Changes for the Better

MITSUBISHI
ELECTRIC

CNC

MELDAS AC SERVO/SPINDLE MDS-C1 Series

SPECIFICATIONS MANUAL

MELDAS

BNP-C3000C(ENG)

USA-E99981-151-C

Introduction

Thank you for selecting the Mitsubishi numerical control unit.
This instruction manual describes the handling and caution points for using this AC servo/spindle.
Incorrect handling may lead to unforeseen accidents, so always read this instruction manual thoroughly to ensure correct usage.
Make sure that this instruction manual is delivered to the end user.
Always store this manual in a safe place.
All specifications for the MDS-C1 Series are described in this manual. However, each CNC may not be provided with all specifications, so refer to the specifications for the CNC on hand before starting use.

Notes on Reading This Manual

(1) Since the description of this specification manual deals with NC in general, for the specifications of individual machine tools, refer to the manuals issued by the respective machine manufacturers. The "restrictions" and "available functions" described in the manuals issued by the machine manufacturers have precedence to those in this manual.
(2) This manual describes as many special operations as possible, but it should be kept in mind that items not mentioned in this manual cannot be performed.

Precautions for safety

Please read this manual and auxiliary documents before starting installation, operation, maintenance or inspection to ensure correct usage. Thoroughly understand the device, safety information and precautions before starting operation.

The safety precautions in this instruction manual are ranked as "WARNING" and "CAUTION".

⚠ **DANGER**	When there is a potential risk of fatal or serious injuries if handling is mistaken.
⚠ **WARNING**	When fatal or serious injuries may occur if handling is mistaken.
⚠ **CAUTION**	When a dangerous situation may occur if handling is mistaken leading to medium or minor injuries, or physical damage.

Note that some items described as ⚠ **CAUTION** may lead to major results depending on the situation. In any case, important information that must be observed is described.

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

In this manual, the following items are generically called the "servomotor".

- Servomotor
- Spindle motor

In this manual, the following items are generically called the "servo drive unit".

- Servo drive unit
- Spindle drive unit
- Power supply + servo drive or spindle drive

DANGER

There are no "DANGER" items in this manual.

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 servo drive unit 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 unit, servomotor 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 a fault occurs in the servo drive unit. Fires could be caused if a large current continues to flow.

Provide a sequence that shut off the power at the regenerative resister error signal-ON when using the regenerative resistor. The regenerative resistor could abnormally overheat and cause a fire due to a fault in the regenerative transistor, etc.

⚠ CAUTION

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.

Do not touch the fin on the servo drive unit, regenerative resister or servomotor, etc., while the power is turned ON or immediately after turning the power OFF. These parts may reach high temperatures, and can cause burns.

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 unit.

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

Follow this Instruction Manual and install the unit 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, or between the servo drive unit and 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 unit or servomotor. 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 unit and servomotor 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	To follow separate specifications	80%RH or less (with no dew condensation)
Storage temperature	To follow separate specifications	–15°C to +70°C
Storage humidity	To follow separate specifications	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 or dust	
Altitude	1000m or less above sea level	
Vibration	To follow separate 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.

Never touch the rotary sections of the servomotor during operations. 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.

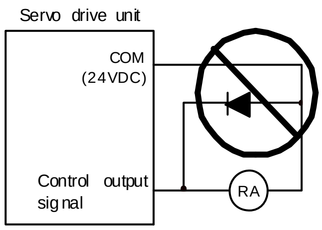
Do not apply a load exceeding the tolerable load onto the servomotor shaft. The shaft could break.

When storing for a long time, 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. Doing so could lead to faults.
- 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 power supply line and power line.
- Use wires and cables that have a wire diameter, heat resistance and flexibility that conforms to the system.

(3) Trial operation and adjustment

- Check and adjust each program and parameter before starting operation. Failure to do so could lead to unforeseen operation of the machine.
- Do not make remarkable adjustments and changes as the operation could become unstable.

CAUTION

(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 servomotor or servo drive unit.

Unqualified persons must not disassemble or repair the unit.

Never make modifications.

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

Use the servomotor, servo drive unit 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 are for holding, and must not be used for normal braking.

There may be cases when holding is not possible due to the magnetic brake's life 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.).

In the following explanations on bits, set all bits not used, including blank bits, to "0".

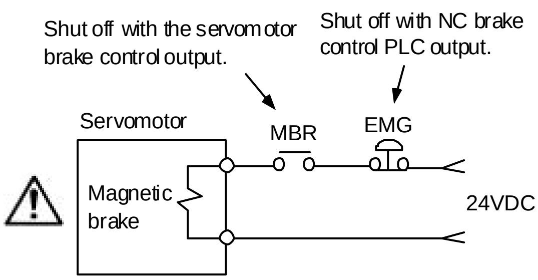
When the breaker is shared for multiple power supply units, if a short-circuit fault occurs in the unit with the smallest capacity, the breaker may not function. This is dangerous, so do not share the breaker.

Please do not use a dynamic brake as a usual slowdown stop. When continuation operation is carried out, the brake resistance for dynamic may be damaged.

(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.)

⚠ CAUTION

(6) Maintenance, inspection and part replacement

⚠ Always backup the servo drive unit programs and parameters before starting maintenance or inspections.

⚠ The capacity of the electrolytic capacitor will drop due to deterioration. To prevent secondary damage 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, back up the machining programs, tool data and parameters with an input/output unit, and then replace the battery.

⚠ Do not short circuit, charge, overheat, incinerate or disassemble the battery.

(7) Disposal

⚠ Treat this unit as general industrial waste.
If the heat radiating fins are protruding on the back face of the MDS Series, substitute Freon is used. Do not dispose of this type of unit as general industrial waste. Always contact the Service Station or Service Center for disposal.

⚠ Do not disassemble the servomotor or servo drive unit.

⚠ 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.

Compliance to European EC Directives

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. "Appendix 2", which explains the unit installation and control panel manufacturing method, etc., has been prepared to make compliance to the EMC Directives easier.

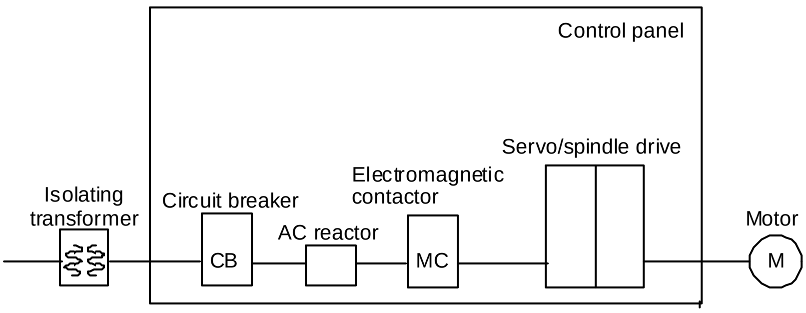
(2) Compliance to Low-voltage Directives

The MDS-C1 Series units are targeted for the Low-voltage Directives. An excerpt of the precautions given in this specification is given below. Please read this section thoroughly before starting use.
A Self-Declaration Document has been prepared for the EMC Directives and Low-voltage Directives. Contact Mitsubishi or your dealer when required.

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 breaker
(Note) Type A ... AC and pulse detection possible
Type B ... Both AC and DC detection possible

(2) Environment

Use the units within an Overvoltage Protection Category III and Pollution Class of 2 or less environment as stipulated in IEC60664.

(a) To attain the Overvoltage Category II, insert an EN or IEC Standard compliant star-connection insulated transformer in the power supply unit input.
(b) To attain a Pollution Class of 2, install the servo/spindle drive unit in a control panel having a structure (IP54 or higher) in which water, oil, carbon or dust cannot enter.

Drive unit

	During operation	Storage	During transportation
Ambient temperature	0°C to 55°C	–15°C to 70°C	–15°C to 70°C
Humidity	90%RH or less	90%RH or less	90%RH or less
Altitude	1000m or less	1000m or less	10000m or less

Motor

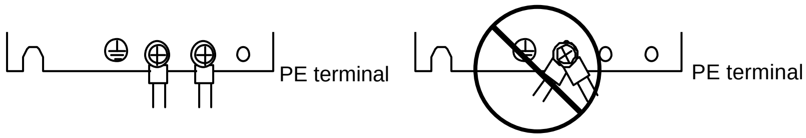
	During operation	Storage	During transportation
Ambient temperature	0°C to 40°C	–15°C to 70°C	–15°C to 70°C
Humidity	80%RH or less	90%RH or less	90%RH or less
Altitude	1000m or less	1000m or less	10000m or less

(3) Power supply

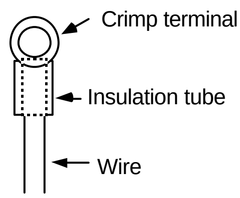
(a) Use the servo/spindle drive unit under the Overvoltage Category III conditions stipulated in IEC60664.
(b) Do not omit the circuit breaker and electromagnetic contactor.

(4) Installation

(a) 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. (Always ground even when using an earth leakage breaker.)
(b) When connecting the earthing wire to the protective earth (PE) terminal, do not tighten the wire terminals together. Always connect one wire to one terminal.



(5) Wiring



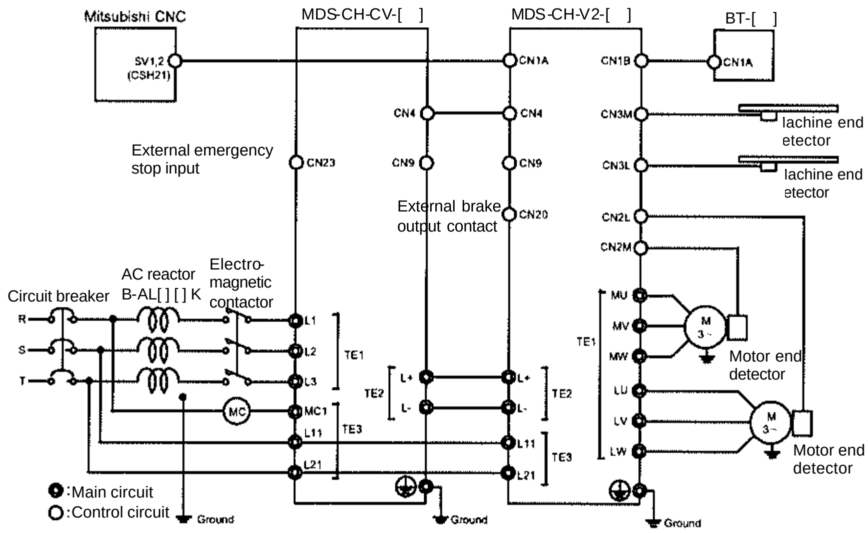
(a) Always use crimp terminals with insulation tubes so that the wires connected to the drive unit terminal block do not contact the neighboring terminals.
(b) Use a tin-plated crimp terminal that does not contain zinc for connecting the earthing wire. When tightening the screw, take care not to crush the screw threads.
(c) Refer to EN60204-1 when selecting the wire size. (Refer to section "8.5 Selection of wire size" for details.)
– Ambient temperature: 40°C max.
– Wire sheath: Cable installed on walls without ducts or conduits
– The control panel and duct wiring must be 3m or less.
If the conditions differ, refer to Table 5 in EN60204-1 Appendix C.

(6) Peripheral devices and options

(a) Use EN/IEC Standards compliant parts for the circuit breaker and electromagnetic contactor.

(7) Miscellaneous

(a) Refer to "Appendix 2 EMC INSTALLATION GUIDELINES" for methods on complying with the EMC Directives.
(b) When using in Europe, earth the device according to each country's requirements.
(c) The control circuit connector (○) is safety separated from the main circuit (◎).



Instruction Manual for Compliance with UL/c-UL Standard

The instruction of UL/c-UL listed products is described in this manual.
The descriptions of this manual are conditions to meet the UL/c-UL standard for the UL/c-UL listed products. To obtain the best performance, be sure to read this manual carefully before use.
To ensure proper use, be sure to read specification manual, connection manual and maintenance manual carefully for each product before use.

1. UL/c-UL listed products

[CNC system]

Unit name	Unit part number
NC control unit	FCU6-MU [*1]-[*2], FCU6-MA [*1]-[*2]
Display unit Keyboard unit	FCU6-DU [*39][*40], FCU6-YZ [*39][*40], FCUA-LD [*41], FCUA-CT [*41], FCUA-CR [*41], FCU6-YZ [*39][*40], FCU6-TZ [*39][*40], FCU6-KB0 [*42], FCUA-KB [*42]
Base I/O unit	FCU6-DX [*3], HR377, HR378, HR353
Remote I/O unit	FCUA-DX [*4]
I/O module	HR357, HR371, QY231

[AC servo/spindle system]

Unit name	Unit part number
Power supply unit	MDS-B-CVE- [*5], MDS-C1-CV-[*5]
Servo drive unit	MDS-B-V1- [*6], MDS-B-V14- [*6], MDS-C1-V1- [*6], MDS-B-V2- [*7], MDS-B-V24- [*7], MDS-C1-V2- [*7], MDS-B-SVJ2- [*8]
Spindle drive unit	MDS-B-SP [*38]-[*9], MDS-C1-SP [*38]-[*9]
Option unit	MDS-B-PJEX
Battery unit	FCU6-BT4D1
Servo motor	HA-FF [*10][*11][*12][*13][*14][*15][*16][*17][*18][*19] HC-MF [*10][*11][*12][*13][*14][*15][*16][*17][*18][*19] HC-SF [*10][*11][*12][*13][*14][*15][*16][*17][*18][*19] HC-RF [*10][*11][*12][*13][*14][*15][*16][*17][*18][*19] HC-MF [*10][*11][*12][*13][*14][*15][*16][*17][*18][*19] HC-RF [*10][*11][*12][*13][*14][*15][*16][*17][*18][*19] HC [*20][*11][*21][*14][*22]-[*23][*24]
Spindle Motor	SJ [*25][*26][*27]-[*28][*29][*30][*31]-[*32] SJ [*33][*26][*28][*34][*35][*36][*37][*31]

Suffixes listed below may be attached to the above part numbers at portions marked with [*]. For details regarding specifications, see the specification manuals.

[*1] 011, 013, 021, 031, 032, 515, 516, 517, 535, 536
[*2] 12, 23
[*3] 210, 211, 220, 221, 310, 311, 320, 321, 330, 331, 340, 341, 350, 351, 410, 411, 420, 421, 430, 431, 440, 441, 450, 451
[*4] 100, 101, 110, 111, 120, 121, 130, 131, 140, 141
[*5] 37, 55, 75, 110, 150, 185, 220, 260, 300, 370, (450, 550: Only B)
[*6] 01, 03, 05, 10, 20, 35, 45S, 45, 70, 90, 110, 150
[*7] 0101, 0301, 0303, 0501, 0503, 0505, 1003, 1005, 1010, 2010, 2020, 3510S, 3510, 3520S, 3520, 3535, 4520, 4535, 4545, 7035, 7045, 7070S, 7070
[*8] 01, 03, 04, 06, 07, 10, 20
[*9] 04, 075, 15, 22, 37, 55, 75, 110, 150, 185, 220, 260, 300, 370, (450,550:Only MDS-B Series)
[*10] 05, 1, 2, 3, 4, 5, 6, 7, 8, 10, 12, 15, 20, 30, 35
[*11] 1, 2, 3
[*12] None, C
[*13] None, P, N, I, E
[*14] None, B
[*15] None, Gn, GnH (n = serial number)
[*16] None, K, D, X, T
[*17] None, Wn (n = serial number)
[*18] None, UL, UE
[*19] None, Sn (n = serial number)
[*20] 5, 10, 15, 20, 35, 45, 70
[*21] None, R
[*22] S, T
[*23] E, A
[*24] 1, 2, 33, 42, 51
[*25] NL, PF, PL, V, VL
[*26] None, K
[*27] None, S
[*28] Two digits decimal two digits
[*29] 01 - 99
[*30] None, F, G, Y, Z
[*31] None, M
[*32] None, S01 - S99
[*33] None, N, P
[*34] A, B, L, M, N, X
[*35] None, 1 - 9, A - F
[*36] None, D, H, P, Z
[*37] None, B, C, F, G, R
[*38] None, H, M, X, HX, MX
[*39] T, C, N
[*40] 31, 32, 33, 34, 35, 36
[*41] 10, 100, 120
[*42] 05, 06, 10, 13, 14, 20, 30

2. Operation surrounding air ambient temperature

The recognized operation ambient temperature of each units are as shown in the table below. The recognized operation ambient temperatures are the same as an original product specification for all of the units.

Classification	Unit name	Operation ambient temperature
CNC system	NC control unit	0~55°C
	Base I/O unit	0~55°C
	Remote I/O unit	0~55°C
	I/O module	0~55°C
AC servo/spindle system	Power supply unit	0~55°C
	Servo drive unit	0~55°C
	Spindle drive unit	0~55°C
	Option unit, Battery unit	0~55°C
	Servo motor, Spindle Motor	0~40°C

3. Notes for CNC system

3.1 Selection of external power supply unit

An UL recognized 24Vdc output power supply unit should be used to CNC system.
The "PD25" power supply unit provided by Mitsubishi will be changed to UL recognized product since September 2000.

4. Notes for AC servo/spindle system

4.1 General Precaution

It takes 10 minutes to discharge the bus capacitor.
When starting wiring or inspection, shut the power off and wait for more than 15 minutes to avoid a hazard of electrical shock.

4.2 Installation

MDS-B/C1 Series have been approved as the products, which have been installed in the electrical enclosure. The minimum enclosure size is based on 150 percent of each MDS-B/C1 unit combination. And also, design the enclosure so that the ambient temperature in the enclosure is 55°C (131°F) or less, refer to the manual book (chapter Ⅰ-section3,7).

4.3 Short-circuit ratings

Suitable for use in a circuit capable of delivering, it is not more than 5kA rms symmetrical amperes.

4.4 Peripheral devices

To comply with UL/c-UL Standard, use the peripheral devices, which conform to the corresponding standard.

- Circuit Breaker, Fuses, Magnetic Contactor and AC Reactor

Applicable power supply unit	Circuit Breaker	Fuse Class K5	Magnetic contactor (AC3)	AC Reactor BKO-NC6851-
MDS-B-CVE-37 MDS-C1-CV-37	NF50 40A	70A	S-N25	H11 (B-AL-7.5K)
MDS-B-CVE-55 MDS-C1-CV-55	NF50 40A	100A	S-N25	H11 (B-AL-7.5K)
MDS-B-CVE-75 MDS-C1-CV-75	NF50 40A	100A	S-N25	H11 (B-AL-7.5K)
MDS-B-CVE-110 MDS-C1-CV-110	NF50 50A	100A	S-N35	H12 (B-AL-11K)
MDS-B-CVE-150 MDS-C1-CV-150	NF100 100A	200A	S-N50	H13 (B-AL-18.5K)
MDS-B-CVE-185 MDS-C1-CV-185	NF100 100A	200A	S-N50	H13 (B-AL-18.5K)
MDS-B-CVE-220 MDS-C1-CV-220	NF225 150A	200A	S-N80	H14 (B-AL-30K)
MDS-B-CVE-260 MDS-C1-CV-260	NF225 150A	300A	S-N80	H14 (B-AL-30K)
MDS-B-CVE-300 MDS-C1-CV-300	NF225 150A	300A	S-N80	H14 (B-AL-30K)
MDS-B-CVE-370 MDS-C1-CV-370	NF225 175A	300A	S-N150	H15 (B-AL-37K)
MDS-B-CVE-450	NF225 200A		S-N150	H16 (B-AL-45K)
MDS-B-CVE-550	NF400 300A		S-N180	H17 (B-AL-55K)

- Circuit Breaker for of spindle motor Fan
  Select the Circuit Breaker by doubling the spindle motor fan rated.
  A rush current that is approximately double the rated current will flow, when the fan is started

<Notice>

– For installation in United States, branch circuit protection must be provided, in accordance with the National Electrical Code and any applicable local codes. – For installation in Canada, branch circuit protection must be provided, in accordance with the Canadian Electrical Code and any applicable provincial codes.

4.5 Flange of servomotor

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

Flange size (mm)	Servo Motor				
	HC□	**HC-RF□**	**HC-MF□**	**HA-FF□**	**HC-SF□**
150×150×6	---	---	Under 100 W	Under 100 W	---
250×250×6	---	---	200 W	200,300 W	---
250×250×12	0.5~1.5 kW	1.0~2.0 kW	400 W	400,600 W	0.5~1.5 kW
300×300×12	---	---	750 W	---	---
300×300×20	2.0~7.0 kW	---	---	---	2.0~7.0 kW

4.6 Motor Over Load Protection

Servo drive unit MDS-B-V1/2/14/24 Series and MDS-C1-V1/2 series and spindle drive unit MDS-B-SP and MDS-C1-SP series have each solid-state motor over load protection.
When adjusting the level of motor over load, set the parameter as follows.

4.6.1 MDS-B-V1/2/14/24, MDS-C1-V1/2 Series

Parameter No.	Parameter Abbr.	Parameter Name	Setting Procedure	Standard Setting Value	Setting Range
SV021	OLT	Overload Time constant	Set the time constant for overload detection. (Unit: 1 second.)	60s	1~300s
SV022	OLL	Overload Detection level	Set the overload current detection level with a percentage (%) of the stall rating.	150%	1~500%

4.6.2 MDS-B-SP, MDS-C1-SP Series

Parameter No.	Parameter Abbr.	Parameter Name	Setting Procedure	Standard Setting Value	Setting Range
SP063	OLT	Overload Time constant	Set the time constant for overload detection. (Unit: 1 second.)	60s	0~1000s
SP064	OLL	Overload Detection level	Set the overload current detection level with a percentage (%) of the rating.	110%	1~200%

4.7 Field Wiring Reference Table for Input and Output

Use the UL-approved Round Crimping Terminals to wire the input and output terminals of MDS-B Series.
Crimp the terminals with the crimping tool recommended by the terminal manufacturer.

Following described crimping terminals and tools type are examples of Japan Solderless Terminal Mfg. Co., Ltd.

4.7.1 Power Supply Unit (MDS-B-CVE, MDS-C1-CV Series)

Capacity [kW]		3.7~7.5	11.0~18.5	22.0~37.0	45.0	55.0
Terminal Screw Size	P, N (L+, L-)	M6	M6	M6	M6, M10	
	Screw Torque [lb in/ N m]	44.3/5.0	49.6/5.6	49.6/5.6	49.6/5.6, 177/20	
	L11, L21, MC1 (R0, S0)	M4	M4	M4	M4	M4
	Screw Torque [lb in/ N m]	17.4/2.0	14.2/1.6	14.2/1.6	14.2/1.6	14.6/1.6
	L1, L2, L3	M4	M5	M8	M8	M10
	Screw Torque [lb in/ N m]	14.6/1.6	29.8/3.37	117.2/13.2	117.2/13.2	177/20

P, N (L+, L-)

Capacity [kW]	3.7, 5.5	7.5	11.0	15.0	18.5, 22.0
Wire Size (AWG) /Temp Rating Note 1	#10/60℃	#8/60°C	#4/60°C	#4/60°C	#3/60°C
	#12/75℃	#10/75℃	#8/75°C	#4/75°C	#4/75°C
Crimping Terminals Type	R5.5-6	R8-6	R22-6	R22-6	
		R5.5-6	R8-6		
Crimping Tools Type	YHT-2210	YHT-8S	YPT-60	YPT-60	
		YHT-2210	YHT-8S		

Capacity [kW]	26.0	30.0	37.0	45.0	55.0
Wire Size (AWG) /Temp Rating Note 1	#1/60°C	#1/75°C	#1/0/75°C	The bus bar is attached to the product.	
	#3/75°C				
Crimping Terminals Type	38-S6	38-S6	L330T 459-12		
	R22-6				
Crimping Tools Type	YPT-60		YET300 YF-1		

L11, L21 (R0, S0), MC1

Capacity [kW]	3.7~55.0
Wire Size (AWG) /Temp Rating Note 1	#14/ 60°C
	#14/ 75°C
Crimping Terminals Type	V2-4
Crimping Tools Type	YNT-1614

L1, L2, L3

Capacity [kW]	3.7	5.5	7.5	11.0	15.0	18.5
Wire Size (AWG) /Temp Rating Note 1	#10/60℃	#10/60℃	#10/75℃	#4/60°C	#3/60°C	#3/75°C
	#12/75℃	#10/75℃		#4/75°C	#4/75°C	
Crimping Terminals Type	5.5-S4			L300T 459-23		
Crimping Tools Type	YHT-2210			YPT-60		
Earth Wire Size (AWG)	#10/60℃	#10/60℃	#10/75℃	#4/60°C	#3/60°C	#3/75°C
	#10/75℃	#10/75℃		#4/75°C	#4/75°C	

Capacity [kW]	22.0	26.0	30.0	37.0	45.0	55.0
Wire Size (AWG) /Temp Rating Note 1	#1/60°C	#1/0/60°C	#1/75°C	1/0/75°C	#2/0 /75°C	#3/0 /75°C
	#2/75°C	#1/75°C				
Crimping Terminals Type	38-S8	L330T 459-12	38-S8	L330T 459-12	70-8	R80-10
		38-S8				
Crimping Tools Type	YPT-60	YET300 YF-1	YPT-60	YET300 YF-1	YTP-150	
		YPT-60				
Earth Wire Size (AWG)	#3/60°C	#1/60°C	#3/75°C	1/75°C	#1/75°C	#1/0/75℃
	#3/75°C	#3/75°C				

4.7.2 Servo Drive Unit (MDS-B-V1/2/14/24, MDS-C1-V1/2 Series)

Axis		1-axis (V1, V14)			2-axes (V2, V24)
Capacity [kW]		0.1～3.5	4.5～9.0	11.0, 15.0	0.1+0.1～7.0+7.0
Terminal Screw Size	P, N (L+, L-)	M6	M6	M6	M6
	Screw Torque [lb in/ N m]	44.3 /5.0	44.3 /5.0	44.3 /5.0	44.3 /5.0
	L11, L21 (R0, S0)	M4	M4	M4	M4
	Screw Torque [lb in/ N m]	17.4 /2.0	17.4 /2.0	17.4 /2.0	17.4 /2.0
	U, V, W	M4	M5	M8	M4
	Screw Torque [lb in/ N m]	14.6 /1.6	28.6 /3.2	117.2 /13.2	14.6 /1.6

P, N (L+, L-)
Wire size depends on the Power Supply Unit (MDS-B-CVE, MDS-C1-CV Series).

L11, L21 (R0, S0)

Capacity [kW]	0.1～15.0
Wire Size (AWG) /Temp Rating Note 1	#14/ 60°C
	#14/ 75°C
Crimping Terminals Type	V2-4
Crimping Tools Type	YNT-1614

U, V, W

Capacity [kW]	0.1～1.0	2.0	3.5	4.5
Wire Size (AWG) /Temp Rating Note 1	#14/60℃	#10/60℃	#8/60°C	#8/60°C
	#14/75℃	#14/75℃	#10/75℃	#10/75℃
Crimping Terminals Type	R2-4	R5.5-4	8-4	R8-5 (8-4)
		T2-4	R5.5-4	R5.5-5 (R5.5-4)
Crimping Tools Type	YHT-2210		YHT-8S	
			YHT-2210	
Earth wire Size (AWG)	#14/60℃	#10/60℃	#8/60°C	#8/60°C
	#14/75℃	#12/75℃	#10/75℃	#10/75℃
Capacity [kW]	7.0	9.0	11.0	15.0
Wire Size (AWG) /Temp Rating Note 1	#8/60°C	#8/60°C	#4/60°C	#2/60°C
	#8/75°C	#8/75°C	#4/75°C	#3/75°C
Crimping Terminals Type	R8-5 (8-4)	R8-5	R22-8	R38-8
Crimping Tools Type	YHT-8S		YPT-60	
Earth Wire Size (AWG)	#8/60°C	#8/60°C	#4/60°C	#3/60°C
	#8/75°C	#8/75°C	#4/75°C	#3/75°C

4.7.3 Spindle Drive Unit (MDS-B-SP, MDS-C1-SP Series)

Capacity [kW]		0.4~3.7	5.5~18.5	22.0~30.0	37.0	45.0/55.0
Terminal Screw Size	P, N (L+, L-)	M6	M6	M6	M10	M10
	Screw Torque [lb in/ N m]	44.3/5.0	44.3/5.0	44.3/5.0	234.3/26.5	177/20
	L11, L21 (R0, S0)	M4	M4	M4	M4	M4
	Screw Torque [lb in/ N m]	17.4/2.0	17.4/2.0	17.4/2.0	17.4/2.0	17.2/2.0
	U, V, W	M4	M5	M8	M8	M10
	Screw Torque [lb in/ N m]	14.6/1.6	28.6/3.2	117.2/13.2	88.5/10.0	177/20

P, N (L+, L-)
Wire size depends on the Power Supply Unit (MDS-B-CVE, MDS-C1-CV Series).

L11, L21 (R0, S0)

Capacity [kW]	0.4~55.0
Wire Size (AWG) /Temp Rating Note 1	#14/60℃
	#14/75℃
Crimping Terminals Type	V2-4
Crimping Tools Type	YNT-1614

U, V, W

Capacity [kW]	0.4, 0.75	1.5	2.2, 3.7	5.5	7.5	11.0	15.0
Wire Size (AWG) /Temp Rating Note 1	#14 /60°C	#10/60℃		#10/60℃	#8/60°C	#8/60°C	#4/60°C
	#14 /75°C	#14/75℃		#12/75℃	#10/75℃	#8/75°C	#4/75°C
Crimping Terminals Type	R2-4	5.5-S4	R5.5-4	R5.5-5	R8-5	R8-5	L330T 459-23
		R2-4			R5.5-5		
Crimping Tools Type	YHT-2210				YHT-8S	YHT-8S	YPT-60
					YHT-2210		
Earth Wire Size (AWG)	#14 /60°C	#11/60℃		#10/60℃	#8/60°C	#8/60°C	#4 /60°C
	#14 /75°C	#14/75℃		#10/75℃	#10/75℃	#8/75°C	#4 /75°C

Capacity [kW]	18.5	22.0	26.0	30.0	37.0	45.0	55.0
Wire Size (AWG) /Temp Rating Note 1	#3/60°C	#2/60°C	#1/60°C	#1/75°C	#1/0/75°C	#2/0 75°C	#4/0 /75°C
	#4/75°C	#3/75°C	#2/75°C				
Crimping Terminals Type	22-S6	R38-8			R60-8	70-10	R100-10
	L330T 459-23						
Crimping Tools Type	YPT-60				YET300 YF-1	YPT-150	
Earth Wire Size (AWG)	#3/60°C	#3/60°C		#3/75°C	#1/75°C	#1/75°C	#3/0 /75°C
	#4/75°C	#3/75°C					

Note 1: 60°C: Polyvinyl chloride insulated wires (IV)
75°C: Grade heat-resistant polyvinyl chloride insulated wires (HIV)
Use copper wire only.
Above listed wire are for use in the electric cabinet on machine or equipment.

4.8 Spindle Drive / Motor Combinations

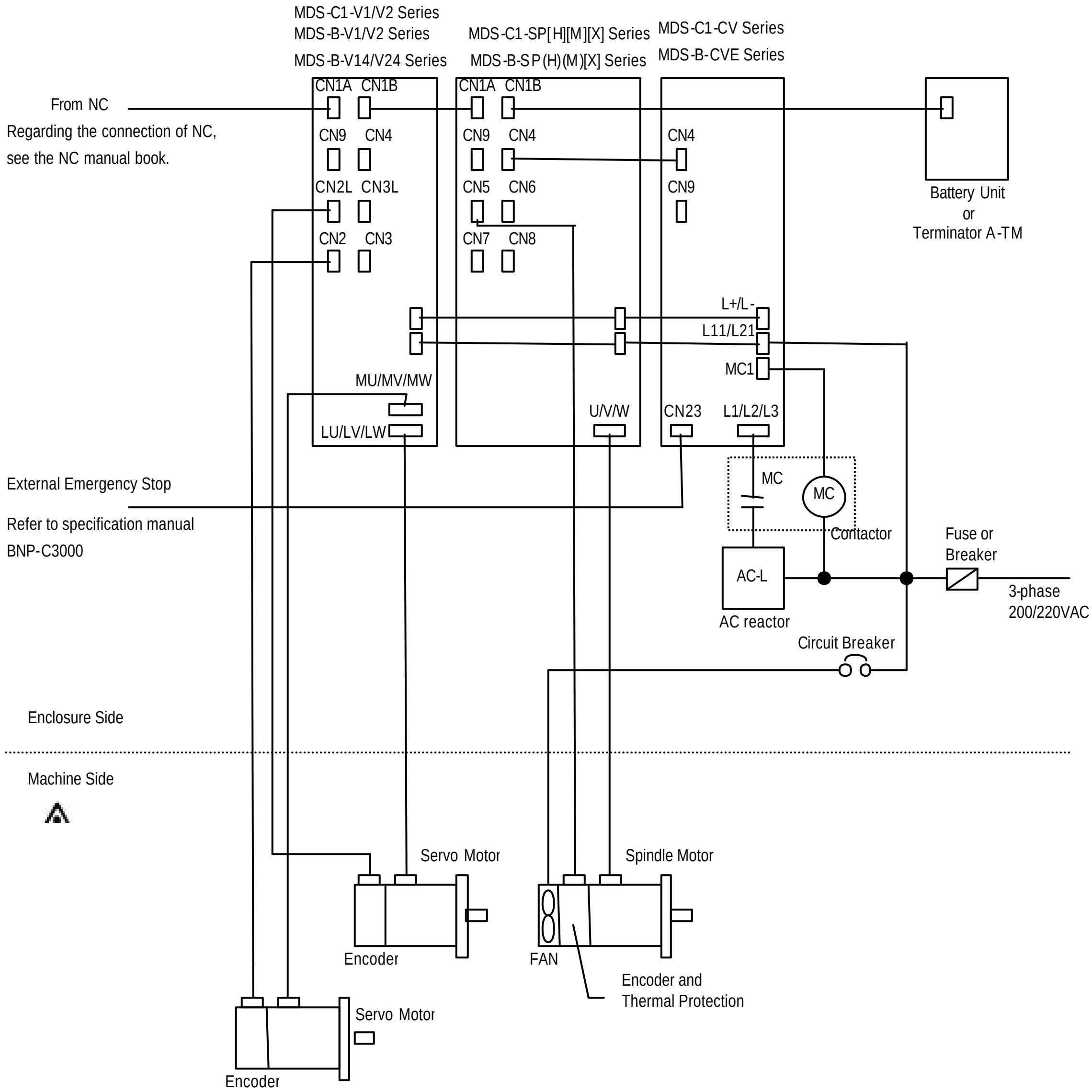
Following combinations are the Standard combinations

Drive Unit Note: 1	Rating Output (kW) Of Applicable Spindle Motor: SJ- ( ) Series SJ-V/VL Series Note: 2	Rating Output (kW) Of Applicable Spindle Motor: SJ-N Series SJ-NL Series
MDS-B-SP []-04 MDS-C1-SP []-04		0.2
MDS-B-SP []-075 MDS-C1-SP []-075		0.75
MDS-B –SP []-15 MDS-C1-SP []-15		1.5
MDS-B –SP []-22 MDS-C1-SP []-22	2.2	2.2
MDS-B –SP []-37 MDS-C1-SP []-37	3.7	3.7
MDS-B-SP []-55 MDS-C1-SP []-55	5.5	5.5
MDS-B-SP []-75 MSD-C1-SP []-75	5.5 7.5	7.5
MDS-B-SP []-110 MDS-C1-SP []-110	5.5 7.5 11	11
MDS-B-SP []-150 MDS-C1-SP []-150	7.5 11 15	
MDS-B-SP []-185 MDS-C1-SP []-185	11 15 18.5	
MDS-B-SP []-220 MDS-C1-SP []-220	11 15 18.5 22	
MDS-B-SP []-260 MDS-C1-SP []-260	11 15 18.5 22 26	
MDS-B-SP []-300 MDS-C1-SP []-300	15 18.5 22 26 30	
MDS-B-SP [] –370	15 18.5 22 26 30 37	
MDS-B-SP [] -450	22 26 30 37 45	
MDS-B-SP [] -550	30 37 45 55	

Note 1: [] can be H, M, X, HX, MX or none.

Note 1: Applicable unit depends on the range of power constant of motor.
Inquire of Mitsubishi about the detail of the combinations.

5. AC Servo/Spindle System Connection



CONTENTS

Chapter II MDS-C1-CV Power Regeneration Type Power Supply Section

Chapter III MDS-C1-Vx Servo System Section

Chapter IV MDS-C1-SP Spindle System Section

Chapter V IPM Spindle Drive System Section

I. MDS-C1 Series

Servo/Spindle System Configuration Section

1. Outline

MDS-C1 Series servo and spindle system outline

The MDS-C1 Series is MELDAS drive system that has been developed totally connected the servo drive and spindle drive sections.
The MDS-C1 Series is the successor to the MDS-B Series, and has been developed to satisfy European Safety Standards. This Series has the following features.

(1) Compact and lightweight

The converters that were conventionally built in each servo and spindle drive have been integrated into one unit. The drive system volume, installation area and weight have been drastically reduced with the incorporation of high density mounted electronic parts IGBT-IPM (Intelligent Power Module) and the high performance heat radiating fin.

(2) Standardization of dimensions

The outline has been standardized to the book end type, and by unifying the height and depth dimensions, installation in control box has been made easy. Furthermore, by matching the shape with the NC unit (M500 Series), an integrated appearance with the NC has been realized.

(3) Low heat generation

By incorporating the IPM and using power supply regeneration in the servo drive, the amount of heat generated has been greatly reduced.

(4) High speed and precision processing

A high speed CPU has been mounted on the control PCB, and a 100,000 pulse/rotation sub micron detector has been incorporated as a standard to allow faster and more precise interpolation.
By incorporating the stable position loop control (SHG control) method, having an outstanding response, the positioning time and tracking have been improved and the machine vibration during acceleration/deceleration has been reduced.
The cutting performance and cutting precision during position control have been improved by using the high speed CPU also for the spindle drive.

(5) High speed spindle orientation

Smooth operations and minimum orientation times have been realized by using the high speed orientation method while allows direct orientation from the high speed during the spindle drive.

(6) Features of the MDS-C1 Series

(a) European Safety Standards compliant
This Series complies with the European Safety Standards (LVD Directives). (Refer to the section "Compliance to European EC Directives" for details.)
(Note that the C1 Series target units are limited to the CV (power regeneration power supply), SP (spindle drive) and V1/V2 (1, 2-axis servo drive).)

(b) Addition of power supply emergency stop input line
With the C1 Series, the external contactor can be directly shut off from the power supply even when the emergency stop hot line from the NC does not function for any reason.
(This function is validated with the rotary switch and connected drive parameter settings. Thus, the functions do not change from the conventional functions when used in the same manner as the A Series.)

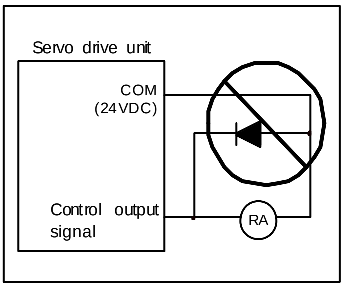
2. Drive Section System Configuration

⚠ WARNING

1. Wiring and inspection work must be done by a qualified technician.
2. Wait at least 15 minutes after turning the power OFF before starting wiring or inspections. Failure to observe this could lead to electric shocks.
3. Wire the servo drive unit and servomotor after installation. Failure to observe this could lead to electric shocks.
4. Do not damage, apply forcible stress, place heavy items or engage the cable. Failure to observe this could lead to electric shocks.

⚠ CAUTION

1. Correctly carry out the wiring. Failure to do so could lead to runaway of the servomotor, or to injuries.
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 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.



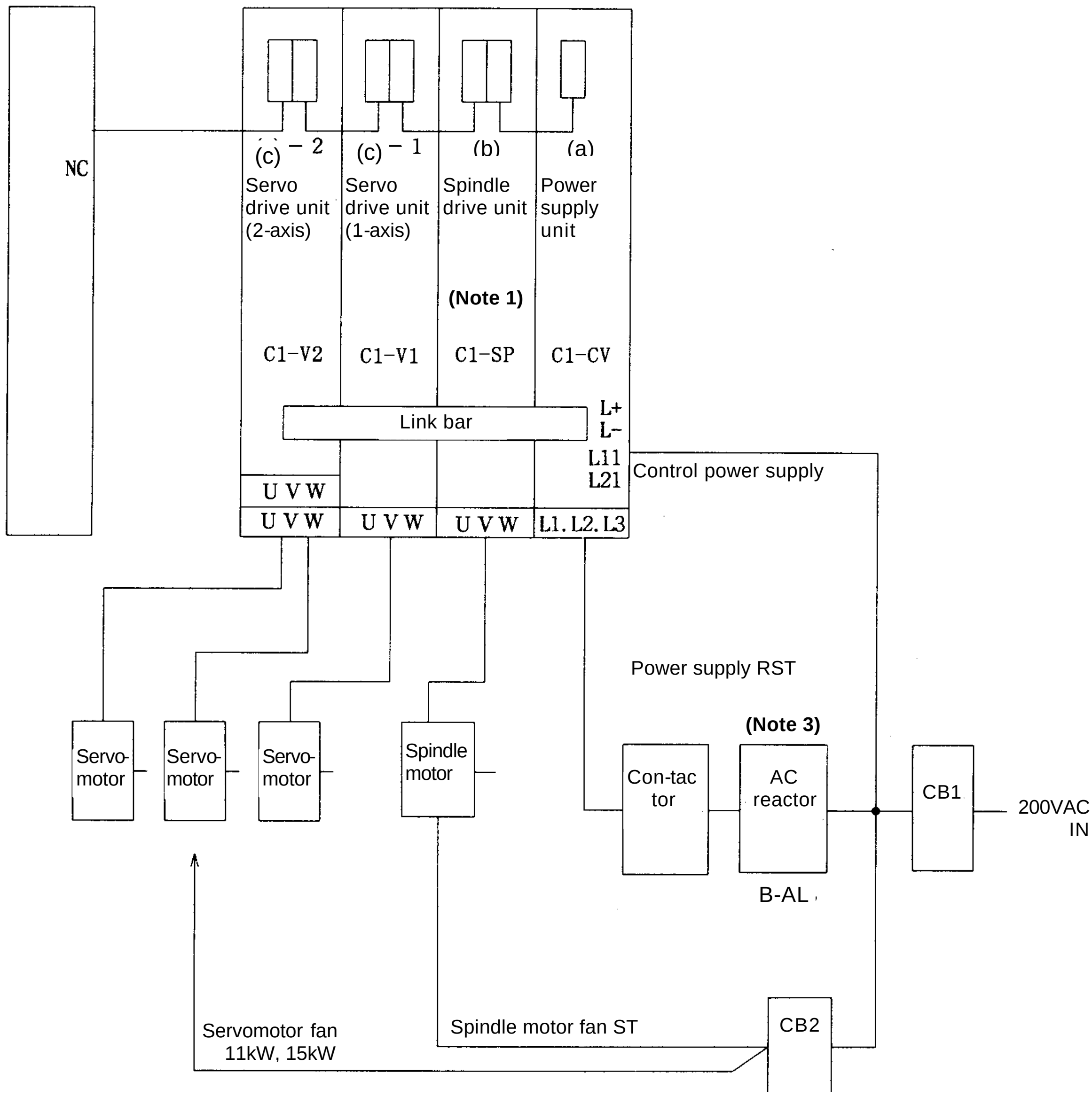
5. Reduce magnetic damage by installing a noise filter,etc. The electronic devices used near the servo drive unit could be affected by magnetic noise.
6. Do not install a condensing capacitor, surge absorber or radio noise filter on the output side of the servo drive unit.
7. Provide a sequence that shut off the power at the regenerative resister error signal-ON when using the regenerative resistor. The regenerative resistor could abnormally overheat and cause a fire due to a fault in the regenerative transistor, etc.
8. Never make modifications.
9. Some parts are the MDS-C1 Series instead of the MDS-B Series. The basic specifications do not differ, but if newly added functions or a newly added capacity is being used, always confirm the changed points before starting use.

⚠ CAUTION

Cautions for using MDS-C1 Series

1. The power supply unit MDS-C1-CV-370 has a different rush sequence from the other power supplies. Thus, always install an external contactor. Do not share the contactor with other power supplies.
2. The servo drive unit MDS-C1-V1-110/150 does not have built-in dynamic brake. Thus, always use an external dynamic brake unit.

(1) **Basic system configuration (Example: Spindle + 3-axis servo)**



(Note 1) In systems which use a spindle drive unit, the spindle drive unit must be placed next to the power supply unit as shown above. Also install the 11kW and higher servo drive unit next to the power supply unit.
If also using spindle drive units, arrange the units next to the power supply in decreasing order of drive capacity size.

(Note 2) Excluding MDS-C1-CV-370, the use of a contactor can be selected.
Excluding MDS-C1-CV-370, use is possible without a contactor, but use of a contactor is recommended for safety purposes.
The rotary switch on the power supply unit must be set as follows according to whether the contactor is installed.

Contactor installed........... Rotary switch setting = 0
Contactor not installed....... Rotary switch setting = 1

(2) List of units

(a) Power supply unit ..... DC power supply to drive unit/regenerative control

No.	Model MDS-	Capacity (kW)	Dimensions (H* W* Dmm)	Type	Correspondence to drive unit capacity when single spindle is used (kW)															
					0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	26	30	37	45	55
1	C1-CV-37	3.7	380*60*200	A1	■	■	■	■	■											
2	C1-CV-55	5.5	380*60*200	A1						■										
3	C1-CV-75	7.5	380*60*200	A1							■									
4	C1-CV-110	11.0	380*90*255	B1								■								
5	C1-CV-150	15.0	380*120*255	C1									■							
6	C1-CV-185	18.5	380*120*255	C1										■						
7	C1-CV-220	22.0	380*150*255	D1											■					
8	C1-CV-260	26.0	380*150*255	D1												■				
9	C1-CV-300	30.0	380*150*255	D1													■			
10	C1-CV-370	37.0	380*150*255	D1														■		
11	A-CR-10	1.0	380*60*180	A0	■	■														
12	A-CR-15	1.5	380*60*180	A0			■													
13	A-CR-22	2.2	380*60*180	A0				■												
14	A-CR-37	3.7	380*60*180	A0					■											
15	A-CR-55	5.5	380*60*180	A0						■										
16	A-CR-75	7.5	380*60*180	A0							■									
17	A-CR-90	9.0	380*60*180	A0							■									

(b) Spindle drive unit ... Spindle motor control						
No.	Model MDS-C1-	Capacity (kW)	Dimensions (H* W* Dmm)	Type	Power supply unit for single spindle	Remarks
1	SP-04	0.4	380*60*180	A0	CV-37	
2	SP-075	0.75	380*60*180		CV-37	
3	SP-15	1.5	380*60*180		CV-37	
4	SP-22	2.2	380*60*255	A1	CV-37	
5	SP-37	3.7	380*60*255		CV-37	
6	SP-55	5.5	380*90*255	B1	CV-55	
7	SP-75	7.5	380*90*255		CV-75	
8	SP-110	11.0	380*90*255		CV-110	
9	SP-150S	15.0	380*90*255		CV-150	
10	SP-150	15.0	380*120*255	C1	CV-150	
11	SP-185	18.5	380*120*255		CV-185	
12	SP-220	22.0	380*150*255	D1	CV-220	
13	SP-260	26.0	380*150*255	D2	CV-260	
14	SP-300	30.0	380*150*255		CV-300	

(c) Servo drive unit					Adaptable motor														
No. of axes	Model MDS-C1-	Capacity (kW)	Dimen-sions Type	Axis	HC□□□														
					52	53	102	103	152	153	202	203	352	353	452	453	702	703	902
1-axis type	V1-01	0.1	A0																
	V1-03	0.3																	
	V1-05	0.5																	
	V1-10	1.0																	
	V1-20	2.0	A1																
	V1-35	3.5																	
	V1-45S	4.5																	
	V1-45	4.5	B1																
	V1-70S	7.0																	
	V1-70	7.0	C1																
	V1-90	9.0																	
	V1-110	11.0	D2																
	V1-150	15.0																	

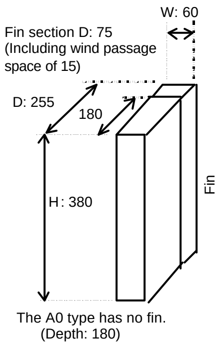
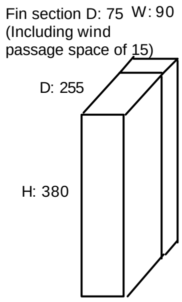
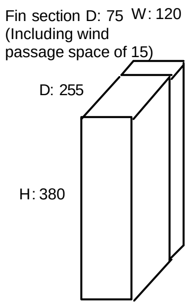
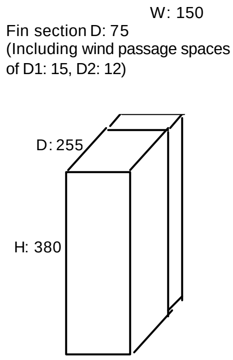
(Note) Limits apply to continuous operation of V1-45S and V1-70S.

(c) Servo drive unit					Adaptable motor														
No. of axes	Model MDS-C1-	Capacity (kw)	Dimen-sions Type	Axis	HC□□□														
					52	53	102	103	152	153	202	203	352	353	452	453	702	703	902
2-axis type	V2-0101	0.1+0.1	A0	LM															
	V2-0301	0.3+0.1		L															
				M															
	V2-0303	0.3+0.3		LM															
	V2-0501	0.5+0.1		L															
				M															
	V2-0503	0.5+0.3		L															
				M															
	V2-0505	0.5+0.5		LM															
	V2-1005	1.0+0.5		L															
				M															
	V2-1010	1.0+1.0		LM															
	V2-2010	2.0+1.0	A1	L															
				M															
	V2-2020	2.0+2.0		LM															
	V2-3510S	3.5+1.0		L															
				M															
	V2-3520S	3.5+2.0		L															
				M															
	V2-3510	3.5+1.0	B1	L															
				M															
	V2-3520	3.5+2.0		L															
				M															
	V2-3535	3.5+3.5		LM															
	V2-4520	4.5+2.0		L															
				M															
	V2-4535	4.5+3.5		L															
				M															
	V2-7070S	7.0+7.0		LM															
	V2-4545	4.5+4.5	C1	LM															
	V2-7035	7.0+3.5		L															
				M															
	V2-7045	7.0+4.5		L															
				M															
	V2-7070	7.0+7.0	D1	LM															

(Note) Limits apply to continuous operation of V2-7070S.

(3) List of unit dimensions

<table>
<tr><th>Outline dimensions of each unit
Outline type</th><th>A0/A1</th><th>B1</th><th>C1</th><th>D1/D2</th></tr>
<tr><td>Outline drawing

(mm)</td>
<td>
</td>
<td>
</td>
<td>
</td>
<td>
</td></tr>
</table>

Precautions

The depth of the fin section for the MDS-C1 Series is smaller than the MDS-A/B Series due to the high efficiency radiation of heat structure.
Provide a wind passage space of 15mm or more behind the fins so that the cold air can pass through. (Provide 12mm or more for the D2 type.)
Units with an "S" at the end of the model have a smaller unit width than the existing series.
Thus, when designing the control box with this unit's outline dimensions, there may be cases when the existing drive unit cannot be installed.

3. Unit Installation

⚠ CAUTION
1. Correctly transport the product according to its weight. 2. Do not stack products past the limit. 3. Install servo drive unit, servomotor and regenerative resistor unit on noncombustible material. Direct installation on combustible material or near combustible material could lead to fires. 4. Follow this Instruction Manual and install the unit in a place where the weight can be borne. 5. Do not get on top of or place heavy objects on the unit. 6. Store and use the units under the designated environmental conditions. 7. Do not allow conductive matter such as screw or cutting chips or combustible matter such as oil enter the servo drive unit or servomotor. 8. Do not block the intake or exhaust ports of the servomotor provided with a cooling fan. 9. The servo drive unit and servomotor are precision devices, so do not drop or apply strong impacts on them. 10. Do not install or operate servo drive units or servomotors that are damaged or that have missing parts. 11. When storing the unit for a long time, contact the Service Center or Service Station.

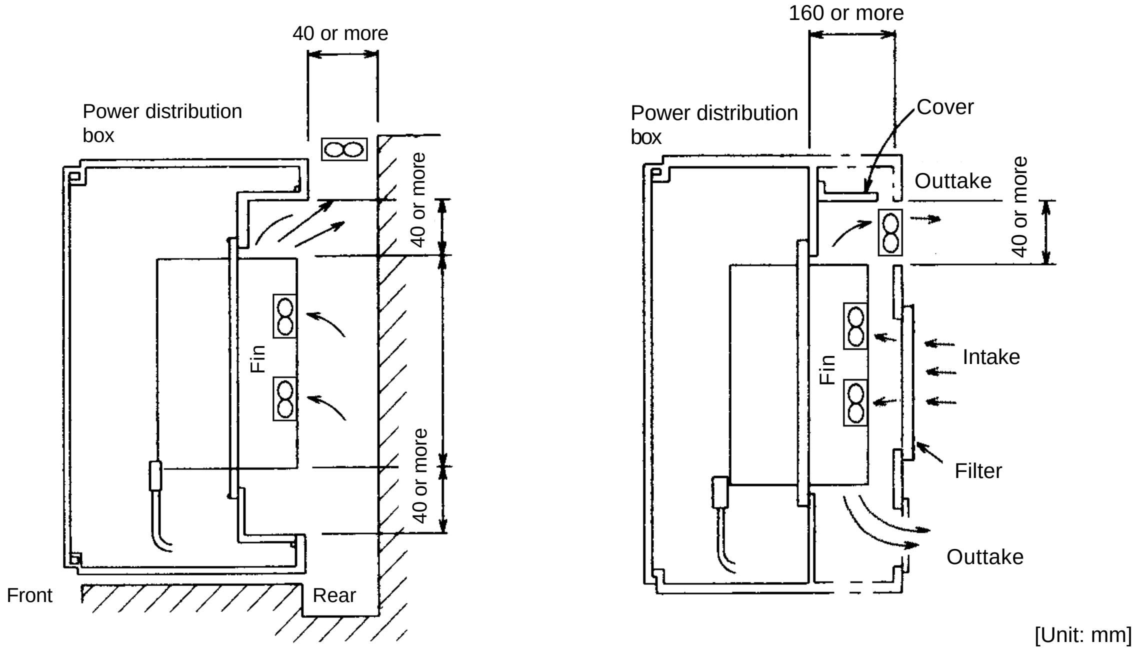
(1) Each unit is designed to be installed in a cabinet such as a power distribution box. Avoid installation in direct sunlight, near heat generating objects or outdoors.

(2) The inner working environment (temperature, humidity, vibration, atmosphere) of the cabinet must be within the limits given in the "Specifications for each unit". The cabinet for the cutting machine must be a totally closed type cabinet.

(3) Make considerations so that inspections and replacement during maintenance is easy.
The required space around each unit is shown in the outline dimensions drawing.

(4) Each unit generates some heat, so leave a space on the top and bottom when installing other equipment or parts.
Refer to the outline drawing for the square hole dimensions. In this case, insert packing between the unit and power distribution box. Refer to the following installation examples for the installation of the servo drive unit.

(5) Provide a structure that separates the intake and outtake. If the air behind the fin is not discharged properly, causing heat to accumulate, always install the forced outtake fan.



Example 1. Leave space for air flow when the power distribution box is at the rear of the machine.
If heat accumulates behind the fin, install forced air cooling (FAN) to discharge the heat.

Example 2. When the outdoor air cooling section is to protrude from the power distribution box, make sure that cutting chips, etc., do not enter the outtake section.
If heat accumulates behind the fin, install forced air cooling (FAN) to discharge the heat outside the box.

⚠ CAUTION

1. Do not hold the front cover when transporting the servo drive unit. The unit could drop.
2. Always observe the installation directions.
3. Secure the specified distance between the servo drive unit and control panel, or between the servo drive unit and other devices.

Note 1. When installing in a poor environment (factories with large quantities of oil mist), install a filter on the intake section.

Note 2. When assembling the control box, make sure that drill cutting chips, etc., do not enter the drive unit.

Note 3. Make sure that oil, water and cutting chips do not enter the drive unit from the control box clearances or fan on top of the control box.

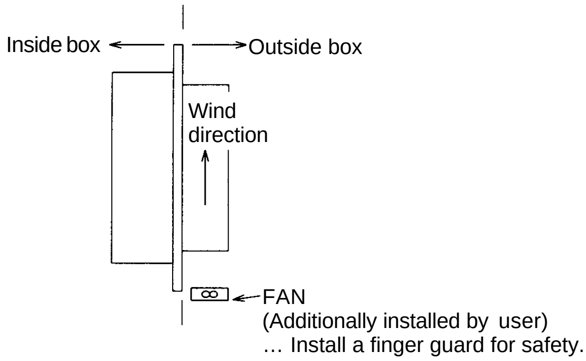
Note 4. When the unit is at the places having high levels of toxic gases or dust, protect the drive unit by air purging (preventing the entry of toxic gases and dust by feeding clean air from an external source, so that inner pressure of control panel is higher than the outside air).

(6) Installation of cooling fan

Each unit (excluding types without fin) are individually provided with cooling fans. If the area around the fan becomes hot (if heat builds-up), install an agitating fan.
Refer to 1) or 2) below according to the panel structure, and install.

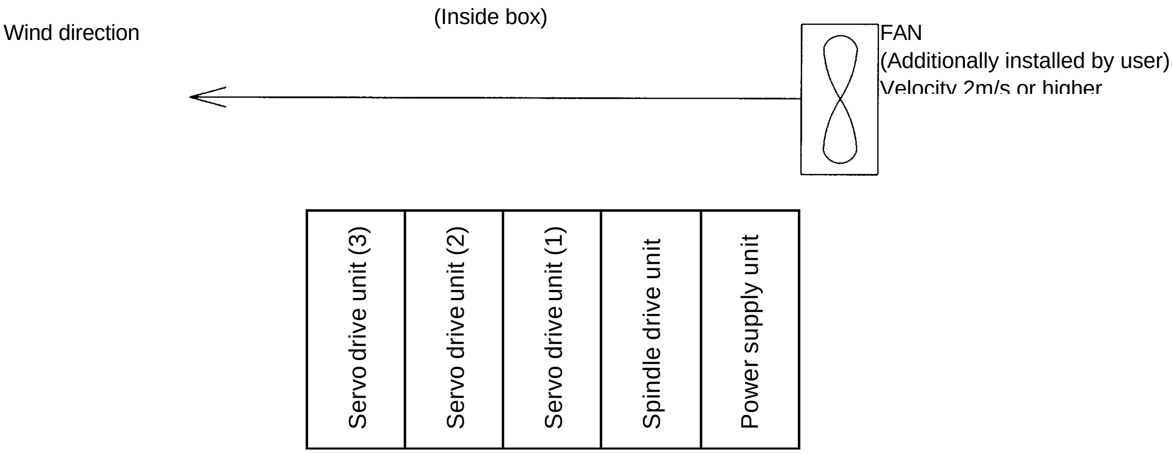
(a) Installing the fan below the heat radiation fins

When using the totally closed type unit installation method and the box structure in which cutting oil and dust, etc., easily enters the unit's fan and fin section (a structure where the fan may stop easily due to the working environment), the user should install a fan at the position indicated as FAN. Forced cooling should then be performed with a velocity of 2m/s or higher. Also consider the maintainability in this case.



(b) Installing the fan above the unit

Due to the structure, heat will tend to accumulate on the top of each unit. Thus, install a fan in the power distribution box to mix the heat at the top of each unit.



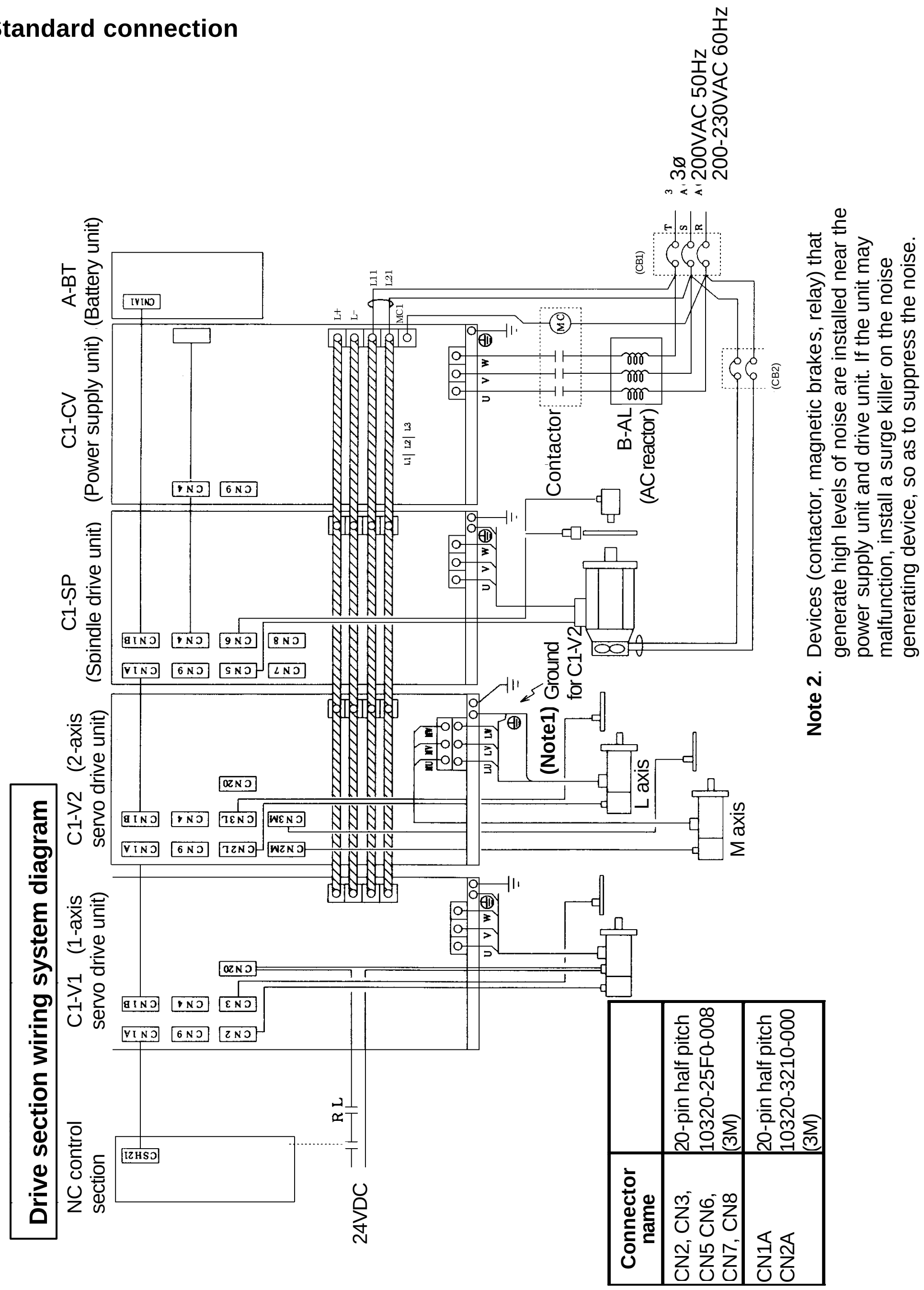
Front view of units in power distribution box

4. Connection of Each Unit

⚠ CAUTION
1. Shut off the power on the servo drive unit side if a fault occurs in the servo drive unit. Fires could be caused if a large current continues to flow. 2. Provide a sequence that shut off the power at the regenerative resister error signal-ON when using the regenerative resistor. The regenerative resistor could abnormally overheat and cause a fire due to a fault in the regenerative transistor, etc. 3. Use a double circuit configuration that allows the operation circuit for the magnetic brakes to be operated even by the external emergency stop signal. 4. MDS-C1-V1-110/150 does not have built-in dynamic brake. Always use an external dynamic brake unit.

Wire the power supply and main circuit as shown below.
Always use a Circuit Breaker (CB) on the power supply input wire.

Standard connection



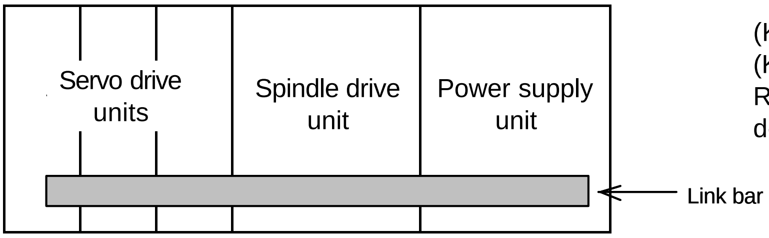
Connector name	
CN2, CN3, CN5 CN6, CN7, CN8	20-pin half pitch 10320-25F0-008 (3M)
CN1A CN2A	20-pin half pitch 10320-3210-000 (3M)

Note 2. Devices (contactor, magnetic brakes, relay) that generate high levels of noise are installed near the power supply unit and drive unit. If the unit may malfunction, install a surge killer on the noise generating device, so as to suppress the noise.

4.1 Layout of each unit

Layout the units according to the following reference as a principle.

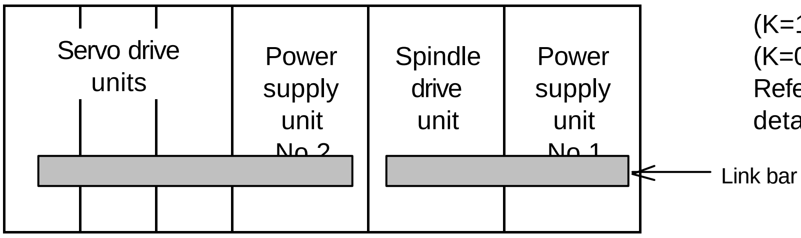
(1) When total of spindle motor output and servomotor output is 38kW or less
Σ (Spindle motor output) +kΣ (servomotor output) $\leq$ 38kW



(Front)

(K = 1 with 1-axis servo)
(K = 0.7 with 2 or more axes servo)
Refer to "8. Selection of Capacity" for details.

(2) When total of spindle motor output and servomotor output is larger than 38kW
Σ (Spindle motor output) +kΣ (servomotor output) > 38kW



(Front)

(K=1 with only 1-axis servo)
(K=0.7 with 2 or more axes servo)
Refer to "8. Selection of Capacity" for details.

⚠ CAUTION
Always connect the power supply unit No. 1 and No. 2 L+ and L– link bars independently.

(Note) The clearance between each unit should generally be 3cm or less.
If the spindle drive unit and servo drive unit must be separated by more than 3cm, observe the conditions listed in section "4.3".

4.2 Link bar specifications

The link bar is the following part, and must be manufactured by the user:

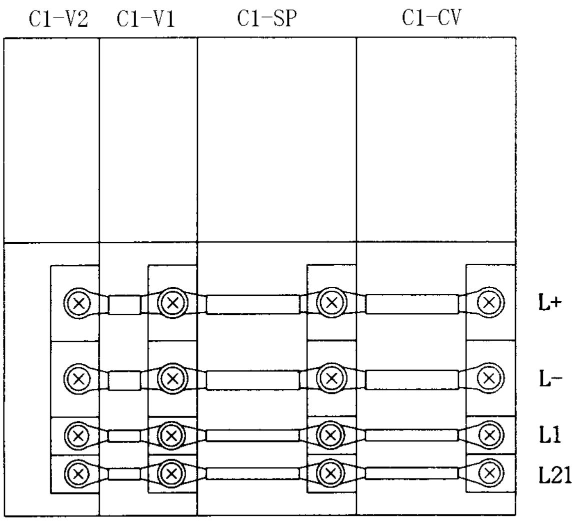
L+, L– —— A connection wire used to supply the converter's DC voltage from the power supply unit to each drive unit.

L11, L21 —— A connection wire used to supply the 200VAC control power to each unit.

This does not necessary need to be a bar (plate), but can be a wire.

Link bar specifications —— The terminal block for link bar connection is the following regardless of the capacity:
L+, L– .... M6 screw
L11, L21 .... M4 screw
An outline connection drawing is shown on the following page for reference.

(1) Outline connection drawing



(Note) Mount the terminal cover after wiring as shown on the left. The terminal cover differs for each unit width. Refer to section "8.5" for selecting the wire size.

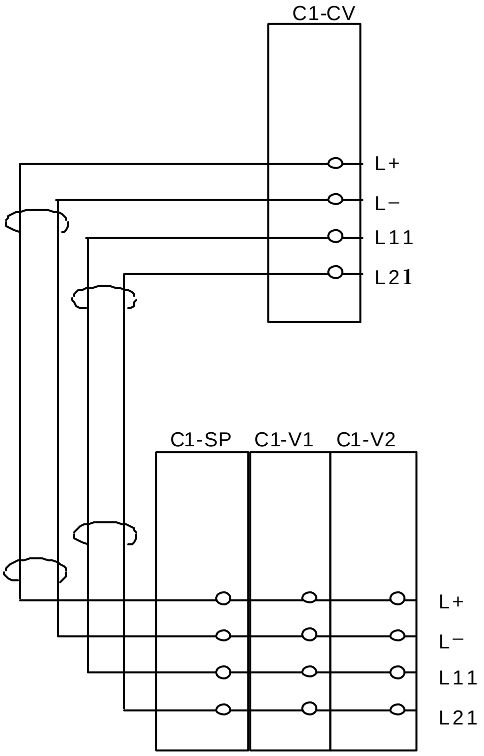
4.3 Unit separated layout

When installing vertically, avoid separating the spindle drive unit (C1-SP) and power supply unit (C1-CV) as shown in (Example 1) below. Do not separate the 11kW and higher servo drive units either.
When using both spindle drive units and 11kW and higher servo drive units, arrange them next to the power supply unit in the following order of priority.

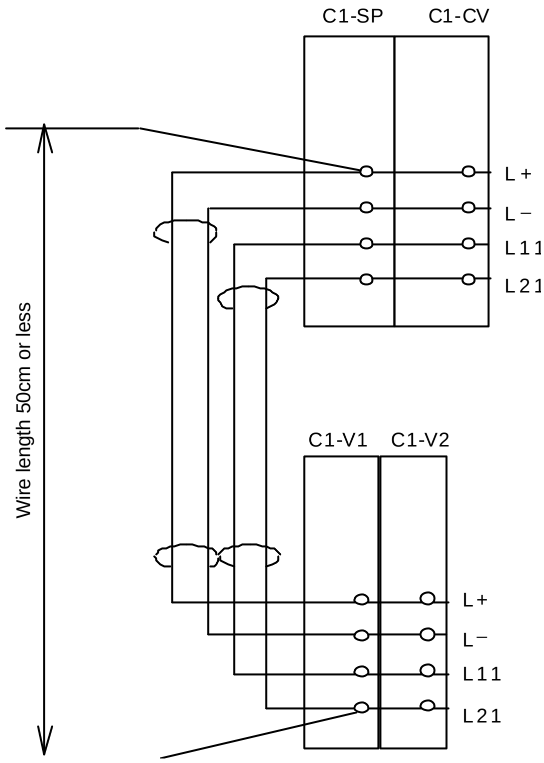
V1-150 > V1-110 > SP-300 > SP-260 > SP-185 > SP-150 ………

For example, when using a combination of SP-260 and V1-150, place the V1-150 next to the power supply unit, and the SP-260 next to that.
The 9kW and below servo drive unit can be installed vertically as shown in (Example 2). Note that the relay link bar length must be 50cm or less, and two bars must be bundled.

(Example 1) NG



(Example 2) OK



(Note) The above details also apply when separating the units to the left and right and installing.

4.4 Precautions for installing multiple power supply units

⚠ CAUTION
Always use this wiring when using MDS-C1-CV-370. (Refer to "8.1.1 (Note 4)".)

The rush circuit and contactor operation sequence of MDS-C1-CV-370 differs from the other power supply units (C1-CV). Thus, always install an independent contactor. If the contactor is not used or if shared with other power supply units, damage will occur.

A system in which a power supply unit (C1-CV (No. 1)) is installed for the spindle drive unit and one (C1-CV (No. 2)) is installed for the servo drive unit is explained as a representative example of multiple power supply unit installation. The same connections are used for other multiple installation systems.

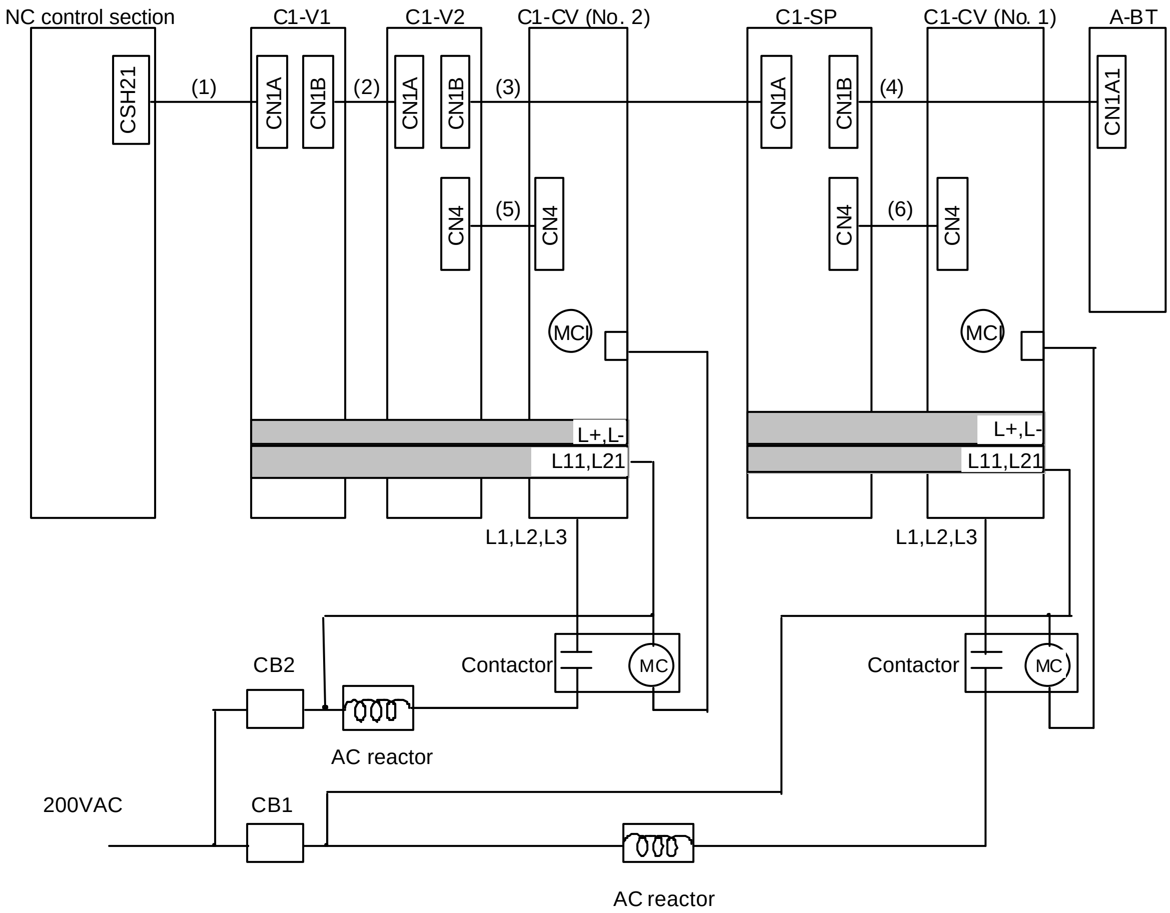


Fig. 1

(a) Connection of NC communication cable

(i) When battery unit (A-BT) is required (when absolute position detection specifications are used)

Connect with the lines (1) to (4) in Fig. 1.

(ii) When battery unit (A-BT) is not required (when absolute position detection specifications are not used).

The (4) connection cable and battery unit will not be required so insert a terminator (A-TM) into the terminating axis CN1B (C1-SP in Fig. 1).

(b) Connection of communication cable between drive unit and power supply unit
Connect the (6) cable to C1-CV (No. 1) and the (5) cable to C1-CV (No. 2) as shown in Fig. 1.

(c) Connection of L+, L–, L11 and L21 link bars
As shown in Fig. 1, the link bar for C1-CV (No. 1) and for C1-CV (No. 2) are connected independently. Make sure that neither of the link bars are short circuited and connected.

(d) Connection of AC reactor
Always use one AC reactor per power supply unit, and install the AC reactor for the C1-CV (No. 1) and C1-CV (No. 2) separately as shown in Fig. 1.

4.5 Precautions for installing only one power supply unit for the 2CH communication specifications with the NC (For 2-system control)

∗ Note that this method cannot be used with the A-CR.

The following systems will be explained in this section. The other 2CH systems also use the same specifications.

- CH1 .... C1-V1 + C1-V2
- CH2 .... C1-V2 + C1-SP

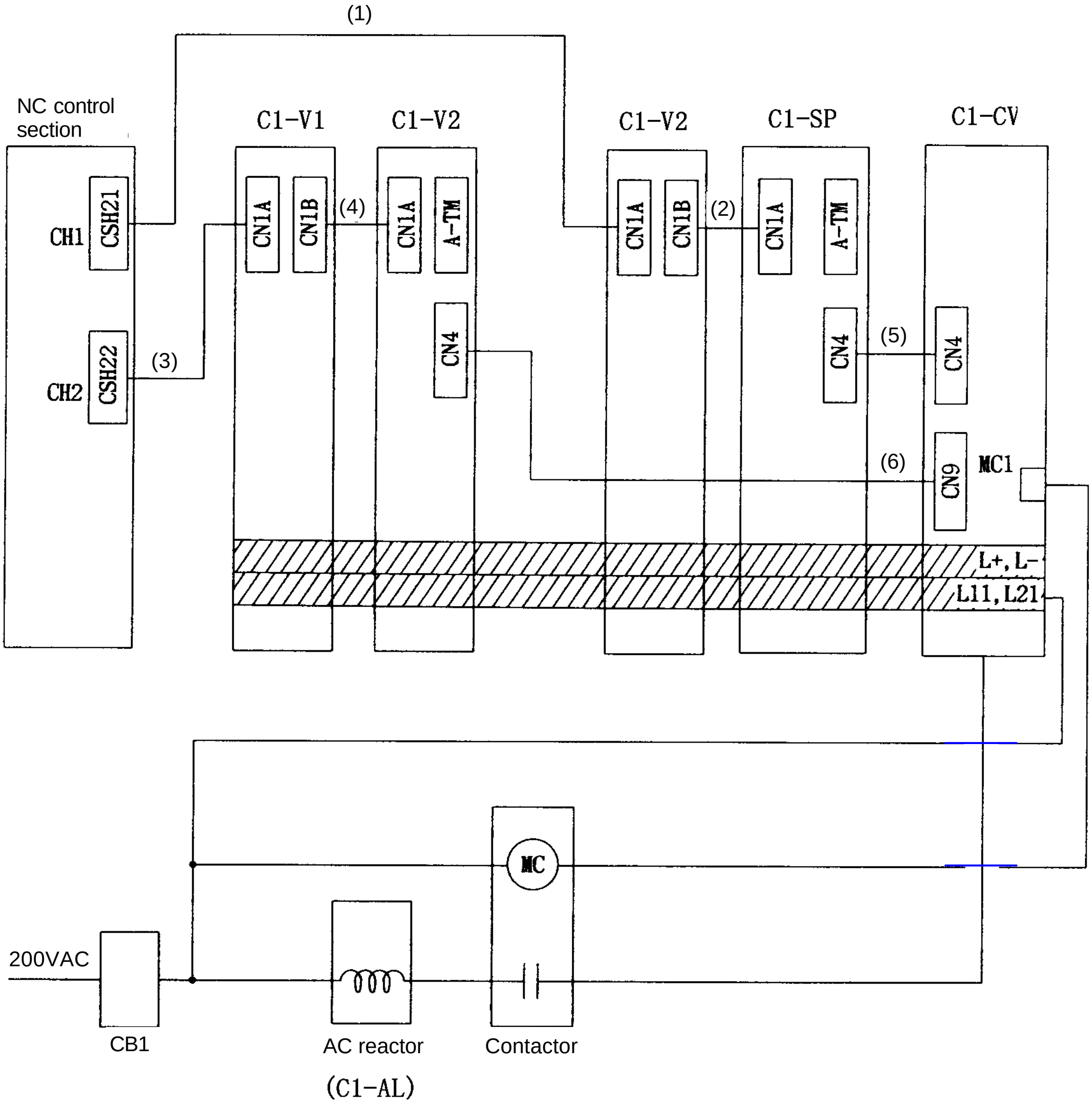


Fig. 2

(a) Connection of NC communication cable
- (i) CH1
  Connect with the lines (1) to (2) shown in Fig. 2.
- (ii) CH2
  Connect with the lines (3) to (4) shown in Fig. 2.

