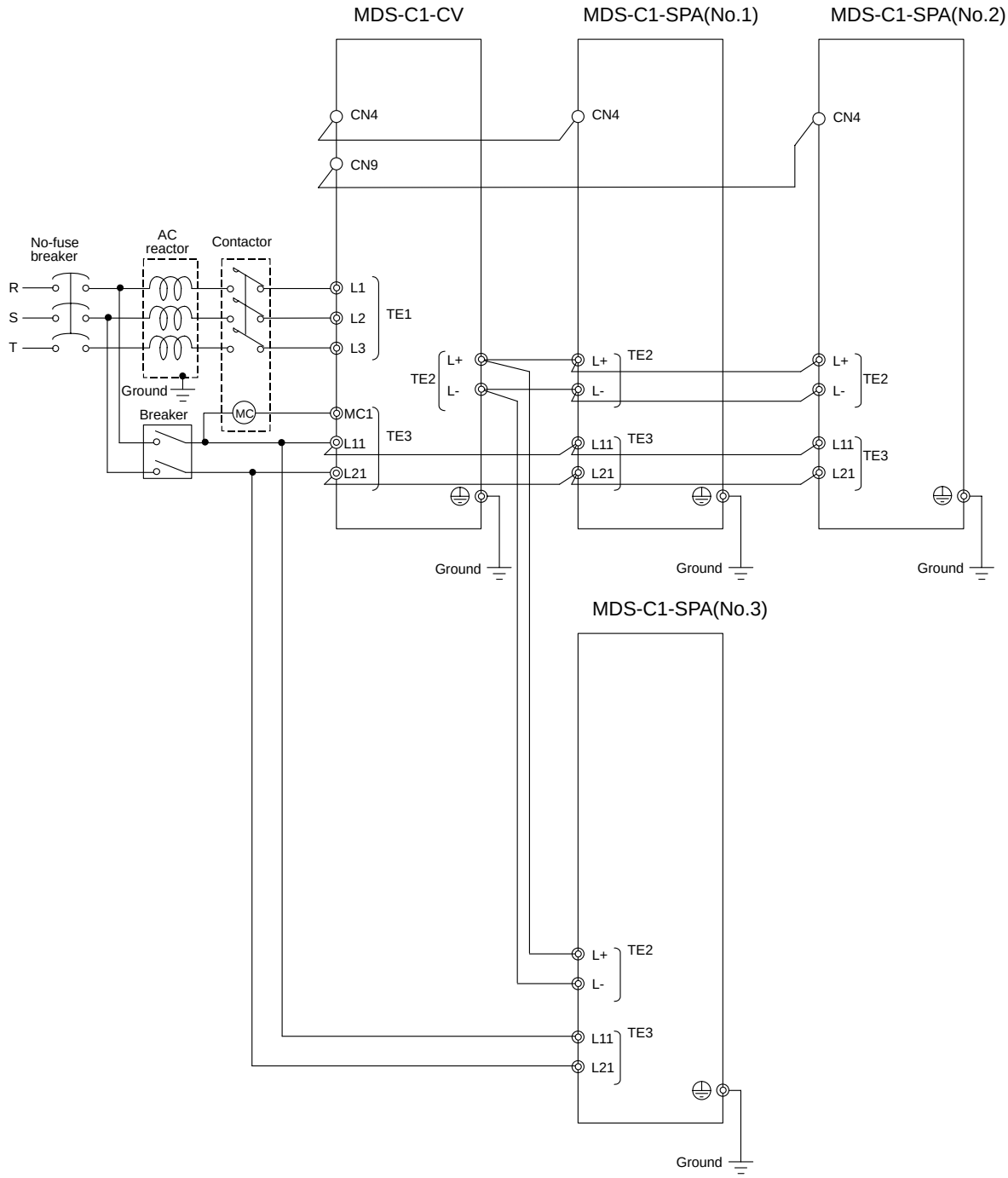
Install a no-fuse breaker and a contactor for each of the power supply units.
Install the drive units so that the distance between power supply unit and spindle drive unit will be 3cm or less. The installation distance between No.1 and No.2.is not particularly specified.



⚠ CAUTION An AC reactor and breaker are required for each power supply unit.

(3) When connecting one power supply unit with two spindle drive units

Only the spindle drive unit connected to the power supply unit's CN4 connector becomes the power supply unit control axis.



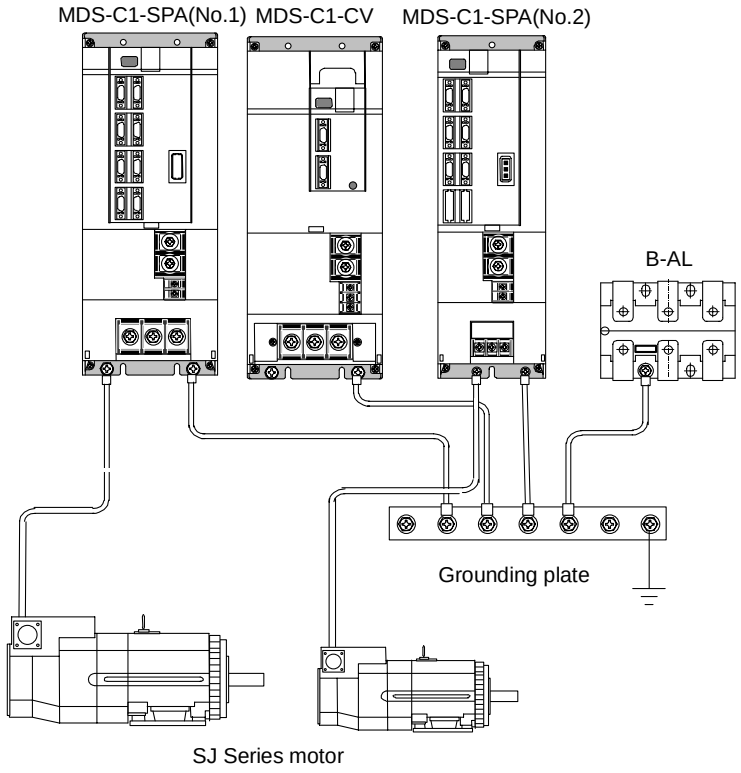
⚠ CAUTION	1. When connecting two or more spindle drive units, install the large-capacity drive units on both sides of the power supply unit. 2. Install units so that the “L+” and “L-” of each unit are in alignment and each space between units is kept to 3cm or less.

2-5-2 Connecting the grounding cable

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

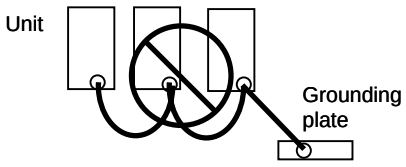
Each unit has a terminal or mounting hole to connect PE (⏚) or FG.
Please connect an earth wire to the main ground of a cabinet or a machine frame at one point.
Ground each device according to the grounding conditions set forth by each country. (Typically, a Y-connection neutral point ground is used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

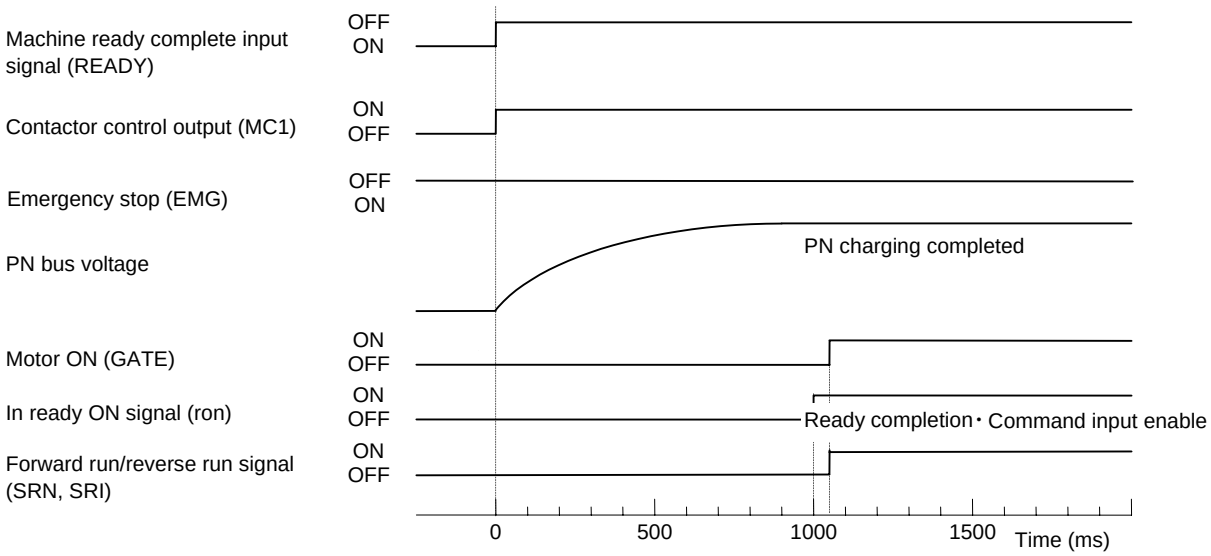
Earth wire size should follow the following table.

Type	Grounding cable size (Required grounding)
MDS-C1-CV Unit	Larger than thickness of wire connected to TE1 (L1/L2/L3). (PE)
MDS-C1-SPA[] 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

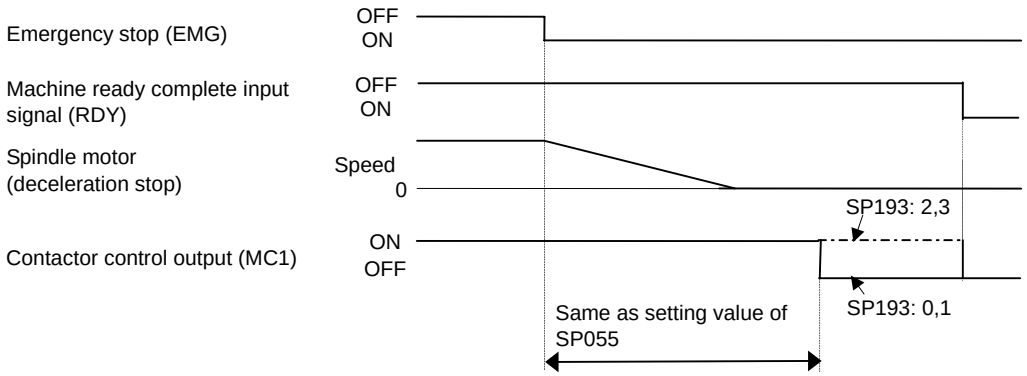
Main circuit power is turned ON in the sequence shown below when an emergency stop status is canceled.



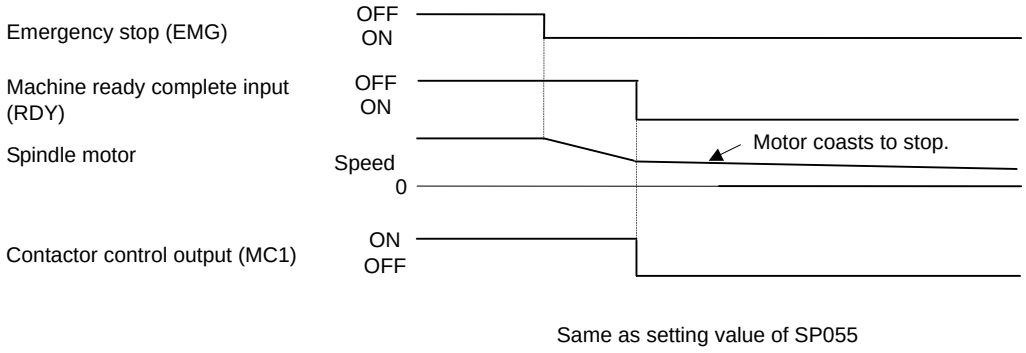
Contactor ON sequence

(2) Contactor shutoff sequence

During the emergency stop signal input (EMG), if the setting of SP193 is "0" or "1" after the spindle motor decelerates to stop, the contactor is turned OFF after a certain amount of time. Even in the emergency stop, the contactor is turned OFF immediately after the machine ready complete signal (RDY) is turned OFF.



Contactor OFF sequence (When machine ready complete input signal is input after the setting time of SP055)



Contactor OFF sequence (When machine ready complete input signal is input during deceleration stop)

2-6 Peripheral control wiring

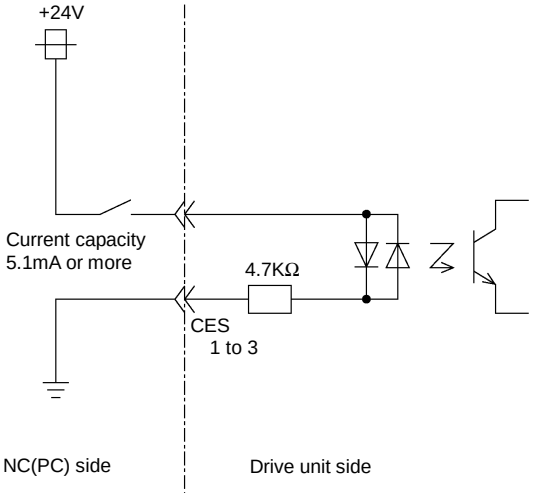
2-6-1 Input interface

(1) Digital input interface: CN10 to 12

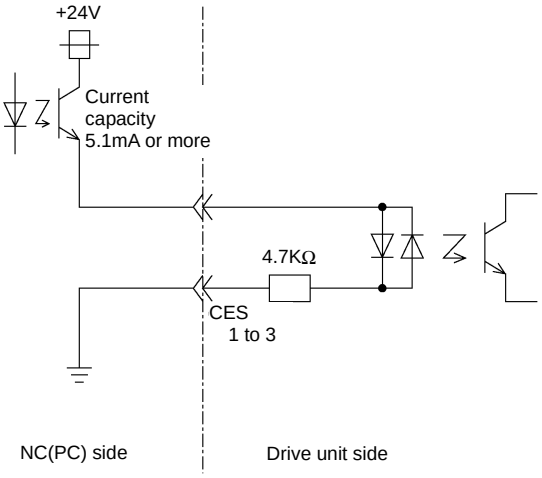
(Special input: 3 points, general-purpose input: 12 points, multi-points orientation command: 12 points, digital speed command: 12 points)

Select from the following.

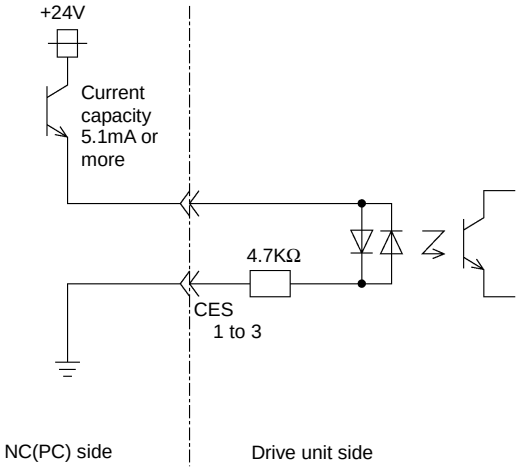
1) Connecting with contact



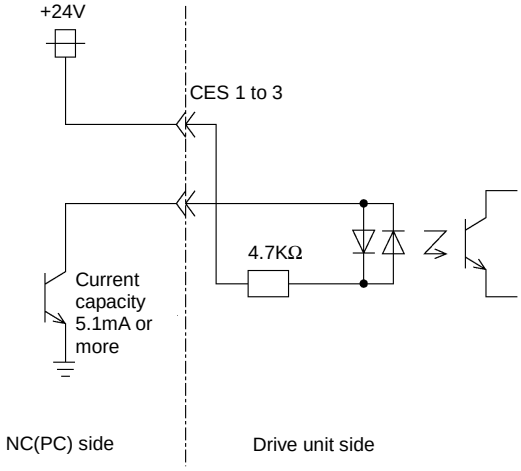
2) Connecting with photo coupler



3) Connecting with open emitter



4) Connecting with open collector



(Note 1) A +24V(±10%) power supply is required for this unit. The required maximum power supply capacity is 26W. DC stabilized power supply must be used here.

(Note 2) Common for dedicated/general-purpose input is CES1, common for digital speed command is CES2, and common for multi-point orientation command is CES3. Each command is electrically separated one another. Thus, when using CES1, 2 or 3, each of them has to be connected to one of the signals (power supply, etc.).

(Note 3) Filter time constant at the input section is 5 to 15ms.

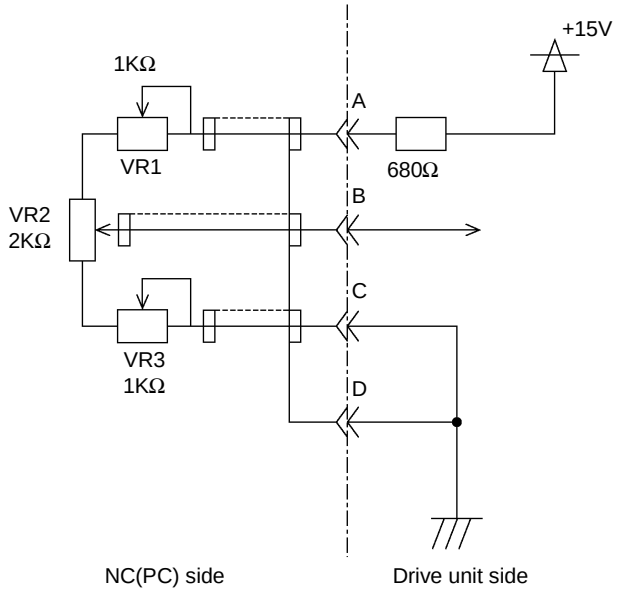
(Note 4) When running the motor on a trial basis, (when only "machine ready complete", "forward run" and "reverse run" are input and all the other 24V I/O are not used.), external +24V power supply is exceptionally not necessary; internal +24V power supply will do. In this case, use CN10-7 pin for +24V, CN10-10 pin for RG (24G).

(Note 5) Power supply unit's CN23 is a similar circuit; however, the resistance is not 4.7kΩ but 2kΩ.

(2) Encoder (1024p/rev) input interface

When connecting an encoder, +5V must be supplied from the drive unit side.
Power does not need to be supplied from the NC(PC) side.

(3) Analog input interface



	Analog speed command input	Override input
VR1	Upper speed limit setting	Not required
VR2	Analog speed setting	Override speed setting
VR3	Lower speed limit setting	Not required
A	RP (CN8A-6)	OR3 (CN8A-16)
B	SE1 (CN8A-7)	OR2 (CN8A-17)
C	SE2 (CN8A-8)	OR1 (CN8A-18)
D	SES (CN8A-5)	ORS (CN8A-15)

Input impedance of input pin B (SE1, OR2):
Approx. 10KΩ

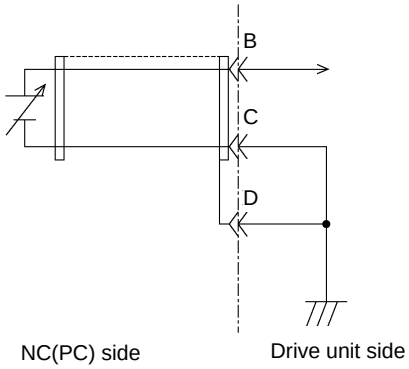
(Note 1) The figure above indicates the case of unipolar input. (Bipolar input cannot be created only with the power supply from the drive unit side.)

(Note 2) +15V power supply is output from the input pin A (RP, OR3) via the resistance.

(Note 3) Input voltage tolerable value of the input pin B (SE1, OR2) is as follows.
SE1: ±12V
OR2: 0 to +12V

(Note 4) Make sure to use a shielded cable for the cable connecting to each input pin and provide with shield treatment.
(represents for a shield.)

(Note 5) If there is a separate analog speed input command (or override input) power supply, connection will be as shown below.



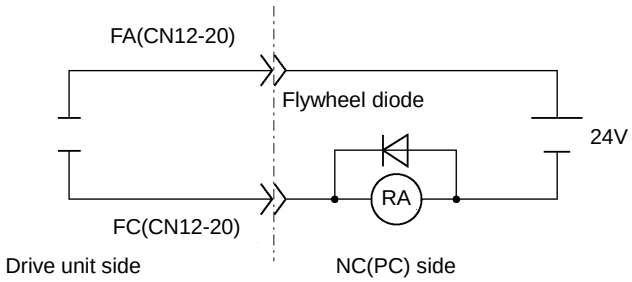
2-6-2 Output interface

(1) External contact output circuit

The drive unit fault output signal FA(CN12-10) and FC(CN12-20) are the outputs.
Use the contacts with the rating indicated below.

24VDC 0.3A or less
Chattering 5ms or less

Compact relay is used. When connecting an inductive load such as relay, preferably use a DC compact relay, and connect a flywheel diode in parallel with the coil as shown in the figure below.

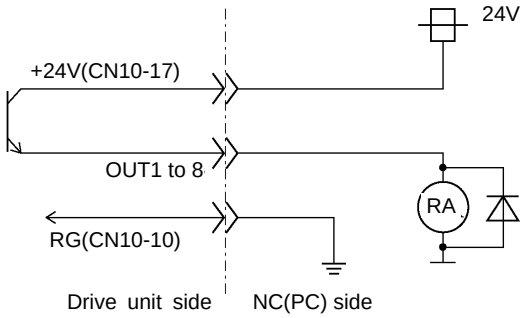


(2) Open emitter output circuit

The followings are the open emitter outputs.

General-purpose output 1: OUT1 (CN11-7)
General-purpose output 2: OUT2 (CN11-17)
General-purpose output 3: OUT3 (CN11-8)
General-purpose output 4: OUT4 (CN11-18)
General-purpose output 5: OUT5 (CN11-9)
General-purpose output 6: OUT6 (CN11-10)
General-purpose output 7: OUT7 (CN11-20)
General-purpose output 8: OUT8 (CN9A-8)

Output transistor rating
M54630P TR array
Tolerable voltage 24VDC or less
Tolerable current 50mA or less
(per 1 output)

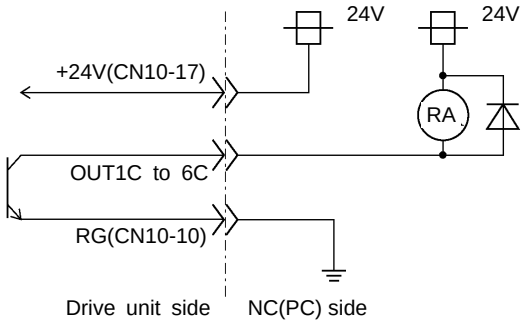


(3) Open collector output circuit

The followings are the open collector outputs.

General-purpose output 1C: OUT1C (CN12-7)
General-purpose output 2C: OUT2C (CN12-17)
General-purpose output 3C: OUT3C (CN12-8)
General-purpose output 4C: OUT4C (CN12-18)
General-purpose output 5C: OUT5C (CN12-9)
General-purpose output 6C: OUT6C (CN10-20)

Output transistor rating
M54633P TR array
Tolerable voltage 24VDC or less
Tolerable current 50mA or less
(per 1 output)



(Note 1) When using a DC relay externally, connect a flywheel diode in parallel with the coil.

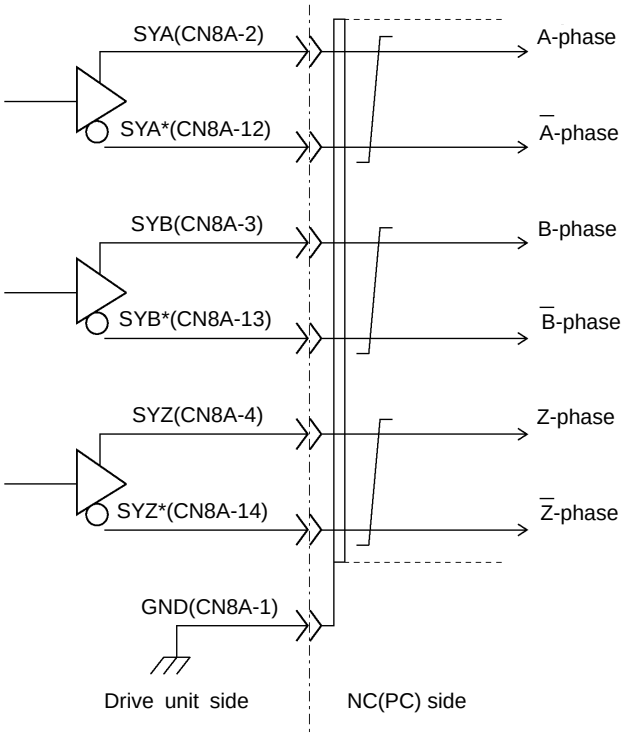
(Note 2) 24V and RG are common for the open emitter and open collector output. Pay attention to the cable size. (24V and RG consume 60mA only for the spindle drive unit internal circuit.)

(Note 3) When all 8 circuits are used for the open emitter output, the total current has to be no more than 350mA.

(Note 4) High-frequency noise due to chopper affects this output signal and may cause the reception side of circuit for this signal to malfunction. In such a case, use a shielded cable for the output signal connection cable, and connect one side of the shielded cable to the spindle drive unit CN10-10 pin and the other one to the 24V power supply's ground.

(4) Pulse feedback output

Pulse feedback output is described as shown in the figure below.
(The output signal is equivalent of RS485.)



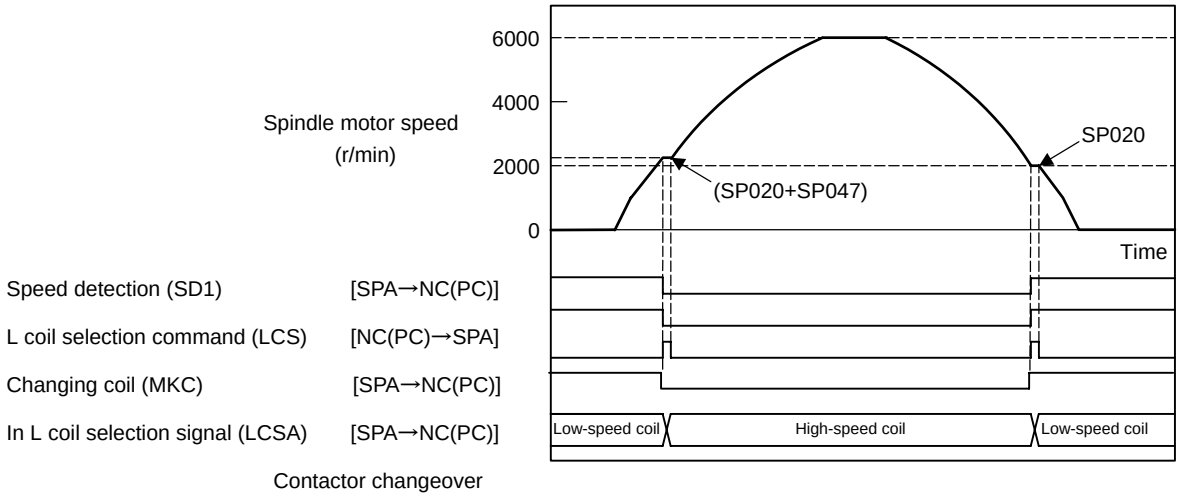
(Note) Use an output IC equivalent of Motorola MC3487.

2-6-3 Spindle coil changeover

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

(1) Coil changeover control

The speed at which to change the coils is detected by the spindle drive according to the value set with spindle parameter SP020. This is conveyed to the NC or PC with a speed detection (SD) signal. The NC or PC 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. The setting value is determined by Mitsubishi according to the specifications of coil changeover motor.	0 to 32767 (r/min)	Depends on the motor to be used.
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)	Lath: 300 Machining: 100
SP129 to SP140	HI01 to HI12	General-purpose input selection	Set the general-purpose input signals IN1 to IN12 as to which function they should have. To have the coil changeover function, set "18" (L coil selection command) in one of those signals.	0 to 13 14 to 9	—
SP141 to SP154	H01e to H01c	General-purpose output selection	Set the general-purpose output signals OUT1 to OUT8 (open emitter) or OUT1C to OUT6C (open collector) as to which function they should have. Set "18" (L coil selected signal) in one of those signals. Also, set "16" (changing coil) in another signal as required.	0 to 4 7 to 23	—

(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, this base is shut off during contactor operation time in order to protect the spindle drive unit's main circuit. This 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 4-2-2 (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

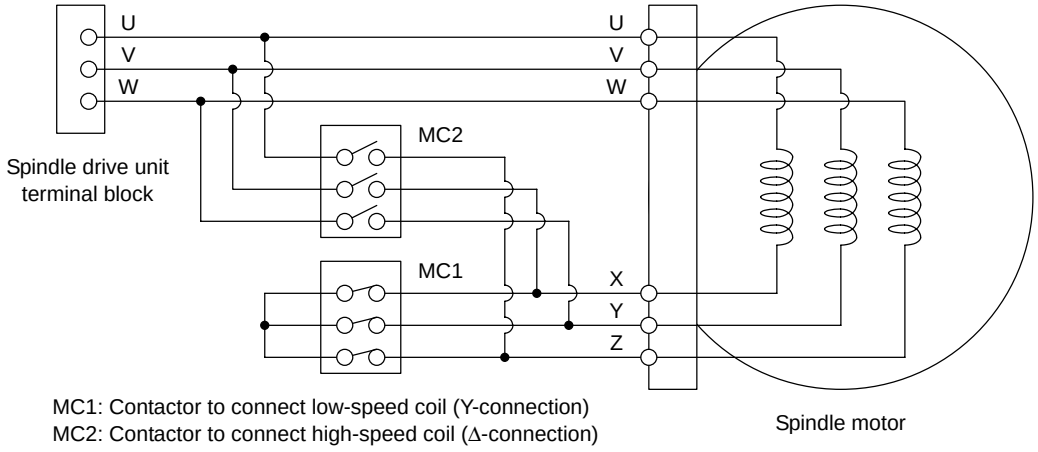
[2] Current limit after coil changeover

Following a coil changeover, the current is limited (SP061) for the period specified by the current limit timer (SP060) in order to stabilize control. When the synchronous tap control is executed immediately after the coil changeover, the output current is limited to the value set in SP061, therefore apply the sequence to execute the position control after the current limit is cancelled.

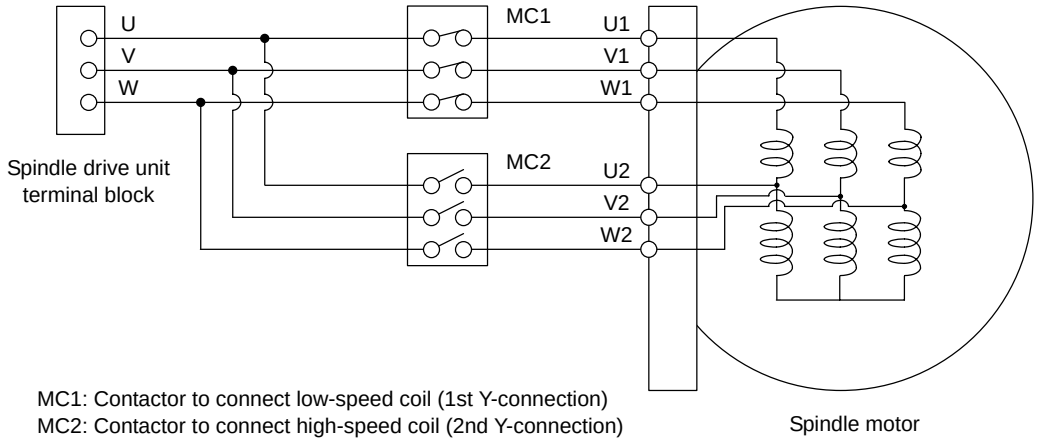
No.	Abbrev.	Parameter name	Description	Setting range	Standard value
SP060	MKT2*	Current limit timer after coil changeover	Set the current limit time to be taken after completion of contactor switching at coil changeover.	0 to 10000 (ms)	500
SP061	MKIL*	Current limit value after coil changeover	Set the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

(3) Wiring

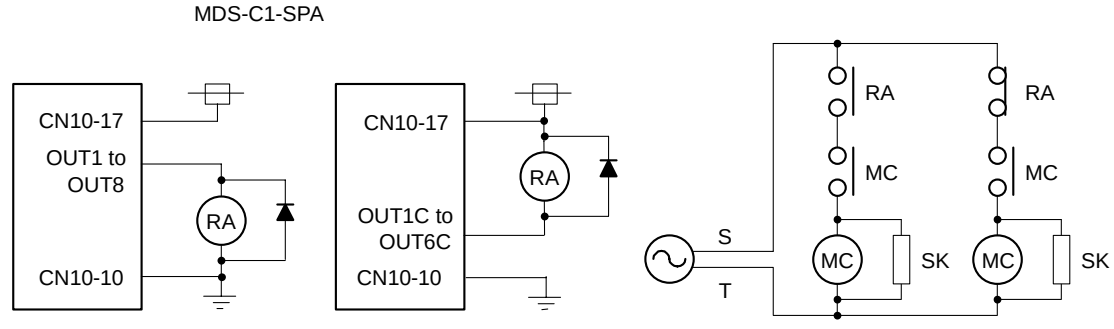
The illustration below shows the 2 types of changeover that occur after a coil changeover, (a) Y (star) – Δ (delta) changeover, and (b) Y (star) – Y (star) changeover. As shown in (c), one of the contactors (MC1 or MC2) is turned ON and the other is turned OFF at all of the coil changeover control circuits.



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



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



Connect the signal wire side of coil RA with the output pin which the In L coil selection signal is provided to.

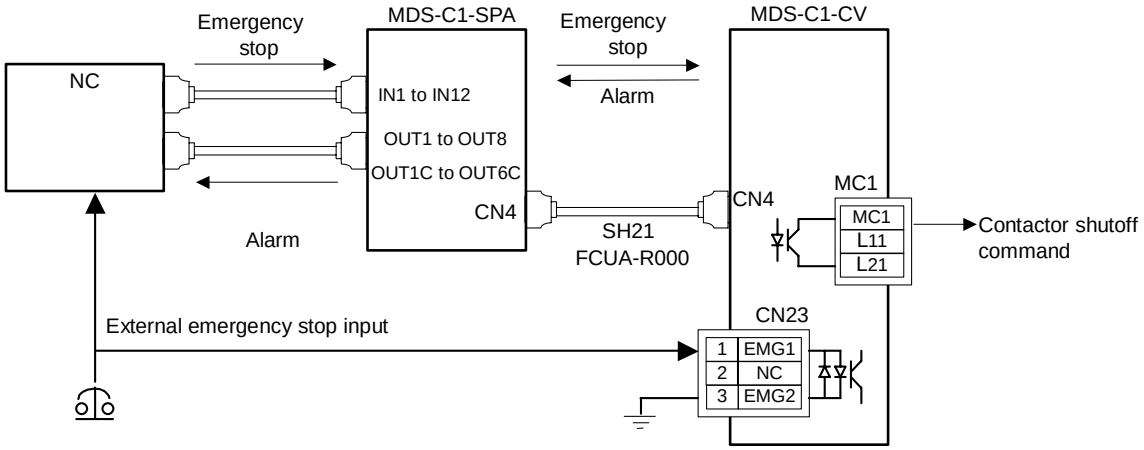
(c) Coil changeover control circuit (common)
Coil changeover relay control circuit

2-6-4 Wiring of an external emergency stop

(1) External emergency stop setting

Besides the emergency stop input from the NC or PC to spindle drive unit, 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 (SP041).

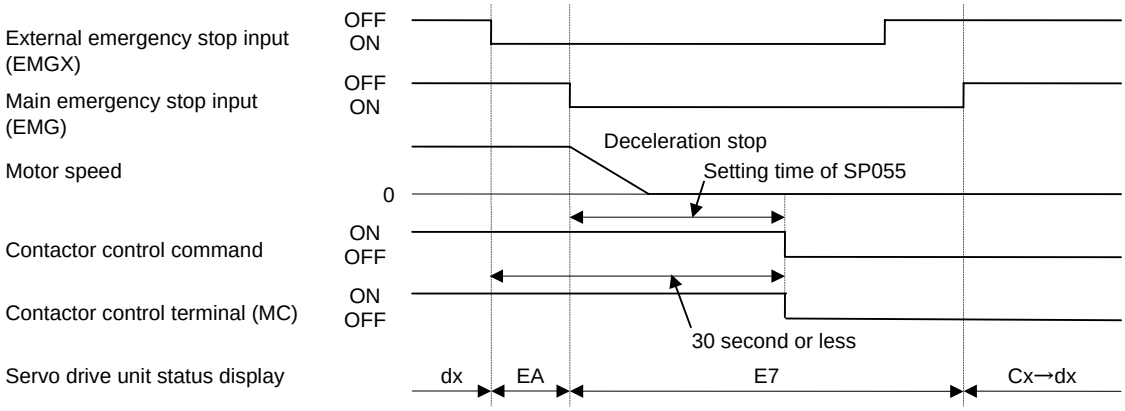
Parameter settings

No.	Abbrev.	Parameter name	Descriptions
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.

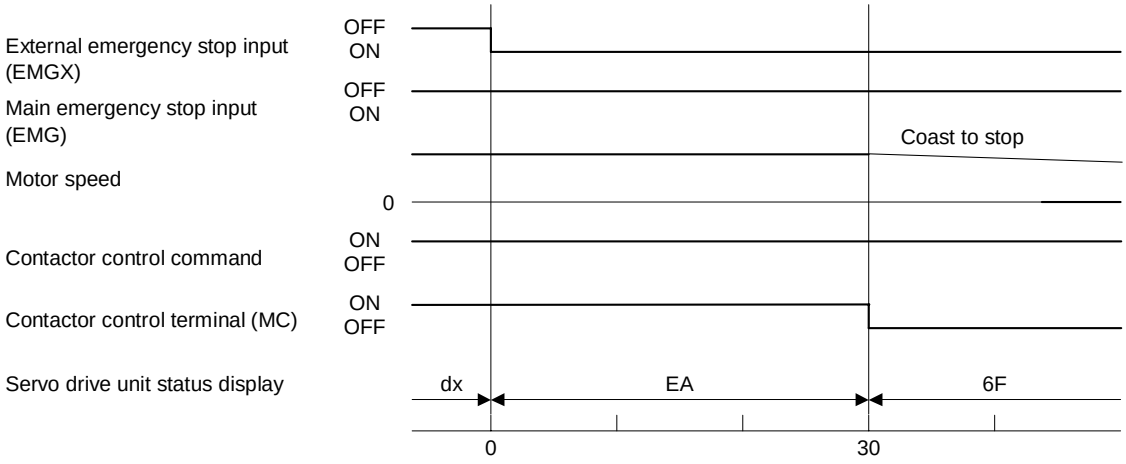
⚠ CAUTION The emergency stop signal input to the CNC side cannot be used as a substitute for the external emergency stop function (CN23).

(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 the spindle drive unit), an "In external emergency stop" (warning EA) will be detected. At this time, the spindle drive unit does not enter an emergency stop status. (There will be no deceleration control.)
If an emergency stop is not issued for the spindle drive unit within 30 seconds and the setting time of SP055 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 within 30 seconds and the setting time of SP055, the warning EA replaces the "In emergency stop" (warning E7). A normal emergency stop status will result if the contactor shutoff command is further input.
When the setting value of SP192 is set to "2" or "3", a power supply error (alarm 6F) will occur even if the emergency stop is input within 30 seconds and the setting time of SP055.
Ready ON is possible even if CN23, an external emergency stop has been input when the emergency stop is canceled, but a power supply error (alarm 6F) will occur after 30 seconds.



External emergency stop input sequences



(a) When the emergency stop is not input, and the contactor shut-off command is not input
(b) When the emergency stop input is not selected for the general-purpose input of spindle drive unit

(3) Example of emergency stop circuit

[1] Outline of function

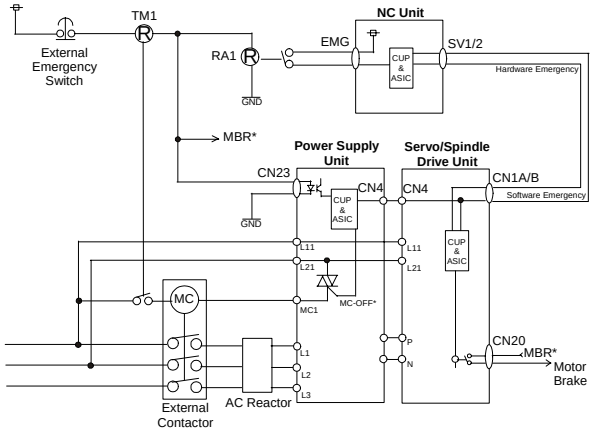
The power supply unit's external emergency stop can be validated by wiring to the CN23 connector, and setting the parameters and rotary switch. If the emergency stop cannot be processed and the external contractor cannot be shut off (due to a fault) by the spindle drive unit, the external contactor can be shut off by the power supply unit instead of the spindle drive unit. At this time, the spindle motor will coast to stop.
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.