(b) Connection of communication cable between drive unit and power supply unit
- (i) CH1
  Connect from the CH1 terminating axis (C1-SP in Fig.2) with the line (5). The pin assignments for cable (5) are the same as the standard specifications. (Refer to section "5.2.1".)
- (ii) CH2
  Connect from the CH2 terminating axis (C1-V2 in Fig. 2) with the line (6). The pin assignments for cable (6) are the same as the standard specifications.

4.6 Connection of battery unit

4.6.1 Battery unit

A battery unit is required for the absolute position system that MDS-C1-V1/V2 Series have used. One battery unit can backup the absolute position data for several axes' servo drive unit. Select the battery unit corresponding to the number of absolute position detector axes from the following table.

Battery option specifications

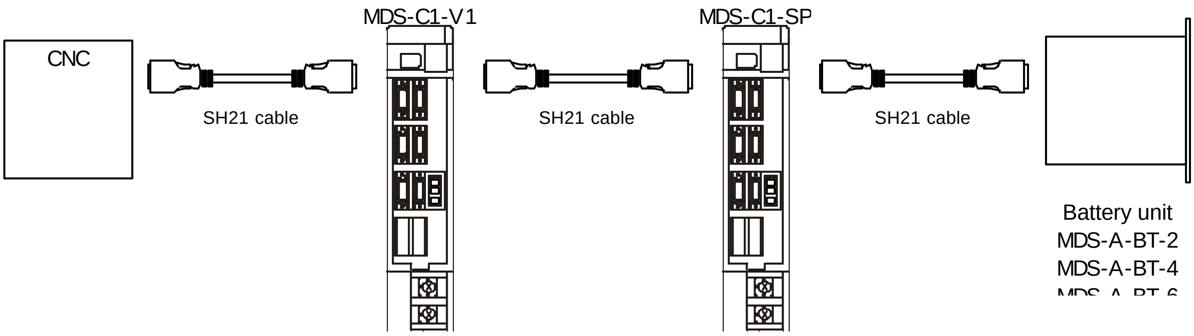
Item	Battery unit			
Model	MDS-A-BT-2	MDS-A-BT-4	MDS-A-BT-6	MDS-A-BT-8
Nominal voltage	3.6V			
Nominal capacity	4000mAh	8000mAh	12000mAh	16000mAh
No. of possible connections (total number of absolute position detectors)	2 axes or less	4 axes or less	6 axes or less	7 axes or less
No. of backup axes	Max. 7 axes in one system (in same wiring)			
Battery continuous back up time	Approx. 12,000 hours			
Battery useful life	7 years from date of unit manufacture			
Data save time during battery replacement	HC Series: 20 hours at time of delivery, 10 hours after 5 years			
Back up time from battery warning to alarm occurrence	Approx. 100 hours			

CAUTION

1. To protect the absolute position, do not shut off the drive unit control power supply if the battery voltage becomes low (warning 9F).
2. The battery life will be greatly affected by the ambient temperature. The above data shows the theoretic values for when the ambient temperature of the battery is 25°C. If the ambient temperature rises, generally the back up time and useful life will be shorter.
3. Contact the Service Center when replacing.

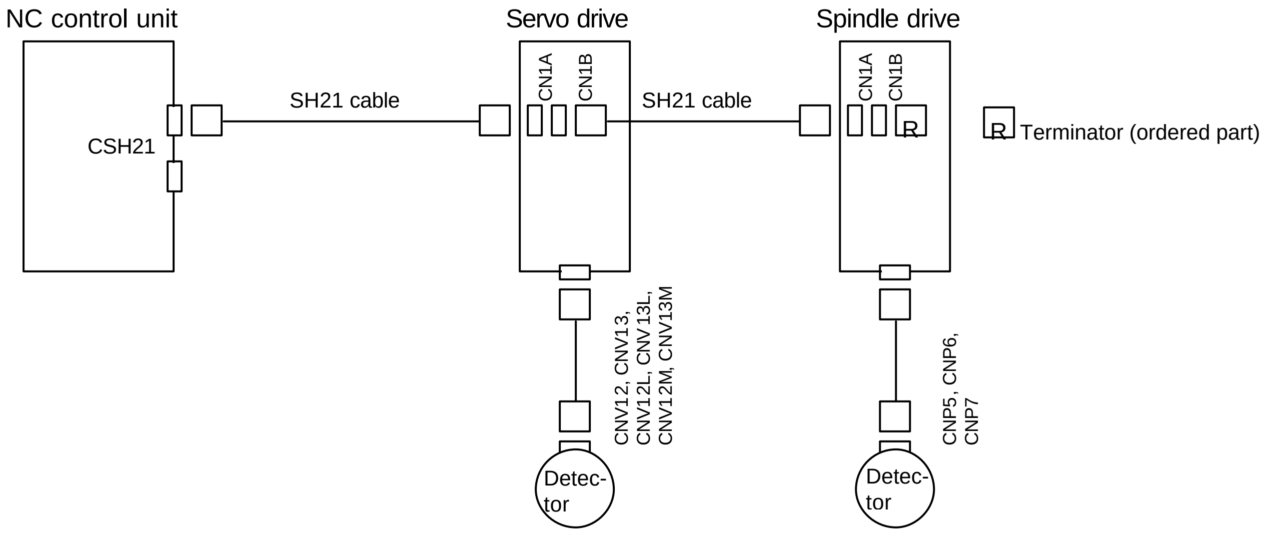
4.6.2 Connection

A terminal connector is built-in, so set as the final connection of the NC and communication cable.



5. Drive Section Connector and Cable Specifications

5.1 Half pitch cable connection system



	Cable name	Connector name on controller side (Maker)	Recommended connector name on cable side (Maker)	Cable materials (Maker)	Cable creation tool (Maker)
	SH21 cable	10220-52A2JL 20220-52A2JL	Shell (Crimp type): 10320-3210-000 (3M) Plug (Crimp type): 10120-6000EL (3M)	UL2789 AWG28 (DDK) 10PVV-SB AWG28X10P (3M)	Press machine unit (with gage block) : 3797-1000 Locator plate : 3795-1A Platen : 3795-2A Cutting unit : 3795-3A Fixture unit : 3796-1A Fixture unit : 3796-2A Fixture unit : 3796-5A Fixture unit : 3796-1A Fixture unit : 3796-3A Cable clamp : 3796-4
Servo drive	CNV12, CNV13, CNV12L, CNV13L, CNV12M, CNV13M, Each cable	Same as above	(1) Controller side Plug (soldered-type): 10120-3000VE (3M) Shell (soldered-type): 10320-52F0-008(3M) (2) Detector side (a) (Straight) 2-type Cannon connector: MS3106B22-14S (Japan Aviation Electronics) Connector clamp: MS3057-12A (Japan Aviation Electronics) (b) (Right angle) 3-type Cannon connector: MS3108B22-14S (Japan Aviation Electronics) Connector clamp: MS3057-12A (Japan Aviation Electronics) (c) (Drive unit terminal) E-type Drive unit terminal: V1.25-4	A14B2343 2PX0.3SQ+10PX0.2SQ (DDK) The HA053/13 motor built-in encoder uses a different cannon plug. (Refer to section "5.2.3 (1)".)	

Half pitch cable connection system (continued)

	Cable name	Connector name on controller side (Maker)	Recommended connector name on cable side (Maker)	Cable materials (Maker)	Cable creation tool (Maker)
Spindle drive	CNP5	20220-52A2JL	(1) Controller side Plug (soldered-type): 10120-3000VE (3M) Shell (soldered-type): 10320-52F0-008(3M) (2) Detector side Connector: AMP-350720-1 (Japan Amplifier) Pin: AMP-350689-1 (Japan Amplifier)	A14B2343 2PX0.3SQ+10PX0.2SQ (DDK)	
	CNP6	Same as above	(1) Controller side Same as above (2) Detector side (a) Magnetic sensor TRC116-12A10-7F10.5 (Tajimi Musen) (b) Encoder MS3106A20-29S (Canon)	Same as above	
	CNP7	Same as above	(1) Controller side Same as above (2) Detector side MS3106A20-29S (Canon)	Same as above	

Cable name system

CN□□□□ – □□ – □ – □

Connector fixed type	None	: One-touch type lock
	S	: Screw type lock
Connector type	E	: E-type (crimp terminal on lead end)
	2	: 2-type (cannon plug straight type or designated connector)
	3	: 3-type (cannon plug L type)
Axis No. (Axis 1 to 9)	0	: No display
	1 to 9	: Axis 1 to 9
System No.	None	: 1-axis system
	2	: 2-axis system
	↓	
	5	: 5-axis system
	P	: PLC axis
Servo and spindle detector type	None	: Servo standard detector or spindle PLG
	S	: Servo small capacity detector (HA053/HA13)
	F	: Servo special motor (HA-FH053C-Y)
	A	: Spindle shaft type encoder
	B	: Spindle built-in type encoder
	M	: Spindle magnetic sensor
Connection connector No.	12	: CN2L or CN2M (servo drive: semi-closed)
	13	: CN3L or CN3M (servo drive: closed)
	5	: CN5 (spindle drive: speed detection)
	6	: CN6 (spindle drive: orientation)
	7	: CN7 (spindle drive: C axis)
	67	: CN6 + CN7 (spindle drive: orientation + C axis)
	71	: CN7 (spindle drive: C axis) + CES11 (NC: threading)
Model	V	: For servo
	P	: For spindle

5.2 Cable details

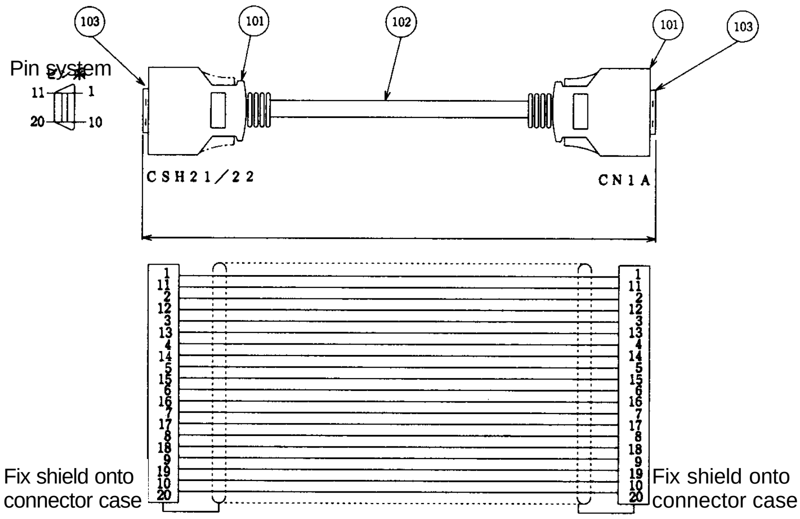
⚠ CAUTION

Do not mistake the connection when manufacturing the detector cable. Failure to observe this could lead to runaway.

5.2.1 Communication cable SH21 (semi ordered product)

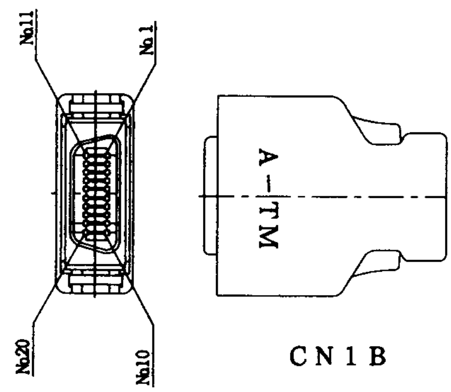
Application	Connector 1	Connector 2	L
NC ↔ drive unit	CSH21/22	CN1A	Standard: 350mm
Drive unit ↔ drive unit	CN1B	CN1A	Standard: 350mm
Drive unit ↔ power supply	CN4	CN4	Standard: 350mm
Drive unit ↔ battery unit	CN1B	CN1A1	Standard: 350mm

Part No.	Part name	Model	Maker
000			
101	Connector (plastic shell)	10320-3210-000	3M
102	Cable	10PVV-SB AWG28×10P (BK0-NC9072)	3M
103	Connector (plug)	10120-6000EL	3M



5.2.2 Terminator A-TM (ordered part)

Model
A-TM

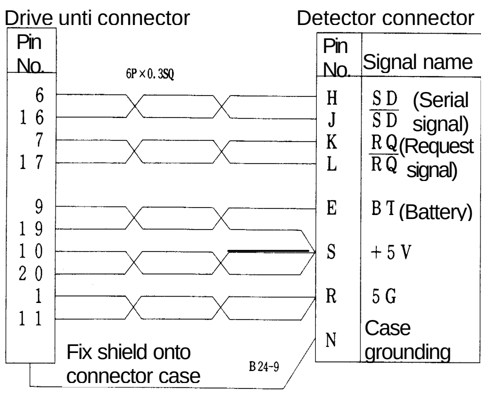


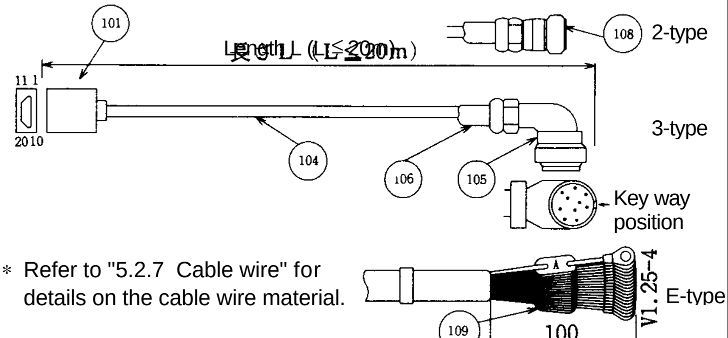
5.2.3 Servo drive unit detector cable

(1) Detector cable for OSE104□/OSA104□/OSE105□/OSA105□

(a) CNV12, CNV13, CNV12L, CNV12M, CNV13L, CNV13M (cable length ≤ 20m)

Part No.	Part name	Model	Qty/type			Maker
			2-type	3-type	E-type	
101	Connector (shell)	10320-52F0-008	1	1	1	3M
102	Connector (plug)	10120-3000VE	1	1	1	3M
103						
104	Cable	TS-91026 2P×0.3SQ+10P×0.2SQ	1	1	1	BANDO Electric Wire
105	Cannon connector	MS3108B22-14S		1		DDK, Japan Aviation Electronics
106	Connector clamp	MS3057-12A	1	1		DDK, Japan Aviation Electronics
107						
108	Cannon connector	MS3106B22-14S	1			DDK, Japan Aviation Electronics

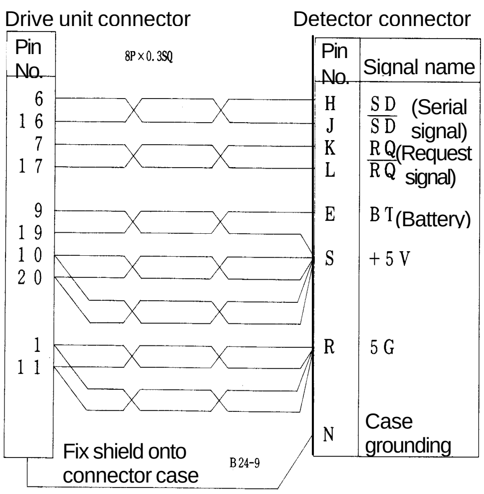


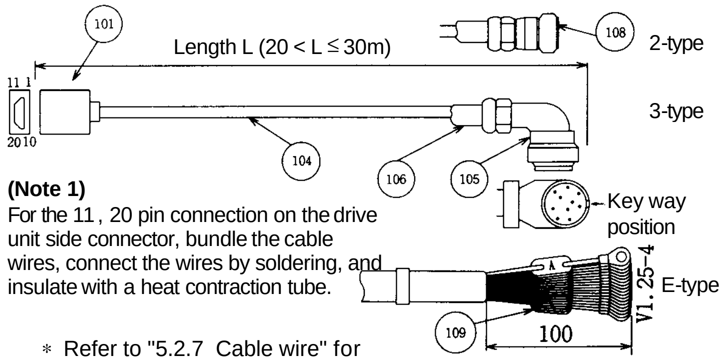


* Refer to "5.2.7 Cable wire" for details on the cable wire material.

(Note)
The connector shell on the servo drive unit is the 3M "10320-52F0-008" but this is a shell with a one-touch locking mechanism that does not require screw locking.
When ordering the cables from Mitsubishi, the shell "10320-52F0-008" with this one-touch lock mechanism will be used.
However, if the cable is to be manufactured by the user, the shell "10320-52A0-008" (3M) with the screw locking mechanism can be

(b) CNV12, CNV13, CNV12L, CNV12M, CNV13L, CNV13M (20m < cable length ≤ 30m)





(Note 1)
For the 11, 20 pin connection on the drive unit side connector, bundle the cable wires, connect the wires by soldering, and insulate with a heat contraction tube.

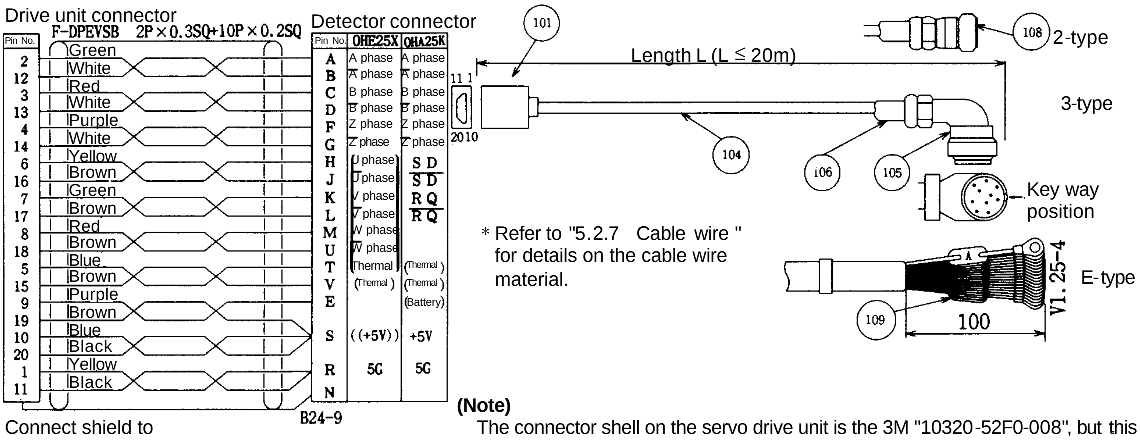
* Refer to "5.2.7 Cable wire" for details on the cable wire material.

(Note) The cable length must be 30m or less.

(2) Detector cable for OHE25K-ET/OHA25K-ET

(a) CNV13, CNV13L, CNV13M (cable length ≤ 20m)

Part No.	Part name	Model	Qty/type			Maker
			2-type	3-type	E-type	
101	Connector (shell)	10320-52F0-008	1	1	1	3M
102	Connector (plug)	10120-3000VE	1	1	1	3M
103						
104	Cable	TS-91026 2P×0.3SQ+10P×0.2SQ	1	1	1	BANDO Electric Wire
105	Cannon connector	MS3108B22-14S		1		DDK, Japan Aviation Electronics
106	Connector clamp	MS3057-12A	1	1		DDK, Japan Aviation Electronics
107						
108	Cannon connector	MS3106B22-14S	1			DDK, Japan Aviation Electronics

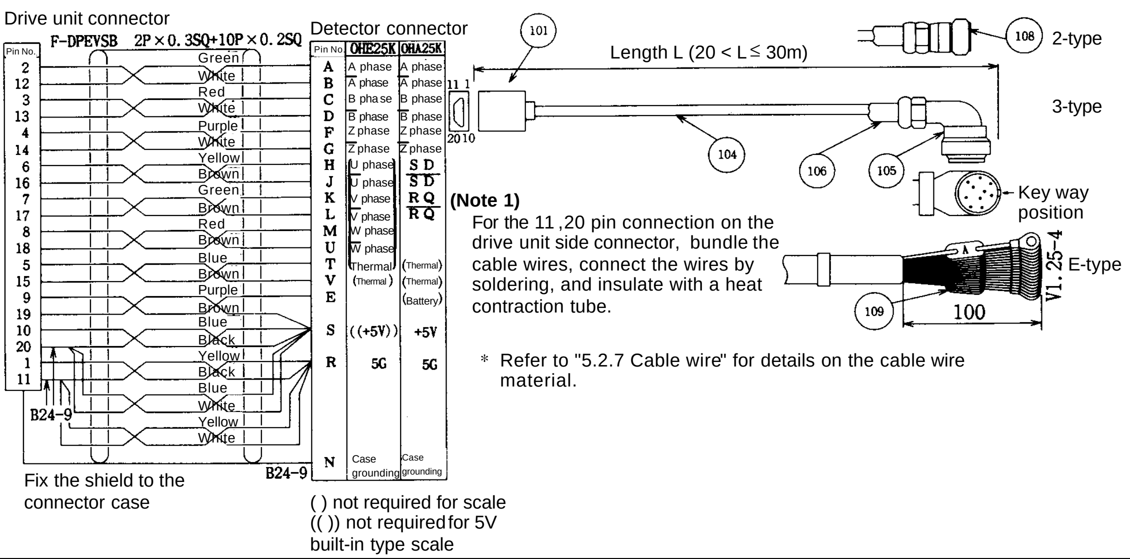


Connect shield to the connector case

( ) not required for scale
(( )) not required for 5V built-in type scale

(Note)
The connector shell on the servo drive unit is the 3M "10320-52F0-008", but this is a shell with a one-touch locking mechanism that does not require screw locking.
When ordering the cables from Mitsubishi, the shell "10320-52F0-008" with this one-touch lock mechanism will be used.
However, if the cable is to be manufactured by the user, the shell "10320-52A0-008" (3M) with the screw lock mechanism can be used instead of the above shell.

(b) CNV13, CNV13L, CNV13M (20m < cable length ≤ 30m)



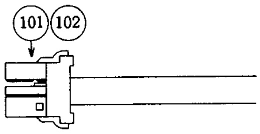
(Note) The cable length must be 30m or less.

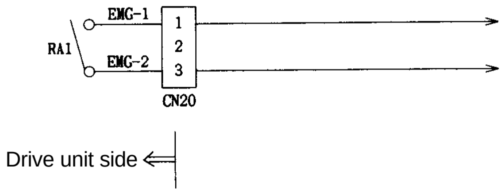
5.2.4 Brake cable

(1) 9kW and below Mechanical brakes

Part No.	Part name	Model	Maker
101	Connector	1-178128-3	Japan Amplifier
102	Contact	1-175218-2	Japan Amplifier

Wire size : 0.5 to 1.25SQ

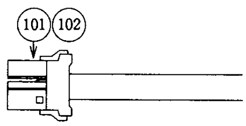


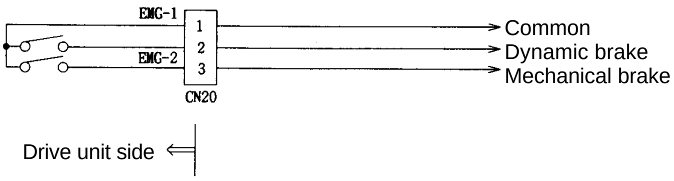


(2) 11kW, 15kW Mechanical brakes and dynamic brakes

Part No.	Part name	Model	Maker
101	Connector	1-178128-3	Japan Amplifier
102	Contact	1-175218-2	Japan Amplifier

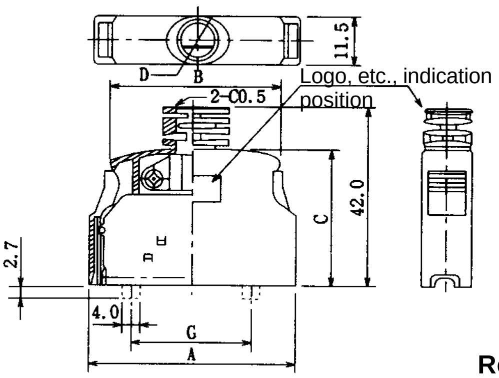
Wire size : 0.5 to 1.25SQ





5.2.5 Communication cable SH21 connector

(a) 10320-3210-000



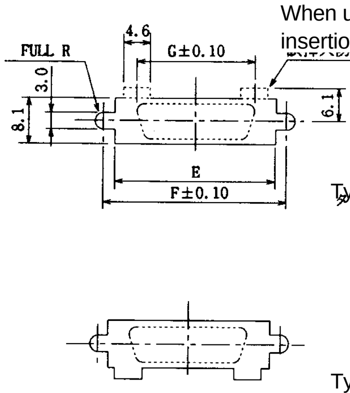
■A	■B	■C	■D	■E	■F	■G (–A00)	■G (–B00)	■G (–C00)
29.7	20.9	33.0	ø6.7	23.8	27.45	16.55	13.15	9.15

Designated dimension tolerance

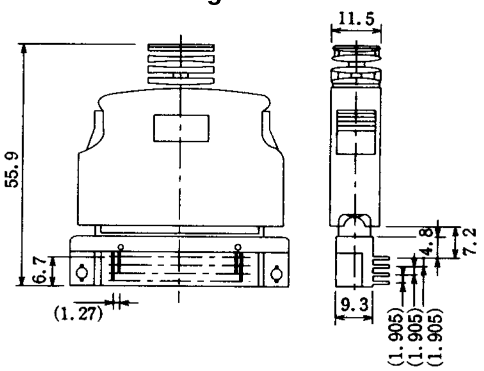
Dimension	.0	.00
Tolerance	± .3	± .13

Unit : mm

Recommended panel cut dimensions drawing



Reference drawing for combination



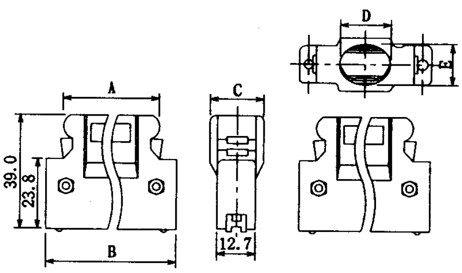
(b) 10320-52F0-008

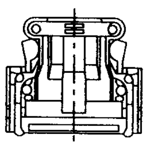
■A	■B	■C	■D	■E	■F
22.0	33.3	14.0	12.0	10.0	27.4

Designated dimension tolerance

Dimension	.0	.00
Tolerance	± .3	± .13

Unit : mm



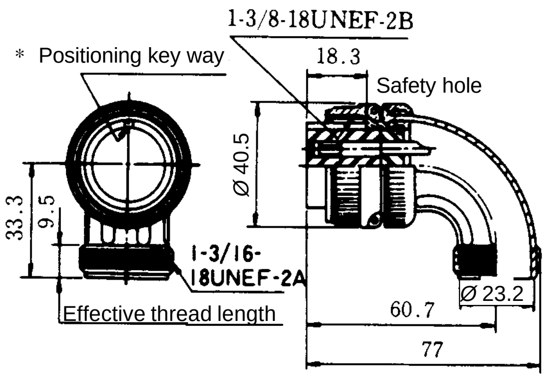


Reference drawing for combination

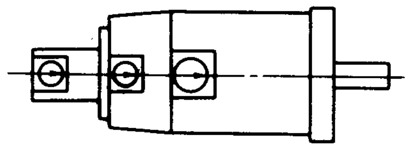
5.2.6 Cannon plug for servomotor detector

1. Standard plug

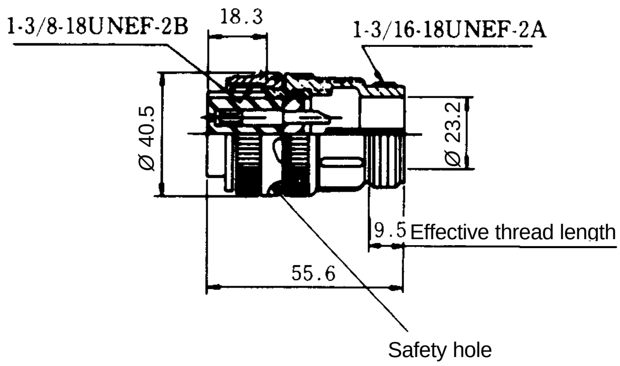
(1) Angle plug MS3108B22-14S (for OSE104□/OSA104□/OSE105□/OSA105□)



* Key position of cannon connector: motor flange direction



(2) Straight plug MS3106B22-14S (for OSE104□/OSA104□/OSE105□/OSA105□)



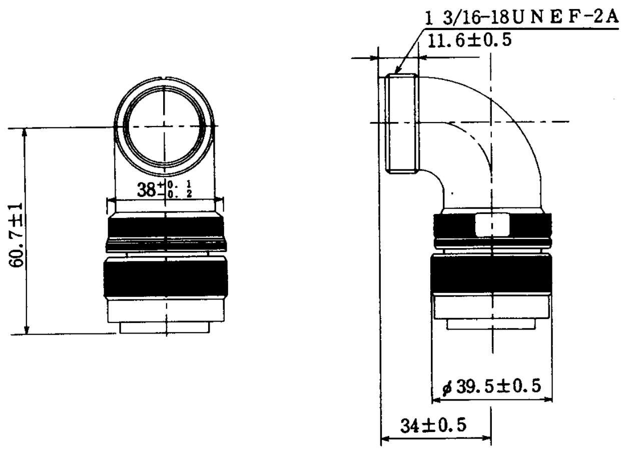
The servo drive unit and the motor are not provided with connector and cables.

2. JIS corresponding plugs (Hirose)

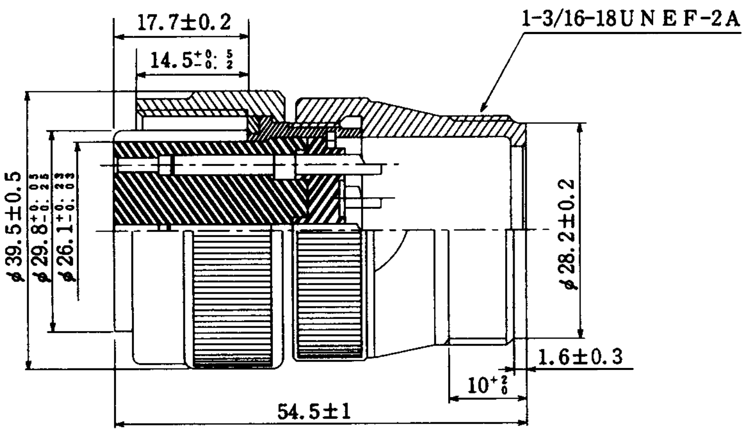
If the JIS B6015 standards must be followed, use the following connectors.
(JIS B6015 standards)

a. In accordance to MIL-C-5015 (US military standards)
b. Structure in which grounding is connected before other circuits are connected, and shut off after other circuits are shut off.
c. Waterproof and oil-proof.

(1) Angle plug H/MS3108B22-14S-N (for OSE104☐/OSA104☐/OSE105☐/OSA105☐)



(2) Straight plug H/MS3106A22-14S-N (for OSE104☐/OSA104☐/OSE105☐/OSA105☐)



5.2.7 Cable wire

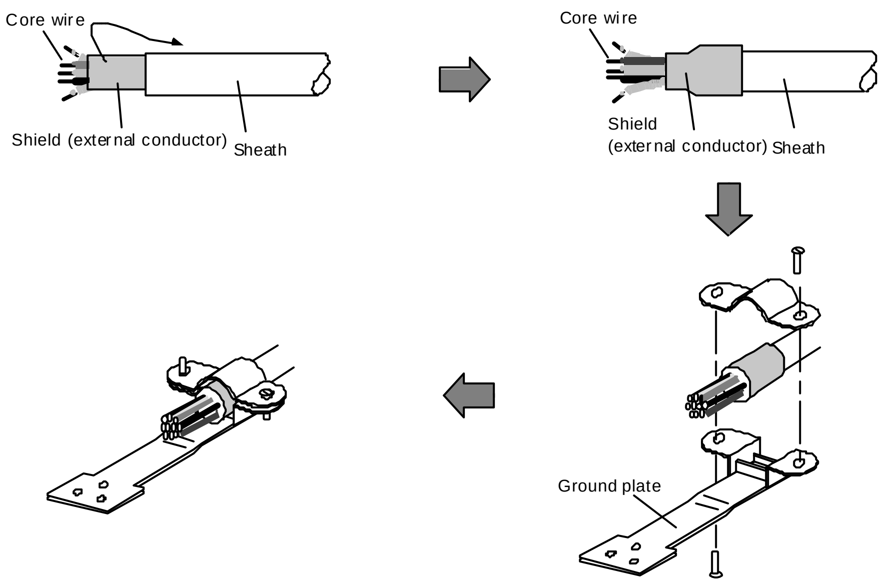
The following shows the specifications and processing of the wire used in each cable. Manufacture the cable using the following recommended wire or equivalent parts.

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	
UL20276 AWG28 10pair	6.1mm	PVC	10	7 strands/ 0.13mm	222Ω/km or less	AC350/ 1min	1MΩ/km or more	NC unit communication cable
A14B2343 (Note)	7.2mm	PVC	6	40 strands/ 0.08mm	105Ω/km or less	AC500/ 1min	1500MΩ/km or more	Detector cable

(Note) Junko Co. (Dealer: Toa Denki)

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.



5.2.8 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.

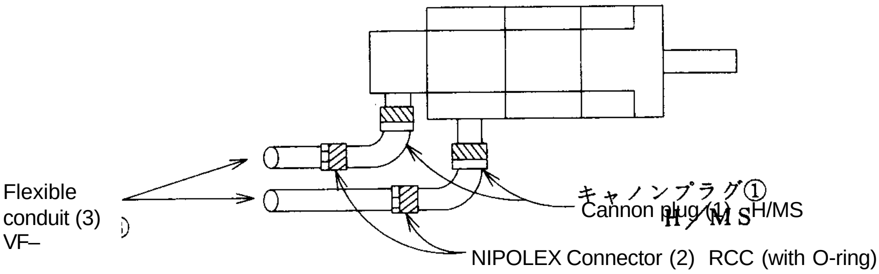
A cable clamp (MS3057) is not installed on the detector side, so be particularly careful of broken wires in applications involving bending and vibration.

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.

5.2.9 Oil-proof type servomotor cable connectors (Recommendation 1)

When using the motor and cable in an environment where cutting fluids or lubricants may come in contact a little, use the oil-proof specification cable connector (plug) shown below for the motor and encoder.



For motor connector

Servomotor model		(1) Cannon plug (Plug unit) 1) Hirose, 2) Japan Aviation Electronics, 3) DDK — 90° angle type	(1) Cannon plug (Plug unit) — Straight type	(2) NIPOLEX connector — Nippon Flex	(3) Flexible conduit — Nippon Flex	(3) Flexible conduit — Min. inner dia.
HA053NC HA13NC HA23NC HA33NC	Standard	1) H/MS3108A18-12S-D	1) H/MS3106A18-12S-D	RCC-103CA18 (with O-ring)	VF-03	10.6
				RCC-104CA18 (with O-ring)	VF-04	14.0
	European standard part	2) JL04V-8A18-12SE-EB 3) CE05-8A18-12SD-B-BAS	2) JL04V-6A18-12SE-EB 3) CE05-6A18-12SD-B-BSS	RCC-106CA18 (with O-ring)	VF-06	19.0
HC52 to HC102 HC53 to HC103 HA50LC to HA150LC HA53LC to HA153LC (HA40NC to HA80NC) (HA43NC to HA83NC)	Standard	1) H/MS3108A22-23S-D	1) H/MS3106A22-23S-D	RCC-104CA2022 (with O-ring)	VF-04	14.0
				RCC-106CA2022 (with O-ring)	VF-06	19.0
	European standard part	2) JL04V-8A22-23SE-EB 3) CE05-8A22-23SD-B-BAS	2) JL04V-6A22-23SE-EB 3) CE05-6A22-23SD-B-BSS	RCC-108CA2022 (with O-ring)	VF-08	24.4
HC152 to HC452 HC203 to HC353 HA200LC to HA500LC HA203LC to HA303LC (HA100NC to HA300NC) (HA103NC to HA203NC)	Standard	1) H/MS3108A24-10S-D	1) H/MS3106A24-10S-D	RCC-104CA2428 (with O-ring)	VF-04	14.0
				RCC-106CA2428 (with O-ring)	VF-06	19.0
	European standard part	2) JL04V-8A24-10SE-EB 3) CE05-8A24-10SD-B- BAS	2) JL04V-6A24-10SE-EB 3) CE05-6A24-10SD-B-BSS	RCC-108CA2428 (with O-ring)	VF-08	24.4
HC702 to HC902 HC453 to HC703 HA700 to HA900 HA303 to HA703	Standard	—	—	—	—	—
	European standard part	CE05-8A32-17SD-B-BAS	CE05-6A32-17SD-B-BSS	RCC-108CA32 (with O-ring)	VF-08	24.4
				RCC-110CA32 (with O-ring)	VF-10	33.0

For brake cable

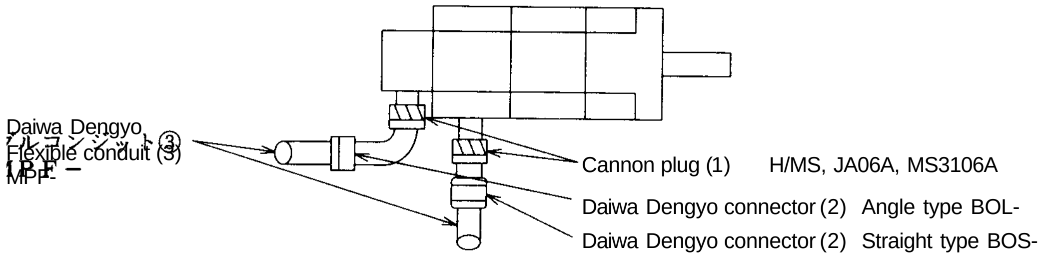
HC202B to HC902B HC203B to HC703B (HA40NCB to HA300NCB) (HA053NCB to HA203NCB)	H/MS 3108A 10SL-4S	H/MS 3106A 10SL-4S	RCC-102CA12 (With O-ring)	VF-02	8.3

For detector cable

OSE104□ OSA104□ OSE105□ OSA105□	H/MS 3108B 22-14S-N	H/MS 3106A 22-14S-N	RCC-104CA2022 (With O-ring)	VF-04	14.0
			RCC-106CA2022 (With O-ring)	VF-06	19.0
			RCC-108CA2022 (With O-ring)	VF-08	24.4

5.2.10 Oil-proof type servomotor connectors (Recommendation 2)

When using the motor and cable in an environment where cutting fluids or lubricants may come in contact a little, use the oil-proof specification connector (plug) shown below for the motor and encoder.



For motor connector

Servomotor model	(1) Cannon plug (Plug unit) 1) Hirose, 2) Japan Aviation Electronics, 3) DDK — Standard	(1) Cannon plug (Plug unit) — European standard part	(2) Daiwa Dengyo connector — Model	(3) Daiwa Dengyo flexible conduit — Model	(3) Min. inner diameter (guide collar)
HA053NC HA13NC HA23NC HA33NC	1) H/MS3106A18-12S-D (03) 2) JA06A-18-12S-J1 3) MS3106A18-12S (D190)	2) JL04V-6A18-12SE 3) CE05-6A18-12SD-B	MSA 12-18 MAA 12-18	FCV-12	12.3
			MSA 16-18 MAA 16-18	FCV-16	15.8
			MSA 22-18 MAA 22-18	FCV-22	20.8
HC52 to HC102 HC53 to HC103 HA50LC to HA150LC HA53LC to HA153LC (HA40NC to HA80NC) (HA43NC to HA83NC)	1) H/MS3106A22-23S-D (03) 2) JA06A-22-23S-J1 3) MS3106A22-23S (D190)	2) JL04V-6A22-23SE 3) CE05-6A22-23SD-B	MSA 16-22 MAA 16-22	FCV-16	15.8
			MSA 22-22 MAA 22-22	FCV-22	20.8
			MSA 28-22 MAA 28-22	FCV-28	26.4
HC152 to HC452 HC203 to HC353 HA200LC to HA500LC HA203LC to HA303LC (HA100NC to HA300NC) (HA103NC to HA203NC)	1) H/MS3106A24-10S-D (03) 2) JA06A-24-10S-J1 3) MS3108B24-10S (D190)	2) JL04V-6A24-10SE 3) CE05-6A24-10SD-B	MSA 16-24 MAA 16-24	FCV-16	15.8
			MSA 22-24 MAA 22-24	FCV-22	20.8
			MSA 28-24 MAA 28-24	FCV-28	26.4

For brake cable

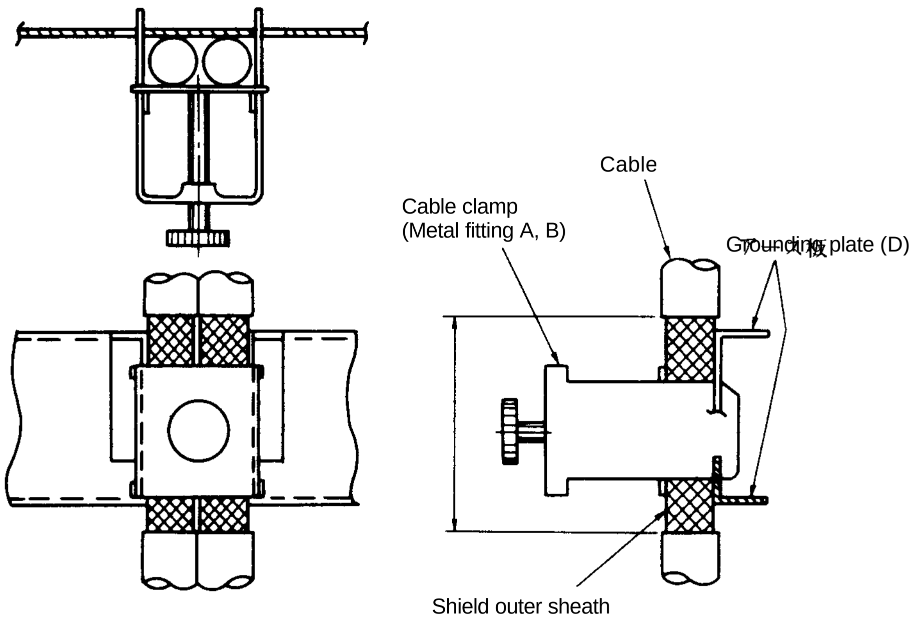
HC202B to HC902B HC203B to HC703B (HA40NCB to HA300NCB) (HA053NCB to HA203NCB)	H/MS 3106A10SL-4S(03) (Hirose) JA06A-10SL-4S-J1 (Japan Aviation Electronics) MS3106A10SL-4S (D190) (DDK)	MSA 10-10 MAA 10-10	FCV-10	8.2

For detector cable

OSE104☐ OSA104☐ OSE105☐ OSA105☐	H/MS 3106A22-14S-N(03) (Hirose) JA06A-22-14S-JI (Japan Aviation Electronics) MS3106A22-14S (D190) (DDK)	MSA 16-22 MAA 16-22	MPF-15	14.2
		MSA 22-22 MAA 22-22	MPF-19	17.2
		MSA 28-22 MAA 28-22	MPF-25	23.5

5.2.11 Cable clamp

Mount the grounding plate near the servo drive unit, peel the cable sheath, and press the peeled shield cable to the grounding plate using the cable clamp. If the cable is thin, clamp several cables.

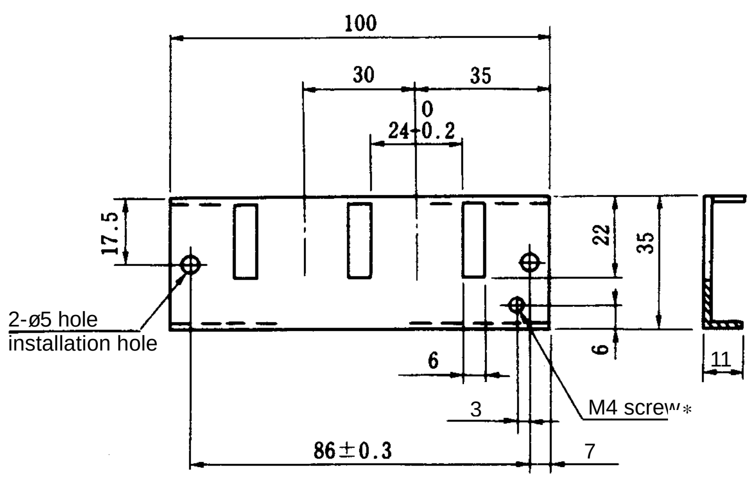


Clamp section drawing

The grounding plate D and cable clamps A and B can be supplied by Mitsubishi.

Grounding plate (D) outline drawing	Cable clamp outline drawing

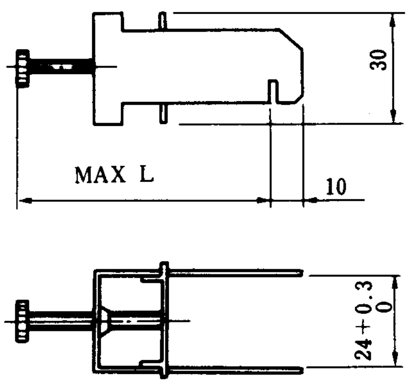
Grounding plate (D) outline drawing



- The grounding wire should be connected between the grounding plate and the cabinet grounding plate.
- Two metal fittings A can be used.

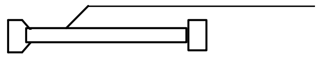
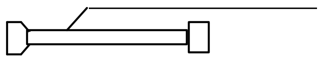
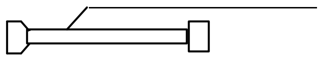
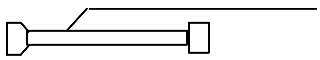
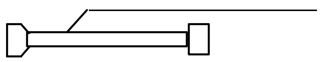
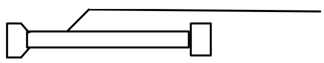
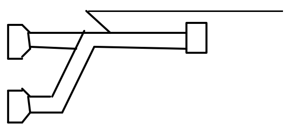
∗ Screw hole for wiring to cabinet grounding plate

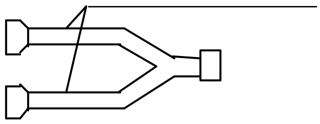
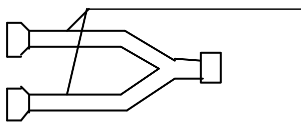
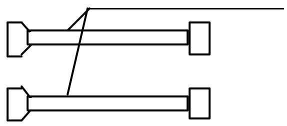
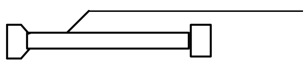
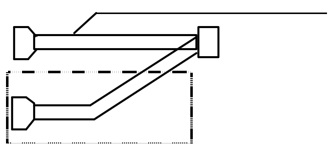
Cable clamp outline drawing



	L
Metal fitting A	70
Metal fitting B	45

5.2.12 Spindle control circuit cable list

No.	Application	Drive unit side connection connector	Cable name	Connected device / Parts name / Maker	Arranged by	Applicable cable finished state	Connected device / Parts name / Maker	Arranged by
(1)	Motor speed detection signal Motor temperature switch signal	CN5	CNP5 cable	Spindle drive unit (Shell) 10320-52F0-008 (Plug) 10120-3000VE Sumitomo 3M	Semi ordered part	Twisted pair batch shield cable 0.2SQ Maximum diameter 11mm 	Motor (connector) Motor (lead wire terminal) (Connector) AMP-350720-1 (Pin) AMP-350689-1 Japan Amplifier	Enclosed with motor
(2)	Magnetic sensor Orientation detection signal	CN6	CNP6M cable	Spindle drive unit (Shell) 10320-52F0-008 (Plug) 10120-3000VE Sumitomo 3M	Semi ordered part	Twisted pair batch shield cable 0.2SQ Maximum diameter 11mm 	Magnetic sensor drive unit TRC116-12A0-7F 10.5 Tajimi Musen	Enclosed with magnetic sensor drive unit
(3)	Encoder Orientation detection signal	CN6	CNP6A cable	Spindle drive unit (Shell) 10320-52F0-008 (Plug) 10120-3000VE Sumitomo 3M	Semi ordered part	Twisted pair batch shield cable 0.2SQ Maximum diameter 11mm 	Encoder (RFH-1024-) MS3106A20-29S DDK	Enclosed with encoder
(4)	C-axis encoder C-axis detection signal (OSE90K+1024)	CN7	CNP7A cable	Spindle drive unit (Shell) 10320-52F0-008 (Plug) 10120-3000VE Sumitomo 3M	Semi ordered part	Twisted pair batch shield cable 0.2SQ Maximum diameter 11mm 	Encoder (OSE90K+1024) MS3106A20-29S DDK	Enclosed with encoder
(5)	C-axis built-in encoder C-axis detection signal (MBE90K)	CN7	CNP7B cable	Spindle drive unit (Shell) 10320-52F0-008 (Plug) 10120-3000VE Sumitomo 3M	Semi ordered part	Twisted pair batch shield cable 0.2SQ Maximum diameter 11mm 	Encoder (MBE90K) (Housing) 69176-020 (Pin) 48235-000 DuPont	Enclosed with encoder
(6)	C-axis built-in encoder C-axis detection signal (MHE90K)	CN7	CNP7H cable	Spindle drive unit (Shell) 10320-52F0-008 (Plug) 10120-3000VE Sumitomo 3M	No ordered part	Twisted pair batch shield cable 0.2SQ Maximum diameter 7mm 	Encoder (MHE90K) (Housing) JAC-15P (Pin) J-SP1140 Japan Solderless	Enclosed with encoder
(7)	C-axis encoder C-axis detection signal + orientation detection signal (OSE90K+1024)	CN6 + CN7	CNP67A cable	Spindle drive unit (Shell) 10320-52F0-008 ×2 (Plug) 10120-3000VE ×2 Sumitomo 3M	Semi ordered part	Twisted pair batch shield cable 0.2SQ Maximum diameter 11mm 	Encoder (OSE90K+1024) MS3106A20-29S DDK	Enclosed with encoder

No.	Application	Drive unit side connection connector	Cable name	Connected device / Parts name / Maker	Arranged by	Applicable cable finished state	Connected device / Parts name / Maker	Arranged by
(8)	C-axis encoder C-axis detection signal + NC speed indication signal (OSE90K+1024)	CN7 + CES11	CNP71A cable	Spindle drive unit (Shell) 10320-52F0-008 (Plug) 10120-3000VE Sumitomo 3M CNC (Connector) CDA-15P (Contact) CD-PC-111 (Case) HDA-CTF Hirose	Semi ordered part	Twisted pair batch shield cable 0.2SQ Maximum diameter 11mm 	Encoder (OSE90K+1024) MS3106A20-29S DDK	Enclosed with encoder
(9)	C-axis built-in encoder C-axis detection signal + NC speed indication signal (MBE90K)	CN7 + CES11	CNP71B cable	Spindle drive unit (Shell) 10320-52F0-008 (Plug) 10120-3000VE Sumitomo 3M CNC (Connector) CDA-15P (Contact) CD-PC-111 (Case) HDA-CTF Hirose	Semi ordered part	Twisted pair batch shield cable 0.2SQ Maximum diameter 11mm 	Encoder (MBE90K) (Housing) 69176-020 (Pin) 48235-000 DuPont 00	Enclosed with encoder
(10)	C-axis built-in encoder C-axis detection signal + NC speed indication signal (MHE90K)	CN7 + CES11	CNP71H cable	Spindle drive unit (Shell) 10320-52F0-008 (Plug) 10120-3000VE Sumitomo 3M CNC (Connector) CDA-15P (Contact) CD-PC-111 (Case) HDA-CTF Hirose	No ordered part	Twisted pair batch shield cable 0.2SQ Maximum diameter 7mm 	Encoder (MHE90K) (Housing) JAC-15P (Pin) J-SP1140 Japan Solderless (Housing) JAC-15P (Pin) J-SP1140 Japan Solderless	Enclosed with encoder
(11)	C-axis built-in encoder Motor speed detection signal + motor temperature switch signal (MHE90K)	CN5	CNP5H cable	Spindle drive unit (Shell) 10320-52F0-008 (Plug) 10120-3000VE Sumitomo 3M	No ordered part	Twisted pair batch shield cable 0.2SQ Maximum diameter 7mm 	Encoder (MHE90K) (Housing) JEC-9P (Pin) J-SP1140 Japan Solderless	Enclosed with encoder
(12)	Speed detection signal	CN8	CNP8 cable	Spindle drive unit (Shell) 10320-52F0-008 (Plug) 10120-3000VE Sumitomo 3M	Semi ordered part	Twisted pair batch shield cable 0.2SQ Maximum diameter 11mm  **(Note)** When the spindle has two axes, a cable must be added as shown in the dotted line.	NC control unit (QX522 card CES11) (Connector) CDA-15P (Contact) CD-PC-111 (Case) HDA-CTF Hirose	

(Note 1) The connector shell on the spindle drive unit is the 3M "10320-52F0-008", but this is a shell with a one-touch locking mechanism that does not require screw locking.
When ordering the cables from Mitsubishi, the shell "10320-52F0-008" with this one-touch locking mechanism will be used.
However, if the cable is to be manufactured by the user, the shell "10320-52A0-008" (3M) with the screw lock mechanism can be used instead of the above shell.

(Note 2) Each cable length must be 30m or less.
The cable for the C-axis built-in encoder MHE90K must be 10m or less.

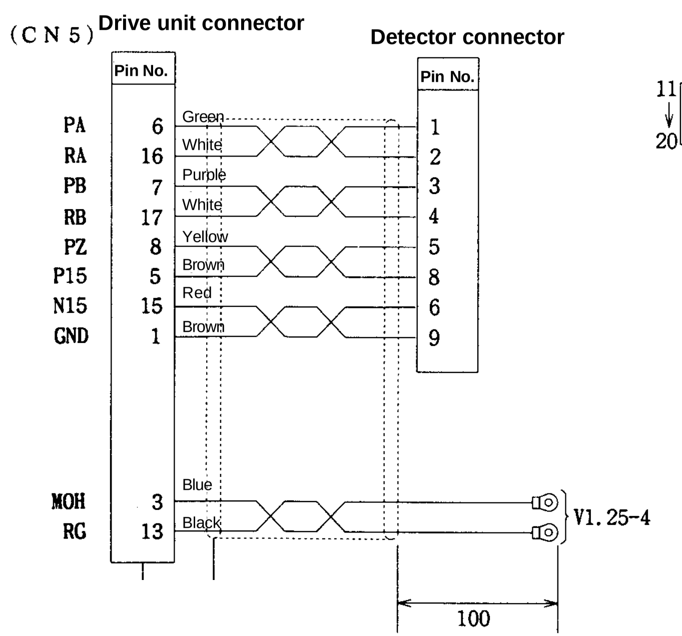
(1) CNP5 cable

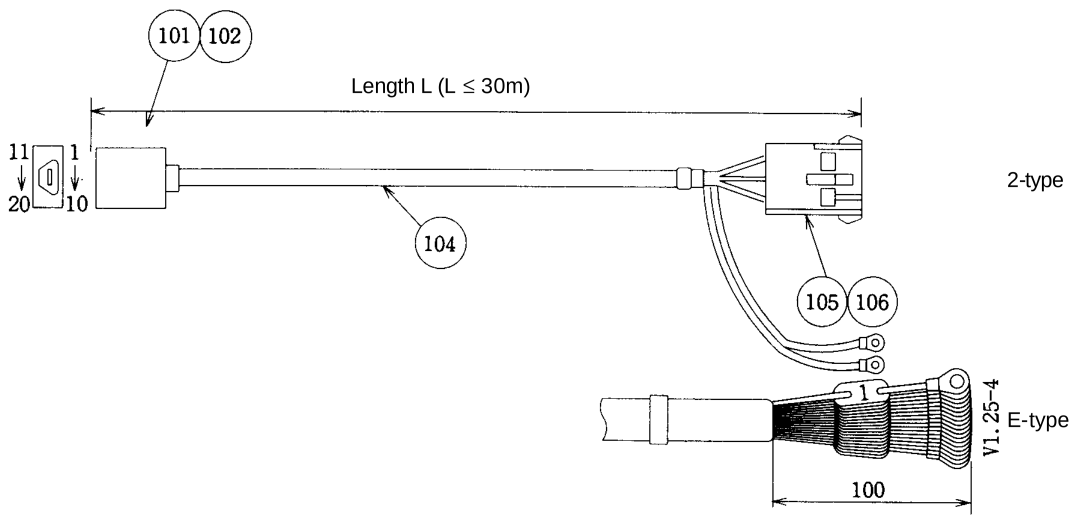
Part No.	Part name	Abbr.	Model	Qty/type				
000				E-type	2-type			
101	Connector (shell)	CON	10320-52F0-008	1	1			
102	Connector (plug)	CON	10120-3000VE	1	1			
103								
104	Cable	SEN	F-DPEVSB TS-91026 (BANDO ELECTRIC WIRE)	1	1			
105	Connector (housing)	CON	350720-1		1			
106	Connector (pin)	CON	350689-1		8			

Cable name

CNP5－□□－□

- Connector type
  - E: E-type (crimp terminal on lead end)
  - 2: 2-type (designated connector)
- Axis No. (Axis 1 to 8)
  - 1 to 8: Axis 1 to 8
- System No.
  - None : 1-axis system
  - 2 : 2-axis system
  - P : PLC axis
- Connection connector No.





(Note) Connect the shield of the cable securely to the connector shell.

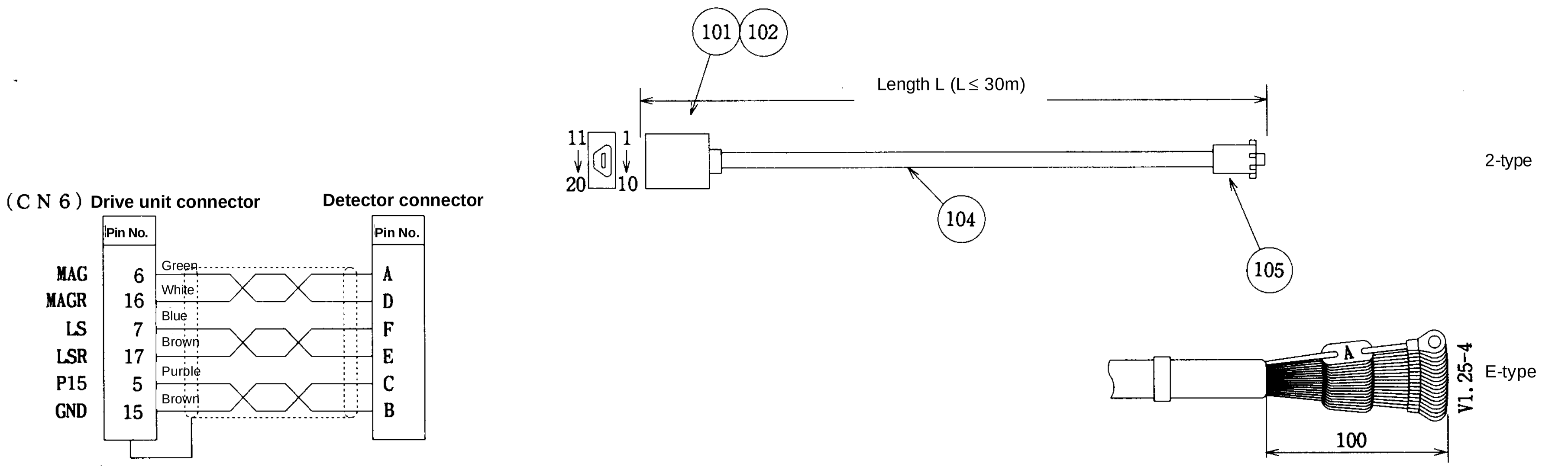
( ) CNP6M cable

Part No.	Part name	Abbr.	Model	Qty/type				
000				E-type	2-type			
101	Connector (shell)	CON	10320-52F0-008	1	1			
102	Connector (plug)	CON	10120-3000VE	1	1			
103								
104	Cable	SEN	F-DPEVSB TS-91026 (BANDO ELECTRIC WIRE)	1	1			
105	Connector	CON	TRC116-12A10-7F10.5		1			
106								
107								
108								

Cable name

CNP6M-□□-□

- Connector type
  - E: E-type (crimp terminal on lead end)
  - 2: 2-type (designated connector)
- Axis No. (Axis 1 to 8)
  - 1 to 8: Axis 1 to 8
- System No.
  - None : 1-axis system
  - 2 : 2-axis system
  - P : PLC axis
- Magnetic sensor signal
- Connection connector No.



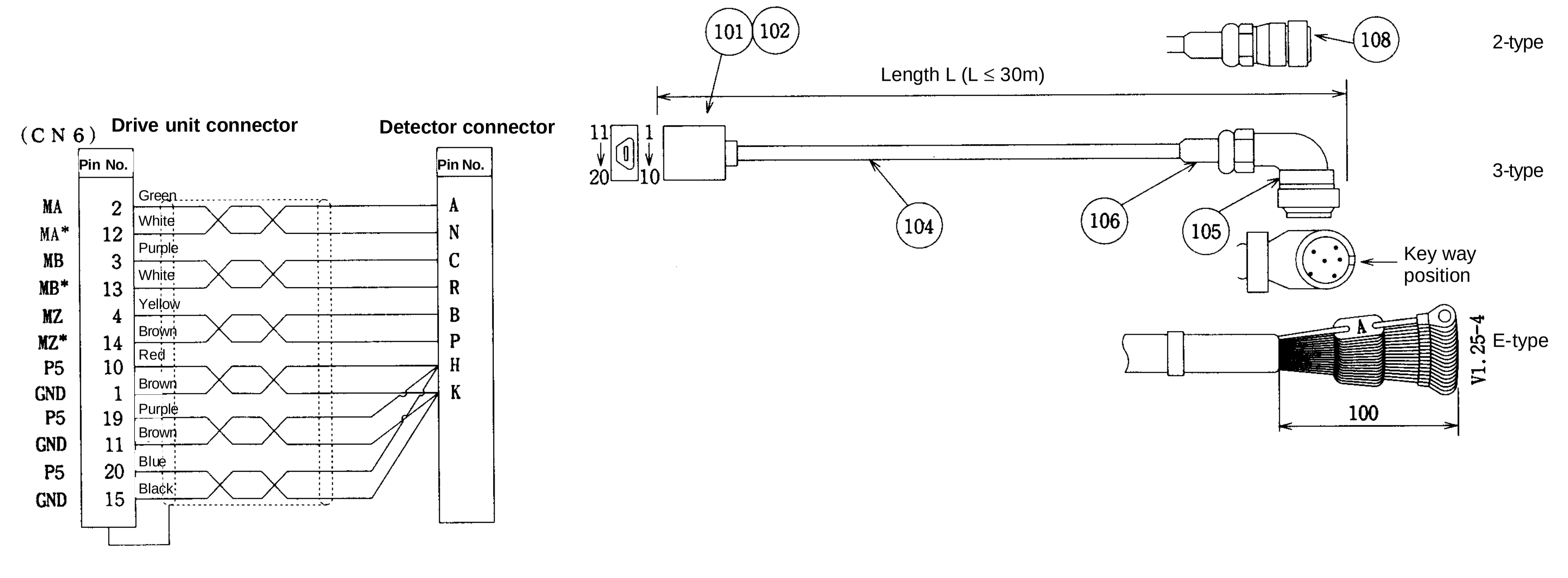
(Note) Connect the shield of the cable securely to the connector shell.

(●) CNP6A cable ●

Part No.	Part name	Abbr.	Model	Qty/type				
000				E -type	2-type	3-type		
101	Connector (shell)	CON	10320-52F0-008	1	1	1		
102	Connector (plug)	CON	10120-3000VE	1	1	1		
103								
104	Cable	SEN	F-DPEVSB TS-91026 (BANDO ELECTRIC WIRE)	1	1	1		
105	Cannon connector (angle)	CON	MS3108B20-29S			1		
106	Connector clamp	CON	MS3057-12A		1	1		
107								
108	Cannon connector (Straight)	CON	MS3106B20-29S		1			

Cable name

CNP6A-□□-□
- Connector type
  - E: E-type (crimp terminal on lead end)
  - 2: 2-type (cannon plug straight type)
  - 3: 3-type (cannon plug L type)
- Axis No. (Axis 1 to 8)
  - 1 to 8: Axis 1 to 8
- System No.
  - None : 1-axis system
  - 2 : 2-axis system
  - P : PLC axis
- Encoder signal (1024P) RFH-1024-
- Connection connector No.



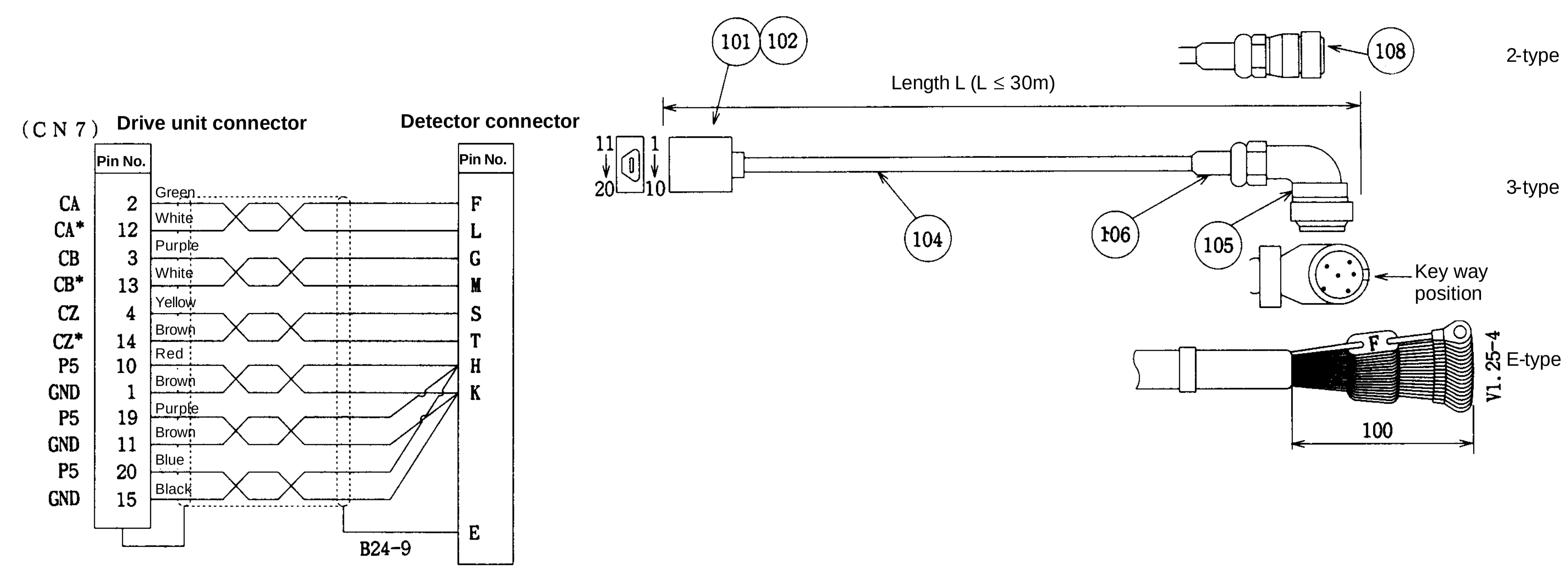
(Note) Connect the shield of the cable securely to the connector shell.

(●) CNP7A cable ●

Part No.	Part name	Abbr.	Model	Qty/type				
000				E-type	2-type	3-type		
101	Connector (shell)	CON	10320-52F0-008	1	1	1		
102	Connector (plug)	CON	10120-3000VE	1	1	1		
103								
104	Cable	SEN	F-DPEVSB TS-91026 (BANDO ELECTRIC WIRE)	1	1	1		
105	Cannon connector (angle)	CON	MS3108B20-29S			1		
106	Connector clamp	CON	MS3057-12A		1	1		
107								
108	Cannon connector (Straight)	CON	MS3106B20-29S		1			

Cable name

CNP7A-□□-□
- Connector type
  - E: E-type (crimp terminal on lead end)
  - 2: 2-type (cannon plug straight type)
  - 3: 3-type (cannon plug L type)
- Axis No. (Axis 1 to 8)
  - 1 to 8: Axis 1 to 8
- System No.
  - None : 1-axis system
  - 2 : 2-axis system
  - P : PLC axis
- Shaft type encoder signal (90,000P) OSE90K+1024
- Connection connector No.



(Note) Connect the shield of the cable securely to the connector shell.

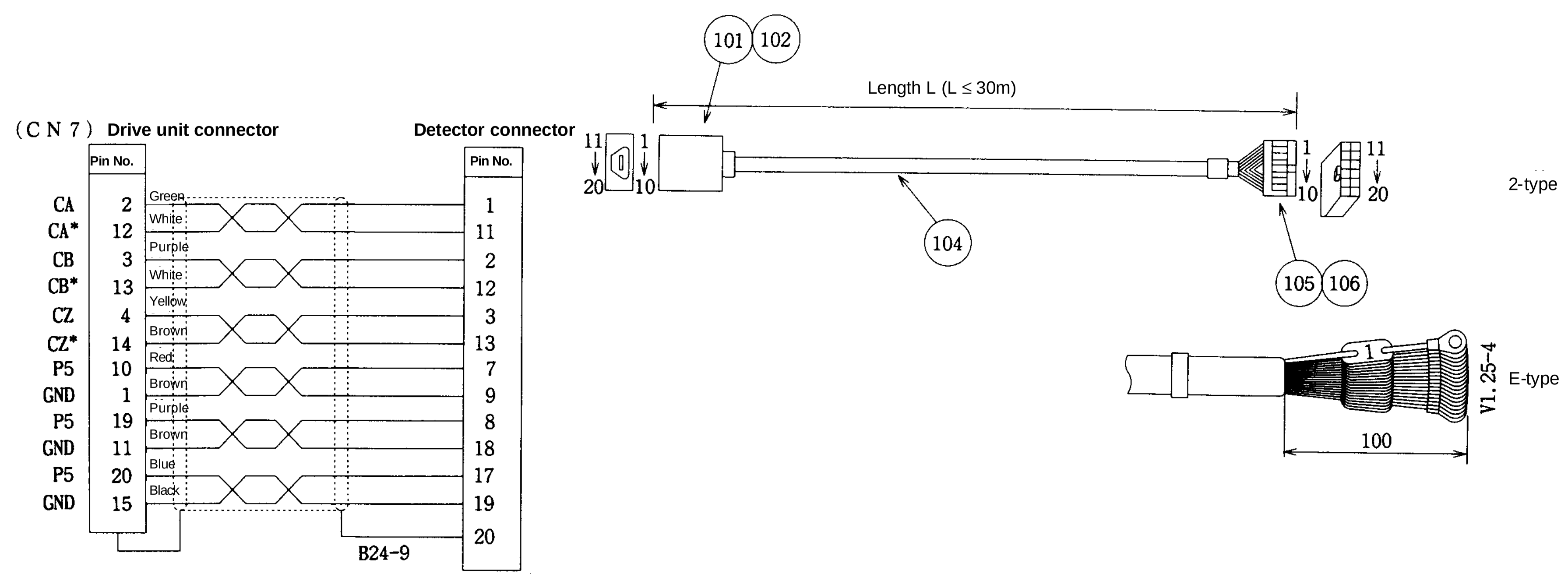
(●) CNP7B cable ●

Part No.	Part name	Abbr.	Model	Qty/type				
000				E-type	2-type			
101	Connector (shell)	CON	10320-52F0-008	1	1			
102	Connector (plug)	CON	10120-3000VE	1	1			
103								
104	Cable	SEN	F-DPEVSB TS-91026 (BANDO ELECTRIC WIRE)	1	1			
105	Connector (housing)	CON	69176-D20		1			
106	Connector (pin)	CON	48235-000		13			
107								
108								

Cable name

CNP7B−□□−□

- Connector type
  - E: E-type (crimp terminal on lead end)
  - 2: 2-type (connection connector)
- Axis No. (Axis 1 to 8)
  - 1 to 8: Axis 1 to 8
- System No.
  - None : 1-axis system
  - 2 : 2-axis system
  - P : PLC axis
- Built-in type encoder signal (90,000P) MBE90K
- Connection connector No.



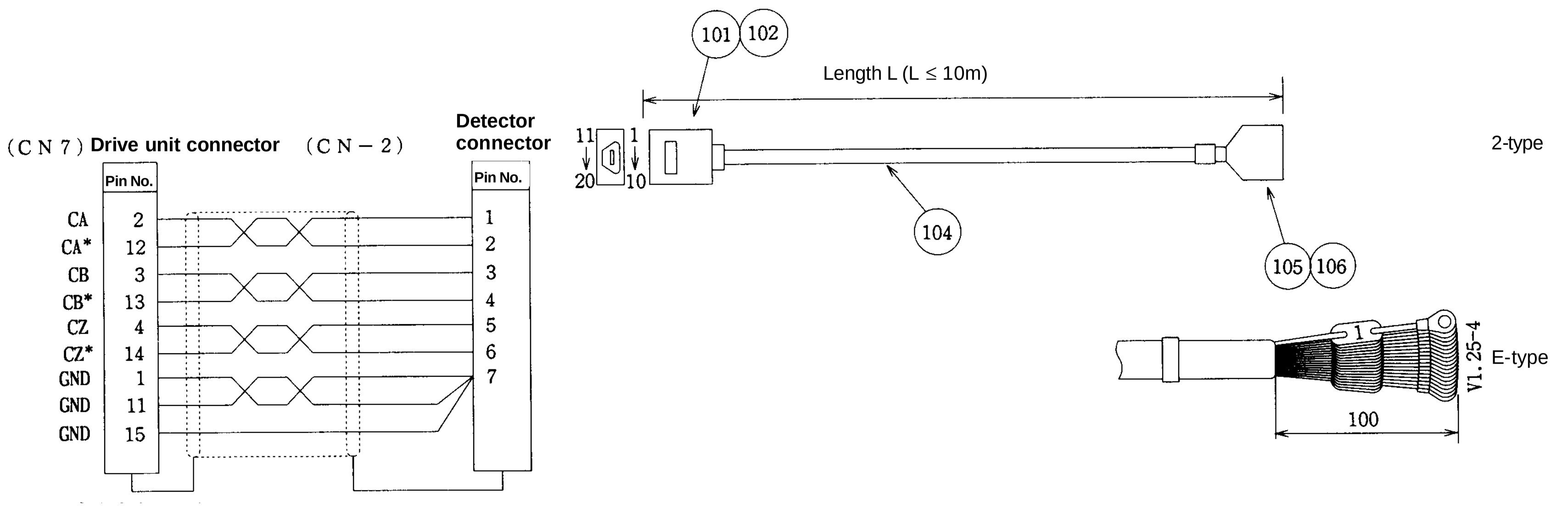
(Note) Connect the shield of the cable securely to the connector shell.

(●) CNP7H cable ●

Part No.	Part name	Abbr.	Model	Qty/type				
000				E-type	2-type			
101	Connector (shell)	CON	10320-52F0-008	1	1			
102	Connector (plug)	CON	10120-3000VE	1	1			
103								
104	Cable	SEN		1	1			
105	Connector (housing)	CON	JAC-15P		1			
106	Connector (pin)	CON	J-SP1140		7			
107								
108								

Cable name

CNP7H-□□-□
- Connector type
  - E: E-type (crimp terminal on lead end)
  - 2: 2-type (designated connector)
- Axis No. (Axis 1 to 8)
  - 1 to 8: Axis 1 to 8
- System No.
  - None : 1-axis system
  - 2 : 2-axis system
  - P : PLC axis
- Built-in type encoder signal (90,000P) MHE90K
- Connection connector No.



(Note 1) This cable is not available from Mitsubishi, and must be manufactured by the user.
(Note 2) Connect the shield of the cable securely to the connector shell.

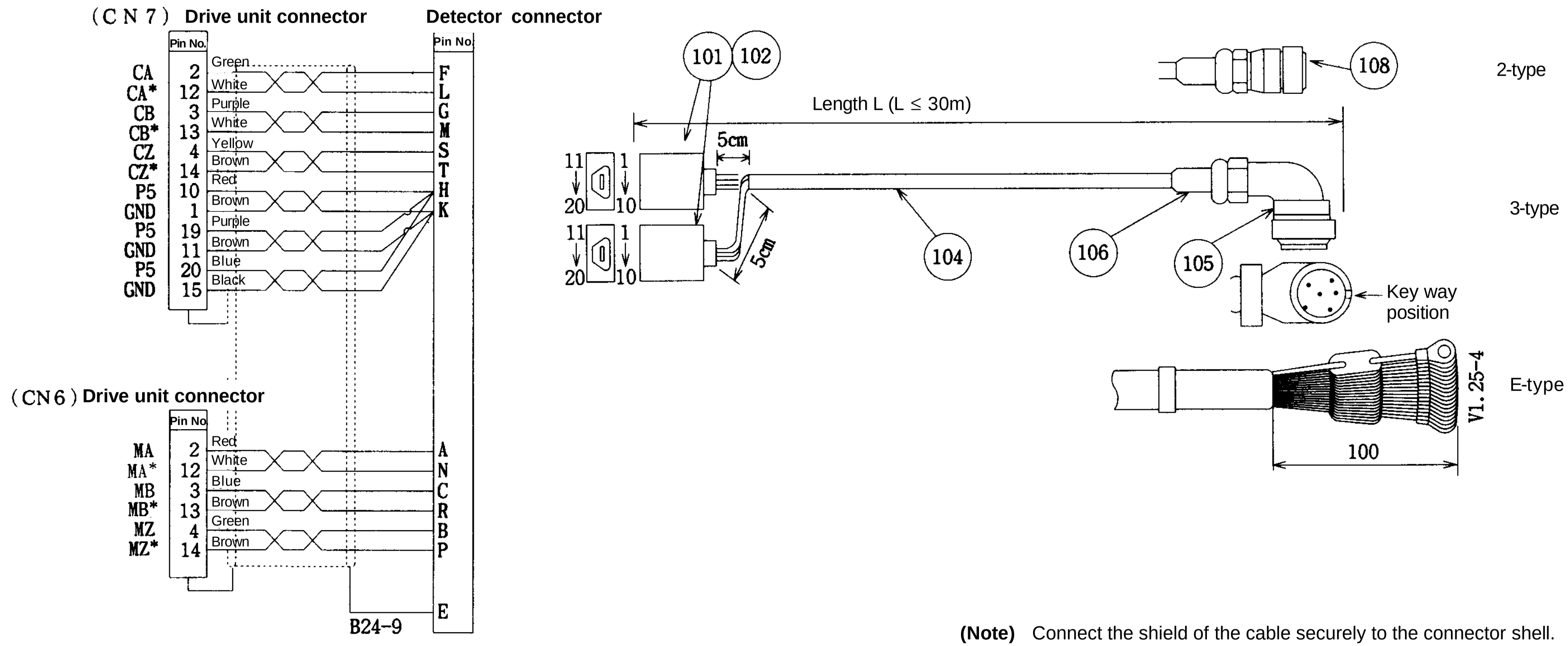
(7) ●NP67A cable ●

Part No.	Part name	Abbr.	Model	Qty/type				
000				E-type	2-type	3-type		
101	Connector (shell)	CON	10320-52F0-008	2	2	2		
102	Connector (plug)	CON	10120-3000VE	2	2	2		
103								
104	Cable	SEN	F-DPEVSB TS-91026 (BANDO ELECTRIC WIRE)	1	1	1		
105	Cannon connector (angle)	CON	MS3108B20-29S			1		
106	Connector clamp	CON	MS3057-12A		1	1		
107								
108	Cannon connector (Straight)	CON	MS3106B20-29S		1			

Cable name

CNP67A-□□-□

- Connector type
  - E: E-type (crimp terminal on lead end)
  - 2: 2-type (cannon plug straight type)
  - 3: 3-type (cannon plug L type)
- Axis No. (Axis 1 to 8)
  - 1 to 8: Axis 1 to 8
- System No.
  - None : 1-axis system
  - 2 : 2-axis system
  - P : PLC axis
- Shaft type encoder signal (90,000P+1024P) OSE90K+102
- Connection connector No.