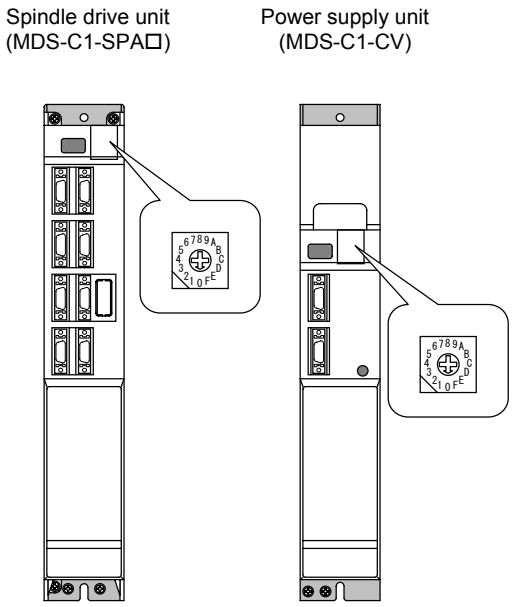
(Caution) Refer to the Standards for details.
Refer to Section 9.2.5.4.2 in EN60204-1: Safety of Machinery Electrical Equipment of Machines – Part 1.

3. Setup

3-1 Initial setup

3-1-1 Setting the rotary switch

Before turning on the power, the settings of the spindle drive unit and power supply unit's rotary switches must be confirmed and changed.



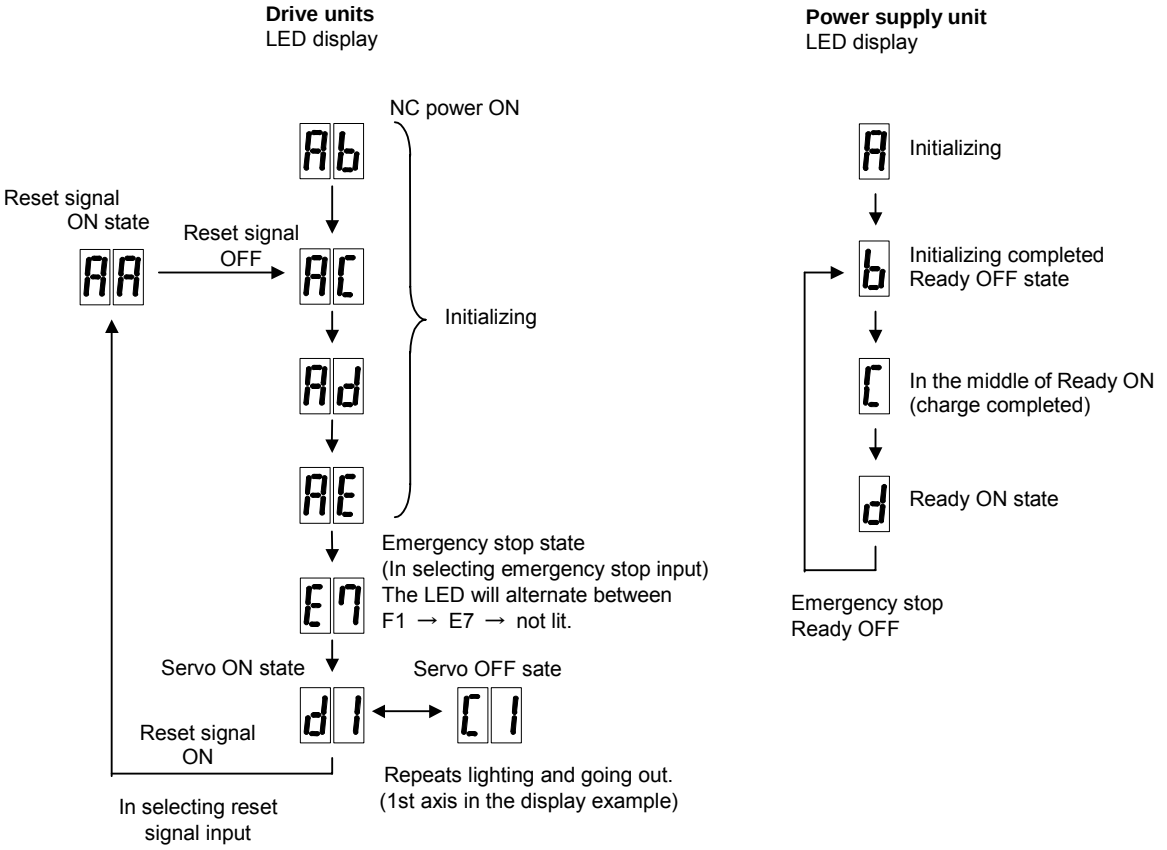
Setting the rotary switch	Details	
	Setting the MDS-C1- SPA□	Setting the MDS-C1-CV
0	Apply this setting when the power is turned ON.	External emergency stop invalid
1	Set when the parameter setting is confirmed and changed.	Setting prohibited
2		
3		
4		External emergency stop valid (Used CN23)
5	Setting prohibited	Setting prohibited
6		
7		
8		
9		
A		
B		
C		
D		
E		
F		

POINT

Even if multiple spindle drive units are used for the same machine, set "0" for the settings of all spindle drive units' rotary switches before the power is turned ON.

3-1-2 Transition of LED display after power is turned ON

The spindle 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 "5-1-1 LED display when alarm or warning occurs" for details on the alarm displays.



⚠ CAUTION	When starting the spindle system, be sure that the machine ready completion input (Ready signal) is turned OFF, or that the emergency stop signal is selected and input.

3-2 Setting the initial parameters for the spindle drive unit

The parameters of spindle drive unit must be set before the spindle system can be started up. Basic settings have been provided in shipping. Therefore, for parameters required to be changed individually, they are input with the rotary switch and push button of the drive unit or the personal computer.

3-2-1 Parameter setting method

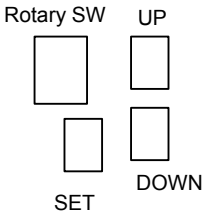
There are two methods of parameter setting as shown below.

(a) Setting by the personal computer
(b) Setting by the spindle drive unit 7-segment, rotary switch and push-buttons

The method (b) is explained in this section.

(1) Layout of display unit

Open the cover on the right side of the LED located in the upper part of the spindle drive unit. The following switch and push-buttons are found there.



Rotary SW : Used to change the display mode.

UP button : Used to increase the data value.

DOWN button : Used to decrease the data value.

SET button : Used to start/finish changing the parameter setting value.

(2) Parameter setting method

⚠ CAUTION	1. Change the parameter in the state where the start signal is not input. 2. All the parameter Nos. have to be converted into HEX when input. The targeted setting data, whether if it is DEC, must also be converted into HEX. (If the setting value is HEX, set the value as it is.) 3. When the parameter is changed with this method, always turn the spindle drive unit's power ON → OFF, or turn the alarm reset signal ON → OFF to validate the parameter.

1) Turn the drive unit main power supply ON.
2) Set the rotary SW to "1".
   At this time, main/sub is displayed on the left side of the spindle drive unit 7-segment LED, and the upper one digit of the parameter No. is displayed on the other side.
   [1] Set the upper digit of parameter No. with UP/DOWN buttons.
   Set "0" for the parameter No. SP255 or lower, set "1" for the parameter No. SP256 or higher.
   [2] Switch Main/Sub with SET button. Main and Sub switch every time the SET button is pressed. When "1" is displayed on the left side of LED, "Main" is selected; when "2" is displayed, "Sub" is selected. Set at the main side for all the specifications other than 1A2M.

3) Set the rotary SW to "2".
At this time, the spindle drive unit 7-segment LED indicates the lower two digits of parameter No. Use the UP/DOWN buttons to set the lower two digits of the parameter No. Keep the button pressed to expedite the operation.

(Setting example)

Parameter No.	LED setting value	
SP001	1	
SP010	A	
SP129	81	
SP255	FF	
SP320	40	(Note that, however, the rotary SW is "1" at this time and so "1" must be set on the right side of LED.)

4) Set the rotary SW to "3".
At this time, the spindle drive unit 7-segment LED indicates the upper two digits of the parameter setting value.
[1] The display lamp starts flashing rapidly when the SET button is pressed.
[2] Use the UP/DOWN button to change the setting value. Keep the button pressed to expedite the operation.
[3] Press the SET button once again when reaching the target setting value. The flashing of the display lamp slows down.

5) Set the rotary SW to "4".
At this time, the spindle drive unit 7-segment LED indicates the lower two digits of the parameter setting value.
[1] The display lamp starts flashing rapidly when the SET button is pressed.
[2] Use the UP/DOWN button to change the setting value. Keep the button pressed to expedite the operation.
[3] Press the SET button once again when reaching the target setting value. The flashing of the display lamp slows down.

(Setting example)

Target setting value (DEC)	Setting value - Rotary SW "3"	Setting value - Rotary SW "4"
1	0	1
10	0	A
100	0	64
1000	3	E8
10000	27	10
32767	7F	FF

This is the end of setting. Set the rotary SW back to "0" and turn the drive unit's power ON again or enter the reset input.

3-2-2 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	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
SP002	PGE*	Encoder 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 to 1000 (0.1 rad/s)	100
SP003			Not used. Set "0".	0	0
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. In the spindle side speed clamp valid (SP097:SPEC0-bit4＝1), the speed limit value will be the spindle speed instead of the motor speed.	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 side 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			Not used. Set "0".	0	0
SP010			Not used. Set "0".	0	0
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 having an abbreviation with "*" (PGM*, etc.) are validated right after the settings are changed by the personal computer, without turning the spindle drive unit's power ON and OFF.

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 signal 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 when the S analog synchronous tapping is valid.)	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 when the torque limit signal 1 is assigned to the general-purpose input and the input is turned ON.	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 having an abbreviation with "*" (TLM1*, etc.) are validated right after the settings are changed by the personal computer, without turning the spindle drive unit's power ON and OFF.

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

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 set by Mitsubishi. Set to "0" unless particularly designated.		
7				0
8				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) Set 0 if there is no particular explanation for the bit.

		Abbr.	Parameter name	Details
SP034		SFNC2	Spindle function 2	

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	This is set by Mitsubishi. Set to "0" unless particularly designated.		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.

No.	Abbr.	Parameter name	Details
SP035	SFNC3	Spindle function 3	

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.

No.	Abbr.	Parameter name	Details
SP036	SFNC4	Spindle function 4	

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.

<table>
<tr><th>No.</th><th>Abbr.</th><th>Parameter name</th><th>Details</th></tr>
<tr><td>SP037</td><td>SFNC5</td><td>Spindle function 5</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>dplg</td><td>ospcl</td><td></td><td></td><td>noplg</td><td>nsno</td><td>nosg</td><td>psdir</td><td></td><td></td><td></td><td></td><td>plgo</td><td>mago</td><td>enco</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>enco</td><td>Encoder orientation invalid</td><td>Encoder orientation valid</td><td>0</td></tr>
<tr><td>1</td><td>mago</td><td>Magnetic sensor orientation invalid</td><td>Magnetic sensor orientation valid</td><td>0</td></tr>
<tr><td>2</td><td>plgo</td><td>PLG orientation invalid</td><td>PLG orientation valid</td><td>0</td></tr>
<tr><td>3</td><td></td><td></td><td></td><td>0</td></tr>
<tr><td>4</td><td></td><td></td><td></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>psdir</td><td>Position shift standard</td><td>Position shift reverse direction</td><td>0</td></tr>
<tr><td>8</td><td>nosg</td><td>No-signal detection type
(Always monitoring)</td><td>No-signal detection valid only in position loop or orientation-mode</td><td>0</td></tr>
<tr><td>9</td><td>nsno</td><td>No-signal detection valid</td><td>No-signal detection invalid</td><td>0</td></tr>
<tr><td>A</td><td>noplg</td><td>Constant monitor of PLG-Z phase no-signal invalid</td><td>Constant monitor of PLG-Z phase no-signal 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></td><td></td><td></td><td>0</td></tr>
<tr><td>D</td><td>ospcl</td><td>Orientation speed clamp
motor speed setting</td><td>Orientation speed clamp
spindle speed setting</td><td>0</td></tr>
<tr><td>E</td><td>dplg</td><td>This is set by Mitsubishi. Set to "0" unless particularly designated.</td><td></td><td>0</td></tr>
<tr><td>F</td><td></td><td></td><td></td><td>0</td></tr>
</table>
(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.
</td></tr>
<tr><td>SP038</td><td>SFNC6</td><td>Spindle function 6</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>oplp</td><td>lmx</td><td>iqsv</td><td></td><td>dcsn</td><td>lmnp</td><td></td><td></td><td>vfbs</td><td>orm</td><td></td><td>Tdn</td><td>plg2</td><td></td><td></td><td>alty</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>alty</td><td>Deceleration stop during special alarm invalid</td><td>Deceleration stop during special alarm valid</td><td>0</td></tr>
<tr><td>1</td><td></td><td></td><td></td><td>0</td></tr>
<tr><td>2</td><td></td><td></td><td></td><td>0</td></tr>
<tr><td>3</td><td>plg2</td><td>Semi-closed pulse signal output×2 invalid</td><td>Semi-closed pulse signal output×2 valid</td><td>0</td></tr>
<tr><td>4</td><td>Tdn</td><td>This is used by Mitsubishi. Set to "0" unless particularly designated.</td><td></td><td>0</td></tr>
<tr><td>5</td><td></td><td></td><td></td><td>0</td></tr>
<tr><td>6</td><td>orm</td><td>Orientation start memo invalid</td><td>Orientation start memo valid</td><td>0</td></tr>
<tr><td>7</td><td>vfbs</td><td>This is set by Mitsubishi. Set to "0" unless particularly designated.</td><td></td><td></td></tr>
<tr><td>8</td><td></td><td></td><td></td><td>0</td></tr>
<tr><td>9</td><td></td><td></td><td></td><td>0</td></tr>
<tr><td>A</td><td>lmnp</td><td>This is set by Mitsubishi. Set to "0" unless particularly designated.</td><td></td><td></td></tr>
<tr><td>B</td><td>dcsn</td><td>Dual cushion during acceleration/ deceleration valid</td><td>Dual cushion during acceleration/ deceleration invalid</td><td>0</td></tr>
<tr><td>C</td><td></td><td></td><td></td><td>0</td></tr>
<tr><td>D</td><td>lqsv</td><td rowspan="2">This is set by Mitsubishi. Set to "0" unless particularly designated</td><td rowspan="2"></td><td rowspan="2"></td></tr>
<tr><td>E</td><td>lmx</td></tr>
<tr><td>F</td><td>oplp</td><td>Open loop operation invalid</td><td>Open loop operation valid</td><td>0</td></tr>
</table>
(Note) Set 0 if there is no particular explanation for the bit.
</td></tr>
</table>

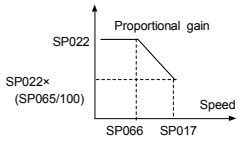
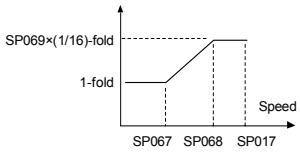
<table>
<tr><th>No.</th><th>Abbr.</th><th>Parameter name</th><th>Details</th><th>Setting range (Unit)</th><th>Standard setting</th></tr>
<tr><td>SP039</td><td>ATYP</td><td>Drive unit type</td><td>Set the spindle drive unit's capacity type.
(HEX setting)
<table><tr><th>Setting</th><th>Unit capacity</th><th>Setting</th><th>Unit capacity</th></tr><tr><td>0000</td><td>---</td><td>0010</td><td>MDS-B-SPA-550</td></tr><tr><td>0001</td><td>MDS-B-SPA-075</td><td>0011</td><td>---</td></tr><tr><td>0002</td><td>MDS-B-SPA -15</td><td>0012</td><td>---</td></tr><tr><td>0003</td><td>MDS-B-SPA -22</td><td>0013</td><td>---</td></tr><tr><td>0004</td><td>MDS-B-SPA -37</td><td>0014</td><td>---</td></tr><tr><td>0005</td><td>MDS-C1-SPA-55</td><td>0015</td><td>---</td></tr><tr><td>0006</td><td>MDS-C1-SPA-75</td><td>0016</td><td>---</td></tr><tr><td>0007</td><td>MDS-C1-SPA-110</td><td>0017</td><td>---</td></tr><tr><td>0008</td><td>MDS-C1-SPA-150</td><td>0018</td><td>---</td></tr><tr><td>0009</td><td>MDS-C1-SPA-185</td><td>0019</td><td>---</td></tr><tr><td>000A</td><td>MDS-C1-SPA-220</td><td>001A</td><td>---</td></tr><tr><td>000B</td><td>MDS-C1-SPA-260</td><td>001B</td><td>---</td></tr><tr><td>000C</td><td>MDS-C1-SPA-300</td><td>001C</td><td>---</td></tr><tr><td>000D</td><td>MDS-B-SPA -370</td><td>001D</td><td>---</td></tr><tr><td>000E</td><td>MDS-B-SPA -450</td><td>001E</td><td>---</td></tr><tr><td>000F</td><td>MDS-B-SPA -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-B-SPA -22</td></tr><tr><td>0002</td><td>SJ-3.7A</td><td>10000 r/min</td><td>MDS-B-SPA -37</td></tr><tr><td>0003</td><td>SJ-5.5A</td><td>8000 r/min</td><td>MDS-C1-SPA-55</td></tr><tr><td>0004</td><td>SJ-7.5A</td><td>8000 r/min</td><td>MDS-C1-SPA-75</td></tr><tr><td>0005</td><td>SJ-11A</td><td>6000 r/min</td><td>MDS-C1-SPA-110</td></tr><tr><td>0006</td><td>SJ-15A</td><td>6000 r/min</td><td>MDS-C1-SPA-150</td></tr><tr><td>0007</td><td>SJ-18.5A</td><td>6000 r/min</td><td>MDS-C1-SPA-185</td></tr><tr><td>0008</td><td>SJ-22A</td><td>4500 r/min</td><td>MDS-C1-SPA-220</td></tr><tr><td>0009</td><td>SJ-26A</td><td>4500 r/min</td><td>MDS-C1-SPA-260</td></tr><tr><td>000A</td><td>SJ-30A</td><td>4500 r/min</td><td>MDS-C1-SPA-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-B-SPA-075</td></tr><tr><td>0012</td><td>SJ-N1.5A</td><td>10000 r/min</td><td>MDS-B-SPA-15</td></tr><tr><td>0013</td><td>SJ-N2.2A</td><td>10000 r/min</td><td>MDS-B-SPA-22</td></tr><tr><td>0014</td><td>SJ-N3.7A</td><td>10000 r/min</td><td>MDS-B-SPA-37</td></tr><tr><td>0015</td><td>SJ-N5.5A</td><td>8000 r/min</td><td>MDS-C1-SPA-55</td></tr><tr><td>0016</td><td>SJ-N7.5A</td><td>8000 r/min</td><td>MDS-C1-SPA-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>SJ-J2.2A</td><td>10000 r/min</td><td>MDS-B-SPA-22</td></tr><tr><td>001C</td><td>SJ-J3.7A</td><td>10000 r/min</td><td>MDS-B-SPA-37</td></tr><tr><td>001D</td><td>SJ-J5.5A</td><td>8000 r/min</td><td>MDS-C1-SPA-55</td></tr><tr><td>001E</td><td>SJ-J7.5A</td><td>8000 r/min</td><td>MDS-C1-SPA-75</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>

<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>
<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 CN4 or CN9 connector of 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>
(Note) When MDS-B-SPA-370, 450 or 550 is used, set "0" even if power regeneration type is applied.</td></tr>
<tr><td>C
D
E
F</td><td>amp</td><td>Always set to "0".</td></tr>
</table>
</td><td></td><td></td></tr>
<tr><td>SP042</td><td></td><td></td><td>Not used. Set "0".</td><td>0</td><td>0</td></tr>
<tr><td>SP043</td><td></td><td></td><td>Not used. Set "0".</td><td>0</td><td>0</td></tr>
<tr><td>SP044</td><td></td><td></td><td>Not used. Set "0".</td><td>0</td><td>0</td></tr>
<tr><td>SP045</td><td>CSNT*</td><td>Dual cushion timer</td><td>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.</td><td>0 to 1000 (ms)</td><td>0</td></tr>
</table>

Parameters having an abbreviation with "*" (CSNT*, etc.) are validated right after the settings are changed by the personal computer, without turning the spindle drive unit's power ON and OFF.

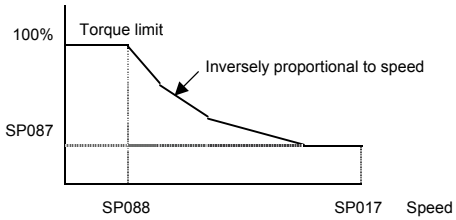
No.	Abbr.	Parameter name	Details	Setting range (Unit)	Standard setting
SP046	CSN2	Speed command dual cushion	For an acceleration/deceleration time constant defined in SP019 (CSN1) , this parameter is used to provide smooth movement only at the start of acceleration/deceleration. As the value of this 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 when the torque limit signal 1, 2 or 1, 2, 3 are assigned to the general-purpose input and only the torque limit 2 is turned ON.	0 to 120 (%)	20
SP050	TLM3*	Torque limit 3	Set the torque limit rate when the torque limit signal 1, 2 or 1, 2, 3 are assigned to the general-purpose input and the torque limit 1, 2 are turned ON.	0 to 120 (%)	30
SP051	TLM4*	Torque limit 4	Set the torque limit rate when the torque limit signal 1, 2, 3 are assigned to the general-purpose input and the torque limit 3 is turned ON.	0 to 120 (%)	40
SP052	TLM5*	Torque limit 5	Set the torque limit rate when the torque limit signal 1, 2, 3 are assigned to the general-purpose input and the torque limit 1, 3 are turned ON.	0 to 120 (%)	50
SP053	TLM6*	Torque limit 6	Set the torque limit rate when the torque limit signal 1, 2, 3 are assigned to the general-purpose input and the torque limit 2, 3 are turned ON.	0 to 120 (%)	60
SP054	TLM7*	Torque limit 7	Set the torque limit rate when the torque limit signal 1, 2, 3 are assigned to the general-purpose input and the torque limit 1, 2, 3 are all turned ON.	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. Motor maximum speed under 10000r/min: Set “7”. Motor maximum speed 10000r/min or more: Set “40”. Note that “20” is set when using some of the ultra high-speed motors.	0 to 50 (r/min)	7
SP058			Not used. Set "0".	0	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 having an abbreviation with "*" (TML2*, etc.) are validated right after the settings are changed by the personal computer, without turning the spindle drive unit's power ON and OFF.

<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 to 32767</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 to 32767</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 to 32767</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 to 1000</td><td>0</td></tr>
</table>

Parameters having an abbreviation with "*" (FHz*, etc.) are validated right after the settings are changed by the personal computer, without turning the spindle drive unit's power ON and OFF.

<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>
<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 rowspan="5" colspan="2">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 rowspan="2" colspan="2">Set by Mitsubishi. Set "0" unless designated in particular.</td><td>0</td></tr>
<tr><td>9</td><td>r2iro</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><td></td><td></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 "0" 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></td><td>Not used. Set "0".</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>
<tr><td>SP085</td><td></td><td></td><td>Not used. Set "0".</td><td>0</td><td>0</td></tr>
<tr><td>SP086</td><td></td><td></td><td>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>
</table>

Parameters having an abbreviation with "*" (R2KWS *, etc.) are validated right after the settings are changed by the personal computer, without turning the spindle drive unit's power ON and OFF.

<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>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></td><td></td><td>Not used. Set "0".</td><td>0</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 226ms.</td><td>0 to 32767 (3.5ms)</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 side and the detector side (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></td><td>-3 to 4</td><td>0</td></tr>
<tr><td>SP097</td><td>SPECO</td><td>Orientation specification</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>ostp</td><td>orze</td><td>ksft</td><td>gchg</td><td></td><td></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>0</td><td>odi1</td><td colspan="2">Orientation rotation direction
00: Previous (the direction in which the motor has so far rotated under speed control)
10: Backward rotation
01: Forward rotation 11: Prohibited</td><td>0</td></tr>
<tr><td>1</td><td>odi2</td><td colspan="2"></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>Encoder installation polarity: +</td><td>Encoder installation 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></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>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">This is used by Mitsubishi.</td><td>0</td></tr>
<tr><td>F</td><td>ostp</td><td colspan="2">Set to "0" unless particularly designated.</td><td>0</td></tr>
</table>
(Note) Set 0 if there is no particular explanation for the bit.
</td></tr>
</table>

Parameters having an abbreviation with "*" (OFSN*, etc.) are validated right after the settings are changed by the personal computer, without turning the spindle drive unit's power ON and OFF.

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			Not used. Set "0".	0	0
SP111			Not used. Set "0".	0	0
SP112			Not used. Set "0".	0	0
SP113			Not used. Set "0".	0	0

Parameters having an abbreviation with "*" (OSP2*, etc.) are validated right after the settings are changed by the personal computer, without turning the spindle drive unit's power ON and OFF.

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
SP126			Not used. Set "0".	0	0
SP127			Not used. Set "0".	0	0
SP128			Not used. Set "0".	0	0

Parameters having an abbreviation with "*" (OPER *, etc.) are validated right after the settings are changed by the personal computer, without turning the spindle drive unit's power ON and OFF.

<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>SP129</td><td>HI01</td><td>General-purpose input selection 1</td><td>Assign signals to general-input 1 (IN1: CN10-12 pin). Select the signal to be assigned from the table below.
<table>
<tr><th>Setting value</th><th>Meaning</th><th>Setting value</th><th>Meaning</th></tr>
<tr><td>0</td><td>Not used for input</td><td>11</td><td>Speed selection 1</td></tr>
<tr><td>1</td><td>Orientation start</td><td>12</td><td>Speed selection 2</td></tr>
<tr><td>2</td><td>Indexing forward run</td><td>13</td><td>Speed selection 3</td></tr>
<tr><td>3</td><td>Indexing reverse run</td><td>14</td><td>Setting prohibited</td></tr>
<tr><td>4</td><td>Torque limit 1</td><td>15</td><td>Digital speed command valid</td></tr>
<tr><td>5</td><td>Torque limit 2</td><td>16</td><td>Override input valid</td></tr>
<tr><td>6</td><td>Torque limit 3</td><td>17</td><td>S analog high-speed tapping</td></tr>
<tr><td>7</td><td>Gear selection 1</td><td>18</td><td>L coil selection</td></tr>
<tr><td>8</td><td>Gear selection 2</td><td>19</td><td>Sub-motor selection</td></tr>
<tr><td>9</td><td>Alarm reset</td><td>20</td><td>Setting prohibited</td></tr>
<tr><td>10</td><td>Emergency stop</td><td>21</td><td>Load meter output changeover</td></tr>
</table>
(Note1) Do not set "14" in any one of the parameters from SP129(H01) to SP140(H12).
(Note2) Always set to "0" for any unused input among the parameters from SP129(H01) to SP140(H12).
(Note3) Do not set any duplicated value in the parameters from SP129(H01) to SP140(H12) (excepting for "0").</td><td>0 to 21</td><td>0</td></tr>
<tr><td>SP130</td><td>HI02</td><td>General-purpose input selection 2</td><td>Assign signals to general-purpose input 2(IN2: CN10-3 pin). The setting method is the same as SP129(HI01).</td><td>0 to 19</td><td>0</td></tr>
<tr><td>SP131</td><td>HI03</td><td>General-purpose input selection 3</td><td>Assign signals to general-purpose input 3(IN3: CN10-13 pin). The setting method is the same as SP129(HI01).</td><td>0 to 19</td><td>0</td></tr>
<tr><td>SP132</td><td>HI04</td><td>General-purpose input selection 4</td><td>Assign signals to general-purpose input 4(IN4: CN10-4 pin). The setting method is the same as SP129(HI01).</td><td>0 to 19</td><td>0</td></tr>
<tr><td>SP133</td><td>HI05</td><td>General-purpose input selection 5</td><td>Assign signals to general-purpose input 5(IN5: CN10-14 pin). The setting method is the same as SP129(HI01).</td><td>0 to 19</td><td>0</td></tr>
<tr><td>SP134</td><td>HI06</td><td>General-purpose input selection 6</td><td>Assign signals to general-purpose input 6(IN6: CN10-5 pin). The setting method is the same as SP129(HI01).</td><td>0 to 19</td><td>0</td></tr>
<tr><td>SP135</td><td>HI07</td><td>General-purpose input selection 7</td><td>Assign signals to general-purpose input 7(IN7: CN10-15 pin). The setting method is the same as SP129(HI01).</td><td>0 to 19</td><td>0</td></tr>
<tr><td>SP136</td><td>HI08</td><td>General-purpose input selection 8</td><td>Assign signals to general-purpose input 8(IN8: CN10-6 pin). The setting method is the same as SP129(HI01).</td><td>0 to 19</td><td>0</td></tr>
<tr><td>SP137</td><td>HI09</td><td>General-purpose input selection 9</td><td>Assign signals to general-purpose input 9(IN9: CN10-16 pin). The setting method is the same as SP129(HI01).</td><td>0 to 19</td><td>0</td></tr>
<tr><td>SP138</td><td>HI10</td><td>General-purpose input selection 10</td><td>Assign signals to general-purpose input 10(IN10: CN10-8 pin). The setting method is the same as SP129(HI01).</td><td>0 to 19</td><td>0</td></tr>
<tr><td>SP139</td><td>HI11</td><td>General-purpose input selection 11</td><td>Assign signals to general-purpose input 11(IN11: CN10-18 pin). The setting method is the same as SP129(HI01).</td><td>0 to 19</td><td>0</td></tr>
<tr><td>SP140</td><td>HI12</td><td>General-purpose input selection 12</td><td>Assign signals to general-purpose input 12(IN12: CN10-9 pin). The setting method is the same as SP129(HI01).</td><td>0 to 19</td><td>0</td></tr>
</table>

<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>SP141</td><td>HO1e</td><td>General-purpose output selection
Open emitter 1</td><td>Assign signals to general-purpose output (open emitter) 1 (OUT1: CN11-7 pin). Select the signal to be assigned from the table below.
<table>
<tr><th>Setting value</th><th>Meaning</th><th>Setting value</th><th>Meaning</th></tr>
<tr><td>0</td><td>Not used for output</td><td>12</td><td>Current detection</td></tr>
<tr><td>1</td><td>Orientation complete</td><td>13</td><td>Speed detection</td></tr>
<tr><td>2</td><td>Positioning complete</td><td>14</td><td>Up-to-speed</td></tr>
<tr><td>3</td><td>Torque reach</td><td>15</td><td>Zero speed</td></tr>
<tr><td>4</td><td>In torque limit</td><td>16</td><td>Changing coil</td></tr>
<tr><td>5</td><td>Setting prohibited</td><td>17</td><td>In 1-drive unit 2-motor changeover</td></tr>
<tr><td>6</td><td>Setting prohibited</td><td>18</td><td>L coil selected</td></tr>
<tr><td>7</td><td>Motor in forward run</td><td>19</td><td>In sub-motor selection</td></tr>
<tr><td>8</td><td>Motor in reverse run</td><td>20</td><td>Alarm code output 1</td></tr>
<tr><td>9</td><td>In alarm</td><td>21</td><td>Alarm code output 2</td></tr>
<tr><td>10</td><td>In emergency stop</td><td>22</td><td>Alarm code output 3</td></tr>
<tr><td>11</td><td>In ready ON</td><td>23</td><td>Alarm code output 4</td></tr>
</table>
(Note 1) Do not set "5" or "6" in any one of the parameters from SP141(HO1e) to SP154(HO6c).
(Note 2) Always set to "0" for any unused input among the parameters from SP141(HO1e) to SP154(HO6c).
(Note 3) When handling the parameters from SP141(HO1e) to SP148(HO8c) in one group and the parameters from SP149(HO1c) to SP154(HO6c) in another group, do not set any duplicated value within the same group (except for "0"). If groups are different, the same value can be set.
(Note 4) When selecting the alarm code output, always set all of the alarm code outputs (1 to 4) to any of the parameters from SP141(HO1e) to SP154(HO6c).</td><td>0 to 23</td><td>0</td></tr>
<tr><td>SP142</td><td>HO2e</td><td>General-purpose output selection
Open emitter 2</td><td>Assign signals to general-purpose output (open emitter) 2(OUT2: CN11-17 pin).
The setting method is the same as SP141(HO1e).</td><td>0 to 23</td><td>0</td></tr>
<tr><td>SP143</td><td>HO3e</td><td>General-purpose output selection
Open emitter 3</td><td>Assign signals to general-purpose output (open emitter) 3(OUT3: CN11-8 pin).
The setting method is the same as SP141(HO1e).</td><td>0 to 23</td><td>0</td></tr>
<tr><td>SP144</td><td>HO4e</td><td>General-purpose output selection
Open emitter 4</td><td>Assign signals to general-purpose output (open emitter) 4(OUT4: CN11-18 pin).
The setting method is the same as SP141(HO1e).</td><td>0 to 23</td><td>0</td></tr>
<tr><td>SP145</td><td>HO5e</td><td>General-purpose output selection
Open emitter 5</td><td>Assign signals to general-purpose output (open emitter) 5(OUT5: CN11-9 pin).
The setting method is the same as SP141(HO1e).</td><td>0 to 23</td><td>0</td></tr>
<tr><td>SP146</td><td>HO6e</td><td>General-purpose output selection
Open emitter 6</td><td>Assign signals to general-purpose output (open emitter) 6(OUT6: CN11-10 pin).
The setting method is the same as SP141(HO1e).</td><td>0 to 23</td><td>0</td></tr>
<tr><td>SP147</td><td>HO7e</td><td>General-purpose output selection
Open emitter 7</td><td>Assign signals to general-purpose output (open emitter) 7(OUT7: CN11-20 pin).
The setting method is the same as SP141(HO1e).</td><td>0 to 23</td><td>0</td></tr>
<tr><td>SP148</td><td>HO8e</td><td>General-purpose output selection
Open emitter 8</td><td>Assign signals to general-purpose output (open emitter) 8(OUT8: CN9A-8 pin).
The setting method is the same as SP141(HO1e).</td><td>0 to 23</td><td>0</td></tr>
</table>

No.	Abbr.	Parameter name	Details	Setting range	Standard
SP149	HO1c	General-purpose output selection Open collector 1	Assign signals to general-purpose output (open collector) 1(OUT1c: CN12-7 pin). The setting method is the same as SP141(HO1e).	0 to 23	0
SP150	HO2c	General-purpose output selection Open collector 2	Assign signals to general-purpose output (open collector) 2(OUT2c: CN12-17 pin). The setting method is the same as SP141(HO1e).	0 to 23	0
SP151	HO3c	General-purpose output selection Open collector 3	Assign signals to general-purpose output (open collector) 3(OUT3c: CN12-8 pin). The setting method is the same as SP141(HO1e).	0 to 23	0
SP152	HO4c	General-purpose output selection Open collector 4	Assign signals to general-purpose output (open collector) 4(OUT4c: CN12-18 pin). The setting method is the same as SP141(HO1e).	0 to 23	0
SP153	HO5c	General-purpose output selection Open collector 5	Assign signals to general-purpose output (open collector) 5(OUT5c: CN12-9 pin). The setting method is the same as SP141(HO1e).	0 to 23	0
SP154	HO6c	General-purpose output selection Open collector 6	Assign signals to general-purpose output (open collector) 6(OUT6c: CN10-20 pin). The setting method is the same as SP141(HO1e).	0 to 23	0
SP155	SAtyp	S analog speed command input type	Select where to input the S analog input. [0]: Input between SE1(CN8A-7 pin) and SE2(CN8A-8 pin) (Standard) (Bipolar input: Possible to input 0 to ±10V) [1]: Input between OR2(CN8A-17 pin) and SE1(CN8A-18 pin) (Unipolar input: Possible to input 0 to +10V only) Note that when "1" is set, the over writing function cannot be used.	0 to 1	0
SP156	DGtyp	Digital speed command input type	Set the digital speed command input method. "0": Signed binary "1": No sign 12-bit binary "2": BCD2 digits "3": BCD3 digits	0 to 3	0
SP157	SAavr	S analog speed command input filter	Set the filter time constant of the S analog speed command input. The actual time in respect to setting value is as follows. Filter time constant = 0.8ms × setting value When "0" is set, this becomes 25.6ms. Use the standard setting value if there is no problem. Note that this setting is invalid during S analog high-speed tapping.	0 to 32767 (0.8ms)	0
SP158	Adofs*	S analog speed command input offset	Set the offset value of the S analog speed command input. Set the value so that the spindle almost stops when the input command is "0". Note that the rotation of the spindle motor may not be stopped in full with this setting. This setting fluctuates depending on the usage time and ambient temperature.	-999 to 999	When SP155=0: 0 When SP155=1: 262
SP159	ADcp1*	S analog speed command input clamp 1	Set the + side non-sensitive band of the S analog speed command input. The speed command input is not accepted when the input command is lower than the value set here. Thus, the motor remains stopped	0 to 999	0
SP160	ADcp2*	S analog speed command input clamp 2	Set the - side non-sensitive band of the S analog speed command input. The detail is the same as SP159; only set in the minus side.	-999 to 0	0
SP161	Sgain*	S analog speed command input gain	Set the gain of the S analog speed command input. Set so that the motor runs at the highest speed when the maximum speed command is input.	0 to 2500 (1/1000-fold)	When SP155=0: 1053 When SP155=1: 1147

Parameters having an abbreviation with "*" (Adofs*, etc.) are validated right after the settings are changed by the personal computer, without turning the spindle drive unit's power ON and OFF.

No.	Abbr.	Parameter name	Details	Setting range	Standard
SP162	SS00	Speed setting 0	Regardless of whether the speed command mode is analog or digital, the motor is run by the value set here when the forward/reverse run signal is input.	0 to 32767 (r/min)	0
SP163	SS01	Speed setting 1	Set the motor speed command value when the speed selection 1 is assigned to the general-purpose input and the input is turned ON.	0 to 32767 (r/min)	0
SP164	SS02	Speed setting 2	Set the motor speed command value when the speed selection 1,2 or 1,2,3 are assigned to the general-purpose input and only the speed selection 2 is turned ON.	0 to 32767 (r/min)	0
SP165	SS03	Speed setting 3	Set the motor speed command value when the speed selection 1,2 or 1,2,3 are assigned to the general-purpose input and the speed selection 1,2 are turned ON.	0 to 32767 (r/min)	0
SP166	SS04	Speed setting 4	Set the motor speed command value when the speed selection 1,2,3 are assigned to the general-purpose input and the speed selection 3 is turned ON.	0 to 32767 (r/min)	0
SP167	SS05	Speed setting 5	Set the motor speed command value when the speed selection 1,2,3 are assigned to the general-purpose input and the speed selection 1, 3 are turned ON.	0 to 32767 (r/min)	0
SP168	SS06	Speed setting 6	Set the motor speed command value when the speed selection 1,2,3 are assigned to the general-purpose input and the speed selection 2, 3 are turned ON.	0 to 32767 (r/min)	0
SP169	SS07	Speed setting 7	Set the motor speed command value when the speed selection 1,2,3 are assigned to the general-purpose input and the speed selection 1,2,3 are all turned ON.	0 to 32767 (r/min)	0
SP170	SSchg	Speed setting switch filter	Set the filter time constant when changing the speed selection command input. The actual time in respect to the setting value is as follows. Filter time constant = 0.8ms × setting value When "0" is set, this becomes no filter. Use the standard setting value if there is no problem.	0 to 32767 (0.8ms)	0
SP171	HSPT	S analog high-speed tapping motor maximum speed	Set the maximum motor speed during S analog high-speed tapping. The value set in SP017(TSP) is applied when "0" is set. During S analog high-speed tapping, when the gear noise is louder than the regular speed loop operation or when the tapping accuracy should be improved, set the motor maximum tapping speed here.	0 to 32767 (r/min)	0
SP172	VGHP	S analog high-speed tapping speed loop proportional gain	Set the speed loop proportional gain during S analog high-speed tapping. The higher the gain becomes, the higher the response, but the greater the vibration and noise become. The value set in SP022(VGNP1) is applied when "0" is set.	0 to 1000	0
SP173	VGHI	S analog high-speed tapping speed loop integral gain	Set the speed loop integral gain during S analog high-speed tapping. If the value of SP172(VGHP) is set, set the value so that the setting value's proportion between SP172 and SP173 is 1:1. The value set in SP023(VGNI1) is applied when "0" is set.	0 to 1000	0
SP174	HPYV	S analog high-speed tapping variable excitation rate (min value)	Set the minimum value of the variable excitation rate during S analog high-speed tapping. Select a smaller value when gear noise is high. Select a bigger value to improve tapping accuracy.	0 to 100 (%)	0
SP175	HSgn*	S analog high-speed tapping speed command gain	Set the speed command voltage gain during S analog high-speed tapping. The value set in SP161(Sgain) is applied when "0" is set.	0 to 2500 (1/1000-fold)	0
SP176	HADof*	S analog high-speed tapping speed command offset	Set the speed command voltage offset value during S analog high-speed tapping. The value set in SP158(ADofs) is applied when "0" is set.	-999 to 999	0

Parameters having an abbreviation with "*" (HSgn*, etc.) are validated right after the settings are changed by the personal computer, without turning the spindle drive unit's power ON and OFF.