(Note) Connect the shield of the cable securely to the connector shell.

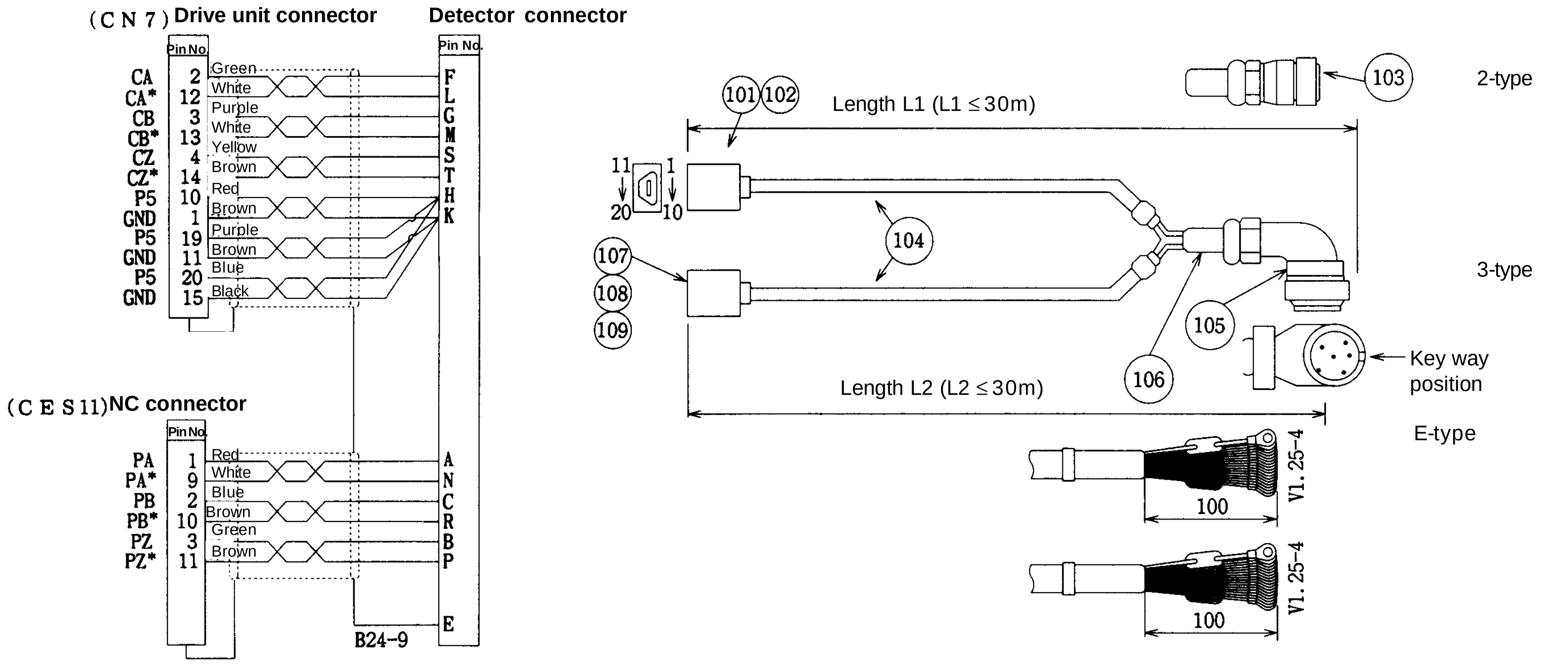
(8) CNP71A cable

Part No.	Part name	Abbr.	Model	Qty/type				
000				E-type	2-type	3-type		
101	Connector (shell)	CON	10320-52F0-008	1	1	1		
102	Connector (plug)	CON	10120-3000VE	1	1	1		
103	Cannon connector (Straight)	CON	MS3106B20-29S		1			
104	Cable	SEN	F-DPEVSB TS-91026 (BANDO ELECTRIC WIRE)	2	2			
105	Cannon connector (angle)	CON	MS3108B20-29S			1		
106	Connector clamp	CON	MS3057-12A		1	1		
107	Connector	CON	CDA-15P	1	1	1		
108	Contact	CON	CD-PC-111	6	6	6		
109	Case	CON	HDA-CTF	1	1	1		

Cable name

CNP71A-□□-□

- Connector type
  - E: E-type (crimp terminal on lead end)
  - 2: 2-type (cannon plug straight type)
  - 3: 3-type (cannon plug L type)
- Axis No. (Axis 1 to 8)
  - 1 to 8: Axis 1 to 8
- System No.
  - None : 1-axis system
  - 2 : 2-axis system
  - P : PLC axis
- Shaft type encoder signal (90,000P+1024P) OSE90K+1024
- Connection connector No.



(Note) Connect the shield of the cable securely to the connector shell.

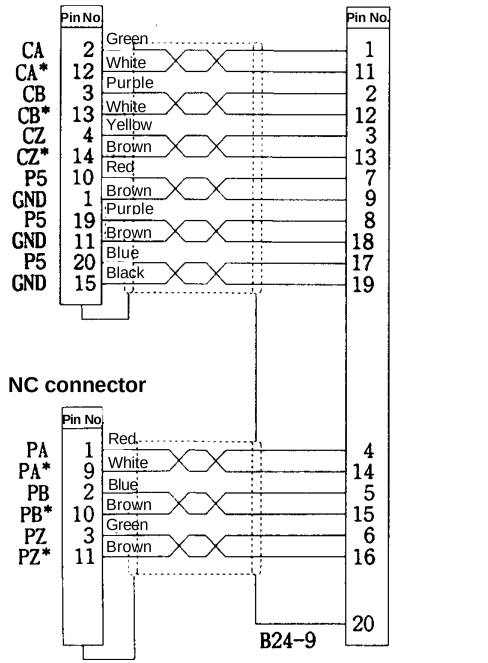
(9) ●NP71B cable ●

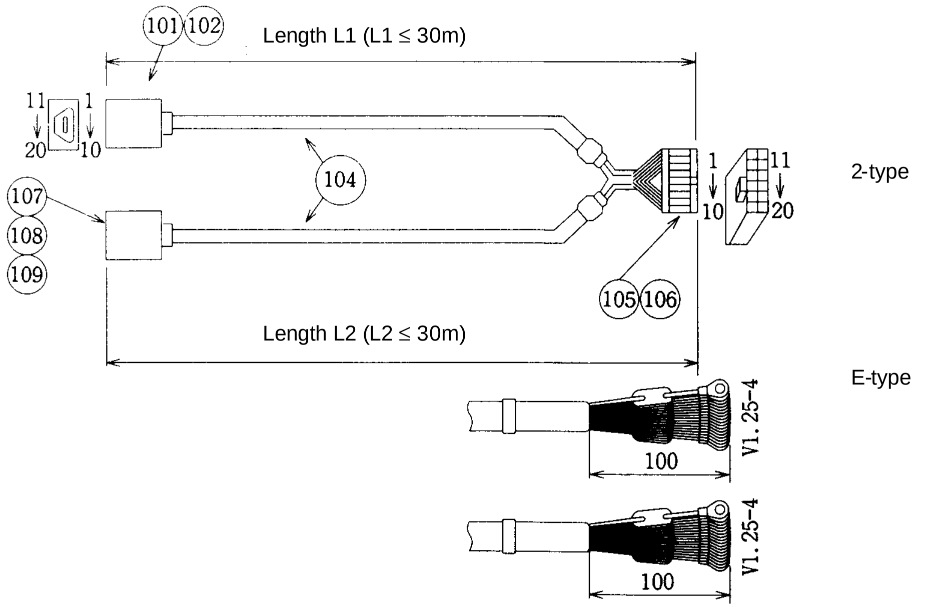
Part No.	Part name	Abbr.	Model	Qty/type				
000				E-type	2-type			
101	Connector (shell)	CON	10320-52F0-008	1	1			
102	Connector (plug)	CON	10120-3000VE	1	1			
103								
104	Cable	SEN	F-DPEVSB TS-91026 (BANDO ELECTRIC WIRE)	2	2			
105	Connector (housing)	CON	69176-020		1			
106	Connector (pin)	CON	48235-000		19			
107	Connector	CON	CDA-15P	1	1			
108	Contact	CON	CD-PC-111	6	6			
109	Case	CON	HDA-CTF	1	1			

Cable name

CNP71B−□□−□

- Connector type
  - E: E-type (crimp terminal on lead end)
  - 2: 2-type (designated connector)
- Axis No.
  - 1 to 8: Axis 1 to 8
- System No.
  - None : 1-axis system
  - 2 : 2-axis system
  - P : PLC axis
- Built-in type encoder signal (90,000P+1024P) MDE90K
- Connection connector No.





(Note) Connect the shield of the cable securely to the connector shell.

(10) CNP71H cable

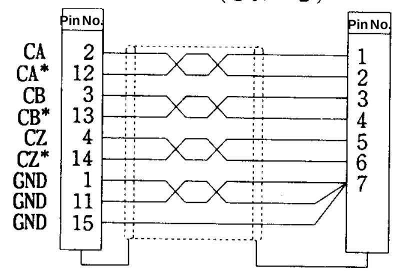
Part No.	Part name	Abbr.	Model	Qty/type				
000				E-type	2-type			
101	Connector (shell)	CON	10320-52F0-008	1	1			
102	Connector (plug)	CON	10120-3000VE	1	1			
103								
104	Cable	SEN	F-DPEVSB TS-91026 (BANDO ELECTRIC WIRE)	2	2			
105	Connector (housing)	CON	JAC-15P		2			
106	Connector (pin)	CON	J-SP1140		13			
107	Connector	CON	CDA-15P	1	1			
108	Contact	CON	CD-PC-111	6	6			
109	Case	CON	HDA-CTF	1	1			

Cable name

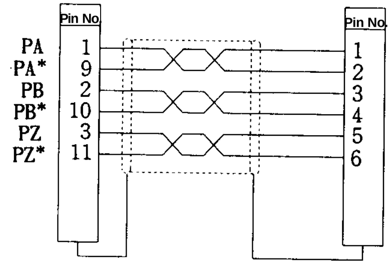
CNP71H-□□-□

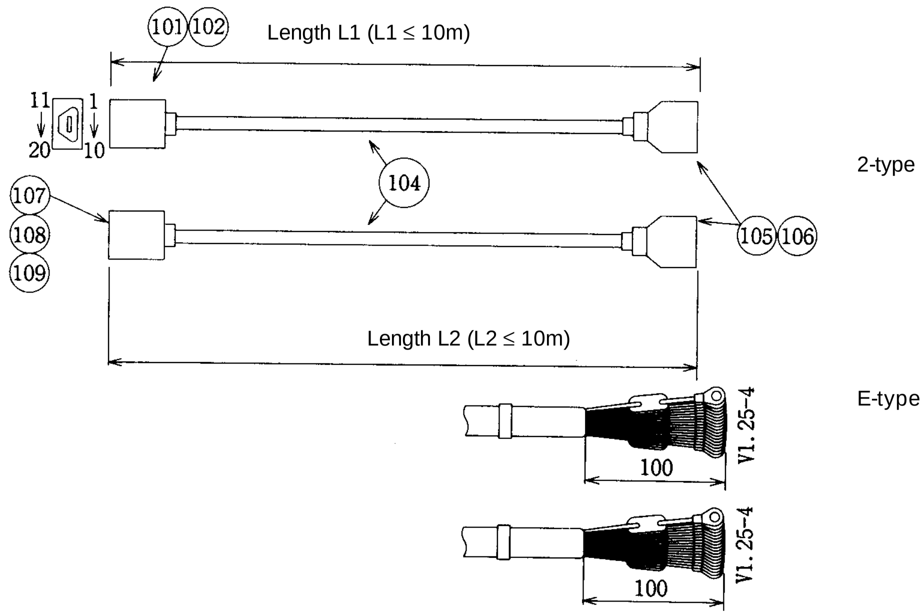
- Connector type
  - E: E-type (crimp terminal on lead end)
  - 2: 2-type (designated connector)
- Axis No. (Axis 1 to 8)
  - 1 to 8: Axis 1 to 8
- System No.
  - None : 1-axis system
  - 2 : 2-axis system
  - P : PLC axis
- Built-in type encoder signal (90,000P/1024P): MHE90K
- Connection connector No.

(CN7) **Drive unit connector** (CN-2) **Detector connector**



(CES11) **NC connector** (CN-3) **Detector connector**





(Note 1) This cable is not available from Mitsubishi, and must be manufactured by the user.
(Note 2) Connect the shield of the cable securely to the connector shell.

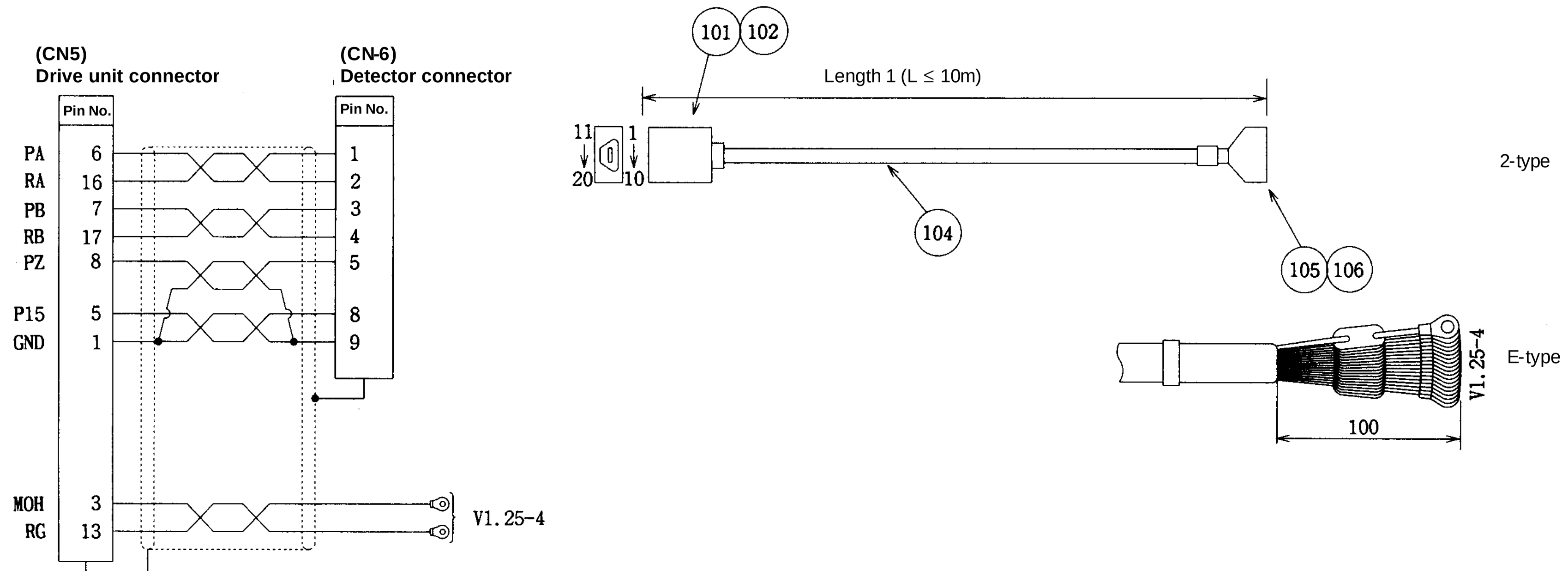
(11) CNP5H cable

Part No.	Part name	Abbr.	Model	Qty/type				
000				E-type	2-type			
101	Connector (shell)	CON	10320-52F0-008	1	1			
102	Connector (plug)	CON	10120-3000VE	1	1			
103								
104	Cable	SEN	F-DPEVSB TS-91026 (BANDO ELECTRIC WIRE)	1	1			
105	Connector (housing)	CON	JEC-9P		1			
106	Connector (pin)	CON	J-SP1140		7			

Cable name

CNP5H－□□－□

- Connector type
  - E: E-type (crimp terminal at lead end)
  - 2: 2-type (designated connector)
- Axis No. (Axis 1 to 8)
  - 1 to 8: Axis 1 to 8
- System No.
  - None : 1-axis system
  - 2 : 2-axis system
  - P : PLC axis
- Built-in type encoder signal (180 wave) MHE90K
- Connection connector No.



(Note 1) This cable is not available from Mitsubishi, and must be manufactured by the user.
(Note 2) Connect the shield of the cable securely to the connector shell.

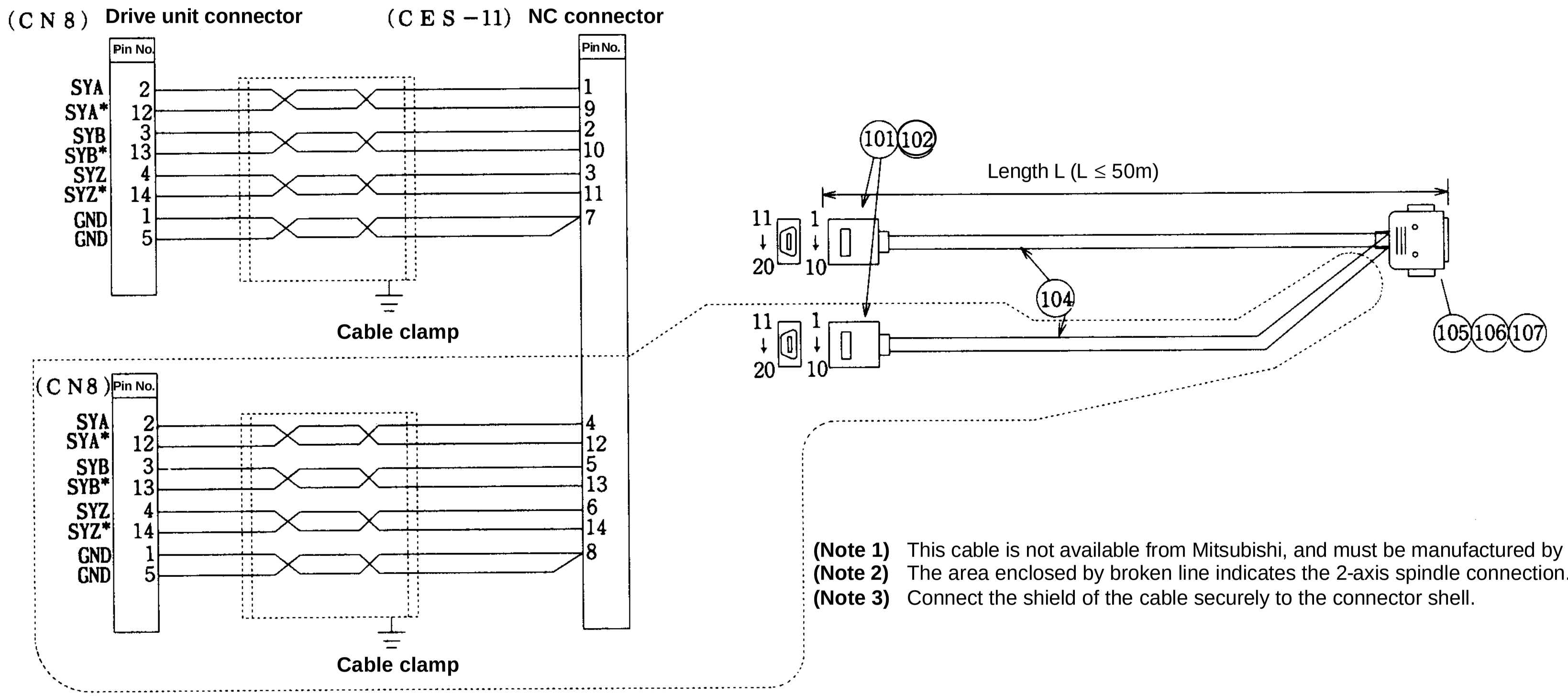
(12) CNP8 cable

Part No.	Part name	Abbr.	Model	Qty/type				
000								
101	Connector (shell)	CON	10320-52F0-008	1				
102	Connector (plug)	CON	10120-3000VE	1				
103								
104	Cable	SEN	F-DPEVSB TS-91026 (BANDO ELECTRIC WIRE)	1				
105	Connector	CON	CDA-15P	1				
106	Contact	CON	CD-PC-111	14				
107	Case	CON	HDA-CTF	1				

(Note) When using the 2-axis spindle, the required quantity of part No. 101 to 104 on the left will be two.

Cable name

CNP8 — Connection connector No.

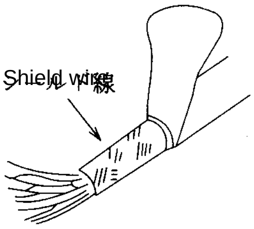
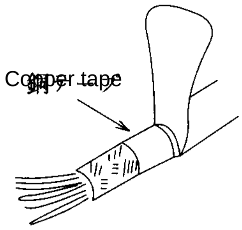
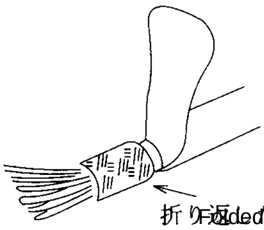
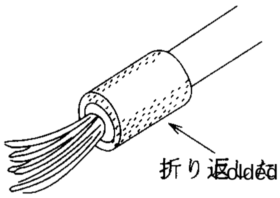
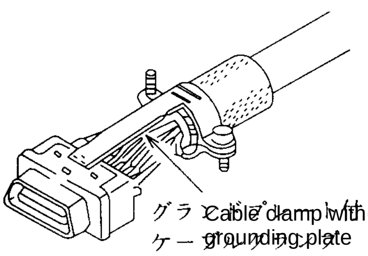


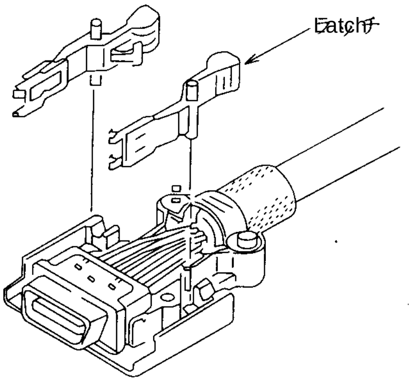
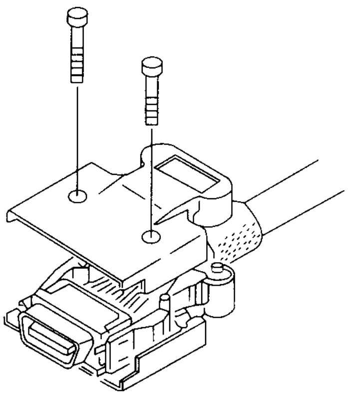
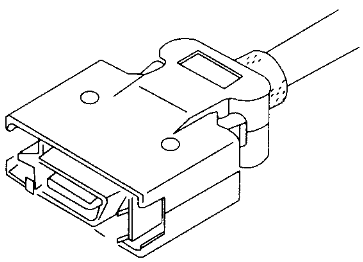
(Note 1) This cable is not available from Mitsubishi, and must be manufactured by the user.
(Note 2) The area enclosed by broken line indicates the 2-axis spindle connection.
(Note 3) Connect the shield of the cable securely to the connector shell.

5.2.13 Cable assembly procedure (Excluding SH21 cable)

(1) Non-shield shell assembly procedure I

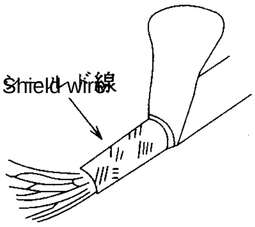
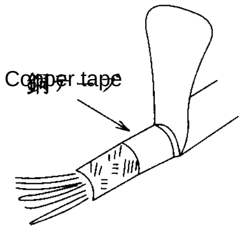
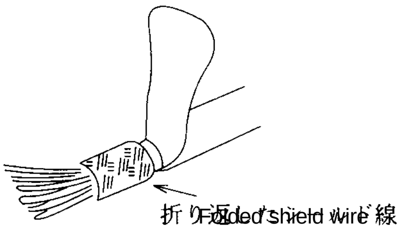
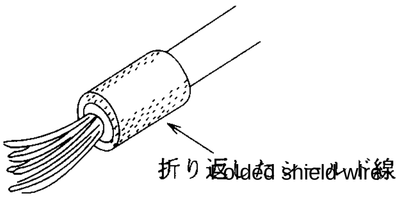
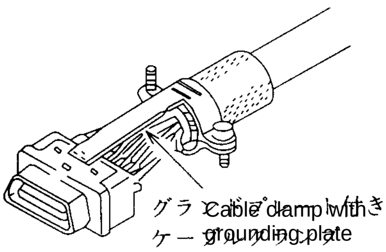
One-touch locking type

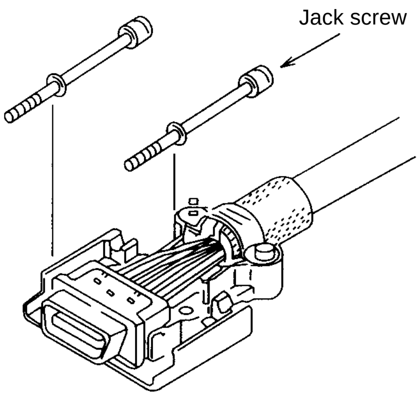
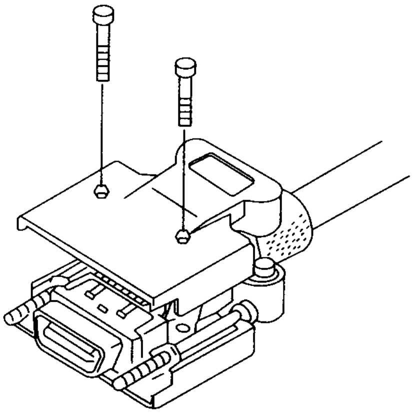
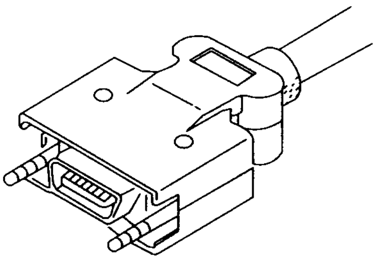
(a) 	Peel the outer sheath so that the shield wires are exposed.
(b) 	Wrap copper tape or vinyl tape around part of the shield wire section.
(c) 	Fold the shield wire over the wrapped copper tape or vinyl tape.
(d) 	Cut off any excess sheath.
(e) 	After connecting the connector and cable, mount the cable clamp approx. 1 to 2mm from the cable end, and tighten the screw until the cable clamp screw section face contacts closely. **(Note)** Adjust the No. of copper tape windings in step (b) so that the shield wire and clamp contact without looseness and so that the clamp's screw section face is closely contacted.

(f) 	Store a connector and latch at the respective positions on one end of the shell. (The male of the shell is same shape as female's, so store on either side.) **(Note)** Make sure that the cable does not rise up or exceed the shell's inner wall to prevent breakage of the cable.
(g) 	Set the other shell and tighten with a screw. **(Note)** Recommended screw tightening torque: 3kgf·cm
(h) 	Completion Confirmation items : • There is no clearance on the shell engaging face. • The latch can be correctly opened and closed when moved with a finger.

(2) Non-shield shell assembly procedure II

Jack screw (screw locking) type

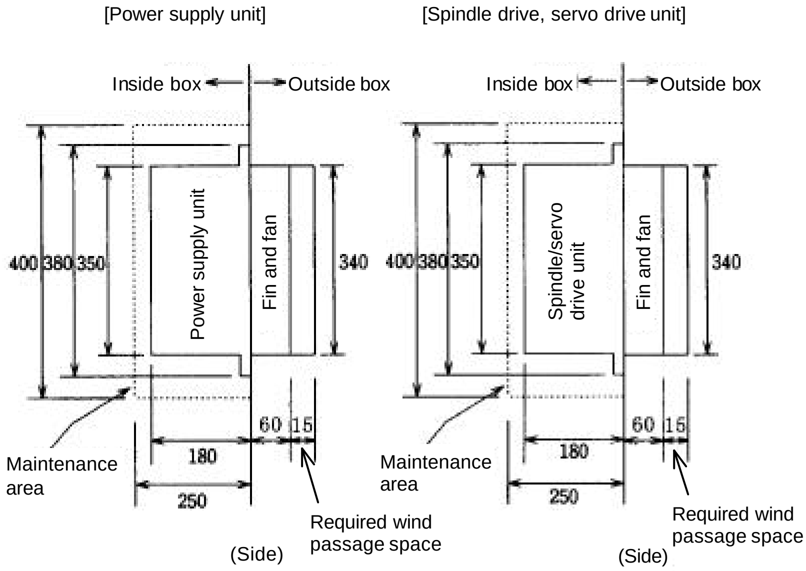
(a) 	Peel the outer sheath so that the shield wires are exposed.
(b) 	Wrap copper tape or vinyl tape around part of the shield wire section.
(c) 	Fold the shield wire over the wrapped copper tape or vinyl tape.
(d) 	Cut off any excess sheath.
(e) 	After connecting the connector and cable, mount the cable clamp approx. 1 to 2mm from the cable end, and tighten the screw until the cable clamp screw section face contacts closely. **(Note)** Adjust the No. of copper tape windings in step (b) so that the shield wire and clamp contact without looseness and so that the clamp's screw section face is closely contacted.

(f) 	Store a connector and jack screw at the respective positions on one end of the shell. (The male of the shell is same shape as female's, so store on either side.) **(Note)** Make sure that the cable does not rise up or exceed the shell's inner wall to prevent breakage of the cable.
(g) 	Set the other shell and tighten with a screw. **(Note)** Recommended screw tightening torque: 3kgf·cm
(h) 	Completion Confirmation items : • There is no clearance on the shell engaging face.

6. Outline Drawing

6.1 Panel installation structure

(1) Unit outline



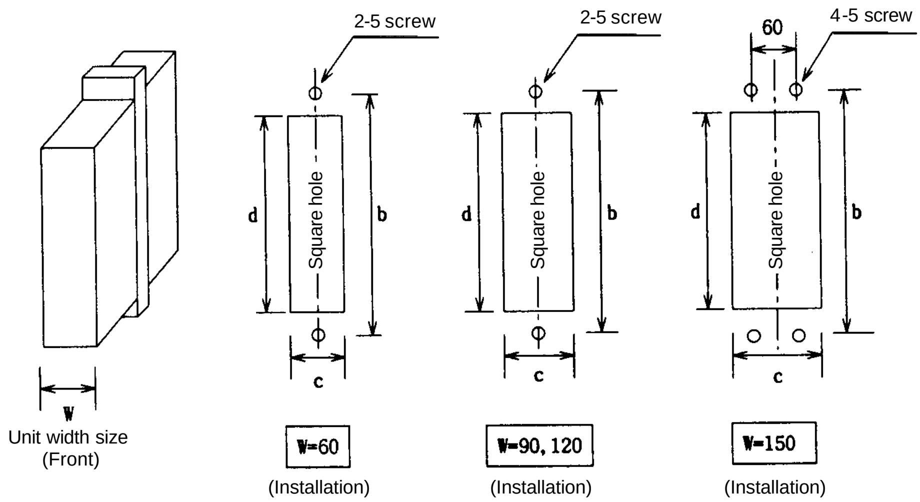
(Note) The type A0 unit noted in section "2.Drive Section System Configuration (2) and (3)" do not have the fin and fan section.

(2) Panel installation hole work drawing

Prepare a square hole to match the unit width.

(Note 1) The A0 type unit described in section "2. Drive Section System Configuration (2) and (3)" does not require to make a square hole.

(Note 2) Install packing around the square hole to provide a seal.



Unit width size W	60	90	120	150
b	360	360	360	360
c	52	82	112	142
d	342	342	342	342

(Unit: mm)

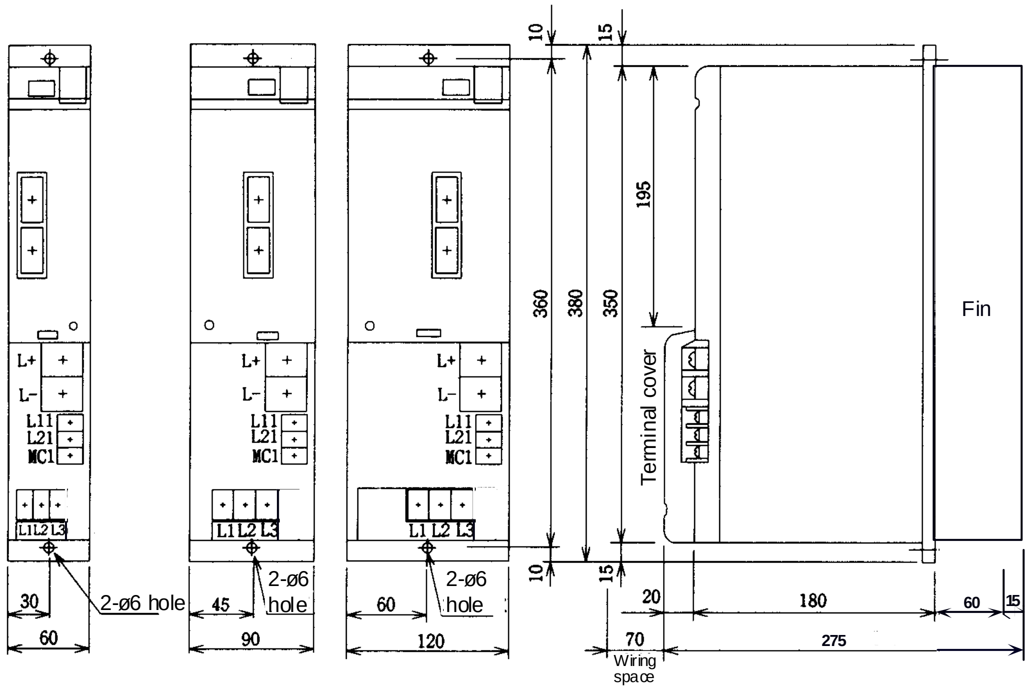
6.2 Power supply unit

∗1 The position of the CV-37 to 185 CN4 and CN9 is approx. 39mm lower than the MDS-B-CV Series. No changes have been made to the CV-220 to 370.

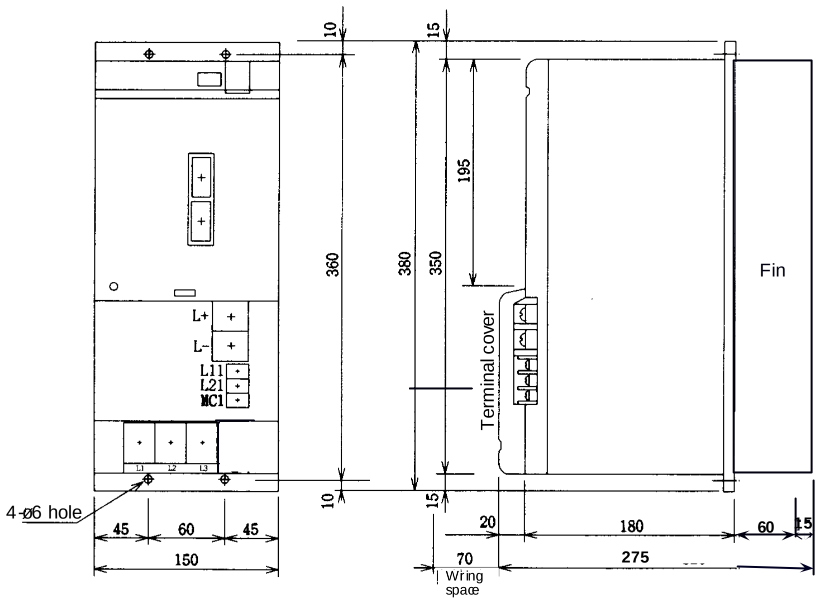
∗2 The position of the ground ⏚ has been moved from the terminal block to the unit installation base.

The fin section includes 15mm required for the wind passage space.

C1-CV-37/55/75 C1-CV-110 C1-CV-150/185



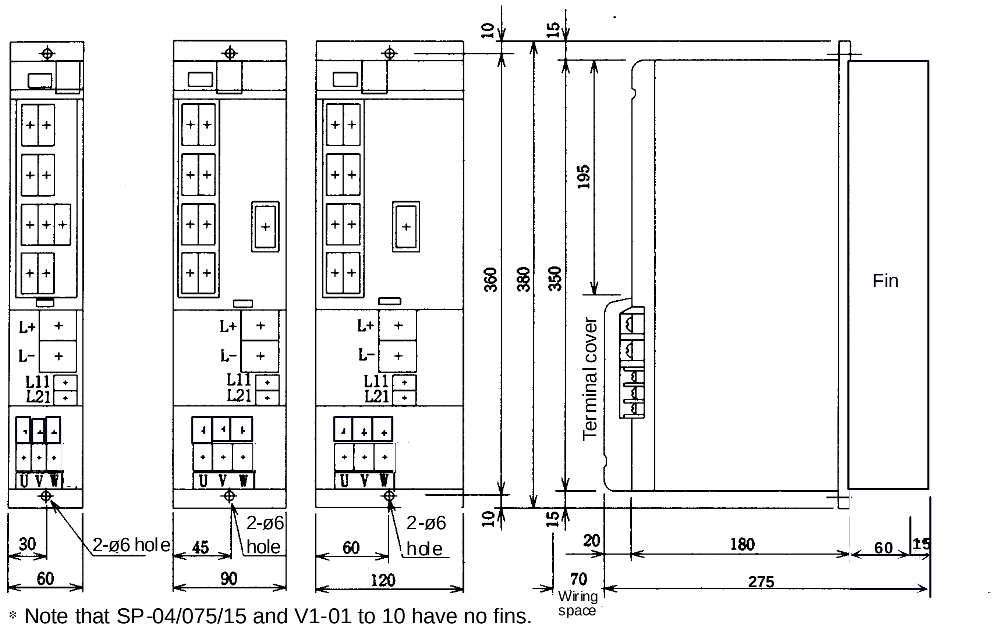
C1-CV-220/260/300/370



6.3 1-axis servo drive unit/2-axis servo drive unit/spindle servo drive unit

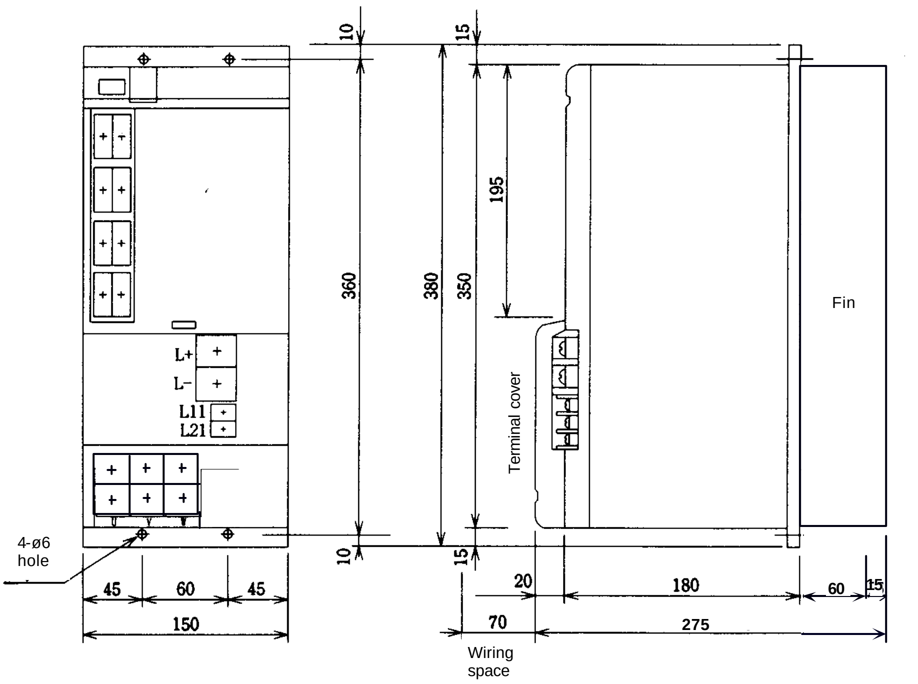
The fin section includes 15mm required for the wind passage.

C1-V1-01/03/05/ 10/20/35/45S V2-0101 to 3520S SP-04/075/15/ 22/37	C1-V1-45/70S V2-3535/ 4520/4535/ 7070S SP-55/75/ 110/150S	C1-V1-70/90 V2-4545/7035/7045 SP-150/185



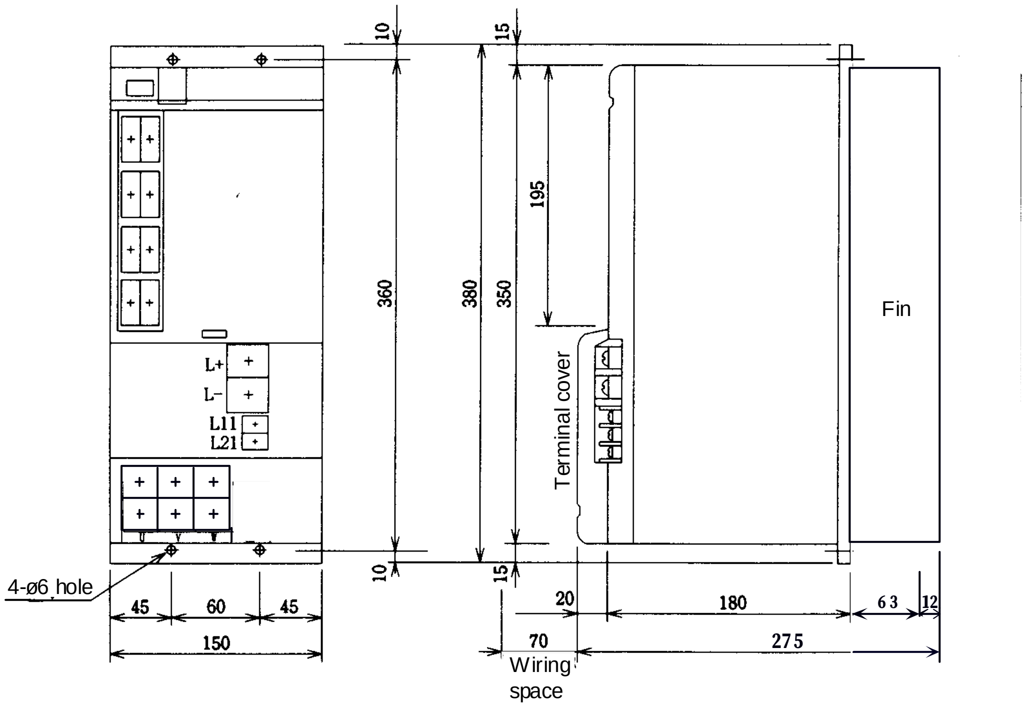
∗ Note that SP-04/075/15 and V1-01 to 10 have no fins.

C1-V2-7070
SP-220



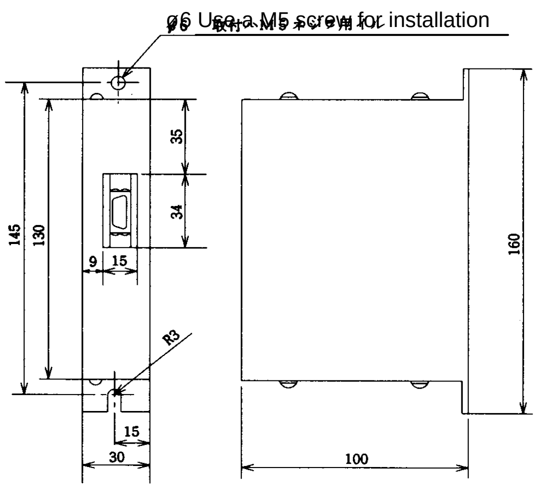
The fin section includes 12mm required for the wind passage space.

C1-V1-110/150
SP-260/300



6.4 Battery unit

MDS-A-BT-2
4
6
8



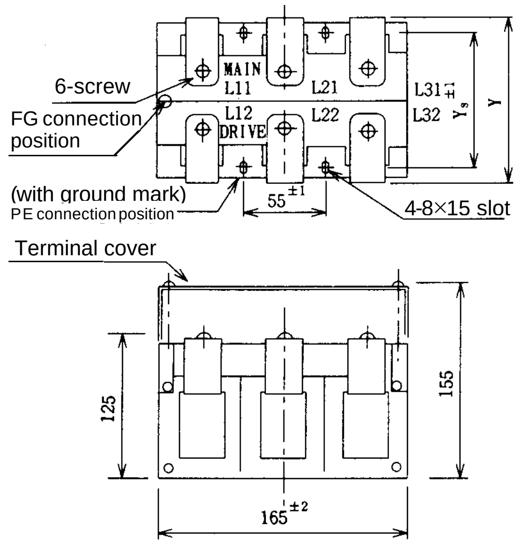
※MDS-Aシリーズ，MDS-Bシリーズ共通です。

Battery unit outline drawing

6.5 AC reactor

AC reactor outline drawing

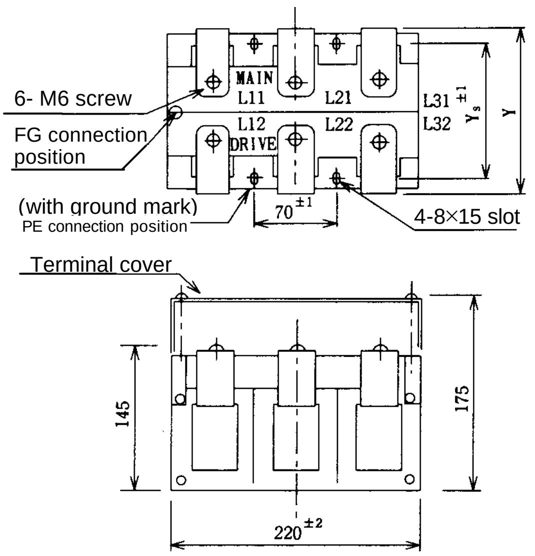
(1) For 30kW or less



ACL model	Corresponding power supply unit	Ys	Y	Weight	Screw
B-AL-7.5K	C1-CV-37, C1-CV-55, C1-CV-75	82	130	3.6kg	M5
B-AL-11K	C1-CV-110	75	130	3.0kg	
B-AL-18.5K	C1-CV-150, C1-CV-185	105	140	5.2kg	M6
B-AL-30K	C1-CV-220, C1-CV-260, C1-CV-300	110	150	6.0kg	

AC reactor outline drawing

(2) 37kW



ACL model	Corresponding power supply unit	Ys	Y	Weight
B-AL-37K	C1-CV-370	110	150	10.0kg

(Note 1) This AC reactor has a PE (protection grounding) terminal for electric shock prevention and an FG (function grounding) terminal for noise measures. Observe the following cautions for treating each terminal.

(1) PE terminal (⏚)

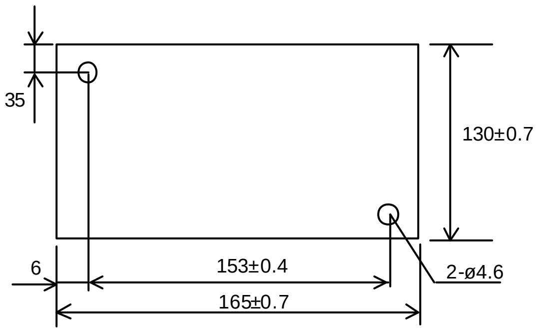
(a) When AC reactor installation side is PE
Install the AC reactor unit with screws (bolts) in all four installation holes.
Always insert a loosening-prevention washer and spring washer in the screw (bolt) used for the ⏚ mark installation hole, and tighten the screw.

(b) When AC reactor installation side is not PE
Install the AC reactor unit with screws (bolts) in all four installation holes.
Always insert a loosening-prevention washer and spring washer and tighten the screw together with the grounding wire (PE) crimp terminal at the ⏚ mark installation hole.
The grounding wire used is the same type as the grounding wire connected to the power supply unit.

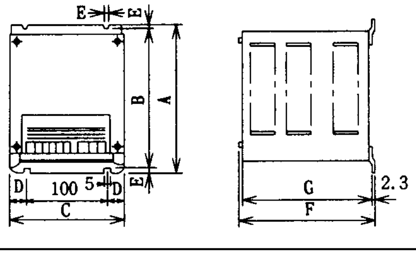
(2) FG terminal (FG)

Screw the function grounding wire crimp terminal at the terminal marked as "FG" on the top of the AC reactor (terminal block).
(With this treatment, the built-in filter's grounding will be directly connected to the grounding, and the noise withstand level will be improved.)
* Function grounding wire: This is a grounding wire not used for protection grounding. Thus, do not use a green/yellow spiral wire.

(Note 2) The dimensions of the terminal cover are as shown on the right.
When separately manufacturing a cover, refer to the dimensions on the right.



6.6 Dynamic brake unit



(Unit: mm)

Model	A	B	C	D	E	F	G	Weight	Applicable servo drive unit
MDS-B-DBU-150	200	190	140	20	5	200	193.8	2kg	V1-110/150

6.7 Contactor

Refer to the section "8.6 Selection of AC reactor, contactor and CB".

6.8 Circuit Breaker (CB)

Refer to the section "8.6 Selection of AC reactor, contactor and CB".

7. Heating Value

(1) Power supply unit

Model	Total heating value (W)	Inside unit (W)	Outside unit (W)
CV- 37	55	21	34
CV- 55	65	23	42
CV- 75	80	25	55
CV-110	125	26	99
CV-150	155	29	126
CV-185	195	33	162
CV-220	210	35	175
CV-260	260	40	220
CV-300	320	46	274
CV-370	400	54	346

(2) Spindle drive unit

Model	Total heating value (W)	Inside unit (W)	Outside unit (W)
SP- 04	30	30	0
SP-075	40	40	0
SP- 15	49	49	0
SP- 22	69	26	42
SP- 37	79	28	51
SP- 55	108	31	76
SP- 75	137	35	102
SP-110	181	41	140
SP-150	235	48	187
SP-185	342	62	280
SP-220	366	65	301
SP-260	483	80	403
SP-300	620	98	522
SP-150S	235	48	140

(3) 1-axis servo drive unit

Model	Total heating value (W)	Inside unit (W)	Outside unit (W)
V1- 01	21	21	0
V1- 03	27	27	0
V1- 05	37	37	0
V1- 10	53	53	0
V1- 20	91	25	66
V1- 35	132	30	102
V1- 45	185	37	148
V1- 70	284	50	234
V1- 90	331	56	275
V1-110	465	74	392
V1-150	641	96	545
V1-45S	158	34	124
V1-70S	189	38	151

(4) 2-axis servo drive unit

Model	Total heating value (W)	Inside unit (W)	Outside unit (W)
V2-0101	38	38	0
V2-0301	41	41	0
V2-0303	43	43	0
V2-0501	46	46	0
V2-0503	52	52	0
V2-0505	62	62	0
V2-1005	78	78	0
V2-1010	96	96	0
V2-2010	155	37	117
V2-2020	178	41	137
V2-3510	190	42	148
V2-3520	213	45	168
V2-3535	260	51	209
V2-4520	266	52	214
V2-4535	307	57	249
V2-4545	359	64	295
V2-7035	406	70	336
V2-7045	459	77	382
V2-7070	558	90	468
V2-3510S	190	44	146
V2-3520S	213	48	165
V2-7070S	365	65	300

(Note 1) The heating value for the spindle drive unit is for during continuous rated output and for the servo drive unit is for during the rated output when operating in the high-gain mode.
If the servo drive unit is operated in the standard mode, the heating value will be less than the B Series heating value. However, the new design is not supposed to operate in the standard mode, so the data has been omitted.

(Note 2) The total heating value for the power supply includes the AC reactor heating value.

(Note 3) For the total heating value for the unit, add the heating value for the corresponding unit above that is mounted on the actual machine.

Example) When mounted unit is CV-185, SP-110, V1-35, V2-2020
Total unit heating value (W) = 195 + 181 + 132 + 178 = 686 (W)

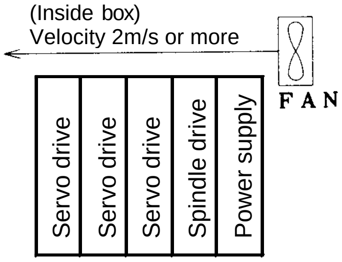
(Note 4) When designing the box for the fully closed installation, consider the actual load ratio as the heating value inside the servo drive unit, and use the following equation.

Heating value inside servo drive unit (considering load ratio) = heating value inside unit obtained with the above table × 0.5

(However, this excludes the power supply unit and spindle drive unit.)
If it is clear that the load ratio is larger than 0.5, substitute that load ratio for "× 0.5" in the above equation.

Example If the mounted servo drive unit is V1-35:
Heating value inside unit (during rated output)
= 30 (W)
Thus,
Heating value inside unit (considering load ratio)
= 30 × 0.5 = 15 (W)

(Note 5) Due to the structure, heat will tend to accumulate that the top of each unit. Thus, install a fan in the distribution box to mix the heat at the top of each unit.



8. Selection of Capacity

8.1 Selection of the power supply unit capacity

In addition to "selection conditions following the rated capacity (continuous rated capacity)" with the conventional method, select the power supply unit so that "selection conditions under the maximum momentary rated capacity" are simultaneously satisfied.

Conventionally, the power supply unit capacity was selected based on the total rated capacity of the motors connected to the power supply unit.
However, as the machines become faster and the increased torque occur during acceleration/ deceleration following that the acceleration/deceleration time constant become shorter, stricter working conditions have been applied to the acceleration/deceleration for the power supply unit. Thus, selection conditions have been set for the maximum momentary rated capacity to prevent use exceeding the momentary power processing capacity.

8.1.1 Selection with rated capacity (continuous rated capacity)

(Note) In this section, "continuous rated capacity" will be indicated as "rated capacity".

(1) When using 1-axis servomotor

Power supply unit rated capacity > Σ (Spindle motor output) + (Servomotor output)	.... 1)

(2) When using 2 or more axes servomotor

Power supply unit rated capacity > Σ (Spindle motor output) + 0.7 × Σ (Servomotor output)	.... 2)

(Note 1) Σ (Spindle motor output) is the total of the spindle motor's short time rated output (kW).
Σ (Servomotor output) is the total of the servomotor rated output (kW).
Note that, <u>the motor output and drive unit capacity will not always match (for example, servo drive unit for servomotor HC203=2kW is V1-35=3.5kW). Thus, substitute the motor rated output instead of the drive unit capacity in the "Spindle motor output" and "Servomotor output" items in equations 1) and 2) above</u>.

- In some cases, the spindle motor is used with different output for acceleration/deceleration and constant operation. In this case, substitute the larger output in the "Spindle motor output" item.
- When using in conditions limiting the spindle motor output, substitute the output obtained by multiplying the limit rate in the "Spindle motor output" item.

(Note 2) The power supply unit capacity is selected the minimum line up capacity that establishes equations 1) and 2).

Example 1) If the value obtained on the right side of equations 1) and 2) is 10kW, the power supply unit capacity will be 11kW (CV/CVE-110).

Example 2) If the value obtained on the right side of equations 1) and 2) is 23kW, the power supply unit capacity will be 26kW (CV/CVE-260).

(Note 3) If the value obtained on the right sides of equations 1) and 2) is suppressed to less than 0.5kW more than line up CVE unit capacity, the excessive amount can be ignored when selecting the CVE unit capacity.
For capacities exceeding 22kW, if the excessive amount is 1kW or less, the amount can be ignored when selecting the CVE unit capacity.

Example 1) If the value obtained on the right sides of equations 1) and 2) is 15.5kW, the power supply unit capacity will be 15kW.
Example 2) If the value obtained on the right sides of equations 1) and 2) is 15.6kW, the power supply unit capacity will be 18.5kW.
Example 3) If the value obtained on the right sides of equations 1) and 2) is 22.9kW, the power supply unit capacity will be 22kW.
Example 4) If the value obtained on the right sides of equations 1) and 2) is 23.1kW, the power supply unit capacity will be 26kW.

(Note 4) If the value obtained on the right sides of equations 1) and 2) is larger than 38kW, there is no corresponding power supply unit. Thus,

(1) When Σ (Spindle motor output) < 38kW

Power supply unit (No. 1) rated capacity > Σ (Spindle motor output)

Power supply unit (No. 2) rated capacity > k × Σ (Servomotor output)

∗ However, select a power supply unit so that coefficient k is k=1 when the servomotor has one axis, and k=0.7 when the servomotor has two or more axes.

(2) When Σ (Spindle motor output) > 38kW

Power supply unit (No.1) rated capacity > Σ (Spindle motor output 1)

∗ Where, Σ (Spindle motor output 1) is the total of the spindle motor output that is 38kW or less.

Power supply unit (No. 2) rated capacity > Σ (Spindle motor output 2) + K × Σ (Servomotor output)

∗ Where, Σ (Spindle motor output 2) is the total of the spindle motor output that is not added to the power supply unit (No. 1).

However, select a power supply unit so that coefficient k is k=1 when the servomotor has one axis, and k=0.7 when the servomotor has two or more axes.

(3) If the value obtained on the right sides of equations 1) and 2) is larger than 76kW, three or more power supply units will be required. However, even in this case, the same selection method as (2) is used.

(Note 5) When the servomotor has two or more axes, the value is calculated as k = 0.7. However, if the capacity of the power supply unit determined by the calculation is smaller than the largest output of the servomotor being used, select a power supply unit that is the same rated capacity as the largest servomotor output.

(Example 1) When using the power supply unit with two servomotors (servomotor output = 9.0kW and servomotor output = 1.0kW), if the equation 2) is used for calculation, the power supply unit only needs rated capacity of 7kW or more (CV/CVE-75 or above). However, in this case, a power supply unit with a rated capacity of 9.0kW or more is required.

8.1.2 Selection with maximum momentary rated capacity

Select the capacity so that the total value of the two outputs "total sum of maximum momentary output during spindle motor acceleration" and "total sum of maximum momentary output during acceleration of servomotor that is accelerating and decelerating simultaneously" is not more than the maximum momentary rated capacity of the power supply unit.

Maximum momentary rated capacity of power supply unit $\geq \Sigma$ (Maximum momentary output of spindle motor) $+ \Sigma$ (Maximum momentary output of servomotor accelerating/decelerating simultaneously)

If the total value of the right side exceeds 75kW, divide the capacity in two power supply units.

Maximum momentary output of spindle motor

Maximum momentary output of spindle motor = Spindle motor acceleration/deceleration output × 1.2

Spindle motor acceleration/deceleration output means the maximum output (kW) specified in the acceleration/deceleration output characteristics, or the maximum output (kW) of the short-time rated output specified at a time of 30 minutes or less.
If there are no specifications other than the 30-minute rated output, the 30-minute rated output will be the spindle motor acceleration/deceleration output.

8.1.3 Selection data

Servomotor rated output, maximum momentary output

Motor	HC52	HC102	HC152	HC202	HC352	HC452	HC702	HC902
Servo drive unit	B-V1-05 C1-V1-05	B-V1-10 C1-V1-10	B-V1-20 C1-V1-20	B-V1-20 C1-V1-20	B-V1-35 C1-V1-35	B-V1-45 C1-V1-45	B-V1-70 C1-V1-70	B-V1-90 C1-V1-90
Rated output (kW)	0.5	1.0	1.5	2.0	3.5	4.5	7.0	9.0
Maximum momentary output (kW)	1.5	2.7	4.5	5.3	7.4	10.6	15	19.5

Motor	HC53	HC103	HC153	HC203	HC353	HC453	HC703
Servo drive unit	B-V1-05 C1-V1-05	B-V1-10 C1-V1-10	B-V1-20 C1-V1-20	B-V1-35 C1-V1-35	B-V1-45 C1-V1-45	B-V1-70 C1-V1-70	B-V1-90 C1-V1-90
Rated output (kW)	0.5	1.0	1.5	2.0	3.5	4.5	7.0
Maximum momentary output (kW)	1.6	3.2	5.4	7.6	10.6	13.7	20.1

(Note 1) The maximum momentary output in this table is reference data for selecting the power supply unit and does not guarantee the maximum output.

Power supply unit rated capacity, maximum momentary rated capacity

B-CVE- C1-CV-	37	55	75	110	150	185	220	260	300	370
Rated capacity (kW)	3.7	5.5	7.5	11	15	18.5	22	26	30	37
Maximum momentary rated capacity (kW)	14	19	21	28	41	42	53	54	55	75

8.1.4 Selection example

(Example 1) Spindle motor : 30-minute rated output 22kW × 1 unit
Servomotor : HC352 (V1-35) × 3 units
.... The three units are simultaneously accelerated/decelerated.

(1) Selection with rated capacity

22kW + 0.7 × (3.5kW × 3) = 29.35kW
→ Rated capacity 30kW:

- MDS-B-CVE-300 or more is required.
- MDS-C1-CV-300 or more is required.

(2) Selection with maximum momentary rated capacity

22kW × 1.2 + 7.4kW × 3 = 48.6kW
→ Maximum momentary rated capacity 53kW:

- MDS-B-CVE-220 or more is required.
- MDS-C1-CV-220 or more is required.

Power supply units that satisfy conditions (1) and (2):

- Select MDS-B-CVE-300.
- Select MDS-C1-CV-300.

(Example 2) Spindle motor : 30-minute rated output 22kW × 1 unit
Servomotor : HC353 (V1-45) × 1 units
HC453 (V1-70) × 2 units
.... The three units are simultaneously accelerated/decelerated.

(1) Selection with rated capacity

22kW + 0.7 × (3.5kW + 4.5kW × 2) = 30.75kW
→ Rated capacity 30kW:

- MDS-B-CVE-300 or more is required.
- MDS-C1-CV-300 or more is required.

(2) Selection with maximum momentary rated capacity

22kW × 1.2 + 10.6kW + 13.7kW × 2 = 64.4kW
→ Maximum momentary rated capacity 75kW:

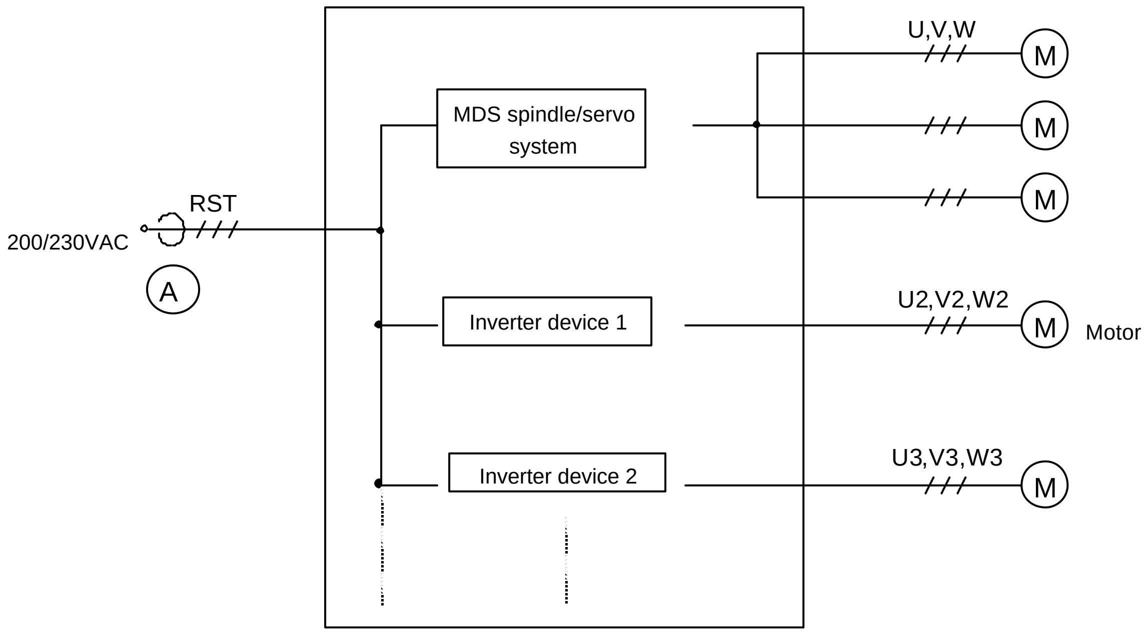
- MDS-B-CVE-370 or more is required.
- MDS-C1-CV-370 or more is required.

Power supply units that satisfy conditions (1) and (2):

- Select MDS-B-CVE-370.
- Select MDS-C1-CV-370.

8.2 Selection of leakage breaker

As a PWM-controlled higher harmonic chopper current flows into the AC servo/spindle, the leakage current is higher than a motor operated with commercial power. When installing a leakage breaker as indicated below, make sure to ground both the drive unit and motor.



Machine power distribution box

The commercial frequency element of the leakage current in the MELDAS MDS Series spindle/servo system is approx. 6mA per spindle and approx. 1mA per servo axis. However, when selecting the leakage breaker, calculate this as max. 15mA per spindle and max. 2mA per servo axis in consideration of the motor power cable length, distance from grounding and motor size, etc.
If other inverter devices are connected on the same power line, consider the leakage current for these devices when selecting the leakage breaker, and install these at the section shown with A above.
Note that a leakage breaker (inverter compatible) that removes the higher harmonic elements with a filter and detects only the leakage current in the commercial frequency range (approx. 50 to 60Hz) must be selected.
Incorrect operations may take place if a breaker that is too sensitive to the higher harmonic elements is used.

(Note) For the MDS Series, there is one spindle and three servo axes. Select a leakage breaker so that when the total leakage current of the devices on the same power line is 7mA, the following calculation value is within the rated non-operational sensitive current:
15mA + 2mA × 3 + 7mA = 28mA

When using a leakage tester to check faults such as malfunctioning of the leakage breaker, select a tester that is not easily affected by the higher harmonics, and set the measurement range to 50 to 60Hz.

Example) SOUKOU Electric LC-30F

(Note) For safety purposes, always ground the machine with Class C grounding (previously, Class 3).

8.3 Noise filter

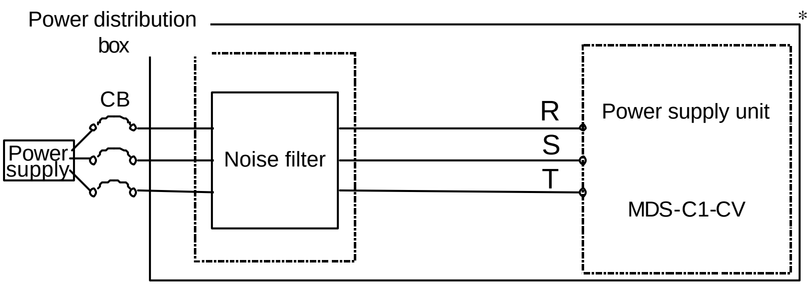
(1) Selection

If the radio noise needs to be reduced, select a noise filter from the following table to match the power supply unit model.

MDS-C1-CV	Noise filter model (Tohoku Kinzoku)
37	LF-330
55	LF-340
75	LF-350
110	LF-360
150, 185	LF-380K
220, 260, 300, 370	Two LF-380K units in parallel

(2) Noise filter installation position

Insert the noise filter at the unit input.



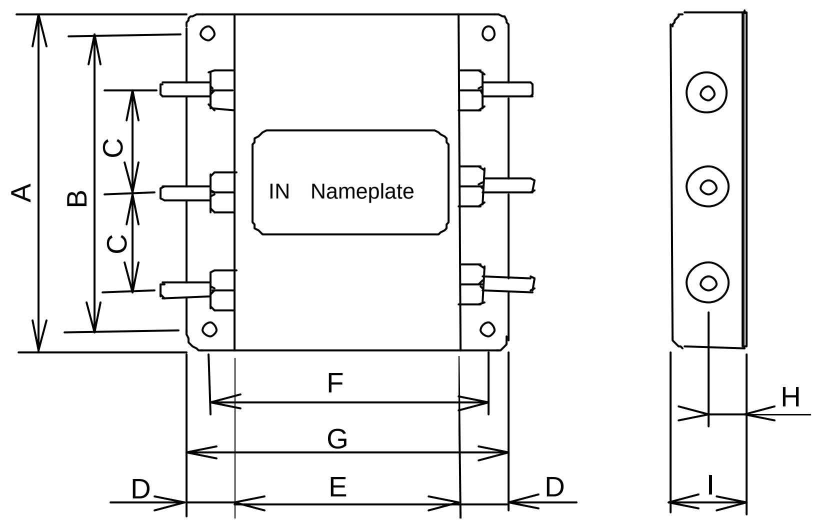
* If the power supply unit has a transformer, connect the filter to the transformer input.

(3) Specifications

Part name	Rated voltage AC DC (V)	Rated current AC DC (V)	Test voltage VAC between case terminals for 1 minute	Insulation resistance (MW) 500VDC	Leakage current (mA) 250V 60Hz	Working temperature Ambient (°C)
330	200V	30A	1500	>300	<1	-20 to +55
340	200V	40A	1500	>300	<1	-20 to +45
350	200V	50A	1500	>300	<1	-20 to +45
360	200V	60A	1500	>300	<1	-20 to +45
380K	200V	80A	2000	>300	<5	-25 to +55

(4) Filter dimensions

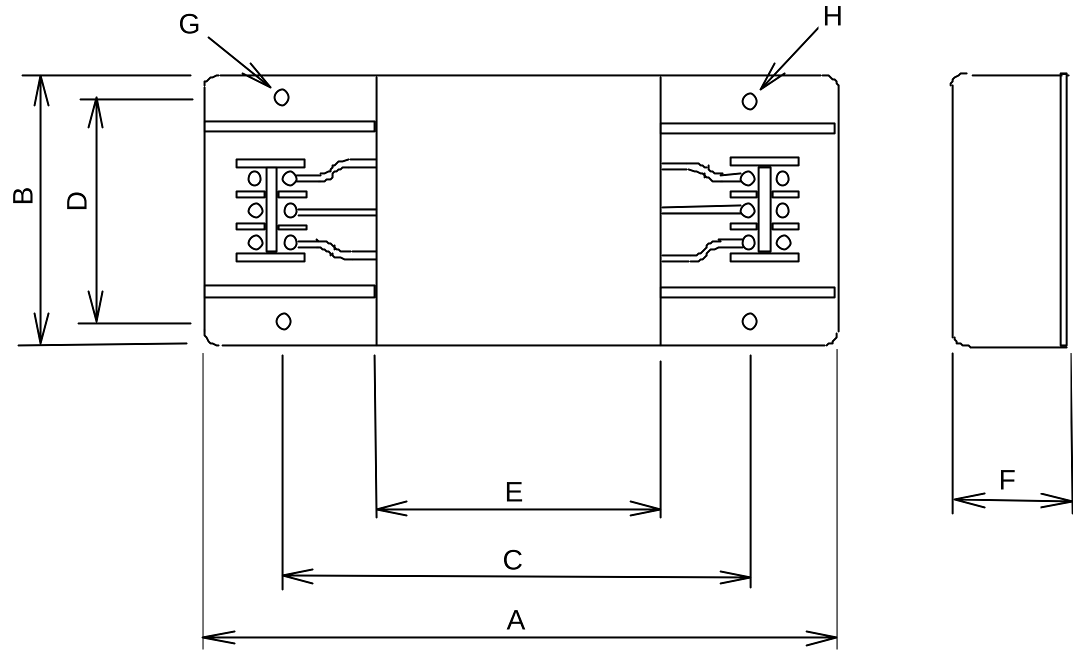
LF-300 Series



(mm)

Model	A	B	C	D	E	F	G	H	I
LF-330	180	170	60	20	120	135	150	35	65
LF-340	180	160	60	30	200	220	240	40	80
LF-350	180	160	60	30	200	220	240	40	80
LF-360	200	180	60	30	300	320	340	50	100

LF-K Series



Model	Terminal plate	A	B	C	D	E	F	G	H	I	J
LF-380K	TE-K22 M6	670	400	560	380	500	170	9×6.5ø	6.5ø	00	00

8.4 Selection of power supply capacity

The actually required power supply capacity is calculated with the following equation based on this power supply capacity reference values.

$$\text{Power supply capacity (kVA)} = \frac{\text{Right side value (kW) obtained in equations 1) and 2) in section 8.1.1}}{\text{Power supply unit capacity (kW) selected from section 8.1.1}} \times \text{Power supply capacity reference value (kVA)} \quad \text{........ 3)}$$

When using multiple power supply units, the total of the power supply capacity for each power supply unit obtained in equation 3) will be the total power supply capacity.

Example) When the value obtained on the right sides of equations 1) and 2) in section 8.1.1 is 13.5kW, the CV-150 power supply unit will be selected, so the power supply capacity reference value (kVA) will be 23. Thus, from equation 3), the power supply capacity (kVA) will be (13.5/15) × 23 = 20.7 (kVA).

The power supply capacity reference values for the power supply unit selected in section 8.1.1 are as follow:

Power regeneration type power supply unit	**C1-CV-37**	**C1-CV-55**	**C1-CV-75**	**C1-CV-110**	**C1-CV-150**	**C1-CV-185**
Power supply capacity reference values (KVA)	7	9	12	17	23	28

Power regeneration type power supply unit	**C1-CV-220**	**C1-CV-260**	**C1-CV-300**	**C1-CV-370**
Power supply capacity reference values (KVA)	33	37	44	54

8.5 Selection of wire size

(1) Recommended power lead-in wire size

Select the wire size based on the power supply unit capacity as shown below regardless of the motor type.

Power supply unit	C1-CV-37	C1-CV-55	C1-CV-75	C1-CV-110	C1-CV-150	C1-CV-185
Recommended power lead-in wire size	IV3.5SQ or HIV2SQ	IV3.5SQ or HIV3.5SQ	HIV5.5SQ	IV14SQ or HIV14SQ	IV22SQ or HIV14SQ	IV30SQ or HIV22SQ

Power supply unit	C1-CV-220	C1-CV-260	C1-CV-300	C1-CV-370
Recommended power lead-in wire size	IV38SQ or HIV30SQ	IV50SQ or HIV38SQ	IV60SQ or HIV38SQ	HIV50SQ

(2) Recommended wire size for spindle motor output wire

Select the wire size based on the spindle drive unit capacity as shown below regardless of the motor type.

Spindle drive unit capacity	0.4K	0.75K	1.5K	2.2K	3.7K	5.5K	7.5K
Recommended wire size for spindle motor output wire	IV2SQ or HIV2SQ	IV2SQ or HIV2SQ	IV3.5SQ or HIV2SQ	IV3.5SQ or HIV2SQ	IV3.5SQ or HIV2SQ	IV3.5SQ or HIV2SQ	IV5.5SQ or HIV35SQ

Spindle drive unit capacity	11K	15K	18.5K	22K	26K	30K
Recommended wire size for spindle motor output wire	IV8SQ or HIV5.5SQ	IV14SQ or HIV14SQ	IV22SQ or HIV14SQ	IV30SQ or HIV22SQ	IV38SQ or HIV30SQ	IV60SQ or HIV38SQ

(3) Recommended wire size for servomotor output wire

Select the wire size based on the servo drive unit capacity as shown below regardless of the motor type.

Servo drive unit capacity	0.1K	0.3K	0.5K	1.0K	2.0K	3.5K	4.5K
Recommended wire size for servomotor output wire	IV1.25SQ or HIV1.25SQ	IV1.25SQ or HIV1.25SQ	IV2SQ or HIV2SQ	IV2SQ or HIV2SQ	IV3.5SQ or HIV2SQ	IV5.55SQ or HIV3.5SQ	IV5.5SQ or HIV3.5SQ

Servo drive unit capacity	7.0K	9.0K	11K	15K
Recommended wire size for servomotor output wire	IV8SQ or HIV5.5SQ	IV8SQ or HIV8SQ	IV14SQ or HIV14SQ	IV30SQ or HIV22SQ

(Note) The wire sizes recommended in (1) to (3) above are selected with conditions of an ambient temperature of 30°C and wiring three same tubes.
During actual use, select the wire based on the above reference while considering the ambient temperature, wire material, and wiring state.

(4) Wire size for L11, L21 link bar

Regardless of the power supply unit and drive unit capacity, the wire size must be IV2SQ or more. The wire between CB ⟷ L11 and L21 must also be IV2SQ or more.

(5) Wire size for L+, L– link bar

[Selection method 1]

To unify the L+ and L– link bar size:

To unify the L+ and L– link bar size, use the wire sizes given below or a larger wire size for the L+ and L– link bar connected to the same power supply unit according to the power supply unit capacity.

Power supply unit	C1-CV-37	C1-CV-55	C1-CV-75	C1-CV-110	C1-CV-150
L+ and L- link bar wire size	IV3.5SQ or HIV2SQ	IV3.5SQ or HIV2SQ	IV5.5SQ or HIV3.5SQ	IV14SQ or HIV8SQ	IV14SQ or HIV14SQ

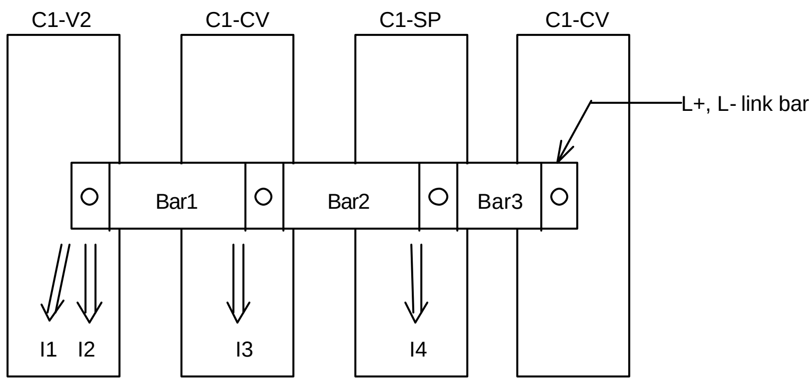
Power supply unit	C1-CV-185	C1-CV-220	C1-CV-260	C1-CV-300	C1-CV-370
L+ and L- link bar wire size	IV22SQ or HIV14SQ	IV22SQ or HIV14SQ	IV38SQ or HIV22SQ	IV60SQ or HIV38SQ	IV60SQ or HIV50SQ

[Selection method 2]

To suppress the L+ and L– link bar size to the minimum required for each unit:

To suppress the L+ and L– link bar size to the minimum required for each unit, select the wire size based on the current value that actually flows to the link bar.

The following drawing shows an example of a spindle and 3-axis servo system. The same selection method is used for other systems.



(a) If the current that flows through the L+, L– bus bars of each drive unit is I1 to I4, the current that flows through each link bar (Bar 1 to Bar 3) will be as follows:

$$\left.\begin{array}{l} I\ (Bar\ 1) = I1 + I2 \\ I\ (Bar\ 2) = I1 + I2 + I3 \\ I\ (Bar\ 3) = I1 + I2 + I3 + I4 \end{array}\right\} \quad .... \quad 4)$$

Thus, the wire for each L+, L– link bar should tolerate the above current as a minimum.

(b) The I1 to I4 values are actually obtained with the following equation:

(I1 to I4) = Motor output current × 1.1	.... 5)

However, the motor output current in equation 5) is obtained with the following.

(i) Spindle motor
Substitute the following according to the spindle drive unit capacity :

Spindle drive unit capacity	0.4K	0.75K	1.5K	2.2K	3.7K	55K	7.5K	11K	15K	18.5K	22K	26K	30K
Motor output current (A)	4	6	10	17	25	30	40	60	74	94	103	127	165

(ii) Servomotor
Substitute the following according to the servomotor model:

Motor model	HC52	HC102	HC152	HC202	HC352	HC452	HC702	HC902
Motor output current (A)	3.94	7.4	11.1	15.4	22.9	40.4	46.2	55.9

Motor model	HC53	HC103	HC153	HC203	HC353	HC453	HC703
Motor output current (A)	5.8	9.8	15.9	22.4	33.3	57.3	69.2

Motor model	HA053 HA13	HA23	HA33	HA40	HA43	HA80	HA83	HA100	HA103	HA200	HA203	HA300	HA303
Motor output current (A)	1.4	3.0	3.0	3.6	5.0	6.6	8.8	14.0	19.6	22.0	34.5	37.0	55

Motor model	HA700	HA703	HA900	HA50L	HA100L	HA150L	HA200L	HA300L	HA500L	HA-LH 11K2	HA-LH 15K2
Motor output current (A)	49.0	68	56.0	4.0	8.0	11.5	18.2	25.0	44.0	84.0	100.0

(c) Based on the I1 to I4 values obtained with equation 5), obtain I (Bar 1) to I (Bar 3) values with equation 4). Match the obtained value with the values given below, and select the IV wire size.

Wire size	Tolerable current (A)	
	IV wire (60°C)	HIV wire (75°C)
2SQ	27	33
3.5SQ	37	45
5.5SQ	49	60
8SQ	61	74
14SQ	88	107
22SQ	115	140
38SQ	162	198
60SQ	217	265

(Ambient temperature 30°C or less)

(d) A selection example is shown below.

Drive unit	Motor	Motor output current
C1-SP-75	SJ-7.5A	Substitute 40A
C1-V1-20	HA100	Substitute 14A
C1-V2-1010	HA80 × 2	Substitute 6.6A × 2

∗ The power supply unit capacity is as follows according to equation 2) in section 8.1.1:
Power supply unit capacity >
7.5+0.7 × (2+1+1) = 10.3 → 11 (kW).
Thus, select CV-110.

For the above drive system, the following applies:

$$\begin{cases} I1 = 6.6A \times 1.1 = 7.3A \\ I2 = 6.6A \times 1.1 = 7.3A \\ I3 = 14A \times 1.1 = 15.4A \\ I4 = 40A \times 1.1 = 44.0A \end{cases}$$

Thus,

$$\begin{cases} I\,(Bar1) = I1 + I2 = 14.6A \\ I\,(Bar2) = I1 + I2 + I3 = 30.0A \\ I\,(Bar3) = I1 + I2 + I3 + I4 = 74.0A \end{cases}$$

Therefore, the following is selected according to the table in (c):

Bar1 .... IV2SQ
Bar2 .... IV3.5SQ
Bar3 .... IV14SQ

(6) Drive unit connection screw size

The screw size for each unit is as follows.

	Power supply unit				Spindle drive unit				Servo drive unit							
									1-axis				2-axis			
Capacity (Model)	To 75	110	150 to 185	220 to 370	To 37	55 to 110 150S	150 to 185	220 to 300	To 35 45S	45 70S	70 to 90	110 to 150	To 2020 3510S 3520S	3510 to 4535 7070S	4545 to 7045	7070
Capacity (kW)	To 7.5	11	15 to 18.5	22 to 37	To 3.7	5.5 to 15	15 to 18.5	22 to 30	To 4.5	4.5 7	7 to 9	11 to 15	To 2+2 To 3.5 +2	To 4.5 +3.5 7+7	To 7 +4.5	7+7
Unit width	60	90	120	150	60	90	120	150	60	90	120	150	60	90	120	150
L1, L2, L3, ⏚	M4	M5	M5	M8	—	—	—	—	—	—	—	—	—	—	—	—
U, V, W, ⏚	—	—	—	—	M4	M5	M5	M8	M4 **(Note)**	M5	M5	M8	M4	M4	M4	M4
L+, L-	M6	M6	M6	M6	M6	M6	M6	M6	M6	M6	M6	M6	M6	M6	M6	M6
L11, L21	M4	M4	M4	M4	M4	M4	M4	M4	M4	M4	M4	M4	M4	M4	M4	M4
MC1	M4	M4	M4	M4	—	—	—	—	—	—	—	—	—	—	—	—

(Note) M5 screws, the same as V1-45 are used for U, V, W terminal screw sizes of the V1-45S. (Note that the ⏚ screw is M4.)

(7) Select the wire size as follows for EC Directives compliance. (The sizes are all mm^2 units.)
The wire types are as follows.
PVC : Polyvinyl chloride
EPR : Ethylene polypropylene
SIR : Silicone rubber

(a) MDS-C1-CV (L1, L2, L3, PE)

Unit		37	55	75	110	150	185	220	260	300	370
Wire	PVC	2.5	2.5	4	6	10	16	25	35	50	70
	EPR	1.5	2.5	4	6	10	16	25	35	35	50
	SIR	1.0	1.5	2.5	4	6	10	16	16	25	25
Terminal screw size		M4			M5			M8			

(b) MDS-C1-SP (U, V, W, PE)

Unit		04	075	15	22	37	55	75	110	150	185	220	260	300
Wire	PVC	1.0	1.0	1.0	1.0	1.5	2.5	4	6	10	16	25	35	70
	EPR	1.0	1.0	1.0	1.0	1.5	2.5	4	6	10	16	25	35	50
	SIR	1.0	1.0	1.0	1.0	1.0	1.0	2.5	4	6	10	10	16	25
Terminal screw size		M4					M5					M8		

(c) MDS-C1-V1, V2 (U, V, W, PE)

Unit		01	03	05	10	20	35	45	70	90	110	150
Wire	PVC	1.0	1.0	1.0	1.0	1.5	2.5	4	6	10	25	35
	EPR	1.0	1.0	1.0	1.0	1.0	1.5	4	6	10	16	25
	SIR	1.0	1.0	1.0	1.0	1.0	1.0	2.5	2.5	4	10	16
Terminal screw size		M4							M5		M8	

(d) Wire size for L11 and L21 link bar
Regardless of the power supply unit, spindle drive unit and servo drive unit capacity, the wire size must be $1.5mm^2$ or more. (This also applies to the wire between CB-L11 and L21.)

(e) Wire size for L+ and L– link bar (for size unification)

Unit		C1-CV-37	C1-CV-55	C1-CV-75	C1-CV-110	C1-CV-150	C1-CV-185	C1-CV-220	C1-CV-260	C1-CV-300	C1-CV-370
Wire	PVC	2.5	2.5	6	10	16	25	35	50	70	–
	EPR	1.5	2.5	4	10	16	25	35	35	70	70
	SIR	1.0	1.5	2.5	4	10	10	16	25	35	35
Terminal screw size		M6									

∗ The above wire sizes follow EN60204 under the following conditions.
- Ambient temperature: 40°C
- Wire installed on wall or open cable tray

When using under other conditions, refer to table 5 of EN60204 and Appendix C.

8.6 Selection of AC reactor, contactor and CB

(a) Select the AC reactor, contactor and CB from the following table when using only one power supply unit.

<table>
<tr><th>Power supply unit capacity</th><th>To 7.5kW</th><th>11kW</th><th>15 to 18.5kW</th><th>22 to 30kW</th><th>37kW</th></tr>
<tr><td>AC reactor (ordered part)</td><td>B-AL-7.5K
(Mitsubishi Electric)
* Refer to section "6. Outline Drawing" for the dimensions.</td><td>B-AL-11K</td><td>B-AL-18.5K</td><td>B-AL-30K</td><td>B-AL-37K</td></tr>
<tr><td>Recommended contactor (non-ordered part)</td><td>SN25-AC200V
(Mitsubishi Electric)
* Refer to section "6. Outline Drawing" for the dimensions.</td><td>SN35-AC200V</td><td>SN50-AC200V</td><td>SN80-AC200V</td><td>SN150-AC200V</td></tr>
<tr><td>Recommended CB1 (non-ordered part)</td><td>NF50CS3P-40A05
(Mitsubishi Electric)
* Refer to section "6. Outline Drawing" for the dimensions.</td><td>NF50CS3P-50A05</td><td>NF100CS3P-100A05</td><td>NF225CS3P-150A05</td><td>NF225CS3P-175A05</td></tr>
<tr><td>Recommended CB2 (non-ordered part)</td><td colspan="5">A CB or CP (circuit protector) can be used as the breaker for the motor fan.
Select the CB or CP by doubling the motor fan rated current value as a guideline. Contact the CB or CP maker for the recommended wire size.
<table>
<tr><td>Spindle motor frame size</td><td>71</td><td>90</td><td>112</td><td>132</td><td>160</td><td>180</td></tr>
<tr><td>Motor fan rated current</td><td>0.1A</td><td>0.2A</td><td>0.2A</td><td>0.2A</td><td>0.6A</td><td>0.6A</td></tr>
</table>
<table>
<tr><td>Servomotor capacity</td><td>HA-LH11K2</td><td>HA-LH15K2</td></tr>
<tr><td>Motor fan rated current</td><td>0.2A</td><td>0.2A</td></tr>
</table>
* A rush current that is approximately double the above rated current will flow when the fan is started.</td></tr>
</table>

(Note 1) The following applies to the above table:
- Ordered parts refer to parts ordered by the user and shipped from Mitsubishi.
- Non-ordered parts refer to parts not ordered, but arranged by the user.

(Note 2) Use the EN/IEC Standards compliant parts for the contactor and CB to comply with the EC Directives.

CAUTION

When the breaker is shared for multiple power supply units, if a short-circuit fault occurs in the unit with the smallest capacity, the breaker may not function. This is dangerous, so do not share the breaker.

(b) Select the batch contactor as follows when using two or more power supply units.

Contactor

Total input current (A) = CV (No.1) input current (A) + CV (No.2) input current (A).

Substitute the following for the above equation of right side and obtain the total input current (A):

Power supply unit	C1-CV-37	C1-CV-55	C1-CV-75	C1-CV-110	C1-CV-150
Input current (A)	20	30	40	50	70

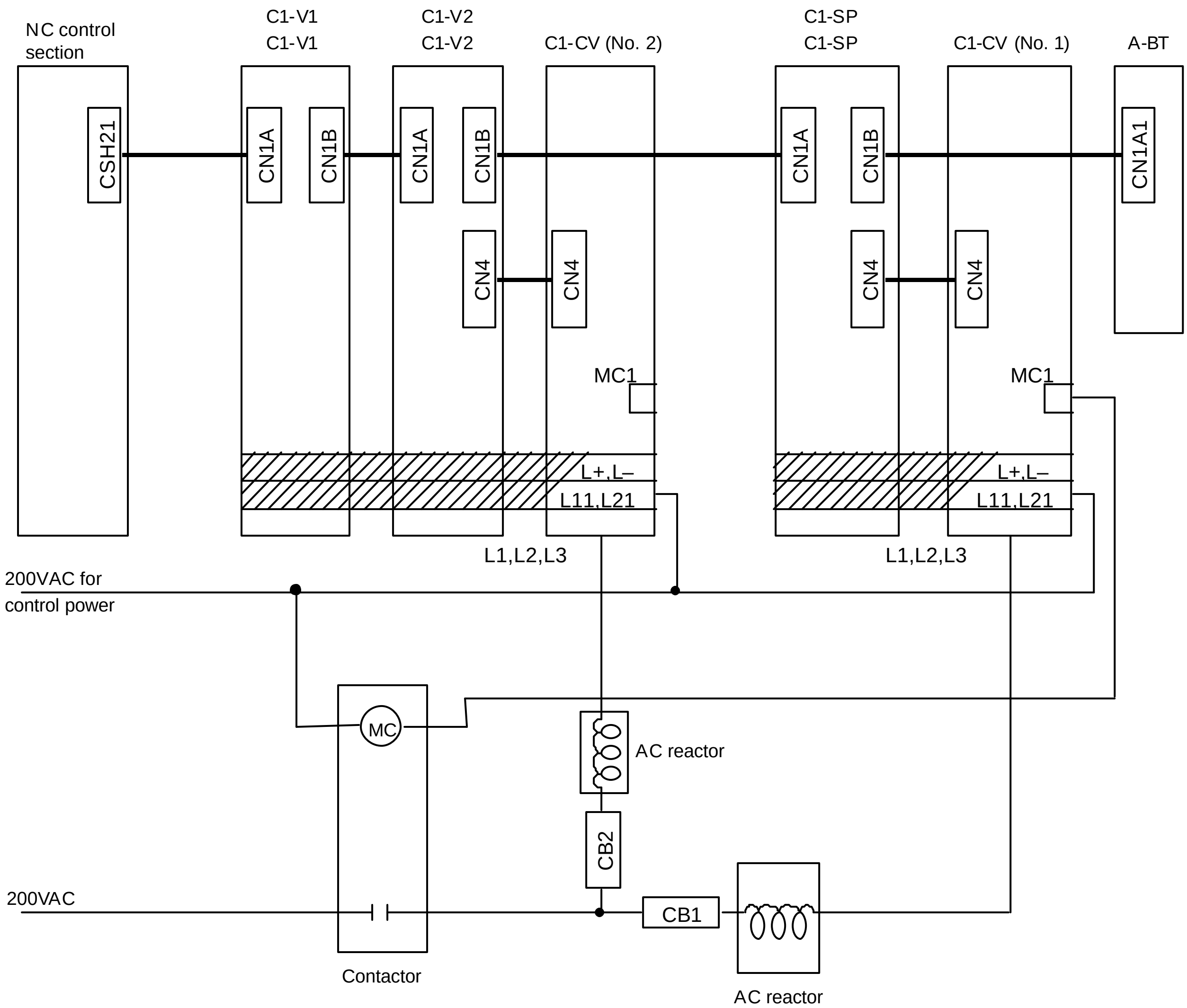
Power supply unit	C1-CV-185	C1-CV-220	C1-CV-260	C1-CV-300	C1-CV-370
Input current (A)	80	100	120	135	160

Substitute the total input current (A) value in the following:

Contactor .... Rated conductivity current (A) in recommended contactor table

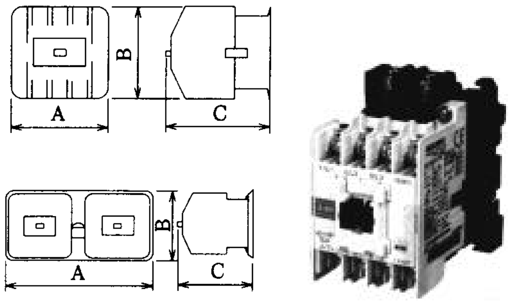
Select the contactor having a rated current larger than the total input current.

(c) The AC reactor and CB cannot be shared between two and more power supply units. Always use one AC reactor or CB for each power supply unit.



[Reference for contactor selection]

Mitsubishi Electric contactor



S-N11 type

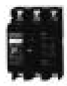
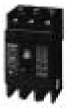
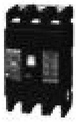
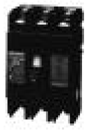
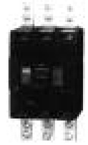
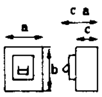
AC operation AC electromagnetic contactor

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	–	100	124	127
	S-N95	100	93	150	2a2b	–	100	124	127
	S-N125	125	120	150	2a2b	–	100	150	136
	S-N150	150	150	200	2a2b	–	120	160	145
	S-N180	180	180	260	2a2b	–	138	204	174
	S-N220	220	220	260	2a2b	–	138	204	174
	S-N300	300	300	350	2a2b	–	163	243	195
	S-N400	400	400	450	2a2b	–	163	243	195
	S-N600	630	630	660	2a2b	–	290	310	234
	S-N800	800	800	800	2a2b	–	290	310	234

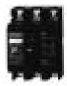
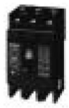
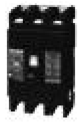
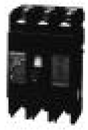
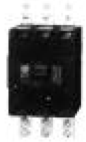
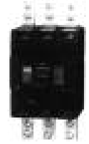
(Note 1) Noise is generated when the contactor turns ON to OFF, so use of a type with built-in surge absorber is recommended.

[Reference for CB selection]

- CB made by Mitsubishi Electric

Frame A				30		50		60		100		225		400		600		800
Model				NF-30CS		NF50-CP		NF60-CP		NF100-CP		NF225-CP		NF400-CS		NF600-CS		NF800-CS
Appearance																		
Rated current (A) **Reference ambient temp. 40° C** **(IEC: 30°C For ships: 45°C)**				3 5 10 15 20 30		(3) (5) 10 15 20 30 40 50		(10) (15) (20) (30) (40) (50) 60 (Note 1)		(50) 60 75 100		(Note 2) (100) 125 150 175 200 225		250 300 350 400		500 600		Adjustable 600 700 800
No. of poles				2	3	2	3	2	3	2	3	2	3	2	3	2	3	3
Rated insulation voltage V			**AC**	500		600		600		600		600		600		600		600
			DC	–		250 (Note 3)	–	250 (Note 3)	–	250 (Note 3)	–	250 (Note 4)	–	250 (Note 4)	–	250 (Note 4)	–	–
Rated shut-off capacity (kA)	**JIS C8370**	**AC**	**550V**	–		1.5		1.5		7.5		10		15		18		18
			460V	1.5		2.5		2.5		10		15		25		35		35
			220V	2.5		5		5		25		30		35		50		50
		DC	**250V**	–		2.5	–	2.5	–	7.5	–	10	–	20	–	20	–	–
	IEC 947-2 (Icu/Ics)	**AC**	**690V**	–		–		–		–		–		–		–		–
			500V	–		2.5/1		2.5/1		7.5/4		10/5		15 (Note 5)		18 (Note 5)		18 (Note 5)
			440V	1.5/1.5 (415V)		2.5/1		2.5/1		10/5		15/8		25 (415V) (Note 5)		35 (415V) (Note 5)		35 (415V) (Note 5)
			400V	1.5/1.5 (380V)		5/2		5/2		10/5		18/9		25 (380V) (Note 5)		35 (380V) (Note 5)		35 (380V) (Note 5)
			230V	2.5/2 (240V)		5/2		5/2		25/13		30/15		35 (240V) (Note 5)		50 (240V) (Note 5)		50 (240V) (Note 5)
		DC	**250V**	–		2.5/1	–	2.5/1	–	7.5/4	–	10/5	–	20 (Note 5)	–	20 (Note 5)	–	–
	NK	**AC**	**500V**	1.5 (460V)		2.5		2.5		10		15		25		30		30
			250V	2.5		5		5		25		30		35		50		50
		DC	**250V**	–		2.5	–	2.5	–	7.5	–	10	–	–		–		–
Dimensions (mm)			**a**	45	67.5	50	75	50	75	60	90	105		140		210		210
			b	96		130		130		155		165		257		275		275
			c	52		68		68		68		68		103		103		103
			ca	67		90		90		90		92		132		155		155
Surface type product weight (kg)				0.25	0.35	0.45	0.65	0.45	0.65	0.7	1.0	1.3	1.5	5.0	5.8	8.8	9.5	10.9
Connection method	**Surface type (F)**	**Page**		◉ For crimp terminal		◉ For crimp terminal		◉ For crimp terminal		◉ For crimp terminal		◉ For crimp terminal		◉ With bar terminal		◉ With bar terminal		◉ With bar terminal
	Rear surface type (B)	**100**		Round stud (built-in)		○ Round stud		○ Round stud		○ Bar stud		○ Bar stud		○ Bar stud		○ Bar stud		○ Bar stud
	Inlaid type (FP)			–		○		○		◉		◉		◉		◉		◉
	Insertion type (PM)			–		○		○		○		○		○		○		○
With accessory devices	**Alarm switch (AL)**	**110**		○ (Note 6)		○ (Note 7)		○ (Note 7)		○ (Note 7)		○ (Note 7)		○		○		○
	Auxiliary switch (AX)			○ (Note 6)		○ (Note 7)		○ (Note 7)		○ (Note 7)		○ (Note 7)		○		○		○
	Voltage trip device (SHT)			–		○ (Note 7)		○ (Note 7)		○ (Note 7)		○ (Note 7)		○		○		○
	Undervoltage trip device (UVT)			–		○		○		○		○		○		○		○
	Vertical lead terminal block (SLT)	**122**		○		○		○		○		○		○		○		○
	Horizontal lead terminal block (LT)			○		–		–		–		–		○		○		○
	Pre-alarm module (PAL)	**124**		–		–		–		–		–		–		–		–

Refer to the following page for the optional parts, etc. of Mitsubishi electric CB.

Frame A				30	50		60		100		225	400	600	800
Model				NF-30CS	NF50-CP		NF60-CP		NF100-CP		NF225-CP	NF400-CS	NF600-CS	NF800-CS
Appearance														
Optional parts	**Breaker box (in box)**	**Closed type (S)**	**134**	◉	◉	◉	◉	◉	◉	◉	◉	–	–	–
		Dust-proof type (I)		–	○		○		○		○	△	\	\
		Water-proof type (W)		–	–	\	–	\	–	\	\	\	\	\
	Electric operation device (NFM)		**150**	–	–		–		–	◉ (electric)	◉ (electric)	\ (electric, spring charge) (Note 8)	\ (electric, spring charge) (Note 8)	\ (electric, spring charge) (Note 8)
	Machine connector (MI)	**Panel installation**	**142**	–	◉		◉		◉		◉	◉	◉	◉
		For inlaid type		–	\		\		\		\	\	\	\
		Direct breaker installation		–	–	\	–	\	–	\	\	\	\	\
	Handle lock device	**LC**	**140**	◉	◉		◉		◉		◉	◉	◉	◉
		HL		–	◉		◉		◉		◉	○ (Note 8)	○ (Note 8)	○ (Note 8)
		HL-S		–	○	○	○	○	○	○	○	–	–	–
	Operation handle	**F type**	**126**	–	◉	◉	◉	◉	◉	◉	◉	◉	◉	◉
		S type		–	◉		◉		◉		◉	◉	◉	◉
		SS type		–	◉		◉		◉		◉	◉	◉	◉
	Terminal cover (TC-L, TTC, BTC)		**137**	◉	◉		◉		◉		◉	◉ (TC-L, TTC, BTC)	◉ (TC-L) \ (TTC, BTC)	◉ (TC-L) \ (TTC, BTC)
	Rear surface stud (B-ST)		**102**	–	◉		◉		◉		◉	\ ◉	–	–
	Inlaid installation frame (FP)			–	◉		◉		◉		◉	◉	◉	◉
	Insert terminal block (PM)			–	◉		◉		◉		◉	◉	◉	\
	IEC35mm rail installation adaptor		**149**	◉	◉	◉	◉	◉	◉	◉	–	–	–	–
Reverse connection				–	○		○		○		○	○	○	○
Electrical part type approval (▽ certified)				▽	▽		▽		▽		–	–	–	–
Classification Society approval (☆ certified) (NK,LR,AB,GL)				☆ (NK, LR, AB)	☆							☆	☆	☆
Overcurrent trip method				Fully electromagnetic					Heat – electromagnetic				Heat – adjustable electro-magnetic	Electronic
With trip button				\ (Note 9)	Yes		Yes		Yes		Yes	Yes	Yes	Yes

(Note 1) The 50A or less type has the same structure as NF50-CP.
(Note 2) When the rated voltage is 100A, NK is not displayed. The JIS C8370 220VAC rated breaker capacity is 25kA.
(Note 3) Designate when using for DC. If a 3-pole external part is required, designate Z2P.
(Note 4) Designate when using for DC.
(Note 5) IEC157-1 is displayed. (The breaking capacity value follows P-1 liabilities).
(Note 6) The lead wire horizontal lead-out method is the standard, but a load lead-out type can be manufactured when required. (Only surface type)
(Note 7) This is a cassette type that can be installed by the user. As a standard, this is also compatible with breaker side seating installation,
(Note 8) Order as a set with the breaker unit.
(Note 9) This is enclosed only when the alarm switch (AL) is provided

II. MDS-C1-CV
Power Regeneration Type
Power Supply Section

1. Power Regeneration Type Power Supply

1.1 C1-CV Outline

The unit outline, excluding the fins, is same as the B-CV, so the installation is compatible with the B-CV. However, the positions of the connectors (CN4, 9) and the ground (⏚) differ, so take care when wiring.
The C1-CV does not use a rush relay, so the alarms "65" and "6B" have been deleted.
The precautions related to conform to the European EC Directives, unit installation, applicable cables and connection are same as the B-CV. (Refer to "MDS-B Series Specifications Manual BNP-B3759B" for details.)
With the B-CV, a mechanical contact was used for the external contactor's drive circuit, but with the C1-CV, a semiconductor element has been incorporated to eliminate the contact life. However, to protect the circuit, a leakage current of 15mA or less will flow from the MC1 terminal, so do not use a contactor that can function at a 15mA coil current. If the contactor has an electronic circuit inside, it could malfunction due to the leakage current, so confirm that the contactor will not malfunction before using it.
(Refer to the external contactor listed in "1.4 List of specifications".)
With the C1-CV, the power voltage distortion can be monitored with the L11 and L21 terminals.
To prevent incorrect judgments during regeneration, always wire the L11 and L21 on the AC reactor commercial power supply side and with the power supply for the same system as the L1, L2 and L3 terminals.
An external contactor was always required for the B-CV-370, but the C1-CV-370 can be used without the external contactor. Thus, whether to use the external contactor can be selected.

1.2 Model configuration

MDS-C1-CV Series

MDS-C1-CV-□

Power supply capacity class symbol

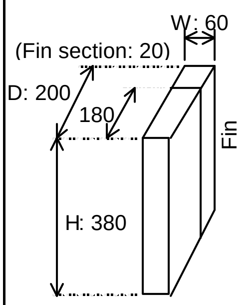
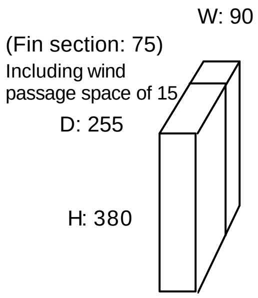
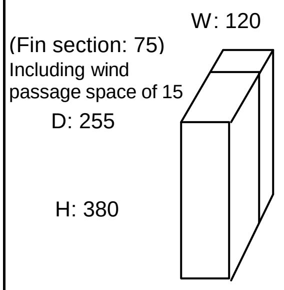
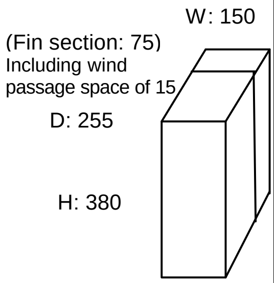
Symbol	Capacity
37	3.7 kW
55	5.5 kW
75	7.5 kW
110	11 kW
150	15 kW
185	18.5 kW
220	22 kW
260	26 kW
300	30 kW
370	37 kW

1.3 List of unit models and outlines

(1) List of units

No.	Model	Capacity (kW)	Weight (kg)	Outline (H* W* D mm)	Outline Type
1	CV-37	3.7	3.5	380* 60* 200	A1
2	CV-55	5.5	4.0	380* 60* 200	
3	CV-75	7.5	4.0	380* 60* 200	
4	CV-110	11	6.0	380* 90* 255	B1
5	CV-150	15	7.0	380* 120* 255	C1
6	CV-185	18.5	7.0	380* 120* 255	
7	CV-220	22	9.0	380* 150* 255	D1
8	CV-260	26	9.0	380* 150* 255	
9	CV-300	30	9.5	380* 150* 255	
10	CV-370	37	9.5	380* 150* 255	

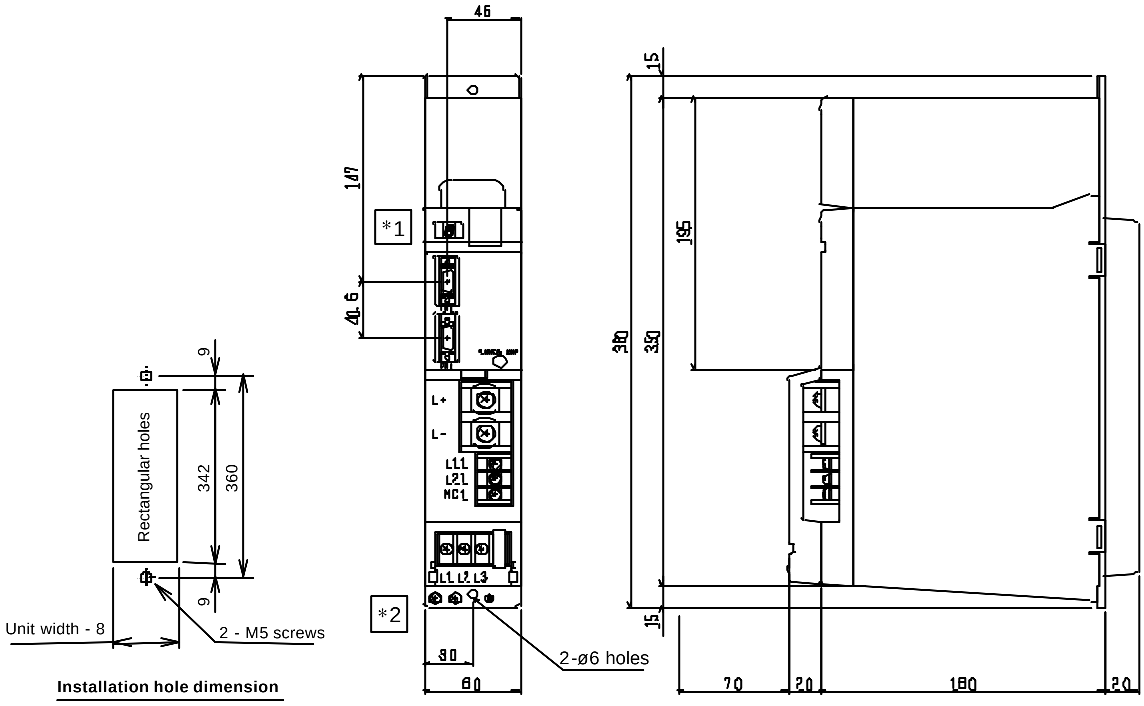
(2) List of unit outline dimensions

Outline type	A1	B1	C1	D1
H∗W∗D mm	380∗60∗200	380∗90∗255	380∗120∗255	380∗150∗255
Outline drawing (mm)				

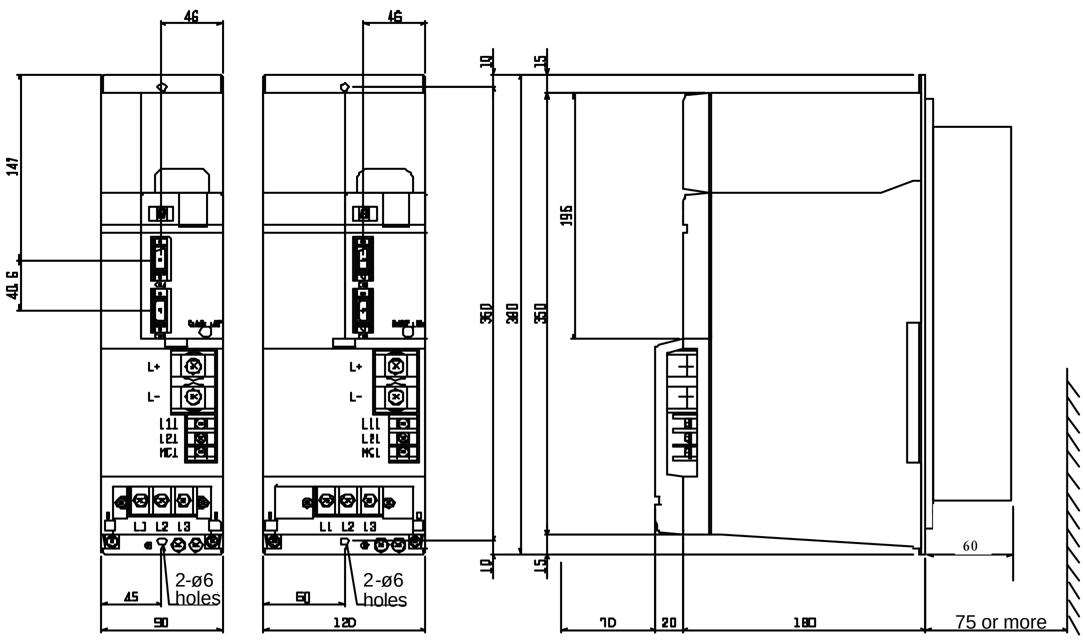
⚠CAUTION	Never hold the case section when holding the unit as the unit could drop or the case could be damaged. When holding the unit, always hold the installation sections (aluminum) at the top and bottom of the unit with both hands. Note that the top and bottom installation sections are made of aluminum, and the edges can be dangerous. Carefully handle the unit and wear protective gloves if necessary.

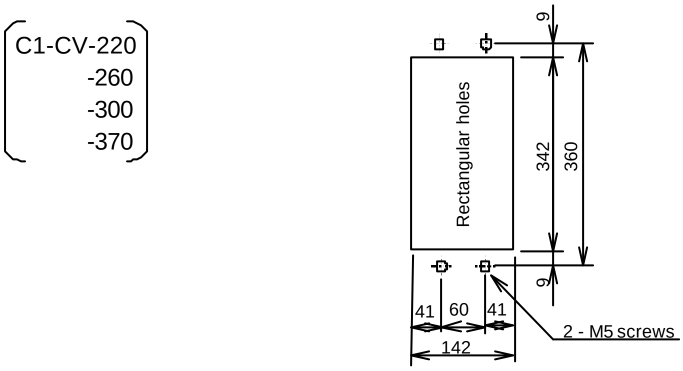
(3) Unit detailed outline dimension drawing

[C1-CV-37
-55
-75]

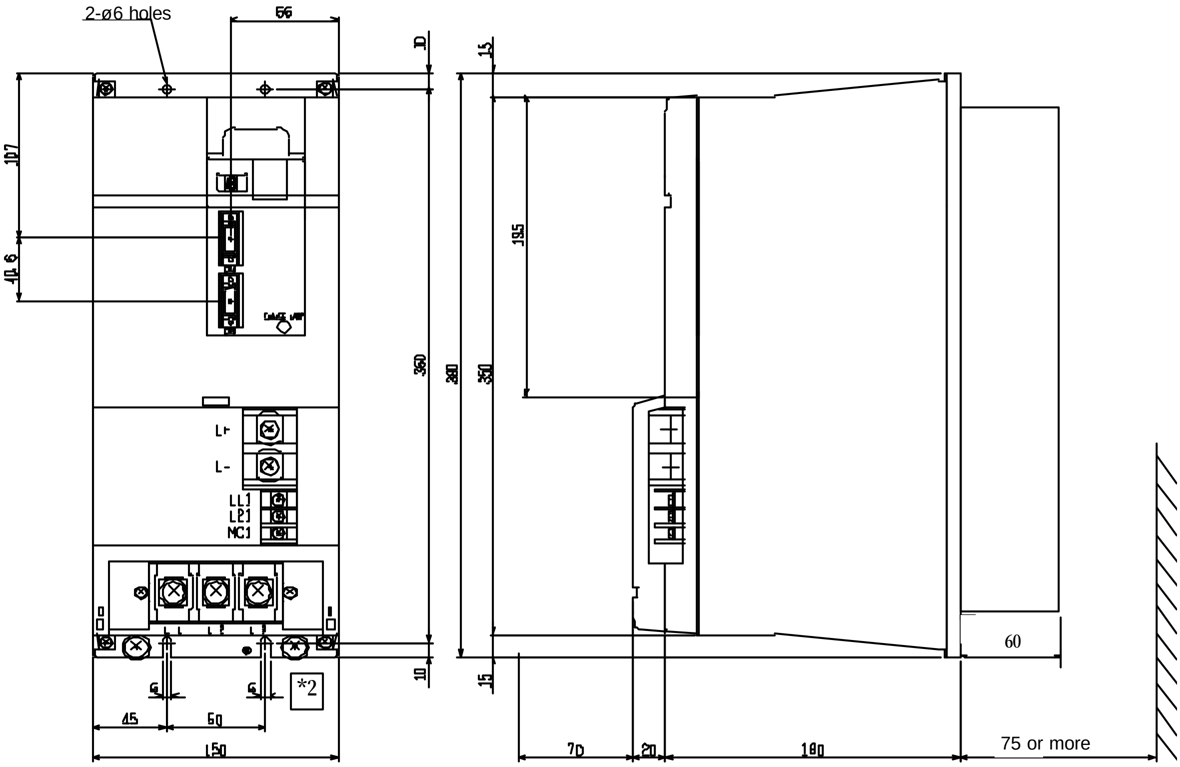


[C1-CV-110]   [C1-CV-150
-185]



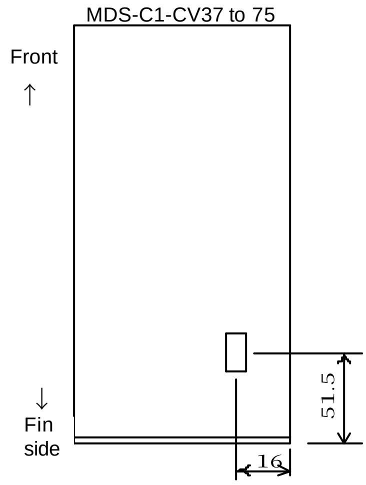


Installation hole dimension

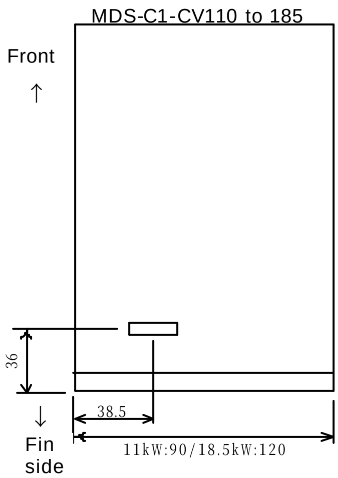


(4) CN23 connector layout drawing
The position of the CN23 connector has been changed as shown below.
These drawings show the view from below the unit. (The cooling fins are not shown.)

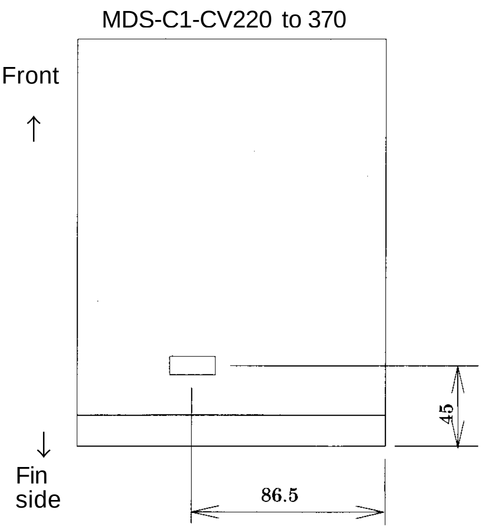
7.5kW or less



11kW to 18.5kW

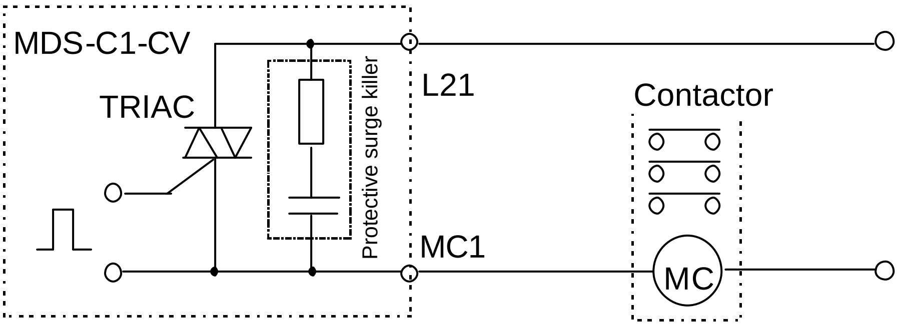


22kW to 37kW



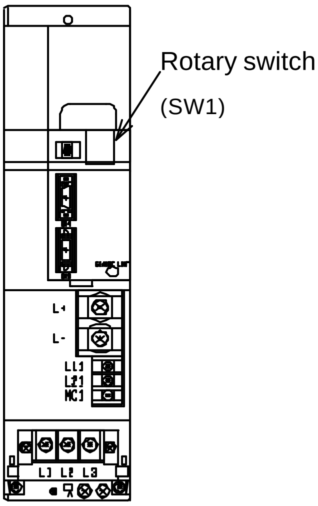
1.4 List of specifications

<table>
<tr><td colspan="2"></td><td colspan="10">Power supply unit MDS-C1-CV Series</td></tr>
<tr><td colspan="2">Model MDS-C1-CV-</td><td>37</td><td>55</td><td>75</td><td>110</td><td>150</td><td>185</td><td>220</td><td>260</td><td>300</td><td>370</td></tr>
<tr><td colspan="2">Rated output [kW]</td><td>3.7</td><td>5.5</td><td>7.5</td><td>11.0</td><td>15.0</td><td>18.5</td><td>22.0</td><td>26.0</td><td>30.0</td><td>37.0</td></tr>
<tr><td rowspan="3">Input</td><td>Rated voltage [V]</td><td colspan="10">200/200-230VAC</td></tr>
<tr><td>Frequency [Hz]</td><td colspan="10">50/60Hz Frequency fluctuation within ±3%</td></tr>
<tr><td>Rated current [A]</td><td>16</td><td>20</td><td>26</td><td>35</td><td>49</td><td>66</td><td>81</td><td>95</td><td>107</td><td>121</td></tr>
<tr><td rowspan="2">Output</td><td>Rated voltage [V]</td><td colspan="10">270-311VDC</td></tr>
<tr><td>Rated current [A]</td><td>17</td><td>20</td><td>30</td><td>41</td><td>58</td><td>76</td><td>95</td><td>115</td><td>144</td><td>164</td></tr>
<tr><td rowspan="3">Control Power supply</td><td>Voltage [V]</td><td colspan="10">200/200-230VAC</td></tr>
<tr><td>Frequenc [Hz]</td><td colspan="10">50/60Hz</td></tr>
<tr><td>Current [A]</td><td colspan="10">Max. 0.2A</td></tr>
<tr><td colspan="2">Main circuit method</td><td colspan="10">Converter with power regeneration circuit (intelligent power module incorporated)</td></tr>
<tr><td colspan="2">Structure</td><td colspan="10">Fully enclosed, self-cooling (protection degree: IP65, IP67)</td></tr>
<tr><td rowspan="5">Environ-ment</td><td>Ambient temperature [°C]</td><td colspan="10">Operation: 0 to 55°C (non freezing), Storage/transportation: –15°C to 70°C (non freezing)</td></tr>
<tr><td>Ambient humidity [%RH]</td><td colspan="10">Operation: 90%RH or less. (non condensing),
Storage/transportation: 90%RH or less. (non condensing)</td></tr>
<tr><td>Atmosphere</td><td colspan="10">Indoors (no direct sunlight): no corrosive gas, inflammable gas, oil mist, or dust</td></tr>
<tr><td>Elevation [m]</td><td colspan="10">Operation/storage: 1000 meters or less above sea level,
Transportation: 10000 meters or less above sea level</td></tr>
<tr><td>Vibration/ Impact [m/s²]</td><td colspan="10">4.9m/s² (0.5G) / 49m/s² (5G)</td></tr>
<tr><td colspan="2">Cooling type</td><td colspan="3">Self-cooling</td><td colspan="7">Forced air cooling</td></tr>
<tr><td colspan="2">Weight [kg]</td><td colspan="3">3.4</td><td>4.6</td><td>5.8</td><td>6.0</td><td>8.3</td><td>8.4</td><td>8.6</td><td>8.8</td></tr>
<tr><td colspan="2">Maximum heating value [W]</td><td>55</td><td>65</td><td>80</td><td>125</td><td>155</td><td>195</td><td>210</td><td>260</td><td>320</td><td>400</td></tr>
<tr><td colspan="2">Noise</td><td colspan="10">Less than 55dB</td></tr>
<tr><td colspan="2">Required devices</td><td colspan="10">An AC reactor is required for each power supply unit.
(Use the AC reactor used with the existing B-CV.)</td></tr>
</table>

External contactor	The unit can be used without the contactor. However, use of the contactor is recommended for safety purposes. With the B-CV-370, a contactor was always required. **Note**: A semiconductor element (TRIAC) is used for the contactor drive circuit, so a leakage current of 15mA or less will flow with its protective surge killer. Do not use a contactor that turns ON at 15mA or less or a contactor that cannot be turned OFF at the leakage current 15mA. When using a contactor with an electronic circuit inside, contact the contactor maker and confirm that it will operate correctly at the 15mA leakage current. Note that there are some contactors that will not turn OFF unless separated from the mechanical contact. The Mitsubishi S-N Series or S-K Series is recommended. Before using a contactor other than the recommended type, confirm the operation in respect to the leakage current. ∗ The internal circuit configuration is shown below. (Reference drawing)  External contactor drive circuit

1.5 Hardware and parameter setting

(1) Hardware settings



Set the rotary switch (SW1) as shown below.

SW1 setting	C1-CV specifications	
0	During operation with contactor (deposits are detected)	External emergency stop
1	During operation with no contactor	When not used
2	Setting prohibited	
3		
4	During operation with contactor (deposits are detected)	External emergency stop
5	During operation with no contactor	When used
6	Setting prohibited	
7		
8		
9		
10		
11		
12		
13		
14		
15		

(2) Parameter settings
The following parameter is set only for the drive unit to which the power supply unit is connected.

[Servo parameters/spindle parameters]
SV036/SP041 PTYP
F E D C B A 9 8 7 6 5 4 3 2 1 0

		ptyp

Note) If SP-370 or above is connected to CV-220 or above, set the PTYP bit8 to "1".
Correct operations will not take place if this is not set.

ptyp Power supply type (Set the model as shown below.)

Power supply unit	PTYP	
	External emergency stop When not used	**External emergency stop When used**
Not connected	00	00
C1-CV-37	04	44
C1-CV-55	06	46
C1-CV-75	08	48
C1-CV-110	11	51
C1-CV-150	15	55
C1-CV-185	19	59
C1-CV-220	22	62
C1-CV-260	26	66
C1-CV-300	30	70
C1-CV-370	37	77

1.6 Status display

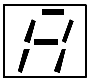
⚠ WARNING
1. Do not touch the switches with wet hands. Failure to observe this could lead to electric shocks.
2. Do not operate the unit with the front cover removed. The high voltage terminals and charged sections will be exposed, and can cause electric shocks.
3. Do not open the front cover while the power is ON or during operation. Failure to observe this could lead to electric shocks.

⚠ CAUTION
1. Check and adjust each program and parameter before starting operation. Failure to do so could lead to unforeseen operation of the machine.
2. Do not touch the fin on the servo drive unit, regenerative resister or servomotor, etc., while the power is turned ON or immediately after turning the power OFF. These parts may reach high temperatures, and can cause burns.

1.6.1 7-segment LED display

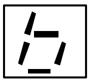
(1) Power ON

↓



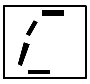
Initializing

↓



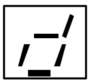
Ready OFF

↓



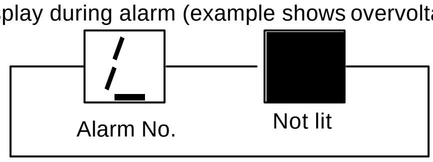
Ready ON, servo OFF

↓



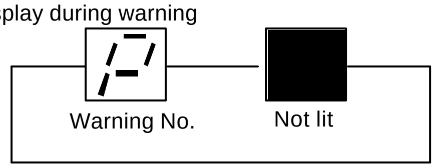
Servo ON

(2) Display during alarm (example shows overvoltage alarm)



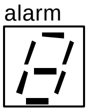
The alarm No. flickers

(3) Display during warning



The warning No. flickers

(4) Watch dog alarm



1.6.2 Charge lamp

This lamp lights when the voltage between L+ and L– is charged over a set level. Always confirm that the charge lamp is not lit, and using a tester, confirm that the voltage has been discharged before starting maintenance work such as replacing the unit.

1.7 List of alarms and warnings

⚠ CAUTION
When an alarm occurs, remove the cause of the alarm, confirm that an operation signal is not being input, and secure the safety. Then reset the alarm to resume operation.

When an alarm occurs in the power supply unit, the servo drive unit will carry out the base interception and the motor will coast to a stop. In such case, turn the power OFF with an external sequence. (Refer to "1.10 Main circuit connection".)
To reset an alarm, remove the cause, and then turn the power ON.

(1) Alarms

[Alarm No.] Alarm No. displayed on drive unit connected with power supply unit
[LED display] LED display on power supply unit
[Release] AR : Release by turning power supply unit on again
PR : Release by turning the NC power supply on again
NR : Release with the NC RESET key

Alarm No.	LED display	Name	Meaning	Release
61 [61]	1	Power module overcurrent	An overcurrent (oc) was detected in the power module (IPM).	PR
62 [62]	2	Frequency error	The input power frequency was not within the specifications range. Specifications: 50Hz ±3% 60Hz ±3%	PR
67 [67]	7	Open phase	One of the input power phases (R,S,T) is open.	PR
68 [68]	8	Watch dog	The power supply software process did not complete within the set time.	AR
69 [69]	9	Ground fault	There is a ground fault in the motor. This is detected only at READY ON.	PR
6A [6A]	A	External contactor melt	The externally installed contactor turned on even during READY OFF.	PR
6C [6C]	C	Main circuit error	The main circuit capacitor charging operation is not normal.	PR
6E [6E]	E	Memory error	An error occurred in the memory circuit.	AR
6F [6F]	F	AD converter error Power supply error	An AD converter error or power supply error was detected.	AR
71 [71]	H	Instantaneous stop External emergency stop	The external contactor turned off even during READY ON. An instantaneous power stop occurred for 55ms or more.	NR
73 [73]	J	Over-regeneration	The regeneration performance limit of the power supply was exceeded.	PR (Note 1)
75 [75]	L	Overvoltage	The voltage between L+ and L– exceeded 410V.	NR (Note 2)
76 [76]	n	External emergency stop setting error	The rotary switch setting and parameter (PTYP) setting do not match.	AR
77 [77]	m	Power module overheat	Overheating of the power module (IPM) was detected.	AR

(Note 1) With alarm "73", to prevent immediately resumption of operation from the over-regeneration state, the alarm cannot be released unless the control power (L11, L12) continuity state has continued for 15 minutes or more after the alarm has occurred. The alarm cannot be released even if the NC power or control power is turned ON immediately after the alarm occurs. If the power is turned ON immediately after the alarm occurred, wait 15 minutes or more in the continuity state, and then turn the power ON again.

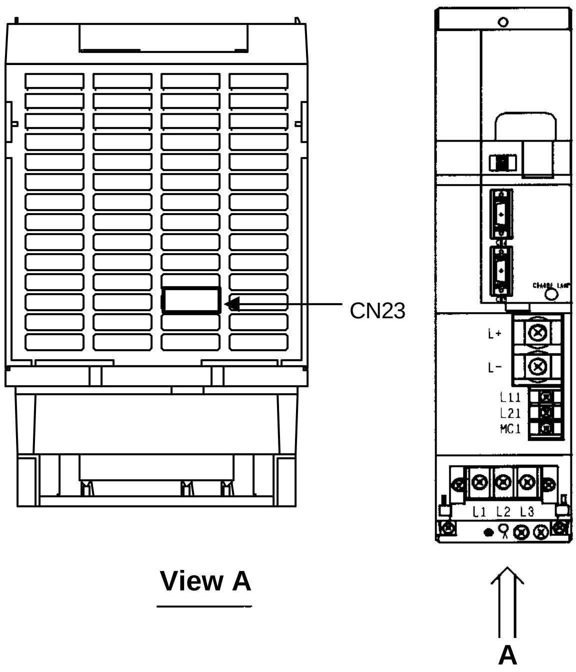
(Note 2) Immediately after alarm "75" occurs, the voltage between L+ and L– will be higher than the power voltage, so if the alarm is reset in this state, another alarm could occur.
Wait at least five minutes before resetting alarm "75".

(2) Warning

Warning No.	LED display	Name	Meaning
E9 [E9]	P [P]	Instantaneous stop warning	An instantaneous power stop occurred for 25ms or more. (As the main circuit voltage has not dropped, an alarm has not occurred.)
EA [EA]	q [q]	External emergency stop input	The external emergency stop input signal was input. (24V is not applied on the CN23 connector.)
EB [Eb]	r [r]	Over-regeneration warning	80% of the over-regeneration alarm level was reached.

1.8 Explanation of connectors and terminal block

		Name	Application	Remarks
Connector		CN4	For connection of servo drive unit and spindle drive unit (CH1)	
		CN9	For connection of servo drive unit and spindle drive unit (CH2)	
		CN23	For connection of the external emergency stop	
Terminal block	TE2	L+	Converter voltage output (+)	
		L–	Converter voltage output (–)	
	TE3	L11 L12	200VAC single phase input	
		MC1	For externally installed contactor relay control	
	TE1	L1 L2 L3	3-phase input power 200/220VAC	
Unit installation base		⏚	Ground	



1.9 Power supply external emergency stop function

(1) Outline

The external emergency stop signal that is input directly to the power supply has been added to the emergency stop signal from the NC bus line, allowing double protection to be provided. Synchronize the external emergency stop signal with the emergency stop signal from the NC.

(2) Details of detection

(a) Setting

When using the external emergency stop, the protection setting must be validated with the rotary switch on the front of the MDS-C1-CV and the parameter (PTYP) of the connected drive unit.

Rotary switch : External contactor valid .... Set to 4

External contactor invalid..... Set to 5

Parameter (PTYP) : Add 0040 to the currently set value.

(Example)

Current	Setting value
0008	0048
0030	0070

Note) If either of the settings are not made, an "external emergency stop setting error" will occur.

(b) Detection details

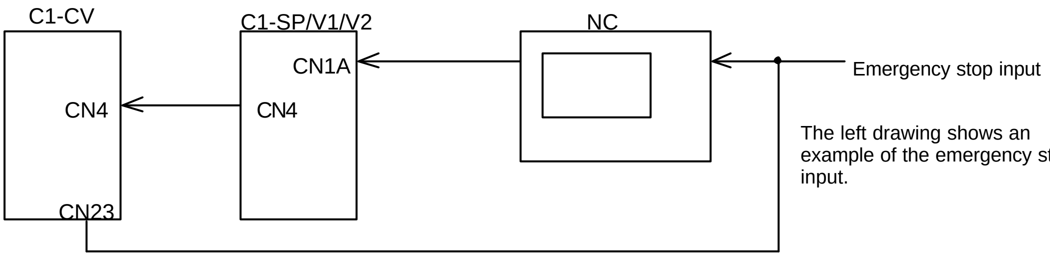
If the external emergency stop input is detected continuously for 200ms or more, this function will start.

If the contactor OFF command from the NC is not received within 30 seconds after the external emergency stop input is detected, the CV itself will turn the contactor OFF.

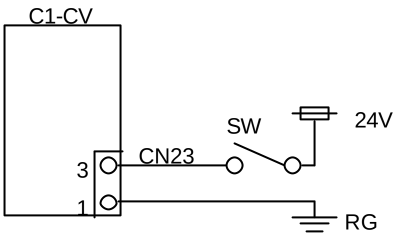
(c) Alarm (Warning) list

CV display (flicker)	Connected drive unit display	Alarm/warning details
m [m]	76 [76]	External emergency stop setting error
q [q]	EA [EA]	Emergency stop state is applied from NC when external emergency stop input is input.
q [q]	6F [6F]	When emergency stop from NC is not applied even when the external emergency stop is input

(3) Connection



The left drawing shows an example of the emergency stop input.



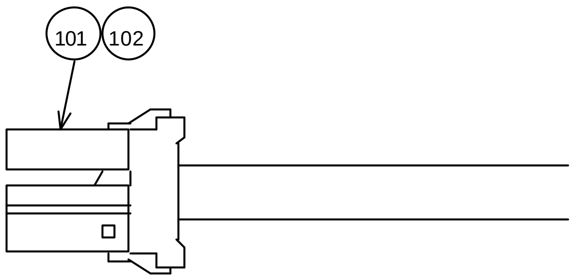
* The current that flows when the contact is ON is 15mA.
  Make sure not to mistake the polarity.
  (This function will not work if the 24VDC polarity is mistaken.)

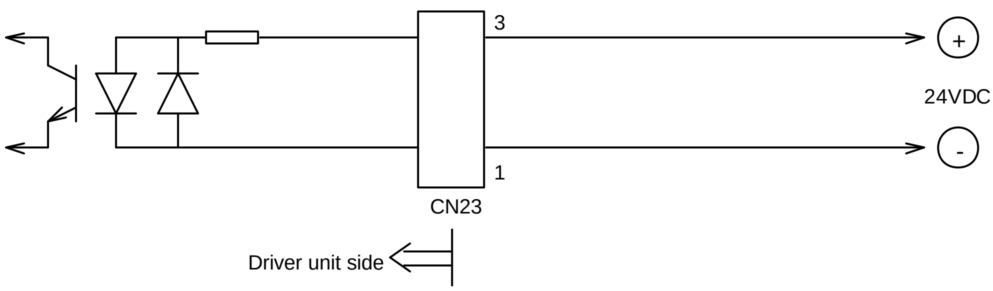
* The emergency stop operation is applied when the SW in the diagram opens.

(4) Connector name

Part No.	Name	Type	Maker
101	Connector	2-178288-3	Japan AMP
102	Contact	1-175218-2	Japan AMP

Wire size: 0.5 to 1.25SQ





(5) Example of emergency stop circuit

(a) Outline of function

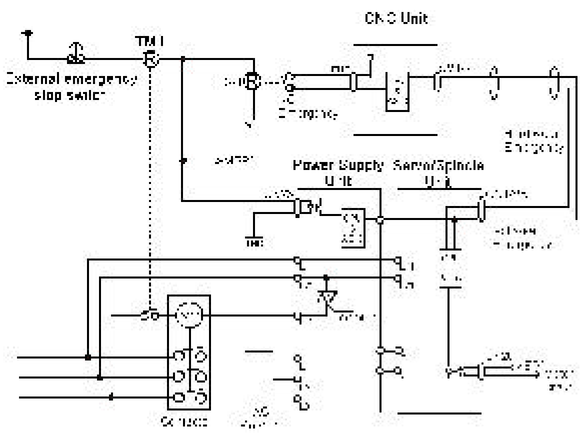
The power supply unit's external emergency stop can be validated by wiring to the CN23 connector, and setting the parameters and rotary switch. If the emergency stop cannot be processed and the external contractor cannot be shut off (due to a fault) by the CNC unit, the external contactor can be shut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

EN60204-1 Category 1 can be basically complied with by installing the external emergency stop switch and contactor.

CAUTION	1. The power supply unit external emergency stop function is a function that assists the NC emergency stop. 2. The emergency stop signal input to the CNC side cannot be used as a substitute for the external emergency stop function (CN23). 3. It will take 30 seconds for the external contactor to function after the emergency stop is input to CN23. (This time is fixed.)

(b) Example of emergency stop circuit

The emergency stop is a signal used to stop the machine in an emergency. This is connected to the CNC unit. Wire to the power supply unit when necessary. The servo/spindle unit will be decelerated and controlled by the software according to the deceleration stop command issued from the CNC unit.



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.

> 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 ≥ All axes stop time

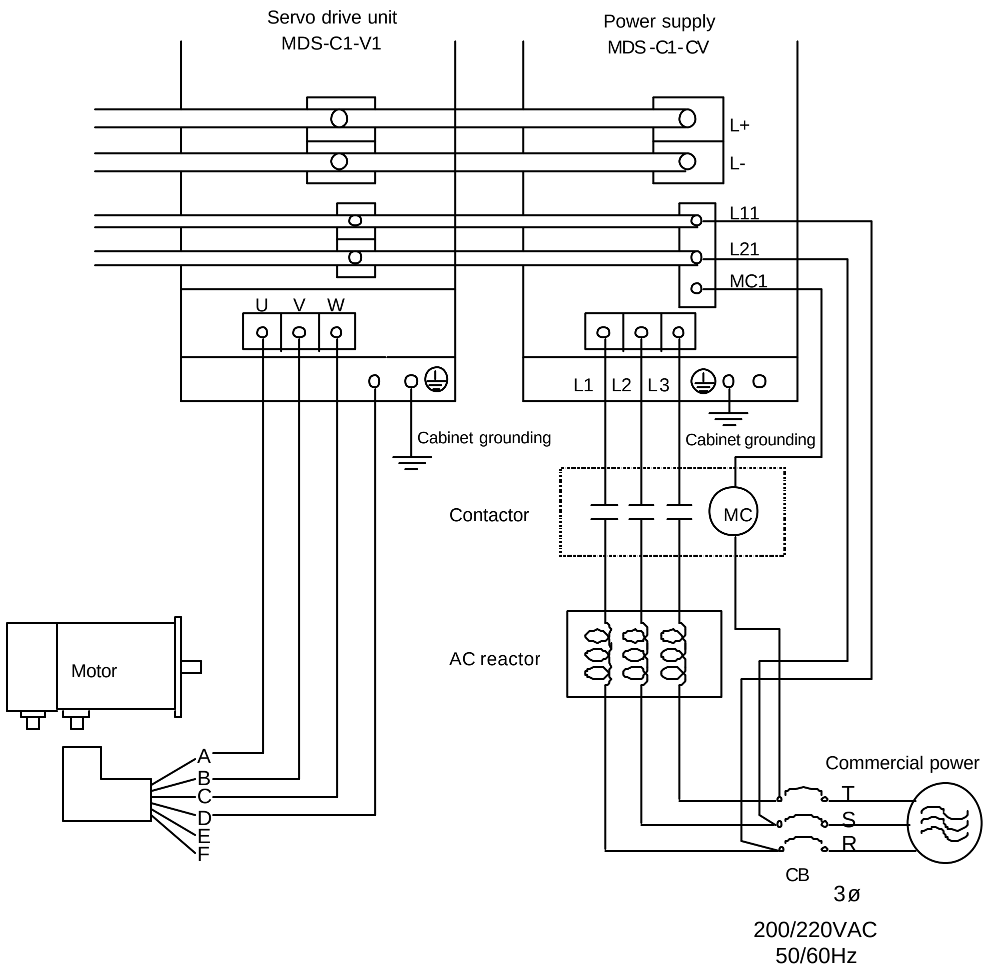
Provide a mechanism that shuts off the power even if the CNC system fails.

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.

1.10 Main circuit connection

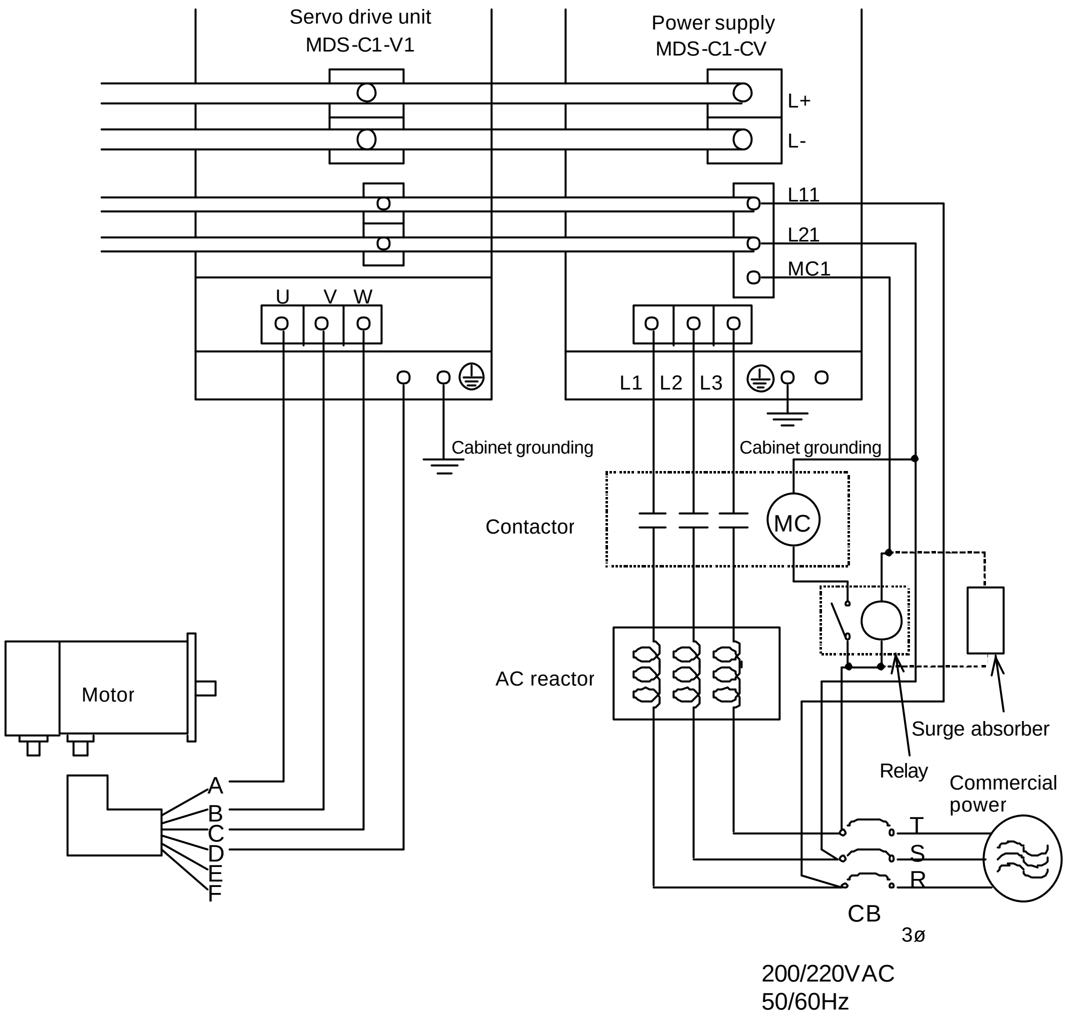
⚠ WARNING
Ground the servo drive unit and servomotor with Class C (former class 3) grounding or higher.

⚠ CAUTION
1. Correctly connect the output side (terminals U, V, W). Failure to do so could lead to abnormal operation of the servomotor. 2. 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. 3. Note that the power supply unit MDS-C1-CV protection ground is provided on the unit installation base instead of the terminal block. Correctly connect this ground. 4. To prevent malfunctioning of the contactor, use a contactor that does not turn ON at an operation coil current of 15mA or less and a relay, or a contactor that can be turned OFF at 15mA and a relay. (Refer to the external contactor in "1.4 List of specifications".) 5. As shown below, always wire the L11 and L21 terminals on the AC reactor commercial power supply side and with same phase power supply as the L1, L2 and L3 terminals. When inserting a power stabilization unit, such as a UPS, to the L11, L21 terminals, use unit for which the UPS input/output voltage phases are the same. Correct regeneration control will not be possible if the L11, L12 terminals and L1, L2, L3 terminals are wired from a separated power supply (not synchronized). Do not use this setup.



Precautions for connections

(1) The wires and crimp terminals will differ according to the capacity.
(Refer to "8.5" in the Chapter I Servo/Spindle System Configuration Section.)
(2) A 200V class power supply is used.
The main circuit section does not have a transformer so always ground it.
(3) The phase order of the power supply terminals L1, L2, L3 is random.
(4) Refer to "8.4" in the Servo/Spindle System Configuration Section for the selection of the contactor, AC reactor and Circuit Breaker connected to the power supply.
(5) The specified power supply must be connected to the drive unit power supply terminals (L1, L2 and L3). Adjust voltage using a transformer when the power supply is not as specified.
(6) The power lines (R, S, T) must not be connected to the motor output terminals (U, V, W).
(7) The output terminal (U, V, W) and motor terminal (A, B, C) phases must match.
(8) Do not directly apply commercial power on the motor.
(9) Check once again that the wires are connected correctly as indicated in the connection diagram.
(10) As shown below, do not connect a general control relay to the contactor drive terminal MC1.
If a relay must be used, select one following the external contactor conditions given in "1.4 List of specifications". If the relay does not operate correctly, install a surge absorber on the relay coil terminal.
Recommended surge absorber: OKAYA ELECTRIC XEB0475 (47Ω+0.5µF) VDE0565-1
When using a different surge absorber, select one that has a resistance value of 47 to 220Ω and a capacitor that is 0.5µF or more.



III. MDS-C1-Vx
Servo System Section

1. Outline

(1) High performance

High-performance servo control equivalent to the high gain drive unit (B-V14/V24) is mounted.

(2) Compact

The fin outline dimensions have been downsized with the high-efficiency fin and low-loss compact IPM, and a thin drive unit has been realized.

(3) Reliability

The heating value has been reduced by incorporating a low-loss IPM, and the inner support structure has been strengthened by integrating the terminal block and wiring conductors. Through these element developments, the reliability has been improved from the existing B Series.

(4) Compatibility

This unit can be used in the same machine as the B Series without problem. The installation dimensions and servo/spindle parameters are compatible with the B Series.

- Outline dimensions, installation dimensions, terminal connection
  Compatible with current B Series.
  - ∗ Some changes have been made to the PE terminal position and control terminal positions (in some capacities).
    (Refer to "Outline Manual BNP-B8361-403" for details.)
- Control functions (servo)
  Replacement from the standard drive unit (B-V1/V2) or high-gain drive unit (B-V14/V24) is automatically judged. The parameters are compatible. Refer to the following pages for details.
  - ∗ There are some limits to the motor end encoder. Refer to the following pages.
  - ∗ This unit is shipped with the high-gain specifications as the default. Refer to the following pages.
- Control functions (spindle)
  The control functions and parameters are compatible.
  - ∗ This unit can be used in the same machine as the B Series without problem.

2. Motor

2.1 Outline

The following motor series are compatible with MDS-C1-Vx Series.

(1) HC Series

- By incorporating a new neodymium magnet, the L dimensions have been shortened by approx. 40% compared with the existing HA Series servomotors, by that contributing to downsizing of the machine.
- The shaft shape and flange size are the same as the existing HA Series servomotors, so replacement from the HA Series is possible.
- A max. 1,000,000 pulse/rev absolute position detector is incorporated, allowing ultra-high-accuracy control to be realized. A 100,000 pulse/rev detector is also available.

(2) HC∗∗R Series

- The low-inertia specification HC∗∗R Series servomotors have been prepared as a servomotor for use in CNC machine peripheral axes. This Series is compact and has a high power rate, so it is suitable for high-speed positioning of peripheral axes. This also contributes to shortening the cycle time.

(3) HA Series

- Existing HA Series servomotors can be used to allow replacement from the existing servo drive unit MDS-A/B Series.

⚠ CAUTION
The detector is only compatible with the serial encoder (OSE104, OSA104, OSE105, OSA105).

2.2 Model configuration

(1) HC Series

HC (a) (b) (c) (d) – (e)

(e) Detector

Symbol	Detection method	Detector resolution	Detector type
E42	Incremental	100,000p/rev	OSE104S2
E51		1,000,000p/rev	OSE105S2
A42	ABS (Absolute position)	100,000p/rev	OSA104S2
A51		1,000,000p/rev	OSA105S2

(d) Protective structure

Symbol	Protective structure
None	IP65
P	IP67

(c) Shaft end shape

Symbol	Shaft end shape
S	Straight
T	Taper

Motors of medium inertia 2kW or larger and low inertia 3.5kW or larger only have straight shafts.

(b) Magnetic brake

Symbol	Magnetic brake
None	None
B	With magnetic brake

(a) Rated output, rated rotation speed and motor series

HC** Series				HC**R Series	
Rating 2000r/min		Rating 3000r/min		Rating 3000r/min	
Symbol	Rated output	Symbol	Rated output	Symbol	Rated output
52	0.5kW	53	0.5kW	103R	1.0kW
102	1.0kW	103	1.0kW	153R	1.5kW
152	1.5kW	153	1.5kW	203R	2.0kW
202	2.0kW	203	2.0kW	353R	3.5kW
352	3.5kW	353	3.5kW	503R	5.0kW
452	4.5kW	453	4.5kW		
702	7.0kW	703	7.0kW		
902	9.0kW				

(2) HA Series

HA□ □ □ □—□ □ □

D5 : IP65
D7 : IP67
No symbol : IP54 (Note that the 11K2/15K2 is equivalent to IP44.)

R : HA303, HA700, HA703, HA900 sealed type terminal box
No symbol : Other

T : Tapered shaft (applicable only to HA23, 33)
No symbol : Straight shaft (other than HA40, 43, 80, 83)

Motor	Symbol	Shaft
HA23, 33	T	Tapered
	None	Straight
HA40, 80, 43, 83	None	Tapered
	S	Straight

B : With electromagnetic brake
No symbol : No electromagnetic brake

C : Main circuit cannon connector type
No symbol : Main circuit terminal box type

N : Medium inertia motor
NL : Low inertia motor
L : Conventional (M300 Series) low inertia motor
(Already changed to the same specification NL type)
No symbol : Conventional (M300 Series) medium inertia motor

Motor power class

N-type 2000r/min		N-type 3000r/min		L-type 2000r/min		L-type 3000r/min	
Motor	kW	Motor	kW	Motor	kW	Motor	kW
40	0.5	053	0.05	50	0.5	53	0.5
80	1.0	13	0.1	100	1.0	103	1.0
100	2.0	23	0.3	150	1.5	153	1.5
200	3.5	33	0.45	200	2.0	203	2.0
300	4.5	43	0.5	300	3.0	303	3.0
700	7.0	83	1.0	500	5.0	503	5.0
900	9.0	103	2.0	-LH11K2	11.0		
		203	3.5	-LH15K2	15.0		
		303	4.5				
		703	7.0				

2.3 Main equipment list

(1) HC motor main equipment

Item \ Maximum speed / Motor model		2000r/min: HC52 HC102 HC152	2000r/min: HC202 HC352 HC452 HC702 HC902	3000r/min: HC53 HC103 HC153	3000r/min: HC203 HC353 HC453 HC703
Oil seal	Presence	○	○	○	○
	Absence	×	×	×	×
Shaft end	Straight shaft	○	○	○	○
	Tapered shaft	○	×	○	×
Electro-magnetic brake	Presence	○	○	○	○
	Absence	×	×	×	×
Connector type	Cannon connector	○	○	○	○
	Terminal box	×	×	×	×
IP65/67 compatible		○	○	○	○

(2) HA motor main equipment

Maximum speed		2000r/min			3000r/min				
Item \ Motor model		HA40N HA80N	HA100N HA200N HA300N	HA700N HA900N	HA053 HA13	HA23N HA33N	HA43N HA83N	HA103N HA203N	HA303N HA703N
Oil seal	Presence	○	○	○	○	○	○	○	○
	Absence	×	×	×	×	×	×	×	×
Shaft end	Straight shaft	△	○	○	○	○	△	○	○
	Tapered shaft	○	×	×	×	○	○	×	×
Electro-magnetic brake	Presence	○	○	○	○	○	○	○	○
	Absence	○	○	○	○	○	○	○	○
Connector type	Cannon connector	○	○	△	○	○	○	○	×
	Terminal box	×	×	○	×	×	×	×	○
IP65/67 compatible		△	△	×	×	△	△	△	×

Maximum speed		2000r/min			3000r/min		
Item \ Motor model		HA50NL HA100NL HA150NL	HA200NL HA300NL HA500NL	HA-LH11K2 HA-LH15K2	HA53NL HA103NL HA153NL	HA203NL HA303NL	HA503NL
Oil seal	Presence	○	○	○	○	○	○
	Absence	×	×	×	×	×	×
Shaft end	Straight shaft	○	○	○	○	○	○
	Tapered shaft	○	×	×	○	×	×
Electro-magnetic brake	Presence	×	×	×	×	×	×
	Absence	○	○	○	○	○	○
Connector type	Cannon connector	○	○	×	○	○	×
	Terminal box	×	×	○	×	×	○
IP65/67 compatible		×	×	×	×	×	×

○ : Standard product　△ : Special product　× : No specification

2.4 Specifications list

(1) HC Series

Motor model			HC Series (2000r/min rating)							
			INC specifications: HC＊＊-E51/-E42, ABS specifications:HC＊＊-A51/-A42							
			HC52	HC102	HC152	HC202	HC352	HC452	HC702	HC902
Continuous characteristics	Rated output	[kW]	0.5	1.0	1.5	2.0	3.5	4.5	7.0	9.0
	Rated current	[A]	3.2	6.0	9.0	10.7	16.9	23.3	32.8	40.8
	Stall current	[A]	3.94	7.4	11.1	15.4	22.9	40.4(31.5)	46.2(41.0)	55.9
	Rated torque (±10%)	[N·m]	2.39	4.78	7.16	9.55	16.7	21.5	33.4	43.0
	Stall torque (±10%)	[N·m]	2.94	5.88	8.82	13.7	22.5	37.2(29.0)	49.0(44.0)	58.8
Rated rotation speed		[r/min]	2000							
Maximum rotation speed		[r/min]	2000							
Maximum current		[A]	17	28	47	47	64	85	113	141
Maximum torque (±10%)		[N·m]	11.8	21.6	35.3	41.7	59.8	87.5	120	153
Power rate at continuous rated torque		[kW/s]	8.7	16.7	25.6	21.5	34.0	38.2	69.7	82.5
Instantaneous angle acceleration		[rad/s^2]	21530	18599	15680	9859	7293	7233	7500	7518
Motor inertia		[× 10^{-4} kg·m^2]	6.6	13.7	20.0	42.5	82	121	160	204
Motor inertia with brake		[× 10^{-4} kg·m^2]	8.6	15.7	22.0	51.1	92	131	170	214
Recommended motor shaft conversion load inertia rate			High-speed, high-accuracy machine : 2 times or less of motor inertia General machine tool : 3 times or less of motor inertia General machine : 5 times or less of motor inertia							
Armature resistance (phase 20°C)		[Ω]	1.44	0.57	0.30	0.21	0.10	0.052	0.047	0.033
Armature inductance (phase 20°C)		[mH]	6.9	2.9	1.8	3.7	2.0	0.87	0.76	0.62
Inductive voltage constant (phase 20°C, ±10%)		[mV/r/min]	31.1	30.8	31.2	33.8	37.3	35.5	38.1	38.7
Torque constant (±10%)		[N·m/A]	0.89	0.88	0.89	0.97	1.07	1.02	1.09	1.11
Electrical time constant		[ms]	4.8	5.1	6.0	17.7	20.0	16.7	16.2	18.9
Mechanical time constant		[ms]	3.6	3.0	2.3	2.8	2.2	1.8	1.9	1.6
Thermal time constant		[min]	15	20	25	35	45	50	55	60
Static friction torque		[N·m]	0.13	0.18	0.20	0.16	0.21	0.40	0.50	0.59
Armature coil temperature upper limit degree		[°C]	100							
Motor end detector			Resolution per motor rotation E51/A51: 1000000 pulse/rev, E42/A42: 100000 pulse/rev							
Structure			Fully closed, self-cooling (protective degree: IP65, IP67)							
Environment conditions			To follow section "2.12 Environment conditions"							
Weight Without/with brake		[kg]	5.0/7.5	7.0/9.0	9.0/11	12/18	19/25	25/30	32/38	45/51
Armature insulation class			Class F							

(Note 1) The above characteristics values are representative values. The maximum current and maximum torque are the values when combined with the drive unit.

(Note 2) The values in parentheses are for combination with the S type drive unit.

Motor model			HC Series (3000r/min rating)						
			INC specifications: HC* * -E51/-E42, ABS specifications: HC* * -A51/-A42						
			HC53	**HC103**	**HC153**	**HC203**	**HC353**	**HC453**	**HC703**
Continuous characteristics	Rated output	[kW]	0.5	1.0	1.5	2.0	3.5	4.5	7.0
	Rated current	[A]	3.2	5.3	8.6	10.4	16.5	22.1	30.5
	Stall current	[A]	5.8	9.8	15.9	22.4	33.3	57.3	69.2
	Rated torque (±10%)	[N·m]	1.59	3.18	4.77	6.37	11.1	14.3	22.3
	Stall torque (±10%)	[N·m]	2.94	5.88	8.82	13.7	22.5	37.2	49.0
Rated rotation speed		[r/min]	3000						
Maximum rotation speed		[r/min]	3000						
Maximum current		[A]	17	28	47	64	85	113	141
Maximum torque (±10%)		[N·m]	8.82	16.7	28.4	40.2	55.9	79.8	105
Power rate at continuous rated torque		[kW/s]	3.8	7.4	11.4	9.5	15.0	16.9	29.3
Instantaneous angle acceleration		[rad/s^2]	7234	6970	14308	9459	6817	6593	6566
Motor inertia		[$\times 10^{-4}$ kg·m^2]	6.6	13.7	20.0	42.5	82	121	160
Motor inertia with brake		[$\times 10^{-4}$ kg·m^2]	8.6	15.7	22.0	52.5	92	131	170
Recommended motor shaft conversion load inertia rate			High-speed, high-accuracy machine : 2 times or less of motor inertia General machine tool : 3 times or less of motor inertia General machine : 5 times or less of motor inertia						
Armature resistance (phase 20°C)		[Ω]	0.55	0.33	0.20	0.11	0.06	0.030	0.026
Armature inductance (phase 20°C)		[mH]	2.8	1.8	1.1	2.0	1.05	0.60	0.49
Inductive voltage constant (phase 20°C, ±10%)		[mV/r/min]	20.4	24.4	23.5	24.0	26.4	26.7	27.4
Torque constant (±10%)		[N·m/A]	0.58	0.70	0.67	0.69	0.76	0.76	0.79
Electrical time constant		[ms]	5.1	5.5	5.4	17.2	17.4	20.1	19.0
Mechanical time constant		[ms]	3.2	2.8	2.7	3.1	2.6	1.8	2.0
Thermal time constant		[min]	15	20	25	35	45	50	55
Static friction torque		[N·m]	0.13	0.18	0.20	0.16	0.21	0.40	0.50
Armature coil temperature upper limit degree		[°C]	100						
Motor end detector			Resolution per motor rotation E51/A51: 1,000,000 pulse/rev, E42/A42: 100,000 pulse/rev						
Structure			Fully closed, self-cooling (protective degree: IP65, IP67)						
Environment conditions			To follow section "2.12 Environment conditions"						
Weight Without/with brake		[kg]	5.0/7.5	7.0/9.0	9.0/11	12/18	19/25	25/30	32/38
Armature insulation class			Class F						

(Note 1) The above characteristics values are representative values. The maximum current and maximum torque are the values when combined with the drive unit.