<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>SP178</td><td>SMG*</td><td>Speed meter output full scale adjustment</td><td>Adjust the speed meter full scale.
Adjust so that the fluctuations of the speed meter is at the intended position when "1" is set in SP177(MADJ).</td><td>0 to 1000 (1/1000-fold)</td><td>938</td></tr>
<tr><td>SP179</td><td>LMG*</td><td>Load meter output full scale adjustment</td><td>Adjust the load meter full scale.
Adjust so that the fluctuations of the load meter is at the intended position when "1" is set in SP177(MADJ).</td><td>0 to 1000 (1/1000-fold)</td><td>938</td></tr>
<tr><td>SP180</td><td>Sgnb*</td><td>Fixed control constant</td><td>Set by Mitsubishi.
Set "0" unless otherwise designated.</td><td>0 to 2500</td><td>0</td></tr>
<tr><td>SP181</td><td>HSgnb*</td><td>Fixed control constant</td><td>Set by Mitsubishi.
Set "0" unless otherwise designated.</td><td>0 to 2500</td><td>0</td></tr>
<tr><td>SP182</td><td>VGHD</td><td>Fixed control constant</td><td>Set by Mitsubishi.
Set "0" unless otherwise designated.</td><td>0 to 1000</td><td>0</td></tr>
<tr><td>SP183</td><td>VCGH</td><td>Fixed control constant</td><td>Set by Mitsubishi.
Set "0" unless otherwise designated.</td><td>0 to 100</td><td>0</td></tr>
<tr><td>SP185</td><td>IQGH</td><td>Fixed control constant</td><td>Set by Mitsubishi.
Set "0" unless otherwise designated.</td><td>1 to 1000</td><td>0</td></tr>
<tr><td>SP186</td><td>IDGH</td><td>Fixed control constant</td><td>Set by Mitsubishi.
Set "0" unless otherwise designated.</td><td>1 to 1000</td><td>0</td></tr>
<tr><td>SP187</td><td>TQSLM</td><td>Fixed control constant</td><td>Set by Mitsubishi.
Set "0" unless otherwise designated.</td><td>0 to 32767</td><td>60</td></tr>
<tr><td>SP188</td><td>TQgn*</td><td>Fixed control constant</td><td>Set by Mitsubishi.
Set "0" unless otherwise designated.</td><td>-9999 to 9999</td><td>15</td></tr>
<tr><td>SP189</td><td>TQofs*</td><td>Fixed control constant</td><td>Set by Mitsubishi.
Set "0" unless otherwise designated.</td><td>-999 to 999</td><td>0</td></tr>
<tr><td>SP190</td><td>TQflt*</td><td>Fixed control constant</td><td>Set by Mitsubishi.
Set "0" unless otherwise designated.</td><td>0 to 2250</td><td>0</td></tr>
<tr><td>SP191</td><td>TQLMT*</td><td>Fixed control constant</td><td>Set by Mitsubishi.
Set "0" unless otherwise designated.</td><td>0 to 150</td><td>0</td></tr>
<tr><td>SP192</td><td>FNC0</td><td>Function selection at emergency stop</td><td>Set the state of alarm output and ready-ON output at the emergency stop.
<table>
<tr><th>Setting value</th><th>Alarm output</th><th>Ready-ON output</th></tr>
<tr><td>0</td><td>Not available</td><td>Turned OFF when the amount of time set in SP055(SETM) has passed after the motor had stopped</td></tr>
<tr><td>1</td><td>Available</td><td>Same as above</td></tr>
<tr><td>2</td><td>Not available</td><td>Continued ON</td></tr>
<tr><td>3</td><td>Available</td><td>Continued ON</td></tr>
</table>
(Note) When the ready-ON input signal is turned OFF, the ready-ON signal turns OFF regardless of the settings above.</td><td>0 to 1000</td><td>15</td></tr>
<tr><td>SP193</td><td>LMG2*</td><td>Load meter output range changeover gain</td><td>This will be validated when "21" (load meter output range changeover) is set in SP129(HI01) to SP140(HI12) and the signal is turned ON. The load meter output voltage gain equals to the value set here, and not to the one in SP179(LMG).
When "0" is set, the gain has the same value as set in the usual SP179(LMG).</td><td>0 to 32767 (1/1000-fold)</td><td>0</td></tr>
</table>

Parameters having an abbreviation with "*" (MADJ*, etc.) are validated right after the settings are changed by the personal computer, without turning the spindle drive unit's power ON and OFF.

No.	Abbr.	Parameter name	Details	Setting range (Unit)	Standard setting
SP194	SE2R*	Speed excessive deflection 2 detection range	Set the speed detection width when the speed excessive deflection 2 alarm is output. The setting is as follows. Detection width = Speed command × current setting value/100 (r/min) When the result of the expression above is smaller than 45r/min, the detection width is clamped at 45r/min. When "0" is set, detection will not be carried out.	0 to 100 (%)	0
SP195	SE2T*	Speed excessive deflection 2 detection time	Set the duration required to detect the alarms indicated above. The speed excessive deflection 2 alarm is output when a speed deflection larger than the speed detection width is continued for more than the duration set here. When "0" is set, detection will be carried out instantly.	0 to 3000 (ms)	0
SP196 to SP224			Not used. Set "0".	0	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
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 to SP241			Not used. Set "0".	0	0
SP242	Vavx*	Fixed control constant	Set by Mitsubishi. Set "0" unless designated in particular.	0 to 32767	0
SP243	UTTM*	Fixed control constant	Set by Mitsubishi. Set "0" unless designated in particular.	0 to 5000	0
SP244	OPLP*	Fixed control constant	Set by Mitsubishi. Set "0" unless designated in particular.	0 to 4096	0
SP245	PGHS*	Fixed control constant	Set by Mitsubishi. Set "0" unless designated in particular.	0 to 1	0
SP246			Not used. Set "0".	0	0
SP247			Not used. Set "0".	0	0
SP248	FNC	Fixed control constant	Set by Mitsubishi. Set "0" unless designated in particular.	0 to 7	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

Parameters having an abbreviation with "*" (SE2R*, etc.) are validated right after the settings are changed by the personal computer, without turning the spindle drive unit's power ON and OFF.

No.	Abbr.	Parameter name	Details	Setting range (Unit)	Standard setting
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 having an abbreviation with "*" (DA1NO *, etc.) are validated right after the settings are changed by the personal computer, without turning the spindle drive unit's power ON and OFF.

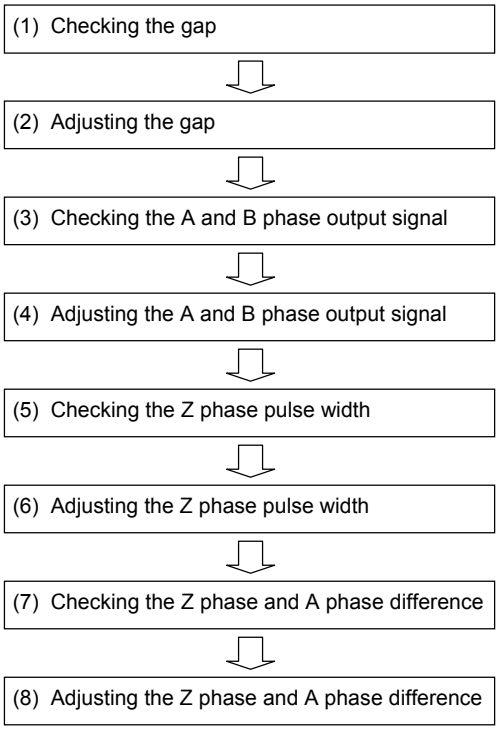
No.	Abbr.	Parameter name	Details	Setting range (Unit)	Standard setting
SP257 to SP320		Motor constant (H coil)	This parameter is valid only in the following two conditional cases: (a) In case that SP034 (SFNC2)/bit0=1 and SP034 (SFNC2)/bit2=0 Set the motor constants when using a special motor, not described 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 spindle drive unit's power turned ON/OFF or with the alarm reset input turned ON/OFF.

3-3 Initial adjustment of the spindle PLG

3-3-1 Adjusting the PLG installation

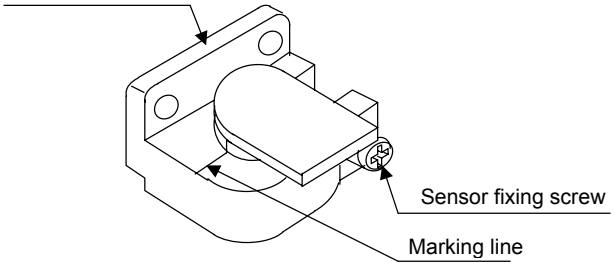
The PLG (spindle motor speed detector) mounted on the Mitsubishi framed spindle motor is shipped from Mitsubishi in the adjusted state. If there are no particular problems, carrying out the adjustment in this section is not required.
When dismantling a motor, or when using the built-in spindle, the PLG 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.)



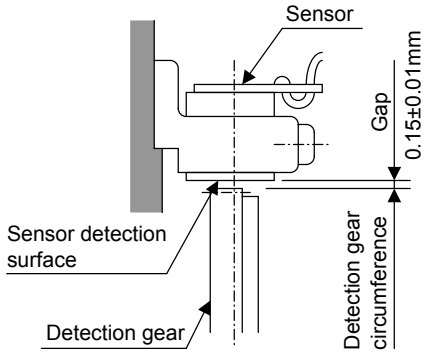
Flow of PLG installation and adjustment

(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

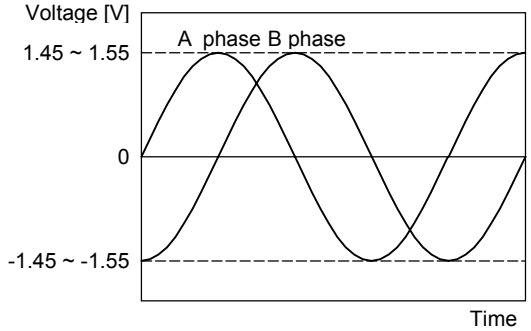
Number of detection gear teeth	Number of A and B phase pulses	Reference speed for signal confirmation
128	128	3600 r/min
180	180	2500 r/min
256	256	1800 r/min
512	512	1200 r/min

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

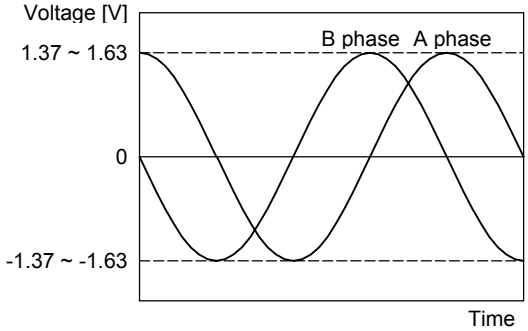
During forward run . When the detection gears are rotating in the clockwise direction looking from the sensor lead side.

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.



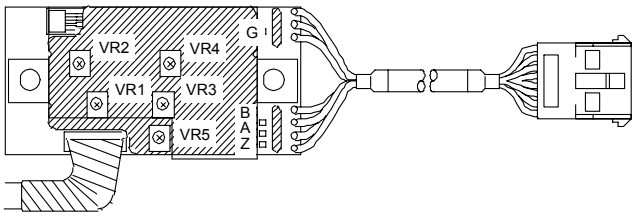
A phase/B phase output signal waveform during forward run



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 spindle drive unit 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

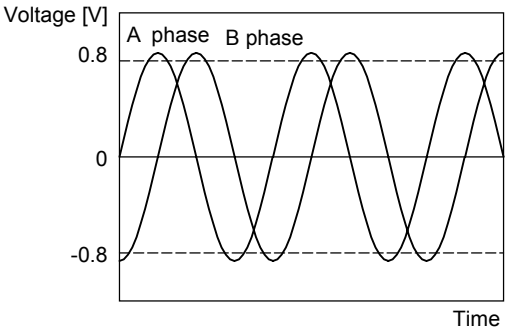
Volume function

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)

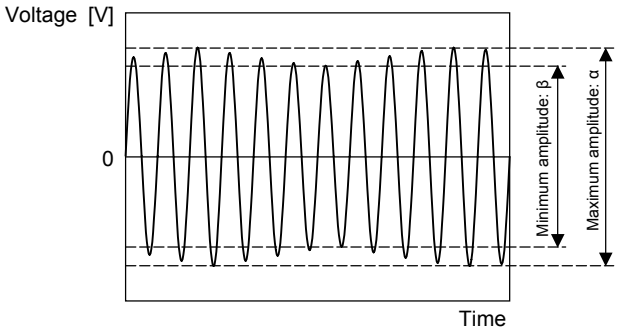
[6] Set the spindle drive unit to the closed loop operation state (normal operation).
[7] Run the motor at the maximum speed, and confirm that the A phase and B phase output voltage peak value is larger than 0.8V on both the plus side and minus side during both forward run and reverse run.
[8] Run the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

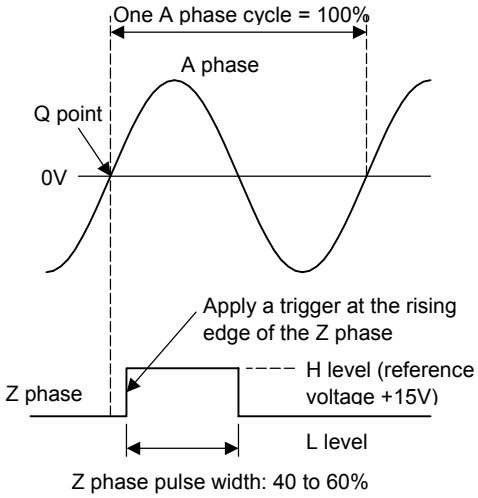
Check the output signal waveform by measuring the signals of the check terminals on the PCB with the DC range of the synchroscope.

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

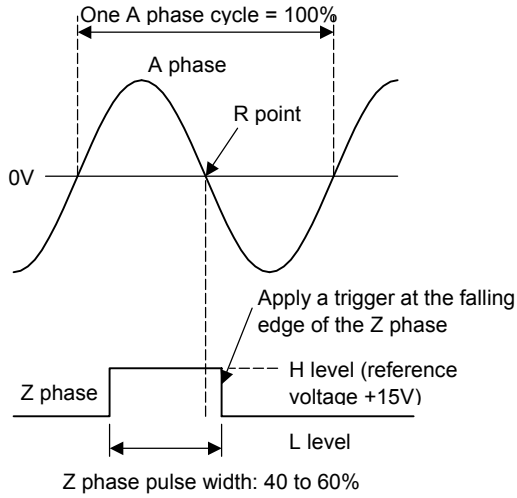
The output signal waveform is confirmed during motor forward run and reverse run. Set the synchroscope as follows to measure the waveform during each run direction.

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

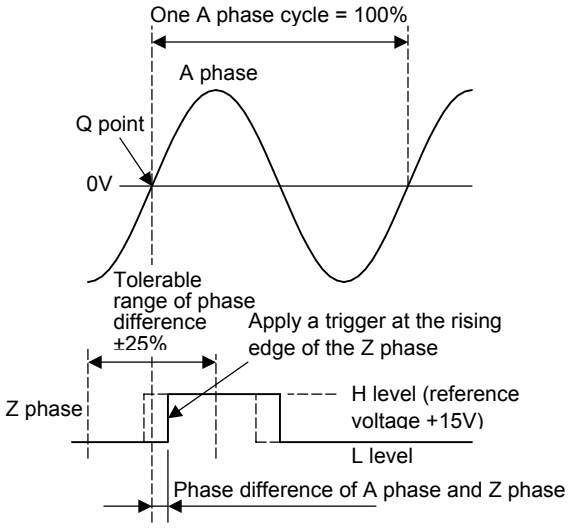
The output signal waveform is confirmed during motor forward run and reverse run. Set the synchroscope as follows to measure the waveform during each run direction.

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

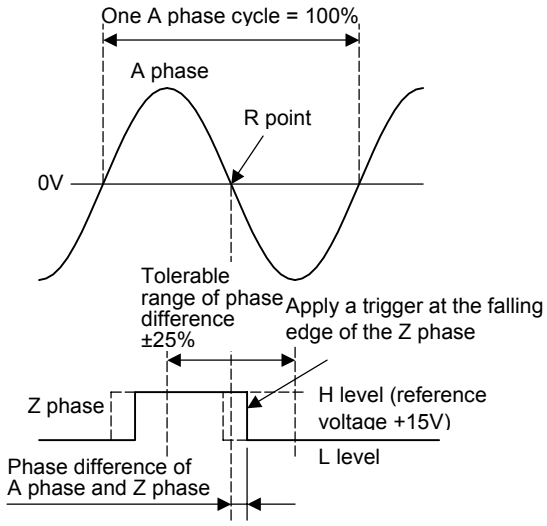
The phase difference for the Z phase signal and A phase signal is defined as follows.

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

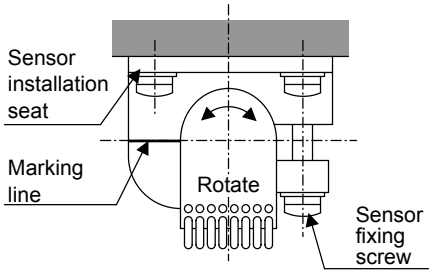
[1] Stop the motor, and make sure that the detection gears are not rotating. The sensor could be damaged if adjustments are carried out while the gears are rotating.

[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.



2.1.1.1.1Adjustin

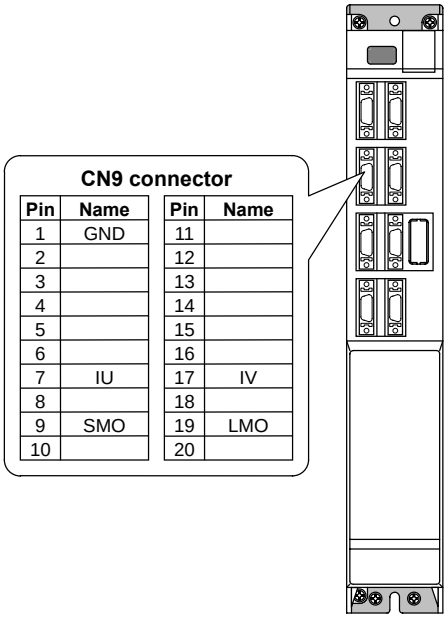
4. Spindle Adjustment

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

The 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.

4-1-1 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 SMO = Pin 9 (D/A channel1) LMO = Pin 19 (D/A channel2) GND = Pin 1
Function	Phase current feedback output function IU (U phase current FB) : Pin 7 IV (V phase current FB) : Pin 17



4-1-2 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
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**				

4-1-3 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 226ms.	0 to 32767 (3.5ms)	0
SP177	MADJ*	Meter full scale compulsory output	When carrying out a full-scale adjustment to the speed meter and load meter, set to "1" here so that the full scale voltage is output and the adjustment mode is entered. Adjustment is carried out with SP178(SMG) and SP179(LMG) at this time. Always return the setting value to "0" when the adjustment is completed.	0 to 1	0
SP178	SMG*	Speed meter output full scale adjustment	Adjust the speed meter full scale. Adjust so that the fluctuations of the speed meter is at the intended position when "1" is set in SP177(MADJ).	0 to 1000 (1/1000-fold)	938
SP179	LMG*	Load meter output full scale adjustment	Adjust the load meter full scale. Adjust so that the fluctuations of the load meter is at the intended position when "1" is set in SP177(MADJ).	0 to 1000 (1/1000-fold)	938
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".

$$\text{DATA} \times \frac{\text{SP255}}{256} \times \frac{10\ [\text{V}]}{256\ (8\ \text{bit})} + 5\ [\text{V}]\ (\text{offset}) = \text{Output voltage}\ [\text{V}]$$

(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.

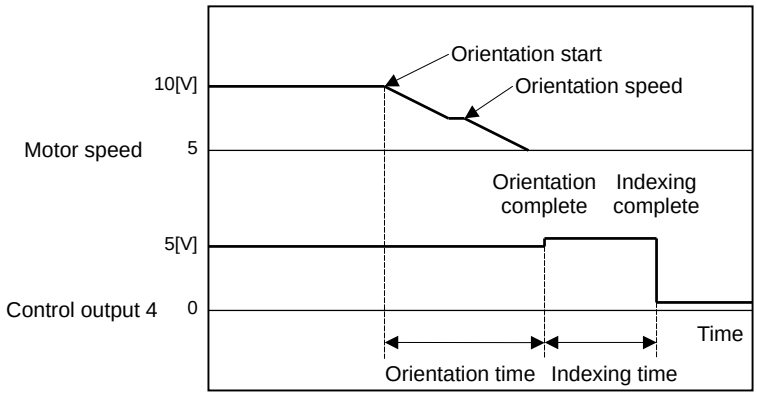
(Example) Orientation indexing control

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

4-2 Spindle control signal

The sequence input/output signals of the spindle drive unit are explained in this section. The status of each signal is displayed on the spindle monitor of the personal computer when the personal computer is connected.

4-2-1 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
					TL3	TL2	TL1	ALMR	PRM						RDY

bit		Details
0	RDY	READY ON command
1		
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		
C		
D		
E		
F		

bit0. READY ON command (RDY)

1) This signal is input when the motor is ready to rotate. This is valid when the circuit between 1 pin (REDY) and 19 pin (CES1) of CN10 is closed (ON). When this signal is turned ON, the main circuit of the converter unit will be turned ON.
2) Before this signal is turned ON or within approx. one second from when this signal is turned ON till the "in READY ON" signal is turned ON, signals are not accepted even if turning the forward/reverse run command, orientation command ON.
3) If this signal is turned OFF during motor rotation, the current to the motor is shut OFF and the motor will coast to stop.
4) Turn this signal OFF for safety before the operator touches the spindle directly and attaches/removes the workpiece or tools. However, be careful not to turn this signal ON/OFF too frequently (100 times or more/day).

bit6. Parameter conversion command (PRM)

This is started when the spindle parameters are converted on the personal computer screen.

bit7. Drive unit alarm reset command (ALMR)

This turns ON while the alarm reset is input. Spindle alarms are reset.
However, if this signal is turned ON during the motor rotation, the power supplied to the motor is shut off and the motor will coast to stop.

Related spindle parameters

No.	Abbr.	Parameter name	Details	Setting range	Standard
SP129 to SP140	HI01 to HI12	General-purpose input selection1 to general-purpose input selection12	Set the following value in any one of these parameters when using the alarm reset. "9": Alarm reset	0 to 21	0

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 when the torque limit signal 1 is assigned to the general-purpose input and the input is turned ON.	0 to 120(%)	10
SP049	TLM2*	Torque limit 2	Set the torque limit rate when the torque limit signal 1, 2 or 1, 2, 3 are assigned to the general-purpose input and only the torque limit 2 is turned ON.	0 to 120(%)	20
SP050	TLM3*	Torque limit 3	Set the torque limit rate when the torque limit signal 1, 2 or 1, 2, 3 are assigned to the general-purpose input and the torque limit 1, 2 are turned ON.	0 to 120(%)	30
SP051	TLM4*	Torque limit 4	Set the torque limit rate when the torque limit signal 1, 2, 3 are assigned to the general-purpose input and the torque limit 3 is turned ON.	0 to 120(%)	40
SP052	TLM5*	Torque limit 5	Set the torque limit rate when the torque limit signal 1, 2, 3 are assigned to the general-purpose input and the torque limit 1, 3 are turned ON.	0 to 120(%)	50
SP053	TLM6*	Torque limit 6	Set the torque limit rate when the torque limit signal 1, 2, 3 are assigned to the general-purpose input and the torque limit 2, 3 are turned ON.	0 to 120(%)	60
SP054	TLM7*	Torque limit 7	Set the torque limit rate when the torque limit signal 1, 2, 3 are assigned to the general-purpose input and the torque limit 1, 2, 3 are all turned ON.	0 to 120(%)	70
SP129 to SP140	HI01 to HI12	General-purpose input selection1 to general-purpose input selection12	Set the following value in any one of these parameters when using the torque limit. "4": Torque limit signal1 (TL1) "5": Torque limit signal2 (TL2) "6": Torque limit signal3 (TL3)	0 to 21	0

(2) Spindle control input 2

Not used.

(3) Spindle control input 3

Name	Details
Spindle control input 3	

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
	MSI	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	MSI	Sub-motor selection command (for 1-drive unit 2-motor changeover)
F		

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	*	*	

(Note) The asterisk indicates 1 or 0.

Since this input is automatically created inside, particular attention is not required.

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

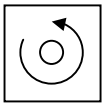
No.	Abbr.	Parameter name	Details	Setting range	Standard setting
SP025	GRA1*	Spindle gear teeth count 1	Set the number of gear teeth of the spindle corresponding to gear 000.	1 to 32767	1
SP026	GRA2*	Spindle gear teeth count 2	Set the number of gear teeth of the spindle corresponding to gear 001.	1 to 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
SP129 to SP140	HI01 to HI12	General-purpose input selection1 to general-purpose input selection12	Set the following value in any of these parameters when using the gear selection. "7": Gear selection1 (GR1) "8": Gear selection2 (GR2)	0 to 21	0

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.
This is validated when closing (ON) the circuit between 11 pin (SRN) and 19 pin (CES1) of CN10.

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



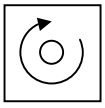
Counterclockwise direction

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.
This is validated when closing (ON) the circuit between 2 pin (SRI) and 19 pin (CES1) of CN10.

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

(Note 1) If READY ON signal is turned OFF, both forward run and reverse run signals will not be accepted.

(Note 2) If both forward run signal and reverse run signal are turned ON, the motor will be stopped regardless of the value of the speed command. In this case, note that the power is supplied to the motor even if the motor is stopped.

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.

For the related parameters, refer to the adjustment for the indexing control in the adjustment procedure for each control.

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.

For the related parameters, refer to the adjustment for the orientation control in the adjustment procedure for each control.

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.

bitE. Sub-motor selection command (MsI)

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.

(4) Spindle control input 4

Name	Details
Spindle control input 4	

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
								hsp	ovr	deg		ss3	ss2	ss1	Emg

bit		Details
0	Emg	Emergency stop
1	ss1	Speed selection1
2	ss2	Speed selection2
3	ss3	Speed selection3
4		
5	deg	Digital speed command valid
6	ovr	Override input
7	hsp	S-analog speed synchronous tapping
8		
9		
A		
B		
C		
D		
E		
F		

bit0. Emergency stop (Emg)

This signal turns ON when the emergency stop input signal is opened (OFF). When this signal is opened (OFF) during motor rotation, the motor will decelerate to stop.

Related spindle parameters

No.	Abbr.	Parameter name	Details	Setting range	Standard
SP129 to SP140	HI01 to HI12	General-purpose input selection 1 to General-purpose input selection 12	Set the following value in any one of these parameters when using the emergency stop. "10": Emergency stop (emg)	0 to 21	0
SP192	FNC0	Function selection at emergency stop	Set the state of alarm output and ready-ON output at the emergency stop. **Setting value** / **Alarm output** / **Ready-ON output** 0 / Not available / Turned OFF when the amount of time set in SP055(SETM) has passed after the motor stopped 1 / Available / Same as above 2 / Not available / Continued ON 3 / Available / Continued ON Note) When the ready-ON input signal is turned OFF, the ready-ON signal is turned OFF regardless of the settings above.	0 to 1000	0

bit1. Speed selection 1 (ss1)

bit2. Speed selection 2 (ss2)

bit3. Speed selection 3 (ss3)

This is used to determine the speed command with three inputs.
By using the combination of ss1 to 3 input, set the speed command value to the value set in SP162 to SP169.
Note that, however, if the value of SP162 is "0" and ss1 to 3 are all OFF, the speed command is the input given by the regular analog voltage.

ss3	ss2	ss1	Speed setting value
0	0	0	SP162
0	0	1	SP163
0	1	0	SP164
0	1	1	SP165
1	0	0	SP166
1	0	1	SP167
1	1	0	SP168
1	1	1	SP169

Related spindle parameters

No.	Abbr.	Parameter name	Details	Setting range	Standard
SP162	SS00	Speed setting 0	Regardless of whether the speed command mode is analog or digital, the motor is run by the value set here when the forward/reverse run signal is input.	0 to 32767 (r/min)	0
SP163	SS01	Speed setting 1	Set the motor speed command value when the speed selection 1 is assigned to the general-purpose input and the input is turned ON.	0 to 32767 (r/min)	0
SP164	SS02	Speed setting 2	Set the motor speed command value when the speed selection 1, 2 or 1, 2, 3 are assigned to the general-purpose input and only the speed selection 2 is turned ON.	0 to 32767 (r/min)	0
SP165	SS03	Speed setting 3	Set the motor speed command value when the speed selection 1, 2 or 1,2,3 are assigned to the general-purpose input and the speed selection 1,2 are turned ON.	0 to 32767 (r/min)	0
SP166	SS04	Speed setting 4	Set the motor speed command value when the speed selection 1,2,3 are assigned to the general-purpose input and the speed selection 3 is turned ON.	0 to 32767 (r/min)	0
SP167	SS05	Speed setting 5	Set the motor speed command value when the speed selection 1,2,3 are assigned to the general-purpose input and the speed selection 1,3 are turned ON.	0 to 32767 (r/min)	0
SP168	SS06	Speed setting 6	Set the motor speed command value when the speed command 1,2,3 are assigned to the general-purpose input and the speed selection 2,3 are turned ON.	0 to 32767 (r/min)	0
SP169	SS07	Speed setting 7	Set the motor speed command value when the speed selection 1,2,3 are assigned to the general-purpose input and the speed selection 1,2,3 are all turned ON.	0 to 32767 (r/min)	0
SP129 to SP140	HI01 to HI12	General-purpose input selection 1 to General-purpose input selection 12	Set the following value in any one of these parameters when using the speed selection. "11": Speed selection 1 (ss1) "12": Speed selection 2 (ss2) "13": Speed selection 3 (ss3)	0 to 21	0

bit5. Digital speed command input valid (deg)

This signal turns ON when the digital speed command input is closed (ON). When this signal is turned ON, the speed command is determined by the external input R01(CN12-1 pin) to R12(CN12-16 pin) 12bit. The common is CES2(CN12-19 pin).
The types of digital speed command include the followings, and one of them can be selected (by the parameter).

1) BCD code 2 digits: 8bit
2) BCD code 3 digits: 12bit
3) Binary (12-bit binary): 12bit
4) Signed binary: 12bit

1) BCD code 2 digits

Rotation speed in respect to command value is as shown below.

BCD code	Motor rotation speed (When the max. speed is 10000r/min)	Motor rotation speed (When the max. speed is 6000r/min)
00	0r/min	0r/min
01	101r/min	60r/min
02	202r/min	121r/min
•	•	•
•	•	•
•	•	•
•	•	•
•	•	•
98	9898r/min	5939r/min
99	10000r/min	6000r/min

(Example) Input method is as shown below. ("1"=Contact ON(closed), "0"=Contact OFF(open))

BCD code	R08	R07	R06	R05	R04	R03	R02	R01
01	0	0	0	0	0	0	0	1
99	1	0	0	1	1	0	0	1

2) BCD code 3 digits

Rotation speed in respect to command value is as shown below.

BCD code	Motor rotation speed (When the max. speed is 10000r/min)	Motor rotation speed (When the max. speed is 6000r/min)
000	0r/min	0r/min
001	10r/min	6r/min
002	20r/min	12r/min
•	•	•
•	•	·
•	•	•
•	•	•
•	•	•
998	9989r/min	5993r/min
999	10000r/min	6000r/min

(Example) Input method is as shown below. ("1"=Contact ON(closed), "0"=Contact OFF(open))

BCD code	R12	R11	R10	R09	R08	R07	R06	R05	R04	R03	R02	R01
001	0	0	0	0	0	0	0	0	0	0	0	1
999	1	0	0	1	1	0	0	1	1	0	0	1

3) Binary (12-bit binary)

Rotation speed in respect to command value is as shown below.

BINARY code	Motor rotation speed (When the max. speed is 10000r/min)	Motor rotation speed (When the max. speed is 6000r/min)
000	0r/min	0r/min
001	2r/min	1r/min
002	4r/min	2r/min
•	•	•
•	•	•
•	•	•
•	•	•
•	•	•
FFE	9997r/min	5998r/min
FFF	10000r/min	6000r/min

(Example) Input method is as shown below. ("1"=Contact ON(closed), "0"=Contact OFF(open))

BINARY code	R12	R11	R10	R09	R08	R07	R06	R05	R04	R03	R02	R01
001	0	0	0	0	0	0	0	0	0	0	0	1
FFF	1	1	1	1	1	1	1	1	1	1	1	1

4) Signed binary

Rotation speed in respect to command value is as shown below.

BINARY code	Motor rotation speed (When the max. speed is 10000r/min)		Motor rotation speed (When the max. speed is 6000r/min)	
000	↑	10000r/min	↑	6000r/min
001		9995r/min		5997r/min
002		9990r/min		5994r/min
▪	Reverse	▪	Reverse	▪
7FF	run	4r/min	run	2r/min
800		0r/min		0r/min
801	Forward	4r/min	Forward	2r/min
▪	run	▪	run	▪
FFE	↓	9995r/min	↓	5997r/min
FFF		10000r/min		6000r/min

(Note) The table below indicates the state where the motor is run by the forward run start signal input.When the motor is run by the reverse run start signal input, the rotation direction is revered.

(Example) Input method is as shown below. ("1"=Contact ON(closed), "0"=Contact OFF(open))

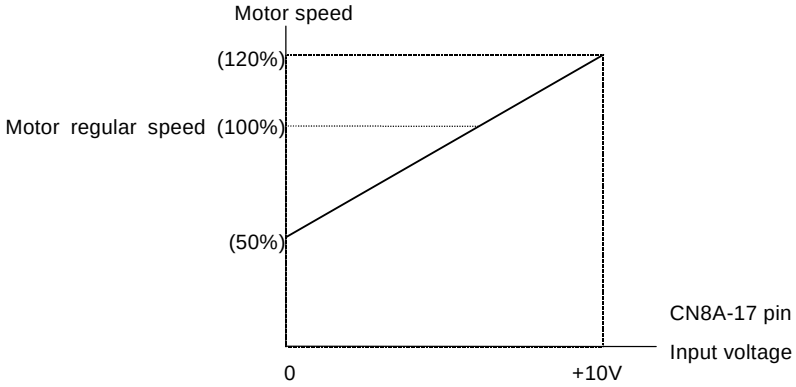
BINARY code	R12	R11	R10	R09	R08	R07	R06	R05	R04	R03	R02	R01
001	0	0	0	0	0	0	0	0	0	0	0	1
800	1	0	0	0	0	0	0	0	0	0	0	0
FFF	1	1	1	1	1	1	1	1	1	1	1	1

Related spindle parameters

No.	Abbr.	Parameter name	Details	Setting range	Standard
SP129 to SP140	HI01 to HI12	General-purpose input selection 1 to General-purpose input selection 12	Set the following value in any one of these parameters when using the digital speed command. "15": Digital speed command valid (deg)	0 to 21	0
SP156	DGtyp	Digital speed command input type	Set the digital speed command input method. "0": Signed binary "1": No sign 12-bit binary "2": BCD2 digits "3": BCD3 digits	0 to 3	0

bit6. Override analog input (OR1, OR2)

This signal turns ON when the override input is closed (ON: valid).
This is used apart from the speed command to change the motor rotation speed.
Note that, however, this input can be used only when the S analog speed command or digital speed command is used, and the commanded voltage is input in the CN8A-7 pin in the case with the S analog speed command input. This cannot be used when using the speed setting function.
The motor speed in respect to the CN8A-17 pin (OR2) input voltage is as shown below.



If the speed command is Nr/min now, the speed can be changed to 0.5-1.2Nr/min with this input. With the input of 0V, 0.5Nr/min, with +10V, 1.2Nr/min can be achieved.
Note that, however, the speed is clamped at the motor maximum speed setting value (parameter: SP017(TSP)).

Related spindle parameters

No.	Abbr.	Parameter name	Details	Setting range	Standard
SP129 to SP140	HI01 to HI12	General-purpose input selection 1 to General-purpose input selection 12	Set the following value in any one of these parameters when using the override input. "16": Override input valid (ovr)	0 to 21	0

bit7. S analog high-speed synchronous tapping

This signal turns ON when the S analog high-speed synchronous tapping input is closed (ON).
For the related parameters, refer to the section covering the adjustment procedures for each control "adjusting S analog high-speed synchronous tapping"

4-2-2 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					TL3A	TL2A	TL1A	ALM	PRMA		WRN				RON

bit		Details
0	RON	In READY ON
1		
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		
C		
D		
E		
F	CL	Limiting current

bit0. In READY ON (RON)

When the READY ON signal is input, 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 turns OFF while the spindle motor is rotating, this signal is turned OFF immediately, and the motor will coast to stop.

No.	Abbr.	Parameter name	Details	Setting range	Standard
SP141 to SP154	HO1e to HO6c	General-purpose output selection Open emitter 1 to General-purpose output selection Open collector 6	Set the following value in any one of these parameters when using the alarm reset. "11": In READY ON (RON)	0 to 23	0

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 personal computer 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.

No.	Abbr.	Parameter name	Details	Setting range	Standard
SP141 to SP154	HO1e to HO6c	General-purpose output selection Open emitter 1 to General-purpose output selection Open collector 6	Set the following value in any one of these parameters when using the in drive unit alarm output. "9": In alarm (ALM)	0 to 23	0

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.
For the general-purpose output, the output is not compatible with an individual input. Only the signal turned ON if any one of them is input can be set.

No.	Abbr.	Parameter name	Details	Setting range	Standard
SP141 to SP154	HO1e to HO6c	General-purpose output selection Open emitter 1 to General-purpose output selection Open collector 6	Set the following value in any one of these parameters when using the in torque limit output. "9": In torque limit (TLA)	0 to 23	0

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

Not used.

(3) Spindle control output 3

Name	Details
Spindle control output 3	

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	In sub-motor selection (for 1-drive unit 2-motor changeover)
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.

No.	Abbr.	Parameter name	Details	Setting range	Standard
SP141 to SP154	HO1e to HO6c	General-purpose output selection Open emitter 1 to General-purpose output selection Open collector 6	Set the following value in any one of these parameters when using the motor in forward run output. "7": Motor in forward run (SRNA)	0 to 23	0

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.

No.	Abbr.	Parameter name	Details	Setting range	Standard
SP141 to SP154	HO1e to HO6c	General-purpose output selection Open emitter 1 to General-purpose output selection Open collector 6	Set the following value in any one of these parameters when using the motor in reverse run output. "8": Motor in reverse run (SRIA)	0 to 23	0

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. For the details, refer to the adjustment for the indexing control in the adjustment procedure for each control.