(Note 2) The values in parentheses are for combination with the S type drive unit.

Motor model		HC＊＊R Series (3000r/min rating) INC specifications: HC＊＊R-E51/-E42/-E33, ABS specifications: HC＊＊R-A51/-A42/-A33				
		HC103R	HC153R	HC203R	HC353R	HC503R
Continuous characteristics	Rated output [kW]	1.0	1.5	2.0	3.5	5.0
	Rated current [A]	6.1	8.8	14.0	22.5	28.0
	Stall current [A]	6.1	8.8	14.0	22.5	28.0
	Rated torque (±10%) [N·m]	3.18	4.77	6.37	11.1	15.9
	Stall torque (±10%) [N·m]	3.18	4.77	6.37	11.1	15.9
Rated rotation speed [r/min]		3000				
Maximum rotation speed [r/min]		3000				
Maximum current [A]		18.4	23.4	37.0	56.3	70.0
Maximum torque (±10%) [N·m]		7.95	11.9	15.9	27.8	39.8
Power rate at continuous rated torque [kW/s]		67.4	120	176	150	211
Instantaneous angle acceleration [rad/s^2]		53000	62894	69239	33557	33157
Motor inertia [× 10^{-4} kg·m^2]		1.5	1.9	2.3	8.3	12.0
Motor inertia with brake [× 10^{-4} kg·m^2]		1.9	2.3	2.7	11.8	15.5
Recommended motor shaft conversion load inertia rate		5 times or less of motor inertia				
Armature resistance (phase 20°C) [Ω]		0.43	0.28	0.15	0.057	0.044
Armature inductance (phase 20°C) [mH]		7.7	5.8	3.3	2.2	1.9
Inductive voltage constant (phase 20°C, ±10%) [mV/r/min]		35.1	36.5	31.6	31.3	35.6
Torque constant (±10%) [N·m/A]		5.9	6.2	5.3	5.3	6.0
Electrical time constant [ms]		9.1	10.2	10.7	19.3	21.0
Mechanical time constant [ms]		0.57	0.44	0.38	0.53	0.46
Thermal time constant [min]		15	15	15	35	40
Static friction torque [N·m]		0.07	0.09	0.09	0.12	0.16
Armature coil temperature upper limit degree [°C]		100				
Motor end detector		Resolution per motor rotation E51/A51: 1000000 pulse/rev, E42/A42: 100000 pulse/rev, E33/A33: 25000 pulse/rev				
Structure		Fully closed, self-cooling (protective degree: IP65, IP67)				
Environment conditions		To follow section "2.12 Environment conditions"				
Weight Without/with brake [kg]		3.9/6.0	5.0/7.0	6.2/8.3	12/15	17/21
Armature insulation class		Class F				

(Note 1) The above characteristics values are representative values. The maximum current and maximum torque are the values when combined with the drive unit.

(2) HA Series

Standard motor data sheet (2000 r/min)

Item			Symbol	Unit	HA40N	HA80N	HA100N	HA200N	HA300N	HA700N	HA900N
Nominal output			P_R	kW	0.5	1.0	2.0	3.5	4.5	7.0	9.0
Continuous characteristics	Rated speed	Output torque	T_R	N·m	2.39	4.78	9.55	16.7	21.5	33.4	43.0
		Input current	I_R	A	3.0	5.5	10	16	22	33.5	42
	Stall state	Output torque	T_S	N·m	2.94	5.88	13.7	22.6	37.3	49.0	58.8
		Input current	L_S	A	3.6	6.6	14	22	37	49	56
Instantaneous characteristics	Maximum character-istics in stall state	Instantaneous torque	T_{PS}	N·m	14.7	29.4	68.6	112.7	186	245	294
		Instantaneous current	I_P	A	18	33	70	110	185	245	280
		Instantaneous power rate	Q_P	kW/s	220	440	686	967	1805	2364	2713
		Instantaneous angular acceleration	a_P	rad/s^2	15000	15000	10000	8582	9694	9652	9230
Rated speed			Nmax	r/min	2000						
Motor GD^2			GD^2_M	$\times 10^{-4}$kg·m^2	39.2	78.4	274	525	768	1015	1274
Motor inertia			J_M	$\times 10^{-4}$kg·m^2	9.8	19.6	68.6	131.0	192.0	254.0	318.5
Armature resistance (one phase, 20°C)			Ra	Ω	2.23	0.89	0.31	0.136	0.067	0.058	0.045
Armature inductance (one phase)			La	mH	9.6	4.9	3.6	1.8	1.1	0.86	0.8
Induced voltage constant (one phase, 20°C)			K_E	mV/r/min ±10%	29.2	32	34.9	36.7	35.8	37	38
Torque constant			K_T	N·m/A	0.83	0.91	1.00	1.05	1.03	1.06	1.09
Electrical time constant			te	ms	4.3	5.5	11.6	13	16	14.8	17.8
Mechanical time constant			tm	ms	9.4	6.2	6.4	4.9	3.7	4.0	3.3
Thermal time constant			tth	min	40	45	60	65	65	65	65
Static frictional torque			T_F	N·m	0.108	0.157	0.137	0.216	0.294	0.373	0.686
Armature winding temperature rise limit			θmax	°C	130						
Weight (motor only)			–	kg	7	11	20	31	42	55	79
Armature insulation class					Class F						

Standard motor data sheet (3000 r/min)

Item			Symbol	Unit	HA053N	HA13N	HA23N	HA33N	HA43N	HA83N	HA103N	HA203N	HA303N	HA703N
Nominal output			P_R	kW	0.05	0.1	0.3	0.45	0.5	1.0	2.0	3.5	4.5	7.0
Continuous characteristics	Rated speed	Output torque	T_R	N·m	0.16	0.32	0.95	1.43	1.60	3.19	6.37	11.2	14.3	22.3
		Input current	I_R	A	0.95	0.95	2.9	2.2	2.8	4.9	9.2	18	21	31
	Stall state	Output torque	T_S	N·m	0.25	0.49	0.98	1.96	2.94	5.88	13.7	22.6	37.3	49.0
		Input current	L_S	A	1.4	1.4	3.0	3.0	5	8.8	19.6	34.5	55	68
Instantaneous characteristics	Maximum character-istics in stall state	Instantaneous torque	T_{PS}	N·m	1.22	2.45	4.9	9.8	15.7	29.4	68.6	113	186	245
		Instantaneous current	I_P	A	7.0	7.0	15	15	25	44	98	127.5	275	340
		Instantaneous power rate	Q_P	kW/s	81.4	167.0	24500	490	220	440	686	967	1805	2364
		Instantaneous angular acceleration	a_P	rad/s^2	66490	68490	50000	50000	15000	15000	10000	8582	9694	9652
Rated speed			Nmax	r/min	3000									
Motor GD^2			GD^2_M	× 10^{-4}kg·m^2	0.74	1.43	3.92	7.84	39.2	78.4	274	525	768	1015
Motor inertia			J_M	× 10^{-4}kg·m^2	0.18	0.36	0.98	1.96	9.8	19.6	68.6	131.0	192.0	254.0
Armature resistance (one phase, 20°C)			Ra	Ω	7.2	9.3	2.22	3.0	1.16	0.5	0.18	0.052	0.0316	0.0244
Armature inductance (one phase)			La	mH	6.4	10.8	4.4	8.7	5	2.8	2.1	0.72	0.46	0.42
Induced voltage constant (one phase, 20°C)			K_E	mV/r/min ±10%	6.2	12.4	12.1	24.2	21	23.9	24.8	23	24.5	25.8
Torque constant			K_T	N·m/A	0.18	0.35	0.34	0.69	0.60	0.69	0.71	0.66	0.71	0.75
Electrical time constant			te	ms	0.89	1.16	2.0	2.9	4.3	5.6	11.7	14	15	17
Mechanical time constant			tm	ms	12.8	8.0	5.5	3.7	9.5	6.3	7.4	4.6	3.7	3.4
Thermal time constant			tth	min	10	10	20	25	40	45	60	65	65	65
Static frictional torque			T_F	N·m	0.005	0.007	0.039	0.059	0.108	0.157	0.137	0.216	0.294	0.373
Armature winding temperature rise limit			θmax	°C	130									
Weight (motor only)			–	kg	1.1	1.5	2.0	3.0	7	11	20	31	42	55
Armature insulation class					Class F									

Low inertia AC servomotor data sheet (2000 r/min)

Item			Symbol	Unit	HA50LC-S HA50LC-TS	HA100LCS HA100LC-TS	HA150LCS HA150LC-TS	HA200 LC-S	HA300 LC-S	HA500 LC-S	HA-LH11 K2-S1	HA-LH15 K2-S1
Nominal output			P_R	kW	0.5	1.0	1.5	2.0	3.0	5.0	11.0	15.0
Continuous characteristics	Rated speed	Output torque	T_R	N·m	2.39	4.78	7.16	9.55	14.3	23.8	52.5	71.6
		Input current	I_R	A	3.4	6.8	9.5	13	16	28	68.0	78.0
	Stall state	Output torque	T_S	N·m	2.94	5.88	8.83	13.7	22.6	37.3	70.6	91.7
		Input current	L_S	A	4	8	11.5	18.2	25	44	84.0	100.0
Instantaneous characteristics	Maximum character-istics in stall state	Instantaneous torque	T_{PS}	N·m	14.7	29.4	44.1	68.6	112.7	186	353	490
		Instantaneous current	I_P	A	20	40	57.5	91	125	220	420	500
		Instantaneous power rate	Q_P	kW/s	788	1575	2362	2401	4320	3931	235	177
		Instantaneous angular acceleration	a_P	rad/s^2	53571	53571	53571	35000	38333	21111	30000	16892
Rated speed			Nmax	r/min	2000							
Motor GD^2			GD^2_M	× 10^{-4}kg·m^2	11	22	33	78.4	117.6	352.8	470	1160
Motor inertia			J_M	× 10^{-4}kg·m^2	2.75	5.49	8.24	19.6	29.4	88.3	118.0	290.0
Armature resistance (one phase, 20°C)			Ra	Ω	1.36	0.484	0.29	0.143	0.112	0.041	0.03	0.026
Armature inductance (one phase)			La	mH	7.3	3.4	3.4	1.43	1.37	0.74	0.43	0.40
Induced voltage constant (one phase, 20°C)			K_E	mV/r/min ±10%	27	26	27	26.5	32	30	29.6	34.3
Torque constant			K_T	N·m/A	0.76	0.75	0.77	0.76	0.91	0.85	0.84	0.98
Electrical time constant			te	ms	5.4	7.0	8.3	10	12.3	18	14.4	15.6
Mechanical time constant			tm	ms	1.9	1.4	1.2	1.5	1.2	1.5	1.6	2.32
Thermal time constant			tth	min	40	45	45	60	65	65	30	30
Static frictional torque			T_F	N·m	0.108	0.157	0.206	0.294	0.392	0.490	0.412	0.539
Armature winding temperature rise limit			θmax	°C	130							
Weight			–	kg	6.5	9.5	12.5	16	22	35	70	108

＊ The same characteristics apply to the HA＊＊NLC motor.

Low inertia AC servomotor data sheet (3000 r/min)

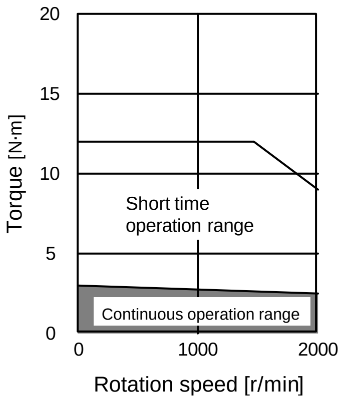
Item			Symbol	Unit	HA53LC-S HA53LC-TS	HA103LC-S HA103LC-TS	HA153LC-S HA153LC-TS	HA203LC-S	HA303LC-S	HA503LC-S
Nominal output			P_R	kW	0.5	1.0	1.5	2.0	3.0	5.0
Continuous characteristics	Rated speed	Output torque	T_R	N·m	1.60	3.19	4.77	6.36	9.55	16.0
		Input current	I_R	A	3.5	6.5	9.6	11.0	15.2	26.0
	Stall state	Output torque	T_S	N·m	2.94	5.88	8.82	13.7	22.5	37.3
		Input current	L_S	A	5.8	11.0	16.2	21	32	54
Instantaneous characteristics	Maximum character-istics in stall state	Instantaneous torque	T_{PS}	N·m	14.7	29.4	44.1	68.6	112.7	186
		Instantaneous current	I_P	A	29	55	81	105	160	270
		Instantaneous power rate	Q_P	kW/s	788	1575	2362	2401	4320	3930
		Instantaneous angular acceleration	a_P	rad/s^2	53571	53571	53571	35000	38333	21111
Rated speed			Nmax	r/min	3000					
Motor GD^2			GD^2_M	$\times 10^{-4}$kg·m^2	11	22	33	78.4	117.6	352.8
Motor inertia			J_M	$\times 10^{-4}$kg·m^2	2.7	5.5	8.2	19.6	29.4	88.3
Armature resistance (one phase, 20°C)			Ra	Ω	0.6	0.25	0.142	0.11	0.066	0.0289
Armature inductance (one phase)			La	mH	3.2	1.7	1.14	1.0	0.77	0.49
Induced voltage constant (one phase, 20°C)			K_E	mV/r/min ±10%	18.5	19.8	20.0	24.2	25.2	25.5
Torque constant			K_T	N·m/A	0.53	0.57	0.57	0.69	0.72	0.73
Electrical time constant			te	ms	5.4	6.8	8.1	9.1	11.7	17.0
Mechanical time constant			tm	ms	1.8	1.3	1.1	1.4	1.1	1.5
Thermal time constant			tth	min	40	45	45	60	65	65
Static frictional torque			T_F	N·m	0.108	0.157	0.206	0.294	0.392	0.490
Armature winding temperature rise limit			θmax	°C	130					
Weight			–	kg	6.5	9.5	12.5	16	22	35

* The same characteristics apply to the HA**NLC motor.

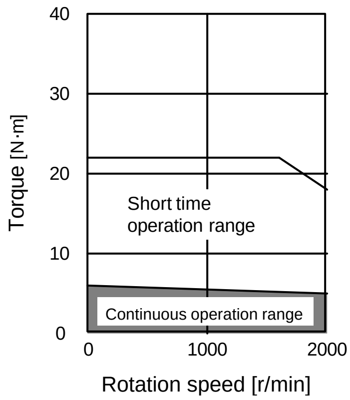
2.5 Torque characteristics

(1) HC Series

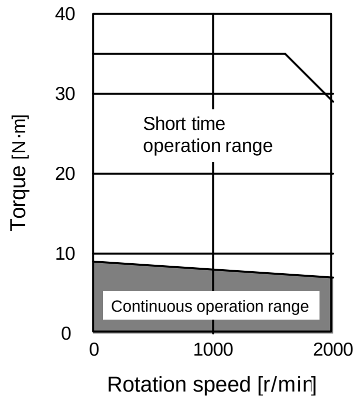
[HC52]



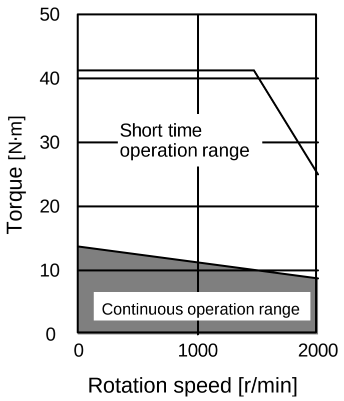
[HC102]



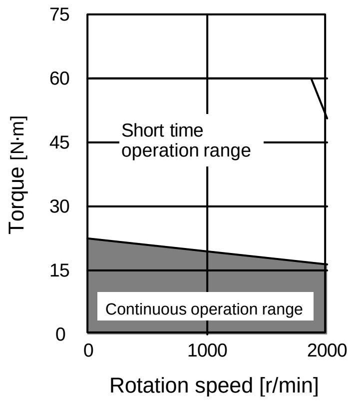
[HC152]



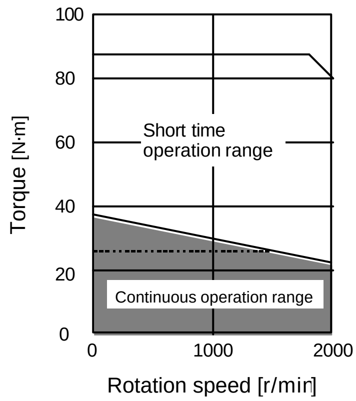
[HC202]



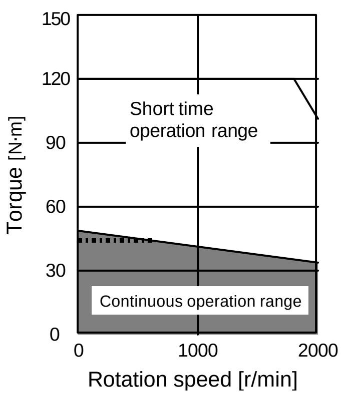
[HC352]



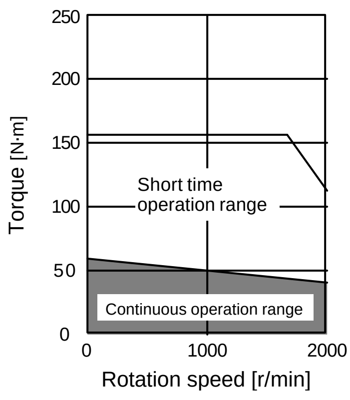
[HC452]



[HC702]

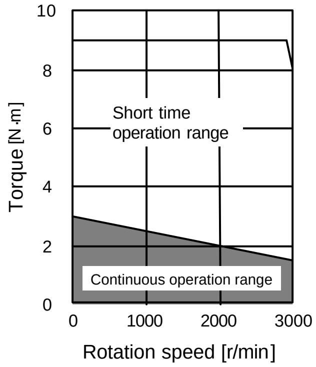


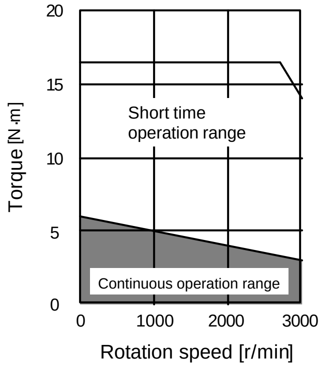
[HC902]

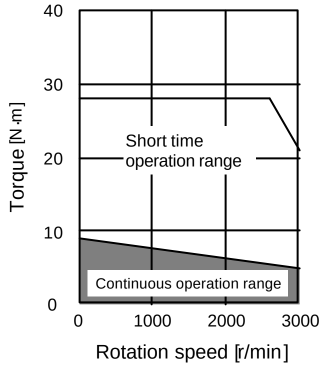


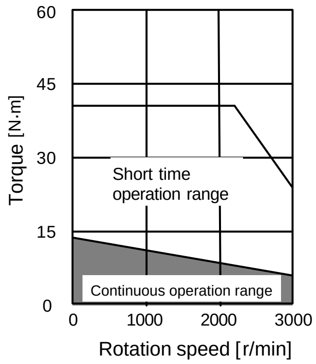
Note 1: The above graphs show the data for the input voltage of 200VAC.
When the input voltage is 200VAC or less, the short time operation range is limited.

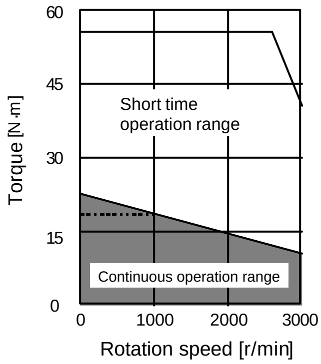
Note 2: The broken line indicates the torque when connecting to S type drive unit.

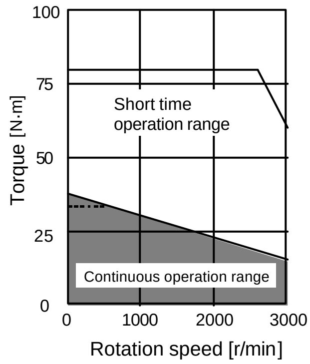
[HC53]


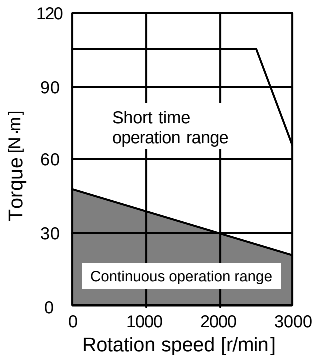
[HC103]


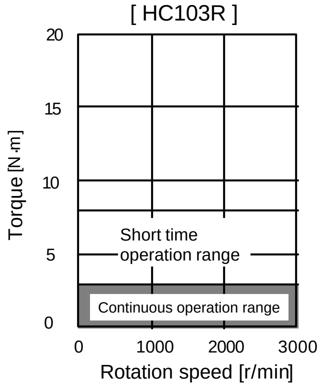
[HC153]


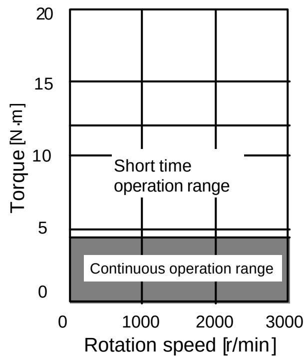
[HC203]


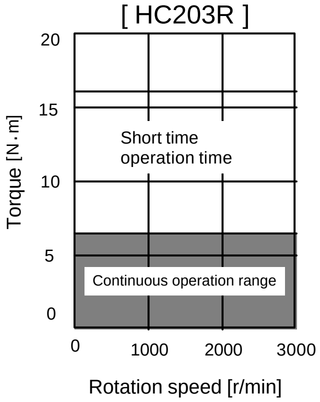
[HC353]


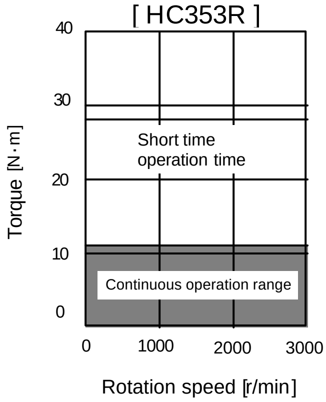
[HC453]


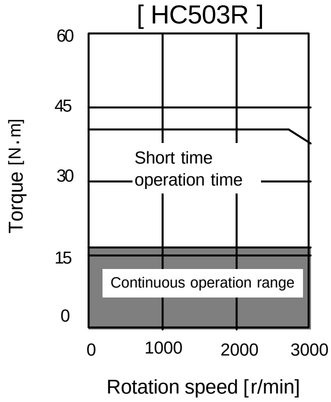
[HC703]


[HC103R]


[HC153R]


[HC203R]


[HC353R]


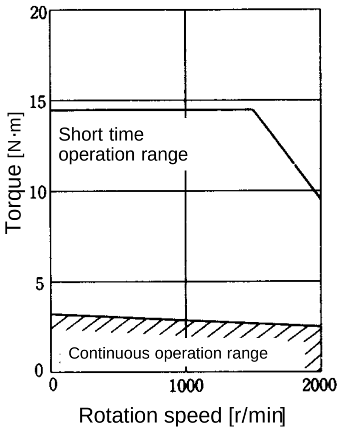
[HC503R]


Note 1: The above graphs show the data for the input voltage of 200VAC.
When the input voltage is 200VAC or less, the short time operation range is limited.

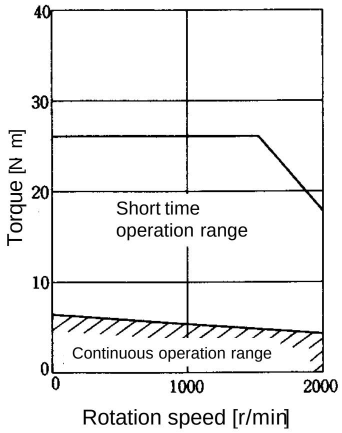
Note 2: The broken line indicates the torque when correcting to S type drive unit.

(2) HA Series

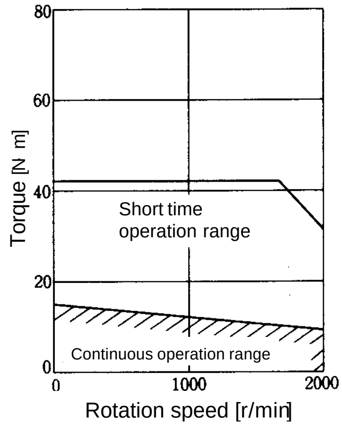
[HA40N]



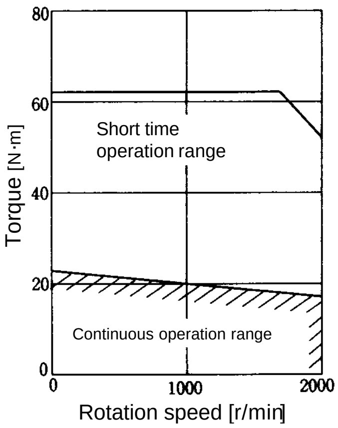
[HA80N]



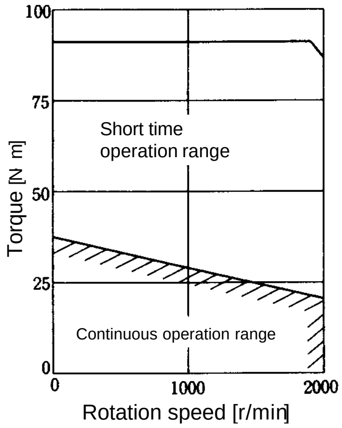
[HA100N]



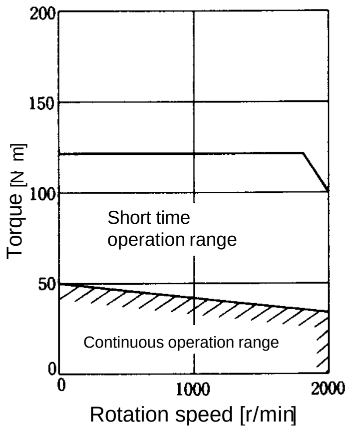
[HA200N]



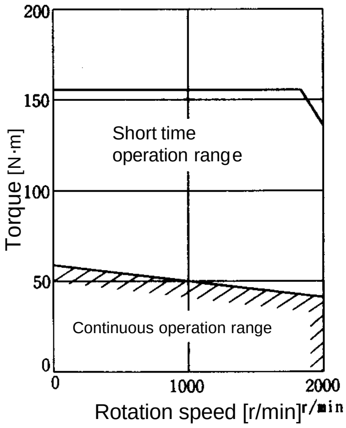
[HA300N]



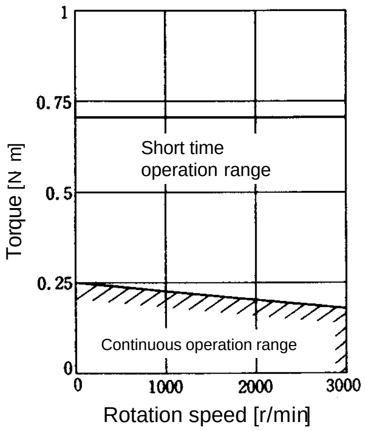
[HA700N]



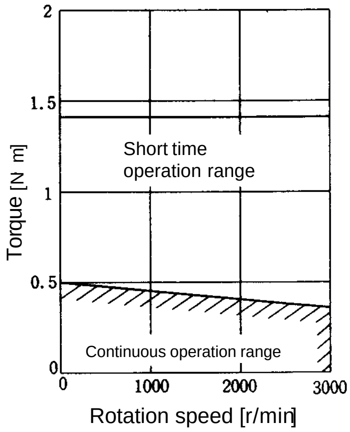
[HA900N]



[HA053N]

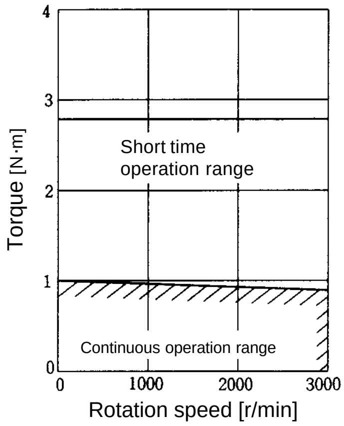


[HA13N]

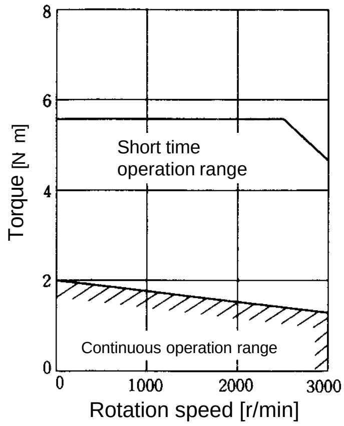


* The above graphs show the data for the input voltage of 200VAC.

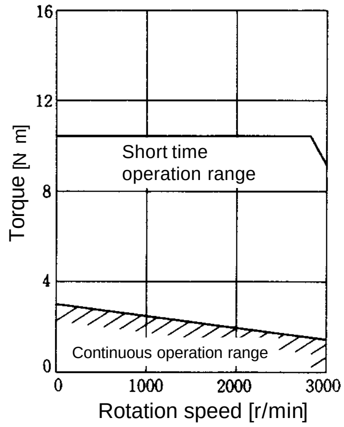
[HA23N]



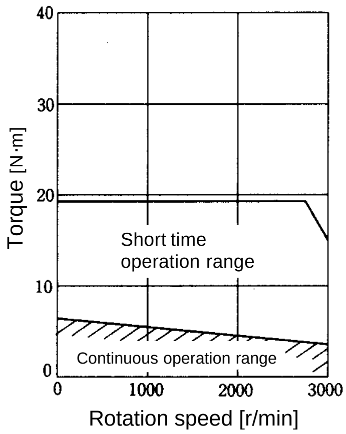
[HA33N]



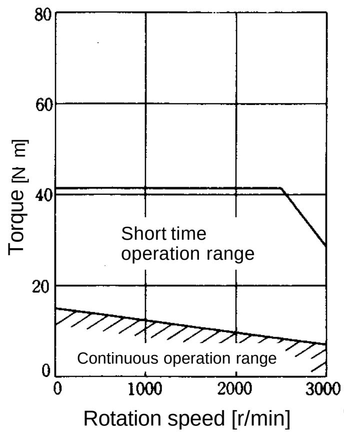
[HA43N]



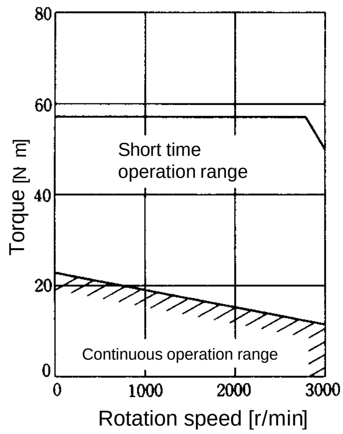
[HA83N]



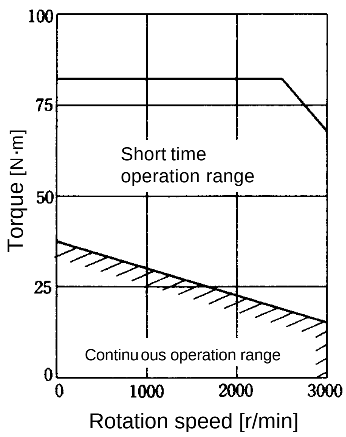
[HA103N]



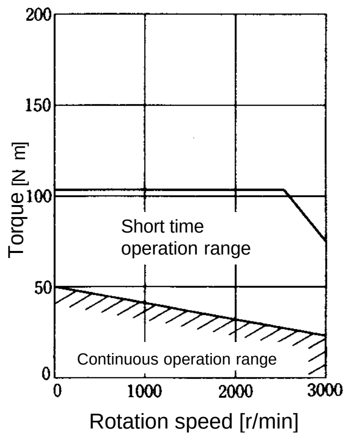
[HA203N]



[HA303N]

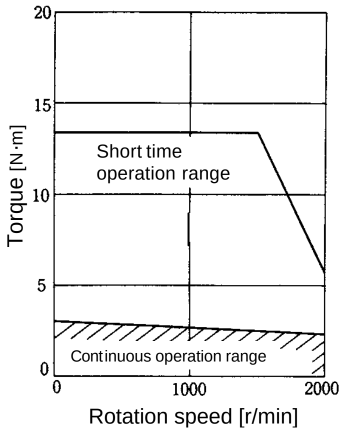


[HA703N]

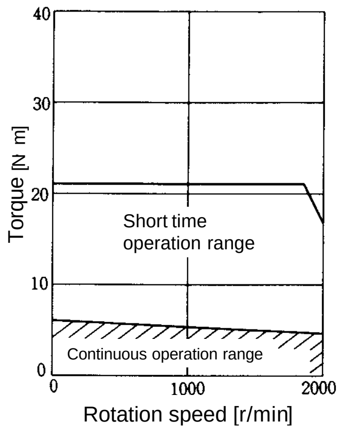


* The above graphs show the data for the input voltage of 200VAC.

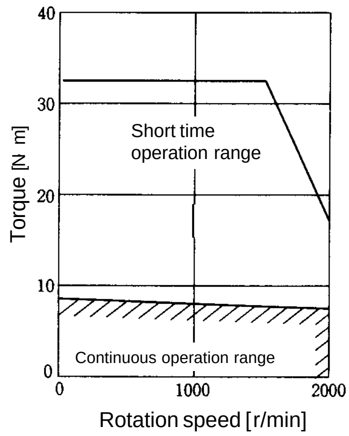
[HA50NL]



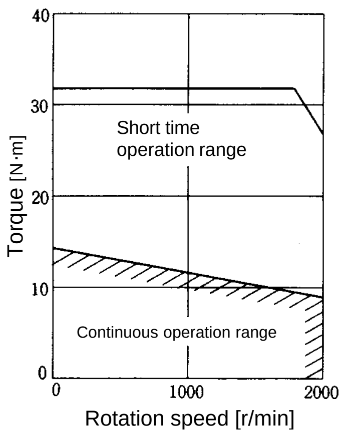
[HA100NL]



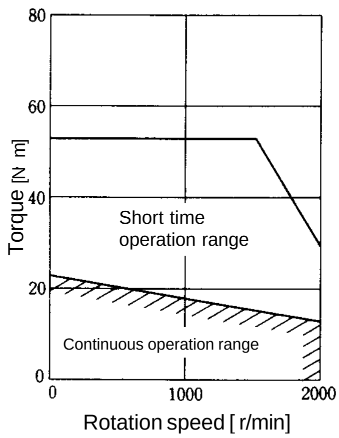
[HA150NL]



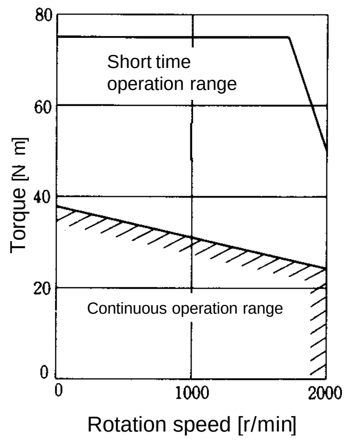
[HA200NL]



[HA300NL]

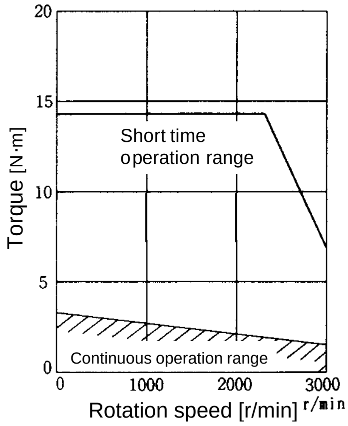


[HA500NL]

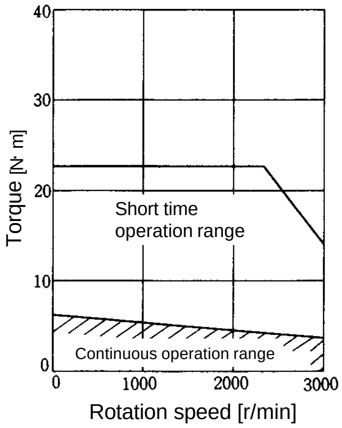


* The above graphs show the data for the input voltage of 200VAC.

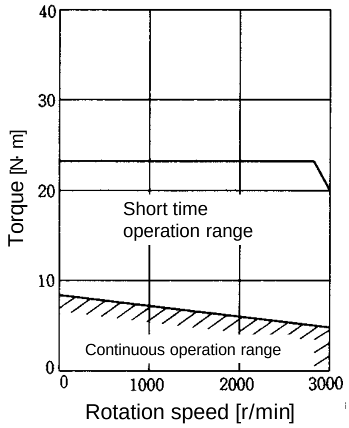
[HA53NL]



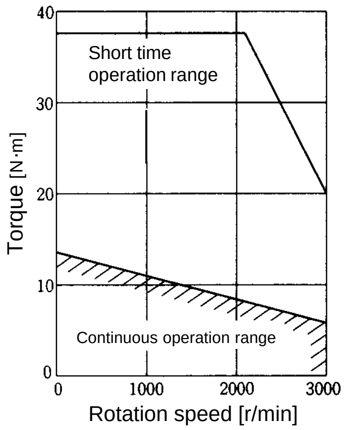
[HA103NL]



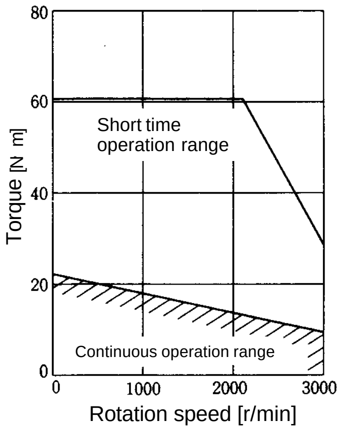
[HA153NL]



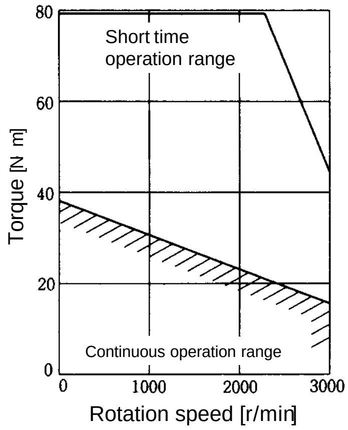
[HA203NL]



[HA303NL]

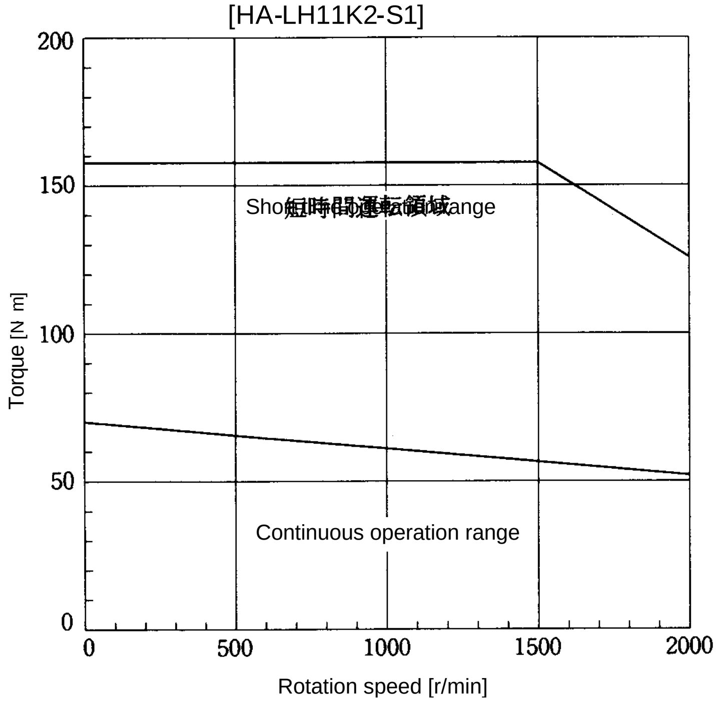


[HA503NL]

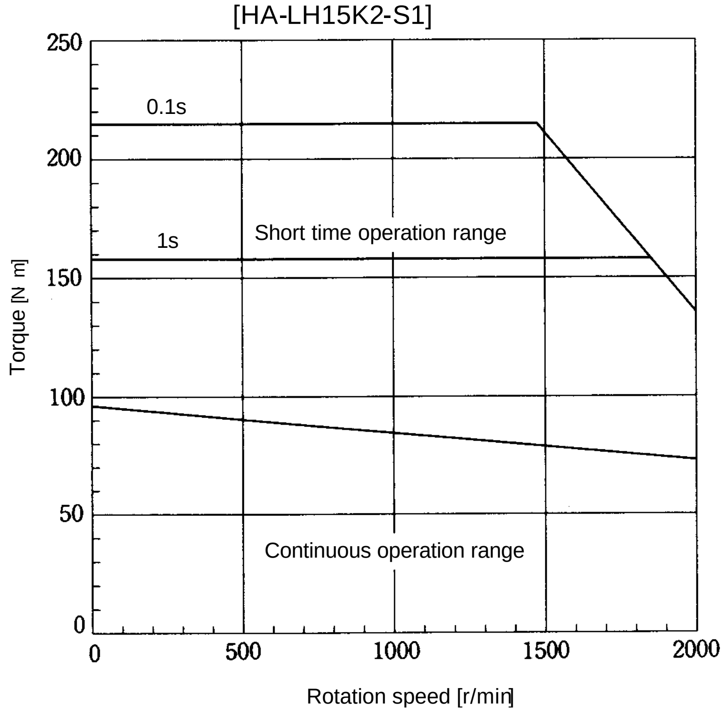


* The above graphs show the data for the input voltage of 200VAC.

[HA-LH11K2-S1]



[HA-LH15K2-S1]



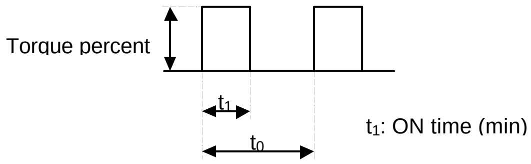
When using a combination of the HA-LH15K2-S1 and V1-150, the short time operation range is further subdivided by the operation time.

(Note) The above torque characteristics are for a 200V power voltage.

These characteristics are not guaranteed when the power voltage drops.

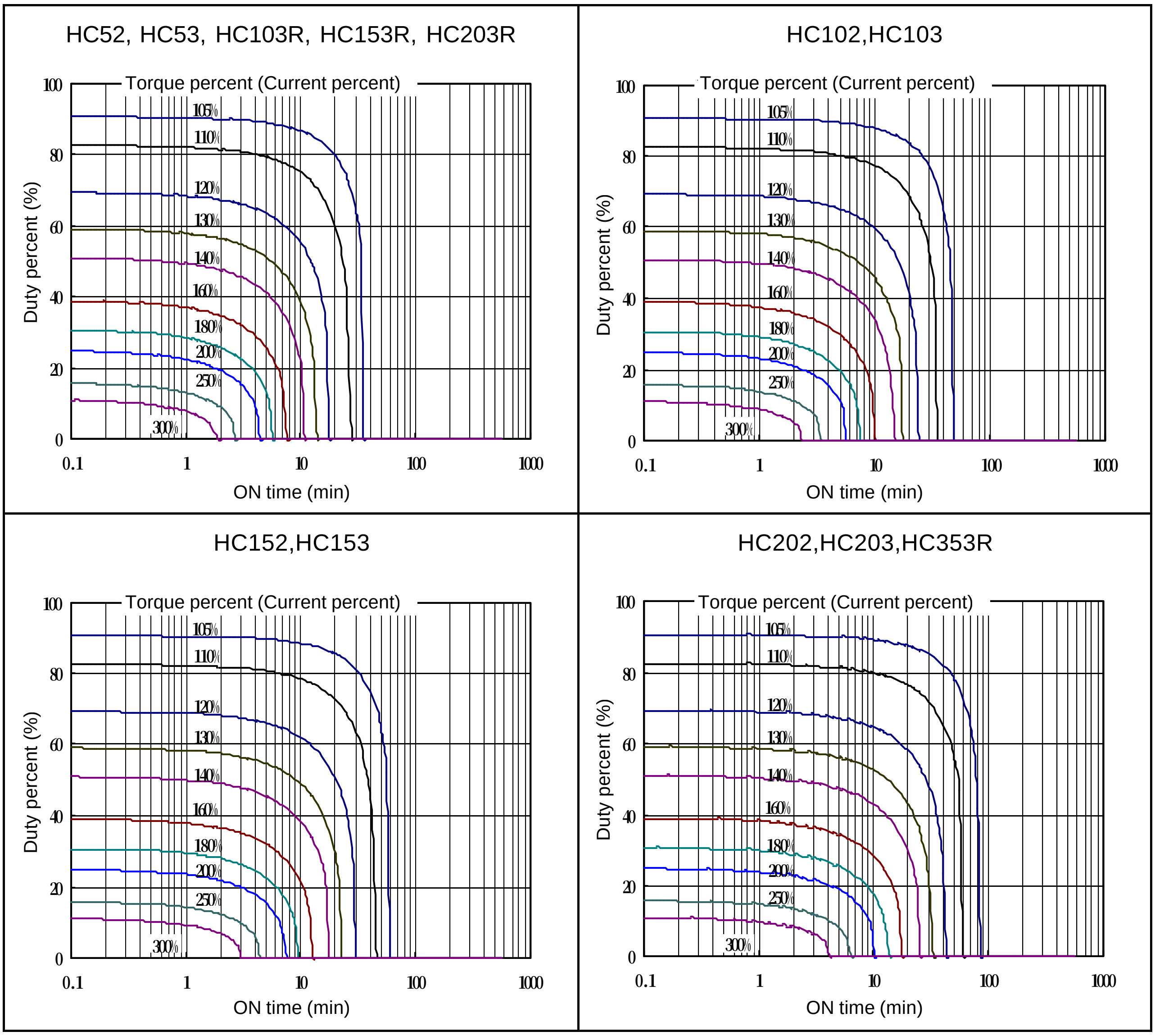
2.6 Duty drive characteristics

The duty-drive characteristics are calculated from the motor's armature coil temperature upper limit degree and the thermal constants. The output limit characteristics for the motor during rotation are expressed. If this limit is exceeded, the motor's thermal protect will be activated and motor overheat (ALM46) will be detected.
In the actual servo system, the electronic thermal protection control is carried out inside the servo drive unit with software operation, so this characteristic may be limited by the servo drive unit.

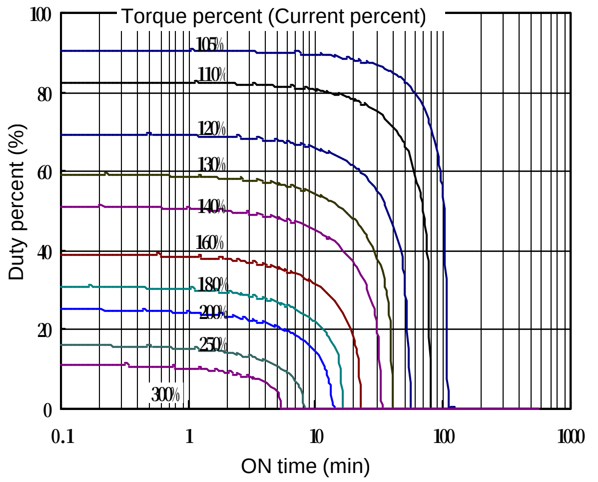


$$\text{Duty percent} = \frac{t_1}{t_0} \times 100\ (\%)$$

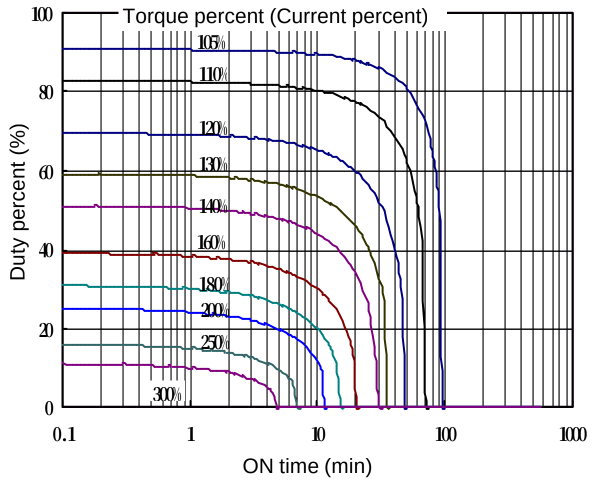
(1) HC Series, HC**R Series



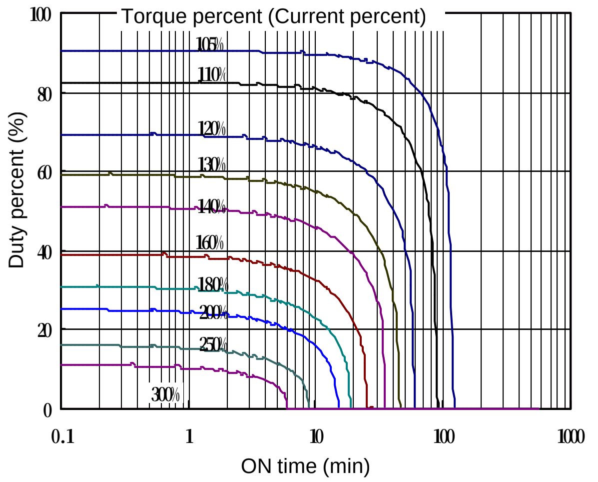
HC352, HC353



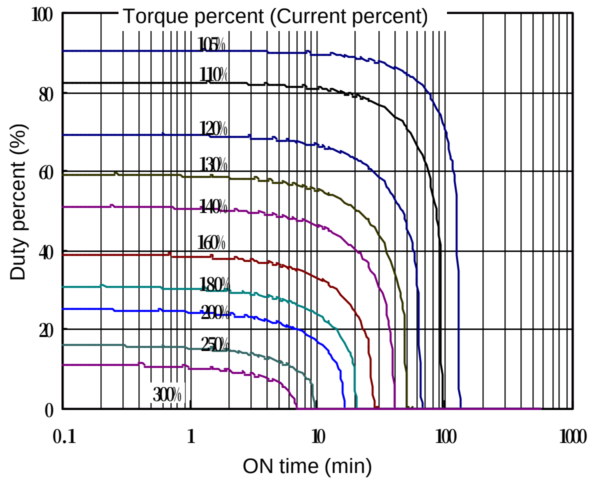
HC503R



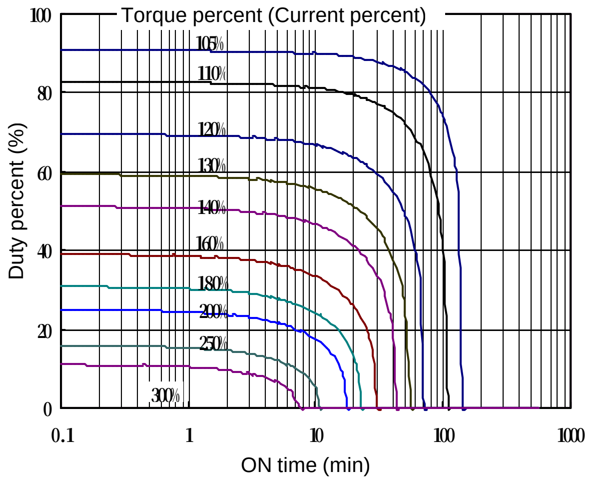
HC452,HC453



HC702,HC703

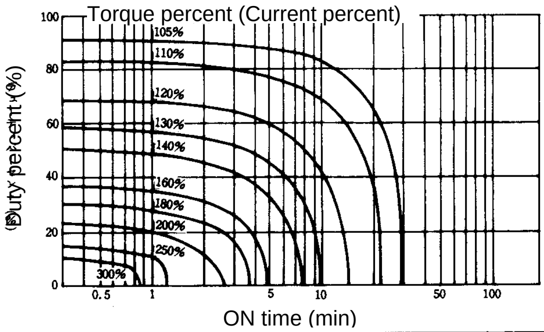


HC902

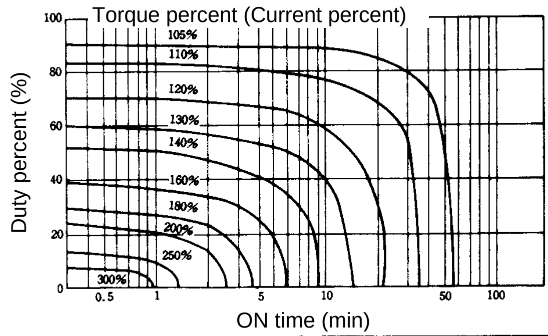


(2) HA Series

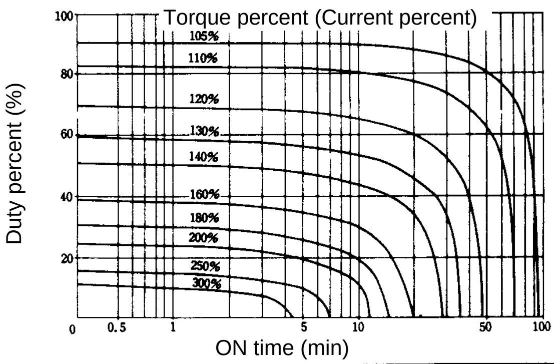
HA053, HA13



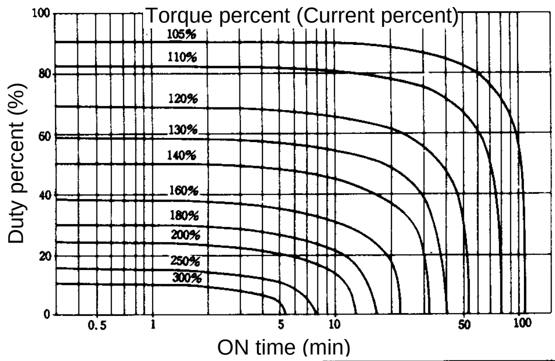
HA23N, HA33N



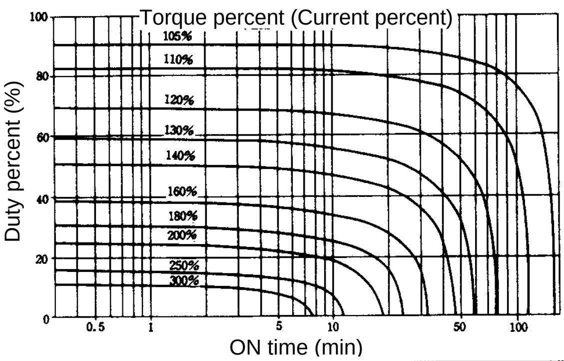
HA40N, HA43N, HA50NL, HA53NL



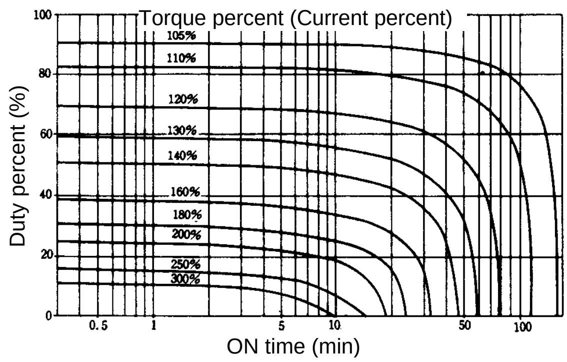
HA80N, HA83N, HA100NL, HA103NL
HA150NL, HA153NL



HA100N, HA103N, HA200NL, HA203NL



HA200N, HA203N, HA300NL, HA303NL
HA300N, HA303N, HA500NL, HA503NL
HA700N, HA703N
HA900N



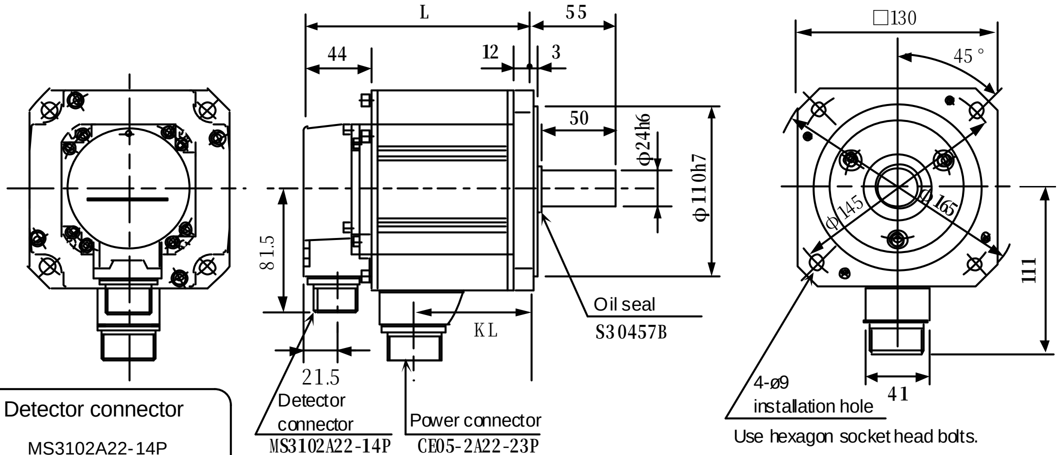
2.7 Outline dimension drawings

(1) HC Series

- HC52(B)S • HC52(B)T
- HC102(B)S • HC102(B)T
- HC152(B)S • HC152(B)T

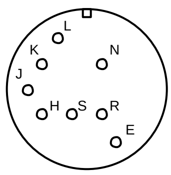
- HC53(B)S • HC53(B)T
- HC103(B)S • HC103(B)T
- HC153(B)S • HC153(B)T

[Unit:mm]

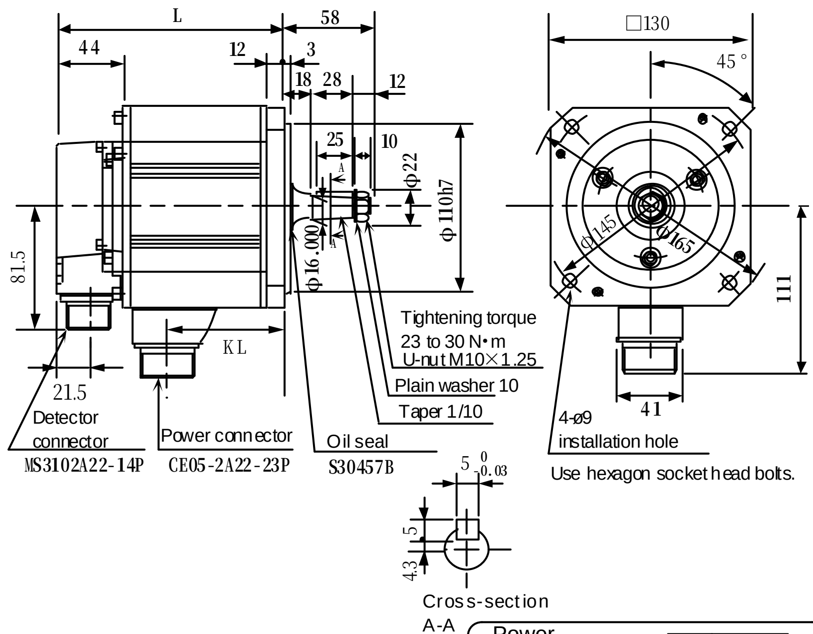


Detector connector

MS3102A22-14P



Pin	Signal
A	
B	
C	
D	
E	BT
F	
G	
H	SD
J	$\overline{SD}$
K	RQ
L	$\overline{RQ}$
M	
N	SD
P	
R	5G
S	+5V
T	
U	
V	



The detector connector is common for all HC Series.

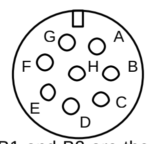
Motor model		L **(Note 1)**	KL
2000r/min	3000r/min		
HC52(B)□	HC53(B)□	125 (158)	51.5
HC102(B)□	HC103(B)□	150 (183)	76.5
HC152(B)□	HC153(B)□	175 (208)	101.5

Note 1. The dimensions given in parentheses are for when magnetic brakes are provided.

Note 2. Use a friction coupling (Spun ring, etc.) to connect with the load.

Power connector

CE05-2A22-23P

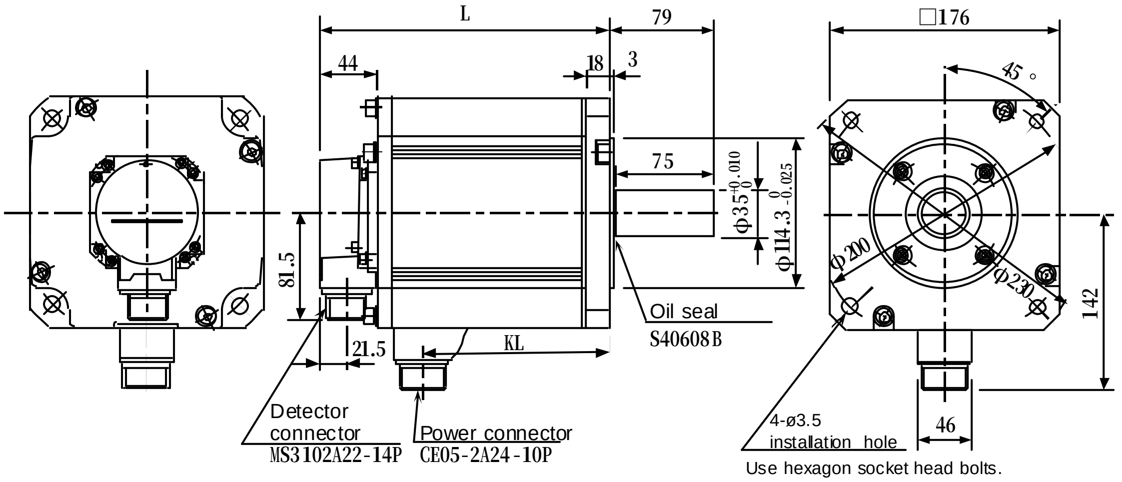


Pin	Signal
A	U
B	V
C	W
D	⏚ Ground
E	
F	
G	B1
H	B2

B1 and B2 are the brake terminals.
(Only for motor with brakes.)
There is no need for concern regarding the polarity when supplying 24VDC.

- HC202S
- HC203S
- HC352S
- HC353S
- HC452S

[Unit:mm]



Motor model		L	KL
2000r/min	3000r/min		
HC202S	HC203S	150	69
HC352S	HC353S	192	111
HC452S	—	234	153

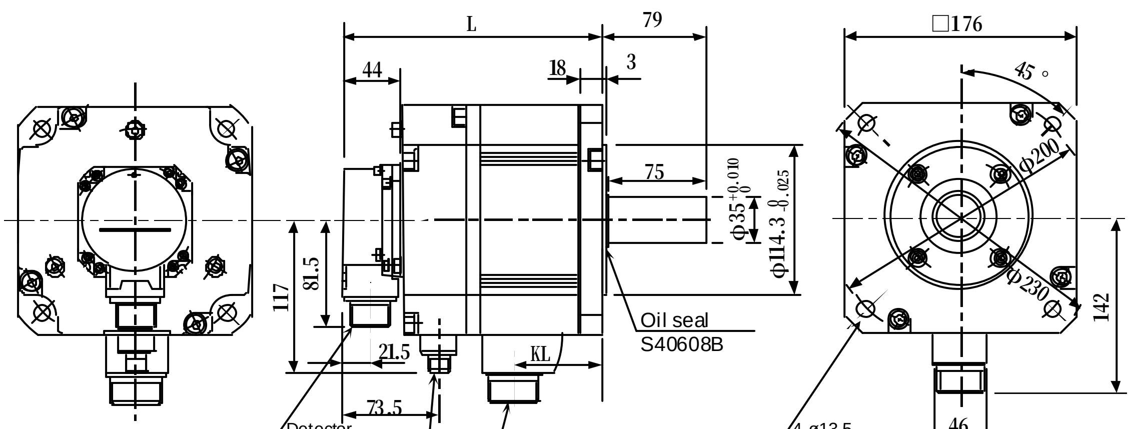
Note 1. Use a friction coupling (Spun ring, etc.) to connect with the load.

Power connector
CE05-2A24-10P

Pin	Signal
A	U
B	V
C	W
D	⏚ Ground
E	
F	
G	

- HC202BS
- HC203BS
- HC352BS
- HC353BS
- HC452BS

[Unit:mm]



Brake
MS3102A10SL-4P

Pin	Signal
A	B1
B	B2

There is no need for concern regarding the polarity when supplying 24VDC.

Motor model		L	KL
2000r/min	3000r/min		
HC202BS	HC203BS	198	69
HC352BS	HC353BS	240	111
HC452BS	–	282	153

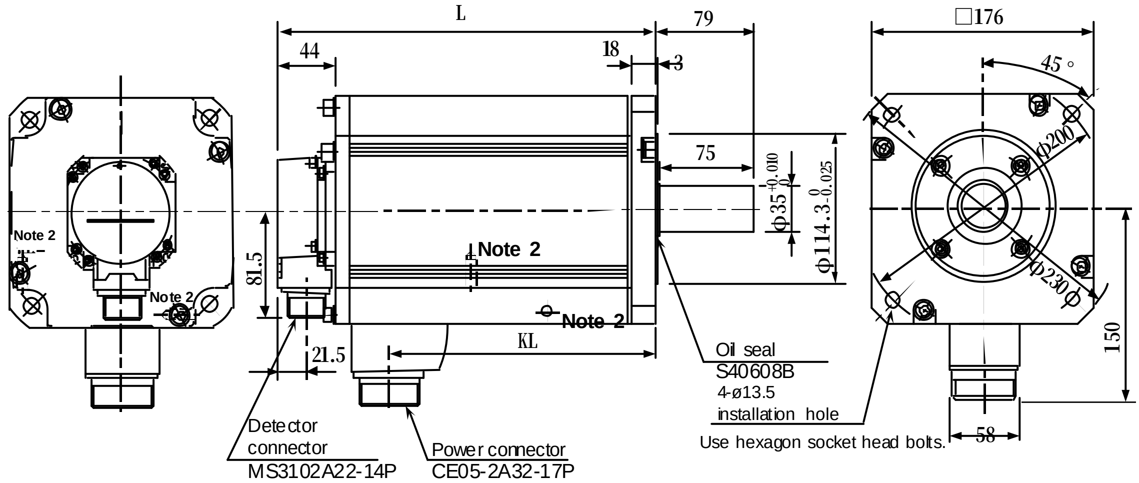
Note 1. Use a friction coupling (Spun ring, etc.) to connect with the load.

Power connector
CE05-2A24-10P

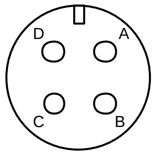
Pin	Signal
A	U
B	V
C	W
D	⏚ Ground
E	
F	
G	

- HC702S
- HC453S
- HC703S

[Unit:mm]



Power connector
CE05-2A32-17P



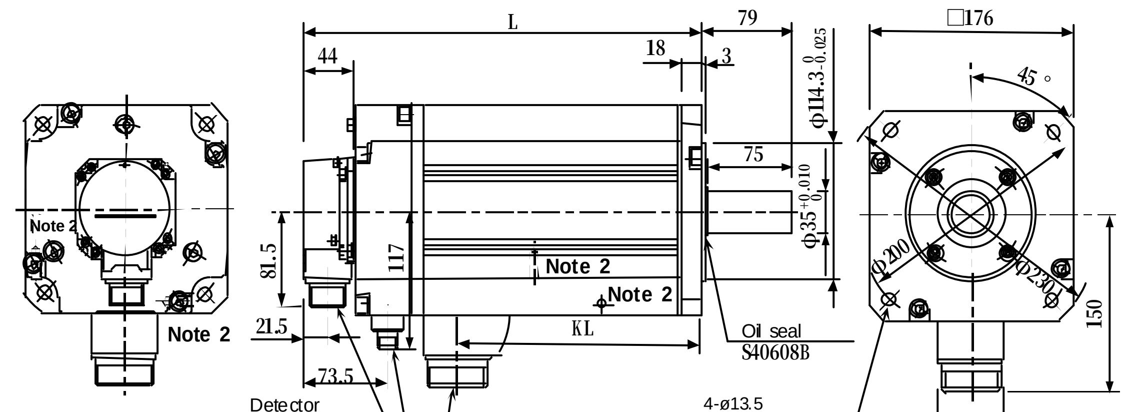
Pin	Signal
A	U
B	V
C	W
D	⏚ Ground

Motor model		L	KL
2000r/min	3000r/min		
—	HC453S	234	148
HC702S	HC703S	297	211

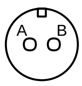
Note 1. Use a friction coupling (Spun ring, etc.) to connect with the load.
Note 2. Only HC702S and HC703S have screw holes for hanging bolt (M8).

- HC702BS
- HC453BS
- HC703BS

[Unit:mm]



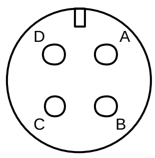
Brake
MS3102A10SL-4P



Pin	Signal
A	B1
B	B2

There is no need for concern regarding the polarity when supplying 24VDC.

Power connector
CE05-2A32-17P



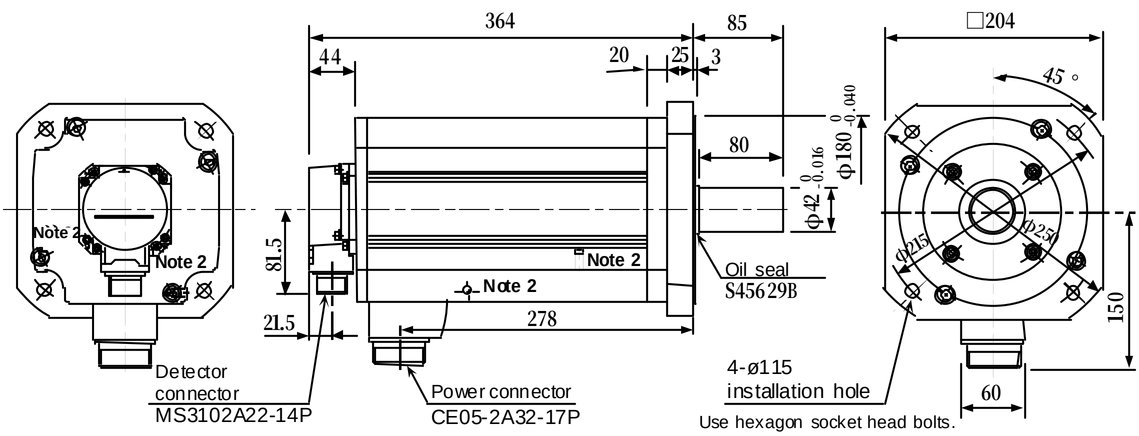
Pin	Signal
A	U
B	V
C	W
D	⏚ Ground

Motor model		L	KL
2000r/min	3000r/min		
—	HC453BS	282	148
HC702BS	HC703BS	345	211

Note 1. Use a friction coupling (Spun ring, etc.) to connect with the load.
Note 2. Only HC702BS and HC703BS have screw holes for hanging bolt (M8).

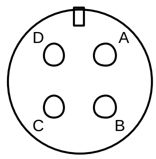
• HC902S

[Unit:mm]



Note 1. Use a friction coupling (Spun ring, etc.) to connect with the load.
Note 2. These are screw holes for hanging bolt (M8).

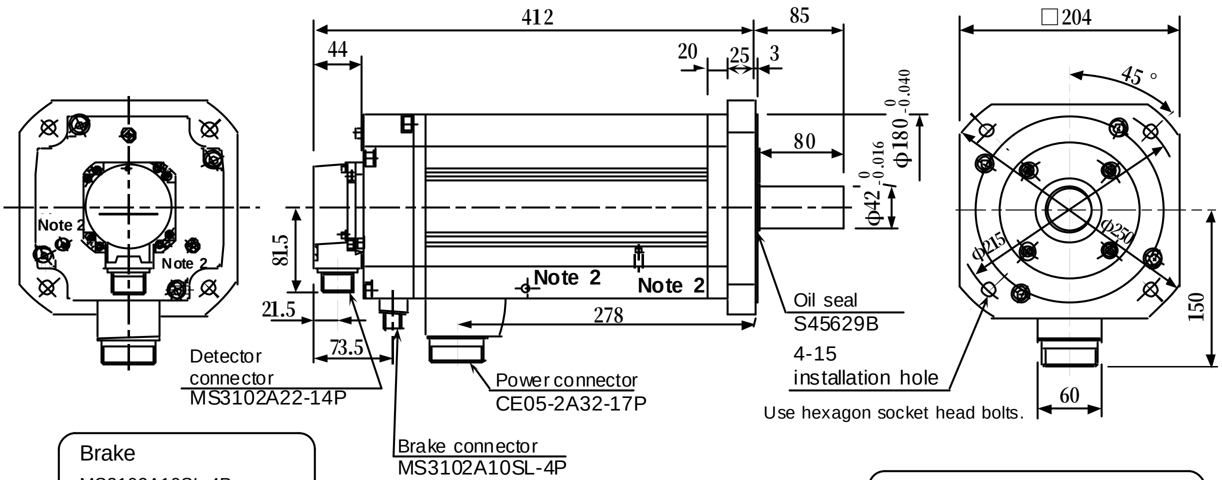
Power connector
CE05-2A32-17P



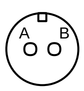
Pin	Signal
A	U
B	V
C	W
D	⏚ Ground

• HC902BS

[Unit:mm]



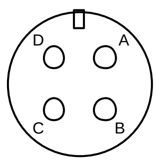
Brake
MS3102A10SL-4P



Pin	Signal
A	B1
B	B2

There is no need for concern regarding the polarity when supplying 24VDC.

Power connector
CE05-2A32-17P



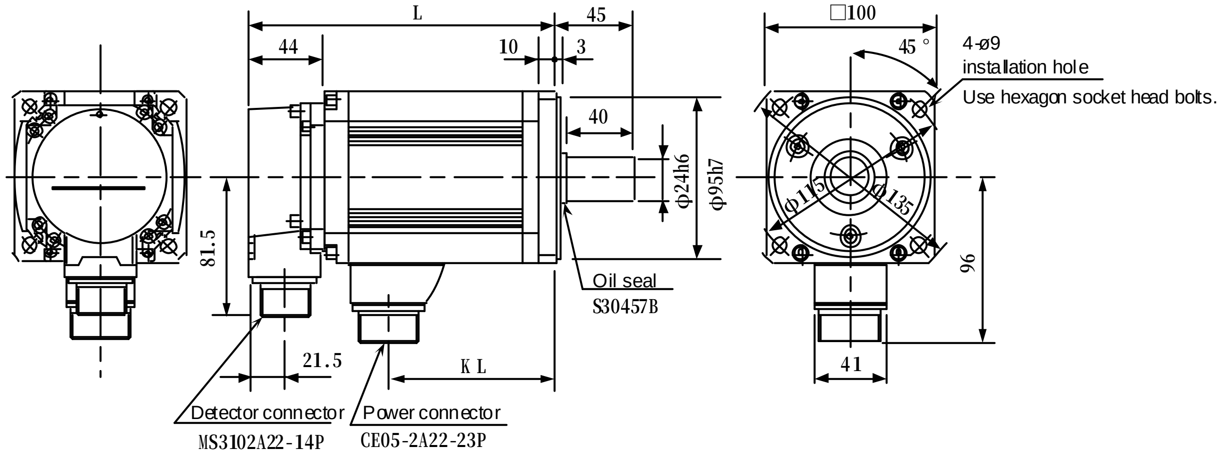
Pin	Signal
A	U
B	V
C	W
D	⏚ Ground

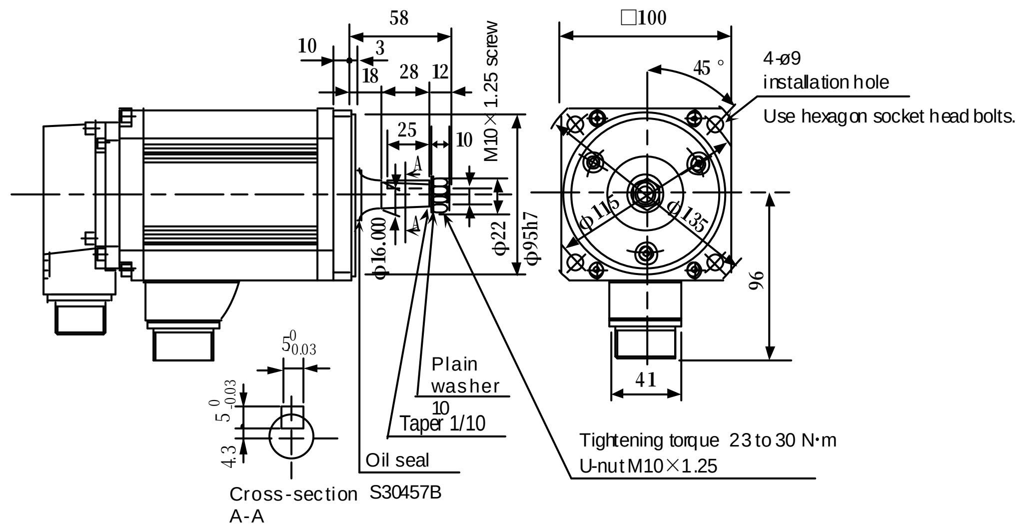
Note 1. Use a friction coupling (Spun ring, etc.) to connect with the load.
Note 2. These are screw holes for hanging bolt (M8).

(2) HC＊＊R Series

- HC103R(B)S • HC103R(B)T
- HC153R(B)S • HC153R(B)T
- HC203R(B)S • HC203R(B)T

[Unit:mm]



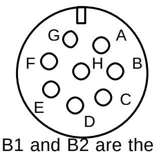


Motor model	L (Note 1)	KL
HC103R(B)□	152 (189)	71
HC153R(B)□	177 (214)	96
HC203R(B)□	202 (239)	121

Note 1. The dimensions given in parentheses are for when magnetic brakes are provided.

Note 2. Use a friction coupling (Spun ring, etc.) to connect with the load.

Power connector
CE05-2A22-23P

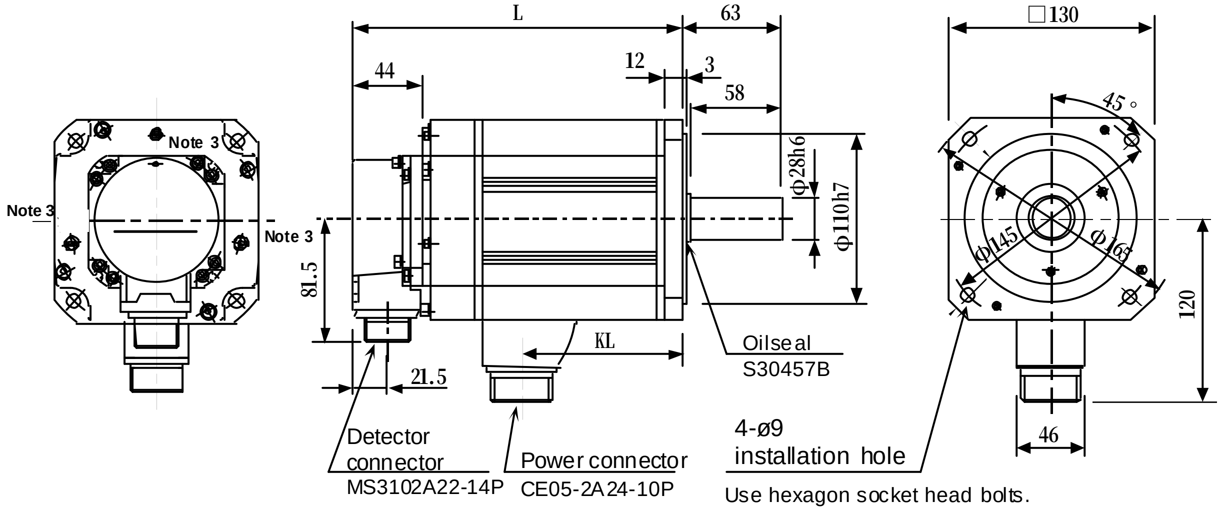


Pin	Signal
A	U
B	V
C	W
D	Ground
E	
F	
G	B1
H	B2

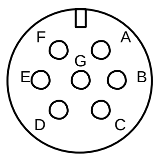
B1 and B2 are the brake terminals. (Only for motor with brakes.)
There is no need for concern regarding the polarity when supplying 24VDC.

- HC353R(B)S
- HC503R(B)S

[Unit:mm]



Power connector
CE05-2A24-10P



Pin	Signal
A	U
B	V
C	W
D	Ground
E	B1
F	B2
G	
H	

B1 and B2 are the brake terminals.
(Only for motor with brakes.)
There is no need for concern regarding the polarity when supplying 24VDC.

Motor model	L (Note 1)	KL
HC353R(B)S	222 (258)	148
HC503R(B)S	279 (315)	205

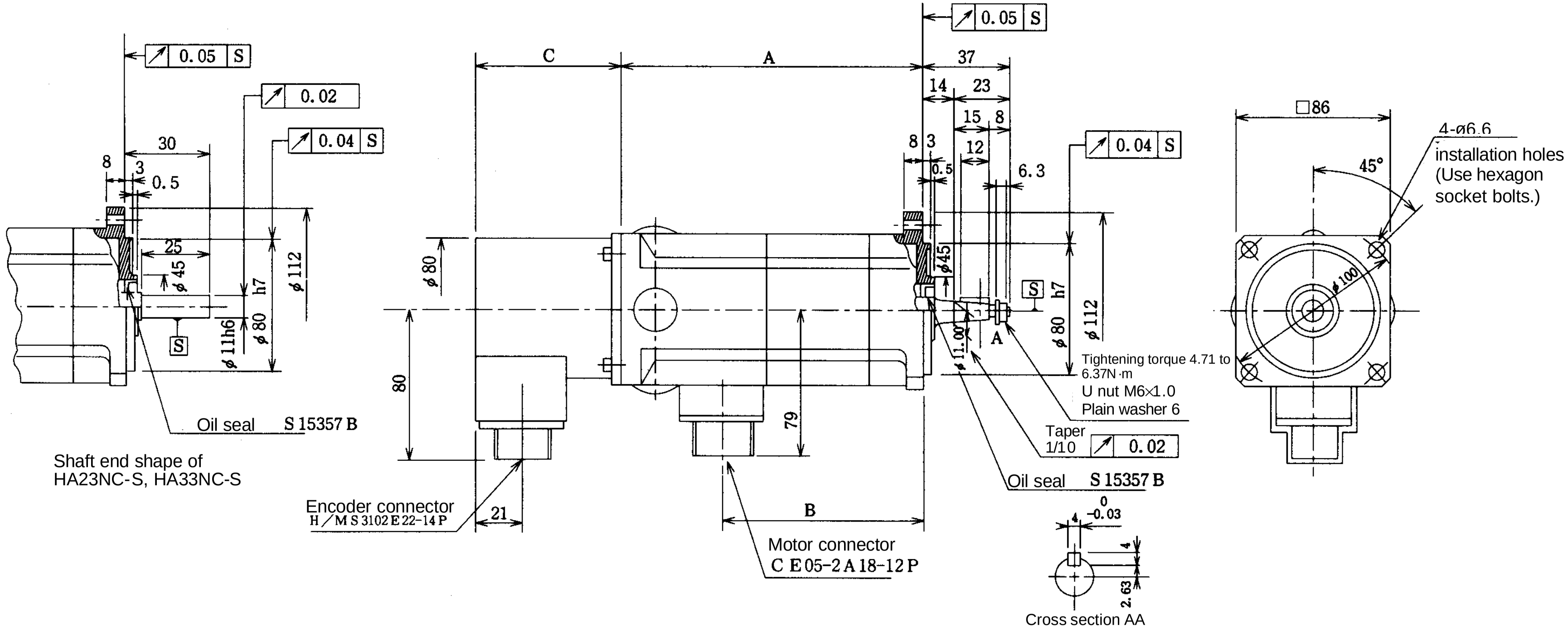
Note 1. The dimensions given in parentheses are for when magnetic brakes are provided.
Note 2. Use a friction coupling (Spun ring, etc.) to connect with the load.
Note 3. Only for models with electromagnetic brakes.

(3) HA Series

Motor model	Dimensions A	Dimensions B	Weight	Tolerable shaft end radial load	Shaft shape
HA23NC-TS	125	81	3.5kg	25kg	Tapered shaft
HA33NC-TS	155	111	4.5kg		
HA23NC-S	125	81	3.5kg		Straight shaft
HA33NC-S	155	111	4.5kg		

Serial encoder		
Spec.	Model	Dimensions C
INC	OSE104S/OSE105S	45
ABS	OSA104S/OSA105S	45

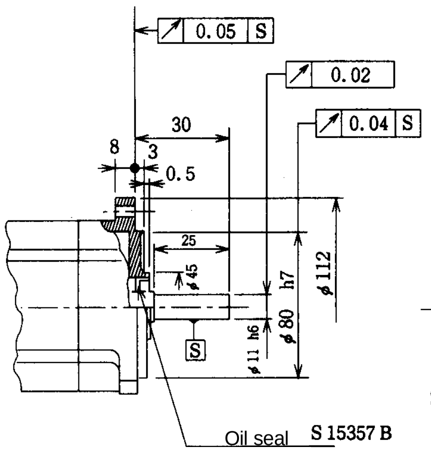
Notes: 1. It is recommended that the cannon connector be mounted in a downward orientation to improve its splash-proof performance.
2. The wiring side plug is optional. It is only provided when ordered.



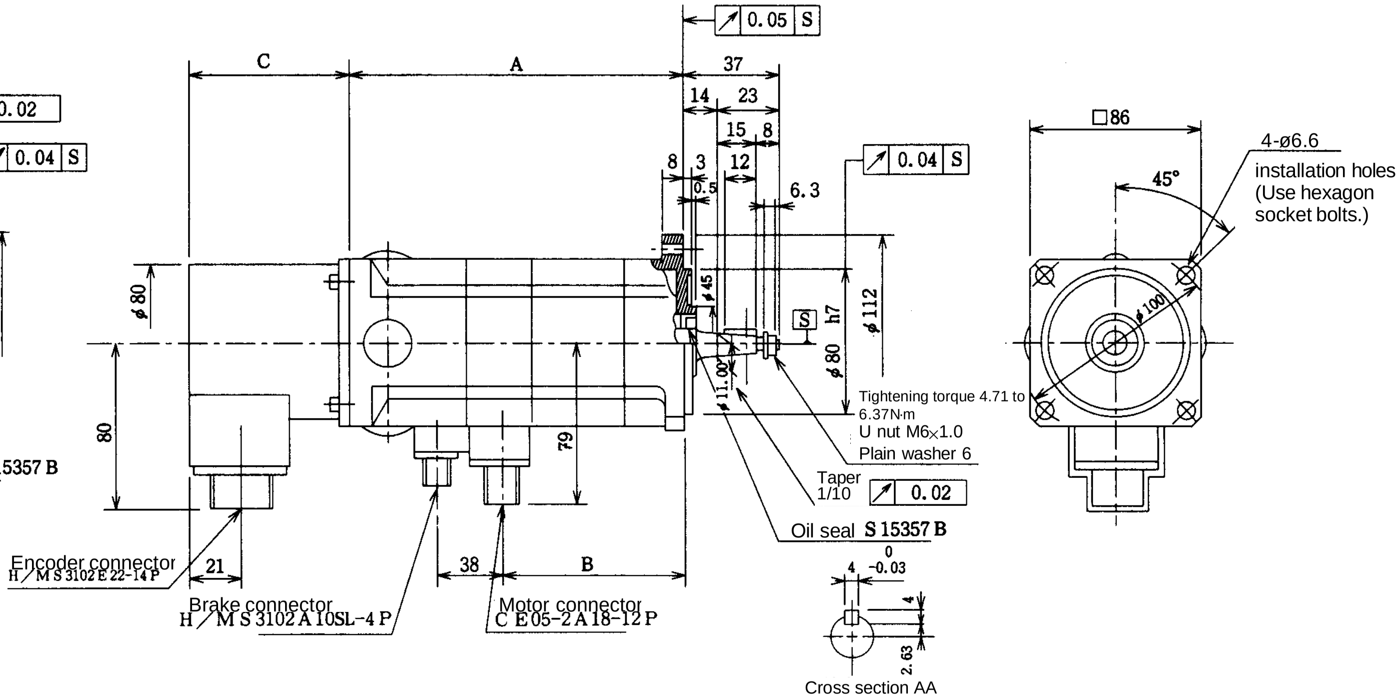
Motor model	Dimensions A	Dimensions B	Weight	Tolerable shaft end radial load	Shaft shape
HA23NCB-TS	162	81	4.5kg	25kg	Tapered shaft
HA33NCB-TS	192	111	5.5kg		
HA23NCB-S	162	81	4.5kg		Straight shaft
HA33NCB-S	192	111	5.5kg		

Serial encoder		
Spec.	Model	Dimensions C
INC	OSE104S/OSE105S	45
ABS	OSA104S/OSA105S	45

Notes: 1. It is recommended that the cannon connector be mounted in a downward orientation to improve its splash-proof performance.
2. The wiring side plug is optional. It is only provided when ordered.

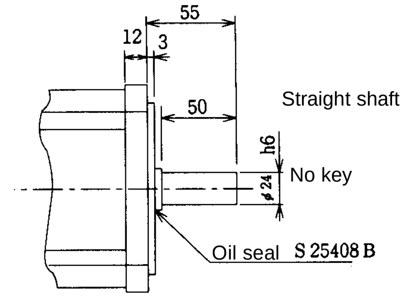


Shaft end shape of
HA23NCB-S, HA33NCB-S

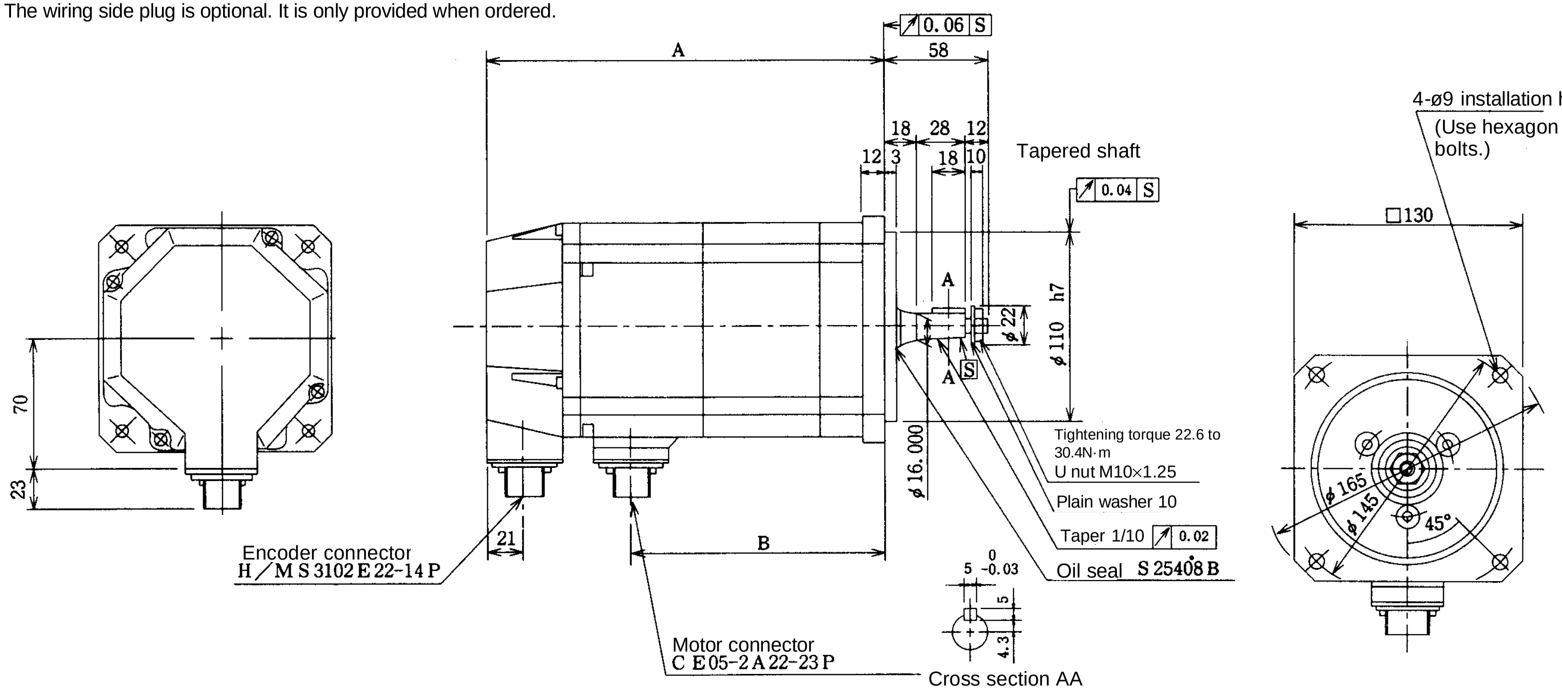


Motor model	Dimensions		Weight	Tolerable shaft end radial load (kg)	Shaft shape	Electro-magnetic brake
	A	B				
HA40NC-S·HA43NC-S	214	131	8kg	40	Tapered shaft	None
HA80NC-S·HA83NC-S	254	171	12kg			
HA40NCB-S·HA43NCB-S	270	131	10kg			5.88 N·m with 24VDC
HA80NCB-S·HA83NCB-S	310	171	14kg			
HA40NC-SS·HA43NC-SS	214	131	8kg	100	Straight shaft	None
HA80NC-SS·HA83NC-SS	254	171	12kg			
HA40NCB-SS·HA43NCB-SS	270	131	10kg			5.88 N·m with 24VDC
HA80NCB-SS·HA83NCB-SS	310	171	14kg			

Encoder	
INC	OSE104, OSE105
ABS	OSA104, OSA105



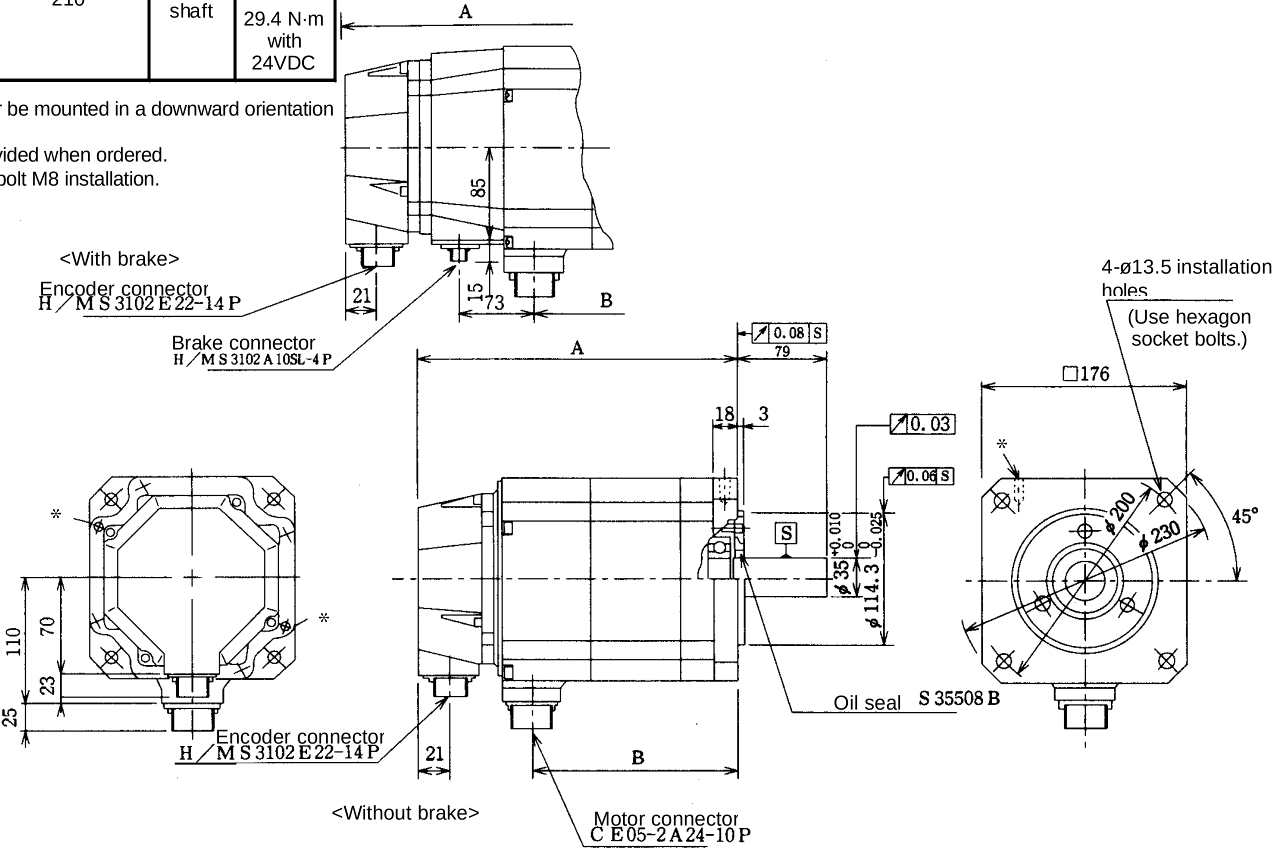
Notes: 1. It is recommended that the cannon connector be mounted in a downward orientation to improve its splash-proof performance.
2. The wiring side plug is optional. It is only provided when ordered.



Motor model	Dimensions A	Dimensions B	Weight	Tolerable shaft end radial load (kg)	Shaft shape	Electro-magnetic brake
HA100NC-S·HA103NC-S	260	179	21kg	210	Straight shaft	None
HA200NC-S·HA203NC-S	328	247	32kg			
HA300NC-S	396	315	42kg			
HA100NCB-S·HA103NCB-S	336	179	27kg			29.4 N·m with 24VDC
HA200NCB-S·HA203NCB-S	404	247	38kg			
HA300NCB-S	472	315	47kg			

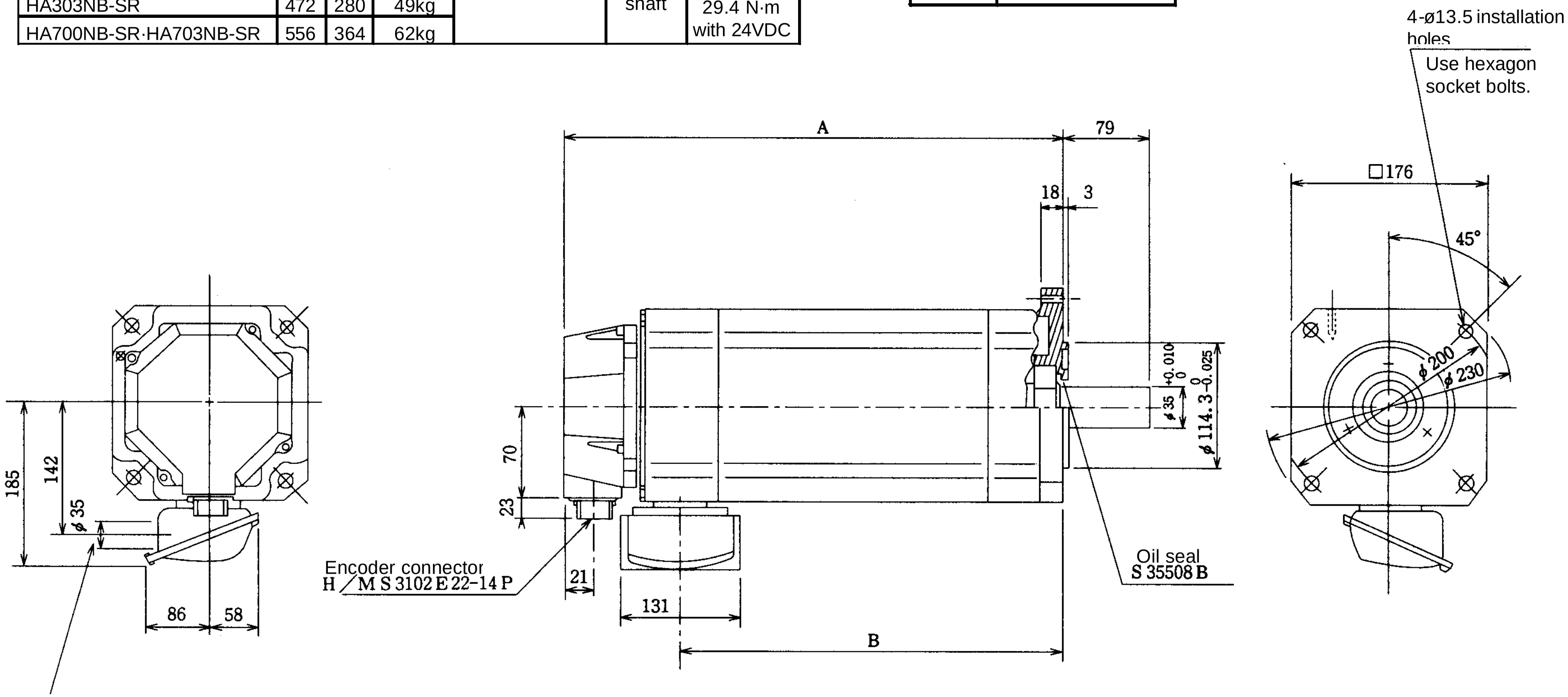
Encoder	
INC	OSE104, OSE105
ABS	OSA104, OSA105

Notes: 1. It is recommended that the cannon connector be mounted in a downward orientation to improve its splash-proof performance.
2. The wiring side plug is optional. It is only provided when ordered.
3. Holes marked with * are screw holes for eyebolt M8 installation.



Motor model	Dimen-sions		Weight	Tolerable shaft end radial load (kg)	Shaft shape	Electro-magnetic brake
	A	B				
HA303N-SR	395	280	43kg	210	Straight shaft	None
HA700N-SR·HA703N-SR	479	364	56kg			
HA303NB-SR	472	280	49kg			29.4 N·m with 24VDC
HA700NB-SR·HA703NB-SR	556	364	62kg			

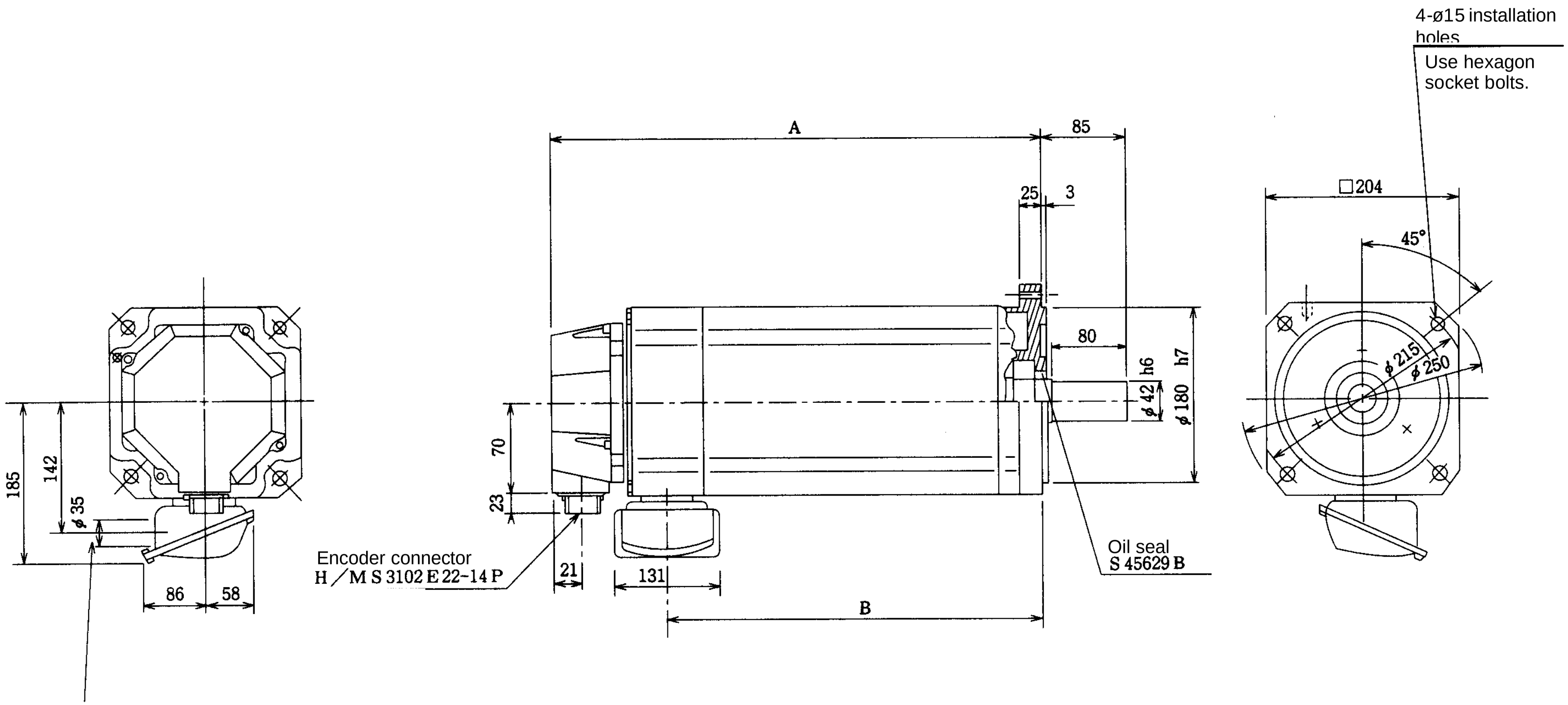
Encoder	
INC	OSE104, OSE105
ABS	OSA104, OSA105



The motor terminal box lead outlet direction can be changed forward/backward/right/left with a 90° angle.
A steel sealed type terminal box is used.

Motor model	Dimensions		Weight	Tolerable shaft end radial load (kg)	Shaft shape	Electro-magnetic brake
	A	B				
HA900N-SR	565	450	79kg	250	Straight shaft	None
HA900NB-SR	642	450	85kg			29.4 N·m with 24VDC

Encoder	
INC	OSE104, OSE105
ABS	OSA104, OSA105

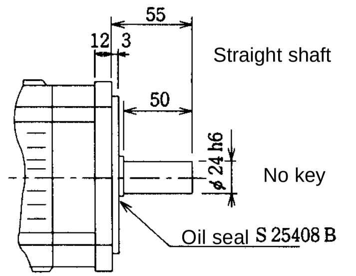


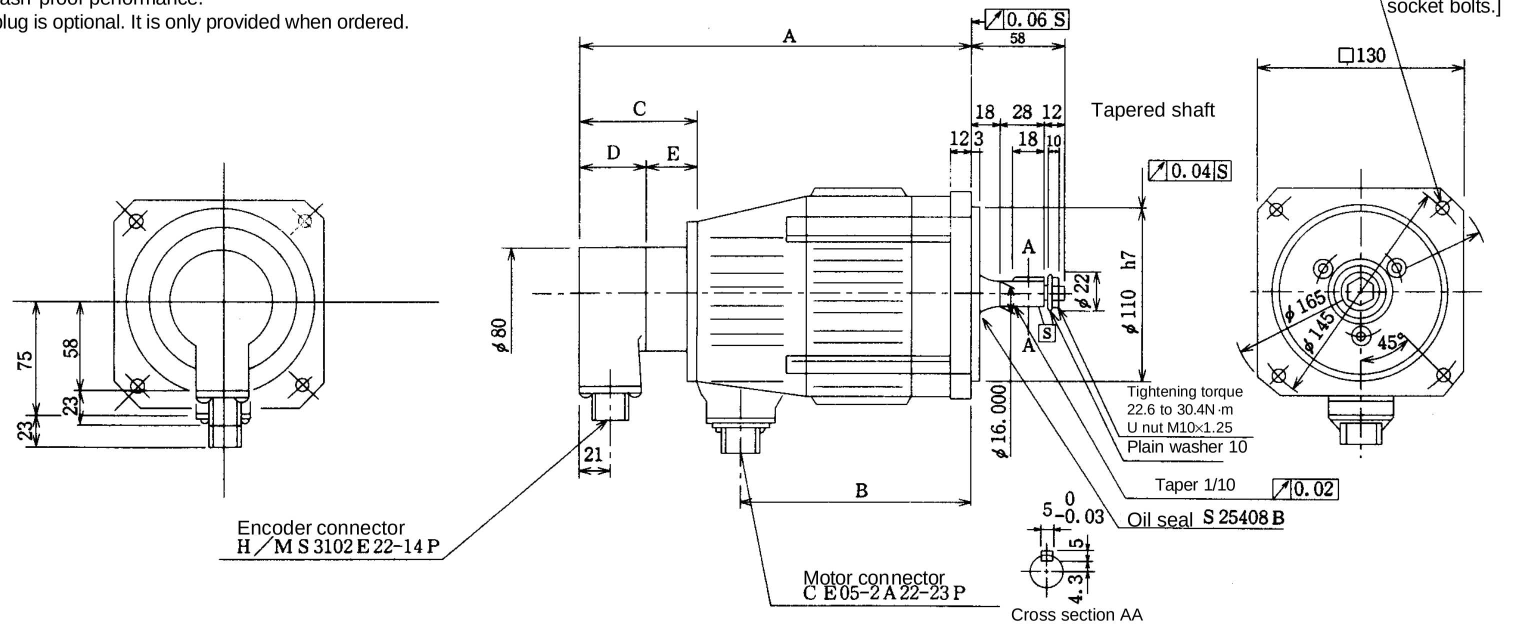
The motor terminal box lead outlet direction can be changed forward/backward/right/left with a 90° angle.
A steel sealed type terminal box is used.

Motor model	Dimensions A		Dimensions B	Weight	Tolerable shaft end radial load	Shaft shape
	OHE/OHA type	OSE/OSA type				
HA50LC-TS·HA53LC-TS	238	213	117	6.5kg	40kg	Tapered shaft
HA100LC-TS·HA103LC-TS	278	253	157	9.5kg		
HA150LC-TS·HA153LC-TS	328	303	207	12.5kg		
HA50LC-S·HA53LC-S	238	213	117	6.5kg	100kg	Straight shaft
HA100LC-S·HA103LC-S	278	253	157	9.5kg		
HA150LC-S·HA153LC-S	328	303	207	12.5kg		
HA50NLC-TS·HA53NLC-TS	– – – –	213	117	6.5kg	40kg	Tapered shaft
HA100NLC-TS·HA103NLC-TS	– – – –	253	157	9.5kg		
HA150NLC-TS·HA153NLC-TS	– – – –	303	207	12.5kg		
HA50NLC-S·HA53NLC-S	– – – –	213	117	6.5kg	100kg	Straight shaft
HA100NLC-S·HA103NLC-S	– – – –	253	157	9.5kg		
HA150NLC-S·HA153NLC-S	– – – –	303	207	12.5kg		

Notes: 1. It is recommended that the cannon connector be mounted in a downward orientation to improve its splash-proof performance.
2. The wiring side plug is optional. It is only provided when ordered.

Serial encoder			
Spec.	Model	Encoder dim. D	Adaptor dim. E
INC	OSE104S/OSE105S	45	28
ABS	OSA104S/OSA105S	45	28

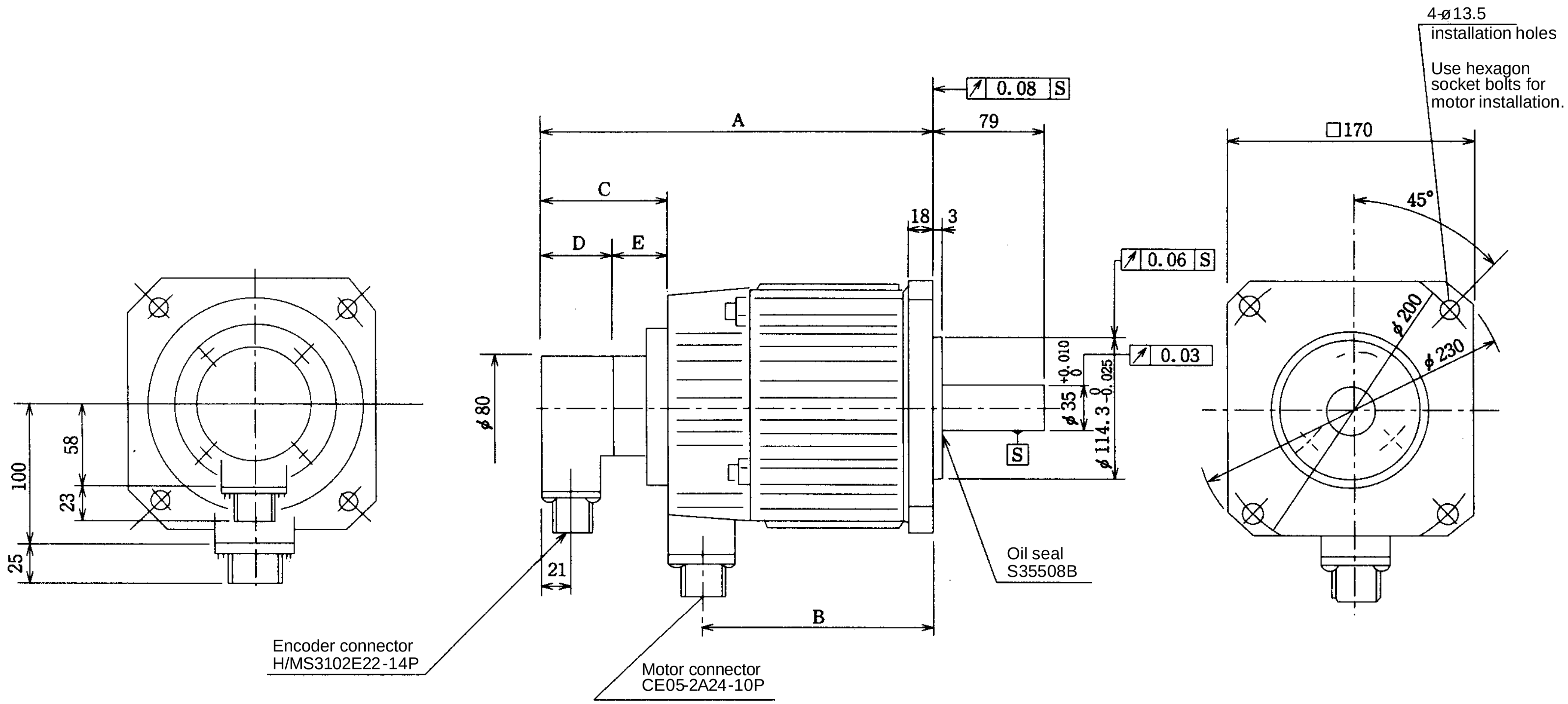




Motor model	Dimensions A		Dimen-sions B	Weight	Tolerable shaft end radial load	Shaft shape
	OHE/OHA type	OSE/OSA type				
HA200LC-S·HA203LC-S	293	268	171	16kg	210kg	Straight shaft
HA300LC-S·HA303LC-S	333	308	211	22kg		
HA200NLC-S·HA203NLC-S	– – – –	268	171	16kg		Straight shaft
HA300NLC-S·HA303NLC-S	– – – –	308	211	22kg		

Notes: 1. It is recommended that the cannon connector be mounted in a downward orientation to improve its splash-proof performance.
2. The wiring side plug is optional. It is only provided when ordered.

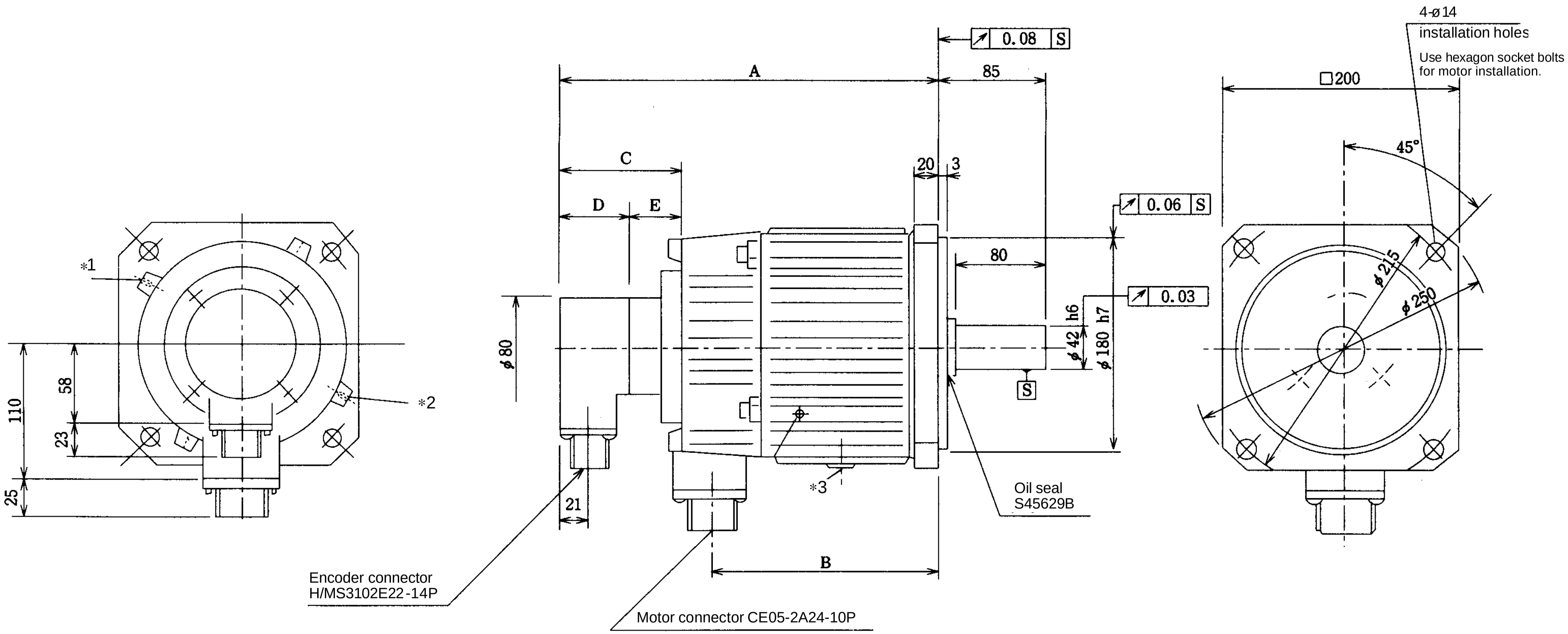
Serial encoder			
Spec.	Model	Encoder dim. D	Adaptor dim. E
INC	OSE104S/OSE105S	45	28
ABS	OSA104S/OSA105S	45	28



Motor model	Dimensions A		Dimen-sions B	Weight	Tolerable shaft end radial load	Shaft shape
	OHE/OHA type	OSE/OSA type				
HA500LC-S	363	338	249	35kg	250kg	Straight shaft
HA500NLC-S	– – – –	338	249	35kg		Straight shaft

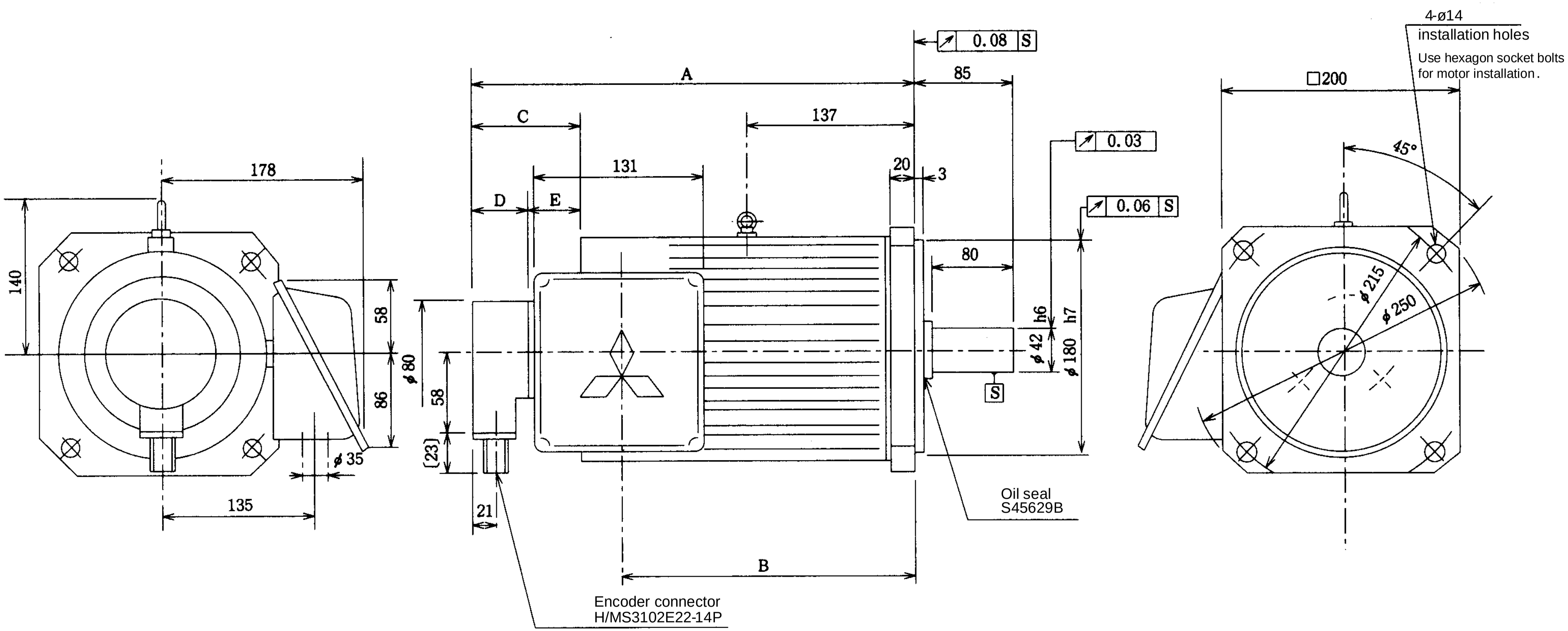
Serial encoder			
Spec.	Model	Encoder dim. D	Adaptor dim. E
INC	OSE104S/OSE105S	45	28
ABS	OSA104S/OSA105S	45	28

Notes: 1. It is recommended that the cannon connector be mounted in a downward orientation to improve its splash-proof performance.
2. The wiring side plug is optional. It is only provided when ordered.
3. M8 screw holes for hanging bolt are machined in the positions marked *1 to *3.

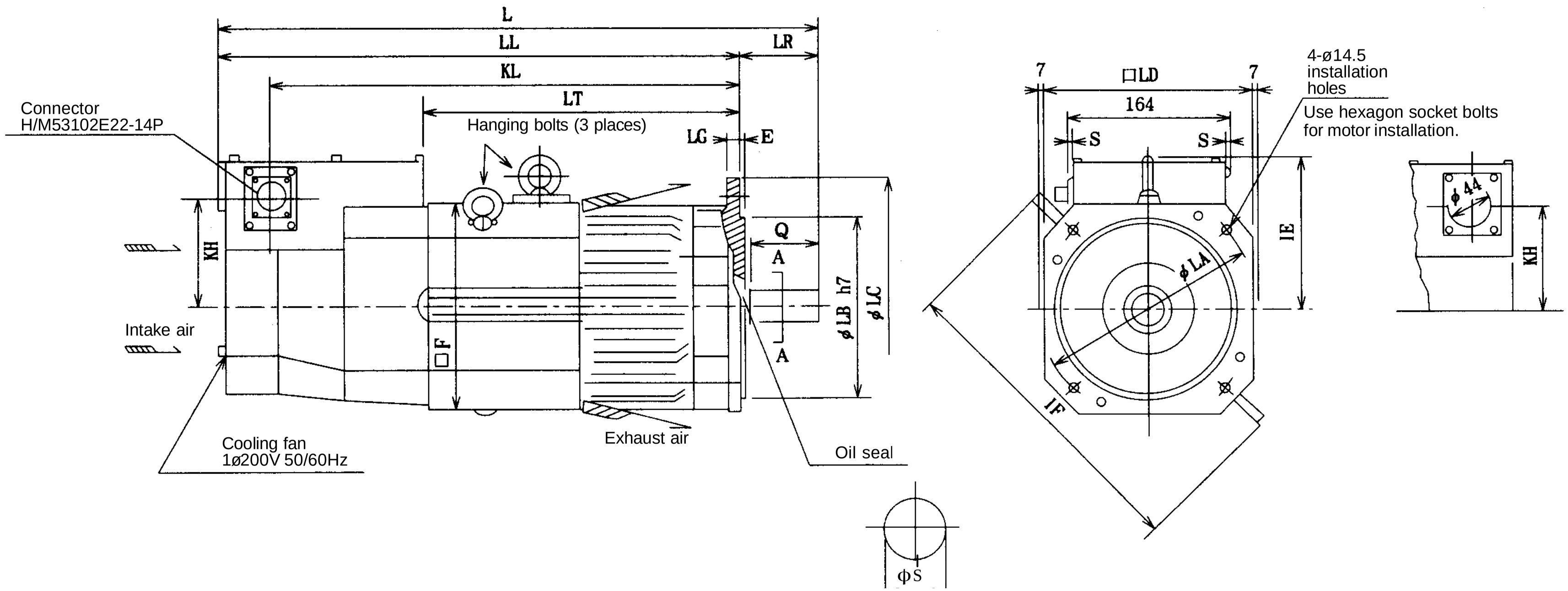


Motor model	Dimensions A		Dimensions B	Weight	Tolerable shaft end radial load	Shaft shape
	OHE/OHA type	OSE/OSA type				
HA503L-SR	363	338	245	35kg	250kg	Straight shaft
HA503NL-SR	– – – –	338	245	35kg		Straight shaft

Serial encoder			
Spec.	Model	Encoder dim. D	Adaptor dim. E
INC	OSE104S/OSE105S	45	28
ABS	OSA104S/OSA105S	45	28



●HA-LH11K2-S1, HA-LH15K2-S1

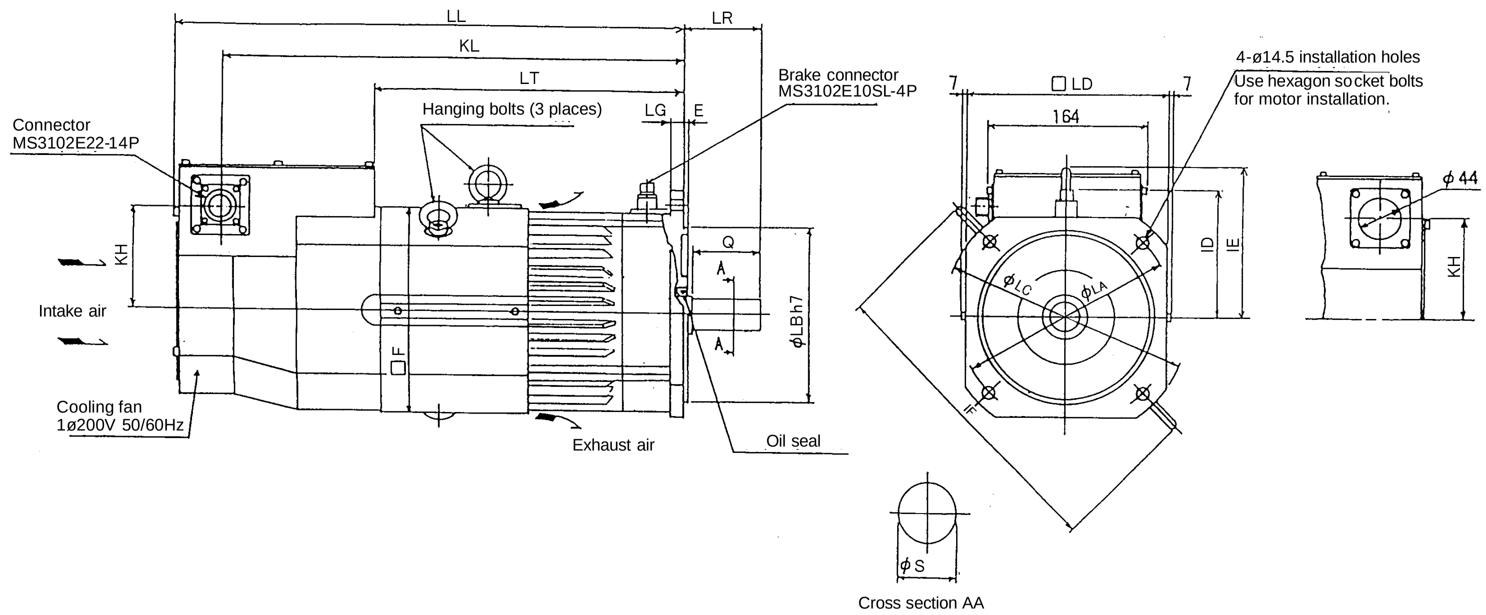


Unit: mm

Model	Motor														Shaft end				Weight
	F	L	LA	LB	LC	LD	LG	LL	LT	KL	KH	IE	IF	Hanging bolt	E	LR	Q	S	Oil seal	(kg)
HA-LH11K2-S1	208	614	215	180	250	204	20	529	316	478	102	152	317	M10	3	85	80	42h6	S45629B	70
HA-LH15K2-S1	254	688	265	230	300	250	25	578	365	527	117	180	376	M12	5	110	100	55m6	S60829B	108

(Notes) 1. Leave 30mm or more between the cooling fan and wall.
2. Use a friction coupling (spun ring, etc.) for the coupling with the load.
3. When removing the hanging bolts and using the motor, plug the screw holes with bolts.
4. This motor is equivalent to IP44, so take care to oil

●HA-LH11K2B-S2, HA-LH15K2B-S2



Unit: mm

Model	Motor														Shaft end				Weight
	F	LA	LB	LC	LD	LG	LL	LT	KL	KH	ID	IE	IF	Hanging bolt	E	LR	Q	S	Oil seal	(kg)
HA-LH11K2B-S2	208	215	180	250	204	20	594	379	543	102	140	152	317	M10	3	85	80	42h6	S45629B	80
HA-LH15K2B-S2	254	265	230	300	250	25	658	442	607	117	158	180	376	M12	5	110	100	55m6	S60829B	128

(Notes) 1. Leave 50mm or more between the intake air side of the motor and wall.
2. When removing the hanging bolts and using the motor, plug the screw holes with the following bolts.
   HA-LH11K2B-S2: M10×15 or less
   HA-LH15K2B-S2: M12×18 or less
3. Use a friction coupling (spun ring, etc.) for the coupling with the load.
4. There are a total of 5 lead-out wires inside the terminal box: U, V and W wires and two fan wires.

2.8 Motor connection

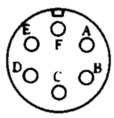
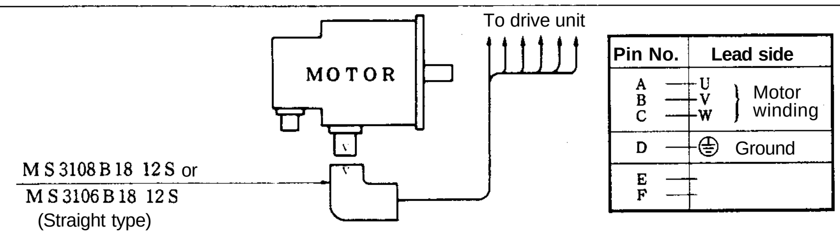
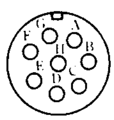
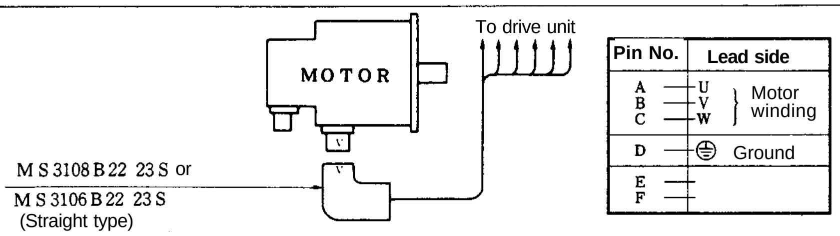
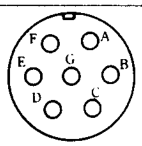
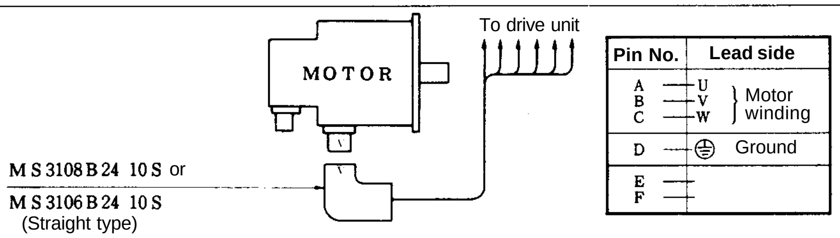
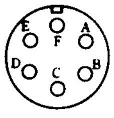
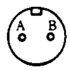
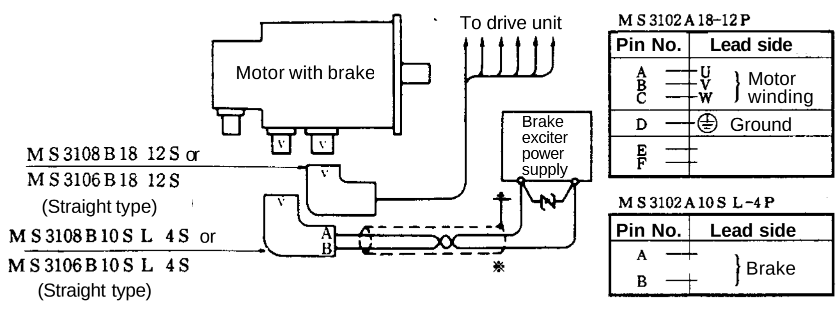
⚠ WARNING
Always insulate the connection section of the power supply terminal. Failure to do so could lead to electric shocks.

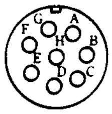
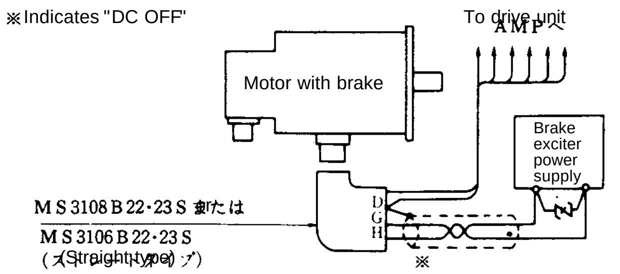
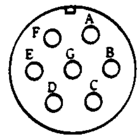
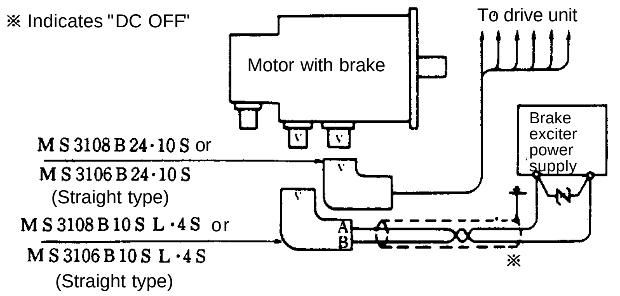
⚠ CAUTION
Do not directly connect commercial power supply to the servomotor. Doing so could lead to faults.

(a) Always match the power lead phases (A, B, C) and the drive unit output terminal (U, V, W) phases.
(b) Application of commercial power supply to the motor terminals (U, V, W) could cause the motor to demagnetize or burn.
The commercial power can be connected only to the servo drive unit output terminals (U, V, W).
(c) Always ground with the grounding terminal E. Connect to the grounding terminal of the servo drive unit, and ground to the earth with the grounding plate in the control box. (Refer to "Servo and Spindle System Configuration Section 4 Connection of each unit".)
(d) Supply 24VDC user-prepared (refer to "2.9 Motors with electromagnetic brake") to the brake lead of the motor with magnetic brake.
The internal power supply VDD (24VDC) in the servo drive unit cannot be used.

(1) Cannon plugs to be used

* Cannon plugs for HC motor series are shown in "2.7 Outline dimension drawings".

Motor model	Motor side connector	Cannon plug to be used
HA053C HA13C HA23NC HA33NC	 CE05-2A18-12P	
HA40NC HA43NC HA80NC HA83NC HA50NLC HA100NLC HA150NLC HA53NLC HA103NLC HA153NLC	 CE05-2A22-23P	
HA100NC HA200NC HA300NC HA103NC HA203NC HA200NLC HA300NLC HA500NLC HA203NLC HA303NLC	 CE05-2A24-10P	
HA053CB HA13CB HA23NCB HA33NCB	 CE05-2A18-12P  H/MS3102A10SL-4P	

Motor model	Motor side connector	Cannon plug to be used
HA40NCB HA43NCB HA80NCB HA83NCB	 CE05-2A22-23P	
HA100NCB HA200NCB HA300NCB HA103NCB HA203NCB	 CE05-2A24-10P  H/MS3102A10SL-4P	

MS3102A18-12P

Pin No.	Lead side
A	U
B	V } Motor winding
C	W
D	⏚ Ground
E	
F	
G	} Brake
H	

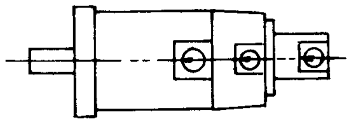
MS3102A24-10P

Pin No.	Lead side
A	U
B	V } Motor winding
C	W
D	⏚ Ground
E	
F	

MS3102A10SL-4P

Pin No.	Lead side
A	} Brake
B	

Notes 1. The angle plug (MS3108), straight plug (MS3106), cable clamp (MS3057), and wiring connector should be selected by user.
2. The key position of the cannon connector should be in the direction of the motor flange.
3. Refer to the following table for the European Standards compliant parts.



Cannon connector list

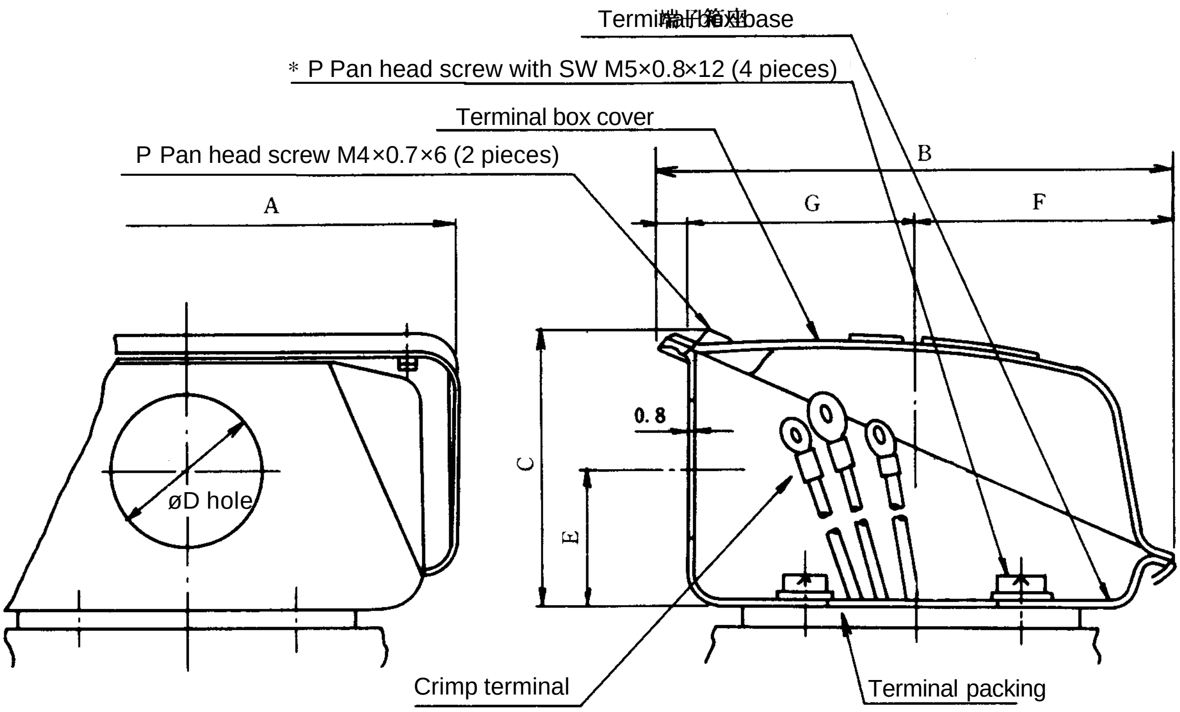
Compatible motor	Cannon Type	Standard connector Plug (with back shell)	European Standards compliant connector Plug (with back shell)	Cable clamp	Plug (single block)
HA053-33	Straight	MS3106A18-12S	CE05-6A18-12SD-B-BSS	CE3057-10A-□ (D265)	CE05-6A18-12SD-B
	Angle	MS3108B18-12S	CE05-8A18-12SD-B-BAS		–––––––––
HA40-80	Straight	MS3106A22-23S	CE05-6A22-23SD-B-BSS	CE3057-12A-□ (D265)	CE05-6A22-23SD-B
	Angle	MS3108B22-23S	CE05-8A22-23SD-B-BAS		–––––––––
HA100-300	Straight	MS3106A24-10S	CE05-6A24-10SD-B-BSS	CE3057-16A-□ (D265)	CE05-6A24-10SD-B
	Angle	MS3108B24-10S	CE05-8A24-10SD-B-BAS		–––––––––

＊Use the cannon plug single block together with a conduit, etc.

(2) Terminal box type motors

Models applicable: HA700N-SR, HA900N-SR, HA303N-SR, HA703N-SR, HA700NB-SR, HA900NB-SR, HA303NB-SR, HA703NB-SR, HA503NL-SR

Motor terminal box detailed drawing



- The direction of the øD hole of the terminal box can be changed every 90°.
  However, since the øD hole is positioned as shown in the outline dimension drawing when shipping, remove the screw marked with ∗ when the direction should be changed.
- When a spare part is required due to damage, the part should be ordered from Mitsubishi Electric along with the parts number listed in the drawing.

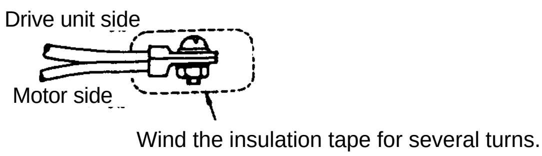
	Dimensions							Model	
Model	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**Terminal box cover**	**Terminal box base**
HA700N, HA700NB HA900N, HA900NB HA303N, HA303NB HA703N, HA703NB HA503NL	131	144	78	35	37	60	76	M953C771H01	M952B407H20

Types of terminal box lead wires

Servomotor			
Lead wire type		**Lead wire crimp terminal**	
Item	**Indica-tion**	**HA700/900 HA503NL HA303/703**	**HALH11K HALH15K**
Electromagnetic brake (when specified)	Blue Blue	M4	–
Motor winding	U	M6	M6
	V		
	W		
Motor ground	**(Note 2)**	M5	M5
Motor fan	BU	–	M4
	BU		

Servo drive unit					
Terminal	**C1-V1-01 03 05**	**C1-V1-10 20 30**	**C1-V1-45**	**C1-V1-70 90**	**C1-V1-110 150**
L+	M6	M6	M6	M6	M6
L–					
L11	M4	M4	M4	M4	M4
L21					
U	M4	M4	M5	M5	M8
V					
W					
⏚					

Notes 1. For the terminal box type servomotors of special models, pay special attention to the model names.
2. Use one of the screws marked with ∗ in the terminal box detailed drawings as the motor ground.
3. When an electromagnetic brake is provided, a surge absorber can be housed in the motor terminal box. See the installation procedure drawing N109D132.
4. The terminals should be connected as shown in the following figure using the screws listed in the above table.
Each connection section should be insulated by winding several turns of insulation tape around it so that it is securely insulated. When housing the connection sections in the terminal box, take care not to damage the insulation section.



5. For the cables to be used, see the following section.

(3) Wires to be used

Model	U.V.W (Motor main circuit)	(Note 2) Grounding wire (Motor ground)	(Note 3) Electromagnetic brake for excitation
HA053 HA13 HA23N HA33N	$1.25mm^2$ ($1.25mm^2$ or less)	$1.25mm^2$ ($1.25mm^2$ or less)	$0.5mm^2$ or more ($1.25mm^2$ or less)
HA40N HA43N	$2mm^2$ or more ($3.5mm^2$ or less)	$2mm^2$ or more ($3.5mm^2$ or less)	$0.5mm^2$ or more ($3.5mm^2$ or less)
HA80N HA83N	$2mm^2$ or more ($3.5mm^2$ or less)	$2mm^2$ or more ($3.5mm^2$ or less)	$0.5mm^2$ or more ($3.5mm^2$ or less)
HA100N	$3.5mm^2$ or more ($8mm^2$ or less)	$3.5mm^2$ or more ($8mm^2$ or less)	$0.5mm^2$ or more ($8mm^2$ or less)
HA103N HA200N	$5.5mm^2$ or more ($8mm^2$ or less)	$5.5mm^2$ or more ($8mm^2$ or less)	$0.5mm^2$ or more ($8mm^2$ or less)
HA203N HA300N	$5.5mm^2$ or more ($8mm^2$ or less)	$5.5mm^2$ or more ($8mm^2$ or less)	$0.5mm^2$ or more ($8mm^2$ or less)
HA700N HA900N HA303N HA703N	$8mm^2$ or more	$8mm^2$ or more	$0.5mm^2$ or more ($8mm^2$ or less)
HA50NLC HA100NLC HA53NLC HA103NLC	$2mm^2$ or more ($3.5mm^2$ or less)	$2mm^2$ or more ($3.5mm^2$ or less)	
HA150NLC HA153NLC	$2mm^2$ or more ($3.5mm^2$ or less)	$2mm^2$ or more ($3.5mm^2$ or less)	
HA200NLC HA300NLC HA203NLC HA303NLC	$5.5mm^2$ or more ($8mm^2$ or less)	$5.5mm^2$ or more ($8mm^2$ or less)	
HA500NLC	$5.5mm^2$ or more ($8mm^2$ or less)	$5.5mm^2$ or more ($8mm^2$ or less)	
HA503NL	$8mm^2$ or more	$8mm^2$ or more	
HA-LH11K2	$14mm^2$ or more	$14mm^2$ or more	
HA-LH15K2	$22mm^2$ or more	$22mm^2$ or more	

Notes
1. For reference, thewire size in parentheses above represents a restricted value from the soldered cup dimensions of the cannon plug.
2. "Internal wire regulation" for identifying the grounding wire is described as follows:

140-14 Green color identification of grounding wire

1. A green identification sign shall be placed on any grounding wire for any grounding work except:
   (1) when only the grounding wire is connected and it can be easily identified.
   (2) when one conductor in a cable, tough rubber sheathed cable or cord with a multiple number of conductors is used as a grounding wire and when the conductor is a bare wire or has a green and yellow stripe pattern.

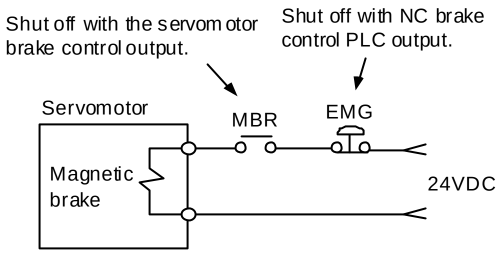
   [Note] When one conductor in a cable, tough rubber sheathed cable or cord with a multiple number of conductors is used as a grounding wire, any other conductor except for one which has a green or greenish yellow stripe pattern cannot be used as a grounding wire.
2. If any other conductor except for one with a green or greenish yellow stripe pattern is used as a grounding wire, it is necessary to indicate that the conductor is a ground wire using green tape and the like at the terminal and proper positions.

3. When the electromagnetic brake works in "DC OFF", use shielded wires.
4. When the motor is used in an application where it travels, select wires with high flexibility.
5. For crimp terminals connected to the servo drive units, see section (2).

2.9 Motors with electromagnetic brake

⚠ CAUTION

1. The axis will not be mechanically held even when the dynamic brakes are used. If the machine could drop when the power fails, use a servomotor with magnetic brakes or provide an external brake mechanism as holding means to prevent dropping.
2. The brake (magnetic brake) assembled into the servomotor, are for holding, and must not be used for normal braking.
3. 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.
4. Use a double circuit configuration so that the magnetic brake operation circuit will activate even with the external emergency stop signal.



When using the motor with electromagnetic brake for double dynamic safety to prevent dropping of the vertical axis or during an emergency stop, note the following cautions.

(1) The brake is a safety brake. The brake is applied when the power (24VDC) is OFF.
(2) Always turn the servo OFF (SON signal) when applying the brakes.
(3) When using to prevent dropping of the vertical axis, create a sequence that considers the braking delay time.

(1) Outline of motors with electromagnetic brake

(a) Types
Motors with electromagnetic brakes are a lineup of the HC Series. Their specifications are described in the following paragraphs.

(b) Applications
When a motor with an electromagnetic brake is used for a vertical feed axis in a machining center, and even if the hydraulic pressure of a hydraulic balancer becomes 0 due to power OFF, the brake prevents the spindle head from dropping. In robots, even if the power is abruptly turned off, this type of motor can prevent the robot body from falling down.
When this type of motor is used for the feed axis of a grinding machine, a dual safety system can be structured along with an emergency stop dynamic brake, thereby preventing collisions and spraying of ground materials.
This motor cannot be used for any other purposes than holding and braking at the time of power failure (in emergency).

(c) Features
(i) Since the electromagnetic brake is a DC excitation type,
- The brake has a simple mechanism and high reliability.
- The brake tap selection is not necessary for frequencies of 50Hz and 60Hz.
- With excitation ON, no rush current and no shock occur.
- The brake portion is smaller than the motor section.

(ii) Since the electromagnetic brake is housed in the motor, the installation dimensions of this motor type are the same as those of non-brake type motors.
(iii) For electromagnetic brake, no maintenance inspections are required.
(iv) This motor type can be safely and securely mounted in elevated locations (with eyebolt taps holes for the HA100NB or larger models).

(2) Characteristics of electromagnetic brake

Item \ Model			HC52B HC53B HC102B HC103B HC152B HC153B	HC202B HC203B HC352B HC353B HC452B HC453B HC702B HC703B HC902B
Type **(Note 1)**			Spring type safety brake	
Rated voltage			24VDC	
Rated current at 20°C		(A)	0.80	1.43
Excitation coil resistance at 20°C		(Ω))	29	16.8
Capacity		(W)	19	34
Attraction current		(A)	0.2	0.4
Drop current		(A)	0.08	0.2
Static frictional torque		(N·m)	8.3	43.1
Inertia moment **(Note 2)**		(× 10^{-4}kg·m^2)	2.0	10
Release delay time **(Note 3)**		(s)	0.04	0.1
Braking delay time **(Note 3)**	AC OFF	(s)	0.12	0.12
	DC OFF	(s)	0.03	0.03
Tolerable braking work amount	One braking action	(J)	400	4500
	One hour	(J)	4000	45000
Brake looseness at motor shaft		(degree)	0.2 to 0.6	0.2 to 0.6
Brake life **(Note 4)**	Times		20000	20000
	Braking work per braking action	(J)	200	1000

Item \ Model			HA053B HA13B	HA23NB HA33NB	HA40NB HA43NB HA80NB HA83NB	HA100NB HA103NB HA200NB HA203NB HA300NB HA303NB HA700NB HA703NB HA900NB
Type **(Note 1)**			Spring type safety brake			
Rated voltage			24VDC			
Rated current at 20°C		(A)	0.5	0.7	0.9	1.5
Excitation coil resistance at 20°C		(Ω)	111	49	38	23
Capacity		(W)	12	17	22	36
Attraction current		(A)	0.15	0.2	0.25	0.5
Drop current		(A)	0.06	0.06	0.12	0.18
Static frictional torque		(N·m)	0.39	1.96	5.88	29.42
Inertia moment **(Note 2)**		(× 10^{-4}kg·m^2)	0.02	0.20	0.68	4.25
Release delay time **(Note 3)**		(s)	0.03	0.05	0.07	0.10
Braking delay time **(Note 3)**	AC OFF	(s)	0.10	0.20	0.24	0.27
	DC OFF	(s)	0.02	0.03	0.04	0.04
Tolerable braking work amount	One braking action	(J)	5.6	49.0	294.2	980.7
	One hour	(J)	55.9	490.3	2942.0	9806.7
Brake looseness at motor shaft		(degree)	0.25 to 2.5	0.2 to 1.5	0.16 to 0.57	0.10 to 0.36
Brake life **(Note 4)**	Times		30000	30000	30000	30000
	Braking work per braking action	(J)	5.6	49.0	294.2	980.7

Note 1. There is no manual open mechanism. When handling is required such as when centering the machine, prepare a separate 24VDC power supply, and electrically open the brake.
Note 2. This is the value added to servomotors without a break.
Note 3. This is the value at 20ºC for the initial attraction gap.
Note 4. The brake gap will widen as the brake lining wears from braking, but the gap cannot be adjusted. Thus, when adjustments are required, the brakes have reached their lives.
Note 5. The servomotor with a magnetic brake generates a leakage magnetic flux at the shaft end.
Note 6. When operating at the low-speed regions, a clattering sound may be heard from the brake lining, but this is not a problem in the functionality of the brakes.

(3) Using electromagnetic brake

⚠ CAUTION
Mount surge absorber to brake terminal in DC OFF. Do not connect or disconnect while the brake power is energized. The pins of the cannon plug could be damaged due to spark.

(a) Brake excitation power

(i) The brake excitation power should be determined by considering both the voltage fluctuation and the excitation coil temperature so as to securely feed the flowing current.
(ii) There is no need for concern regarding the polarity of brake terminals. Do not mistake the brake terminals for another circuit.

(b) Brake excitation circuit

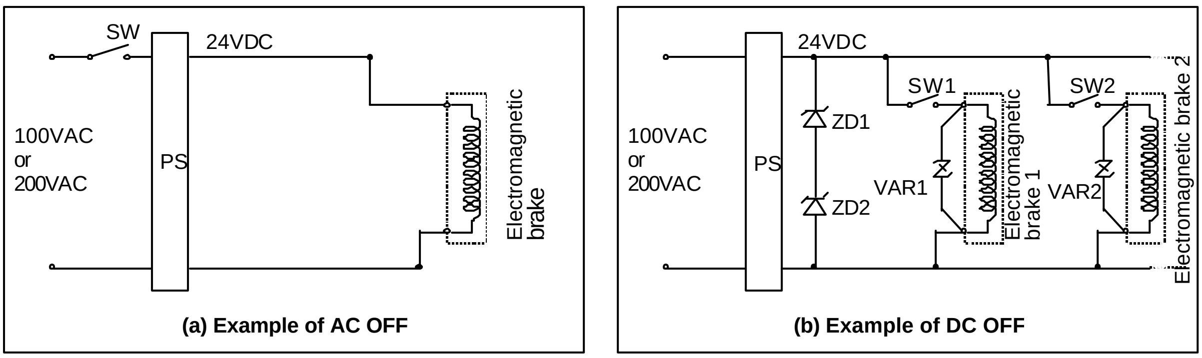
The brake excitation power can be turned OFF (brakes applied) with (a) AC OFF or (b) DC OFF.

(i) AC OFF
The braking delay time increases, the excitation circuit will become simple, and the relay shut-off capacity can be reduced.

(ii) DC OFF
The braking delay time can be shortened. However, in this case, a surge absorber will be required and the relay shut-off capacity will increase.

<Precautions>

- The contact DC shut-off capacity should be properly provided.
- Use a surge absorber.
- In the cannon connector type, the surge absorber is located far from the switch, therefore shield the cable between the switch and the surge absorber.



(a) Example of AC OFF   **(b) Example of DC OFF**

PS : 24VDC stabilized power
ZD1, ZD2 : Zener diode for power protection (1W, 24V ;Mitsubishi MZ424-A)
VAR1, VAR2 : Surge absorber (220V;Matsushita Electric Works ERZ-C10DK221)

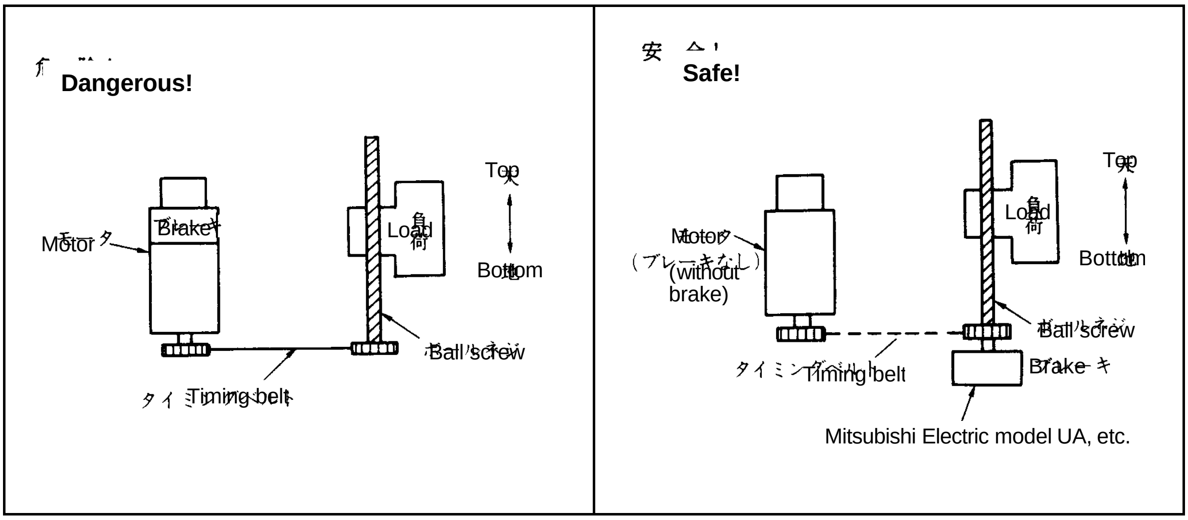
Electromagnetic brake circuit

Refer to the following table for selecting the power supply.

Motor	Power supply		
	Input voltage AC (V)	**Output voltage DC (V)**	**Output current DC (A)**
HC52B, HC102B, HC152B HC53B, HC103B, HC153B	100 or 200	24	0.80
HC202B, HC352B, HC452B, HC702B, HC902B HC203B, HC353B, HC453B, HC703B	100 or 200	24	1.43
HA053NB, HA13NB	100 or 200	24	0.5A or more
HA23NB, HA33NB	100 or 200	24	0.7A or more
HA40NB, HA43NB HA80NB, HA83NB	100 or 200	24	0.9A or more
HA100NB, HA103NB, HA900NB HA200NB, HA203NB HA300NB, HA303NB HA700NB, HA703NB	100 or 200	24	1.5A or more

(c) Safety considerations

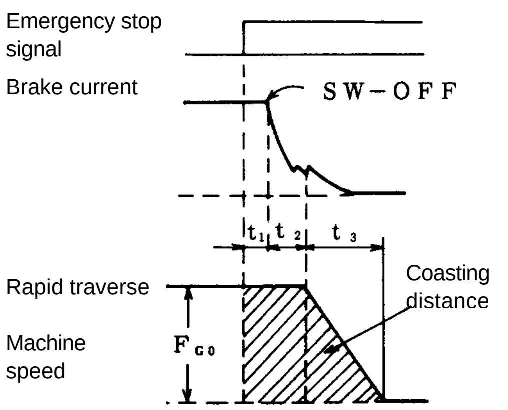
(i) Using timing belt
As shown below on the left, when the HC motor with electromagnetic brake is connected to a load (such as a ball screw) with a timing belt, if the belt is broken, a dangerous situation occurs. Even if the safety coefficient of the belt is increased, the belt may break due to over-tension or cutting chips. In this case, use the method as shown below on the right to improve the safety.