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.

No.	Abbr.	Parameter name	Details	Setting range	Standard
SP141 to SP154	HO1e to HO6c	General-purpose output selection Open emitter 1 to General-purpose output selection Open collector 6	Set the following value in any one of these parameters when using the L coil selected output. "18": L coil selected (LCSA)	0 to 23	0

bitE. In sub-motor selection (MSA)

This signal turns ON when selecting sub-motor with 1-drive unit 2-motor specification.

(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
AL4	AL3	AL2	AL1	EMGA	TLU		MTC	WRCF	MKC		ORCF	ZS	US	SD	CD

bit		Details
0	CD	Current detection
1	SD	Speed detection
2	US	Up-to-speed
3	ZS	Zero speed
4	ORCF	Orientation complete
5		
6	MKC	Changing coil
7	WRCF	Index positioning completed
8	MTC	In changeover (for 1-drive unit 2-motor changeover)
9		
A	TLU	Torque reach
B	EMGA	In emergency stop
C	AL1	Alarm code 1
D	AL2	Alarm code 2
E	AL3	Alarm code 3
F	AL4	Alarm code 4

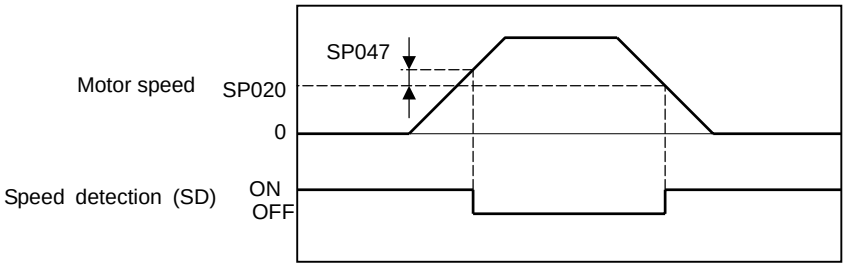
bit0. Current detection (CD)

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.)

No.	Abbr.	Parameter name	Details	Setting range	Standard
SP141 to SP154	HO1e to HO6c	General-purpose output selection Open emitter 1 to General-purpose output selection Open collector 6	Set the following value in any one of these parameters when using the current detection output. "12": Current detection (CD)	0 to 23	0

bit1. Speed detection (SD)

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.



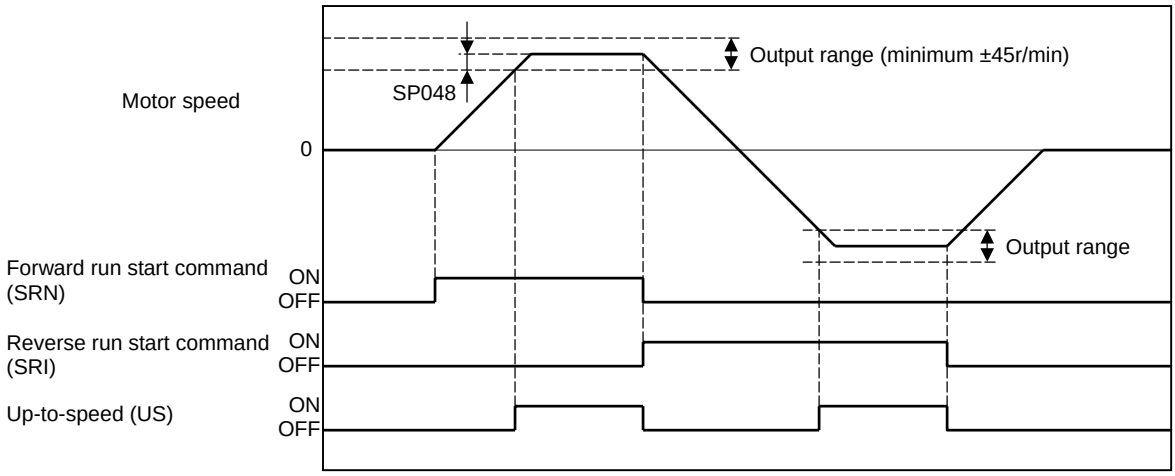
Speed detection (SD) sequence

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
SP141 to SP154	HO1e to HO6c	General-purpose output selection Open emitter 1 to General-purpose output selection Open collector 6	Set the following value in any one of these parameters when using the speed detection output. "13": Speed detection (SD)	0 to 23	0

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.



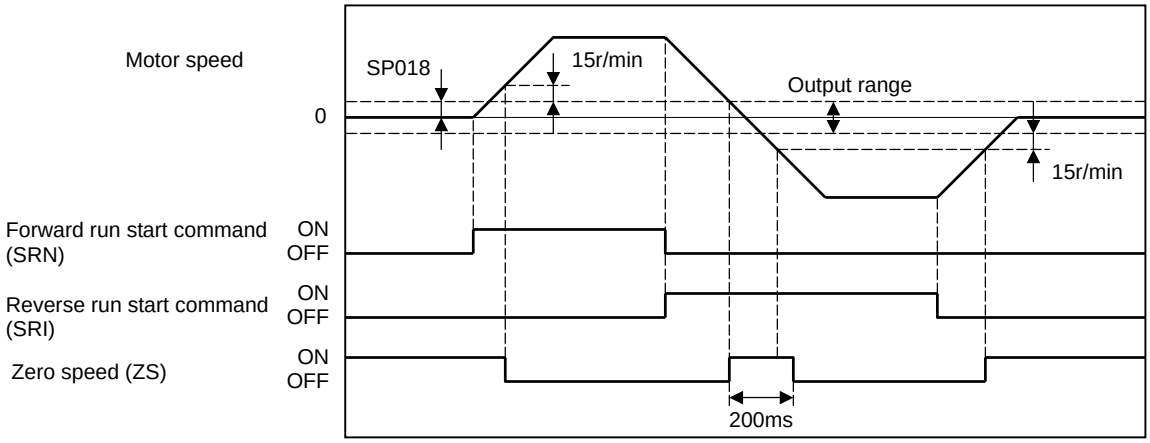
Up-to-speed (US) sequence

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
SP141 to SP154	HO1e to HO6c	General-purpose output selection Open emitter 1 to General-purpose output selection Open collector 6	Set the following value in any one of these parameters when using the up-to-speed output. "14": Up-to-speed (US)	0 to 23	0

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
SP141 to SP154	HO1e to HO6c	General-purpose output selection Open emitter 1 to General-purpose output selection Open collector 6	Set the following value in any one of these parameters when using the zero speed output. "15": Zero speed (ZS)	0 to 23	0

bit4. Orientation complete (ORCA)

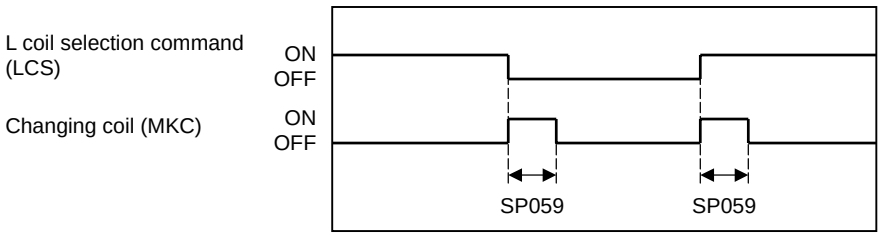
This signal turns ON when the orientation command is input, and the spindle position is reached the set range (within the in-position range) in respect to the target stop position. This signal turns OFF when orientation is completed and the spindle position deviates from the in-position range, but it 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
SP141 to SP154	HO1e to HO6c	General-purpose output selection Open emitter 1 to General-purpose output selection Open collector 6	Set the following value in any one of these parameters when using the orientation complete output. "1": Orientation complete (ORCA)	0 to 23	0

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
SP141 to SP154	HO1e to HO6c	General-purpose output selection Open emitter 1 to General-purpose output selection Open collector 6	Set the following value in any one of these parameters when using the changing coil output. "16": Changing coil (MKC)	0 to 23	0

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.

For the details, refer to the adjustment for the indexing control in the adjustment procedure for each control.

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
SP141 to SP154	HO1e to HO6c	General-purpose output selection Open emitter 1 to General-purpose output selection Open collector 6	Set the following value in any one of these parameters when using the index positioning completed output. "2": Index positioning completed (WRCF)	0 to 23	0

bit8. In 1-drive unit 2-motor changeover (MTC)

This signal turns ON during motor changeover with 1-drive unit 2-motor specification.

No.	Abbr.	Parameter name	Details	Setting range	Standard
SP141 to SP154	HO1e to HO6c	General-purpose output selection Open emitter 1 to General-purpose output selection Open collector 6	Set the following value in any one of these parameters when using the in changeover (for 1-drive unit 2-motor changeover) output. "17": In changeover (for 1-drive unit 2-motor changeover) (MTC)	0 to 23	0

bitA. Torque reach (TLU)

This signal turns ON when the start command is input and the torque command in the drive unit reaches to the clamp value.

Related spindle parameters

No.	Abbr.	Parameter name	Details	Setting range	Standard
SP141 to SP154	HO1e to HO6c	General-purpose output selection Open emitter 1 to General-purpose output selection Open collector 6	Set the following value in any one of these parameters when using the torque reach output. "3": Torque reach (TLU)	0 to 23	0

bitB. In emergency stop (EMGA)

This signal turns ON when the emergency stop input is turned ON.

Related spindle parameters

No.	Abbr.	Parameter name	Details	Setting range	Standard
SP141 to SP154	HO1e to HO6c	General-purpose output selection Open emitter 1 to General-purpose output selection Open collector 6	Set the following value in any one of these parameters when using t the in emergency stop output. "10": In emergency stop (EMGA)	0 to 23	0

bitC. Alarm code output1 (AL1)
bitD. Alarm code output2 (AL2)
bitE. Alarm code output3 (AL3)
bitF. Alarm code output4 (AL4)

When an alarm occurs in the drive unit, this signal outputs the content of the alarm that occurred in a combination of 4bit.
Even if the unit is normal, this signal may turn ON for 1 second after the power is turned ON.

AL4	AL3	AL2	AL1	Alarm content	Spindle drive unit 7-segment display
0	0	0	0	No alarm (normal)	—
0	0	0	1	Motor overheat	46
0	0	1	0	Excessive speed deviation	23
0	0	1	1	Overspeed	31
0	1	0	0	Overcurrent	32
0	1	0	1	Overload	50
0	1	1	0	Emergency stop	E7
0	1	1	1	Spindle drive unit side alarm other than above	10 to 5F
1	0	0	0	Power module error	61
1	0	0	1	Phase failure detection	67
1	0	1	0	Ground fault detection	69
1	0	1	1	Main circuit error	6C
1	1	0	0	Instantaneous / external emergency stop	71
1	1	0	1	Overvoltage	75
1	1	1	0	No signal	82
1	1	1	1	Other alarms	60～

1: Output ON
0: Output OFF

Related spindle parameters

No.	Abbr.	Parameter name	Details	Setting range	Standard
SP141 to SP154	HO1e to HO6c	General-purpose output selection Open emitter 1 to General-purpose output selection Open collector 6	Set the following value in any one of these parameters when using t the alarm code 1 to 4. Make sure that all of these four output are set to any parameter No. “20”: Alarm code output1 (AL1) “21”: Alarm code output2 (AL2) “22”: Alarm code output3 (AL3) “23”: Alarm code output4 (AL4)	0 to 23	0

4-3 Adjustment procedures for each control

4-3-1 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] Is the rotation smooth?
[4] Is there any abnormal noise?
[5] Are there any abnormal odors?
[6] Has the bearing temperature risen abnormally?

(2) Adjusting the speed meter/load meter

The speed meter/load meter is adjusted when using the display measurement output.
[1] Set "1" in the parameter SP177(MADJ).
[2] Change value in the parameter SP178(SMG) and adjust so that the speed meter displays the maximum speed.
[3] Change value in the parameter SP179(LMG) and adjust so that the load meter displays the full scale.
[4] Return the parameter SP177(MADJ) to "0" when the adjustment is completed. Failure to do this could result in displaying full scale for both meters at all times.

No.	Abbr.	Parameter name	Details	Setting range	Standard
SP177	MADJ*	Meter full scale compulsory output	When carrying out a full-scale adjustment to the speed meter and load meter, set to "1" here so that the full scale voltage is output and the adjustment mode is entered. Adjustment is carried out with SP178(SMG) and SP179(LMG) at this time. Always return the setting value to "0" when the adjustment is completed.	0 to 1	0
SP178	SMG*	Speed meter output full scale adjustment	Adjust the speed meter full scale. Adjust so that the fluctuations of the speed meter is at the intended position when "1" is set in SP177(MADJ).	0 to 1000 (1/1000-fold)	938
SP179	LMG*	Load meter output full scale adjustment	Adjust the load meter full scale. Adjust so that the fluctuations of the load meter is at the intended position when "1" is set in SP177(MADJ).	0 to 1000 (1/1000-fold)	938

(3) Adjusting the motor (spindle) rotation speed

(a) When using analog input for the speed command

1) When using bipolar input (SE1-SE2 input) for the speed command

[1] Confirm if "0" is set to the parameter SP155(SAtyp) and SP158(Adofs), and "1053" to SP161(Sgain).

[2] Start the motor by commanding SO(0 rotation command) from NC(PC).

[3] Adjust the value of SP158(Adofs) so that the motor(spindle) almost stops.
The motor (spindle) rotation may not be stopped completely even if SP158(Adofs) is adjusted.

[4] Start the motor by inputting S*** from NC(PC).
At this time, S*** equals to the value "maximum spindle speed×0.95" (Motor speed = S***×(1/gear ratio))

[5] Adjust SP161(Sgain) so that the motor (spindle) rotation speed becomes the speed set in [4] above.

$$\text{SP161(Sgain)} \quad \fallingdotseq 1053 \times \left[\frac{\text{S command rot. speed}}{\text{Spindle actual rotation speed}} \quad \text{or} \quad \frac{\text{S command rot. speed x (1/gear ratio)}}{\text{Motor actual rotation speed}} \right]$$

[6] After following all the setting procedures above, change the S command and confirm if the rotation speed changes accordingly.

2) When using unipolar input (OR1-OR2 input) for the speed command

[1] Confirm if "1" is set to the parameter SP155(SAtyp), "262" to SP158(Adofs), and "1147" to SP161(Sgain).

[2] Start the motor by commanding SO from NC(PC).

[3] Adjust SP158 so that the motor (spindle) is stopped.
Subtract "1" from the value at which the motor (spindle) starts rotating from a stop state, and then set that value in SP158(Adofs).

(Example)

SP158(Adofs) = "257" : Motor (spindle) stops

SP158(Adofs) = "258" : Motor (spindle) starts rotating

The setting value of SP158(Adofs) = "257"

[4] Start the motor by inputting S*** from NC(PC).
At this time, S*** equals to the value "maximum spindle speed×0.95" (Motor speed = S***×(1/gear ratio))

[5] Adjust SP161(Sgain) so that the motor (spindle) rotation speed becomes the speed set in [4] above.

$$\text{SP161(Sgain)} \quad \fallingdotseq 1147 \times \left[\frac{\text{S command rot. speed}}{\text{Spindle actual rotation speed}} \quad \text{or} \quad \frac{\text{S command rot. speed x (1/gear ratio)}}{\text{Motor actual rotation speed}} \right]$$

[6] After following all the setting procedures above, change the S command and confirm if the rotation speed changes accordingly.

No.	Abbr.	Parameter name	Details	Setting range	Standard
SP155	SAtyp	S analog speed command input type	Select where to input the S analog input. [0]: Input between SE1(CN8A-7 pin) and SE2(CN8A-8 pin) (Standard) (Bipolar input: Possible to input 0 to ±10V) [1]: Input between OR2(CN8A-17 pin) and SE1(CN8A-18 pin) (Unipolar input: Possible to input 0 to +10V only) Note that when "1" is set, the over writing function cannot be used.	0 to 1	0
SP158	Adofs*	S analog speed command input offset	Set the offset value of the S analog speed command input. Set the value so that the spindle almost stops when the input command is "0". Note that the rotation of the spindle motor may not be stopped in full with this setting. This value fluctuates depending on the usage time and ambient temperature.	-999 to 999	When SP155=0: 0 When SP155=1: 262
SP161	Sgain*	S analog speed command input gain	Set the S analog speed command input gain. Set so that the motor runs at the highest speed when the maximum speed command is input.	0 to 2500 (1/1000-fold)	When SP155=0: 1053 When SP155=1: 1147

(b) When using digital speed command input for the speed command

No adjustment required. Confirm the following items.

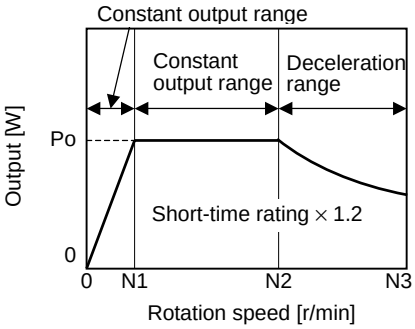
1) Confirm if the drive unit type is correct. (Is "D" marked at the end of capacity indication of the drive unit type?)
2) Confirm if the setting value of the parameter SP156(DGtyp) is correct.

No.	Abbr.	Parameter name	Details	Setting range	Standard
SP156	DGtyp	Digital speed command input type	Set the digital speed command input method. "0": Signed binary "1": No sign 12-bit binary "2": BCD2 digits "3": BCD3 digits	0 to 3	0

4-3-2 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 the 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, the motor can output at 120% of the short-time rating. Thus, the motor output Po in the output range during acceleration/deceleration follows the expression below.

Po = (Short-time rated output) × 1.2 [W]

(b) Total load GD^2: GD^2

GD^2 of the total load which is accelerated and decelerated follows the expression below.

GD^2 = (Motor GD^2) + (motor shaft conversion load GD^2) [kg•m^2] **(Note 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→N [r/min] (0≤N≤N1)
(For N>N1, apply N=N1 and calculate t2 or t3.)

$$t1 = \frac{1.03 \times GD^2 \times N1 \times N}{375 \times Po} \text{ [s]} \quad \textbf{(Note 1)}$$

(d) Acceleration/deceleration time for constant output range: t2···N1→N [r/min] (N1≤N≤N2)
(For N>N2, apply N=N2 and calculate t3.)

$$t2 = \frac{1.03 \times GD^2 \times (N^2 - N1^2)}{2 \times 375 \times Po} \text{ [s]} \quad \textbf{(Note 1)}$$

(e) Acceleration/deceleration time in deceleration output range: t3···N2→N [r/min] (N2≤N≤N3)

$$t3 = \frac{1.03 \times GD^2 \times (N^3 - N2^3)}{3 \times 375 \times Po \times N2} \text{ [s]} \quad \textbf{(Note 1)}$$

Based on the above expressions, the acceleration/deceleration time: t from 0 to N3 [r/min] is:

t = t1 + t2 + t3 [s] **(Note 2)**

(Note 1) Note that "GD^2" is four times the inertia（J）.

(Note 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 SJ-V5.5-01 motor having the output characteristics shown on the right, when the motor shaft conversion load GD^2 is 0.2[kg•m^2].

Po = (Short-time rated output) × 1.2 = 5500 × 1.2 = 6600 [W]

GD^2 = (Motor GD^2) + (load GD^2) = 0.059 + 0.2 = 0.259 [kg•m^2]

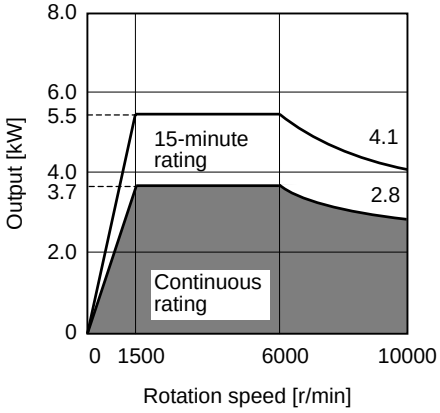
$$t1 = \frac{1.03 \times GD^2 \times N1^2}{375 \times Po} = \frac{1.03 \times 0.259 \times 1500^2}{375 \times 6600} = 0.243 \text{ [s]}$$

$$t2 = \frac{1.03 \times GD^2 \times (N2^2 - N1^2)}{2 \times 375 \times Po} = \frac{1.03 \times 0.259 \times (6000^2 - 1500^2)}{2 \times 375 \times 6600} = 1.819 \text{ [s]}$$

$$t3 = \frac{1.03 \times GD^2 \times (N3^3 - N2^3)}{3 \times 375 \times Po \times N2} = \frac{1.03 \times 0.259 \times (10000^3 - 6000^3)}{3 \times 375 \times 6600 \times 6000} = 4.695 \text{ [s]}$$

Thus,

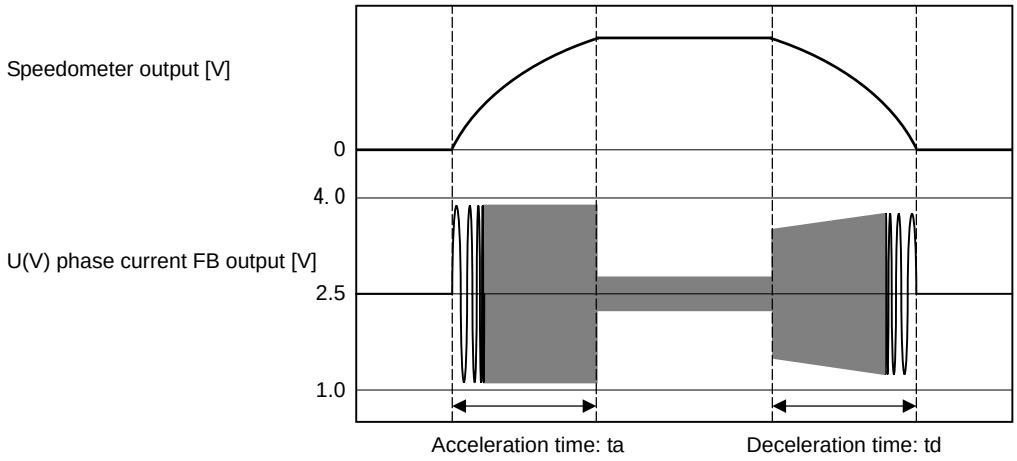
t = t1 + t2 + t3 = 0.243 + 1.819 + 4.695 = 6.757 [s]



SJ-V5.5-01 output characteristics

(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 "4-1 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 "3-3 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 the parameter SP019(CSN1). When the acceleration time is 10s or less, use the standard value 30 (300ms).

Alarm can be avoided by adjusting the parameter SP055(SETM). 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

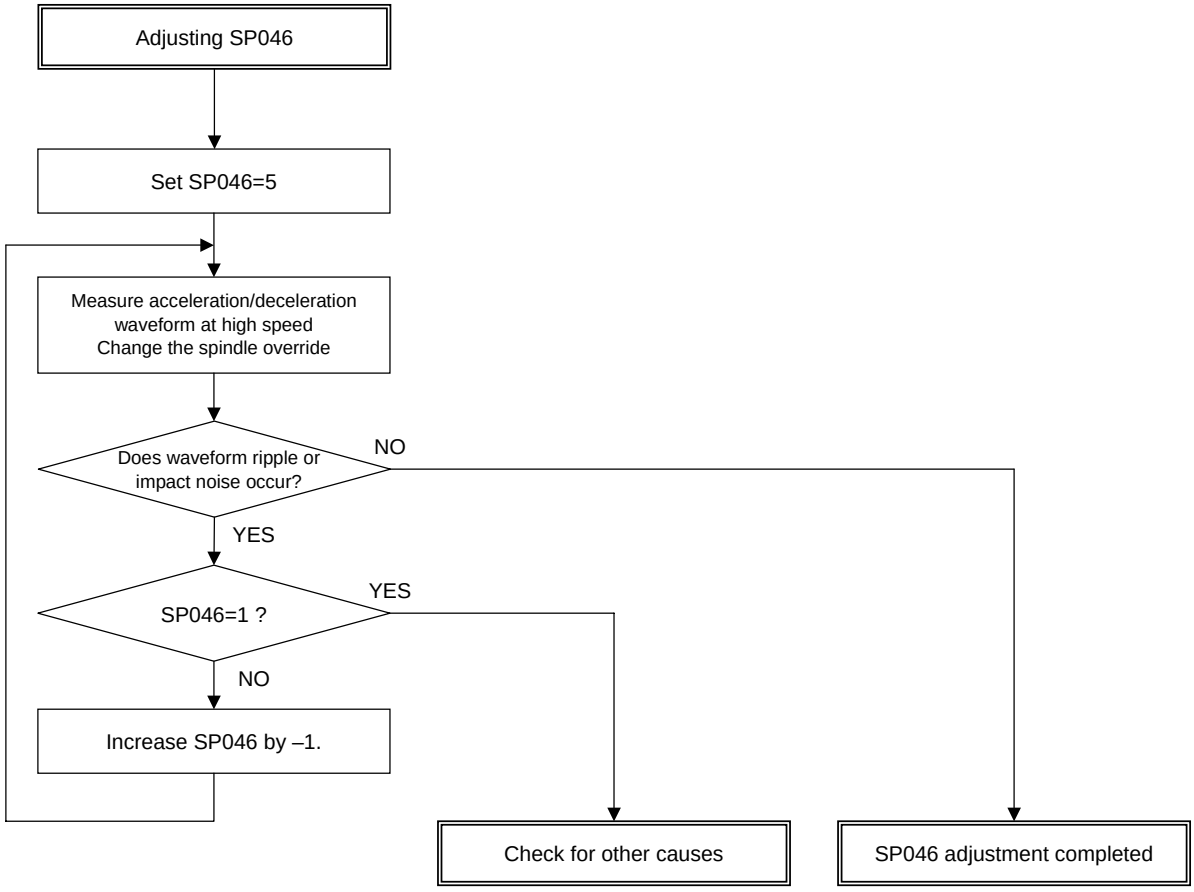
(4) Adjustment when machine system vibration (noise) is generated

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 parameter SP070(FH z), 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 the parameter SP076(FONS) to prevent the vibration.

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

(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 parameter SP046(CSN2) 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

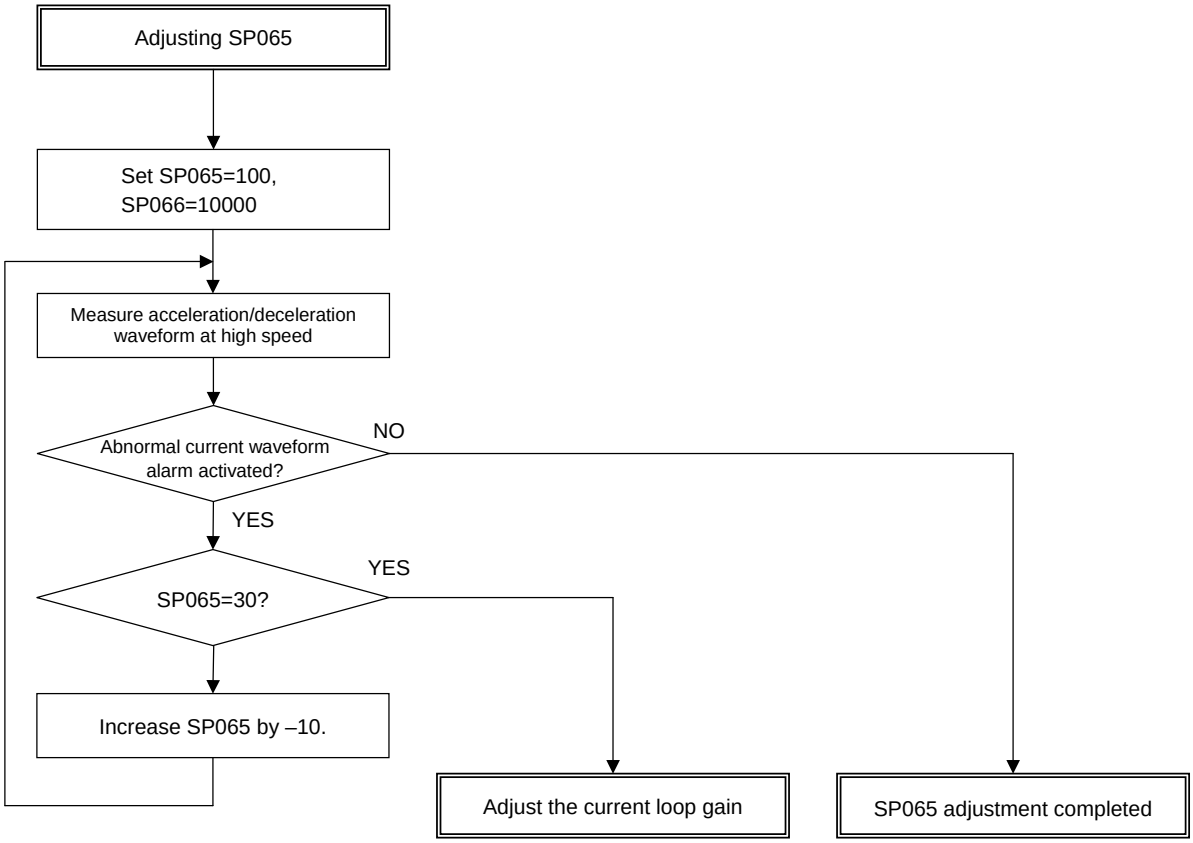
(6) Adjusting speed loop gain

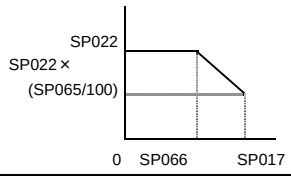
The speed loop gain adjustment is made to improve the high-speed range characteristics for speeds of 10,000r/min and higher. Use only the motor-specific standard settings for the basic parameters SP022(VGNP1) and SP023(VGNI1).

If the problems shown below occur during constant-speed operation at a speed of 10,000r/min or higher, set and adjust the parameter SP065(VCGN1)and the parameter SP066(VCSN1).

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.

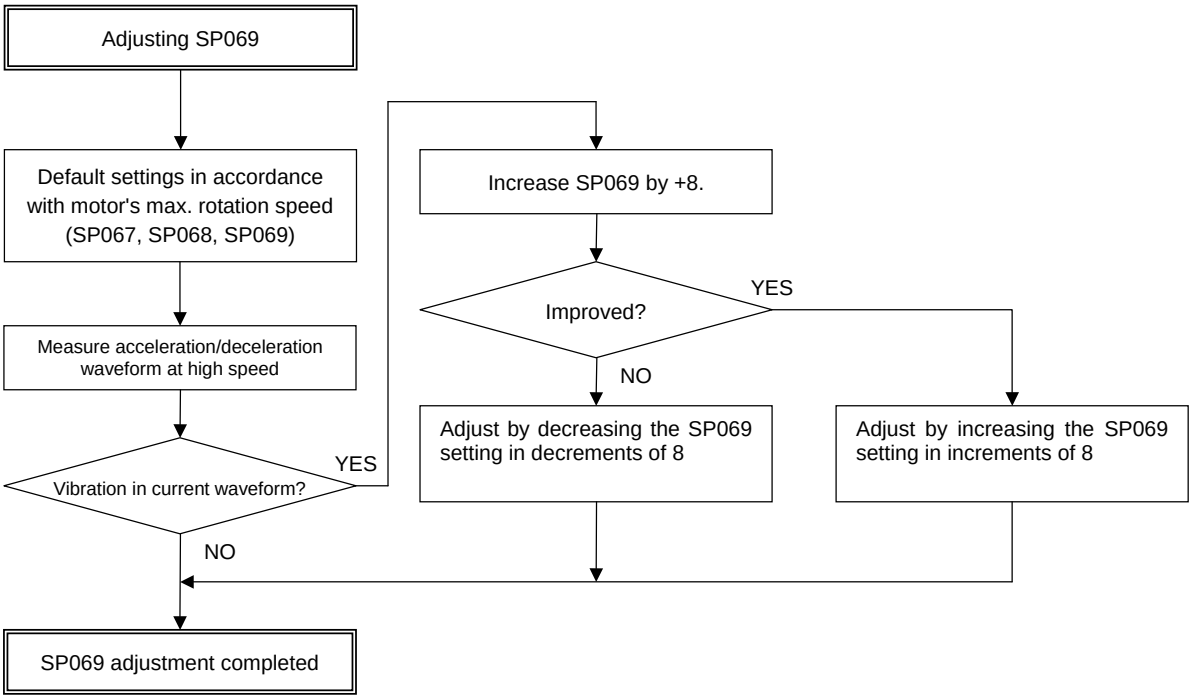


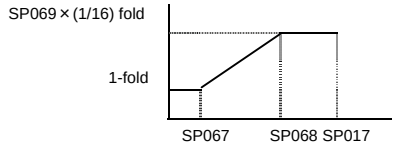
No.	Abbr.	Parameter name	Details	Setting range	Standard
SP022	VGNP1*	Speed loop gain proportional term under speed control	Basically, use standard setting value set for each motor.	0 to 1000	63
SP023	VGMI1*	Speed loop gain integral term under speed control		0 to 1000	60
SP065	VCGN1*	Target value of variable 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 parameter SP069(VIGN) while observing the current waveform in the high-speed range. Adjust until the output waveform to the spindle motor stabilizes.

Set the parameter SP067(VIGWA) and the parameter SP068(VIGWB) in accordance with the motor's maximum rotation speed.



No.	Abbr.	Parameter name	Details	Setting range	Standard
SP067	VIGWA*	Change starting speed of variable current loop gain	Set the speed where the current loop gain change starts.	0 to 32767 (r/min)	0
SP068	VIGWB*	Change ending speed of variable current loop gain	Set the speed where the current loop gain change ends.	0 to 32767 (r/min)	0
SP069	VIGN*	Target value of variable current loop gain	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.  SP017(TSP) Maximum motor speed / Setting value: SP067 (VIGWA), SP068 (VIGWB), SP069 (VIGN) 0 to 6000: 0, 0, 0 6001 to 8000: 5000, 8000, 45 8001 or more: 5000, 10000, 64	0 to 32767 (1/16-fold)	0

(8) Adjusting excitation rate

If the motor noise is excessive during constant-speed operation, adjust the value of the parameter SP056(PYVR) downward in decrements of 10 from the standard setting of 50 (setting lower limit = 25). The setting of the parameter SP033(SFNC1)/bit9 is an effective way to reduce noise or improve the temperature rise of the motor for high-speed operation (it lowers the excitation rate also for high-speed operation).

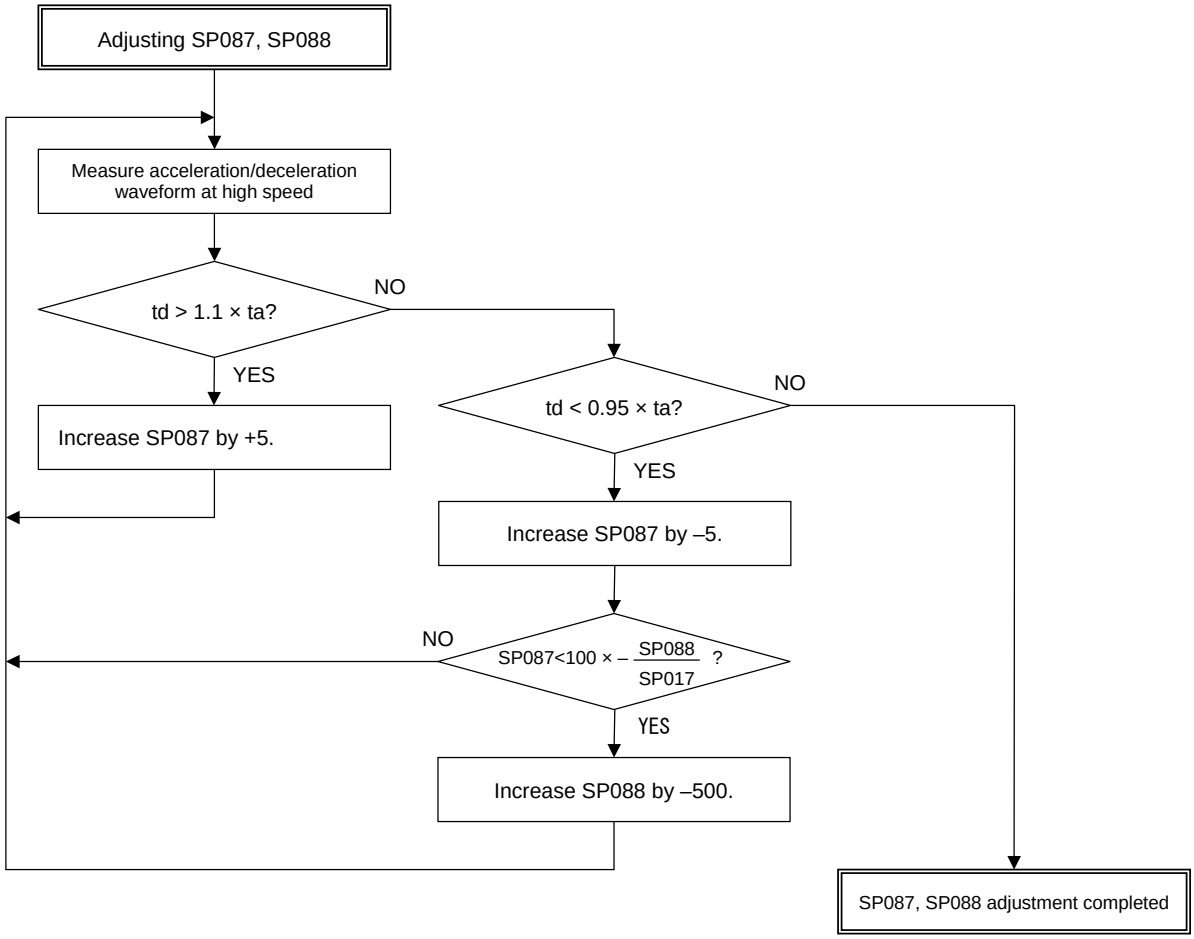
No.	Abbr.	Parameter name	Details	Setting range	Standard
SP056	PYVR	Variable excitation (min value)	Set the minimum value of the variable excitation rate. Select a smaller value when gear noise is too high. Larger value is more effective on impact response.	0 to 100 (%)	50
SP033	SFNC1*	Spindle function 1	<For MDS-C1-SP/SPH/SPX/SPHX>		

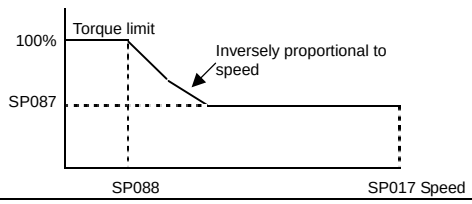
F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
poff	hzs		ront			pycal	pychg	pyst	pyoff				sftk	dflt	1a2m

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 setting of the parameter SP087(DIQM). In cases, however, where the variable torque characteristic cannot be lowered to the SP087 level, adjust by changing the setting of the parameter SP088(DIQN).



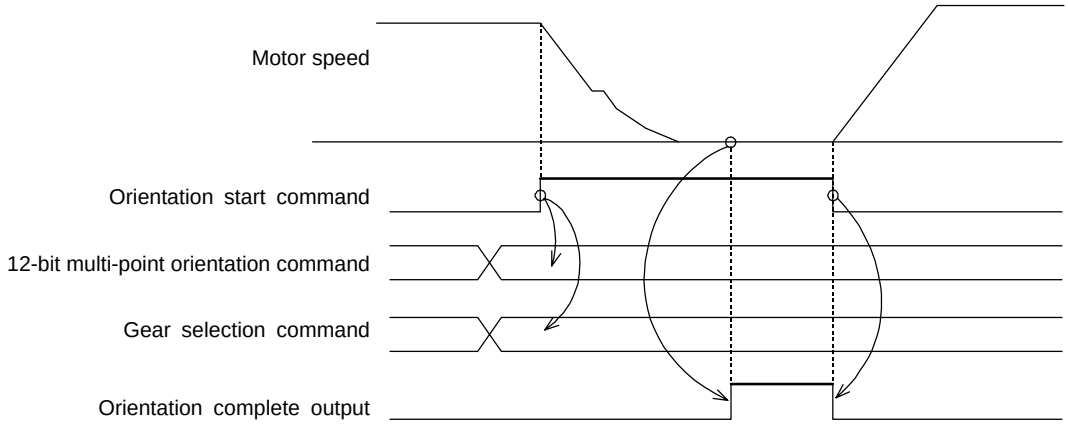
No.	Abbr.	Parameter name	Details	Setting range	Standard
SP087	DIQM*	Target value of variable torque limit magnification at deceleration	Set the minimum value of variable torque limit at deceleration.	0 to 150 (%)	75
SP088	DIQN*	Speed for starting change of variable torque limit magnification at deceleration	Set the speed where the torque limit value at deceleration starts to change. 	0 to 32767 (r/min)	3000

4-3-3 Adjusting the orientation control

(1) Necessary input/output

1) Input:
   [1] Orientation start command (ORC)
   Connect to any one of the general-purpose inputs
   [2] Multi-point orientation positioning data (R1 to R12)
   Connect when changing to an arbitrary stop position from outside during encoder orientation or motor PLG orientation
2) Output: Orientation complete (ORCA)
   Connect to any one of the general-purpose outputs

(2) Operation sequence



1) The 12-bit multi-point orientation command (R1 to R12) is read at the rising edge of the orientation start command (ORC) and must be changed before turning the orientation start command ON.
2) The gear selection command (GR1,GR2) will be valid at all times even after the orientation start command has been turned ON. Change the gear selection command before turning the orientation start command ON and keep it ON until the orientation start command is turned OFF.