(ii) Application for grinding machine feed axis
When NC is emergency-stopped, the dynamic brake is activated and the motor stops suddenly, but even if the electromagnetic brake is used along with the dynamic brake, the coasting distance cannot be remarkably shortened.
When considering a failsafe system for the grinding machine, test the coasting distance to determine the limit of the dynamic brake, and then evaluate whether the system is safe or not. In this case, the machine decelerates and stops in the pattern shown in the drawing. The coasting distance in the rapid traverse state, L_{MAX}, is the hatched area in the following drawing, and is calculated by the following equation:

$$L_{MAX} = \frac{F_{GO} \times 10^3}{60} \left(t_1 + t_2 + \frac{t_3}{2}\right) \text{ (mm)}$$

Braking using electromagnetic brake

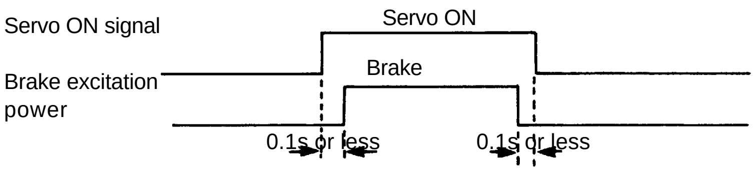


F_{GO} : Machine speed in rapid traverse state (m/min)
t_1 : Delay time in NC (0.05s)
$*t_2$: Electromagnetic braking delay time (s)
t_3 : $\dfrac{(GD_M^2 + GD_L^2)\, N_{GO}}{9.55 \times 10^4 (T_L + 0.8T_B)}$ (s)
$*GD_M^2$: GD^2 of motor with brake ($\times10^{-4}$kg·m^2)
GD_L^2 : GD^2 on load side converted into motor shaft ($\times10^{-4}$kg·m^2)
N_{GO} : Rapid traverse motor speed (r/min)
T_L : Dynamic friction torque on motor speed conversion load side (N·m)
$*T_B$: Static friction torque of electromagnetic brake (N·m)

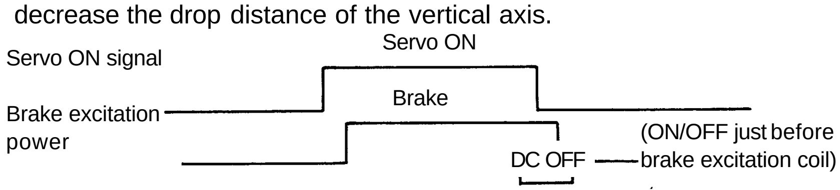
For the asterisk mark (∗), see the data in paragraph "2.9(2)".

(d) Precautions for sequence
Although the brake excitation power supply should be prepared by the user, exercise the following precautions:

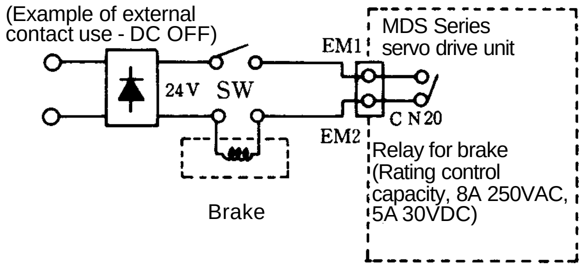
(i) When the brake is released (excitation power is ON), make sure that the servo ON state takes place. The following sequence prevents the vertical axis from dropping.

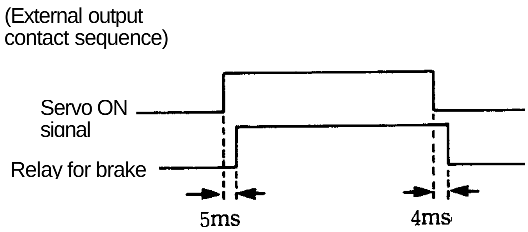


(ii) When the above sequence cannot be formed, use the "DC OFF" of the excitation power to decrease the drop distance of the vertical axis.



(iii) In the MDS Series, the external output contacts on the servo drive unit can be used.



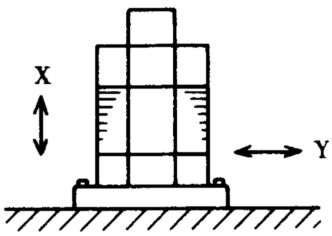


2.10 Motor vibration resistance

Motor model	Direction of vibration	
	Axial (X)	Perpendicular to axis (Y)
HC52, HC102, HC152, HC53, HC103, HC153 HA50L, HA100L, HA150L HA053N, HA13N, HA23N, HA33N (HA40N, HA80N, HA43N, HA83N)	$9.8m/s^2$(1G) or less	$24.5m/s^2$(2.5G) or less
HC202, HC352 HC203, HC353 HA200L, HA300L (HA100N, HA200N, HA103N, HA203N)	$19.6m/s^2$(2G) or less	$49.0m/s^2$(5G) or less
HC452, HC702 HC453, HC703 HA500L (HA300N, HA700N, HA303N, HA703N)	$11.7m/s^2$(1.2G) or less	$29.4m/s^2$(3G) or less
HC902 HA-LH11K2, HA-LH15K2 (HA900N)	$9.8m/s^2$(1G) or less	$24.5m/s^2$(2.5G) or less

Conditions

1. In the motor stop state
2. In the installed state
3. No abnormalities occur when the above vibrations are applied for 6 hours at 250Hz (check that there is no resonance point at 250Hz or less).



Vibration unit

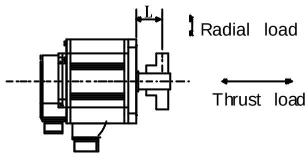
Note 1. Even if the vibration value is within above values, for machines with excess vibrations, (turret punch press, press, shearer, etc.), carefully check the looseness of the cannon plug, cable condition, and cable clamps, etc. on the machine side.

2.11 Motor shaft strength

When the AC servomotor is connected to a load, check that the load being applied to the motor shaft does not exceed the values shown in the following table.

Motor shaft end tolerable load

Model	Tolerable radial load	Tolerable thrust load
HA053NS, HA13NS	78.4N (L=26)	49N
HA23NS, HA33NS	245N (L=30)	147N
HC52T, HC102T, HC152T HC53T, HC103T, HC153T HA50LT, HA100LT, HA150LT HA53LT, HA103LT, HA153LT (HA40NT, HA80NT, HA43NT, HA83NT)	392N (L=58)	490N
HC52S, HC102S, HC152S HC53S, HC103S, HC153S HA50LS, HA100LS, HA150LS HA53LS, HA103LS, HA153LS (HA40NS, HA80NS, HA43NS, HA83NS)	980N (L=55)	490N
HC202S, HC352S, HC452S, HC702S HC203S, HC353S, HC453S, HC703S (HA100NS, HA200NS, HA300NS, HA700NS) (HA103NS, HA203NS, HA303NS, HA703NS)	2058N (L=79)	980N
HC902S HA500LS, HA503LS, HA-LH11K2S (HA900NS)	2450N (L=85)	980N
HA-LH15K2S	2940N (L=100)	980N



L : Distance between flange installation surface and center of load weight (mm)

Note 1. The tolerable thrust load indicates that no radial load is applied.
The above tolerable values are the maximum values and are not the continuous tolerable loads.
When the motor is connected to the load, the radial load applied to the motor shaft is calculated as follows.

Direct connection:

Use flexible coupling, and align the core as much as possible. When using highly rigid coupling, further precise core alignment will be required.
The radial load applied to the shaft on which the coupling is used is obtained by the following equation.

$$P = K_R \times \delta$$

P : Radial load (kg)
K_R : Spring constant in radial direction of coupling (kg/mm)
δ : Core deviation (mm)

Gear:

The radial load applied to the axis on which a gear is directly engaged to the motor shaft is obtained by the following equation.

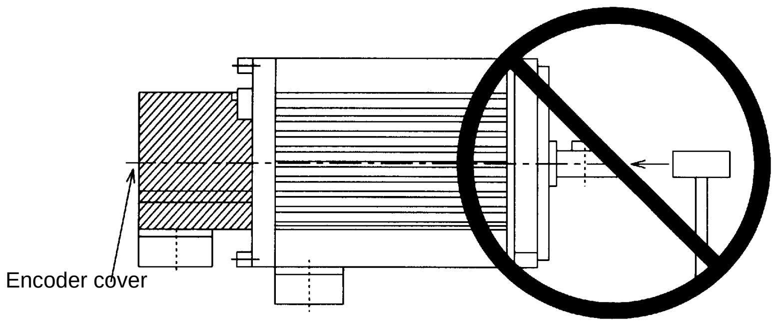
$$P = \frac{1}{980} \cdot \frac{T_{max}}{\frac{D}{2} \cos \alpha}$$

P : Radial load (kg)
T_{max} : Maximum motor torque (N·m)
D : Gear pitch circle (cm)
α : Gear pressure angle (degree)

When the timing belt is used, obtain the total of the initial tension of the belt and the force by the load torque. For the calculation method, see the related document issued by the timing belt manufacturer.

Note 2. Cautions for mounting load (prevention of impact on shaft)

- When using the servomotor with keyway, use the screw hole at the end of the shaft to mount the pulley onto the shaft. When installing, first insert both screw bolts into the screw holes on the shaft, and press them in while tightening the nuts.
- When pulling out the pulley, use a pulley puller.
- When transporting the unit, do not put hands or ropes on the encoder cover.
- When assembling, do not tap the shaft end with a hammer, etc.
  (The detector could be damaged.)

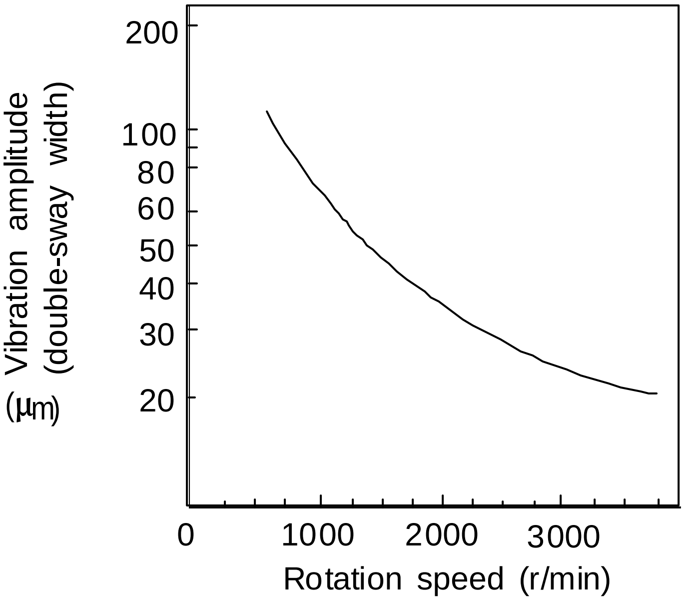


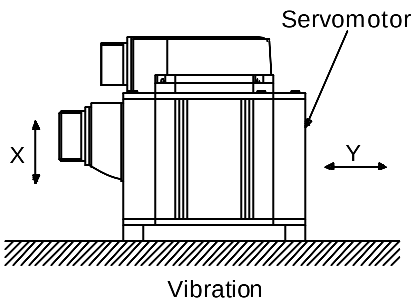
- The direction that the detector is installed on the servomotor cannot be changed.

2.12 Environmental conditions

Environment	Conditions	
Ambient temperature	0°C to +40°C (with no freezing)	
Ambient humidity	80% RH or less (with no dew condensation)	
Storage temperature	–15°C to +70°C (with no freezing)	
Storage humidity	90% RH or less (with no dew condensation)	
Atmosphere	• Indoors (Where unit is not subject to direct sunlight) • No corrosive gases, flammable gases, oil mist or dust	
Altitude	1000m or less above sea level	
Vibration	HC52/102/152/53/103/153 HC103R/153R/203R/353R/503R	X: 9.8 m/s^2 (1G) or less Y: 24.5m/s^2 (2.5G) or less
	HC202/352 HC203/353	X: 19.6 m/s^2 (2G) or less Y: 49 m/s^2 (5G) or less
	HC452/702 HC453/ 703	X: 11.7 m/s^2 (1.2G) or less Y: 24.5 m/s^2 (2.5G) or less
	HC902	X: 9.8 m/s^2 (1G) or less Y: 24.5m/s^2 (2.5G) or less

The vibration conditions are as shown below.

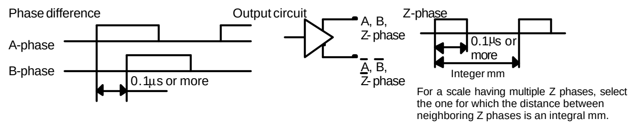




3. Detectors

> ⚠ **CAUTION**
>
> The MDS-C1 Series servo drive units use the serial encoders only as the motor end detectors.
> The OHE/OHA type detectors cannot be used as the motor end detectors.

3.1 List of detector specifications

Class	Type	Model name	Max. rotation speed	Detector output	Output signal usage class
Motor end detector	Relative position detector	OSE104, OSE104S, OSE104S1, OSE104S2	3000r/min	Serial data	Motor position detection 100000p/rev
	Absolute position detector	OSE105, OSE105S, OSE105S1, OSE105S2	3000r/min	Serial data	Motor position detection 1000000p/rev
Ball screw end detector	Relative position detector	OHE25K-ET	3000r/min	A, B-phase 25000p/rev	Ball screw end position detection 100000p/rev after multiplying by four
				Z-phase 1p/rev	Zero point indexing
		OSE104-ET	3000r/min	Serial data	Ball screw end position detection 100000p/rev
		OSE105-ET	3000r/min	Serial data	Ball screw end position detection 1000000p/rev
	Absolute position detector	OHA25K-ET	3000r/min	A, B-phase 25000p/rev	Ball screw end position detection 100000p/rev after multiplying by four
				Z-phase 1p/rev	Zero point indexing
		OSA104-ET	3000r/min	Serial data	Ball screw end position detection 100000p/rev
		OSA105-ET	3000r/min	Serial data	Ball screw end position detection 1000000p/rev
Machine end detector	Relative position detector	Use an incremental scale for the machine end that satisfies the conditions on the right.	(1) When linear scale I/F unit (MDS-B-HR) is not used ・Use a scale with an A/B phase difference and Z-phase width of 0.1μs or more at the maximum feedrate. ・Use an A, B, Z-phase signal with differential output (RS-422 standard product) for the output signal. 		
			(2) * When linear scale I/F unit (MDS-B-HR) is used (Output signal) (a) 2.5V reference $1V_{p-p}$ analog A-phase, B-phase, Z-phase differential output (b) 2.5V reference $2V_{p-p}$ analog A-phase, B-phase, Z-phase differential output (Output signal frequency) Max. 200kHz		
(Note) Purchase from a manufacturer.	Absolute position detector	AT41 (Mitsutoyo product)	50m/min	A, B-phase	Machine end position detection 1μm/p after multiplying by four
				Z-phase	Zero point indexing 10mm spacing
				Serial data	Absolute position 1μm/p
		FME, FML (FUTABA product)	5.1 to 120m/min Differs according to the resolution.	A, B-phase	Machine end position detection 0.1 to 10μm/p after multiplying by four
				Serial data	Differs according to the kinds of scales.
		MP scale (Mitsubishi Heavy Industries product) * Motor end detector also needs an absolute position encoder.	30m/min	A, B-phase	Machine end position detection 1μm/p after multiplying by four
				Z-phase	Zero point indexing 2mm spacing
		AT342 (Mitsutoyo product)	110m/min	Serial data	Machine end position detection 0.5μm/p
		*AT343 (Mitsutoyo product)	120m/min	Serial data	Machine end position detection 0.05μm/p
		*LC191M (HEIDENHAIN product)	120m/min	Serial data	Machine end position detection 0.1μm/p

> ⚠ **CAUTION**
>
> The connection to MDS-B-HR, AT343 and LC191M is limited to the control system with the servo drive unit set to high-gain drive unit mode. It cannot be connected in standard drive unit mode.

3.2 Serial pulse encoder

3.2.1 Features

(1) With the serial pulse encoder, high resolution and high-speed rotation can be handled, allowing high resolution position detection to be selected.
(2) The detector resolutions include the following two types.
  (a) 1,000,000p/rev (ABS/INC)
  (b) 100,000p/rev (ABS/INC)
  Various detection units can now be handled according to the machine specifications.
(3) The signal wiring can be decreased compared to the conventional A, B, Z signals.
(4) The serial pulse encoder series is available for the standalone type encoder (ET Series).
  However, there are restrictions to the combination with conventional parts.
(5) The L dimensions are approx. 25mm shorter than the conventional part for the small capacity servomotor (200/300W).
(6) By achieving a smooth speed waveform, an improved effect of the new robust control (disturbance observer, etc.) function that carries out estimation from the speed can be anticipated.

3.2.2 Types

(1) Motor end encoder

	Type	Resolution
Absolute value detector	OSA105	1,000,000p/rev
	OSA104	100,000p/rev
Incremental detector	OSE105	1,000,000p/rev
	OSE104	100,000p/rev

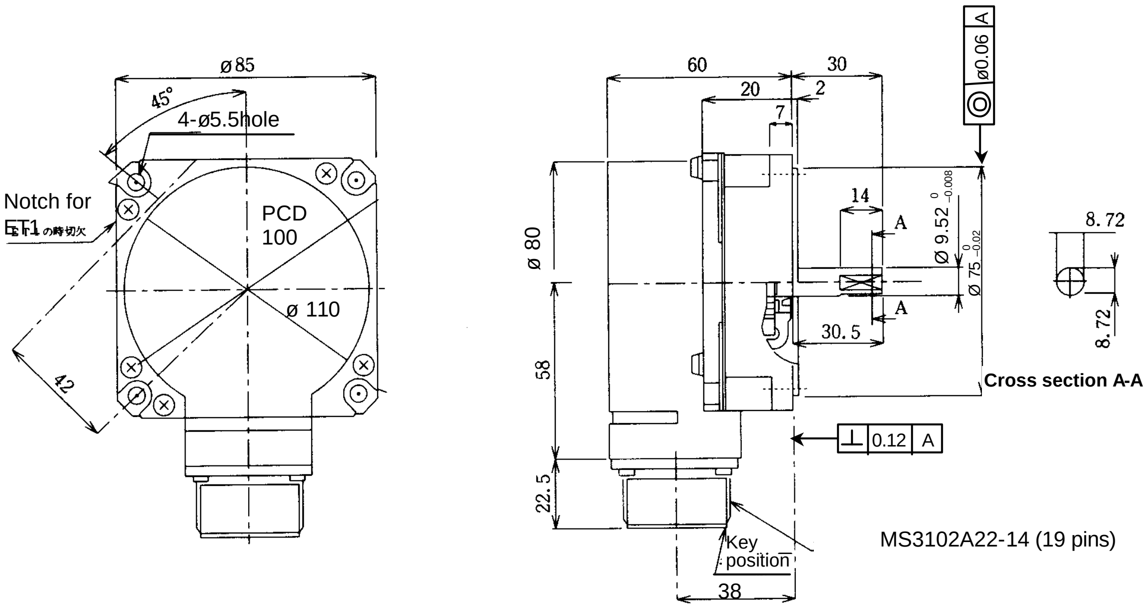
(2) Standalone encoder (machine end detection)

	Type	Resolution
Absolute value detector	OHA25K-ET	25,000p/rev
	OSA105ET	1,000,000p/rev
	OSA105ET1	
	OSA104ET	100,000p/rev
	OSA104ET1	
Incremental detector	OHE25K-ET	25,000p/rev
	OSE105ET	1,000,000p/rev
	OSE105ET1	
	OSE104ET	100,000p/rev
	OSE104ET1	

The ET1 has notches. (Refer to "3.2.3 Outline drawing".)

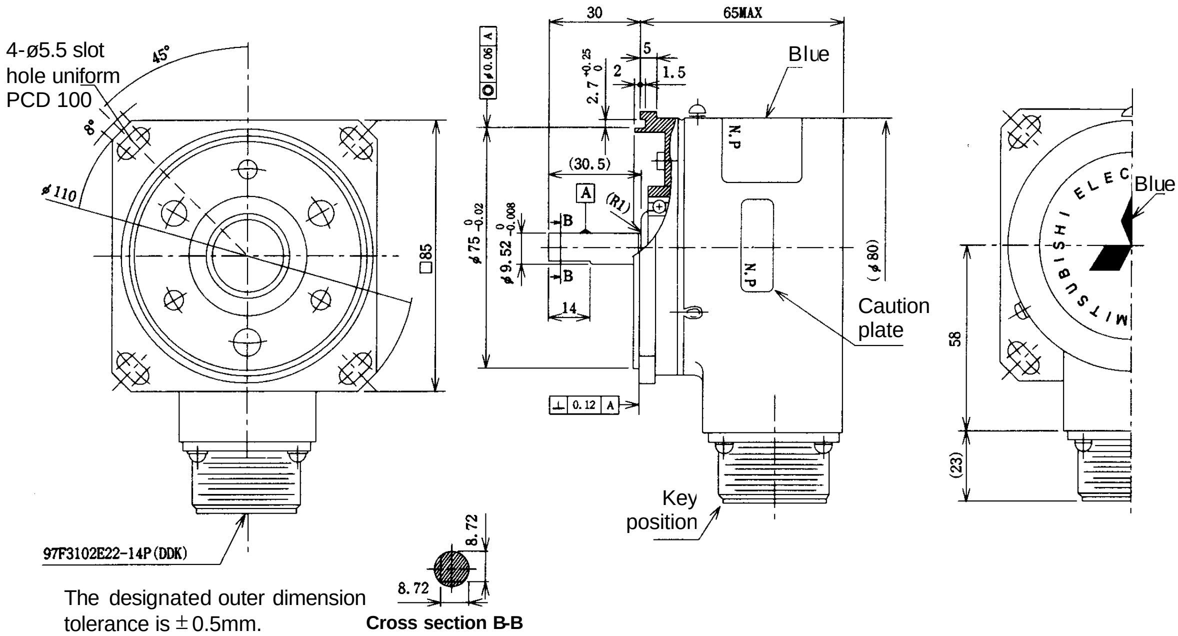
3.2.3 Outline dimension drawings

(1) Standalone encoder (OSA□ET/OSE□ET Series) outline drawing



(2) Outline drawings of OHE/OHA type ball screw end detector

· **OHE 25K-ET**



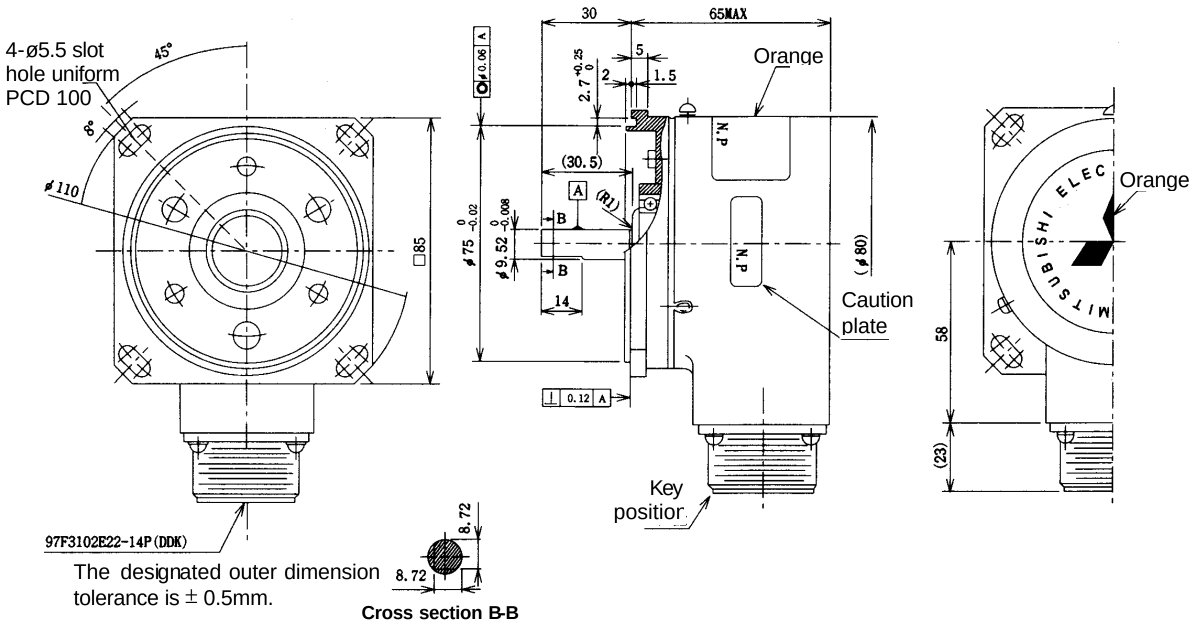
Connector: 97F3102E22-14P (DDK)

Weight	1.0kg or less
Moment of inertia	0.2×10^{-4} kg·m^2 or less
Friction torque	0.0196N·m or less
Thermal relay	Functions at 85±5°C

Pin No.	Function	Pin No.	Function
A	A-phase signal	K	V-phase signal
B	$\overline{A}$ -phase signal	L	$\overline{V}$ -phase signal
C	B-phase signal	M	W-phase signal
D	$\overline{B}$ -phase signal	N	Case grounding
E	NC	P	NC
F	Z-phase signal	R	GND
G	$\overline{Z}$ -phase signal	S	+5VDC
H	U-phase signal	U	$\overline{W}$-phase signal
J	$\overline{U}$ -phase signal	T	Thermal relay
		V	Thermal relay

(Note 1) This is an incremental encoder for the ball screw end.
(Note 2) The outline dimensions are the same as for the absolute encoder, and only the nameplate color differs.

· **OHA 25K-ET**



Weight	1.0kg or less
Moment of inertia	0.2×10^{-4}kg · m^2 or less
Friction torque	0.0196N · m or less
Thermal relay	Functions at 85 ± 5°C

Connector: 97F3102E22-14P (DDK)

Pin No.	Function	Pin No.	Function
A	A-phase signal	K	RQ signal (Request signal)
B	$\overline{A}$ -phase signal	L	$\overline{RO}$ signal (Request signal)
C	B-phase signal	M	NC
D	$\overline{B}$ -phase signal	N	Case grounding
E	VB (Battery)	P	NC
F	Z-phase signal	R	GND
G	$\overline{Z}$ -phase signal	S	+5VDC
H	RX signal (Serial absolute signal)	T	Thermal relay
		U	NC
J	$\overline{RX}$ signal (Serial absolute signal)	V	Thermal relay

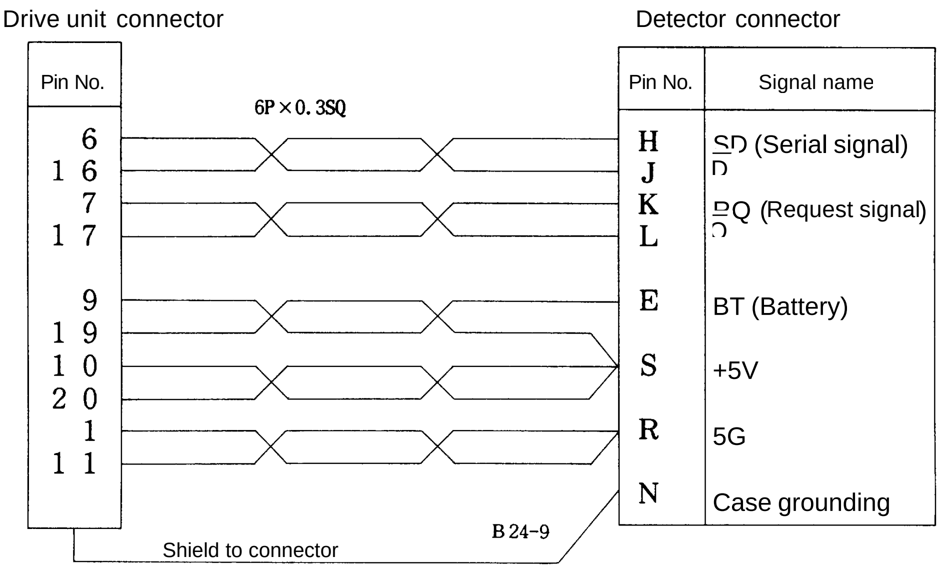
(Note 1) This is an incremental encoder for the ball screw end.
(Note 2) The outline dimensions are the same as for the absolute encoder, and only the nameplate color differs.

3.2.4 Cable connection diagram

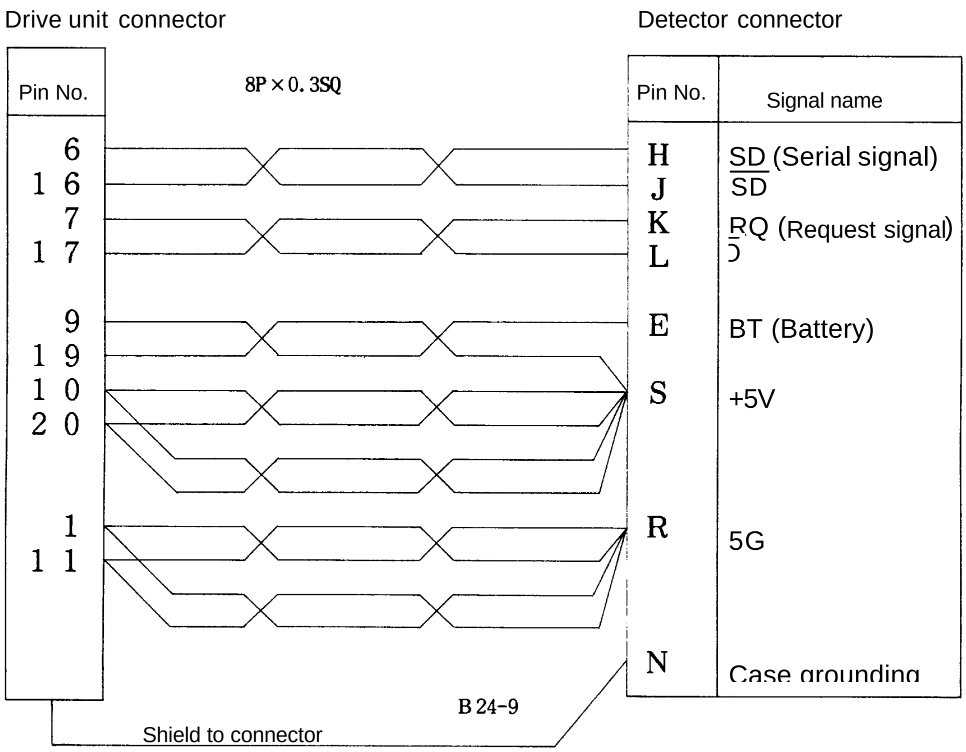
⚠ CAUTION
Do not mistake the connection when manufacturing the detector cable. Failure to observe this could lead to runaway.

The conventional CNV2 and 3 can be used for the cable.
To reduce the amount of wiring, the following serial encoder dedicated cable can be used.
In this case, the conventional detector cannot be used.

(1) CNV12, CNV13 cable (L £ 20m)



(2) CNV12, CNV13 cable (20 < L £ 30m)



The connectors on the drive unit side and detector side are the same as the conventional CN2 and 3 connectors.)

3.2.5 Maintenance

⚠ WARNING
1. Wait at least 15 minutes after turning the power OFF before starting maintenance or inspections. Failure to observe this could lead to electric shocks. 2. Only qualified persons must carry out the maintenance or inspections. Failure to observe this could lead to electric shocks. Contact Service Center or Service Station for repairs or part replacements.

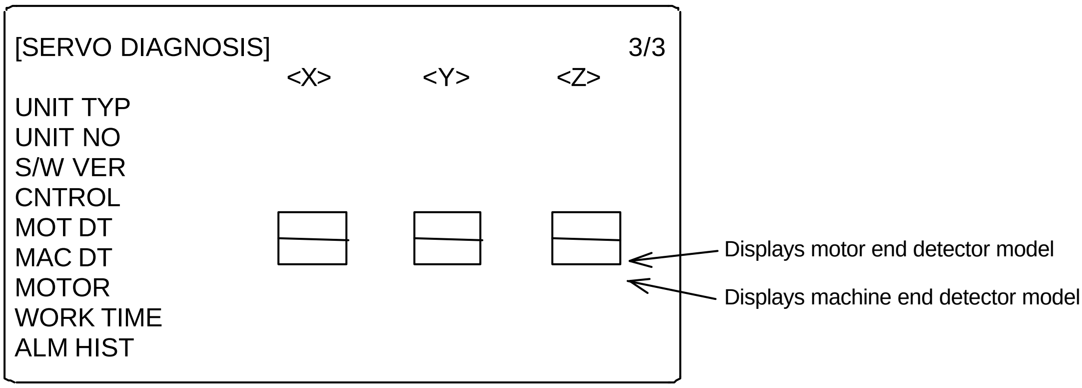
If any fault occurs in the configuration components, carry out service with the following procedures.

(1) Encoder

Always prepare the service parts for the conventional type and the serial encoder. As a rule, replace the detector with the same type as the detector before exchanging it.
If changes are to be made, always confirm the compatibility and usable combination.

- Confirmation of encoder model
  Confirm the encoder model on the nameplate attached to the motor cover, or displayed on the Servo Monitor screen.

Servo Monitor (SERVO DIAGNOSIS) Screen



If a fault occurs in the motor unit, replace the motor and encoder as a set.

3.3 Scale I/F unit

3.3.1 Outline

MDS-B-HR outline

(1) The unit interpolates the original wave of scale analog output to create high-resolution position data.
Increasing the detector resolution is effective for obtaining high gain of the servo.

(2) 1-scale, 2-drive operation will be possible with the signal distribution function (model division available).

3.3.2 Model configuration

MDS-B-HR model configuration

MDS-B-HR-□□□□

Protective degree
No-mark: IP65 P: IP67

Availability of magnetic pole detection unit
No-mark: None M: Available

Used for linear servo system

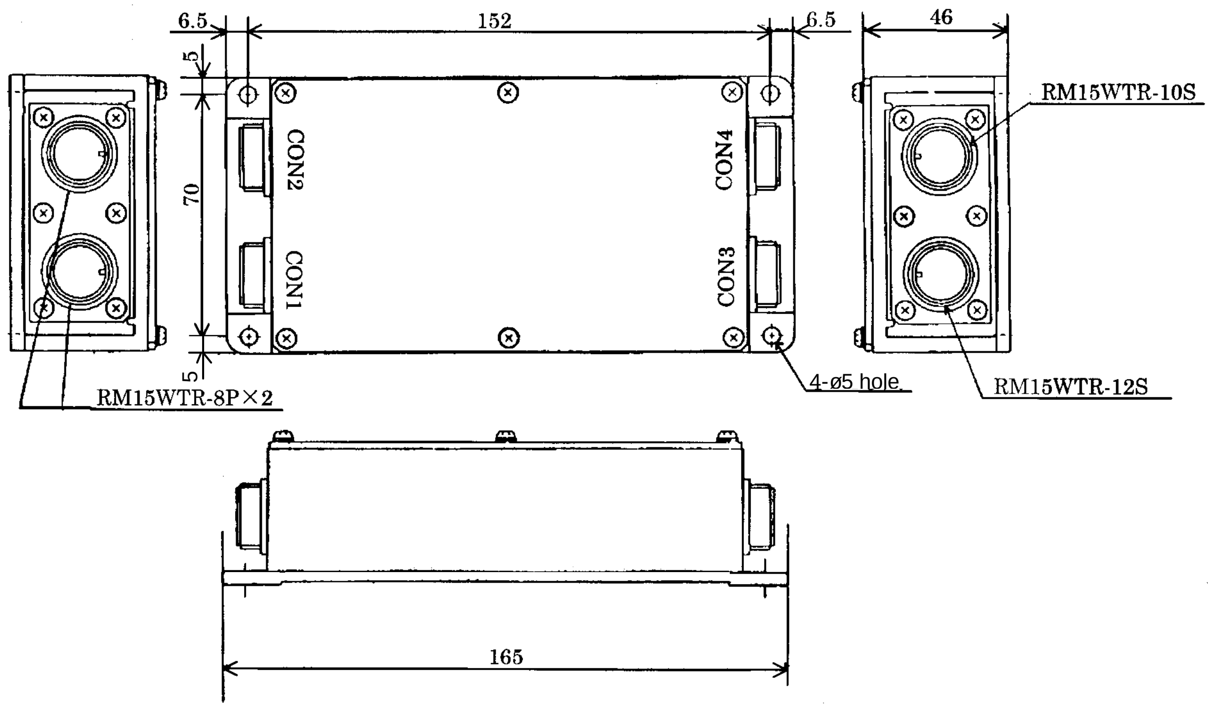
Signal distribution function
1: Output number 1
2: Output number 2 (Distribution available)

Scale output voltage
1: Scale output voltage $1V_{p-p}$ specifications
2: Scale output voltage $2V_{p-p}$ specifications

3.3.3 List of specifications

	Unit	Scale I/F unit model							
		MDS-B-HR-		MDS-B-HR-		MDS-B-HR-		MDS-B-HR-	
		11	12	11P	12P	21	22	21P	22P
Corresponding scale (Example)		LS186/LIDA181/LIF181 (HEIDENHAIN product)				AT342 special (Mitsutoyo product)			
Signal 2-distribution function		×	○	×	○	×	○	×	○
Analog signal input specification		A-phase, B-phase and Z-phase 2.5V reference Amplitude $1V_{p-p}$				A-phase, B-phase and Z-phase 2.5V reference Amplitude $2V_{p-p}$			
Applicable frequency		Analog original waveform 200 kHz max.							
Scale resolution		Analog original waveform/512 div.							
Input/output communication form		High-speed serial communication I/F, equivalent to RS485							
Availability of magnetic pole detector		None							
Tolerable ambient temperature	°C	0 to 55°C							
Tolerable ambient relative humidity	%	90% or less (no condensing)							
Atmosphere		With no poisonous gas							
Tolerable vibration	m/s^2 (G)	$98.0m/s^2$ (10G)							
Tolerable impact (shock)	m/s^2 (G)	$294.0m/s^2$ (30G)							
Tolerable power voltage	V	5VDC±5%							
Maximum heat generation	W	2W							
Weight	kg	0.5kg or less							
Protective degree		IP65		IP67		IP65		IP67	

3.3.4 Unit outline dimension drawing



3.3.5 Description of connector

Connector name	Application	Remarks
CON1	For connection with servo drive unit (2nd system)	None for 1st system specifications
CON2	For connection with servo drive unit	
CON3	For connection with scale	
CON4	For connection with magnetic pole detection unit (MDS-B-MD)	* When linear servo system is used

Assignment of connector pins

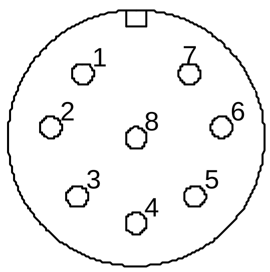
CON1	
Pin No.	**Function**
1	RQ+ signal
2	RQ– signal
3	SD+ signal
4	SD– signal
5	P5
6	P5
7	GND
8	GND

CON2	
Pin No.	**Function**
1	RQ+ signal
2	RQ– signal
3	SD+ signal
4	SD– signal
5	P5
6	P5
7	GND
8	GND

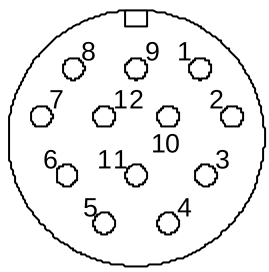
CON3	
Pin No.	**Function**
1	A+ phase signal
2	A– phase signal
3	B+ phase signal
4	B– phase signal
5	Z+ phase signal
6	Z– phase signal
7	RQ+ signal
8	RQ– signal
9	SD+ signal
10	SD– signal
11	P5
12	GND

CON4	
Pin No.	**Function**
1	A-phase signal
2	REF signal
3	B-phase signal
4	REF signal
5	P24
6	MOH signal
7	P5
8	P5
9	TH signal
10	GND

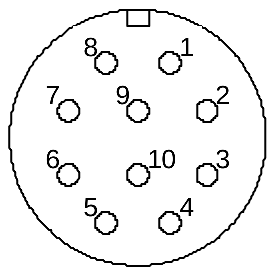
Connector: RM15WTR – 8P (Hirose Electric) CON1, CON2
RM15WTR – 12S (Hirose Electric) .... CON3 RM15WTR – 10S (Hirose Electric) CON4



CON1
CON2

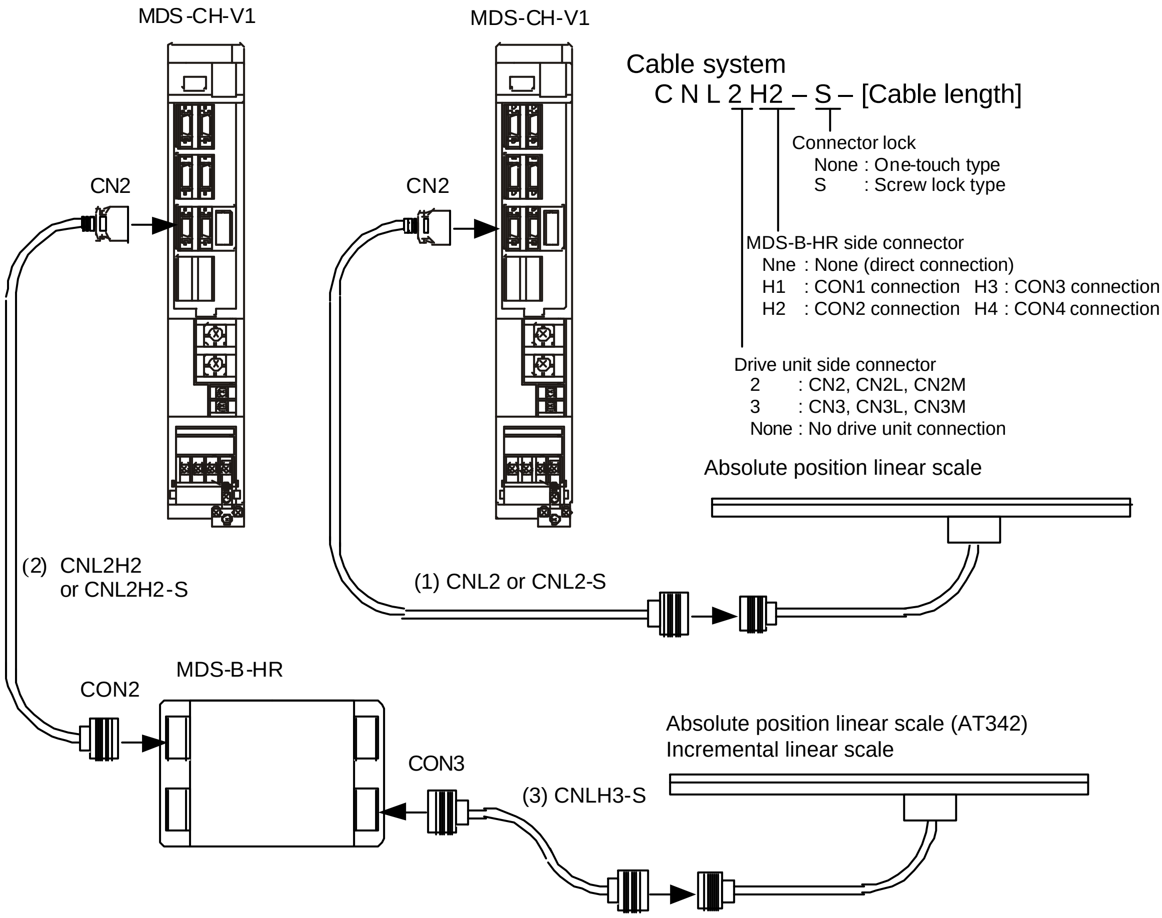


CON3

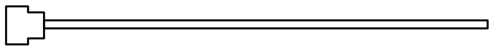
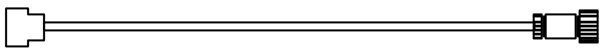
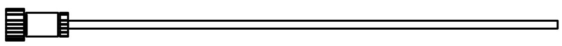


CON4

3.3.6 Example of scale I/F unit connection

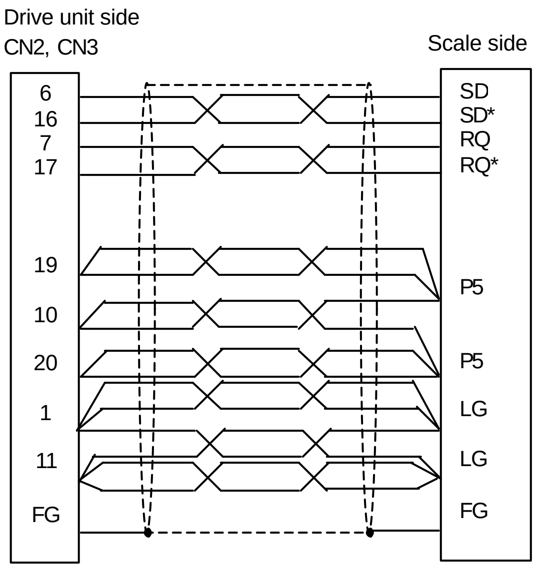


Cable list

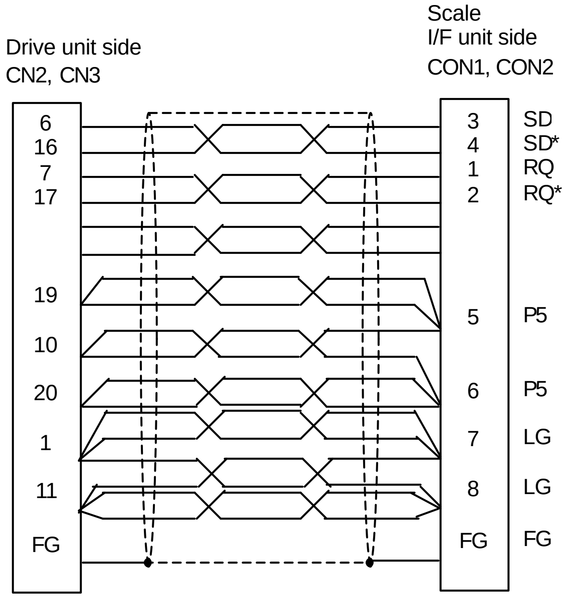
Item			Model name	Content
For CN2 CN3	<1>	Cable for direct connection with scale	CNL2, CNL2-S CNL3, CNL3-S Cable length max. 30m	Servo drive unit side connector (3M or the equivalent) Connector: 10120-3000VE Shell kit : 10320-52F0-008 (One-touch type) : 10320-52A0-008 (Screw type)  This cable must be manufactured by the user.
	<2>	Cable between drive unit and HR unit	CNL2H2, CNL2H2-S CNL3H2, CNL3H2-S CNL2H1, CNL2H1-S CNL3H1, CNL3H1-S Cable length 2, 5, 10, 20, 30m	Servo drive unit side connector (3M or the equivalent) Connector: 10120-3000VE Shell kit: 10320-52F0-008 (One-touch type) 10320-52A0-008 (Screw type) MDS-B-HR unit side connector (Hirose Electric) Connector: RM15WTP-8S Clamp: RM15WTP-CP (10) 
For MDS-B- HR unit	<3>	Cable between HR unit and scale	CNLH3-S Cable length max. 30m	MDS-B-HR unit side connector (Hirose Electric) Connector: RM15WTP-12S Clamp : RM15WTP-CP (10)  This cable must be manufactured by the user.

3.3.7 Cables

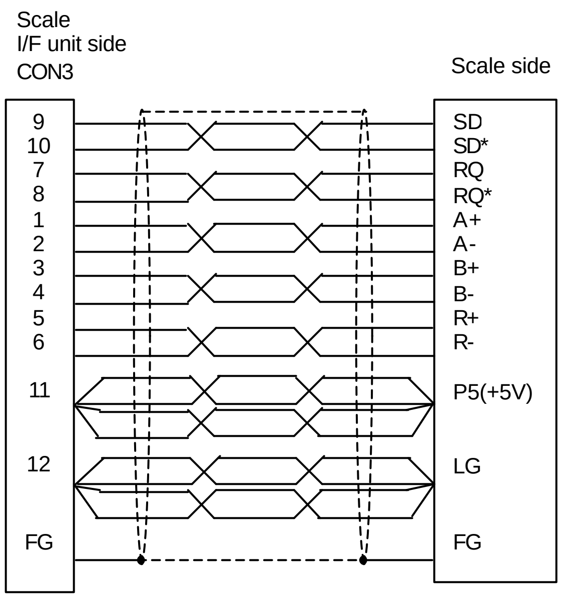
(1) Direct scale connection
< CNL2,CNL2-S cable connection diagram>



(2) Between drive unit and HR unit
<CNL2H1,CNL2H2,CNL2H1-S,CNL2H2-S cable connection diagram>
<CNL3H1,CNL3H2,CNL3H1-S,CNL3H2-S cable connection diagram>



(3) Between HR unit and scale
<CNLH3-S cable connection diagram>



Refer to Chapter I "5.2.7 Cable wire" in the "I. MDS-C1 Series Servo/Spindle System Configuration Section" for details on the wire material.
Recommended wire type: A14B2343 (Junkosha)

4. Servomotor and Detector Installation

4.1 Installation

⚠ CAUTION

1. Do not hold the cables, axis or detector when transporting the servomotor.
2. Use the suspension bolts on the servomotor only to transport the servomotor. Do not transport the servomotor when it is installed on the machine.
3. Always install the servomotor with reduction gear in the designated direction. Failure to do so could lead to oil leaks.
4. Securely fix the servomotor to the machine. Insufficient fixing could lead to the servomotor slipping off during operation.
5. When connecting a coupling to the servomotor shaft end, do not apply an impact by using a hammer, etc. Failure to observe this could lead to detector damage.
6. Install a cover, etc., on the shaft so that the rotating sections of the servomotor are not contacted during operation.
7. Do not apply a load exceeding the tolerable load onto the servomotor shaft. The shaft could brake.

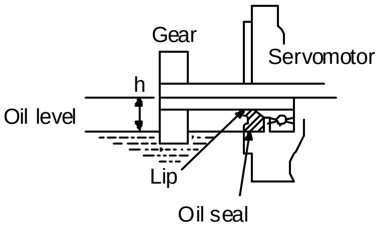
(1) Precautions for oil and water

a. Since the servomotor is not water/oil resistant do not splash cutting fluid or lubrication oil on the servomotor. If cutting fluid, etc., enters the servomotor or the detector, the insulation of the motor coil may be damaged or the detector failure may occur.
b. If cutting fluid, etc., splashes on the motor, put a protection cover on the motor. Check the joints, bends, shape, and dimensions of the protection cover.
c. Use the oil-proof specifications wiring tube and oil-proof connector when using the servomotor in an environment where it will be exposed to large amounts of cutting fluid or the protection cover is not adequate.
d. Do not use the servomotor if part of the servomotor is submerged in oil or water. When the servomotor is located near the floor, install a water drain path on the floor to direct the flow. Do not clog the water drain path with cutting chips.
e. Check the drain path of oil and water on the moving table and the slide cover.
   Be aware of the following conditions.
   - When the table arrives at a specific position, the drain hole comes to the upper section of the motor. Thus, oil or water splashes the motor.
   - Depending on the movement of the slide cover and table, oil or water which stays on the slide cover or table splashes the motor.
   - Depending on the shrinkage or expansion of the cover, oil or water which stays on the slide cover leaks from the wiper section and drops on the motor.
f. The servomotor should be installed in a well ventilated place where oil and water will not splash it, and where it can be easily installed or removed.

(2) Precautions against gear oil

a. Although the servomotor can be installed horizontally or at the upper or lower end of the axis, when the servomotor is installed at the upper end, take extra measures on the machine side to avoid oil from the gear box, etc., from entering the motor. In this situation, the oil seal of the motor is not sufficient protection.
b. Oil level and pressure in the gear box
   The oil level in the gear box where the servomotor is horizontally mounted should be always lower than the oil seal lip of the servomotor shaft (both in the stop and rotation states). If the oil level is higher than the oil lip, oil may enter the motor. Some servomotors are not provided with shaft end oil seals. To prevent the inner pressure of the gear box from increasing, provide an intake-hole on the gear box.

[Machine side]



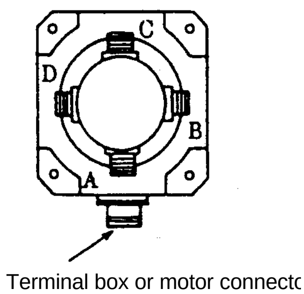
Model	HA053N HA13N	HA23N HA33N	HC52 HC53 HC102 HC103 HA50L HA100NL HA150NL HA53NL HA103NL HA153NL (HA40N) (HA43N) (HA80N) (HA83N)	HC152, HC203 HC202, HC353 HC352, HC453 HC452, HC703 HC702 HA200NL, HA300NL HA203NL, HA303NL (HA100N), (HA103N) (HA200N), (HA203N) (HA300N), (HA303N) (HA700N), (HA703N)	HC902 HA500NL, HA503NL, HA-LH11K2 (HA900N)	HA-LH15K2
Height from center of motor shaft h (mm)	8	10	20	25	30	40

(3) Detector

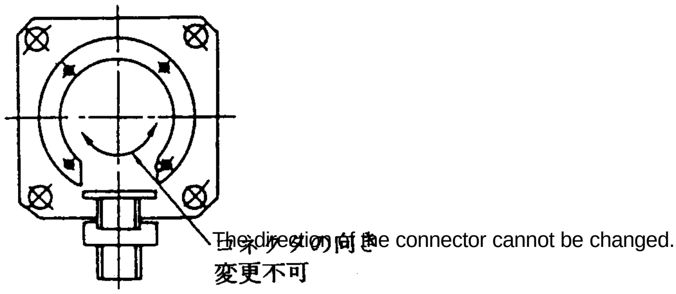
a. When transporting and installing the servomotor, avoid shocks to the detector on the servo-motor. To prevent items from hitting the detector workers from getting on the detector and tools or workpieces from dropping on the detector, install a protection cover around the detector. Any design where a coupling should be struck to the motor shaft should be avoided to prevent damage to the detector.

b. The detector cover for motors other than HA053N, HA13N, HA23N and 33N can be turned 90°, but design the machine so that it faces the "A" direction as a standard.
The parameter settings must be changed when the connector is faced in the B, C or D directions for the HA23N and 33N motors. (The setting changes are complicated and the combinations may be mistaken, so the connector direction should not be changed if possible.)

Symbol of direction of detector connector (The "A" direction is standard.)



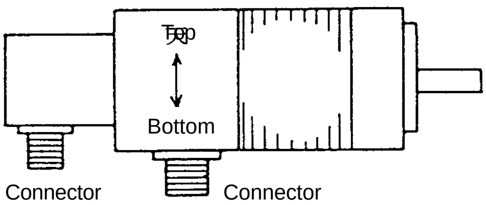
c. The detectors for motors other than HA23N and 33N are fixed to the motor with pins. The HA23N and 33N motor detectors are fixed to the motor with screws, but the polarity must be matched correctly when installing. If this is ignored and the detector is replaced or the detector connector direction is changed, the control will not be possible, and the motor may run out of control. The relation of the detector and motor position should not be changed after delivery from Mitsubishi.

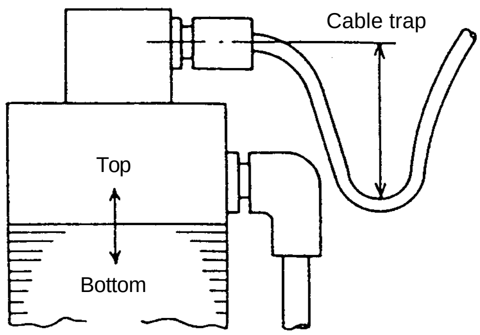


∗ When using the low inertia motor and IP67 compatible motor, do not remove the encoder and encoder cover.
The magnetic pole position of the low inertia motor has been adjusted when the encoder was installed.
The IP67 compatible motor has been tested in water with the encoder and cover installed.

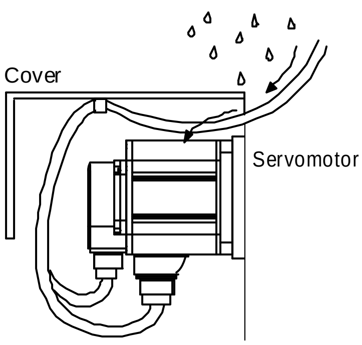
(4) Connector and cable

a. The connector should be located so that it faces downward.
When the motor is installed vertically or on an incline, provide a cable trap.

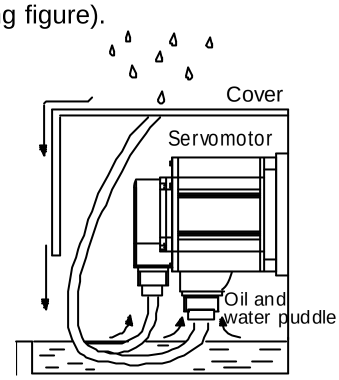




b. The standard cannon plugs are not waterproof.
c. The cables may lead oil and water to the motor and the detector, causing negative effects. Avoid allowing the cables to lead oil and water to the motor and the detector, and do not allow the cables to dip in oil and water (see the following figure).



<Poor> Respiration



<Poor> Capillary tube action

d. Adhere to the cable clamping method and avoid bending or stressing the cable connections under the dead weight of the cable.
If the motor shifts, the cable bending radius should be determined according to the required bending life and the cable type.
e. Prevent sharp chips from cutting the cable's outer sheath and from being abraded by contact with any edge of the machine. In addition, prevent the cable from being trampled by people and automobiles.

(5) Attaching/detaching connectors

a. While the machine is turned ON, do not connect or disconnect any connector to or from the machine, otherwise, the motor may be damaged. Also, avoid dropping the machine and abrupt motor start, or generation large arcs may occur.
It is recommended to tie each cannon plug with a wire.
b. Even when the power is turned OFF, the absolute value detector is backed up by a battery. Thus, when the detector cable is disconnected, the absolute position is lost. It is recommended to tie this plug with a wire and indicate a warning sign "do not disconnect this plug even while power is turned OFF."
c. The cannon plugs are tightened manually. Provide enough space to correctly tighten each cannon plug.

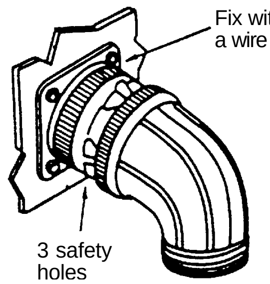
(6) Applications involving vibration

Tie the cannon plugs and cable clamps of the motor and detector with wires. Clamp carefully to avoid vibration stress and the stress of the cable dead weight on the cable connections, both of which may affect the relationship between the cable finish diameter and the clamp size. In addition, check that the clamps are not loose.
Include the retightening of the cannon plugs and the clamps in the machine manual as a periodical inspection item.

● **Safety holes for protection against connector separation**

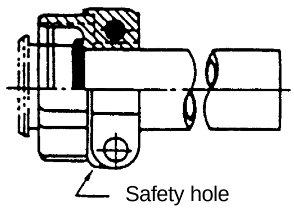
If the coupling nut has safety holes, when the connector is exposed to strong shock and vibration, pass a wire through the holes and fix the connector to protect the connector from being disconnected. Under normal conditions, this treatment is not required (extracted from a catalog).

- Since the cable clamp has two safety holes which are similar to the connector, it can also be fixed.
- The safety holes differ slightly in structure depending on the manufacturer.



● **Fixing wire (0.813ø annealed stainless steel wire)**

QQ-W-423 FORM-1 FS304 CD-A 0.032 (inches) is recommended because of its mechanical strength and easy machining.



● **Optimum tightening torque for coupling nuts**

The connector is designed so that it can be easily tightened by turning the coupling nut manually without using a special tool. When the connector is exposed to vibration, it should be fixed with a wire. There is no regulation for the tightening torque in the MIL Standards.
When this connector is used for an airplane, the connector should be fixed with a wire by the user.

(7) Any design which requires modification, disassembling, or additional machining of the motor should be avoided.

4.2 Coupling with the load

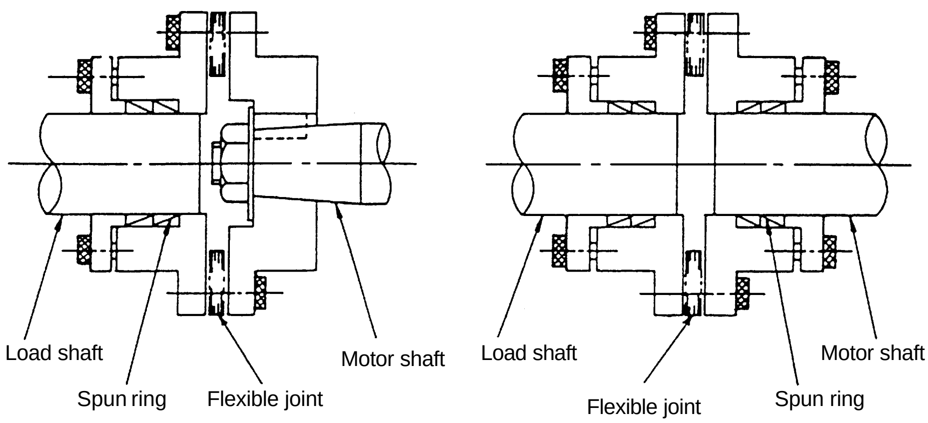
The motor shaft is coupled to the machine by one of the following methods:
The direct coupling method, in which the motor shaft is coupled directly to the machine by a flexible joint.
The gear method, in which the motor speed is reduced when using a gear.
The timing belt method, in which the motor shaft is coupled to the machine using a timing belt.
This method is an important factor that affects the machine performance.
The following table outlines comparisons among the three methods.

	Noise	No lubri-cation	Back-lash	Rigid-ity	Reliability of coupling	Life	Torque up by speed reduction	Degree of freedom of installing motor	Cause of motor shaft breakage
Direct coupling	○	○	○	○	○ Looseness of bolt	○	×	×	Misalignment of shaft center
Gear	×	×	△	△	Breakage of teeth	△	○	○	Too small backlash, undersized pitch diameter
Timing belt	△	○	○	×	× Breakage of belt	×	○	○	Excess belt tension, undersized pitch diameter

(1) Direct coupling

When a load is directly coupled to the motor shaft, use a flexible joint. Although the flexible joint can absorb misalignment, to maximize the durability of the machine, it is necessary to completely match the load with the shaft center during the initial installation. In addition, it is necessary to periodically adjust the misalignment. When the flexible joint is used, carefully select a joint according to the environmental conditions and operate it according to the specification manual issued by the manufacturer.
Although a coupling whose rigidity is low decreases the alignment accuracy, it is not preferable for the servomotor. To use the submicron specification, skillfully align it, and use a high rigidity coupling. When such conditions are not satisfied, the servo performance cannot be maximized, (the gain cannot be increased) and the motor shaft may break.

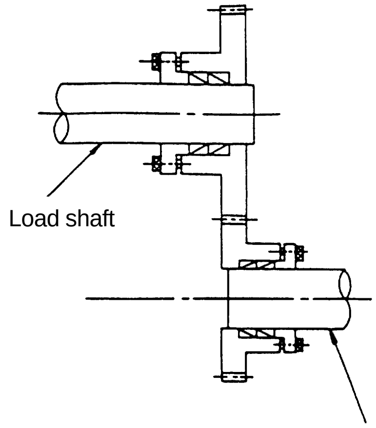
Example of direct coupling with load



(a) In the case of tapered shaft **(b) In the case of straight shaft**

(2) Gear coupling

To obtain a large torque by reducing speed, a gear is used between the motor shaft and the load.
The accuracy of the gear and the amount of backlash depend largely on the accuracy of the machine positioning and the noise of the machine operation.
In the gear coupling method, it is necessary to properly select the accuracy and the amount of the backlash.
In the gear coupling method, take measures to prevent oil from entering the motor. Refer to "4.1(2)" for details.



Example of coupling with load using gear

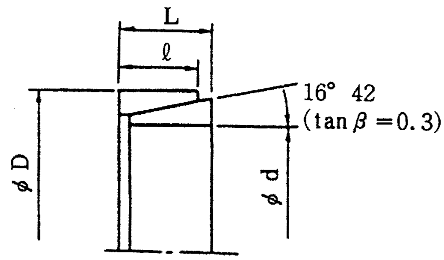
(3) Spun ring

Since the output shaft of a servomotor of 2 kW or greater does not have a key groove, it is necessary to use a frictional joint such as a spun ring for coupling with the load shaft.
For details of the usage of the spun ring, contact the manufacturer or dealer.

● **Table of characteristics and dimensions RfN8006**

d ´ D mm	L mm	l mm	Effective contact area Ft mm^2	Note 1 P_O N	Note 2 P_A N	Transmission torque Mt N·m	Tangent transmission force Pax N	Gap xmm Number of set 1	2	3	4	Weight G kg
11×14	4.5	3.7	128	7502	6933	8.43	1540	2	2	3	3	0.00198
24×28	6.3	5.3	400	8189	21182	56.88	4707	3	3	4	5	0.0068
35×40	7	6	659	9905	34912	135.33	7747	3	3	4	5	0.014

(Note 1) Axial pressure necessary for allowing the engagement clearance to be 0.
(Note 2) Net pressure force necessary for producing transmission force

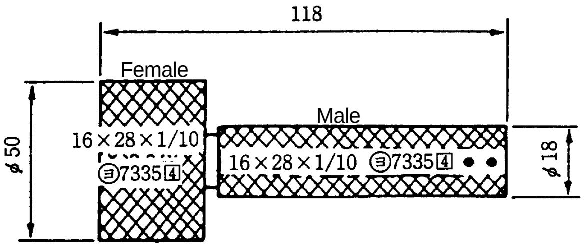


Outline dimension drawing of RfN8006

Various manufacturers produce frictional joints as substitutes of spun ring.
The specifications, dimensions, etc., of the products may differ depending on the manufacturers.
When using them, carefully check the specifications.

(4) Taper gauge

The standard shaft end of a servomotor of 1 kW or less is a tapered shaft. When the taper should be matched on the machine side, a copy gauge should be made in accordance with the master gauge of Mitsubishi Electric.
The copy gauge should be directly ordered through the following manufacturer. Note the following items.



1) Place order with:
   Chubu Seiki Seisakusho
2) Requirement:
   Taper gauge (copy): 16 × 28 × 1/10
   Mitsubishi Nagoya Works should have the master of the copy gauge.
   (㋵ 7335)

(5) Other reference items

The shapes and dimensions of the servomotor mounting flange section and the shaft end conform to the standards of Japan Machine Tool Industry Association MAS402.
The only available coupling methods for the servomotor for the MCI machine tool are the method using the straight shaft without the key (spun ring) and the method using the taper shaft end.
The method of the straight shaft with the key cannot be practically used because of the wear caused by the backlash of the key.
The method by which the motor shaft and the hub are simultaneously machined, and a taper pin is used to couple them, should be avoided because a service motor is not provided. A motor modified in such a manner cannot be repaired and the spare parts may not be supplied.
For the strength of the motor shaft, see section 2.11.
For the operation of the electromagnetic brake when a timing belt is coupled in the vertical axis, see section 2.9 (3). Assuming that the diameter of ball screw is Dm (mm) and the speed is N (r/min), the following relation is satisfied.

$$DmN < 70000.$$

This performance can be enhanced by controlling the lubrication and cooling methods.
As the standard for precision ball screws, JIS-B-1192 has been issued.

Tightening torque for tapered shaft end screw.

The screw shaft will be damaged if the tightening torque of the tapered shaft end screw is too tight. Follow the values given below when tightening.

Model	Tapered shaft end screw tightening torque	Reference	
		Screw size	Tightening torque
HA23N HA33N	4.71 to 6.37N·m	M6 × 1.0	Approx. 300kg
HC52 HC53 HC102 HC103 (HA40N) (HA43N) (HA80N) (HA83N)	22.56 to 30.40N · m	M10 × 1.25	Approx. 900kg

5. MDS-C1-V1 Servo Drive

5.1 Availability of 2-system (standard drive unit mode and high-gain drive unit mode)

(1) Outline

- The C1 Series can be controlled in two modes: the mode equivalent to the standard drive unit (MDS-B-V1/V2) and the mode equivalent to the high-gain drive unit (MDS-B-V14/V24).
  Thus, reloading both from the standard drive unit (MDS-B-V1/V2) and high-gain drive unit (MDS-V14/V24) with the same parameter becomes available.
- Whether the reloading is from the standard drive unit or from the high-gain drive unit is recognized automatically through the state of the servo parameter set in the machine.

⚠ CAUTION

If the control mode has to be changed to the high-gain drive unit (MDS-B-V14/V24) mode after reloading from the standard drive unit (MDS-B-V1/V2), it is necessary to change the parameter again as the high-gain drive unit and to adjust the servo parameter.

(2) Applicable software version

The software to be applied to 2-system is A1 Version (BND-582W000-A1) or later.

∗ The A0 Version cannot be applied to the standard drive unit mode and is used only in high-gain drive unit mode.

(3) Control mode changeover discrimination

Whether the servo drive unit is started in standard drive unit mode or in high-gain drive unit mode is recognized with the servo parameters SV009 to SV012, and SV033 set in the machine.

<table>
<tr><th colspan="2">Control mode</th><th>High-gain mode</th><th>Standard mode</th><th>Standard mode</th><th>High-gain mode</th><th>High-gain mode</th></tr>
<tr><td rowspan="3">Servo parameter</td><td>SV009 to SV012</td><td>SV009 = 4096 or more,
SV010 = 4096 or more,
SV011 = 768 or more, and
SV012 = 768 or more</td><td>The setting that does not satisfy any of the following conditions:
SV009 = 4096 or more
SV010 = 4096 or more,
SV011 = 768 or more,
SV012 = 768 or more</td><td>SV009 = ∗
SV010 = ∗
SV011 = ∗
SV012 = ∗</td><td>SV009 = ∗
SV010 = ∗
SV011 = ∗
SV012 = ∗</td><td>SV009 = ∗
SV010 = ∗
SV011 = ∗
SV012 = ∗</td></tr>
<tr><td>SV033 (SSF2) /bit8</td><td>0</td><td>0</td><td>1</td><td>0</td><td>1</td></tr>
<tr><td>SV033 (SSF2) /bit9</td><td>0</td><td>0</td><td>0</td><td>1</td><td>1</td></tr>
</table>

⚠ CAUTION

The changeover of standard drive unit mode and high-gain drive unit mode is actually carried out when the 200V power is turned ON. Thus, if the above servo parameters are changed, the alarm "7F" occurs, requesting for the power to be tuned ON again. The alarm "7F" may also occur when the power is turned ON for the first time after the machine has been installed. Therefore, when the alarm "7F" occurs, turn ON the power again. Unless the above servo parameters are changed, the alarm "7F" will not occur after the power is turned ON for the second time or later.

(4) Display of servo monitor type in high-gain mode and standard drive unit mode (Servo Monitor screen)

Whether the system is set to high-gain mode or to standard drive unit mode can be confirmed through the display of type on the Servo Monitor screen.

Unit type	At standard drive unit mode	At high-gain mode
MDS–C1–V1-□□□	C1V1s□□□	C1V1-□□□
MDS–C1–V2-□□○○	C1V2s□□○○	C1V2-□□○○
MDS–C1–V1-45S	C1V1s4S	C1V1-4S
MDS–C1–V2-7070S	C1V2s7S7S	C1V2-7S7S
MDS–C1–V2-3510S	C1V2s3510	C1V2-3510
MDS–C1–V2-3520S	C1V2s3520	C1V2-3520

⚠ CAUTION
Only the serial encoder (OSE/OSA type) is applicable to the motor end detector for both high-gain mode and standard mode.

5.2 Model configuration

MDS-C1-V1 - □

Servo drive capacity class symbol

Symbol	Capacity	Applicable motor			
		Standard 2000r/min	Standard 3000r/min	Low inertia 2000r/min	Low inertia 3000r/min
01	0.1 kW		HA053 HA13		
03	0.3 kW		HA23N HA33N		
05	0.5 kW	HC52 (HA40N)	HC53 (HA43N)	HA50NL	
10	1.0 kW	HC102 (HA80N)	HC103 (HA83N)	HA100NL	HA53NL (HC103R) (HC153R)
20	2.0 kW	HC152, HC202 (HA100N)	HC153	HA150NL HA200NL	HA103NL HA153NL (HC203R)
35	3.5 kW	HC352 (HA200N)	HC203 (HA103N)	HA300NL	HA203NL (HC353R)
45	4.5 kW	HC452 (HA300N)	HC353 (HA203N)	HA500NL	HA303NL (HC503R)
45S	4.5 kW (With specifi-cations limit)	HC452 ∗ Specifications limit: 78% of the motor stall rating	HC353 ∗ Specifications limit: 94% of the motor stall rating		
70	7.0 kW	HC702 (HA700N)	HC453 (HA303N)		HA503NL
70S	7.0 kW (With specifi-cations limit)	HC702 ∗ Specifications limit: 90% of the motor stall rating	HC453 ∗ Specifications limit: 82% of the motor stall rating		
90	9.0 kW	HC902 (HA900N)	HC703 (HA703N)		
110	11.0 kW			HA-LH11K2	
150	15.0 kW			HA-LH15K2	

∗ The V1-110/150 servo drive unit does not have built-in dynamic brakes, so always install an external dynamic brake unit.

5.3 Specifications list

			1-axis servo drive unit MDS-C1-V1 Series												
Model		**MDS-C1-V1-**	01	03	05	10	20	35	45S	45	70S	70	90	110	150
Rated output		**[kW]**	0.1	0.3	0.5	1.0	2.0	3.5	4.5	4.5	7.0	7.0	9.0	11.0	150
Output	**Rated voltage**	**[V]**	155VAC												
	Rated current	**[A]**	0.95	2.9	3.4	6.8	13.0	19.0	28.0	28.0	33.5	33.5	42.0	68.0	87.0
Input	**Rated voltage**	**[V]**	270-311VDC												
	Rated current	**[A]**	1	3	4	7	14	17	30	30	35	35	45	55	75
Control power supply	**Voltage**	**[V]**	200/200-230VAC												
	Frequen-cy	**[Hz]**	50/60Hz												
	Current	**[A]**	Max. 0.2A												
Control system			Sine-wave PWM control system/current control method												
Braking			Regeneration braking and dynamic braking												
	Dynamic brake		Built-in												
Structure			Fully enclosed, self-cooling (Protective degree: IP65, IP67)												
Environ-ment	**Ambient tempera-ture**	**[°C]**	Operation: 0 to 55°C (non freezing), Storage/transportation: –15 to 70°C (non freezing)												
	Ambient humidity	**[%RH]**	Operation: 90%RH or less (non condensing), Storage/transportation: 90%RH or less (non condensing)												
	Atmosphere		Indoors (no direct sunlight); no corrosive gas, inflammable gas, oil mist, or dust.												
	Eleva-tion	**[m]**	Operation/storage: 1000 meters or less above sea level, Transportation: 10000 meters or less above sea level												
	Vibration/ Impact	**[m/s^2]**	$4.9m/s^2$ (0.5G)/$49m/s^2$ (5G)												
Cooling type			Self-cooling				Forced air cooling								
Weight		**[kg]**	2.1				3.8			4.5	4.9	5.8		6.4	
Maximum heating value		**[W]**	21	27	37	53	91	132	158	185	189	284	331	465	641
Noise			Less than 55dB												

(Note 1) The same capacity drive units with a smaller width are indicated with an "S" at the end of the type. Note that limits will apply to continuous operation.

		Spindle drive unit MDS-C1-SP [ ] Series															
Model	**MDS-C1-SP[ ]**	04	075	15	22	37	55	75	110	150S	150	185	220	260U	260	300U	300
Rated output	**[kW]**	0.1	0.3	0.5	1.0	2.0	3.5	4.5	4.5	7.0	7.0	9.0	11.0	150	26.0	30.0	30.0
Output	**Rated voltage [V]**	155VAC															
	Rated current [A]	1.5	2.6	4.5	10.0	15.0	18	26	37	49		63	79	97		130	
Input	**Rated voltage [V]**	270-311VDC															
	Rated current [A]	1	4	7	13	17	20	30	41	58		76	95	115		144	
Control power supply	**Voltage [V]**	200/200-230VAC															
	Frequency [Hz]	50/60Hz															
	Current [A]	Max. 0.2A															
Control system		Sine-wave PWM control system/current control method															
Braking		Power supply regeneration braking															
	Dynamic brake	Built-in															
Structure		Fully enclosed, self-cooling (Protective degree: IP65, IP67)															
Environment	**Ambient temperature [°C]**	Operation: 0 to 55°C (non freezing), Storage/transportation: –15 to 70°C (non freezing)															
	Ambient humidity [%RH]	Operation: 90%RH or less (non condensing), Storage/transportation: 90%RH or less (non condensing)															
	Atmosphere	Indoors (no direct sunlight); no corrosive gas, inflammable gas, oil mist, or dust.															
	Elevation [m]	Operation/storage: 1000 meters or less above sea level, Transportation: 10000 meters or less above sea level															
	Vibration/ Impact [m/s²]	$4.9m/s^2$ (0.5G)/$49m/s^2$ (5G)															
Cooling type		Self-cooling			Forced air cooling												
Weight	**[kg]**	2.1			3.8		4.4			4.7	5.7		6.5	8.4	6.3	8.4	6.3
Maximum heating value	**[W]**	30	40	49	69	79	108	137	181	235		342	366	483		620	
Noise		Less than 55dB															

(Note 1) The 15kW drive unit with smaller width is indicated with an "S" at the end of the type. Note that limits will apply to continuous operation.

(Note 2) The heat radiation fin for the 26kW/30kW capacities is a straight type. The types with a spiral fin are indicated with a "U" at the end of the type.

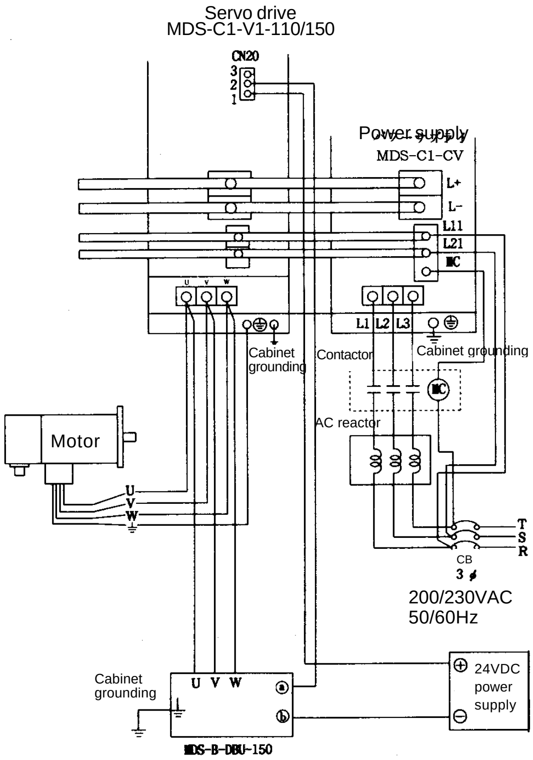
	Unit	Servo drive model name												
		MDS-C1-												
		V1-01	V1-03	V1-05	V1-10	V1-20	V1-35	V1-45	V1-45S	V1-70	V1-70S	V1-90	V1-110	V1-150
Applicable motor		HA053 HA13	HA23N HA33N	HC52 HC53 HA50NL (HA40N) (HA43N)	HC102 HC103 HA100NL HA53NL (HA80N) (HA83N) (HC103R) (HC153R)	HC152 HC202 HC153 HA150NL HA200NL HA103NL HA153NL (HA100N) (HC203R)	HC352 HC203 HA300NL HA203NL (HA200N) (HA103N) (HC353R)	HC452 HC353 HA500NL HA303NL (HA300N) (HA203N) (HC503R)	HC452 HC353	HC702 HC453 HA503NL (HA700N) (HA303N)	HC702 HC453	HC902 HC703 (HA900N) (HA703N)	HA-LH11K2	HA-LH15K2
Output voltage	V	155												
Rated output current	A	0.95	2.9	3.4	6.8	13	16	28	28	33.5	33.5	42	68	87
Stall current	A	1.4	3.0	5.0	8.8	18.2	25	44	31.5	55	41	68	84	100
Maximum output current	A	3.9	8.1	17	28	42	57	85	85	113	113	141	204	260
Maximum output torque (During combination with motor) Same order as applicable motor	N·m	0.69 1.37	2.75 5.6	11.8 8.82 13.0 (14.2) (10.2)	21.6 16.7 20.7 14.1 (25.5) (19.2) (7.95) (11.9)	35.3 41.7 28.4 31 32 22.5 22.8 (42) (15.9)	59.8 40.2 52 37 (60) (40) (27.8)	87.5 55.9 72 60 (87) (56) (39.8)	87.5 55.9	120 79.8 78 (120) (80)	120 79.8	153 105 (153) (105)	158	215

5.4 Connection of dynamic brake unit

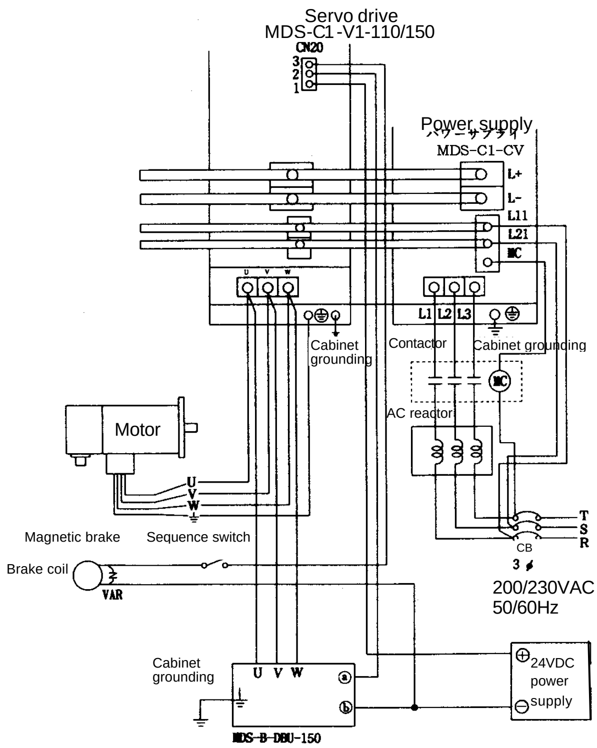
The V1-110/150 servo drive unit does not have built-in dynamic brakes, so always install an external dynamic brake unit.