(3) Confirming the default parameters

Set the orientation start(ORC) and orientation complete(ORCF) for the general-purpose input/output. If there is a gear, set the gear selection 1,2(GR1,GR2) for the general-purpose input. And, set the default parameters for each detector used in orientation control.

(a) Motor PLG

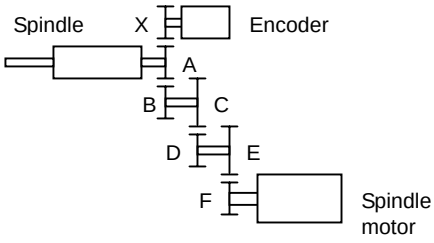
Motor PLG orientation is possible only when the spindle and motor are coupled, or when they are coupled 1:1 with gears (timing belt). The SP025 (GRA1) to SP032 (GRB4) parameters can be set only to 1. The PLG with Z-phase must be mounted on the motor to be used.

(b) 1024p/rev encoder

An accurate gear ratio (pulley ratio) is required from the motor shaft to the encoder 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 encoder in SP096 (EGAR).



Spindle configuration when using spindle side detector

No.	Abbr.	Parameter name	Details	Setting range	Standard
SP096	EGAR*	Encoder gear ratio	Set the gear ratio between the spindle side and the detector side (except for the motor PLG) as indicated below.	0 to 4	0

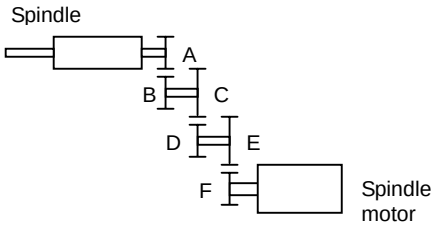
Setting value	Gear ratio (deceleration)
0	1 : 1
1	1 : 1/2
2	1 : 1/4
3	1 : 1/8
4	1 : 1/16

(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

Type	Magnetic sensor type	Parameter setting		
		SP123 (MGD0)	SP124 (MGD1)	SP125 (MGD2)
Standard	MAGNETIC SENSOR BKO-C1810H01-3	542	768	384
High-speed standard	MAGNETIC SENSOR BKO-C1730H01.2.6			
High-speed compact	MAGNETIC SENSOR BKO-C1730H01.2.9	500	440	220
High-speed ring type	MAGNETIC SENSOR BKO-C1730H01.2.41			
	MAGNETIC SENSOR BKO-C1730H01.2.42			
	MAGNETIC SENSOR BKO-C1730H01.2.43			
	MAGNETIC SENSOR BKO-C1730H01.2.44			

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) Encoder	(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	14	14	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

(Note 1) *: Set according to machine specifications, -: Setting irrelevant

(Note 2) For parameters with an asterisk * in the abbreviation, such as PGM*, if the settings of the parameters have been changed with a personal computer, the parameters are validated without turning the spindle drive unit's power ON/OFF immediately after the settings have been changed.

No.	Abbr.	Parameter name	Default parameter settings for detector in use		
			(a) Motor PLG	(b) Spindle detector	(c) Magnetic sensor
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
SP129 to SP140	HI01 to HI12	General-purpose input selection1 to 12	1: Orientation start 7: Gear selection 1 8: Gear selection 2	1: Orientation start 7:Gear selection 1 8: Gear selection 2	1: Orientation start 7: Gear selection 1 8: Gear selection 2
SP141 to SP154	HO1e to HO6c	General-purpose output selection open emitter1 to open corrector6	1: Orientation complete	1: Orientation complete	1: Orientation complete
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 having an abbreviation with "*" (MGD0*, etc.) are validated right after the settings are changed by the personal computer, without turning the spindle drive unit's power ON and OFF.

(4) 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].

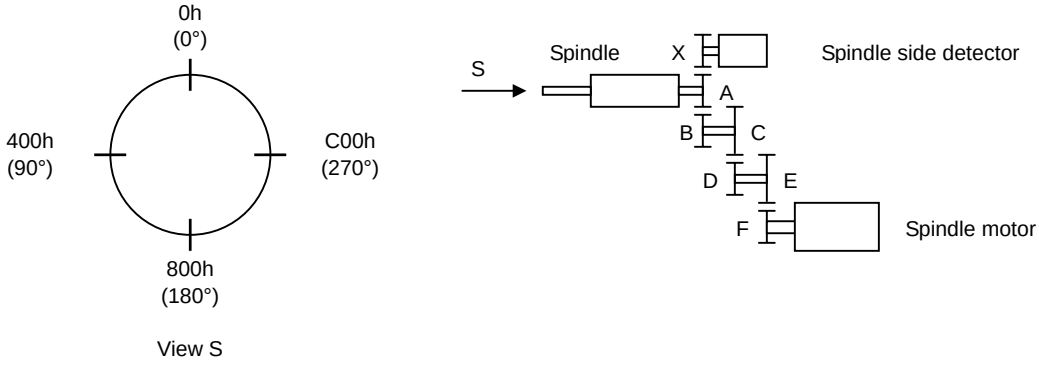
No.	Abbr.	Parameter name	Details
SP097	SPECO*	Orientation specification	

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	Encoder installation polarity: +	Encoder installation 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 side 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) When "1" is set in SP037(SFNC5)/bit7, the stop position by the external stop position data can be changed by 180° in the figure above. (0h: 0°, C00h: 90°, 800h: 180°, 400h: 270°)

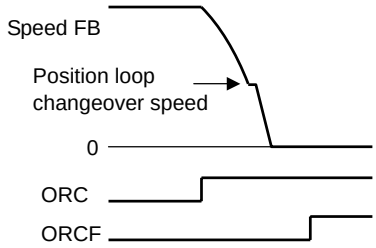
No.	Abbr.	Parameter name	Details	Setting range	Standard
SP037	SFNC5	Spindle function 5			
SP007	OPST	In-position shift amount for orientation	Set the stop position for orientation. (1) Motor PLG, spindle side detector: Set the value by dividing 360° by 4096. (2) Magnetic sensor: Divide –5° to +5° by 1024 and put 0° for 0.	(1) 0 to 4095 (2) -512 to 512	0

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

bit		Meaning when set to 0	Meaning when set to 1	Standard
7	psdir	Position shift (standard)	Position shift (reverse direction)	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 side 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	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
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.

$$\text{Effective position loop gain (H-coil)} = \text{SP001 (SP002)} \times \frac{\text{SP119}}{256}$$

$$\text{Effective position loop gain (L-coil)} = \text{SP001 (SP002)} \times \frac{\text{SP120}}{256}$$

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

- **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.

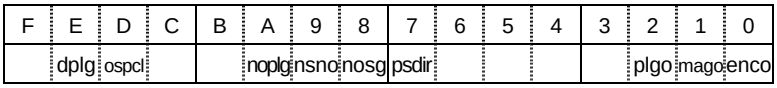
$$\text{Effective deceleration rate (H coil)} = \text{SP006} \times \frac{\text{SP121}}{256}$$

$$\text{Effective deceleration rate (L coil)} = \text{SP006} \times \frac{\text{SP122}}{256}$$

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

[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. This clamp speed can be clamped in the spindle side speed by setting the parameter SP037(SFNC5)/bitD=1. If the gear has two or more stages and the change of the gear rate is large for the gear stage, clamping in the spindle side speed can be stopped more stably.

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
SP037	SFNC5	Spindle function 5			

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.

(5) Adjustments during orientation stop

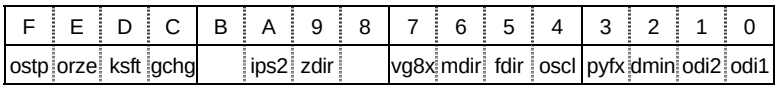
[1] Position loop gain adjustment

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.

$$\text{Effective position loop gain (H coil)} = \text{SP001 (SP002)} \times \frac{\text{SP119}}{256} \times \frac{\text{SP225}}{256}$$

$$\text{Effective position loop gain (L coil)} = \text{SP001 (SP002)} \times \frac{\text{SP120}}{256} \times \frac{\text{SP226}}{256}$$

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
SP097	SPECO	Orientation specification	 bit: C, gchg Meaning when set to 0: Gain changeover during orientation invalid Meaning when set to 1: Gain changeover during orientation valid Standard: 0		
SP225	OXKPH*	Position loop gain magnification after orientation completed (H coil)	If gain changeover is valid (SP097: SPEC0/bitC=1) during orientation, set the position loop gain magnification (H coil) changed to after orientation completed.	0 to 2560 (1/256-fold)	0
SP226	OXKPL*	Position loop gain magnification after orientation completed (L coil)	If gain changeover is valid (SP097: SPEC0/bitC=1) during orientation, set the position loop gain magnification (L coil) changed to after orientation complete.	0 to 2560 (1/256-fold)	0

[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 side 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 the torque limit inputs 1 to 3 are turned ON 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)

(6) 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

(7) 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 side detector..... 1 Magnetic sensor..... 2	Correctly set SP037 (SFNC5).	
		Orientation start is not set to the general-purpose input. Or, the input in which the actual orientation command is wired and the location set in the parameter are different.	Set “1” in any one of the general-purpose inputs SP129 to SP140 which corresponds to the input section where the orientation command has been wired.	
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 selection of gear does not match an actual gear.	Match the selection input (GR1, GR2) of gear with an actual gear.	
		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 side 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	Parameter setting values are incorrect	Orientation complete is not set to the general-purpose output. Or, the input in which the actual orientation complete is wired and the location set in the parameter are different.	Set “1” in any one of the general-purpose outputs SP141 to SP154 which corresponds to the output section where the orientation complete has been wired.	
2	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).	
3	Carry out the items for [1] Orientation does not take place (motor keeps rotating).			

4-3-4 Adjusting the multi-point indexing orientation control

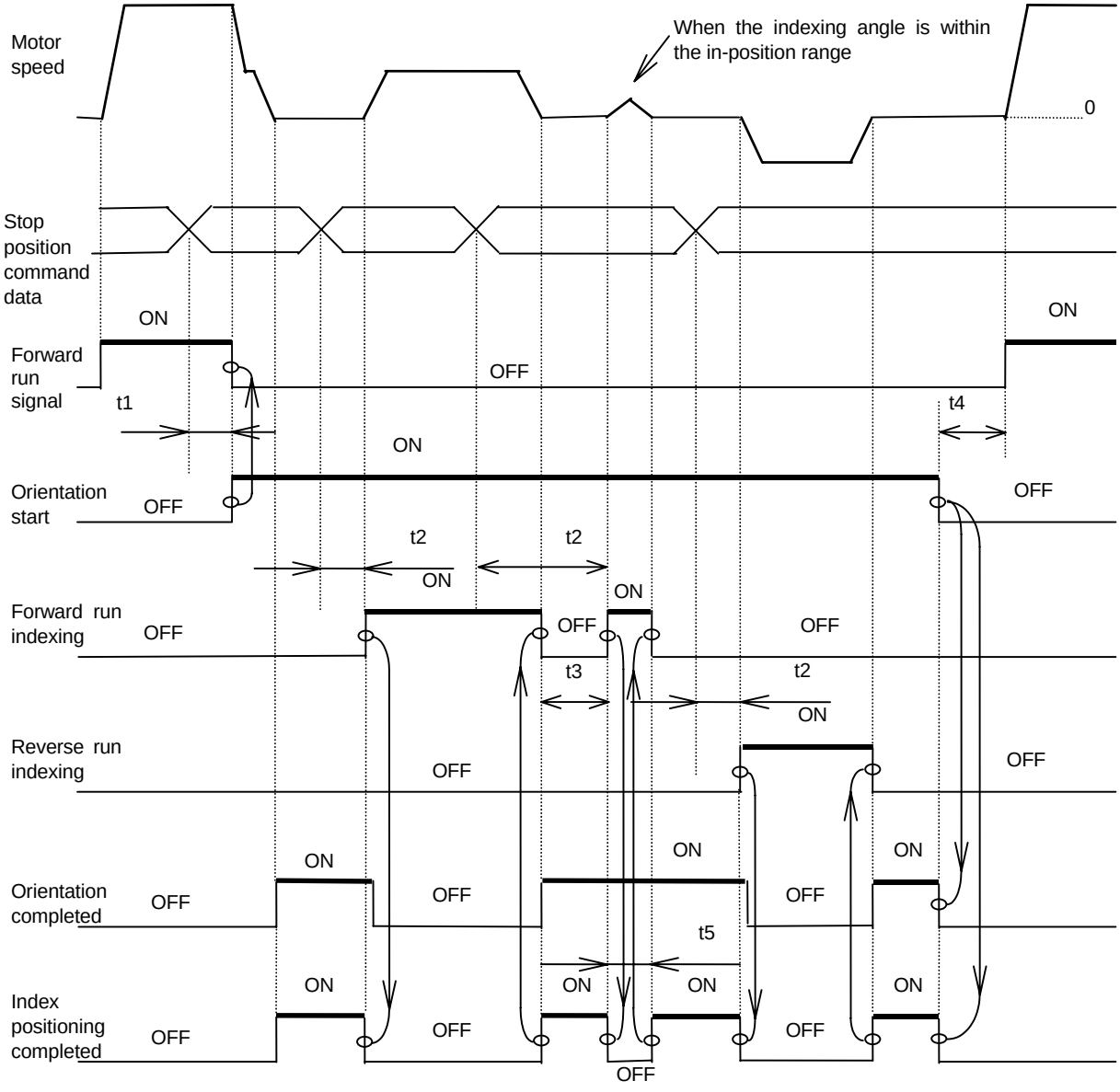
This control is valid only for the encoder orientation or motor PLG orientation specifications.

(1) Necessary input/output

I/O	Signal name	I/O mode	Encoder orientation	Motor PLG orientation
Input	Orientation start command (ORC)	General-purpose input	○	○
	Indexing forward run command, indexing reverse run command (WRN, WRI)	General-purpose input	○	○
	Stop position command data (R1 to R12)	Dedicated input	○	○
	Gear selection command 1, 2 (GR1, GR2)	General-purpose input	△	△
	Torque limit input 1 to 3 (TL1 to TL3)	General-purpose input	△	△
Output	Orientation completed (ORCA)	General-purpose output	○	○
	Index positioning completed (WRCF)	General-purpose output	△	△

○ : Mandatory △ : Set as required

(2) Operation sequence



t1 to t4: 20ms ore more t5: 200ms (Standard value)

[Outline of operation]

After having the motor stop with the orientation stop, change the stop position command data while the orientation command is ON. When the forward (reverse) run indexing signal is turned ON, the motor starts running again and stops at the target stop position within one rotation.
Note that once the orientation command has been turned OFF, it must be turned ON again to make an orientation stop; otherwise, indexing operation cannot be carried out.

⚠ CAUTION

1. Stop position command data (R1 to R12) is read at the rising edge of the forward (reverse) run indexing signal. Thus even if the stop position command data is changed during indexing operation, the angle will not be read until the next forward (reverse) run indexing signal turns ON.
2. When mechanically clamping the spindle motor while the orientation command is being turned ON, execute a torque limit during clamping by turning the torque limit input (TL1 to TL3) ON.
3. Once the forward/reverse run indexing signal has been turned ON, even if the motor is attempted to be turned OFF in the middle of indexing operation, the motor keeps running until its operation is completed. Turn the orientation command or machine ready completion input OFF to stop the motor. The motor is in an uncontrolled state (free run) at this time.
4. The forward/reverse run indexing signal can be turned OFF after outputting the indexing completion signal as shown above, or it can be turned OFF by using a timer after inputting. In the latter case, the timer must be no shorter than 50ms.
5. When executing indexing operations, large torque L-gear is used for the machine with gear steps, and low-speed coil is used for the coil-changeover motor. In this case, shift the machine gear and gear selection command to the L-gear before inputting the orientation command. After that, do not change until turning the orientation start command OFF.
6. The accuracy and least movement increment of indexing may not satisfy the specifications due to the machine backlash, inertia and friction torque. In the case with built-in motor, this may be attributed to the PLG adjustment value, etc., as well.
   In order to secure stable accuracy, especially the following two points must be observed.
   (1) Load inertia shall be less than 3-times the amount of motor inertia.
   (2) Friction torque shall be less than 30% of the motor rating.

(3) Confirming the default parameters

Set the signals listed in (1) to the general-purpose I/O signal, and set the initial parameters for each detector used in orientation control.

(a) Motor PLG

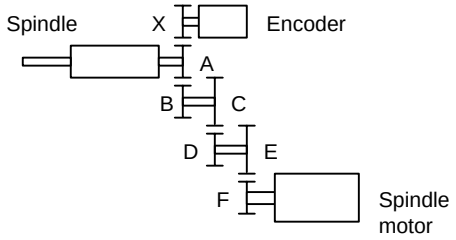
Motor PLG orientation is possible only when the spindle and motor are coupled, or when they are coupled 1:1 with gears (timing belt). Thus, the parameters SP025(GRA1) to SP032(GRB4) are exclusively set to 1. PLG with Z-phase must be mounted on the motor to be used.

(b) 1024p/rev encoder

An accurate gear ratio (pulley ratio) is required from the motor shaft to the encoder 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 encoder in SP096(EGAR).



Spindle configuration when using spindle end detector

No.	Abbrev.	Parameter name	Description	Setting range	Standard value
SP096	EGAR*	Encoder gear ratio	Set the gear ratio between the spindle side and the detector side (except for the motor PLG) as indicated below. 0: 1 : 1 1: 1 : 1/2 2: 1 : 1/4 3: 1 : 1/8 4: 1 : 1/16	0 to 4	0

Initial parameters for the multi-point indexing orientation control are shown below per detector. Confirm that the parameters are correctly set according to the machine specifications.

No.	Abbrev.	Parameter name	Initial parameter setting for each detector	
			(a) Motor PLG	(b) Encoder
SP001	PGM*	Magnetic sensor, motor PLG orientation position loop gain	100	—
SP002	PGE*	Encoder orientation position loop gain	—	100
SP004	OINP*	Orientation in-position width	14	14
SP005	OSP	Orientation mode speed clamp value	0	0
SP006	CSP*	Orientation mode deceleration rate	20	20
SP007	OPST*	In-position shift amount for orientation	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
SP096	EGAR	Encoder gear ratio	—	*
SP097	SPECO	Orientation specification	0010	0010
SP098	VGOP	Speed loop gain proportional term in orientation control mode	63	63
SP099	VGOI	Orientation control mode speed loop gain integral term	60	60
SP100	VGOD	Orientation control mode speed loop gain delay advance term	15	15
SP101	DINP	Orientation advance in-position width	16	16
SP102	OODR	Excessive error value in orientation control mode	32767	32767
SP103	FTM	Index positioning completion OFF time timer	200	200
SP104	TLOR	Torque limit value after orientation completed	100	100
SP105	IQG0	Current loop gain magnification 1 in orientation control mode	100	100
SP106	IDG0	Current loop gain magnification 2 in orientation control mode	100	100
SP107	CSP2*	Deceleration rate 2 in orientation control mode	0	0
SP108	CSP3*	Deceleration rate 3 in orientation control mode	0	0
SP109	CSP4*	Deceleration rate 4 in orientation control mode	0	0
SP114	OPER*	Orientation control pulse miss check value	0	0
SP115	OSP2	Orientation control speed clamp value 2	10	10
SP116	OPYVR*	Minimum excitation value after changeover (2nd minimum excitation rate)	0	0
SP117	ORUT*	Fixed control constant	0	0
SP118	ORCT*	Orientation control number of retry times	0	0
SP119	MPGH*	Orientation control position loop gain H coil magnification	0	0
SP120	MPGL*	Orientation control position loop gain L coil magnification	0	0
SP121	MPCSH*	Orientation deceleration rate H coil magnification	0	0
SP122	MPCSL*	Orientation deceleration rate L coil magnification	0	0
SP129 to SP140	HI01 to HI12	General-purpose input selection 1 to 12	1: Orientation start 2: Forward run indexing 3: Reverse run indexing 4: Torque limit 1 5: Torque limit 2 6: Torque limit 3 7: Gear selection 1 8: Gear selection 2	1: Orientation start 2: Forward run indexing 3: Reverse run indexing 4: Torque limit 1 5: Torque limit 2 6: Torque limit 3 7: Gear selection 1 8: Gear selection 2
SP141 to SP154	HO1e to HO6c	General-purpose output selection open emitter 1 to open collector 6	1: Orientation completed 2: Index positioning completed	1: Orientation completed 2: Index positioning completed
SP225	OXKPH*	Position loop gain magnification after orientation completed (H coil)	0	0
SP226	OXKPL*	Position loop gain magnification after orientation completed (L coil)	0	0
SP227	OXVKP*	Speed loop proportional gain magnification after orientation completed	0	0
SP228	OXVKI*	Speed loop cumulative gain magnification after orientation completed	0	0

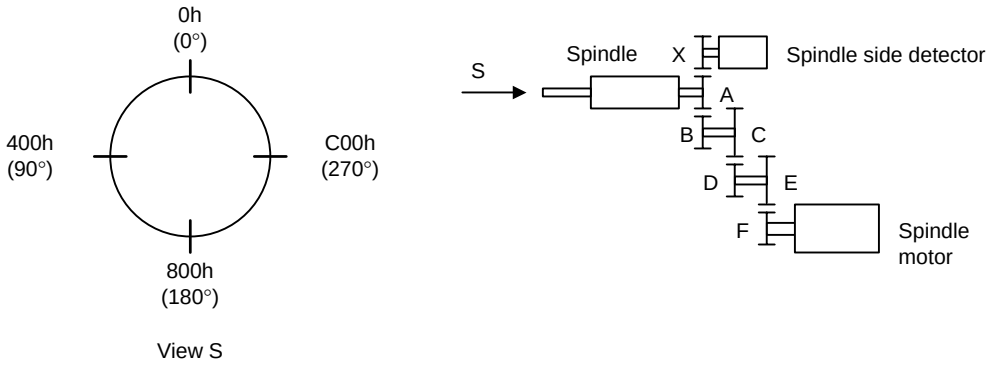
(Note 1) Symbols used in the parameter setting column:
*: Set according to machine specifications, —: Setting irrelevant

(Note 2) Parameters having an abbreviation with "*" (PGM*, etc.) are validated right after the settings are changed by the personal computer, without turning the spindle drive unit's power ON and OFF.

(Note 3) When adjustment of indexing operation is executed after orientation adjustment, set "1" to SP097 bit4, "10" to SP115, and any arbitrary value to SP129 to SP154 and add them to the post-adjustment setting values.

(4) Stop position by the stop position data

The relation between the index stop position and stop position data is the same as the one during orientation. The position that has been shifted with SP007(OPST) equals to the position of 0° in the figure below. With the indexing by the motor PLG, the position shown in the figure below is one viewed from the motor shaft side.



Orientation, multi-point index stop position

(Note) When "1" is set in SP037(SFNC5)/bit7, the stop position by the external stop position data can be changed by 180° in the figure above. (0h: 0°, C00h: 90°, 800h: 180°, 400h: 270°)

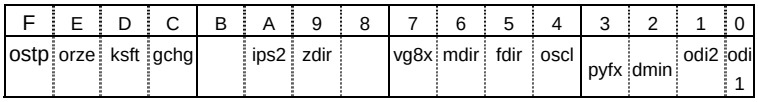
No.	Abbrev.	Parameter name	Description	Setting range	Standard value
SP037	SFNC5	Spindle function 5			

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

bit		Meaning when "0" is set	Meaning when "1" is set	Standard
7	psdir	Position shift (standard)	Position shift (reversed direction)	0

(5) Adjusting the orientation control

Execute the section "4-3-3 Adjusting the orientation control". At this time, if the orientation stop position deviates near the target stop position even if the speed loop gain during orientation (SP098, SP099) is increased within the range that is free from vibration, change the orientation stop control to the PI control. Furthermore, if the stop position deviates in the forward reverse run even if changed to the PI control, set so that the orientation direction is unidirectional.

No.	Abbrev.	Parameter name	Description	Setting range	Standard value
SP097	SPECO	Orientation specification			
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
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 speed 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

bit		Meaning when "0" is set	Meaning when "1" is set	Standard
0	odi1	Orientation rotation direction		0
1	odi2	00: Previous (the direction in which the motor has so far rotated under speed control)		0
		10: Backward rotation 01: Forward rotation 11: Prohibited		

(6) Adjusting the indexing speed

When "1" is set in SP097(SPECO) bit 4, the indexing speed is the value set in SP115(OSP2). Carry out indexing operations and adjust to the desirable speed. Swaying may occur when stopped as speed is increased. Note that the actual indexing speed could be smaller than the value set in SP115 and may not be changed in 1r/min increments.

<table>
<tr><th>No.</th><th>Abbrev.</th><th>Parameter name</th><th>Description</th><th>Setting range</th><th>Standard value</th></tr>
<tr><td>SP097</td><td>SPECO</td><td>Orientation control specification</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>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 "0" is set</th><th>Meaning when "1" is set</th><th>Standard</th></tr>
<tr><td>4</td><td>oscl</td><td>Indexing speed clamp invalid</td><td>Indexing speed clamp valid</td><td>0</td></tr>
</table>
</td><td></td><td></td></tr>
<tr><td>SP115</td><td>OSP2</td><td>Orientation control speed clamp value 2</td><td>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).</td><td>0 to 32767 (r/min)</td><td>0</td></tr>
</table>

(7) Adjustment during index stop

With the machine in which attachments are identified, when inertia or friction torque differs from one applied during regular orientation control, servo rigidity after completion of indexing is set again. Refer to the item "(5) Adjustments during orientation stop" in the section "4-3-3 Adjusting the orientation control" when setting.

(8) Adjusting the indexing complete signal

When the completion of indexing is substituted with the orientation completion signal (ORCA), if the indexing angle or time is insufficient, indexing operation may be continued ON even if the indexing operation is not completed. If this is an issue, use the index positioning completion signal (WRCF). When the forward/reverse run indexing signal turns ON, the indexing completion signal always turns OFF once and then turns ON at the completion of indexing operation. The shortest span for the time being OFF can be set with parameters.

Related spindle parameters

No.	Abbrev.	Parameter name	Description	Setting range	Standard value
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 rising edge of the indexing start signal.	0 to 10000 (ms)	200
SP141 to SP154	HO1e to HO6c	General-purpose output selection open emitter 1 to general-purpose output selection open collector 6	When using the index positioning completed output, set the following value to any one of these parameters. "2": Positioning completed (WRCF)	0 to 23	0

(9) Troubleshooting

For the troubles during orientation, refer to (7) Troubleshooting in the section "4-3-3 Adjusting the orientation control".

[1] Not executing indexing operation

	Cause	Investigation item	Remedy	Remarks
1	Parameter setting values are incorrect	Forward/reverse run indexing start is not set to the general-purpose input. Or, the input in which the actual forward/reverse run indexing signal is wired and the location set in the parameter are different.	Set either "2" or "3" in one of the general-purpose input parameters SP129 to SP140 which corresponds to the input section where the orientation command has been wired.	
2	Sequence error	When the forward/reverse run indexing signal is ON, the orientation command is OFF.	To run indexing operations, always keep the orientation command signal turned ON.	
		The external stop position data has not been changed.	Officially change the external stop position data.	
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 selected gear and the actual gear are different.	Adjust gear selection inputs (GR1, GR2) according to the actual gear.	
		The gear ratio parameters: SP025(GRA1) to SP032(GRB4) are incorrect.	Correctly set SP025(GRA1) to SP032(GRB4).	
		Half the deceleration rate during orientation parameter SP006 (CSP) to solve the problem.	Readjust SP006(CSP).	This also applies to: SP107(CSP2) SP108(CSP3) SP109(CSP4) SP121(MPCSH) SP122(MPCSL)
		Position loop gain parameter Change the value of SP001(PGM), SP002(PGE) to solve the problem.	Readjust SP001(PGM), SP002(PGE).	This also applies to: SP119(MPGH) SP120(MPGL)

[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 between the spindle and encoder. The gear ratio between the spindle and encoder is not 1:1 or 1:2.	For spindle side 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.	

[4] The stop 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, indexing complete signal is not output

	Cause	Investigation item	Remedy	Remarks
1	Parameter setting values are incorrect	Orientation completion or indexing completion is not set to the general-purpose output. Or the actual orientation completion is wired to a different output from the one set in the parameter.	Set "1" or "2" in one of the general-purpose output parameters SP141 to SP154 which corresponds to the output section where the orientation completion has been wired.	
2	The machine's load is heavy	The in-position parameter SP004 (OINP) is too small.	Review the in-position range, and increase SP004 (OINP).	
		Stop the delay compensation control during orientation stop to solve the problem. (Change to the PI control to solve the problem.)	Review the values set for the speed loop gain for orientation parameters SP098 (VGOP), SP099 (VGOI) and SP100 (VGOD).	
3	Carry out the items for [1] Orientation does not take place (motor keeps rotating).			

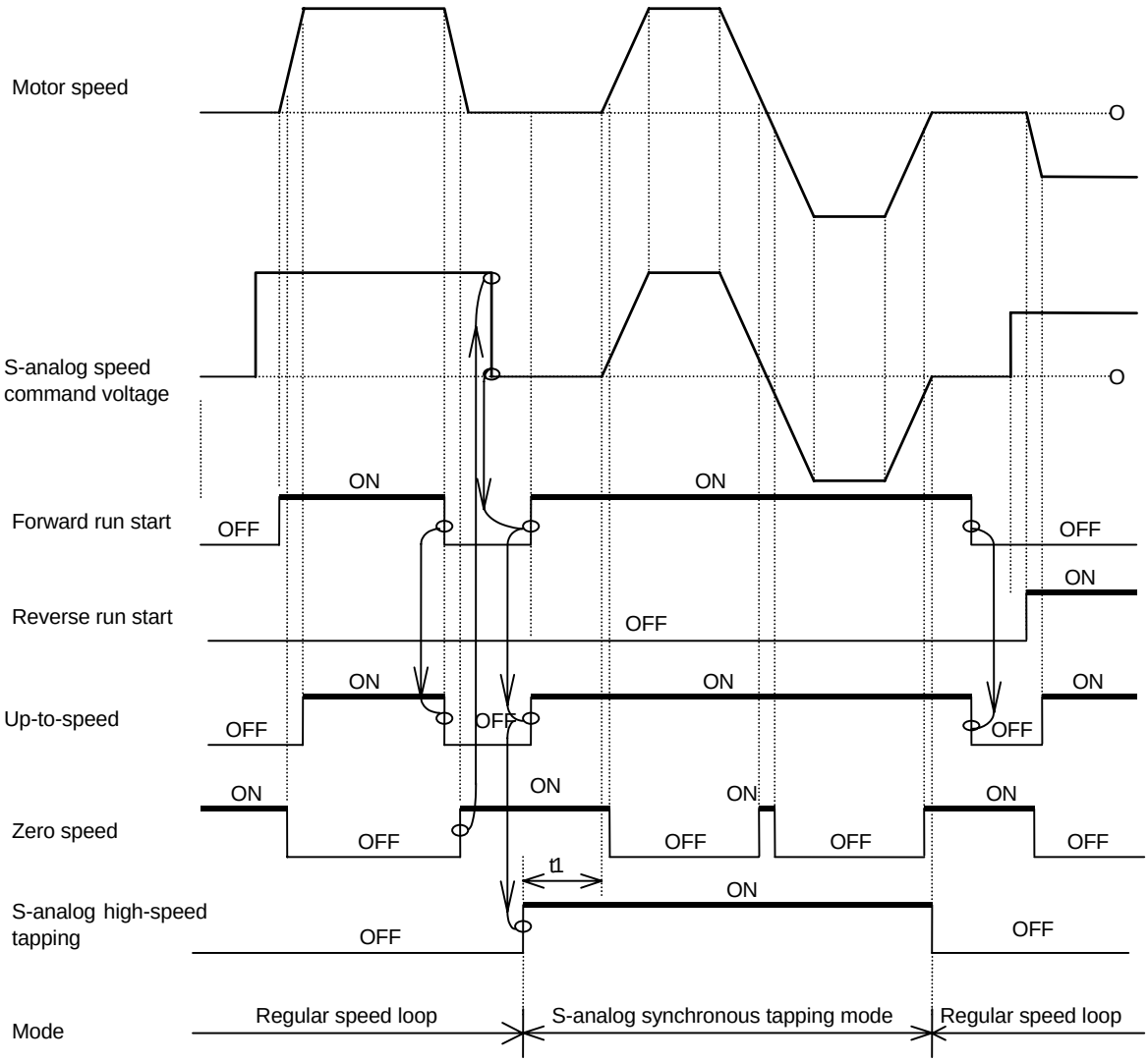
4-3-5 Adjusting S-analog high-speed tapping control

(1) Necessary input/output

I/O	Signal name	I/O mode	Mandatory/Optional
Input	S-analog high-speed tapping input (HSP)	General-purpose input	◯
	Analog speed command input (bipolar)	Analog input	◯
	Forward run signal (SRN), reverse run signal (SRI)	Special input	◯
Output	Pulse feedback output signal	Special output	◯
	Up-to-speed output signal	General-purpose output	◯
	Zero speed output signal	General-purpose output	◯

◯: Mandatory

(2) Operation sequence



[Outline of operation]

Turn OFF the start command for forward run, reverse run and orientation to stop the motor. Then, turn the speed command voltage to "0". After that, turn ON the forward run command, then the S analog synchronous tapping command. The spindle drive unit makes the speed command cushion to "0" while S analog synchronous tapping command is ON and rotates the motor according to the given speed command voltage. Create a position loop for the NC unit, based on A-, B-, Z-phase pulse of the pulse feedback signal output from the spindle drive unit.

⚠ CAUTION

1. A-, B-, Z-phase pulse output from the pulse feedback output are determined by the detector to be used for orientation and cannot be selected arbitrarily when using this function.
2. When focusing precision while using this function, the load inertia shall be less than 3-times the motor inertia.
3. In the case where no orientation function is available, this function can be used even if PLG with Z phase is not mounted onto the motor. However, in that case, Z phase signal will not be output from the pulse feedback output, and the one-rotation position cannot be detected.
4. When inputting the speed command, always use the bipolar analog input section. Also, set the parameters in bipolar settings.
5. When a coil changeover motor is used, do not turn the L-coil selection signal ON/OFF during this control. When L-coil selection signal is turned ON/OFF, the coil changeover operation is immediately executed with the spindle drive unit, causing some failure such as breakage of taps.

(3) Confirming the initial parameters

When using this function, NC side parameters greatly affect, as well. Refer to the NC manual and confirm the default value settings for the NC related parameters.

<Spindle drive unit side parameters>

No.	Abbrev.	Parameter name	Unit	Setting range	Initial value
SP037	SFNC5	Spindle function 5	—	0000 to FFFF	*
SP038	SFNC6	Spindle function 6	—	0000 to FFFF	*
SP129 to SP140	HI01 to HI12	General-purpose input selection 1 to 12	—	0 to 21	17:S-analog high-speed tapping
SP141 to SP154	HO1e to HO6c	General-purpose output selection open emitter 1 to open collector 6	—	0 to 23	14:Up-to-speed 15:Zero speed
SP155	SAtyp	S-analog speed command input type		0 to 1	0
SP171	HSPT	S-analog high-speed tapping motor maximum speed	r/min	0 to 32767	0
SP172	VGHP	S-analog high-speed tapping speed loop proportional gain		0 to 1000	0
SP173	VGHI	S-analog high-speed tapping speed loop integral gain		0 to 1000	0
SP174	HPYV	S-analog high-speed tapping variable excitation rate (min value)	%	0 to 100	0
SP175	HSgn*	S-analog high-speed tapping speed command gain	1/1000-fold	0 to 2500	0
SP176	HADof*	S-analog high-speed tapping speed command offset	—	-999 to 999	0

(Note 1) Symbols used in the parameter setting column
*: Set according to machine specifications, —: Setting irrelevant

(Note 2) Parameters having an abbreviation with "*" are validated right after the settings are changed by the personal computer, without turning the spindle drive unit's power ON and OFF.

POINT

Always adjust the synchronous tap control after adjusting the operation following the speed command and the acceleration/deceleration time, and after adjusting the servo axis synchronized with the spindle during synchronous tap control.

(4) Adjustment

General adjustment method is described in the following. Note that, however, if the adjustment method is described in the adjustment manual for the NC to be used, the NC adjustment manual takes precedence over this manual.

(5) 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 of the measured value as the standard value.

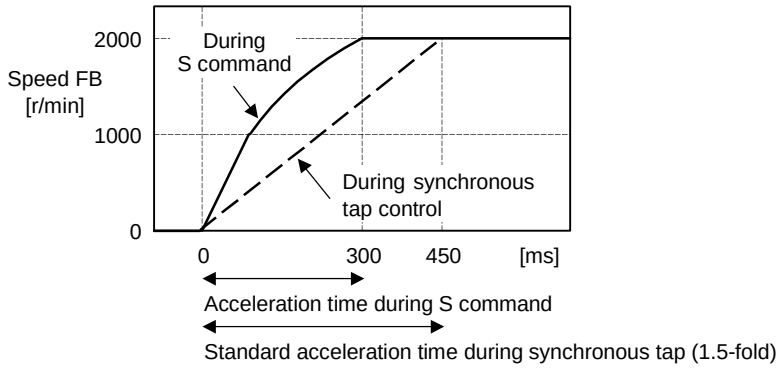
If the spindle maximum rotation speed is 2000r/min during synchronous tap operation, first carry out 2000r/min acceleration/deceleration with the S command as shown below. Then, measure the total acceleration time in a linear, 2-step or 3-step state. The time constant for synchronous tap operation is 450ms which is 1.5-fold 300ms.

When the value other than "0000" is set to the spindle parameters SP314 to SP319 or SP378 to SP383, change the parameter value as follows and turn the spindle drive unit's power ON/OFF or turn the alarm reset input ON/OFF before collecting the acceleration/deceleration data.

Set the same value as SP314 to SP317, SP315 to SP318, and SP316 to SP319.

Set the same value as SP378 to SP381, SP379 to SP382, and SP380 to SP383.

Upon completion of the measurement, be sure to return the changed parameter value to the original setting value.



Measuring the acceleration time during S command

POINT	When executing the synchronous tapping operation with the coil changeover motor, the coil must be fixed and used. In this case, fix all the coils to be used one by one, and carry out S command to measure the acceleration/deceleration time.

(6) Confirming pulse feedback output signal

Pulse feedback signal output from the spindle drive unit is confirmed.
Related parameter Nos. and descriptions are as shown below.

No.	Abbrev.	Parameter name	Description	Setting range	Standard value
SP037	SFNC5	Spindle function 5			
SP038	SFNC6	Spindle function 6			

SP037 SFNC5 Spindle function 5

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

bit		Meaning when "0" is set	Meaning when "1" is set	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

SP038 SFNC6 Spindle function 6

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

bit		Meaning when "0" is set	Meaning when "1" is set	Standard
3	plg2	Semi-closed pulse output signal×2 invalid	Semi-closed pulse output signal×2 valid	0

The pulse feedback signals with the above parameter settings (CN8A-2 to 4, 12 to 14 pins) outputs the following signals.

SP037 setting	CN8A-2(SYA), 12(SYA*)	CN8A-3(SYB), 13(SYB*)	CN8A-4(SYZ), 14(SYZ*)
bit2: "1", or bit0 to 2: "0"	Motor PLG A phase signal	Motor PLG B phase signal	Motor PLG Z phase signal (Note 1)
bit0: "1"	1024p/rev encoder A phase signal	1024p/rev encoder B phase signal	1024p/rev encoder Z phase signal
bit1: "1"	Motor PLG A phase signal	Motor PLG B phase signal	Magnetic sensor LNZ signal

(Note 1) Z-phase signal will not be output when Z-phase signal is not mounted on the motor PLG.
(Note 2) When "1" is set to SP038 bit3, A-phase and B-phase signals of the motor PLG output doubling the number of pulses per revolution. (When PLG is 256p/rev, 512p/rev oblong wave is output.)
(Note 3) All the pulse feedback signals are output in oblong wave. For details, refer to the section "2-6-2 Output interface".

(7) Adjusting the analog command offset

Turn the S-analog synchronous tapping signal ON and confirm the minute vibration when stopped. If the vibration is large, set the value of SP158(Adofs) to SP176(HADof) and adjust the value of SP176(HADof) to minimize the vibration.

Related spindle parameters

No.	Abbrev.	Parameter name	Description	Setting range	Standard value
SP176	HADof*	S-analog high-speed tapping speed command offset	Sets the speed command voltage offset value during S-analog high-speed tapping. When "0" is set, the value will be the one set in SP158(Adofs).	-999 to 999	0

(8) Adjusting analog command gain

Turn the S analog synchronous tapping signal ON to secure a longer stroke. Carry out dry-run operation at the highest speed available for synchronous tapping and adjust SP175(HSgn) to gain the highest desirable speed.

Related spindle parameters

No.	Abbrev.	Parameter name	Description	Setting range	Standard value
SP175	HSgn*	S-analog high-speed tapping speed command gain	Sets the speed command voltage gain during S-analog high-speed tapping. When "0" is set, the value will be the one set in SP161(Sgain).	0 to 2500 (1/1000-fold)	0

(9) Synchronous tapping 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 there is no problem, proceed with actual cutting operation. If there any problem occurs during dry run operation or actual cutting operation, refer to the following table and change the settings accordingly.

	NC side setting		Spindle drive unit side setting	
	Position loop gain	Acceleration/ deceleration time constant	SP172(VGHP) SP173(VGHI)	SP174(HPYV)
Gear noise is louder than one in regular operation	↘	↗	↘	↘
The spindle undershoots or overshoots	↘	↗	↗	↗
Machining accuracy is poor	↗	↗	↗	↗
Machining time is long	↗	↘	→	→

(Note 1) The meaning of the arrows above is as described below.

↗ : Increase the setting value

→ : Do not change the setting value

↘ : Decrease the setting value

(Note 2) When the gear noise is large in standard setting, and the machining precision deteriorates as the speed loop gain is decreased, if the motor maximum speed during S analog high-speed tapping is lower than the regular motor maximum rotation speed, those conditions may be solved by setting a smaller value than SP017(TSP) in SP171(HSPT).
Note that, in this case, the spindle (or the motor) maximum speed during the NC side S analog high-speed tapping must be changed. Thus, analog speed command offset and analog speed command gain must be adjusted again.

Related spindle parameters

No.	Abbrev.	Parameter name	Description	Setting range	Standard value
SP171	HSPT	S-analog high-speed tapping motor maximum speed	Sets the maximum motor speed during S-analog high-speed tapping. When "0" is set, the value will be the one set in SP017(TSP). Sets the maximum motor tapping speed here when the gear noise is louder than during the regular speed loop operation, or when you wish to improve the tapping accuracy.	0 to 32767 (r/min)	0
SP172	VGHP	S-analog high-speed tapping speed loop proportional gain	Sets the speed loop proportional gain during S-analog high-speed tapping. The larger the value, the higher the responsiveness, but the bigger the vibration or noise becomes. When "0" is set, the value will be the one set in SP022(VGNP1).	0 to 1000	0
SP173	VGHI	S-analog high-speed tapping speed loop integral gain	Set s the speed loop integral gain during S-analog high-speed tapping If the value of SP172(VGHP) is set, set the value so that the setting value's proportion between SP172 and SP173 is 1:1. When "0" is set, the value will be the one set in SP023(VGNI1).	0 to 1000	0
SP174	HPYV	S-analog high-speed tapping variable excitation rate (min value)	Sets the minimum value of the variable excitation rate during S-analog high-speed tapping. Smaller value is set to suppress the gear noise, etc., and larger value is set to improve the tapping accuracy.	0 to 100 (%)	0

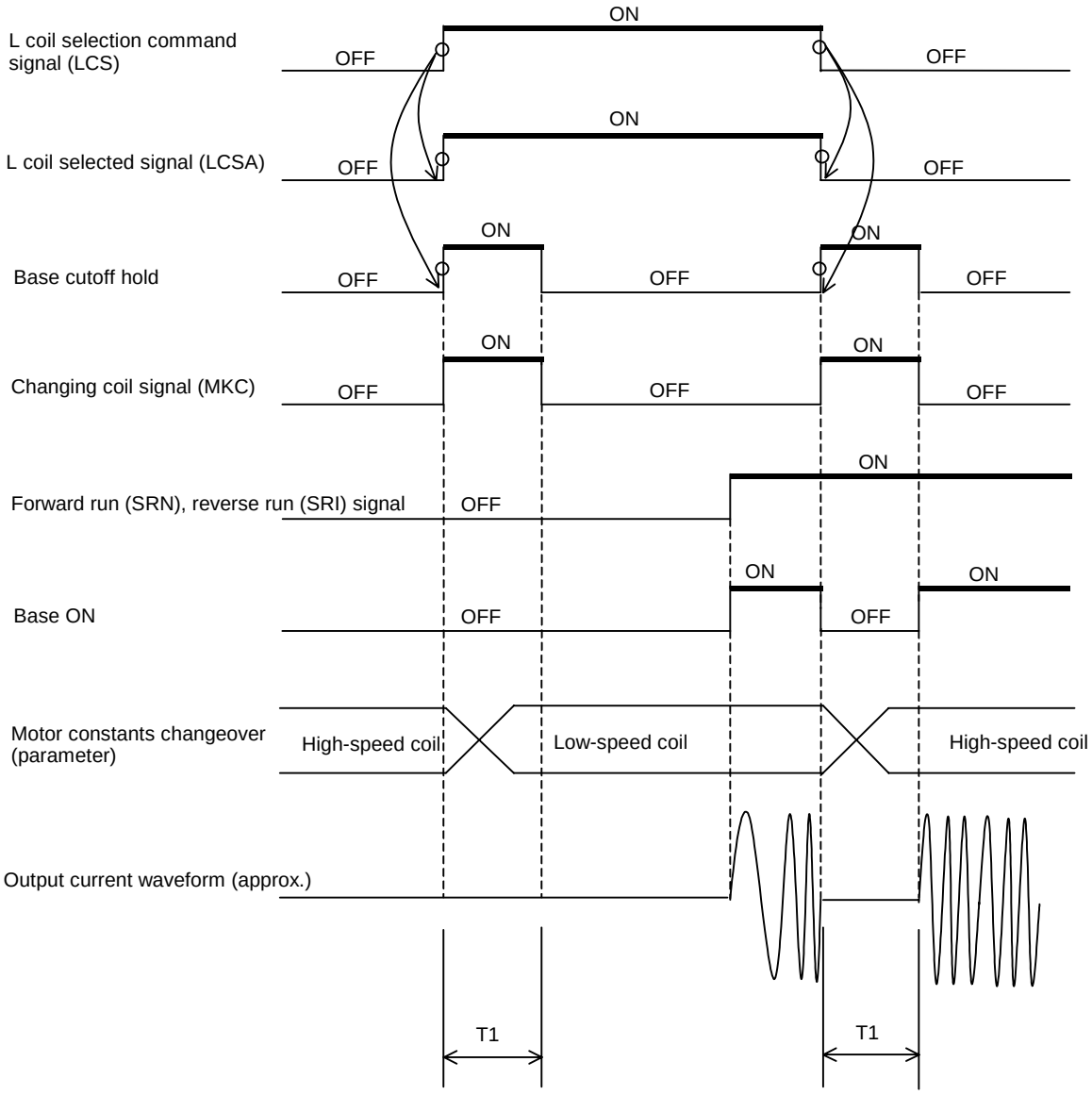
4-3-6 Adjusting coil changeover

(1) Necessary input/output

I/O	Signal name	I/O mode	Mandatory/Optional
Input	L coil selection command signal (LCS)	General-purpose input	○
	Forward run signal (SRN), reverse run signal (SRI)	Dedicated input	○
Output	L coil selected signal (LCSA)	General-purpose output	○
	Changing coil signal (MKC)	General-purpose output	△

○ : Mandatory △ : Optional

(2) Operation sequence



T1: Base cutoff hold time (SP059 Standard setting:150ms)

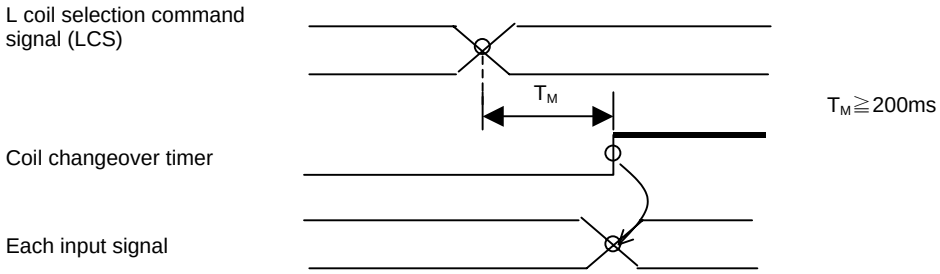
[Outline of operation]

A coil of the motor is changed when using a coil changeover motor. When changing the coil, change the contactor connected outside by turning L coil selection signal ON/OFF during motor operation or motor stop.

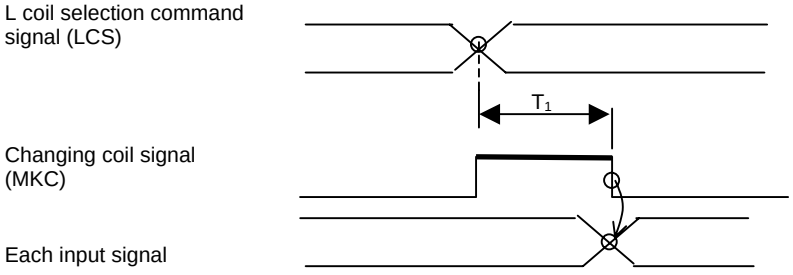
⚠ CAUTION

1. The motor will be in an uncontrolled state after the L-coil selection signal has turned ON/OFF until the coil is fully changed over. Thus, when changing coils during heavily cutting operations, the motor speed may be dropped significantly, or the motor may be stopped. When cutting surface precision is required, do not perform coil changeover or avoid cutting during rotation in this period.
2. In T_1(During base shut-off time) in the figure of the previous page, the spindle drive unit does not accept any input signal (forward run start command, reverse run start command, orientation start command). Thus, input those signals to the spindle drive unit, having TM($=T_1$+50ms) or more timer secured after the L coil selection command signal (LCS) has been changed as shown in the drawing below.
   Instead of using a timer, those signals can be input after the "changing coil" signal (MKC) is turned ON from OFF.
3. Base shut-off time T_1 is determined with the parameter SP059 (MKT) setting value. In connection with the contactor operation, the standard value will be 150ms. Thus, TM usually has to be set to 200ms or more.

[1] Using a timer



[2] Using the "changing coil" signal (valid only when MDS-B-SPA is used)

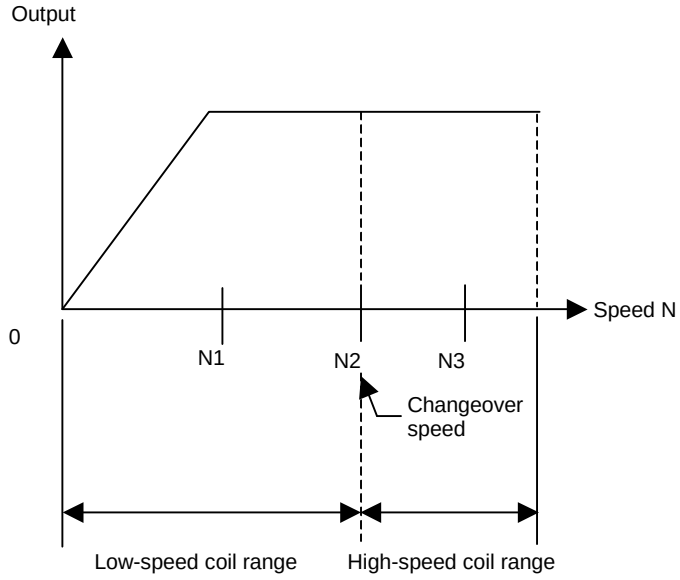


(3) Changing the coil in the speed control mode

When the motor's output characteristics listed on the Mitsubishi motor rating table are as follows, N2 is the coil changeover speed, and the following expression is established.

$\begin{cases} 0 \leq N \leq N2 \text{ is the low-speed coil usage range} \\ N2 < N \text{ is the high-speed coil usage range} \end{cases}$

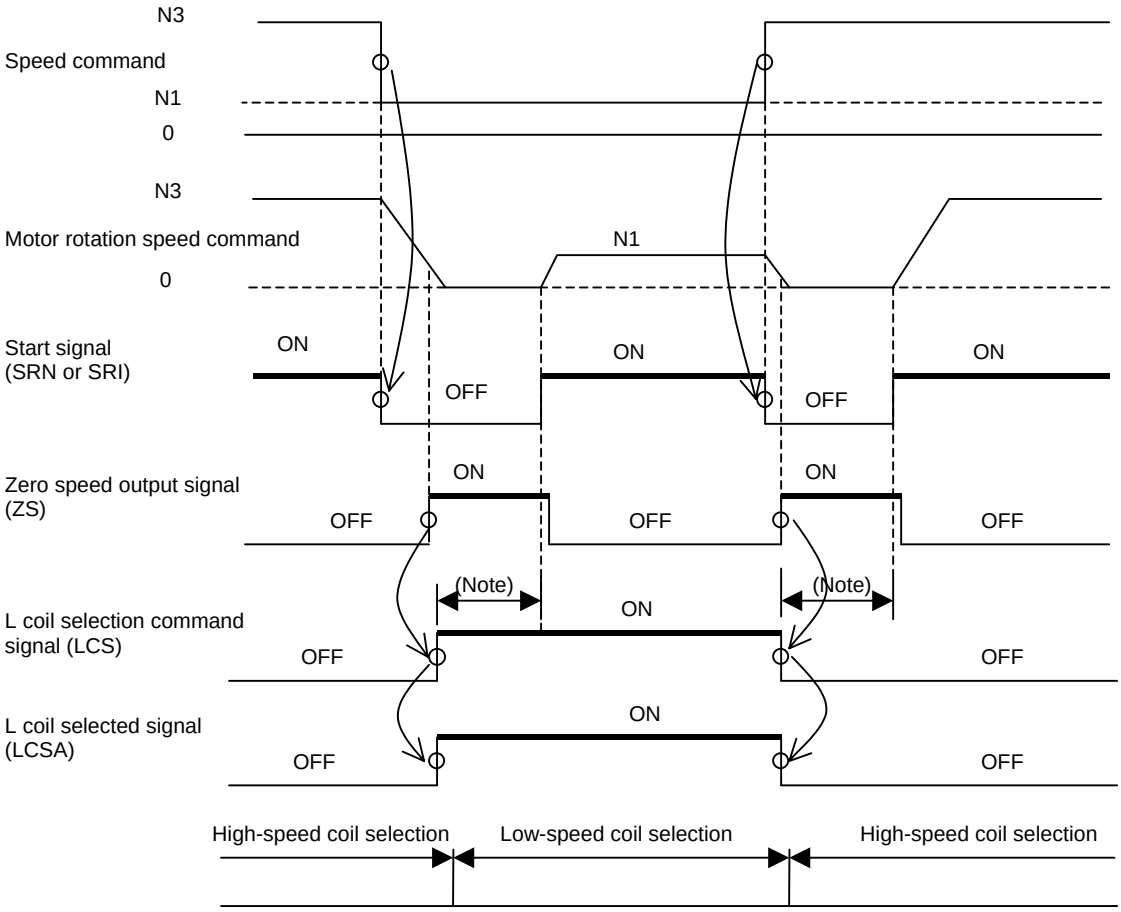
The method for inputting the L coil selection signal (LCS) to change from the low-speed coil range N1 to the high-speed coil range speed N3 (vice versa) is explained in this section.



1) Stopping the spindle motor and changing the coil

With this method, the high-speed coil and low-speed coils are viewed as electronic gears that are handled in the same manner as the mechanical gears.

<Example of N3 → N1 → N3 changeover sequence>



[1] If the speed command changes to N1 while the motor is rotating in N3 (high-speed coil range), the motor is stopped once by the user's sequence. After confirming that the zero speed output signal (ZS) has turned ON, the L coil selection command signal (LCS) is turned ON. After changing from the low-speed coil to the high-speed coil, the start signal (SRN or SRI) is turned ON again, and the motor is accelerated to N1.

[2] In the same manner, when changing the speed command from N1 to N3, the motor is stopped once. After confirming that the zero speed output signal (ZS) has turned ON, the L coil selection command signal is turned OFF. After changing from the high-speed coil to the low-speed coil, the start signal is turned ON, and the motor is rotated at the speed of N3.

(Note) Provide a time longer than T_M from when the L coil selection command signal (LCS) is input to when the start signal turns ON. Or, set the sequence so that the start signal turns ON after the coil changed signal (MKC) changes from ON to OFF instead of using a timer.

2) Changing the coil during spindle motor rotation

This method uses the characteristics of coil changeover to change the coil during motor rotation, and changing directly from the low-speed coil to the high-speed coil. The transition time is shorter compared to the method explained in the previous section. The speed detection signal (SD) is used with this method, and the L coil selection command signal (LCS) is input in the following manner.

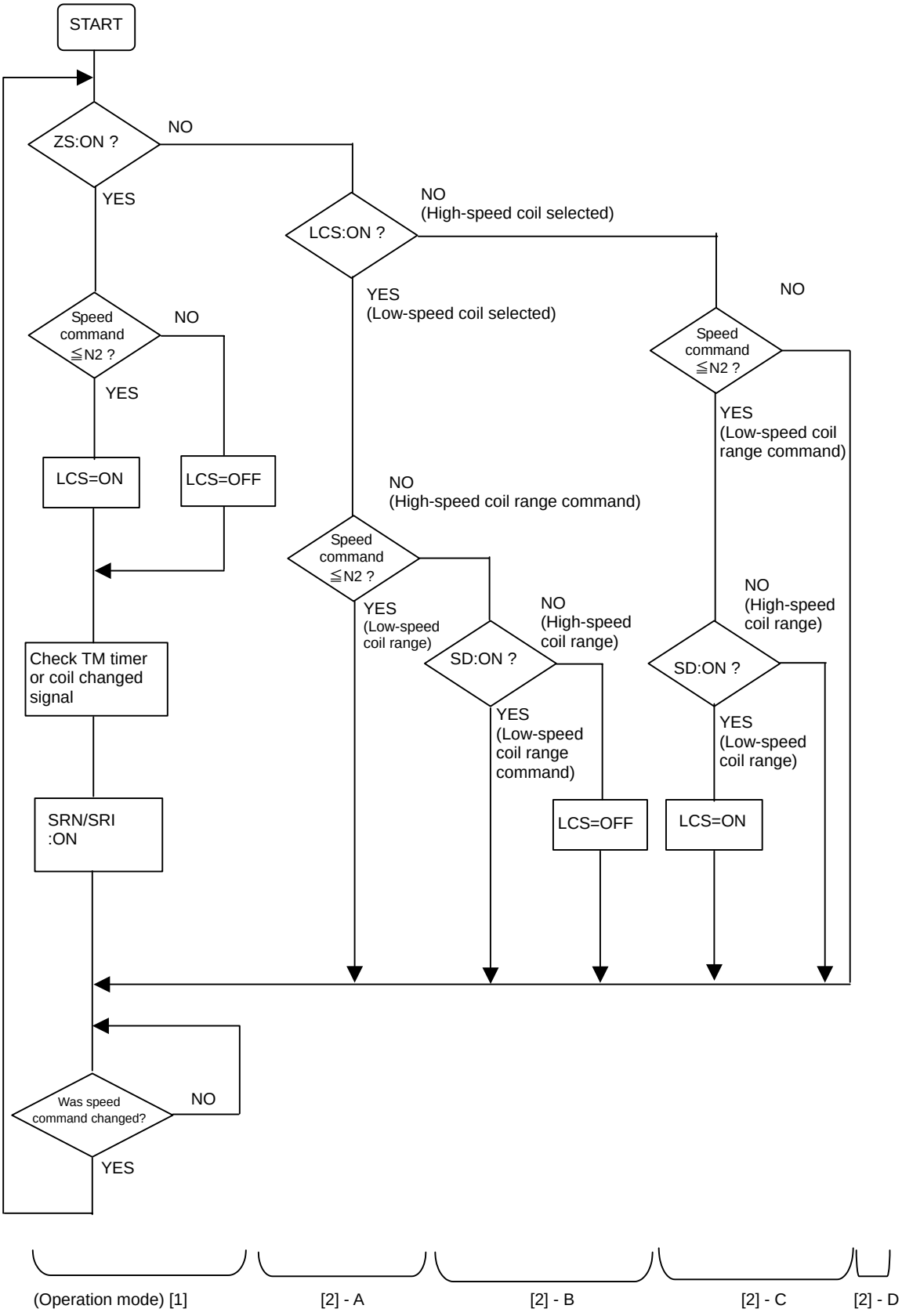
[1] To accelerate from a stopped state (To accelerate after zero speed output signal turns ON)
  (i) First, judge the high-speed/low-speed coil range with the speed command, and select the coil. (Input the L coil selection command signal (LCS).)
  (ii) Next, turn the start signal ON and accelerate the motor.
  (iii) Hold the L coil selection command signal (LCS) in the state of (i).

[2] When varying the speed, turn the L coil selection command signal (LCS) ON and OFF as shown in the following table.

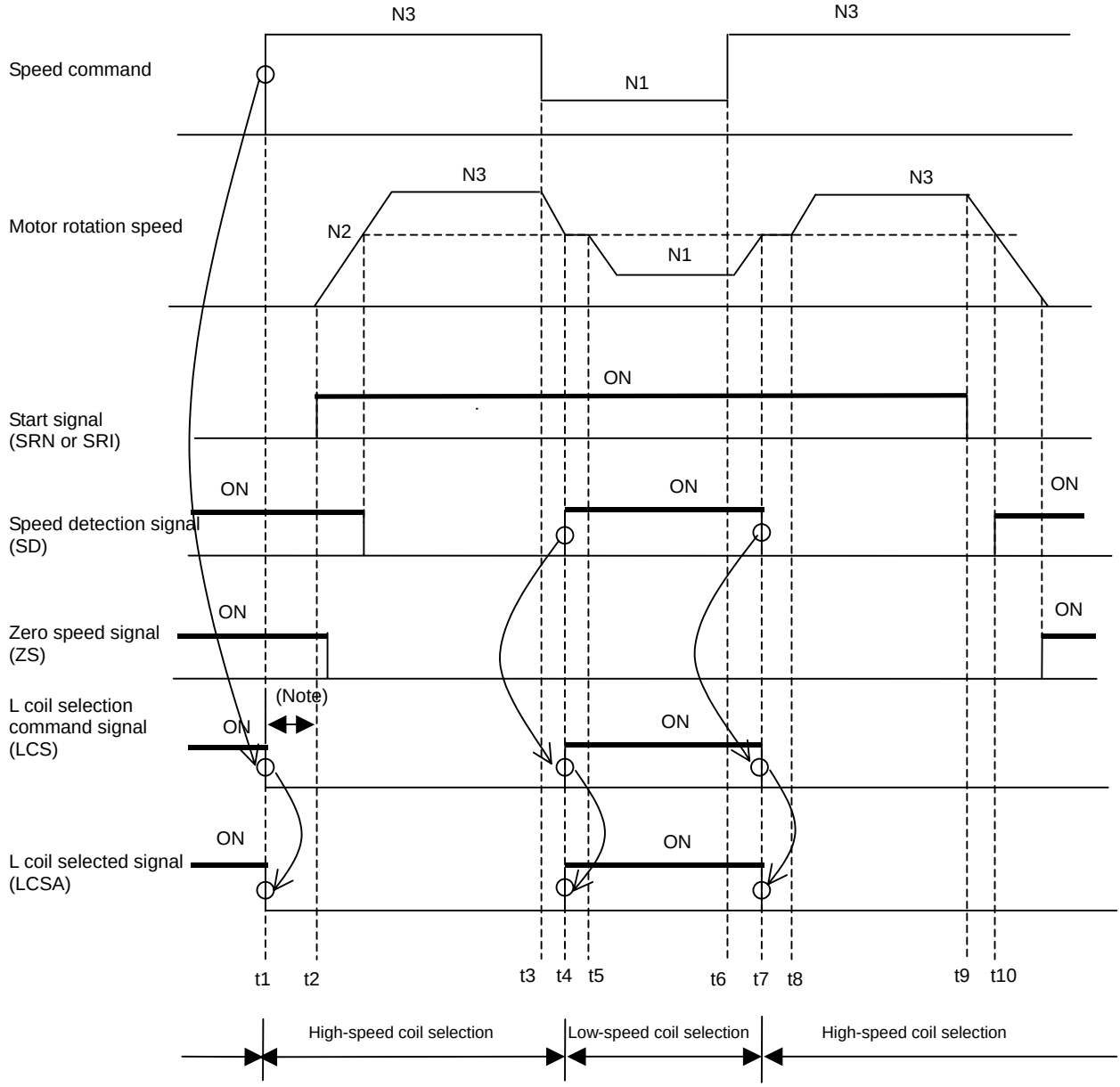
Current coil state	**When low-speed coil is selected**		**When high-speed coil is selected**	
Next speed command	Low-speed coil range Does not change (LCS: ON)	High-speed coil range Judge state of SD signal [1] SD: ON →LCS: ON [2] SD: OFF →LCS: OFF	Low-speed coil range Judge state of SD signal [1]SD: ON →LCS: ON [2] SD: OFF →LCS: OFF	High-speed coil range Does not change （LCS: OFF）
Operation mode	[2]－A	[2]－B	[2]－C	[2]－D

(Note) The conditions in item 1) are applied to prevent the contactor from turning ON/OFF needlessly during acceleration/deceleration.
Since the speed detection signal (SD) has a hysteresis, the conditions in item 2) are applied to prevent the contactor from turning ON/OFF needlessly (inconsistently) when operating near the coil change speed and continuously varying the speed.

(Reference) The generation of the signals in item [1] and [2] are shown in the following flow chart.



<0 → N3 → N1 → N3 → 0 changeover sequence>



[1] When the speed command reaches N3 (high-speed coil range) at t1, the system confirms that the zero speed signal (ZS) is ON, and then turns the L coil selection command signal (LCS) OFF (high-speed coil selection). Then, the start signal (SRN or SRI) is turned ON at t2, and the motor accelerates.

[2] Next when the speed command is changed to N1 (low-speed coil range) at t3, the motor starts decelerating toward N1. However, when it reaches the coil changeover speed N2 at t4, the speed detection signal (SD) changes from OFF to ON. The system confirms that this speed detection signal (SD) has turned ON, and then changes the L coil selection command signal (LCS) from OFF (High-speed coil selection) to ON (low-speed coil selection). This changes the coil, and when completed (t5), the motor continues to decelerate to N1.

[3] When the speed command is changed to N3 (high-speed coil range) at t6, the motor starts to decelerate toward N3. However, when changeover speed N2 is reached at t7, the speed detection signal (SD) changes from ON to OFF.
The system confirms that this speed detection signal (SD) is OFF, and then changes the L coil selection command signal (LCS) from ON (low-speed coil selection) to OFF (high-speed coil selection). The coil changeover is executed with this, and when completed (t6), the motor continues to accelerate to N3.

[4] When the start signal (SRN or SRI) turns OFF at t9, the motor decelerates to a stop. The speed detection signal will change from OFF to ON at t10, but this applies when stopping. Since the speed command does not change, there is no need to change the L coil selection command signal (LCS), and the motor will continue to decelerate to a stop with the high-speed coil.

(Note 1) The speed detection signal (SD) detection level is set with the parameters.
(Note 2) Turn the start signal ON after TM or longer has elapsed from the input of the L coil selection command signal (LCS) or after the coil changed signal has changed from ON to OFF.

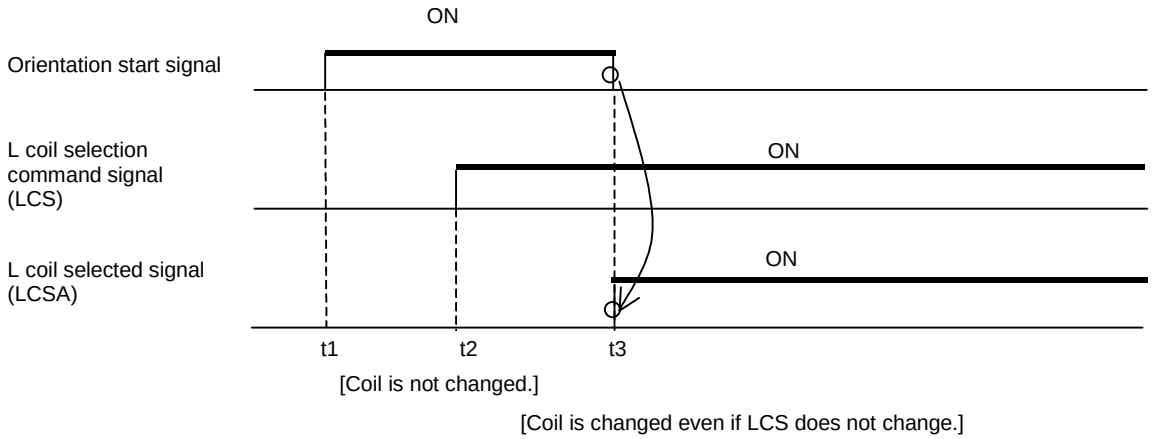
(4) Changing the coil in the speed control mode ⇔ position control mode

The position control mode refers to the mode where position loop control such as orientation control and multi-point indexing orientation control is carried out.

The following cautions must be observed when inputting the L coil selection command signal (LCS) in the position control mode.

⚠ CAUTION

The L coil selection command signal (LCS) will not be accepted if input after the position loop control has started.
- State with orientation command (ORC) ON • • • For orientation control
  In other words, position control will be executed with the same coil state as that of when the position loop control was started. Conversely, when the position loop control is canceled, the L coil selection signal (LCS) input will be valid. If the coil state during position loop control execution and the L coil selection signal (LCS) input after the position loop is canceled differ, the coil may be changed unintentionally when the position loop control is canceled. Thus, before starting position loop control, select the required coil beforehand (input the LCS signal). Then, start position loop control, and hold the L coil selection signal (LCS).



[1] Each input signal must be input after the TM or longer time has elapsed from the input of the L coil selection signal (LCS) and the coil selected signal (MKC) has changed from ON to OFF.

(1) Operation during orientation

[1] If the orientation command (ORC) is turned ON during spindle operation, orientation will be completed with the currently selected coil. (Same as conventional mechanical gears.)

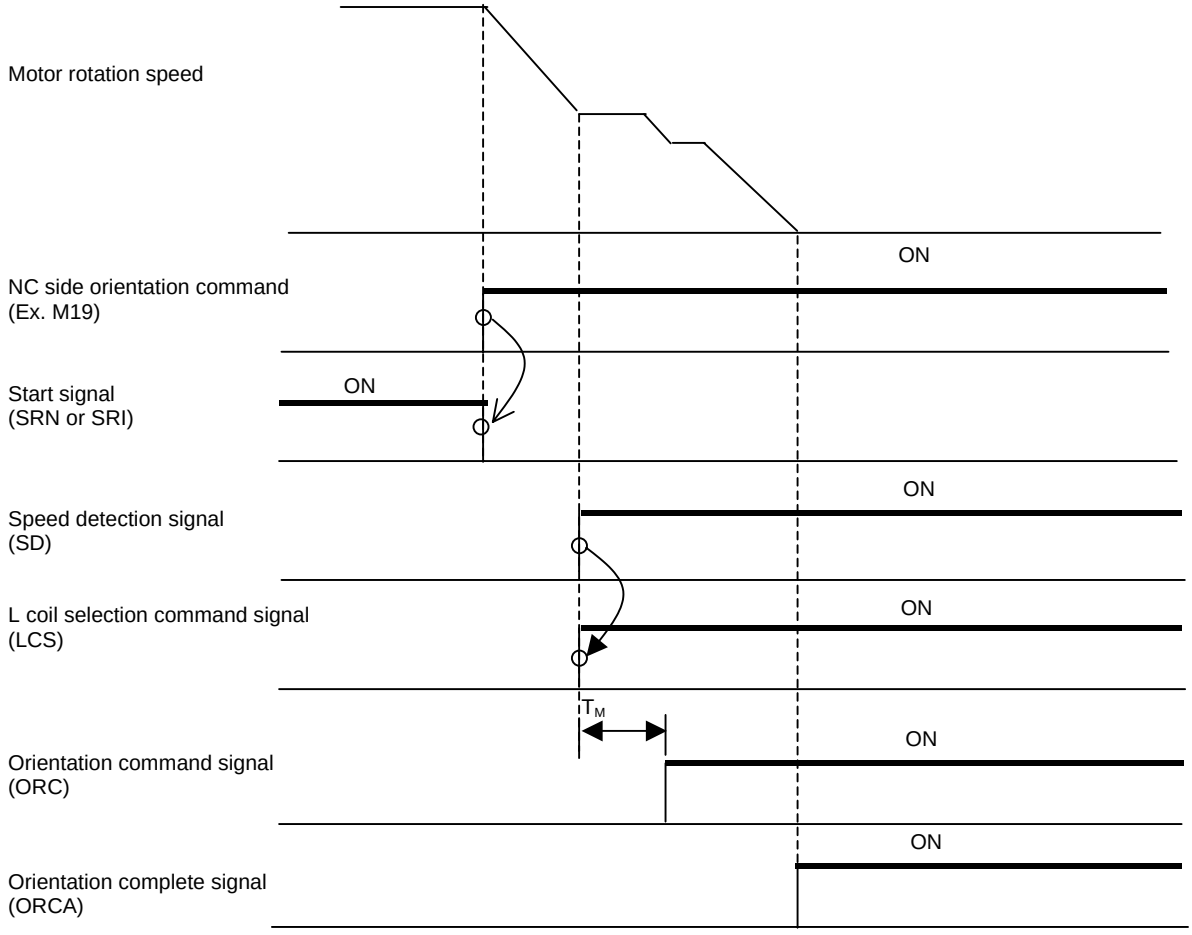
[2] If orientation is to be carried out with the low-speed coil even when operating with the high-speed coil as a means to increase the servo rigidity during orientation, use the following procedure to orient with the low-speed coil without stopping the motor once from the high-speed coil state.

(i) First turn the start signal (SRN or SRI) OFF and decelerate the motor.

(ii) Using the speed detection signal (SD), change the L coil selection command signal (LCS) from the high-speed coil to the low-speed coil.

(iii) After the TM or longer timing, or after the coil selected signal is turned ON and OFF, the orientation command (ORC) is turned ON. Refer to the section (2)-3) for details on TM.

<Changing to the low-speed coil and orienting during operation with high-speed coil>



(5) Related parameters

The parameters related to the coil changeover and the standard setting values used when using a coil changeover motor are shown below.

<table>
<tr><th>No.</th><th>Abbrev.</th><th>Parameter name</th><th>Description</th><th>Setting range</th><th>Standard value</th></tr>
<tr><td>SP037</td><td>SFNC5</td><td>Spindle function 5</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></td><td>mkc2</td><td>mkch</td><td>invm</td><td>mtsl</td></tr>
</table>
<table>
<tr><th colspan="2">bit</th><th>Meaning when "0" is set</th><th>Meaning when "1" is set</th><th>Standard</th></tr>
<tr><td>0</td><td>mtsl1</td><td>Special motor constant setting invalid</td><td>Special motor constant setting valid</td><td>1</td></tr>
<tr><td>2</td><td>mkch</td><td>Coil switch function invalid</td><td>Coil switch function valid</td><td>1</td></tr>
</table>
Set to "0003" when using coil changeover motor.
</td><td></td><td></td></tr>
<tr><td>SP038</td><td>SFNC6</td><td>Spindle function 6</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></td><td>lbsd</td><td>hbsd</td><td>lwid</td><td>hwid</td></tr>
</table>
<table>
<tr><th colspan="2">bit</th><th>Meaning when "0" is set</th><th>Meaning when "1" is set</th><th>Standard</th></tr>
<tr><td>0</td><td>hwid</td><td>H-coil wide-range constant output invalid</td><td>H-coil wide-range constant output valid</td><td>0</td></tr>
<tr><td>1</td><td>lwid</td><td>L-coil wide-range constant output invalid</td><td>L-coil wide-range constant output valid</td><td>0</td></tr>
<tr><td>2</td><td>hbsd</td><td>H-coil base slide invalid</td><td>H-coil base slide valid</td><td>0</td></tr>
<tr><td>3</td><td>lbsd</td><td>L-coil base slide invalid</td><td>L-coil base slide valid</td><td>0</td></tr>
</table>
</td><td></td><td></td></tr>
<tr><td>SP020</td><td>SDTS*</td><td>Speed detection set value</td><td>Set the motor speed for which speed detection output is performed.
The setting value is determined by Mitsubishi according to the specifications of coil changeover motor.</td><td>0 to 32767 (r/min)</td><td>Depends on the motor to be used.</td></tr>
<tr><td>SP047</td><td>SDTR*</td><td>Speed detection reset value</td><td>Set the reset hysteresis width for a speed detection set value defined in SP020 (SDTS).</td><td>0 to 1000 (r/min)</td><td>Lathe: 300
Machining: 100</td></tr>
<tr><td>SP059</td><td>MKT</td><td>Winding changeover base shut-off timer</td><td>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.</td><td>50 to 10000 (ms)</td><td>150</td></tr>
<tr><td>SP060</td><td>MKT2</td><td>Current limit timer after coil changeover</td><td>Set the current limit time to be taken after completion of contactor switching at winding changeover.</td><td>0 to 10000 (ms)</td><td>500</td></tr>
<tr><td>SP061</td><td>MKIL</td><td>Current limit value after winding changeover</td><td>Set the current limit value during a period defined in SP060 (MKT2) after completion of contactor switching at winding changeover.</td><td>0 to 120 (%)</td><td>75</td></tr>
</table>

No.	Abbrev.	Parameter name	Description	Setting range	Standard value
SP129 to SP140	HI01 to HI12	General-purpose input selection	Set the general-purpose input signals IN1 to IN12 as to which function they should have. To have the coil changeover function, set "18" (L coil selection command) in one of those signals.	0 to 21	—
SP141 to SP154	HO1e to HO1c	General-purpose output selection	Set the general-purpose output signals OUT1 to OUT8 (open emitter) or OUT1C to OUT6C (open collector) as to which function they should have. Set "18" (L coil selected signal) in one of those signals. Also, set "16" (changing coil) in another signal as required.	0 to 23	—
SP257 to SP320		Motor constant (H coil)	These parameters are valid only in the following two conditional cases. (a) SP034(SFNC2)/bit0＝1 and SP034(SFNC2)/bit2＝0 Set the motor constants for the special and non-coil changeover motor not indicated in the explanation of SP040 (MTYP). (b) SP034(SFNC2)/bit0＝1 and SP034(SFNC2)/bit2＝1 Set the H coil side motor constants 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)	These parameters are valid only in the following case. (a) SP034(SFNC2)/bit0＝1 and SP034(SFNC2)/bit2＝1 Set the L coil side motor constants of the coil changeover motor. (Note) It is not allowed for the user to change the setting. (HEX setting)	0000 to FFFF	0000

(6) Coil changeover contactor (magnetic contact)

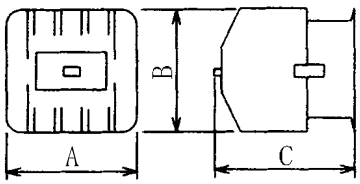
[1] Selection

The coil changeover contactor is selected according to the applicable spindle drive unit's capacity as shown below.

Spindle drive unit type	Applicable contactor type	Spindle drive unit type	Applicable contactor type
MDS-A/B-SPA(H)-040	S-N10	MDS-A/B/C1-SPA(H)-150	S-N50
MDS-A/B-SPA(H)-075	S-N10	MDS-A/B/C1-SPA(H)-185	S-N65
MDS-A/B-SPA(H)-15	S-N10	MDS-A/B/C1-SPA(H)-220	S-N80
MDS-A/B-SPA(H)-22	S-N10	MDS-A/B/C1-SPA(H)-260	S-N80
MDS-A/B-SPA(H)-37	S-N18	MDS-A/B/C1-SPA(H)-300	S-N125
MDS-A/B/C1-SPA(H)-55	S-N20	MDS-B-SPA(H)-370	S-N150
MDS-A/B/C1-SPA(H)-75	S-N25	MDS-B-SPA(H)-450	S-N180
MDS-A/B/C1-SPA(H)-110	S-N35	MDS-B-SPA(H)-550	S-N300

[2] Outline

Name	Model	AC Class 3 rated working current (A)		Rated conductivity current (A)	Support contact		Dimensions (mm)		
		200 to 220V	380 to 440V		Standard	Special	A	B	C
Open type Non-reversible type	S-N10	11	7	20	1a	1b	43	78	78
	S-N11	13	9	20	1a	1b	43	78	78
	S-N12	13	9	20	1a1b	2a	53	78	78
	S-N18	18	13	25	—	—	43	79	81
	S-N20	20	20	32	1a1b	2a	63	81	81
	S-N21	20	20	32	2a2b	—	63	81	81
	S-N25	26	25	50	2a2b	—	75	89	91
	S-N35	35	32	60	2a2b	—	75	89	91
	S-N50	50	48	80	2a2b	—	88	106	106
	S-N65	65	65	100	2a2b	—	88	106	106
	S-N80	80	80	135	2a2b	4a4b	100	124	127
	S-N95	100	93	150	2a2b	4a4b	100	124	127
	S-N125	125	120	150	2a2b	4a4b	100	150	136
	S-N150	150	150	200	2a2b	4a4b	120	160	145
	S-N180	180	180	260	2a2b	4a4b	138	204	174
	S-N220	220	220	260	2a2b	4a4b	138	204	174
	S-N300	300	300	350	2a2b	4a4b	163	243	195
	S-N400	400	400	450	2a2b	4a4b	163	243	195
	S-N600	630	630	660(800)	2a2b	4a4b	290	310	234
	S-N800	800	800	800(1000)	2a2b	4a4b	290	310	234



S-N21 type

5. Troubleshooting

5-1 Points of caution and confirmation

If an error occurs in the 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>

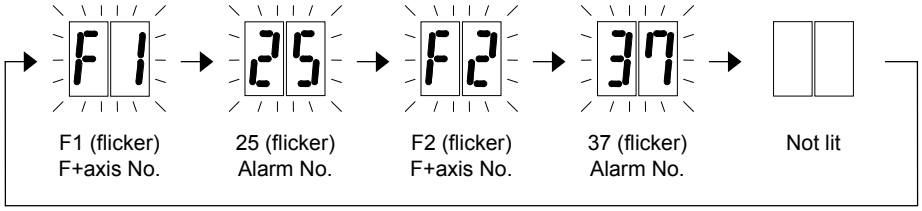
[1] What is the alarm code display?
[2] Can the error or trouble be repeated? (Check alarm history)
[3] Are the spindle motor and spindle drive unit temperature and ambient temperature normal?
[4] Are the power supply unit, spindle drive unit and motor grounded?
[5] Was the unit accelerating, decelerating 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.

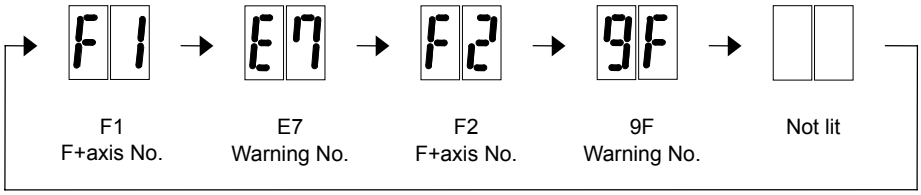
5-1-1 LED display when alarm or warning occurs

(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



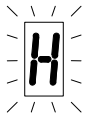
LED display during servo warning or spindle warning

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 "5-2-1 List of alarms" and "5-2-2 List of warnings" for details. The display flickers when an alarm occurs.



Alarm 71 (flicker)

LED display during power supply alarm

Warning E9

LED display during power supply warning

5-2 Protective functions list of units

5-2-1 List of alarms

When an alarm occurs, the spindle drive unit will coast to a stop or will decelerate to a stop. Check the alarm No., and remove the cause of the alarm by following this list.

Drive unit alarm

No.	Alarm name	SP	Alarm details	Reset
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
17	A/D converter error	■	An error was detected in the A/D converter for current FB detection.	PR
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 side 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
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
37	Initial parameter error	■	An illegal parameter was detected in the parameters received from the NC at NC power ON.	PR
3B	Power module overheat	●	The power module's temperature protection function activated.	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
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
46	Motor overheat	○	The temperature protection function in the motor or detector activated.	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
57	Option error	■	An input that does not exist in the option settings was selected for the general-purpose input.	
5C	Orientation feedback error	●	After orientation was completed, the command and feedback error exceeded the parameter setting.	PR
88	Watchdog	●	The system does not operate correctly.	

(Note 1) Motor stopping method applied when spindle drive unit alarm occurs is indicated in the column of SP.
(Note 2) Spindle (SP) alarm stopping method
○: Deceleration control (when SP038/bit0=1 is set) , Coast to a stop (when SP038/bit0=0 is set).
●: Coast to a stop
■: Initial error (while motor is stopped)

Resetting methods
PR: Reset by setting the alarm reset signal to the general-purpose input of the spindle drive unit and turning the signal ON/OFF. This alarm can also be reset with the AR resetting conditions.
AR: Reset by turning the spindle drive unit power ON again.

Power supply alarm

No.	LED display	Alarm name	SP	Alarm details	Reset
61		Power module overcurrent	●	The power module's overcurrent protection function activated.	PR
62		Frequency error	●	The input power frequency exceeded the specified range.	PR
67		Phase failure	●	There is a phase failure in the input power.	PR
68		Watch dog	●	The system is not operating normally.	AR
69		Ground fault	●	The motor power cable is contacting FG (ground).	PR
6A		External contactor melting	●	The external contactor's contact has melted.	PR
6C		Main circuit error	●	An abnormality was detected in the main circuit capacitor's charging operation.	PR
6E		Memory error	●	An error was detected in the internal memory.	AR
6F		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		Instantaneous power failure/ external emergency stop	●	An instantaneous power failure occurred.	NR
73		Over-regeneration	●	The over-regeneration detection level exceeded 100%. The regenerative resistor is in the overload state.	PR
75		Overvoltage	●	The main circuit PN bus voltage exceeded the tolerable value.	NR
76		External emergency stop setting error	●	The rotary switch setting for the external emergency stop does not match the parameter setting.	AR
77		Power module overheat	●	The power module's temperature protection function activated.	AR

(Note 1) If a power supply alarm (60 to 77) occurs, 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.

Resetting methods
PR: Reset by setting the alarm reset signal to the general-purpose input of the spindle drive unit and turning the signal ON/OFF. This alarm can also be reset with the AR resetting conditions.
AR: Reset by turning the spindle drive unit power ON again.

5-2-2 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
A9	Orientation feedback error warn	Retrying during an orientation feedback error.	*
E1	Overload warning	The overload detection level is 80% or more.	*
E4	Parameter error warning	A parameter exceeding the setting range was set.	*
E7	In emergency stop state	Emergency stop was input.	*

(Note 1) Spindle motor does not stop when the warning occurs.
(Note 2) When an emergency stop is input, spindle motor decelerates to a stop. However, if the machine ready complete input signal remains ON, the operation after a stop differs according to the SP192 setting.
SP192=0 or 1: After a stop. the external contactor of CV is turned OFF after a period of time.
SP192=2 or 3: The external contactor of CV has been turned ON after a stop.

Power supply warnings

No.	LED display	Alarm name	Warning details	Reset
E9		Instantaneous power failure warning	An instantaneous power failure occurred.	PR
EA		External emergency stop	The external emergency stop signal was input.	*
EB		Over-regeneration warning	The over-regeneration level is 80% or more.	*

(Note) Spindle motor does not stop when the warning occurs.

Resetting methods

* : Automatically reset once the cause of the warning is removed.
PR : Reset by setting the alarm reset signal to the general-purpose input of the spindle drive unit and turning the signal ON/OFF. This alarm can also be reset with the AR resetting conditions.

5-3 Troubleshooting

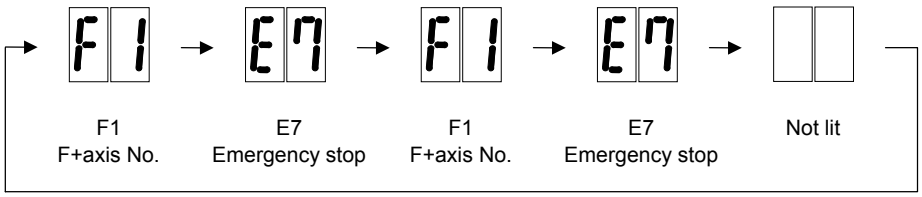
Follow this section to troubleshoot the alarms that occur during start up or while the machine is operating. If the state is not improved with the following investigations, the drive unit may be faulty. Exchange the unit with another unit of the same capacity, and check whether the state is improved.

5-3-1 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	The S/W did not operate correctly when the power was turned ON. The alarm reset signal was input.	External input signal input error	Is the alarm reset signal turned ON?	Turn the signal OFF.
		The drive unit has error.	Other than above	Replace the drive unit. .
Ab	The S/W did not operate correctly when the power was turned ON.	The setting is for use inhibiting.	Is the rotary switch set to "7" to "F"?	Set correctly.
		The drive unit has error.	Other than above	Replace the drive unit.
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 power ON

5-3-2 Troubleshooting for each alarm No.

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**
1	Refer to "5-3-1 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**
1	Check whether the 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. 17	A/D converter error An error was detected in the A/D converter for current FB detection.		
	Investigation details	**Investigation results**	**Remedies**
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. 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**
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 no-signal of 1024p/rev encoder for orientation was detected.		
	Investigation details	**Investigation results**	**Remedies**
1	Check the spindle parameter (SP037/bit0) setting.	Encoder orientation is not used.	Set SP037/bit0 to 0.
		Encoder orientation is used.	Investigate item 3.
2	Check the spindle parameter SP025 to SP031 settings.	The gear rate does not match an actual machine.	Correctly set the value of SP025 to SP031.
		A gear selection of sequence differs from an actual gear.	Correctly select the gear.
3	Check whether the drive unit connectors (servo: CN6, 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 spindle 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. (Time is a value set to SP055.)		
	Investigation details	**Investigation results**	**Remedies**
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. 31	Overspeed A rotation speed exceeding the motor's tolerable rotation speed was detected.		
	Investigation details	**Investigation results**	**Remedies**
1	Confirm the spindle parameter SP017 (TSP) setting.	Setting value is too small.	Correctly set.
		Correctly set.	Investigate item 4.
2	Confirm the PLG output waveform.	There is a problem.	Adjust the PLG output waveform.
		Normal.	Investigate item 5.
3	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**
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. 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 UVW phase of the motor 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 UVW phase of the motor, and check the insulation between the power cable and FG.	The motor is short-circuited.	Replace the motor.
		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.

Alarm No. 37	Initial parameter error An illegal parameter was detected at power ON.		
	Investigation details	**Investigation results**	**Remedies**
1	Check the error parameter No.	SP001 to SP384	Set the value within the designated setting range.

(Note) Refer to "5-3-4 Parameter numbers at initial parameter error".

Alarm No. 3B	Power module overheat The power module's temperature protection function activated.		
	Investigation details	**Investigation results**	**Remedies**
1	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 2.
2	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 3.
3	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 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.	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. 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**
1	Check the load value, 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**
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**
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**
1	Check whether the drive unit connectors (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 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 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.
		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. 46	Motor overheat The temperature protection function in the motor or detector activated.		
	Investigation details	**Investigation results**	**Remedies**
1	Check the repeatability.	The alarm occurs before operation.	Investigate item 2.
		The alarm occurs occasionally after operation is started.	Investigate item 4.
2	Check whether the drive unit connectors (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.	Investigate item 11.
4	Check the load meter (spindle).	The load is large.	Investigate item 7.
		The load is not large.	Investigate item 8.
5	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 6.
6	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 alarm was not forcibly reset.	Investigate item 8.
7	Check the parameter settings.	There was an incorrect setting.	Correctly set.
		The settings are correct.	Investigate item 8.
8	Measure the motor temperature when the alarm occurs.	Hot.	Investigate item 9.
		Not hot.	Investigate item 11.
9	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 10.
		The motor fan wind flow is poor.	Clean.
		There is no problem.	Investigate item 11.
10	Check the fan wiring.	The cable is broken.	Replace the cable.
		The cable is not broken.	Replace the fan.
11	Try replacing the drive unit.	Improved.	Replace the drive unit.
		Not improved.	Replace the motor.

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**
1	Check the overload parameters. 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 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 the PLG output waveform.	There is a problem.	Adjust the PLG output waveform.
		Normal	Investigate item 4.
4	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 5.
5	Try replacing the drive unit.	Improved.	Replace the drive unit.
		Not improved.	Replace the motor.

(Note) PR resetting is 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.

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**
1	Check the load meter value.	The load is large.	Lower the load.
		The load is not large.	Investigate item 2.
2	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**
1	Check the excessive error detection width. SP102 (Orientation control)	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. SP097/bit5 (Orientation control)	The polarity is reversed.	Correctly set the parameters.
		Normal.	Investigate item 3.
3	Check the alarm No. "51" items.		

Alarm No. 57	Option error An input that does not exist in the option settings was selected for the general-purpose input.		
	Investigation details	**Investigation results**	**Remedies**
1	Check the spindle parameters SP140 to SP151 settings.	The setting value is incorrect. Drive unit option symbol None: For 1 to 3, 15 or 17, setting impossible R: For 15 or 17, setting impossible D: For 1 to 3, 15, setting impossible T: For 1 to 3, 17, setting impossible RD: For 17, setting impossible RT: For 17, setting impossible	Change the setting value.
		The setting value is correct.	Replace the drive unit.

Alarm No. 5C	Orientation feedback error After orientation was completed, the command and feedback error exceeded the parameter setting.		
	Investigation details	**Investigation results**	**Remedies**
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

The following alarms of the alarm No. 61 to 77 occur in the power supply unit.

Alarm No. 61	Power module overcurrent The power module's overcurrent protection function activated.		
	Investigation details	**Investigation results**	**Remedies**
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**
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.

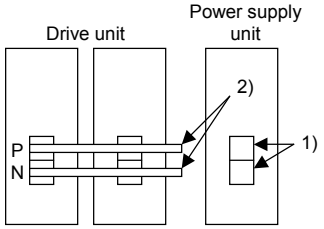
Alarm No. 67	Phase failure There is a phase failure in the input power.		
	Investigation details	**Investigation results**	**Remedies**
1	Check the voltage for each input phase.	There are phases with no voltage.	Correct the power supply.
		There is no problem.	Investigate item 2.
2	Check the alarm No. "71" items.		

Alarm No. 68	Watch dog The system is not operating normally.		
	Investigation details	**Investigation results**	**Remedies**
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**
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**
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. 6C	Main circuit error An abnormality was detected in the main circuit capacitor's charging operation.		
	Investigation details	**Investigation results**	**Remedies**
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		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. 6E	Memory error An error was detected in the internal memory.		
	Investigation details	**Investigation results**	**Remedies**
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**
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**
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**
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. 75	Overvoltage The main circuit PN bus voltage exceeded the tolerable value.		
	Investigation details	**Investigation results**	**Remedies**
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**
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**
1	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 2.
2	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 3.
3	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 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.	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**
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**
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. 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**
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**
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.

5-3-3 Troubleshooting for each warning No.

Warning No. A9	Orientation feedback error warning Retrying during an orientation feedback error.		
	Investigation details	**Investigation results**	**Remedies**
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**
1	Check the alarm No. "50" items.		

Warning No. E4	Parameter error warning A parameter exceeding the setting range was set.		
	Investigation details	**Investigation results**	**Remedies**
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. E7	NC emergency stop Emergency stop was input from the NC.		
	Investigation details	**Investigation results**	**Remedies**
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. E9	Instantaneous power failure warning An instantaneous power failure occurred.		
	Investigation details	**Investigation results**	**Remedies**
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**
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**
1	Check the alarm No. "73" items.		

5-3-4 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, SP155 to SP170, 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.

6. 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.

6-1 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?

6-2 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.

6-3 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.

6-3-1 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

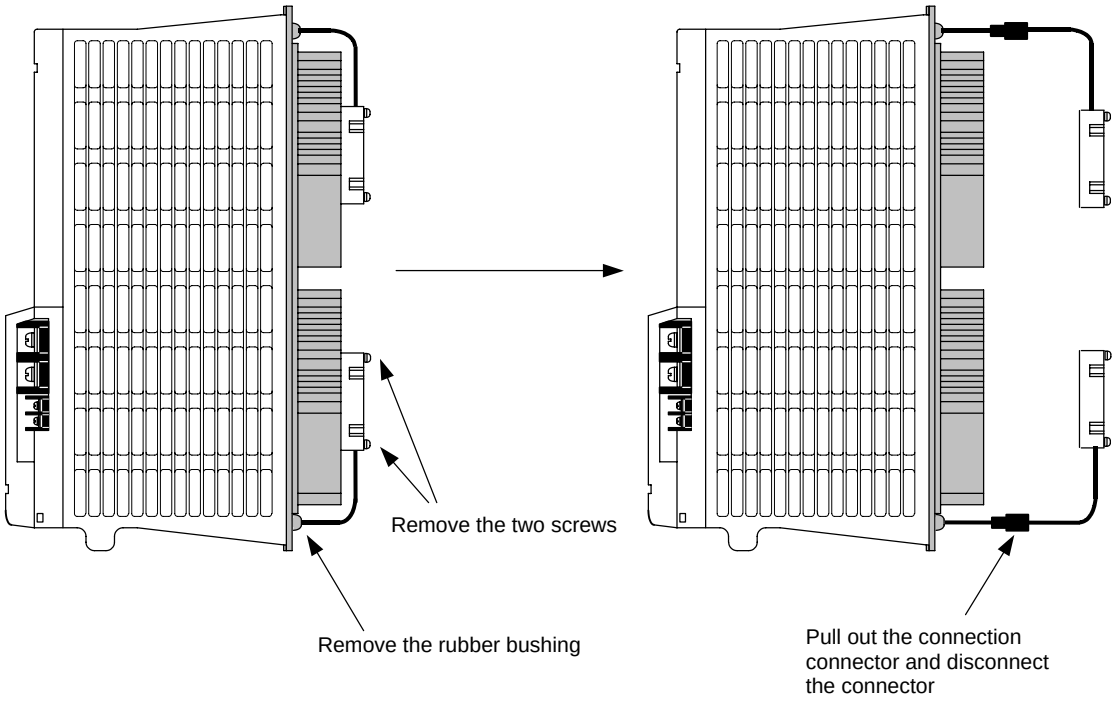
[1] Disconnect the connectors connected to CN4, CN9 and CN23.
[2] Disconnect all wires connected to the terminal block's L1, L2, L3, ⏚, L+, L-, L11, L21 and MC1.
[3] Remove the two (four) screw fixing the unit onto the control unit. Remove the unit from the control panel.
[4] Install the new unit following the removal procedures in reverse.

6-3-2 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. Cable and Connector Specifications

Appendix 1-1 Selection of cable

Appendix 1-1-1 Cable wire and assembly

(1) Cable wire

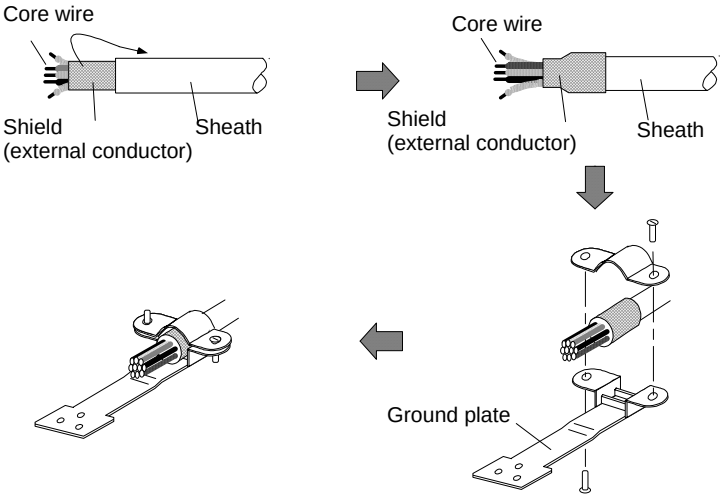
The following shows the specifications and processing of the wire used in each cable. Manufacture the cable using the following recommended wire or equivalent parts.

Recommended wire model (Cannot be directly ordered from Mitsubishi Electric Corp.)	Finished outside diameter	Sheath material	No. of pairs	Wire characteristics					Application
				Configuration	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 communication 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.

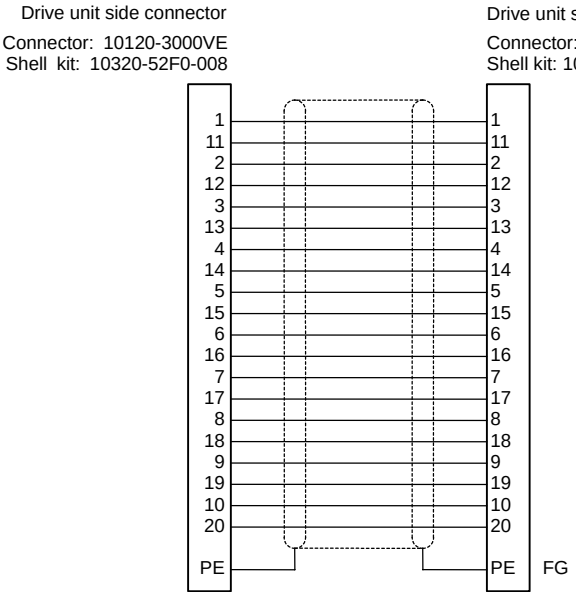
Appendix 1-2 Cable connection diagram

⚠ 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.
4. Do not relay the cable which the shield cable is used in. Malfunctions may occur due to noise from the motor drive wire, other cables or devices. If the cable must be relayed, keep the peeled shield section as short as possible (3cm or less), and separate the cable from the other drive wires and cables. Mitsubishi will not be held liable for any problems that should occur as a result of a relayed cable. The customer is responsible for providing measures against noise.

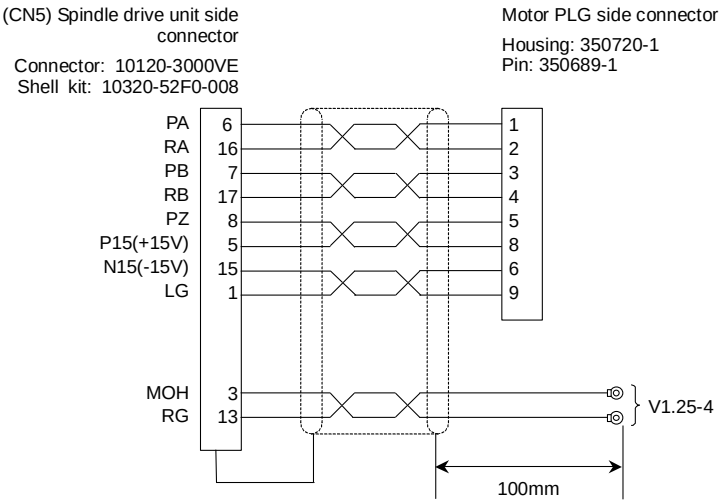
(1) NC bus cable (Cable between spindle drive unit and power supply unit)

<SH21 cable connection diagram>

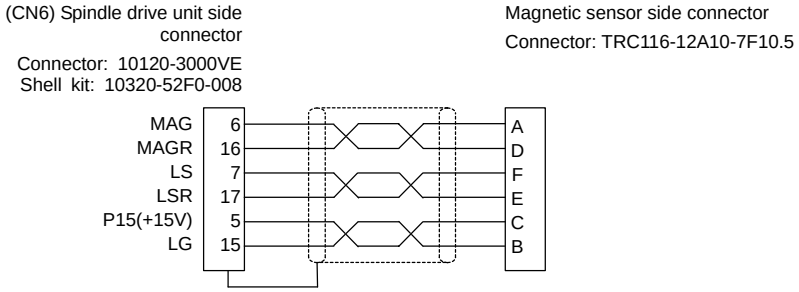


(2) Spindle detector cable

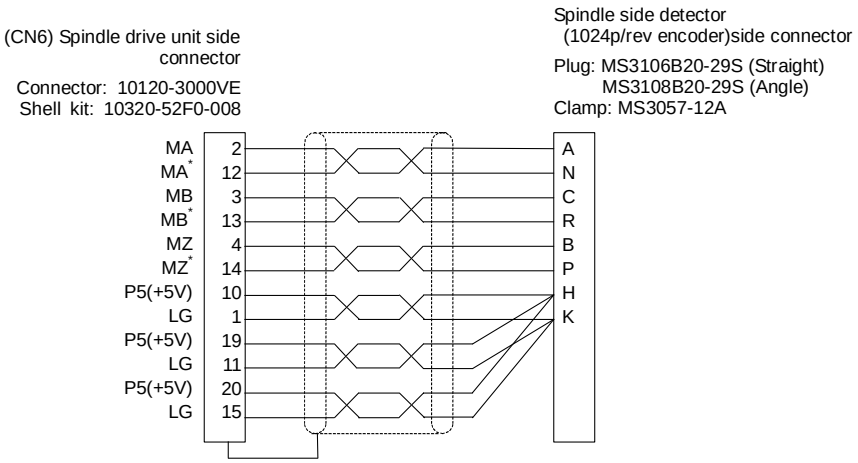
<CNP5 cable connection diagram>



<CNP6M cable connection diagram>

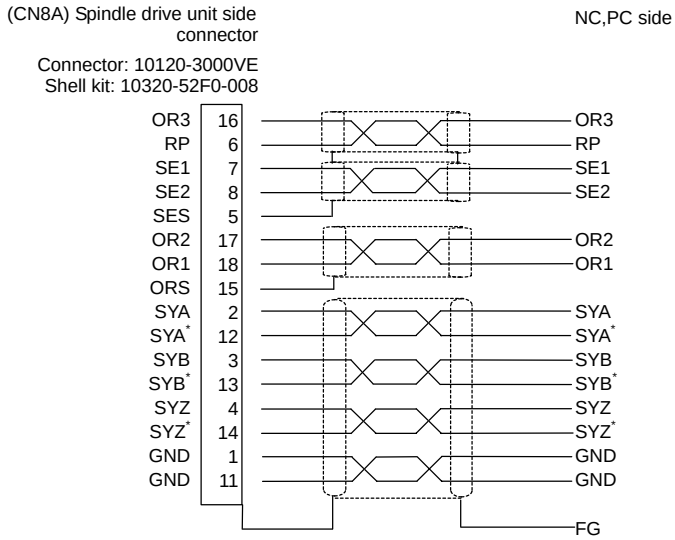


<CNP6A cable connection diagram>

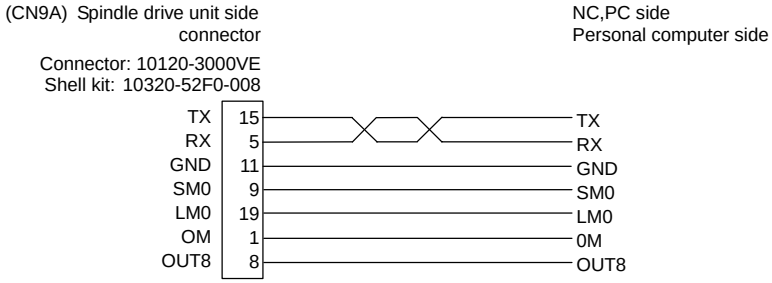


⚠ CAUTION The shield of the spindle detector cable is not connected to the "FG" (earth). Do not connect the cable shield to the earth by clamping the cable, etc.

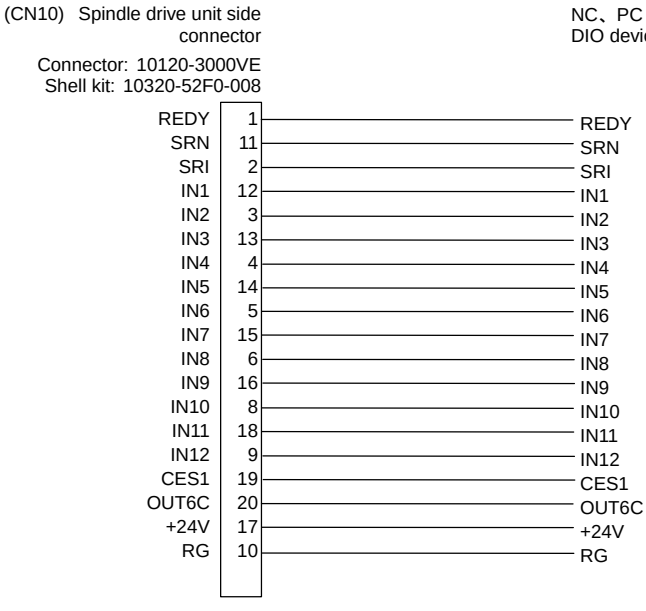
<CN8A cable connection diagram>



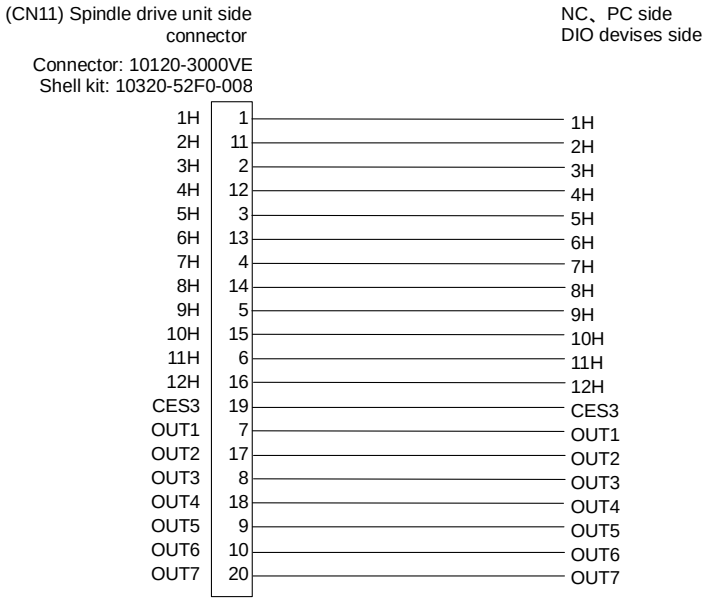
<CN9A cable connection diagram>



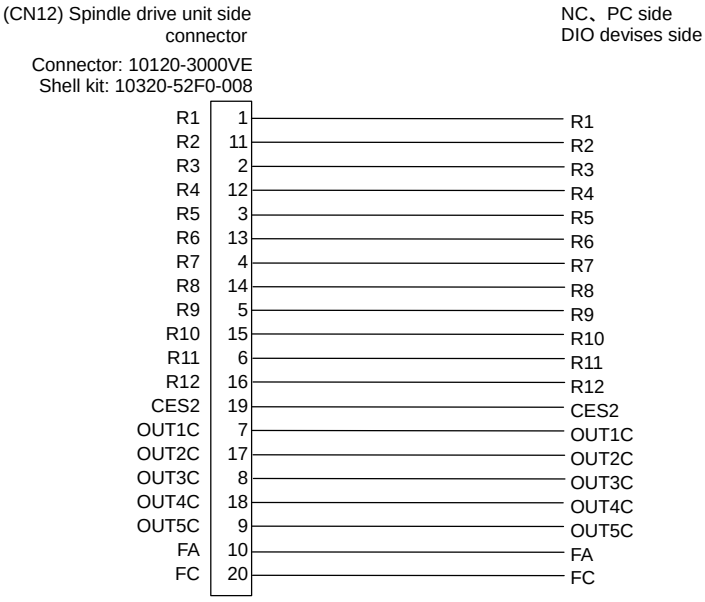
<CN10 cable connection diagram>



<CN11 cable connection diagram>



<CN12 cable connection diagram>

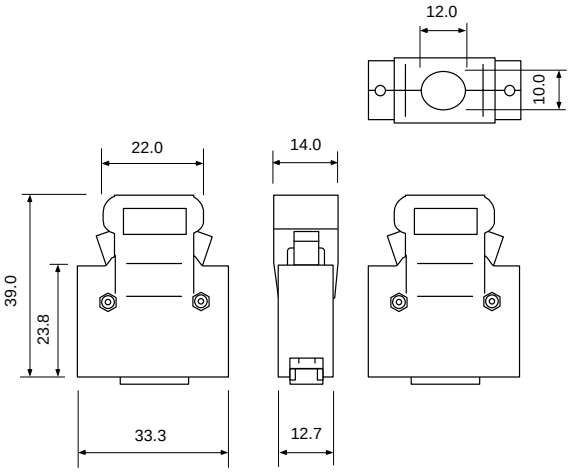


Appendix 1-3 Connector outline dimension drawings

Connector for CN2 Servo drive unit

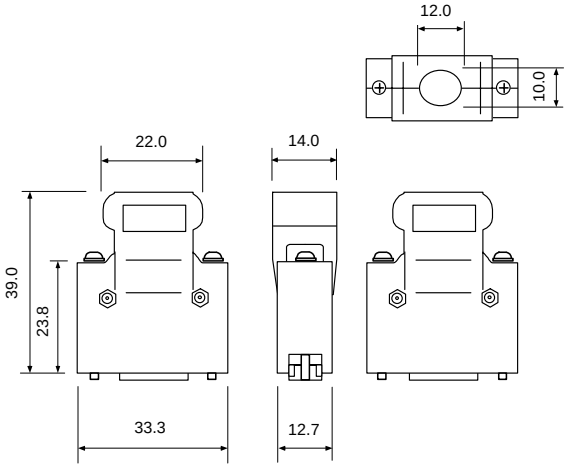
Manufacturer: 3M (Ltd.)
<Type>
Connector: 10120-3000VE
Shell kit: 10320-52F0-008

[Unit: mm]



Manufacturer: 3M (Ltd.)
<Type>
Connector: 10120-3000VE
Shell kit: 10320-52A0-008

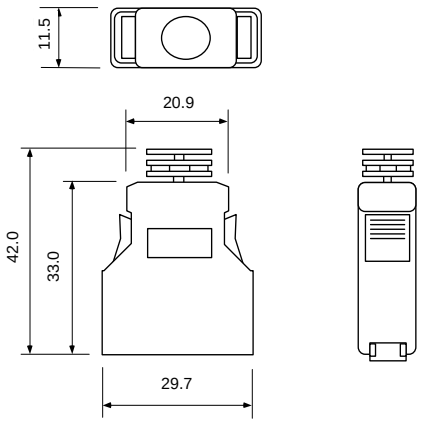
[Unit: mm]



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]



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

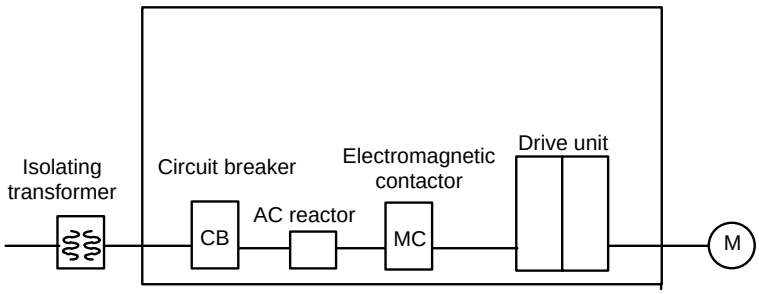
The MDS-C1-SPA Series units are targeted for the Low-voltage Directives. An excerpt of the precautions given in this specification is given below. Please read this section thoroughly before starting use.

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 Category II and Pollution Class of 2 or less environment as stipulated in IEC60664.

These units do not provide protection against electric shock and fire sufficient for the requirements of the Low-voltage Directive and relevant European standards by themselves, so provide additional protection (refer to 5.2.4 and 7.1.6.1 of EN50178)

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	13000m 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	13000m or less

(3) Power supply

[1] Use the power supply and servo/spindle drive unit under an Overvoltage Category II as stipulated in IEC60664.

[2] In case of Overvoltage Category III, connect the PE terminal of the units to the earthed-neutral of the star-connection power supply system.

[3] Do not omit the circuit breaker and electromagnetic contactor.

(4) Earthing

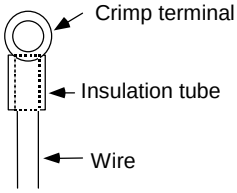
[1] To prevent electric shocks, always connect the servo/spindle drive unit protective earth (PE) terminal (terminal with ⏚ mark) to the protective earth (PE) on the control panel.

[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.

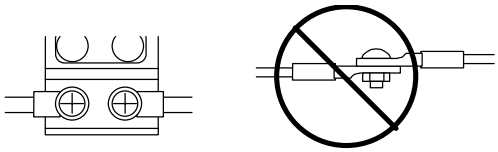
[3] Select the earthing wire size in accordance with Table 1 of EN60204-1.

(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.



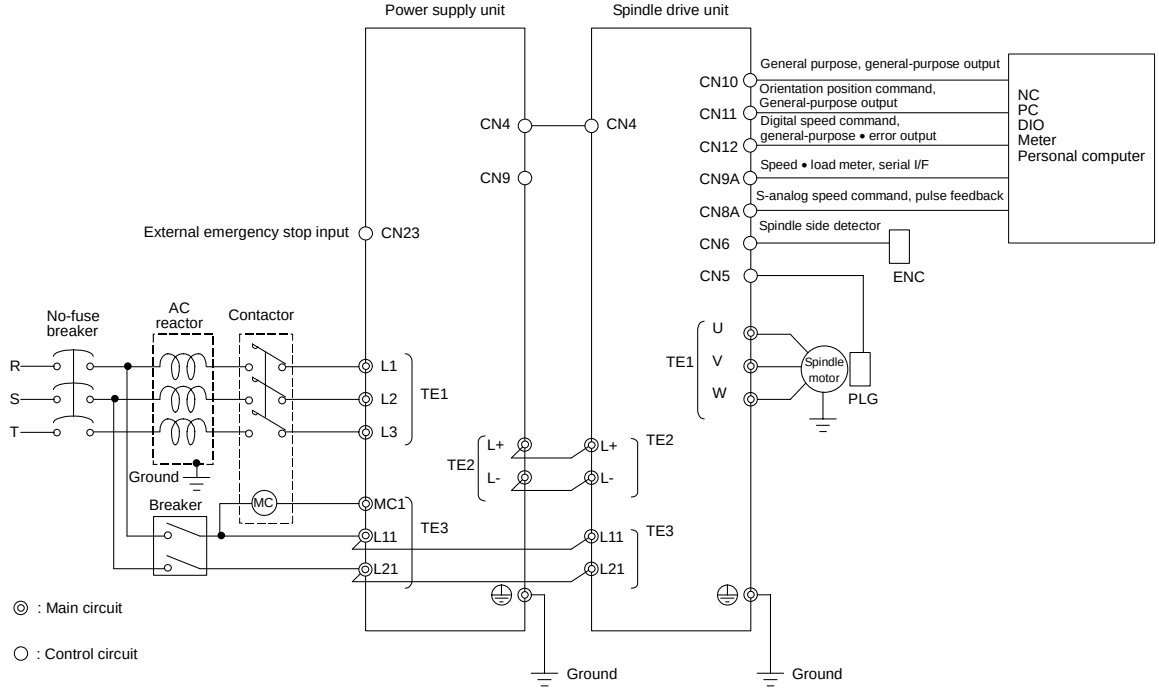
[3] Select the size of the wires for input power supply to Power Supply unit in accordance with Table 4 and 5 of EN60204-1.

(6) Peripheral devices

[1] Use EN/IEC Standards compliant parts for the circuit breaker and contactor.
[2] Select circuit breaker with instantaneous trip function. (Trip within 30 second when over current of 600%). Apply Annex C of EN60204-1 for sizing the circuit breaker.

(7) Miscellaneous

[1] Refer to the next section "EMC Installation Guidelines" 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. EMC Installation Guidelines

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

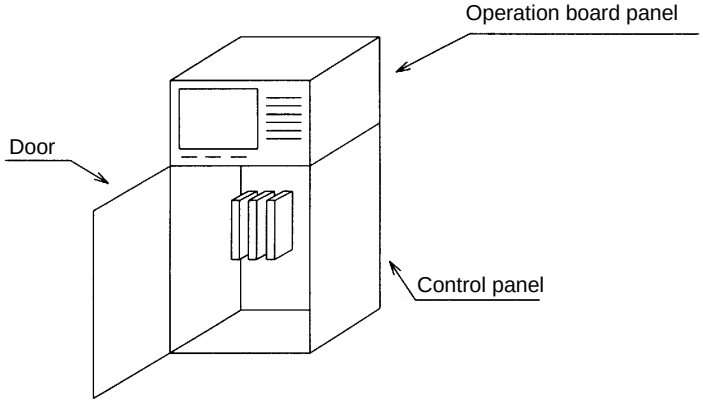
The main items relating to EMC measures include the following.
[1] Store the device in an electrically sealed metal panel.
[2] Earth all conductors that are floating electrically. (Lower the impedance.)
[3] Wire the power line away from the signal wire.
[4] Use shielded wires for the cables wired outside 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.

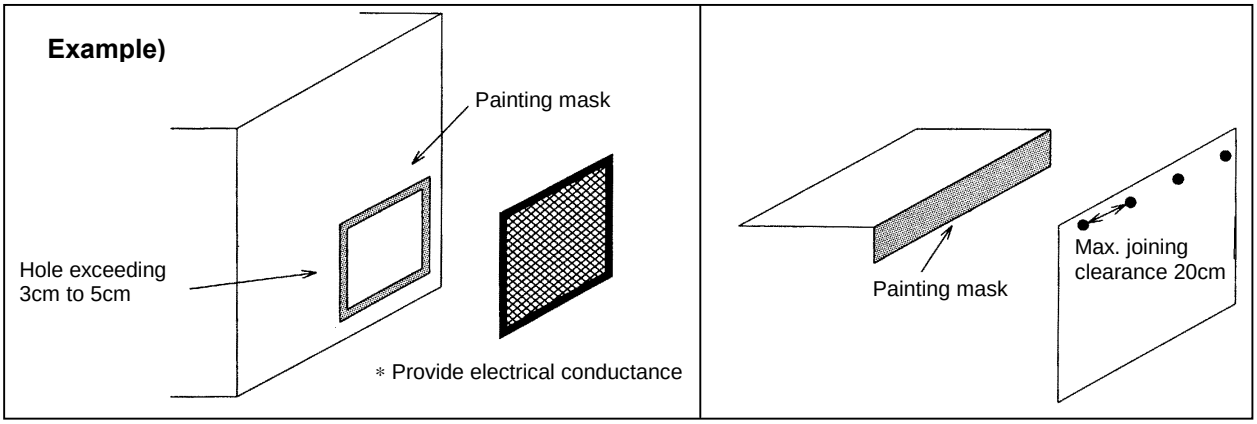
Appendix 3-4 Measures for panel structure

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

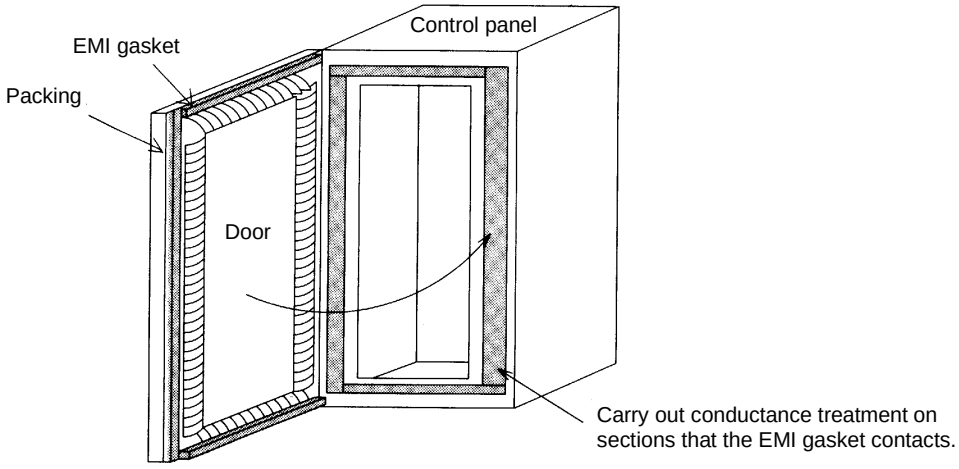
[1] Use metal for all materials configuring the panel.
[2] For the joining of the top plate and side plates, etc., mask the contact surface with paint, and fix with welding or screws.
In either case, keep the joining clearance to a max. of 20cm for a better effect.
[3] Note that if the plate warps due 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.



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.

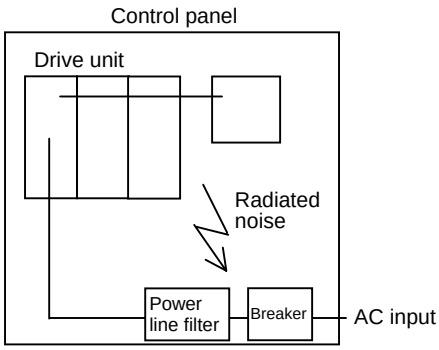
Appendix 3-4-3 Measures for operation board panel

[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.

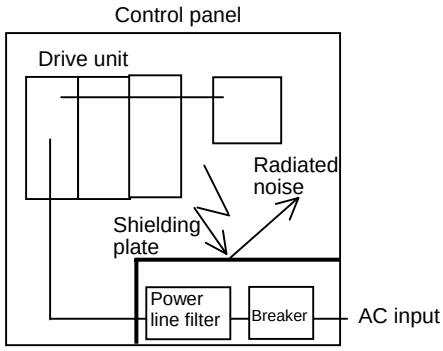
Refer to the "EMC INSTALLATION GUIDELINES" BNP-B2230 for the NC for more details.

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.



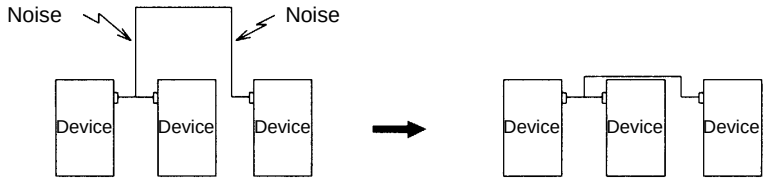
Use a metal plate, etc., for the shielding partition. Make sure not to create a clearance.

Appendix 3-5 Measures for various cables

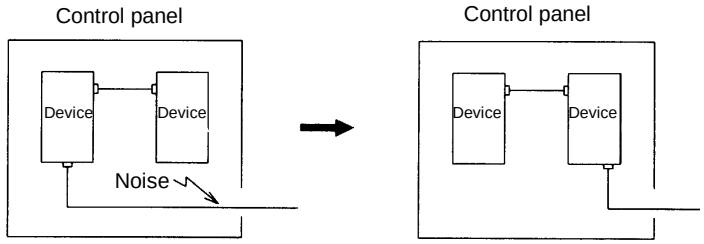
The various cables act as antennas for the noise and discharge the noise externally. Thus appropriate treatment is required to avoid the noise.
The wiring between the drive unit and motor act as an extremely powerful noise source, so apply the following measures.

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

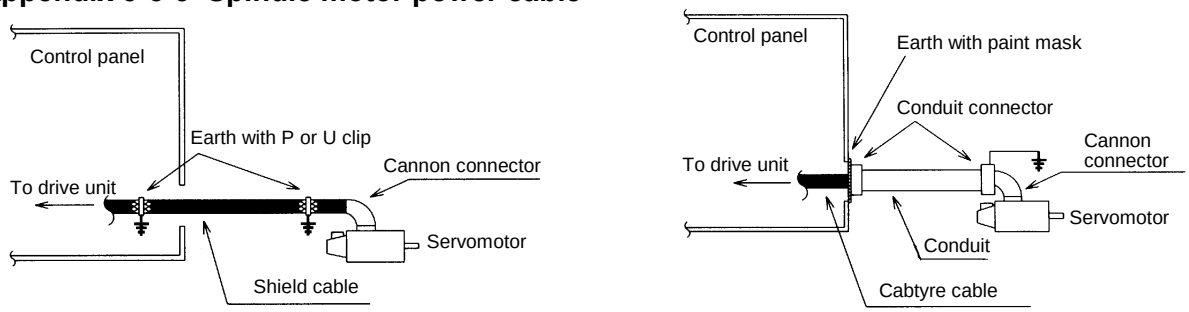
Common items

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 3-6-1 Shield clamp fitting".)
Clamp the shield at a position within 10cm from the panel lead out port.

POINT

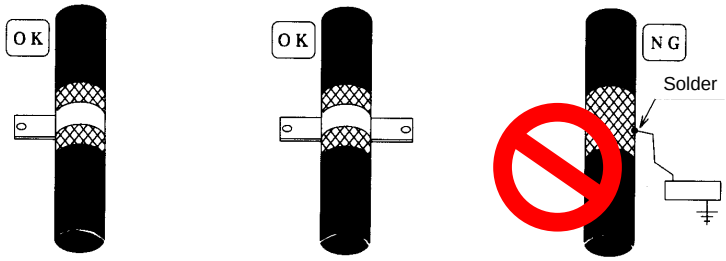
1. When leading the cables, including the grounding wire (FG), outside of the panel, clamp the cables near the panel outlet (recommendation: within 10cm).
2. When using a metal duct or conduit, the cables do not need to be clamped near the panel outlet.
3. When leading cables not having shields outside the panel, follow the instructions given for each cable. (Installation of a ferrite core, etc., may be required.)

Appendix 3-5-3 Spindle motor power cable

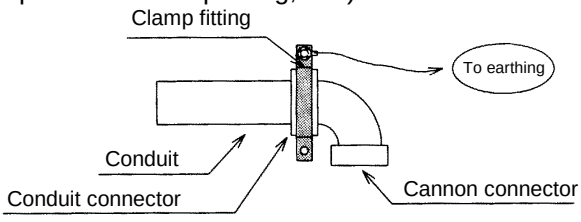


Power cable for servo motor

[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.

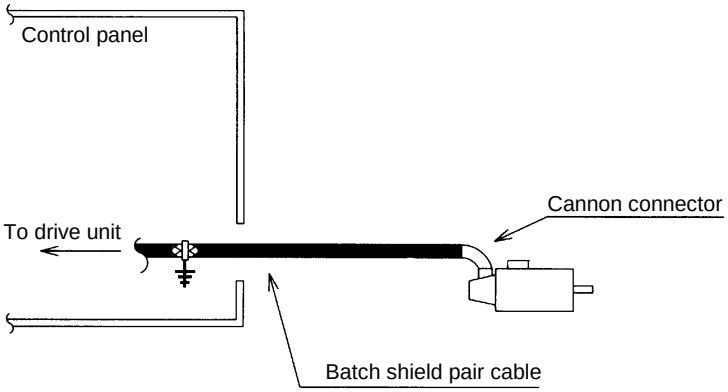


[5] When not using a shield cable for the power cable, use a conventional cabtyre cable. Use a metal conduit outside the cable.
[6] Earth the power cable on the control panel side at the contact surface of the conduit connector and control panel. (Mask the side wall of the control panel with paint.)
[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.)

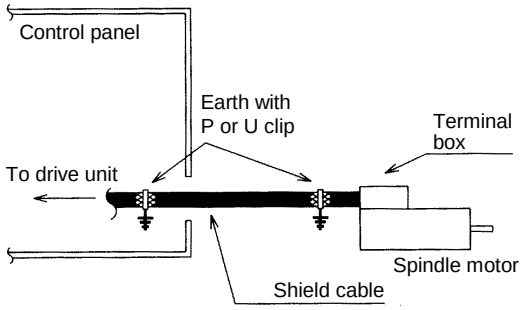


Appendix 3-5-4 Servo motor feedback cable

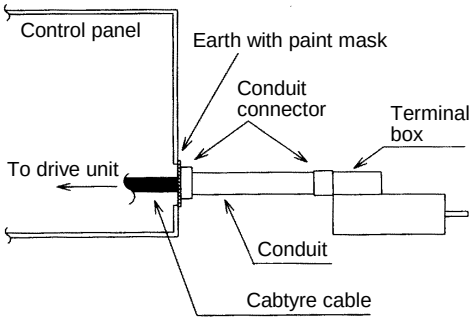
Use a conventional batch shield pair cable for feed back cable of the servo motor to earth on NC side (inside the control panel.)



Appendix 3-5-5 Spindle motor power cable



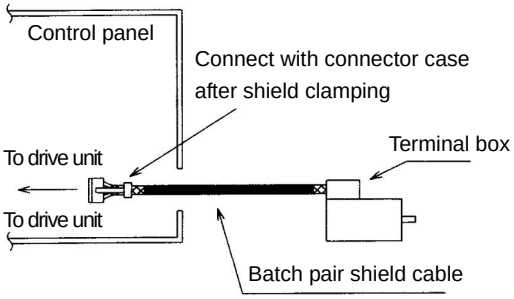
Using shield cable

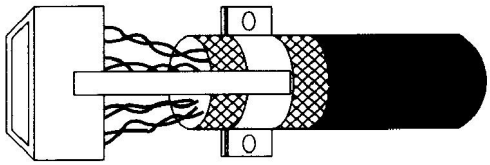


Using conduit

(1) Use four wires (3-phase + earthing) for the power cable that are completely shielded and free from breaks.
(2) Earth the shield in the same manner as the servomotor power cable.
(3) When not using a shield cable for the power cable, use a conventional cabtyre cable. Use a metal conduit outside the cable.
(4) Earth the power cable on the control panel side at the contact surface of the conduit connector and control panel side wall in the same manner as the servomotor power cable. (Mask the side wall of the control panel with paint.)
(5) Earth at the conduit connector section in the same manner as the servomotor power cable.

Appendix 3-5-6 Spindle motor feedback cable





Spindle drive unit side connector (this figure shows when cover is removed)

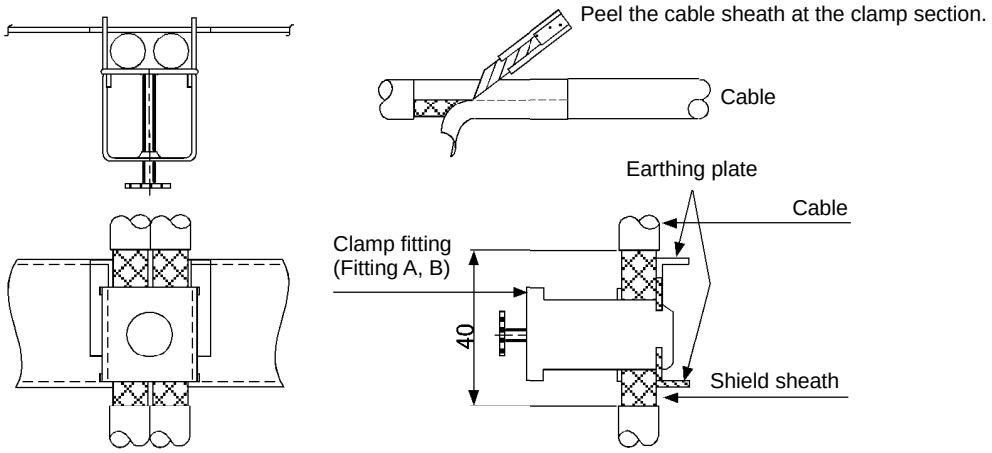
(1) Use a conventional batch shield cable for feedback cable of the spindle motor.

(Note) Shield of the spindle motor feedback cable is not FG. Do not earth.

Appendix 3-6 EMC countermeasure parts

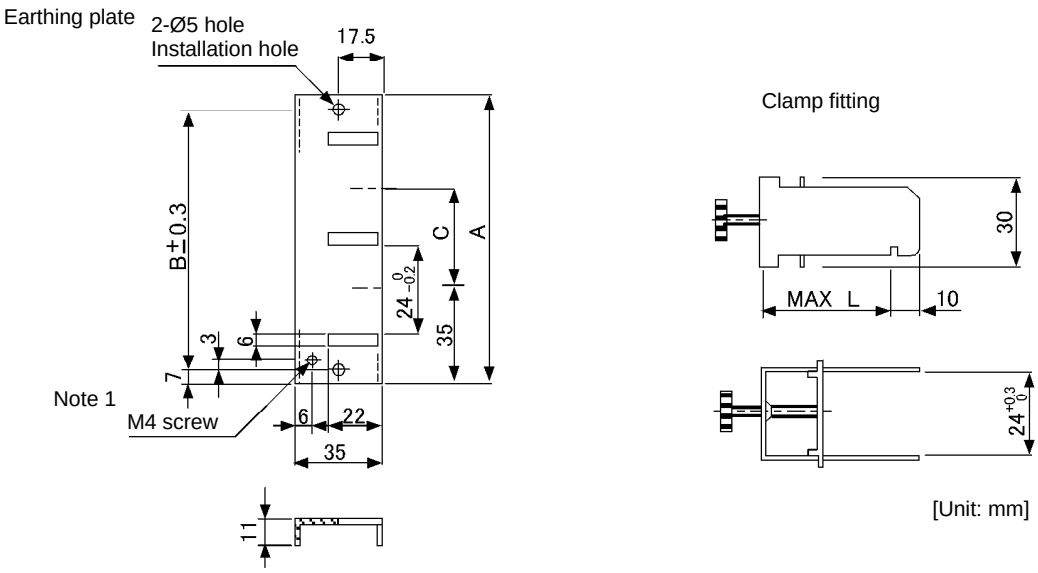
Appendix 3-6-1 Shield clamp fitting

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**



(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

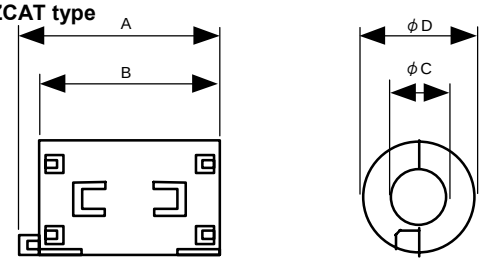


Fig.1

ZCAT-A type

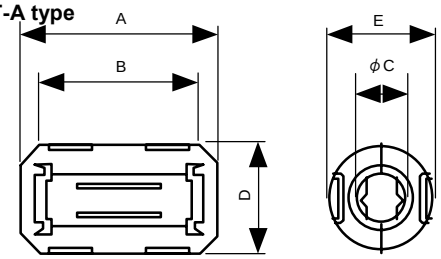


Fig.2

ZCAT-B type

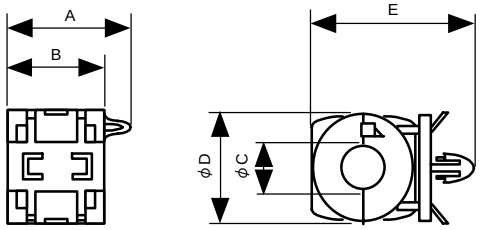


Fig.3

ZCAT-C type

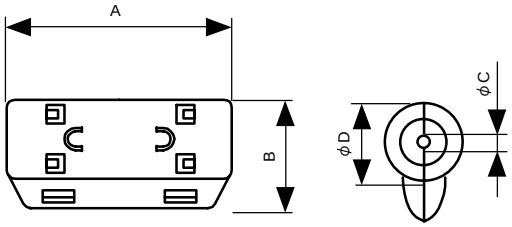


Fig.4

[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.

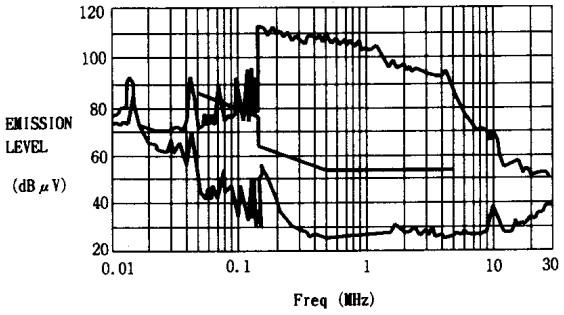
■ Application

- 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										

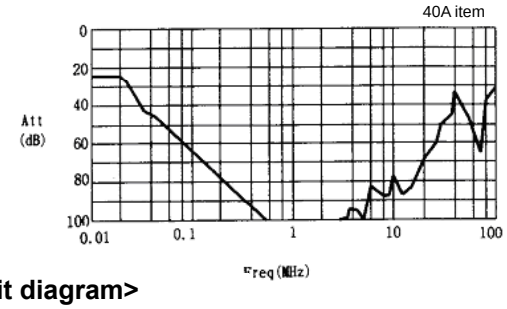
<Example of measuring voltage at noise terminal> ... Measured with IGBT inverter



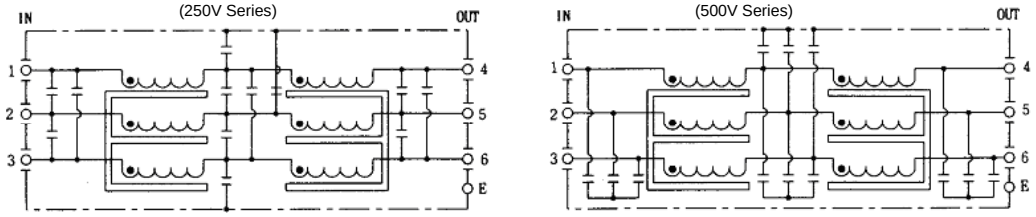
German Official Notice Vfg243 measurement data

EU Standards EN55011 (Class B) measurement data

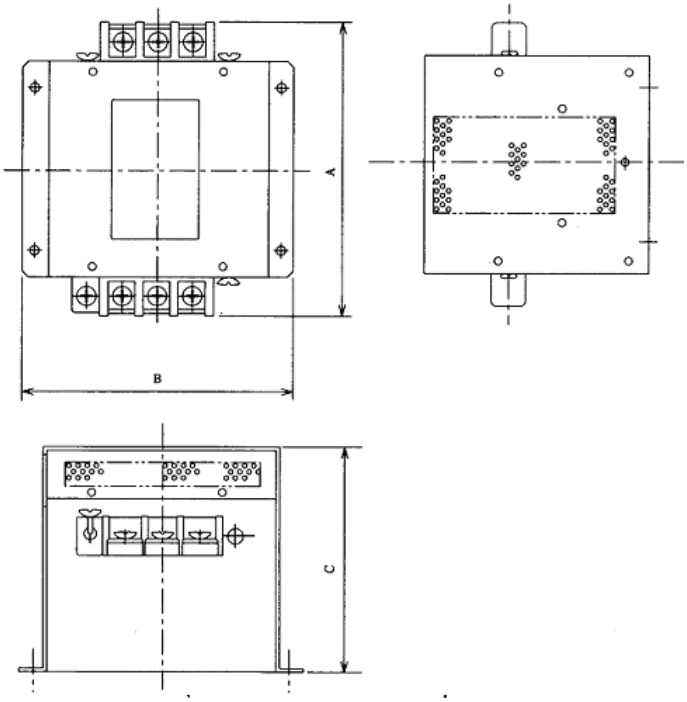
<Typical characteristics>



<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

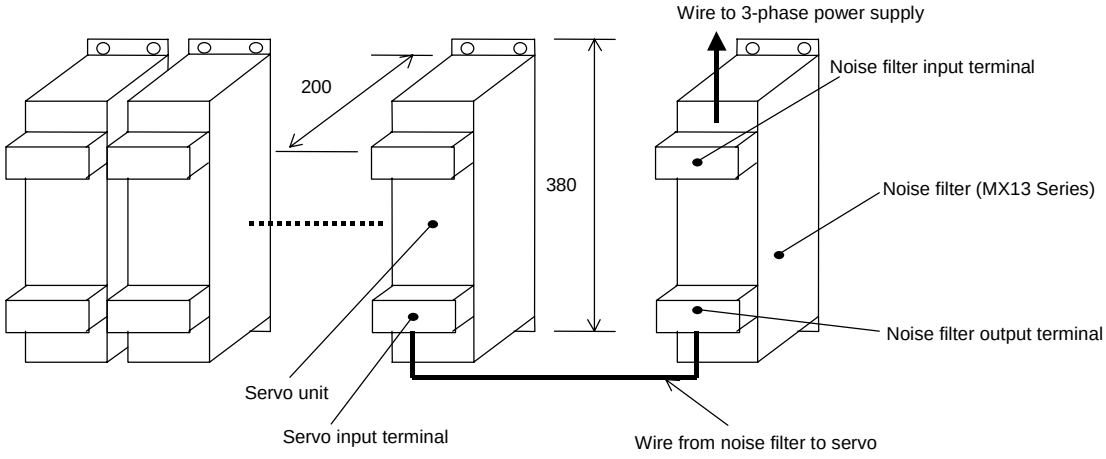
Item \ Type		MX13030	MX13050	MX13100	MX13150
1	Rated voltage (AC)	3-phase 250VAC (50/60Hz)			
2	Rated current (AC)	30A	50A	100A	150A
3	Test voltage (AC for one minute across terminal and case)	2500VAC (100mA) at 25°C, 70% RH			
4	Insulation resistance (500VDC across terminal and case)	100MΩ min. at 25°C, 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.

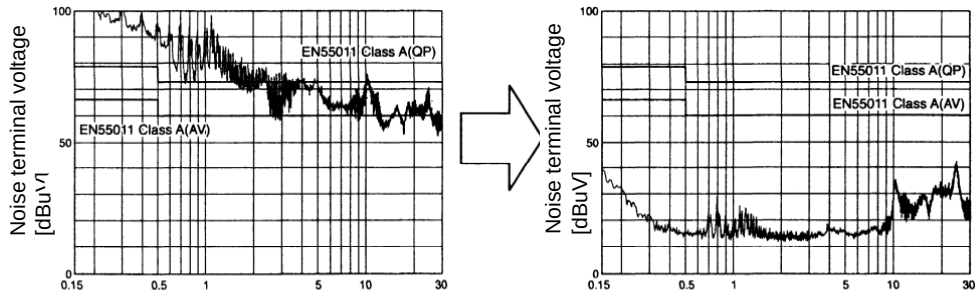
Contact: Densei-lambda Co., Ltd. Telephone: 03-3447-4411 (+81-3-3447-4411)
Fax: 03-3447-7784 (+81-3-3447-7784)
http://www.densei-lambda.com

■ 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.



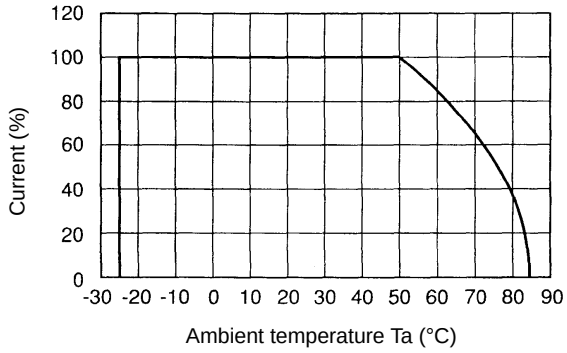
■ Example of noise terminal voltage attenuation



EMI data for independent control panel (with six-axis servo unit mounted)

EMI data for control panel + noise filter (MX13030)

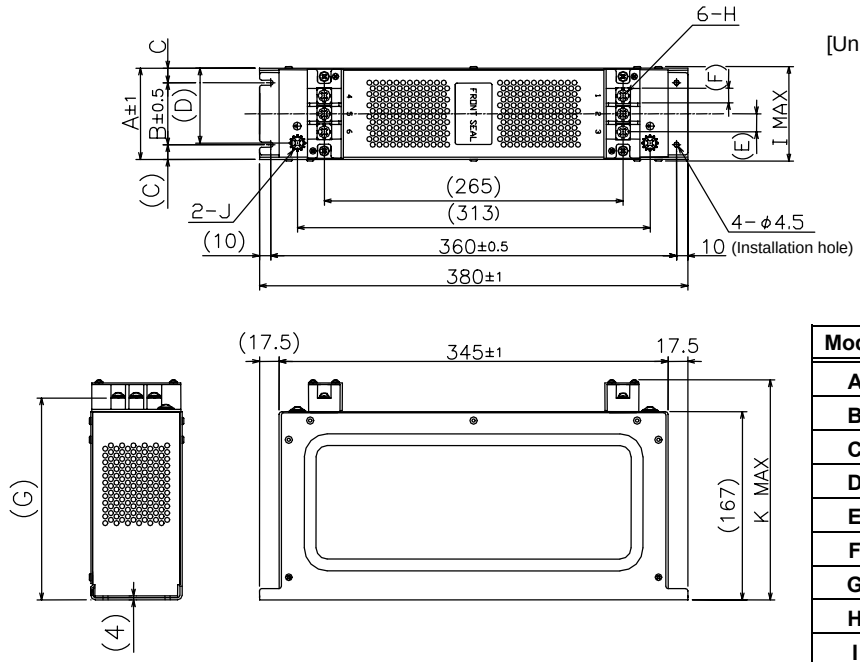
■ Output derating



■ Outline dimension drawings

● MX13030, MX13050

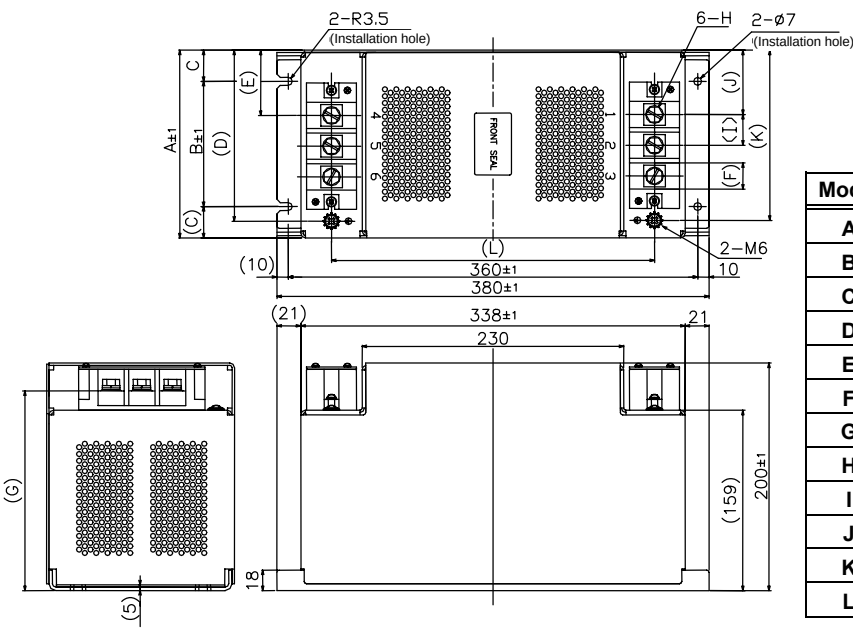
[Unit: mm]



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

[Unit: mm]



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.

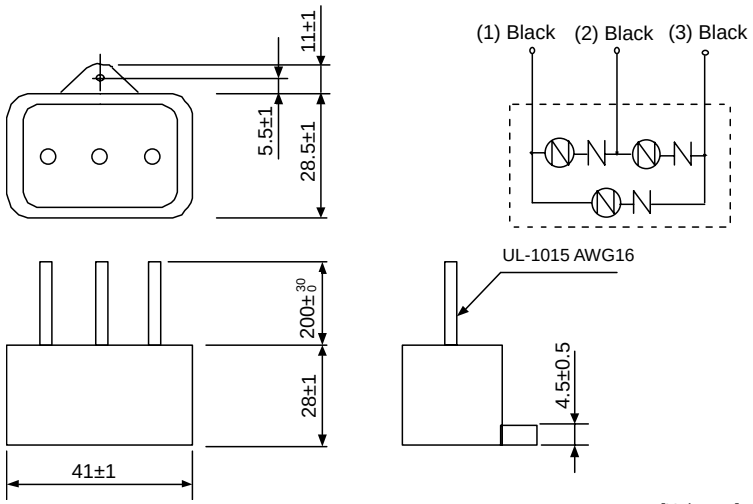
(1) 200V Surge protector

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**



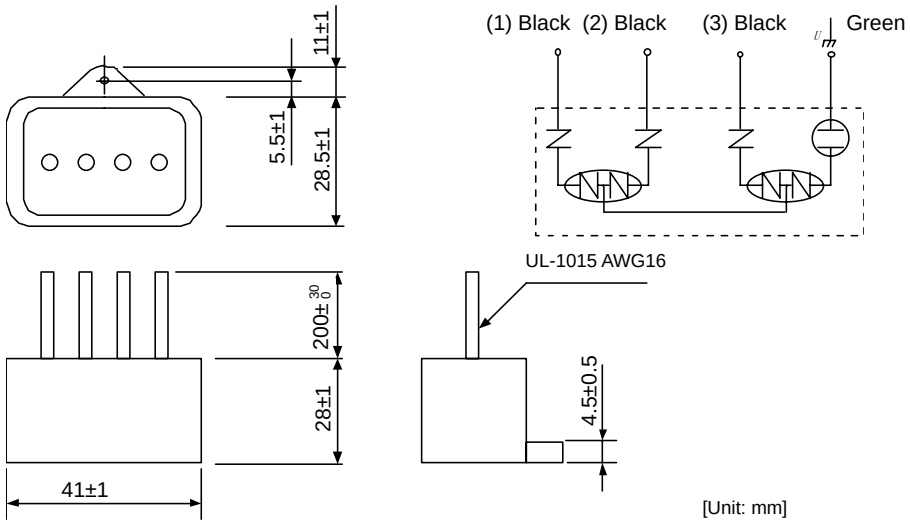
[Unit: mm]

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.

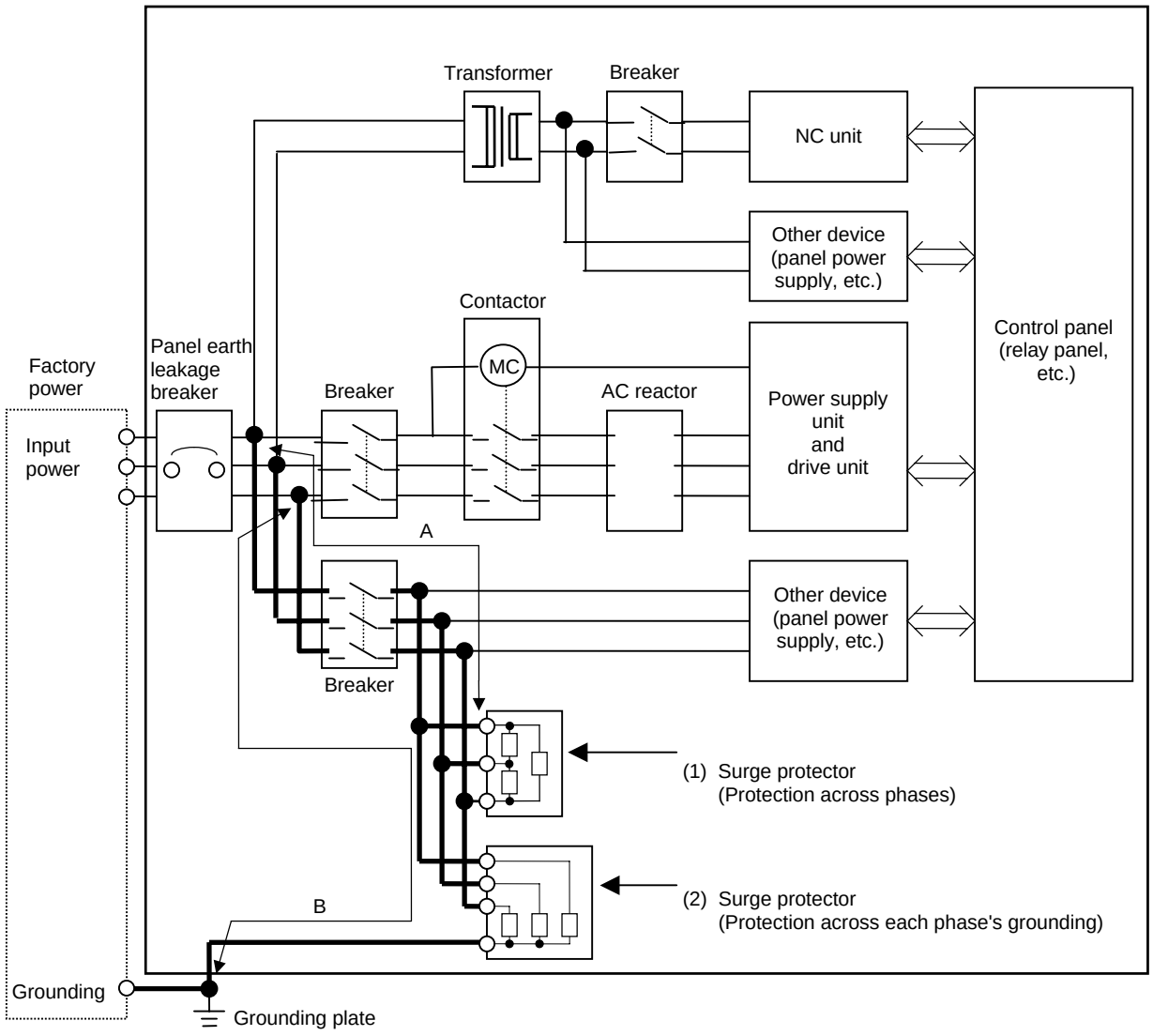
Outline dimension drawings **Circuit diagram**



[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. Servo/spindle drive unit categories based on higher harmonic suppression countermeasure guidelines

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/SPA/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

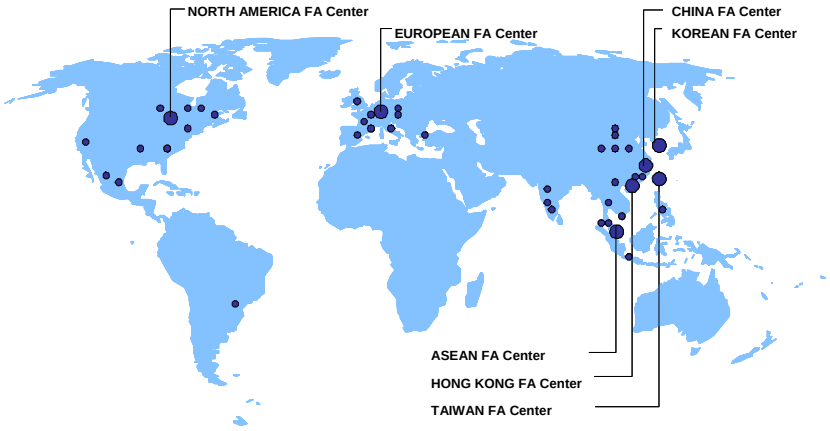
Type	Rated capacity [kVA]	Type	Rated capacity [kVA]	Type	Rated capacity [kVA]
MDS-A/B/C1-SP-37	4.61	MDS-A/B/C1-V1-03	0.6	MDS-A/B/C1-V2-0503	1.6
MDS-A/B/C1-SP-55	6.77	MDS-A/B/C1-V1-05	1.0	MDS-A/B/C1-V2-0505	2.0
MDS-A/B/C1-SP-75	9.07	MDS-A/B/C1-V1-10	1.6	MDS-B/C1-V2-1003	2.2
MDS-A/B/C1-SP-110	13.1	MDS-A/B/C1-V1-20	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
Jan. 2006	IB(NA)1500152-A	First edition created.

Global service network



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Lyon CNC Service Satellite

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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.
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