Model name	Coil specification	Compatible drive unit
MDS-B-DBU-150	24VDC 160mA	V1-110/150

(1) When using only dynamic brake unit



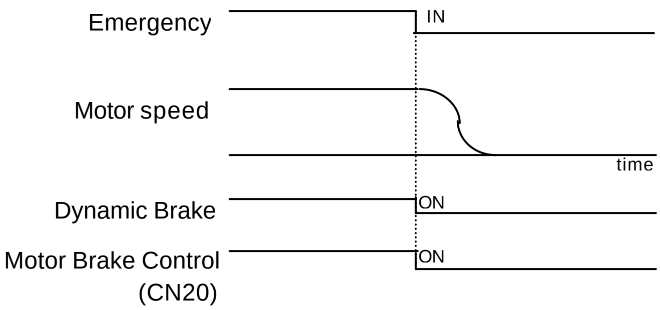
(2) When using dynamic brake unit + magnetic brakes (combination use)



(3) The stop by the Dynamic brake

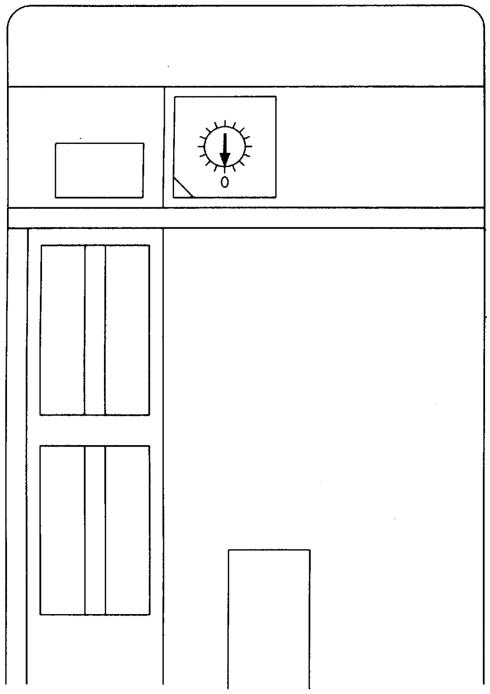
The dynamic brake is built in to MDS-B / C1-V 1-90.
MDS-B/C1-V1-110/150 use an external unit.

It is made to stop in a dynamic brake at the time of emergency stop generating, without performing slowdown control.
A dynamic brake and a motor brake control output (CN20) also operate simultaneously immediately after inputting an emergency stop signal.



⚠ CAUTION
Please do not use a dynamic brake as a usual slowdown stop. When continuation operation is carried out, the brake resistance for dynamic may be damaged.

5.5 Hardware setting



Function	Setting	Meaning
Axis No. setting CS	0	1st axis
	1	2nd axis
	2	3rd axis
	3	4th axis
	4	5th axis
	5	6th axis
	6	7th axis
	7 to E	Not usable
	F	Not used axis selection

The servo drive unit axis No. can be set by opening the upper lid (next to LED status display window) on the top of the MDS-C1-V1 servo drive unit, and turning the rotary switch. When the rotary switch is set to "F" and the servo drive unit power is turned on, that axis will not be controlled. Thus, set axes that are not being used to "F". (The communication with the NC will not take place during initialization, and an alarm will not occur.)
In the above example, the 1st axis is set.

5.6 Parameter settings

⚠ CAUTION
Do not make remarkable adjustments and changes as the operation could become unstable.

(1) Parameter screens

The servo parameters are set on the NC [M_PARAM] screens.
Examples of the screen displays are shown for the 14" CRT screen.
There are a total of 64 servo parameters. Screen page 1 shows the parameters regarding the specifications, and page 2 an excerpt of the parameters used for adjustment. Pages 3 and following are all parameters for SV001 to SV064.
The parameters can be changed from any screen.

[SERVO PARAM] M PARAM 5. 1/6

#			⟨X⟩	⟨Y⟩	⟨Z⟩	⟨W⟩	⟨A⟩	⟨C⟩
1	SPEC	(HEX)	0000	0000	0000	0000	0000	0000
2	MTYP	(HEX)	0002	0002	0002	0002	0002	0002
3	PTYP	(HEX)	0000	0000	0000	0000	0000	0000
4	SSF1	(HEX)	0000	0000	0000	0000	0000	0000
5	SSF2	(HEX)	0000	0000	0000	0000	0000	0000
6	PC1		1	1	1	1	1	1
7	PC2		1	1	1	1	1	1
8	PIT		10	10	10	10	10	10
9	RNG1		100	100	100	100	100	100
10	RNG2		100	100	100	100	100	100
11	PGN		33	33	33	33	33	33

#(11)AXIS<X>DATA(33)

BASE1 | BASE2 | AXIS | ZP-RTN | SERVO | MC-ERR | MACRO | $-SELECT | MENU

[SERVO PARAM] M PARAM 5. 2/6

#			⟨X⟩	⟨Y⟩	⟨Z⟩	⟨W⟩	⟨A⟩	⟨C⟩
1	PGN2		99	99	99	99	99	99
2	YGN		150	150	150	150	150	150
3	VIA		682	682	682	682	682	682
4	VIL		0	0	0	0	0	0
5	FFC	(%)	0	0	0	0	0	0
6	JL	(%)	150	150	150	150	150	150
7	FHz	(Hz)	350	350	350	350	350	350
8	TOF	(%)	−20	−20	−20	−20	−20	−20
9	LMC1		30	30	30	30	30	30
10	LMC2		40	40	40	40	40	40
11	OVS1		25	25	25	25	25	25
12	OVS2		35	35	35	35	35	35

#(11)AXIS<X>DATA(25)

BASE1 | BASE2 | AXIS | ZP-RTN | SERVO | MC-ERR | MACRO | $-SELECT | MENU

[SERVO PARAM] M PARAM 5. 3/6

#		⟨X⟩	⟨Y⟩	⟨Z⟩	⟨W⟩	⟨A⟩	⟨C⟩
1	SV001	1	1	1	1	1	1
2	SV002	1	1	1	1	1	1
3	SV003	33	33	33	33	33	33
4	SV004	99	99	99	99	99	99
5	SV005	150	150	150	150	150	150
6	SV006	150	150	150	150	150	150
7	SV007	0	0	0	0	0	0
8	SV008	682	682	682	682	682	682
9	SV009	1024	1024	1024	1024	1024	1024
10	SV010	1024	1024	1024	1024	1024	1024
11	SV011	256	256	256	256	256	256
12	SV012	256	256	256	256	256	256
13	SV013	500	500	500	500	500	500
14	SV014	500	500	500	500	500	500
15	SV015	0	0	0	0	0	0
16	SV016	40	40	40	40	40	40

#(14)AXIS<X>DATA(500)

BASE1 | BASE2 | AXIS | ZP-RTN | SERVO | MC-ERR | MACRO | $-SELECT | MENU

[SERVO PARAM] M PARAM 5. 4/6

#		⟨X⟩	⟨Y⟩	⟨Z⟩	⟨W⟩	⟨A⟩	⟨C⟩
17	SV017	0000	0000	0000	0000	0000	0000
18	SV018	10	10	10	10	10	10
19	SV019	100	100	100	100	100	100
20	SV020	100	100	100	100	100	100
21	SV021	150	150	150	150	150	150
22	SV022	60	60	60	60	60	60
23	SV023	2	2	2	2	2	2
24	SV024	50	50	50	50	50	50
25	SV025	0002	0002	0002	0002	0002	0000
26	SV026	2	2	2	2	2	2
27	SV027	0000	0000	0000	0000	0000	0000
28	SV028	0	0	0	0	0	0
29	SV029	400	400	400	400	400	400
30	SV030	64	64	64	64	64	64
31	SV031	25	25	25	25	25	25
32	SV032	−20	−20	−20	−20	−20	−20

#(25)AXIS<X>DATA(0000)

BASE1 | BASE2 | AXIS | ZP-RTN | SERVO | MC-ERR | MACRO | $-SELECT | MENU

[SERVO PARAM] M PARAM 5. 5/6

#		⟨X⟩	⟨Y⟩	⟨Z⟩	⟨W⟩	⟨A⟩	⟨C⟩
33	SV033	0000	0000	0000	0000	0000	0000
34	SV034	0000	0000	0000	0000	0000	0000
35	SV035	0000	0000	0000	0000	0000	0000
36	SV036	0000	0000	0000	0000	0000	0000
37	SV037	150	150	150	150	150	150
38	SV038	350	350	350	350	350	350
39	SV039	0	0	0	0	0	0
40	SV040	0	0	0	0	0	0
41	SV041	40	40	40	40	40	40
42	SV042	35	35	35	35	35	35
43	SV043	0	0	0	0	0	0
44	SV044	0	0	0	0	0	0
45	SV045	0	0	0	0	0	0
46	SV046	0	0	0	0	0	0
47	SV047	0	0	0	0	0	0
48	SV048	0	0	0	0	0	0

#(48)AXIS<X>DATA(0)

BASE1 | BASE2 | AXIS | ZP-RTN | SERVO | MC-ERR | MACRO | $-SELECT | MENU

[SERVO PARAM] M PARAM 5. 6/6

#		⟨X⟩	⟨Y⟩	⟨Z⟩	⟨W⟩	⟨A⟩	⟨C⟩
49	SV049	15	15	15	15	15	15
50	SV050	0	0	0	0	0	0
51	SV051	100	100	100	100	100	100
52	SV052	0	0	0	0	0	0
53	SV053	2	2	2	2	2	2
54	SV054	0	0	0	0	0	0
55	SV055	0	0	0	0	0	0
56	SV056	0	0	0	0	0	0
57	SV057	0	0	0	0	0	0
58	SV058	0	0	0	0	0	0
59	SV059	20	20	20	20	20	20
60	SV060	30	30	30	30	30	30
61	SV061	0	0	0	0	0	0
62	SV062	1	1	1	1	1	1
63	SV063	1	1	1	1	1	1
64	SV064	−1	−1	−1	−1	−1	−1

#(64)AXIS<X>DATA(–128)

BASE1 | BASE2 | AXIS | ZP-RTN | SERVO | MC-ERR | MACRO | $-SELECT | MENU

5.6.1 Standard Parameters (Standard Drive unit)

There are a total of 64 servo parameters. The parameters can be changed on any screen.

(Note) In the following explanations on bits, set all bits not used, including blank bits, to "0".

Setting and display method of servo parameters vary with the CNC to be used. Refer to the instruction manuals for each CNC.

Name	Abbr.	Details	Type	MDS-A/B compatible	Change method	Setting unit	Min.	Max.	Type		
									Machine	Servo	Adjust
sv001	PC1	Motor gear ratio	Spec	○	Initial		1	32767	○		
sv002	PC2	Machine gear ratio	Spec	○	Initial		1	32767	○		
sv003	PGN1	Position loop gain 1	Spec	○	Normal	rad/s	1	200			○
sv004	PGN2	Position loop gain 2	Adjust	○	Normal	rad/s	0	999		○	
sv005	VGN1	Speed loop gain 1	Adjust	○	Normal		1	999			○
sv006	VGN2	Speed loop gain 2		○	Normal		-1000	1000			○
sv007	VIL	Speed loop delay compensation	Adjust	○	Normal		0	32767			○
sv008	VIA	Speed loop advance compensation	Adjust	○	Normal		1	9999			○
sv009	IQA	Current loop q-axis advance compensation		○	Normal		1	20480		○	
sv010	IDA	Current loop d-axis advance compensation		○	Normal		1	20480		○	
sv011	IQG	Current loop q-axis gain		○	Normal		1	2560		○	
sv012	IDG	Current loop d-axis gain		○	Normal		1	2560		○	
sv013	ILMT	Current limit value		○	Normal	stall rated current %	0	999			○
sv014	ILMTsp	Current limit value (special operation)		○	Normal	stall rated current %	0	999			○
sv015	FFC	Acceleration feed forward gain	Adjust	○	Normal	%	0	999		○	
sv016	LMC1	Lost motion compensation 1	Adjust	○	Normal	stall rated current %	-1	200			○
sv017	SPEC	Servo specifications	Spec	△	Initial	HEX setting	*	*	○	○	○
sv018	PIT	Ball screw pitch	Spec	○	Initial	mm	1	32767	○		
sv019	RNG1	Position detector resolution	Spec	○	Initial	kp/rev,kp/PIT	1	9999		○	
sv020	RNG2	Speed detector resolution	Spec	○	Initial	kp/rev	1	9999		○	
sv021	OLT	Overload time constant		▲	Normal	s	1	300		○	
sv022	OLL	Overload detection level		▲	Normal	stall rated current %	1	500		○	
sv023	OD1	Excessive error detection width (at SV ON)		○	Normal	mm	0	32767	○		
sv024	INP	In-position width		○	Normal	µm	0	32767	○		
sv025	MTYP	Motor/detector type	Spec	△	Initial	HEX setting	*	*		○	
sv026	OD2	Excessive error detection width (at SV OFF)		○	Normal	mm	0	32767	○		
sv027	SSF1	Special servo function selection 1	Spec	△	Normal	HEX setting	*	*		○	○
sv028											
sv029	VCS	Speed loop gain change starting speed		○	Normal	r/min	0	9999			○
sv030	IVC	Voltage/current compensation		[illegible]	Normal		-32768	32767			○
sv031	OVS1	Overshoot compensation 1	Adjust	○	Normal	%	-1	100			○
sv032	TOF	Torque offset	Adjust	○	Normal	stall rated current %	-100	100			○
sv033	SSF2	Special servo function selection 2	Spec	△/●	Normal	HEX setting	*	*		○	○
sv034	SSF3	Special servo function selection 3		△	Normal	HEX setting	*	*		○	○
sv035	SSF4	Special servo function selection 4		△	Normal	HEX setting	*	*		○	○
sv036	PTYP	Power supply type	Spec	△	Initial	HEX setting	*	*		○	
sv037	JL	Load inertia ratio (Jm+Jl)/Jm	Adjust	○	Normal	%	0	5000			○

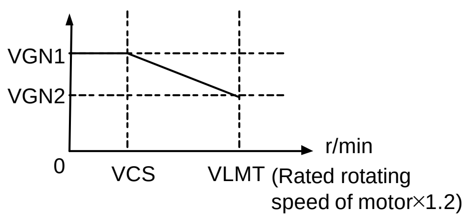
Name	Abbr.	Details	Type	MDS-A/B compatible	Change method	Setting unit	Min.	Max.	Type		
									Machine	Servo	Adjust
sv038	FHz	Frequency of machine resonance suppression filter	Adjust	○	Normal	Hz	0	3000	○		
sv039	LMCD	Lost motion compensation timing		☺	Normal	ms	0	2000			○
sv040	LMCT	Current bias/lost motion compensation dead zone	Adjust	☺/○	Normal	–/μm	-32768	32767			○
sv041	LMC2	Lost motion compensation 2	Adjust	○	Normal	stall rated current %	-1	200			○
sv042	OVS2	Overshoot compensation 2		○	Normal	stall rated current %	-1	100			○
sv043	OBS1	Observer 1		○	Normal	rad	0	1000			○
sv044	OBS2	Observer 2		○	Normal	%	0	500			○
sv045	TRUB	Current compensation/ Friction torque		☺/☺	Normal	–/stall rated current %	-32768	32767			○
sv046											
sv047	EC1	Inductive voltage compensation		○	Normal	%	*	*			○
sv048	EMGrt	Drop prevention brake operation delay time		☺	Normal	ms	0	2000	○		
sv049	PGN1sp	Position loop gain 1 (special operation)		○	Normal	rad/s	1	200			○
sv050	PGN2sp	Position loop gain 2 (special operation)		○	Normal	rad/s	0	999		○	
sv051	DFBT	Dual feedback control time constant		○	Normal	ms	0	9999			○
sv052	DFBN	Dual feedback control dead band width		○	Normal	μm	0	9999			○
sv053	OD3	Excessive error detection width (special operation)		○	Normal	mm	0	32767	○		
sv054	ORE	Closed loop overrun detection width		○	Normal	mm	-1	32767	○		
sv055	EMGx	Emergency stop maximum delay time		☺	Normal	ms	0	2000	○		
sv056	EMGt	Emergency stop deceleration time constant		☺	Normal	ms	-2000	2000	○		
sv057	SHGC	SHG control gain		○	Normal	rad/s	0	999		○	
sv058	SHGCsp	SHG control gain (special operation)		○	Normal	rad/s	0	999		○	
sv059	TCNV	Torque estimated gain		☺	Normal		0	32767			○
sv060	TLMT	G0 collision detection level		☺	Normal	stall rated current %	0	500			○
sv061	DA1NO	D/A output channel-1 data No.		○	Normal		*	*			
sv062	DA2NO	D/A output channel-2 data No.		○	Normal		*	*			
sv063	DA1MPY	D/A output channel-1 magnification		○	Normal		*	*			
sv064	DA2MPY	D/A output channel-2 magnification		○	Normal		*	*			

Type	Spec : Set in servo spec screen.	Adjust : Set in servo adjust screen.
MDS-A/B compatible	○ : Same as MDS-A-Vx. ▲ : Same setting as MDS-A-Vx even if the contents has changed. ● : New parameters of MDS-C1-Vx.	∧ : Includes new parameters of MDS-B-Vx. ☺ : New parameters of MDS-B-Vx.
Change method	Initial: Valid when NC power is turned ON.	Normal: Valid whenever setting.

(1) Parameters

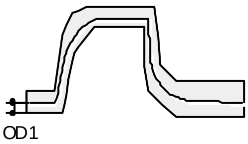
⚠ CAUTION

In the following explanations on bits, set all bits not used, including blank bits, to "0".

Name	Abbr.	Details	Setting range (unit)
SV001	PC1	Set the motor side gear ratio. Set so that PC1 and PC2 have the smallest integer ratio. (Refer to "(2) Limitations to electronic gear setting value".)	1 to 32767
SV002	PC2	Set the machine side gear ratio. Set so that PC1 and PC2 have the smallest integer ratio. (Refer to "(2) Limitations to electronic gear setting value ".)	1 to 32767
SV003	PGN1	Set the position loop gain in increments of "1". Set "33" for ordinary operation.	1 to 200 (rad/s)
SV004	PGN2	In case of SHG control, set this parameter with SV057 (SHGC). Set "0" when it is not used.	0 to 999 (rad/s)
SV005	VGN1	Set the speed loop gain. The standard value is 150. When it is increased, response is improved but vibration and sound become larger.	1 to 999
SV006	VGN2	If it is desired to reduce noise generated at high-speed rotation for rapid traverse, set a speed loop gain (smaller than VGN1) to be gain at high-speed rotation (1.2 times higher than the rated rotating speed). Set the start speed of speed gain decrease to the parameter SV029(VCS). Set "0" when this parameter function is not used. 	–1000 to 1000
SV007	VIL	Set this parameter when the limit cycle occurs in a closed loop, or the overshoot occurs during positioning. Set "0" when this parameter function is not used. Related parameter is vcnt1,vcnt2 in SV027 (SSF1).	0 to 32767
SV008	VIA	Set the speed loop advance compensation.	1 to 9999 (0.0687 rad/s)
SV009	IQA	Set the intra-current loop compensation. The data to be set is predetermined for each motor employed. Refer to section "(10) Standard Parameters for Each Motor".	1 to 20480
SV010	IDA	Set the intra-current loop compensation The data to be set is predetermined for each motor employed. Refer to section "(10) Standard Parameters for Each Motor ".	1 to 20480
SV011	IQG	Set the intra-current loop compensation. The data to be set is predetermined for each motor employed. Refer to section "(10) Standard Parameters for Each Motor ".	1 to 2560
SV012	IDG	Set the intra-current loop compensation. The data to be set is predetermined for each motor employed. Refer to section "(10) Standard Parameters for Each Motor ".	1 to 2560

Name	Abbr.	Details	Setting range (unit)
SV013	ILMT	Set the current limit value by specifying the rate (%) in respect to the stall rated current. For making the maximum driver torque level available, assign "500". (This is the limit value for both + and – directions.)	0 to 999 (Stall rated current %)
SV014	ILMTsp	Set the rate (%) in respect to the stall rated current for special operations (absolute position initialization, stopper operation, etc) to set the current limit value for special operations. For making the maximum driver torque level available, assign "500". (This is the limit value for both the + and – direction.)	0 to 999 (Stall rated current %)
SV015	FFC	Set this parameter when an amount of overshoot caused in feed forward control or a relative error caused in synchronous control is too large. Set "0" when this parameter is not used.	0 to 999 (%)
SV016	LMC1	Set this parameter if the protrusion is large when the arc quadrant is changed. (Caused by dead band from friction, torsion, backlash, etc.) This is valid only when lost motion compensation SV027 (lmc1, lmc2) is selected.	–1 to 200
		Type 1 SV027 (SSF1) lmc1=1, lmc2=0 In low-speed interpolation mode, compensation of this type eliminates bump. Setting "0" to this parameter indicates interpolation gain 0. Setting "100" indicates 100% compensation.	0 to 200 (%)
		Type 2 SV027 (SSF1) lmc1=0, lmc2=1 This is the standard type of MDS series. Use type 2 when type 1 is not enough for compensation such as in high-speed, high-accuracy interpolation. Set data in percentage to stall rated current.	0 to 100 (Stall rated current %)
		To change the compensation gain (type 1) or compensation amount (type 2) according to the direction. To set a different value according to the command direction, set this in addition to SV041 (LMC2). Set the value for changing the command speed from the – to + direction (during command direction CW) in SV016 (LMC1). Set the value for changing the command speed from the + to – direction (during command direction CW) in SV041 (LMC2). When "–1" is set, compensation will not be carried out when the command speed direction changes.	

<table>
<tr><th>Name</th><th>Abbr.</th><th>Details</th><th>Setting range (unit)</th></tr>
<tr><td>SV017</td><td>SPEC</td><td>Set the servo system specifications in bit units.
<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></tr>
<tr><td colspan="4">spm</td><td></td><td></td><td>mpt3</td><td>mp</td></tr>
</table>
<table>
<tr><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>abs</td><td></td><td>vdir</td><td>fdir</td><td>spwv</td><td>seqh</td><td>dfbx</td><td>vdir2</td></tr>
</table>
(Note) Always set to a "0" in a blank bit.
<table>
<tr><th>bit</th><th>Name</th><th>Meaning whenset to 0</th><th>Meaning when set to 1</th></tr>
<tr><td>0</td><td>vdir2</td><td>Speed feedback forward polarity</td><td>Speed feedback reverse polarity</td></tr>
<tr><td>1</td><td>dfbx</td><td>Dual feedback control invalid</td><td>Dual feedback control valid</td></tr>
<tr><td>2</td><td>seqh</td><td>Ready/servo ON time normal mode</td><td>Ready/servo ON time reduced mode</td></tr>
<tr><td>3</td><td>spwv</td><td>Normal mode</td><td>MDS-B-Vx4 Synchronous mode</td></tr>
<tr><td>4</td><td>fdir</td><td>Position feedback forward polarity</td><td>Position feedback reverse polarity</td></tr>
<tr><td>5</td><td>vdir</td><td>Motor end detector installation direction AC</td><td>Motor end detector installation direction BD</td></tr>
<tr><td>6</td><td></td><td></td><td></td></tr>
<tr><td>7</td><td>abs</td><td>Relative position detection</td><td>Absolute position detection</td></tr>
<tr><td>8</td><td>mp</td><td>MP scale 360P (2mm pitch)</td><td>MP scale 720P (1mm pitch)</td></tr>
<tr><td>9</td><td>mpt3</td><td>MP scale absolute position detection type 1/2 selection</td><td>MP scale absolute position detection type 3 selection</td></tr>
<tr><td>A</td><td></td><td></td><td></td></tr>
<tr><td>B</td><td></td><td></td><td></td></tr>
<tr><td>C</td><td rowspan="4">spm</td><td colspan="2" rowspan="4">Special motor selection
Normally set to "0".</td></tr>
<tr><td>D</td></tr>
<tr><td>E</td></tr>
<tr><td>F</td></tr>
</table>
</td><td>HEX setting</td></tr>
<tr><td>SV018</td><td>PIT</td><td>Set the ball screw pitch.
Normally, set "360" for a rotation axis.
Refer to section "(2) Limitations to electronic gear setting value".</td><td>1 to 32767 (mm)</td></tr>
</table>

Name	Abbr.	Details	Setting range (unit)
SV019	RNG1	Set the number of pulses (k pulse) per rotation of the detector used for position control.	1 to 9999
		<Semi-closed loop> Set the number of pulses (k pulse) per rotation of the motor. Set the same value to SV020 (RNG2).	(kp/rev)
		<Closed loop> Set the number of pulses per ball screw pitch. When using a linear scale, set the value obtained from the following calculation expression: $\text{Setting value} = \dfrac{\text{Ball screw pitch (mm)}}{\text{Linear scale resolution (mm)}} \times 10^{-3}$	(kp/rev)
SV020	RNG2	Set the number of pulses (k pulse) per rotation of the motor end detector.	1 to 9999 (kp/rev)
SV021	OLT	Set the time constant for detection of overload 1 (OL1) Set "60" for ordinary operation. When using a 15kW driver (HA-A15KL), the upper limit value is 3 (s).	1 to 300 (s)
SV022	OLL	Set the current detection level of overload 1 (OL1) by specifying the rate (%) in respect to the stall rated current (%). Set "150" for ordinary operation.	1 to 500 (Stall rated current %)
SV023	OD1	Set the excessive detection error width at the time of servo ON. <Setting equation> $OD1 = OD2 = OD3 = \dfrac{F}{60 \times PGN1} \times 0.5 \text{ (mm)}$  F : Max. rapid traverse rate (mm/min) PGN1 : Position loop gain 1 (rad/s) When "0" is set, the excessive error at servo ON will not be detected.	0 to 32767 (mm)
SV024	INP	Set the in-position detection width value. Set "50" for ordinary operation.	0 to 32767 (µm)

<table>
<tr><th>Name</th><th>Abbr.</th><th>Details</th><th>Setting range (unit)</th></tr>
<tr><td>SV025</td><td>MTYP</td><td>Set the motor and detector types.
<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">pen</td><td colspan="4">ent</td><td colspan="8">mtyp</td></tr>
</table>
<table>
<tr><th>bit</th><th>Name</th><th>Details</th></tr>
<tr><td>0</td><td rowspan="8">mtyp</td><td rowspan="8">Set the motor type.
(Refer to "(4) Motor type".)</td></tr>
<tr><td>1</td></tr>
<tr><td>2</td></tr>
<tr><td>3</td></tr>
<tr><td>4</td></tr>
<tr><td>5</td></tr>
<tr><td>6</td></tr>
<tr><td>7</td></tr>
<tr><td>8</td><td rowspan="4">ent</td><td rowspan="4">Set the speed detector type.
(Refer to "(5) Detector type".)</td></tr>
<tr><td>9</td></tr>
<tr><td>A</td></tr>
<tr><td>B</td></tr>
<tr><td>C</td><td rowspan="4">pen</td><td rowspan="4">Set the position detector type.
(Refer to "(5) Detector type".)</td></tr>
<tr><td>D</td></tr>
<tr><td>E</td></tr>
<tr><td>F</td></tr>
</table>
</td><td>HEX setting</td></tr>
<tr><td>SV026</td><td>OD2</td><td>Set the excessive error detection width at the time of servo OFF.
Normally, set same value as SV023 (OD1).
When "0" is set, the excessive error at servo OFF will not be detected.</td><td>0 to 32767 (mm)</td></tr>
</table>

<table>
<tr><th>Name</th><th>Abbr.</th><th>Details</th><th>Setting range (unit)</th></tr>
<tr><td>SV027</td><td>SSF1</td><td>Special servo functions selection 1
<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></tr>
<tr><td>aflt</td><td>zrn2</td><td>afrg</td><td>afse</td><td>ovs2</td><td>ovs1</td><td>lmc2</td><td>lmc1</td></tr>
</table>
<table>
<tr><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>zrn3</td><td>vfct2</td><td>vfct1</td><td></td><td>upc</td><td>vcnt2</td><td>vcnt1</td></tr>
</table>
<table>
<tr><th>bit</th><th>Name</th><th>Meaning when set to 0</th><th>Meaning when set to 1</th></tr>
<tr><td>0</td><td>vcnt1</td><td colspan="2" rowspan="2">00: Delay compensation changeover invalid
01: Delay compensation changeover type 1
10: Delay compensation changeover type 2
11: Reserved</td></tr>
<tr><td>1</td><td>vcnt2</td></tr>
<tr><td>2</td><td>upc</td><td>Starting torque compensation invalid</td><td>Starting torque compensation valid</td></tr>
<tr><td>3</td><td></td><td></td><td></td></tr>
<tr><td>4</td><td>vfct1</td><td colspan="2" rowspan="2">00: Jitter compensation invalid
01: Jitter compensation 1 pulse
10: Jitter compensation 2 pulse
11: Jitter compensation 3 pulse</td></tr>
<tr><td>5</td><td>vfct2</td></tr>
<tr><td>6</td><td>zrn3</td><td>Set for normal use</td><td>Special reference point return type</td></tr>
<tr><td>7</td><td></td><td></td><td></td></tr>
<tr><td>8</td><td>lmc1</td><td colspan="2" rowspan="2">Set the compensation gain with SV016 (LMC1) and SV041 (LMC2).
00: Lost motion compensation invalid
01: Lost motion compensation type 1
10: Lost motion compensation type 2
11: Reserved</td></tr>
<tr><td>9</td><td>lmc2</td></tr>
<tr><td>A</td><td>ovs1</td><td colspan="2" rowspan="2">00: Overshoot compensation invalid
01: Overshoot compensation type 1
10: Overshoot compensation type 2
11: Overshoot compensation type 3</td></tr>
<tr><td>B</td><td>ovs2</td></tr>
<tr><td>C</td><td>afse</td><td>Set for normal use</td><td>Increases adaptive filter sensitivity (Note)</td></tr>
<tr><td>D</td><td>afrg</td><td>Set for normal use</td><td>Set this if the adaptive filter is effective in the speed range.</td></tr>
<tr><td>E</td><td>zrn2</td><td>Reference point return type 1</td><td>Reference point return type 2</td></tr>
<tr><td>F</td><td>aflt</td><td>Adaptive filter invalid</td><td>Adaptive filter valid</td></tr>
</table>
(Note) When setting "afrg" (bitD) to 1, also set "afse" (bitC) to 1.</td><td>0000 to FFFF
HEX setting</td></tr>
<tr><td>SV028</td><td></td><td>Not used. Set "0".</td><td>0</td></tr>
<tr><td>SV029</td><td>VCS</td><td>If the noise is bothersome during high speeds, such as during rapid traverse, set the speed loop gain's drop start motor speed.
The speed loop gain drop target speed loop gain is set in SV006 (VGN2).
Set to "0" when not using this function.</td><td>0 to 9999 (r/min)</td></tr>
<tr><td>SV030</td><td>IVC</td><td>■ Voltage dead band compensation:
The low-order 8 bits are used.
■ Current bias:
The high-order 8 bits are used. (Icx)
This is used in combination with the SV040 and SV045 high-order 8 bits.</td><td>–32768 to 32767</td></tr>
</table>

<table>
<tr><th>Name</th><th>Abbr.</th><th>Details</th><th>Setting range (unit)</th></tr>
<tr><td>SV031</td><td>OVS1</td><td>Set this parameter if overshooting occurs during deceleration/stop using submicron or closed loop control.

The overshoot is improved more as the set value is larger.
Set 2 to 10 (%) for ordinary operation. (Ratio to stall rated current)
(Increase the set value in increments of 2% until a value which suppresses overshoot is found.)
This is valid only when overshoot compensation SV027 (SSF1/ovs1, ovs2) is selected.</td><td>–1 to 100
(Stall rated current %)</td></tr>
<tr><td>SV032</td><td>TOF</td><td>Set the unbalance torque amount of an axis having an unbalanced torque such as a vertical axis, as a percentage in respect to the stall rated current (%).
This is used when SV027 SSF1 lmc1, lmc2 or SV027 SSF1 vcnt1, vcnt2 is set.</td><td>–100 to 100</td></tr>
<tr><td>SV033</td><td>SSF2</td><td>Special servo functions selection 2

<table>
<tr><td>F</td><td>E</td><td>D</td><td>C</td><td>B</td><td>A</td><td>9</td><td>8</td></tr>
<tr><td colspan="4">dos</td><td colspan="2"></td><td>hvx</td><td>svx</td></tr>
</table>
<table>
<tr><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">fhz2</td><td colspan="3">nfd</td><td>zck</td></tr>
</table>

<table>
<tr><th>bit</th><th>Name</th><th>Meaning when set to 0</th><th>Meaning when set to 1</th></tr>
<tr><td>0</td><td>zck</td><td>Z phase check valid
(part of alarm 42)</td><td>Z phase check invalid</td></tr>
<tr><td>1
2
3</td><td>nfd</td><td colspan="2">Adjust the damping amount of the machine resonance suppression filter.
When the setting value is increased, the effect of the machine resonance suppression filter will drop, and the effect onto the speed control will drop.
000: ∞ 001: –18dB 010: –12dB 011: –9dB
100: –6dB 101: –4dB 110: –3dB 111: –1dB</td></tr>
<tr><td>4
5
6
7</td><td>fhz2</td><td colspan="2">Select the main frequency of the 2nd machine resonance suppression filter.
0000:Invalid 0010:1125Hz 0100:563Hz 0110:375HZ
0001:2250Hz 0011:750Hz 0101:450Hz 0111:321Hz Others:281Hz</td></tr>
<tr><td>8
9</td><td>svx
hvx</td><td colspan="2">Control mode 00:Normal 01:Standard mode
10:High-gain mode 11:High-gain mode</td></tr>
<tr><td>A
B</td><td></td><td colspan="2"></td></tr>
<tr><td>C
D
E
F</td><td>dos</td><td colspan="2">Digital signal output selection
0000: The MP scale absolute position detection system offset request signal is output.
0001: The specified speed signal is output.</td></tr>
</table>

(Note) Set "0" in bits with no particular description.</td><td>0000 to FFFF
HEX setting</td></tr>
</table>

Name	Abbr.	Details	Setting range (unit)
SV034	SSF3	Special servo functions selection 3	0000 to FFFF HEX setting

F	E	D	C	B	A	9	8
ovsn							

7	6	5	4	3	2	1	0
toff	os2	zeg	dcd			has2	has1

bit	Name	Meaning when set to 0	Meaning when set to 1
0	has1	Setting for normal use	HAS control 1 valid, high-speed compatible
1	has2	Setting for normal use	HAS control 2 valid, overshooting compatible
2			
3			
4	dcd	Setting for normal use	Do not set. (For special applications.)
5	zeg	Setting for normal use	Z phase opposite edge detection **(Note 1)**
6	os2	Setting for normal use	Changes the overspeed detection level. **(Note 2)**
7	toff	Setting for normal use	Low-speed serial ABS scale communication OFF **(Note 3)**
8			
9			
A			
B			
C	ovsn	Set the overshoot compensation type 3 dead band.	
D			
E			
F			

(Note 1) This is valid only when the special reference point return type is selected.

(Note 2) The following motors are the targets.
HA200, 300: 2400 → 3000r/min
HC53, 103, 153, 203, 353, 453, 153R, 203R: 3600 → 4200r/min

(Note 3) "toff" (Bit 7) is for testing purposes. When set to "1", the absolute position cannot be initialized.

Name	Abbr.	Details	Setting range (unit)
SV035	SSF4	Special servo functions selection 4	0000 to FFFF HEX setting

F	E	D	C	B	A	9	8
clt	clG1			cl2n	clet	cltq	

7	6	5	4	3	2	1	0
	iup	tdt					

bit	Name	Meaning when set to 0	Meaning when set to 1
0 1 2 3 4 5	tdt	Td creation time setting (driver fixed) Setting time (µs) = (tdt + 1) × 0.569 Setting time when "0" is set Less than 7kW: 5.69µs 7kW or more: 8.52µs When tdt<9, the setting is handled as tdt = 0. Normally, set "0".	
6	iup	Setting for normal use	Do not set. (For special applications.)
7			
8 9	cltq	Set the deceleration torque for when a collision is detected. 00: 100% 01: 90% 10: 80% 11: 70%	
A	clet	Setting for normal use	The past two-second estimated disturbance torque peak value is displayed at MPOF on the Servo Monitor screen in the CNC side.
B	cl2n	Setting for normal use	Collision detection method 2 is invalidated.
C D E	clG1	Set the collision detection level for the collision detection method 1, G1 modal. When 0 is set : The method 1, G1 modal collision detection will not be carried out. When 1 to 7 is set: The method 1, G0 modal collision detection level (SV060: TLMT) will be multiplied by the set value, and the value is set as the level for the method 1 G1 model.	
F	clt	Setting for normal use	The guide value for the SV059 (TCNV) setting value is displayed at MPOF on the Servo Monitor screen.

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

<table>
<tr><th>Name</th><th>Abbr.</th><th>Details</th><th>Setting range (unit)</th></tr>
<tr><td>SV036</td><td>PTYP</td><td>Power supply type
<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></tr>
<tr><td colspan="4">amp</td><td colspan="4">rtyp</td></tr>
</table>
<table>
<tr><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="8">ptyp</td></tr>
</table>
<table>
<tr><th>bit</th><th>Name</th><th>Details for each bit</th></tr>
<tr><td>0
1
2
3
4
5
6
7</td><td>ptyp</td><td>Set the power supply type.
(Refer to "(7) Power supply type" for details.)</td></tr>
<tr><td>8
9
A
B</td><td>rtyp</td><td>Set "0" if the power supply unit is a power supply regeneration type.
If the power supply unit is a resistance regeneration type, set the type of resistor being used.
(Refer to "(8) Regenerative resistance type" for details.)</td></tr>
<tr><td>C
D
E
F</td><td>amp</td><td>Set the driver model number.
0: MDS-C1-V1/V2/SP, MDS-B-V1/V2/SP, MDS-A-V1/V2/SP
1: MDS-A-SVJ
2: MDS-A-SPJ</td></tr>
</table>
</td><td>0000 to FFFF
HEX setting</td></tr>
<tr><td>SV037</td><td>JL</td><td>Set the load inertia that includes the motor in respect to the motor inertia.
SV037 (JL) = (Jm + Jl)/Jm × 100
Jm : Motor inertia
Jl : Motor axis conversion load inertia</td><td>0 to 5000 (%)</td></tr>
<tr><td>SV038</td><td>FHz</td><td>If machine vibration occurs, set the vibration frequency to be suppressed.
Note that the value 70Hz or more should be set.
Take care when 100 to 140Hz is set for the versions up to Version AB.
Set "0" when not using this function.</td><td>0 to 3000 (Hz)</td></tr>
<tr><td>SV039</td><td>LMCD</td><td>Set when the lost motion compensation timing is not suitable. Adjust upwards in increments of "10 ms".</td><td>0 to 2000 (ms)</td></tr>
</table>

Name	Abbr.	Details	Setting range (unit)
SV040	LMCT	■Set the lost motion compensation dead band. Set in the low-order 8 bits. Normally set "0". Set only when the lost motion compensation timing is not proper during feed forward control. ■Current bias: Set in the high-order 8 bits. (Icy) This is used in combination with SV030 and SV045 high-order 8 bits.	–32768 to 32767 **(Note)** The setting range of the low-order 8 bits is 0 to 100 (µm).
SV041	LMC2	Normally set "0". Set this with SV016 (LMC1) when setting the lost motion compensation's gain (type 1) or compensation amount (type 2) to different values according to the command direction. • Set the value for changing the command speed from the – to + direction (during command direction CW) in SV016 (LMC1). • Set the value for changing the command speed from the + to – direction (during command direction CW) in SV041 (LMC2). • When "–1" is set, compensation will not be carried out when the command speed direction changes. This is valid only when lost motion compensation (SV027: lmc1, lmc2) is selected.	–1 to 200 (Stall rated current %)
SV042	OVS2	Overshoot compensation 2 Set the overshoot compensation amount for unidirectional movement (command direction CW). When "0" is set, the value set for SV031 (OVS1) will be set. When "–1" is set, compensation will not be carried out during unidirectional movement. This is valid only when overshoot compensation SV027 (SSF1/ovs1) is selected.	–1 to 100 (Stall rated current %)
SV043	OBS1	Observer1 Set the pole of the observer. Normally set approximately "628" (rad). To operate the observer function, also set the SV037 (JL) and SV044 (OBS2). Set to "0" when not used.	0 to 1000 (rad)
SV044	OBS2	Observer2 Set the execution gain of the observer. Normally set to "100". To operate the observer function, also set the SV037 (JL) and SV043 (OBS1). Set to "0" when not used.	0 to 500 (%)
SV045	TRUB	■When using the collision detection function, set the friction torque in the low-order 8 bits with a rate (%) for the stall rated current. Set "0" when not using the collision detection function. ■Current bias : Set in the high-order 8 bits (Ib1). This is used in combination with SV030 and SV040 high-order 8 bits.	–32768 to 32767 **(Note)** The setting range of the low-order 8 bits is 0 to 100 (Stall rated current %).
SV046		Not used. Set "0".	0

Name	Abbr.	Details	Setting range (unit)
SV047	EC1	Inductive voltage compensation Set the execution gain of the inductive voltage compensation. Normally, set "100".	–32768 to 32767 (%)
SV048	EMGrt	Set the brake operation delay time when using the drop prevention function. Set a larger value than the actual brake operation time. Set "0" when not using the drop prevention function. SV055 (EMGx) and SV056 (EMGt) must also be set when this function is used.	0 to 20000 (ms)
SV049	PGN1sp	Set the position loop gain for special operations (synchronous tap, interpolation with spindle C axis, etc.). Normally, set the spindle position loop gain.	1 to 200 (rad/s)
SV050	PGN2sp	Set this with SV058 (SHGCsp) when carrying out SHG control during special operations (synchronous tap, interpolation with spindle C axis, etc.). When this parameter is not used, set "0".	0 to 999 (rad/s)
SV051	DFBT	Set the time constant for dual feedback control.	0 to 9999 (ms)
SV052	DFBN	Set the dead band for dual feedback control.	0 to 9999 (µm)
SV053	OD3	Set the excessive error detection width at servo ON for special operations (absolute position initialization setting, stopper operation, etc.). When "0" is set, the excessive error will not be detected during special operations and servo ON.	0 to 32767 (mm)
SV054	ORE	Set the overrun detection width for the closed loop. For setting synchronous control slave axis, set the overrun detection width for master/slave axis. When "–1" is set, the overrun will not be detected. When "0" is set, the overrun will be detected with a 2 (mm) width.	–1 to 32767 (mm)
SV055	EMGx	Set the emergency stop maximum delay time when using the drop prevention function. Normally, set it to the same value as the SV056 (EMGt). Set "0" when not using the drop prevention function.	0 to 20000 (ms)
SV056	EMGt	Set the deceleration time constant from the maximum rapid traverse speed when using the drop prevention function. Normally, the same value as CNC G0 acceleration/deceleration time constant is set. Set "0" when not using the drop prevention function.	-20000 to 20000 (ms)
SV057	SHGC	Set this with SV004 (PGN2) when carrying out SGH control. Set 0 when not using this function.	0 to 999 (rad/s)
SV058	SHGCsp	Set this with SV050 (PGN2sp) when carrying out SHG control during special operations (synchronous tap, interpolation with spindle C axis, etc.). Set 0 when not using this function.	0 to 999 (rad/s)

Name	Abbr.	Details	Setting range (unit)
SV059	TCNV	When using the collision detection function, set the estimated torque gain. When "1" is set in SV035 (SSF4/clt), the setting value guideline can be displayed in MPOF on the Servo monitor screen. Set "0" when not using the collision detection function.	0 to 32767
SV060	TLMT	When using the collision detection function, set the collision detection level for the method 1·G0 modal with a rate for the stall rated current. Set "0" when not using the collision detection function.	0 to 100 (Stall rated current %)
SV061	DA1NO	Set the output data number for the D/A output channel 1. When "–1" is set, the D/A output of that axis will not be carried out.	–32768 to 32767
SV062	DA2NO	Set the output data number for the D/A output channel 2. When "–1" is set, the D/A output of that axis will not be carried out.	–32768 to 32767
SV063	DA1MPY	Set the output magnification for the D/A output channel 1. The output magnification will be the setting value/256. If "0" is set, the output magnification will be 1-fold, in the same manner as when "256" is set.	–32768 to 32767
SV064	DA2MPY	Set the output magnification for the D/A output channel 2. The output magnification will be the setting value/256. If "0" is set, the output magnification will be 1-fold, in the same manner as when "256" is set.	–32768 to 32767

(2) Limitations to electronic gear setting value

The servo drive unit has internal electronic gear. The command value from the NC is converted into a detector resolution unit to carry out position control. The electronic gears are single gear ratios calculated from multiple parameters. However, each value (ELG1, ELG2) must be 32767 or less.
If the value overflows, the initial parameter error (alarm 37) will be output.
If an alarm occurs, the mechanical specifications and electrical specifications must be revised so that the electronic gears are within the specifications range.

Parameters related to electronic gears **SV001 (PC1), SV002 (PC2), SV003 (PGN1) (SV049 (PGN1sp)), SV018 (PIT), SV019 (RNG1), SV020 (RNG2)**

Reduced fraction of

$$\frac{ELG1}{ELG2} = \frac{PC2 \times RANG}{PC1 \times PIT \times IUNIT} \text{ (reduced fraction)}$$

<Semi-closed loop>
RANG = RNG1

<Closed loop>
RANG = (RNG2 × PGN1sp)

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

When the above is calculated, the following conditions must be satisfied.

$ELG1 \leq 32767$

$ELG2 \leq 32767$

Method of confirming maximum setting range for PC1 and PC2 (Example)

For semi-closed loop, 10mm ball screw lead, 1µm command unit and OSA104 motor end detector.
The following parameters can be determined with the above conditions. SV018 (PIT) = 10, SV019 (RNG1) = 100, SV020 (RNG2) = 100, IUNIT = 2 According to the specifications, the maximum setting value for ELG1 and ELG2 is 32767. $\frac{ELG1}{ELG2} = \frac{PC2 \times 100}{PC1 \times 10 \times 2} = \frac{5 \times PC2}{1 \times PC1}$ Thus, the maximum value is: PC2 < 6553, PC1 < 32767 Set the PC1 and PC2 gear ratio to within the above calculation results.

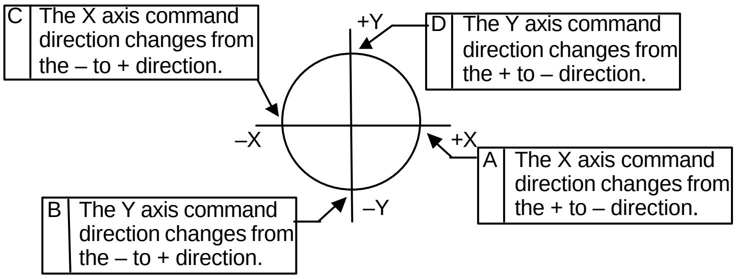
(3) Command polarity

When the motor is to rotate in the clockwise direction (looking from the load side) at the command for the + direction, the command direction is CW. Conversely, when the motor is to rotate in the counterclockwise direction, the command direction is CCW.
This rotation direction can be set with the CNC machine parameters. Note that the meaning of the ± will differ for some servo parameters according to this motor rotation direction. The servo parameters affected by CW/CCW are shown below.

SV016 (LMC1), SV041 (LMC2)	(When different values are set for SV016 and SV041)
SV031 (OVS1), SV042 (OVS2)	(When different values are set for SV031 and SV042)

<Example> If the lost motion compensation amount is to be changed according to the direction, the compensation amount at the quadrant changeover point of each arc where the lost motion compensation is applied will be as shown below according to the command polarity.

	CW	CCW
A	X: SV041	X: SV016
B	Y: SV016	Y: SV041
C	X: SV016	X: SV041
D	Y: SV041	Y: SV016



(4) Motor type

Set "mtyp" of SV025 (MTYP) from the following table.

Motor series	2000r/min standard		2000r/min low inertia	3000r/min low inertia					3000r/min standard			HC 2000r/min medium inertia	HC 3000r/min medium inertia		HC 3000r/min ultra-low inertia	
No.	0x	1x	2x	3x	4x	5x	6x	7x	8x	9x	Ax	Bx	Cx	Dx	Ex	Fx
x0	HA40N		HA50L	HA53L					HA43N			HC52	HC53			
x1	HA80N		HA100L	HA103L					HA83N			HC102	HC103		HC103R	
x2	HA100N		HA200L	HA203L					HA103N			HC152	HC153		HC153R	
x3	HA200N		HA300L	HA303L					HA203N			HC202	HC203		HC203R	
x4	HA300N		HA500L	HA503L					HA303N			HC352	HC353		HC353R	
x5	HA700N								HA703N			HC452	HC453		HC503R	
x6	HA900N											HC702	HC703			
x7			HA-A11KL									HC902				
x8			HA-A15KL													
x9																
xA			HA150L	HA153L					HA93N							
xB																
xC									HA053							
xD									HA13							
xE									HA23N							
xF									HA33N							

(5) Detector type

Set "pen" / "ent" of SV025 (MTYP) from the following table.

No.	Detection method	Detector model name				Device	Remarks
0	High-speed serial	OSE104				Motor end detector	
1	High-speed serial	OSA104					
2	High-speed serial	OSE105	OSA105	HA-FH			
3	ABZ+UVW(No OHM)	HA053	HA13				
4	ABZ	OHE25K-ET				Ball screw end detector	Cannot be set to speed detector type (ent).
	High-speed serial	OSE104-ET					
5	ABZ+low-speed serial	OHA25K-ET					
	High-speed serial	OSA104-ET					
6	High-speed serial	OSE105-ET	OSA105-ET				
7							
8	ABZ	SCALE				Machine end detector	
9	ABZ+low-speed serial	ABS SCALE **(Note 1)**					
A	High-speed serial	ABS SCALE **(Note 2)**					
B							
C	High-speed serial	OSE104	OSE105	OSA104	OSA105	Synchronous control	
D	High-speed serial	OSE104-ET	OSE105-ET	OSA104-ET	OSA105-ET		
		ABS SCALE **(Note 2)**					
E							
F							

⚠ CAUTION

With MDS-C1 series, only the serial encoder is applied as the motor end detector.
Thus, OHE/OHA type detector cannot be used as the motor end detector.

(Note 1) ABS SCALE corresponds to the following absolute position detection scales.
Mitutoyo Corporation AT41
FUTABA Corporation FME type, FLE type

(Note 2) ABS SCALE corresponds to the following absolute position detection scale.
Mitutoyo Corporation AT342

(Note 3) These are not used with the closed loop system.

(6) Detection system and MTYP

Set SV025 (MTYP) from the following table.

(a) Semi-closed loop

Motor end detector	OHE25K		OHA25K		OSE104		OSA104		OSE105		OSA105		HA-FH		HA053/13 HA-FE	
	MTYP	Detect system	MTYP	Detect system	MTYP	Detect system	MTYP	Detect system	MTYP	Detect system	MTYP	Detect system	MTYP	Detect system	MTYP	Detect system
	00xx	INC	11xx	ABS	00xx	INC	11xx	ABS	22xx	INC	22xx	ABS	22xx	ABS	33xx	INC

(b) Closed loop

Machine end detector / Motor end detector	OHE25K-ET		OHA25K-ET		OSE104-ET		OSA104-ET		OSE105-ET		OSA105-ET		SCALE		ABS SCALE low-speed serial		ABS SCALE high-speed serial	
	MTYP	Detect system	MTYP	Detect system	MTYP	Detect system	MTYP	Detect system	MTYP	Detect system	MTYP	Detect system	MTYP	Detect system	MTYP	Detect system	MTYP	Detect system
OSE104	40xx	INC	50xx	ABS	40xx	INC	50xx	ABS	60xx	INC	60xx	ABS	80xx	INC	90xx	ABS	A0xx	ABS
OSA104	41xx	INC	51xx	ABS	41xx	INC	51xx	ABS	61xx	INC	61xx	ABS	81xx	MP ABS	91xx	ABS	A1xx	ABS
OSE105	42xx	INC	52xx	ABS	42xx	INC	52xx	ABS	62xx	INC	62xx	ABS	82xx	INC	92xx	ABS	A2xx	ABS
OSA105	42xx	INC	52xx	ABS	42xx	INC	52xx	ABS	62xx	INC	62xx	ABS	82xx	MP ABS	92xx	ABS	A2xx	ABS
HA053/13	43xx	INC	53xx	ABS	43xx	INC	53xx	ABS	63xx	INC	63xx	ABS	83xx	INC	93xx	ABS	A3xx	ABS
HA-FE	43xx	INC	53xx	ABS	43xx	INC	53xx	ABS	63xx	INC	63xx	ABS	83xx	INC	93xx	ABS	A3xx	ABS

(c) Synchronous control semi-closed loop (set only the slave axis.)

Motor end detector	Speed-command synchronous control								Current-command synchronous control							
	OSE104		OSA104		OSE105		OSA105		OSE104		OSA104		OSE105		OSA105	
	MTYP	Detect system	MTYP	Detect system	MTYP	Detect system	MTYP	Detect system	MTYP	Detect system	MTYP	Detect system	MTYP	Detect system	MTYP	Detect system
	C0xx	INC	C1xx	ABS	C2xx	INC	C2xx	ABS	CCxx	INC	CCxx	ABS	CCxx	INC	CCxx	ABS

(d) Synchronous control closed loop (set only the slave axis.)

Machine end detector / Motor end detector	Speed-command synchronous control									
	OSE104-ET		OSA104-ET		OSE105-ET		OSA105-ET		ABS SCALE high-speed serial	
	MTYP	Detect system	MTYP	Detect system	MTYP	Detect system	MTYP	Detect system	MTYP	Detect system
OSE104	D0xx	INC	D0xx	ABS	D0xx	INC	D0xx	ABS	D0xx	ABS
OSA104	D1xx	INC	D1xx	ABS	D1xx	INC	D1xx	ABS	D1xx	ABS
OSE105	D2xx	INC	D2xx	ABS	D2xx	INC	D2xx	ABS	D2xx	ABS
OSA105	D2xx	INC	D2xx	ABS	D2xx	INC	D2xx	ABS	D2xx	ABS

(7) Power supply type

Set "ptyp" of SV036 (PTYP) from the following table.

No.	0xkW 0x	1xkW 1x	2xkW 2x	3xkW 3x	4xkW 4x	5xkW 5x	6x	7x	0xkW 8x
0	PS non-connect			CV-300					
1		CV-110							CR-10
2			CV-220						CR-15
3									CR-22
4	CV-37								CR-37
5		CV-150			CV-450	CV-550			
6	CV-55		CV-260						CR-55
7				CV-370					
8	CV-75								CR-75
9		CV-185							CR-90
A									
B									
C									
D									
E									
F									

(8) Regenerative resistance type

Set "port" of SV036 (PTYP) from the following table.

No.	Regenerative register type	Resistance value (Ω)	Watts (W)
0			
1	GZG200W260HMJ	26	80
2	GZG300W130HMJ×2	26	150
3	MR-RB30	13	300
4	MR-RB50	13	500
5	GZG200W200HMJ×3	6.7	350
6	GZG300W200HMJ×3	6.7	500
7	R-UNIT-1	30	700
8	R-UNIT-2	15	700
9	R-UNIT-3	15	2100
A			
B			
C			
D			
E			
F			

(9) Current limit value

Motor	Stall rated current	Maximum current	Maximum torque	Torque limit
	A	A	N·m	%
HA40N	3.6	17	14.2	472
HA80N	6.6	28	25.5	424
HA100N	14	42	42	300
HA200N	22	57	60	260
HA300N	37	85	87	230
HA700N	49	113	120	231
HA900N	56	141	153	252
HA053	1.4	3.9	0.69	279
HA13	1.4	3.9	1.37	279
HA23N	3	8.1	2.75	270
HA33N	3	8.1	5.6	270
HA43N	5	17	10.2	340
HA83N	8.8	28	19.2	318
HA103N	19.6	57	40	291
HA203N	34.5	85	56	246
HA303N	55	113	80	205
HA703N	68	141	105	207
HA50NL	4	17	13.0	425
HA100NL	8	28	20.9	350
HA150NL	11.5	42	31	365
HA200NL	18.2	42	32	231
HA300NL	25	57	52	228
HA500NL	44	85	72	193
HA53NL	5.8	28	14.1	482
HA103NL	11.0	42	22.5	381
HA153NL	16.2	42	22.8	259
HA203NL	21	57	37	271
HA303NL	32	85	60	265
HA503NL	54	113	78	209
HA-LH11K2	84	204	158	242
HA-LH15K2	100	260	215	260

Motor	Stall rated current	Maximum current	Maximum torque	Torque limit
	A	A	N·m	%
HC52	3.94	17	11.8	431
HC102	7.4	28	21.6	378
HC152	11.1	47	35.3	423
HC202	15.4	47	41.7	305
HC352	22.9	64	59.8	279
HC452	40.4	85	87.5	210
HC702	46.2	113	120	245
HC902	55.9	141	153	252
HC53	5.8	17	8.82	293
HC103	9.8	28	16.7	286
HC153	15.9	47	28.4	296
HC203	22.4	64	40.2	286
HC353	33.3	85	55.9	255
HC453	57.3	113	79.8	197
HC703	69.2	141	105	210
HC103R	6.1	18.4	7.95	459
HC153R	8.8	23.4	11.9	318
HC203R	14.0	37.0	15.9	300
HC353R	22.5	56.3	27.8	253
HC503R	28.0	70.0	39.8	303

(Note) When "500%" for SV013 ILMT1 is set, the current limit value is maximum current (torque) one shown in the table above.
Set a parameter at the rate (%) of the stall rated current to limit the current value (torque) less than the maximum current value.

(10)Standard Parameters for Each Motor

Motor	Standard motor																				
	HA 40N	HA 43N	HA 80N	HA 83N	HA 93N	HA 100N	HA 103N	HA 200N	HA 203N	HA 300N	HA 303N	HA 700N	HA 703N	HA 900N	HA 053	HA 13	HA 23N	HA 33N	HA-N23	HA-N33	HA-N43
Driver	05	05	10	10	20	20	35	35	45	45	70	70	90	90	01	01	03	03	03	03	05
sv001	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
sv002	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
sv003	33	33	33	33	33	33	33	33	33	33	33	25	25	25	33	33	33	33	33	33	33
sv004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sv005	150	150	150	150	150	150	150	150	150	150	150	250	250	250	70	70	100	100	70	70	35
sv006	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sv007	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sv008	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364
sv009	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048
sv010	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048
sv011	512	256	512	256	256	256	256	256	256	256	256	200	200	200	256	256	224	224	256	256	512
sv012	512	512	512	512	512	512	512	512	512	512	512	256	256	256	256	256	224	224	256	256	512
sv013	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500
sv014	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500
sv015	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sv016	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sv017	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
sv018	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
sv019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	10	-	-	-	-	-
sv020	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	10	-	-	-	-	-
sv021	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60
sv022	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150
sv023	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
sv024	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
sv025	xx00	xx80	xx01	xx81	xx8A	xx02	xx82	xx03	xx83	xx04	xx84	xx05	xx85	xx06	338C	338D	xx8E	xx8F	xx6E	xx6F	xx60
sv026	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
sv027	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
sv028	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sv029	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sv030	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sv031	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sv032	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sv033	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
sv034	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
sv035	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
sv036	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
sv037	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sv038	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sv039	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sv040	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sv041	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sv042	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sv043	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sv044	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sv045	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sv046	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sv047	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
sv048	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sv049	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15
sv050	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sv051	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sv052	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sv053	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sv054	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sv055	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sv056	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sv057	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sv058	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sv059	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sv060	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sv061	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sv062	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sv063	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sv064	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Motor	2000r/min low-inertia motor								3000r/min low-inertia motor												
	HA 50L	HA 100L	HA 150L	HA 200L	HA 300L	HA 500L	HA-A11KL	HA-A15KL	HA 53L	HA 103L	HA 153L	HA 203L	HA 303L	HA 503L							
Driver	05	10	10	20	35	45	110	150	10	20	20	35	45	70							
sv001	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
sv002	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
sv003	33	33	33	33	33	33	33	33	33	33	33	33	33	33							
sv004	0	0	0	0	0	0	0	0	0	0	0	0	0	0							
sv005	30	30	30	30	30	50	150	150	30	30	30	30	30	50							
sv006	0	0	0	0	0	0	0	0	0	0	0	0	0	0							
sv007	0	0	0	0	0	0	0	0	0	0	0	0	0	0							
sv008	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364							
sv009	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048							
sv010	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048							
sv011	512	512	512	512	256	256	512	512	512	512	512	512	256	256							
sv012	512	512	512	512	512	512	512	512	512	512	512	512	512	512							
sv013	500	500	500	500	500	500	500	500	500	500	500	500	500	500							
sv014	500	500	500	500	500	500	500	500	500	500	500	500	500	500							
sv015	0	0	0	0	0	0	0	0	0	0	0	0	0	0							
sv016	0	0	0	0	0	0	0	0	0	0	0	0	0	0							
sv017	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000							
sv018	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
sv019	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
sv020	-	-	-	-	-	-	-	-	-	-	-	-	-	-							
sv021	60	60	60	60	60	60	60	3	60	60	60	60	60	60							
sv022	150	150	150	150	150	150	150	150	150	150	150	150	150	150							
sv023	6	6	6	6	6	6	6	6	6	6	6	6	6	6							
sv024	50	50	50	50	50	50	50	50	50	50	50	50	50	50							
sv025	xx20	xx21	xx2A	xx22	xx23	xx24	xx27	xx28	xx30	xx31	xx3A	xx32	xx33	xx34							
sv026	6	6	6	6	6	6	6	6	6	6	6	6	6	6							
sv027	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000							
sv028	0	0	0	0	0	0	0	0	0	0	0	0	0	0							
sv029	0	0	0	0	0	0	0	0	0	0	0	0	0	0							
sv030	0	0	0	0	0	0	0	0	0	0	0	0	0	0							
sv031	0	0	0	0	0	0	0	0	0	0	0	0	0	0							
sv032	0	0	0	0	0	0	0	0	0	0	0	0	0	0							
sv033	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000							
sv034	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000							
sv035	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000							
sv036	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000							
sv037	0	0	0	0	0	0	0	0	0	0	0	0	0	0							
sv038	0	0	0	0	0	0	0	0	0	0	0	0	0	0							
sv039	0	0	0	0	0	0	0	0	0	0	0	0	0	0							
sv040	0	0	0	0	0	0	0	0	0	0	0	0	0	0							
sv041	0	0	0	0	0	0	0	0	0	0	0	0	0	0							
sv042	0	0	0	0	0	0	0	0	0	0	0	0	0	0							
sv043	0	0	0	0	0	0	0	0	0	0	0	0	0	0							
sv044	0	0	0	0	0	0	0	0	0	0	0	0	0	0							
sv045	0	0	0	0	0	0	0	0	0	0	0	0	0	0							
sv046	0	0	0	0	0	0	0	0	0	0	0	0	0	0							
sv047	100	100	100	100	100	100	100	100	100	100	100	100	100	100							
sv048	0	0	0	0	0	0	0	0	0	0	0	0	0	0							
sv049	15	15	15	15	15	15	15	15	15	15	15	15	15	15							
sv050	0	0	0	0	0	0	0	0	0	0	0	0	0	0							
sv051	0	0	0	0	0	0	0	0	0	0	0	0	0	0							
sv052	0	0	0	0	0	0	0	0	0	0	0	0	0	0							
sv053	0	0	0	0	0	0	0	0	0	0	0	0	0	0							
sv054	0	0	0	0	0	0	0	0	0	0	0	0	0	0							
sv055	0	0	0	0	0	0	0	0	0	0	0	0	0	0							
sv056	0	0	0	0	0	0	0	0	0	0	0	0	0	0							
sv057	0	0	0	0	0	0	0	0	0	0	0	0	0	0							
sv058	0	0	0	0	0	0	0	0	0	0	0	0	0	0							
sv059	0	0	0	0	0	0	0	0	0	0	0	0	0	0							
sv060	0	0	0	0	0	0	0	0	0	0	0	0	0	0							
sv061	0	0	0	0	0	0	0	0	0	0	0	0	0	0							
sv062	0	0	0	0	0	0	0	0	0	0	0	0	0	0							
sv063	0	0	0	0	0	0	0	0	0	0	0	0	0	0							
sv064	0	0	0	0	0	0	0	0	0	0	0	0	0	0							

Motor	HC standard motor																				
	HC 52	HC 53	HC 102	HC 103	HC 152	HC 153	HC 202	HC 203	HC 352	HC 353	HC 452	HC 453	HC 702	HC 703	HC 902						
Driver	05	05	10	10	20	20	20	35	35	45	45	70	70	90	90						
sv001	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-						
sv002	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-						
sv003	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33						
sv004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
sv005	100	100	100	100	100	100	100	100	100	100	100	100	150	100	150						
sv006	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
sv007	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
sv008	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364						
sv009	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048						
sv010	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048	2048						
sv011	512	256	512	256	512	256	256	256	256	256	256	256	200	256	200						
sv012	512	512	512	512	512	512	512	512	512	512	512	512	256	512	256						
sv013	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500						
sv014	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500						
sv015	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
sv016	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
sv017	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000						
sv018	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-						
sv019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-						
sv020	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-						
sv021	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60						
sv022	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150						
sv023	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6						
sv024	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50						
sv025	xxB0	xxC0	xxB1	xxC1	xxB2	xxC2	xxB3	xxC3	xxB4	xxC4	xxB5	xxC5	xxB6	xxC6	xxB7						
sv026	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6						
sv027	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000						
sv028	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
sv029	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
sv030	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
sv031	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
sv032	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
sv033	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000						
sv034	0003	0003	0003	0003	0003	0003	0003	0003	0003	0003	0003	0003	0003	0003	0003						
sv035	0000	0000	0000	0000	0040	0040	0040	0040	0040	0040	0040	0040	0040	0040	0040						
sv036	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000						
sv037	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
sv038	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
sv039	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
sv040	0	0	0	0	0	0	10240	10240	10240	10240	10240	10240	10240	10240	10240						
sv041	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
sv042	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
sv043	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
sv044	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
sv045	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
sv046	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
sv047	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100						
sv048	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
sv049	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15						
sv050	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
sv051	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
sv052	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
sv053	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
sv054	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
sv055	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
sv056	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
sv057	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
sv058	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
sv059	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
sv060	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
sv061	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
sv062	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
sv063	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
sv064	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						

Motor	HC**R motor			
	HC 103R	HC 153R	HC 203R	HC 353R
Driver	10	10	20	35
sv001	-	-	-	-
sv002	-	-	-	-
sv003	33	33	33	33
sv004	0	0	0	0
sv005	15	15	20	40
sv006	0	0	0	0
sv007	0	0	0	0
sv008	1364	1364	1364	1364
sv009	4096	4096	4096	4096
sv010	4096	4096	4096	4096
sv011	256	256	256	256
sv012	512	512	512	512
sv013	500	500	500	500
sv014	500	500	500	500
sv015	0	0	0	0
sv016	0	0	0	0
sv017	0000	0000	0000	0000
sv018	-	-	-	-
sv019	-	-	-	-
sv020	-	-	-	-
sv021	60	60	60	60
sv022	150	150	150	150
sv023	6	6	6	6
sv024	50	50	50	50
sv025	xxE1	xxE2	xxE3	xxE4
sv026	6	6	6	6
sv027	4000	4000	4000	4000
sv028	0	0	0	0
sv029	0	0	0	0
sv030	0	0	0	0
sv031	0	0	0	0
sv032	0	0	0	0
sv033	0000	0000	0000	0000
sv034	0000	0000	0000	0000
sv035	0000	0000	0000	0000
sv036	0000	0000	0000	0000
sv037	0	0	0	0
sv038	0	0	0	0
sv039	0	0	0	0
sv040	0	0	0	0
sv041	0	0	0	0
sv042	0	0	0	0
sv043	0	0	0	0
sv044	0	0	0	0
sv045	0	0	0	0
sv046	0	0	0	0
sv047	100	100	100	100
sv048	0	0	0	0
sv049	15	15	15	15
sv050	0	0	0	0
sv051	0	0	0	0
sv052	0	0	0	0
sv053	0	0	0	0
sv054	0	0	0	0
sv055	0	0	0	0
sv056	0	0	0	0
sv057	0	0	0	0
sv058	0	0	0	0
sv059	0	0	0	0
sv060	0	0	0	0
sv061	0	0	0	0
sv062	0	0	0	0
sv063	0	0	0	0
sv064	0	0	0	0

5.6.2 High-gain Parameters (High-gain Drive unit)

There are a total of 65 servo parameters. The parameters can be changed on any screen.

(Note) In the following explanations on bits, set all bits not used, including blank bits, to "0".

Setting and display method of servo parameters vary with the CNC to be used. Refer to the instruction manuals for each CNC.

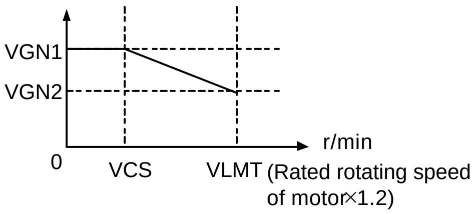
Name	Abbr.	Details	Type	B-Vx compatible	Change method	Setting unit	Min.	Max.	Type		
									Machine	Servo	Adjust
sv001	PC1	Motor gear ratio	Spec	○	Initial		1	*	○		
sv002	PC2	Machine gear ratio	Spec	○	Initial		1	*	○		
sv003	PGN1	Position loop gain 1	Spec	○	Normal	rad/s	1	200			○
sv004	PGN2	Position loop gain 2	Adjust	○	Normal	rad/s	0	999		○	
sv005	VGN1	Speed loop gain 1	Adjust	○	Normal		1	999			○
sv006	VGN2	Speed loop gain 2		○	Normal		-1000	1000			○
sv007	VIL	Speed loop delay compensation	Adjust	○	Normal		0	*			○
sv008	VIA	Speed loop advance compensation	Adjust	○	Normal		1	9999			○
sv009	IQA	Current loop q-axis advance compensation		○	Normal		1	20480		○	
sv010	IDA	Current loop d-axis advance compensation		○	Normal		1	20480		○	
sv011	IQG	Current loop q-axis gain		○	Normal		1	4096		○	
sv012	IDG	Current loop d-axis gain		○	Normal		1	4096		○	
sv013	ILMT	Current limit value		○	Normal	stall rated current %	0	999			○
sv014	ILMTsp	Current limit value (special operation)		○	Normal	stall rated current %	0	999			○
sv015	FFC	Acceleration feed forward gain	Adjust	○	Normal	%	0	999		○	
sv016	LMC1	Lost motion compensation 1	Adjust	○	Normal	stall rated current %	-1	200			○
sv017	SPEC	Servo specifications	Spec	△	Initial	HEX setting	*	*	○	○	○
sv018	PIT	Ball screw pitch	Spec	○	Initial	mm	1	*	○		
sv019	RNG1	Position detector resolution	Spec	○	Initial	kp/rev,kp/PIT	1	9999		○	
sv020	RNG2	Speed detector resolution	Spec	○	Initial	kp/rev	1	9999		○	
sv021	OLT	Overload time constant		○	Normal	s	1	999		○	
sv022	OLL	Overload detection level		○	Normal	stall rated current %	10	500		○	
sv023	OD1	Excessive detection error width (at SV ON)		○	Normal	mm	0	*	○		
sv024	INP	In-position width		○	Normal	μm	0	*	○		
sv025	MTYP	Motor/detector type	Spec	△	Initial	HEX setting	*	*		○	
sv026	OD2	Excessive detection error width (at SV OFF)		○	Normal	mm	0	*	○		
sv027	SSF1	Special servo function 1	Spec	△	Normal	HEX setting	*	*		○	○
sv028											
sv029	VCS	Speed loop gain change starting speed		○	Normal	r/min	0	9999			○
sv030	IVC	Voltage/current compensation		○	Normal		*	*			○
sv031	OVS1	Overshoot compensation 1	Adjust	○	Normal	%	-1	100			○
sv032	TOF	Torque offset	Adjust	○	Normal	stall rated current %	-100	100			○
sv033	SSF2	Special servo function 2	Spec	△/●	Normal	HEX setting	*	*		○	○
sv034	SSF3	Special servo function 3		△	Normal	HEX setting	*	*		○	○
sv035	SSF4	Special servo function 4		○	Normal	HEX setting	*	*		○	○
sv036	PTYP	Power supply type	Spec	○	Initial	HEX setting	*	*		○	
sv037	JL	Load inertia ratio (Jm+Jl/Jm)	Adjust	○	Normal	%	0	5000			○

Name	Abbr.	Details	Type	B-Vx compatible	Change method	Setting unit	Min.	Max.	Type		
									Machine	Servo	Adjust
sv038	FHz1	Frequency 1 of machine resonance suppression filter	Adjust	∧	Normal	Hz	0	9000	○		
sv039	LMCD	Lost motion compensation timing		○	Normal	ms	0	2000			○
sv040	LMCT	Current bias/lost motion compensation dead zone	Adjust	○	Normal	–/μm	*	*			○
sv041	LMC2	Lost motion compensation 2	Adjust	○	Normal	stall rated current %	-1	200			○
sv042	OVS2	Overshoot compensation 2		○	Normal	stall rated current %	-1	100			○
sv043	OBS1	Observer 1		○	Normal	rad	0	1000			○
sv044	OBS2	Observer 2		○	Normal	%	0	500			○
sv045	TRUB	Friction torque/Current bias		○	Normal	–/stall rated current %	*	*			○
sv046	FHz2	Frequency 2 of machine resonance suppression filter		☺	Normal	Hz	0	9000	○		
sv047	EC1	Inductive voltage compensation		○	Normal	%	*	*			○
sv048	EMGrt	Drop prevention brake operation delay time		○	Normal	ms	0	20000	○		
sv049	PGN1sp	Position loop gain 1 (special operation)		○	Normal	rad/s	1	200			○
sv050	PGN2sp	Position loop gain 2 (special operation)		○	Normal	rad/s	0	999		○	
sv051	DFBT	Dual feedback control time constant		○	Normal	ms	0	9999			○
sv052	DFBN	Dual feedback control dead zone width		○	Normal	μm	0	9999			○
sv053	OD3	Excessive error width (special operation)		○	Normal	mm	0	*	○		
sv054	ORE	Closed loop overrun detection width		○	Normal	mm	-1	*	○		
sv055	EMGx	Emergency stop maximum delay time		○	Normal	ms	0	20000	○		
sv056	EMGt	Emergency stop deceleration time constant		○	Normal	ms	-20000	20000	○		
sv057	SHGC	SHG control gain		○	Normal	rad/s	0	1200		○	
sv058	SHGCsp	SHG control gain (special operation)		○	Normal	rad/s	0	1200		○	
sv059	TCNV	Torque estimated gain		○	Normal		*	*			○
sv060	TLMT	G0 collision detection level		○	Normal	stall rated current %	0	999			○
sv061	DA1NO	D/A output channel-1 data No.		∧	Normal		*	*			○
sv062	DA2NO	D/A output channel-2 data No.		∧	Normal		*	*			○
sv063	DA1MPY	D/A output channel-1 magnification		∧	Normal		*	*			○
sv064	DA2MPY	D/A output channel-2 magnification		○	Normal		*	*			○
sv065	TLC	Machine end compensation spring constant		☺	Normal		*	*	○		○

Type	Spec : Set in servo spec screen.	Adjust : Set in servo adjust screen.
MDS-B-Vx compatible	○ : Same as MDS-B-Vx. ▲ : Same setting as MDS-B-Vx even if the contents has changed. ⬣ : New parameters of MDS-C1-Vx.	∧ : Includes new parameters of MDS-B-Vx.4 ☺ : New parameters of MDS-B-Vx.4
Change method	Initial: Valid when NC power is turned ON.	Normal: Valid whenever setting.

(1) Parameters

⚠ CAUTION
In the following explanations on bits, set all bits not used, including blank bits, to "0".

Name	Abbr.	Details	Setting range (unit)
SV001	PC1	Set the motor side gear ratio. Set so that PC1 and PC2 have the smallest integer ratio. (Refer to "(2) Limitations to electronic gear setting value".)	1 to 32767
SV002	PC2	Set the machine side gear ratio. Set so that PC1 and PC2 have the smallest integer ratio. (Refer to "(2) Limitations to electronic gear setting value".)	1 to 32767
SV003	PGN1	Set the position loop gain in increments of "1". Set "33" for ordinary operation.	1 to 200 (rad/s)
SV004	PGN2	In case of SHG control, set this parameter with SV057 (SHGC). Set "0" when it is not used.	0 to 999 (rad/s)
SV005	VGN1	Set the speed loop gain. The standard value is 150. When it is increased, response is improved but vibration and sound become larger.	1 to 999
SV006	VGN2	If it is desired to reduce noise generated at high-speed rotation for rapid traverse, set a speed loop gain (smaller than VGN1) to be gain at high-speed rotation (1.2 times higher than the rated rotating speed). Set the start speed of speed gain decrease to the parameter SV029(VCS). Set "0" when this parameter function is not used. 	–1000 to 1000
SV007	VIL	Set this parameter when the limit cycle occurs in a closed loop, or the overshoot occurs during positioning. Set "0" when this parameter function is not used. Related parameter is SV027 SSF1 (vcnt1,vcnt2).	0 to 32767
SV008	VIA	Set the speed loop integral gain.	1 to 9999 (0.0687 rad/s)
SV009	IQA	Set the current control gain. The data to be set is predetermined for each motor employed. Refer to section "(10) Standard Parameters for Each Motor".	1 to 20480
SV010	IDA	Set the current control gain. The data to be set is predetermined for each motor employed. Refer to section "(10) Standard Parameters for Each Motor".	1 to 20480
SV011	IQG	Set the current control gain. The data to be set is predetermined for each motor employed. Refer to section "(10) Standard Parameters for Each Motor".	1 to 4096
SV012	IDG	Set the current control gain. The data to be set is predetermined for each motor employed. Refer to section "(10) Standard Parameters for Each Motor".	1 to 4096

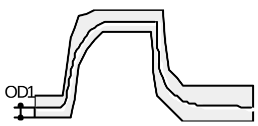
Name	Abbr.	Details	Setting range (unit)
SV013	ILMT	Set the rate (%) in respect to the stall rated current. For making the maximum driver torque level available, assign "500". (This is the limit value for both + and – directions.)	0 to 999 (Stall rated current %)
SV014	ILMTsp	Set the rate (%) in respect to the stall rated current for special operations (absolute position initialization, stopper operation, etc). For making the maximum driver torque level available, assign "500". (This is the limit value for both the + and – direction.)	0 to 999 (Stall rated current %)
SV015	FFC	Set this parameter when an amount of overshoot caused in feed forward control or a relative error caused in synchronous control is too large. Set "0" when this parameter is not used.	0 to 999 (%)
SV016	LMC1	Set this parameter if the protrusion is large when the arc quadrant is changed. (Caused by non-sensitive band from friction, torsion, backlash, etc.) This is valid only when lost motion compensation SV027 (lmc1, lmc2) is selected.	–1 to 200
		Type 1 SV027 (SSF1) lmc1=1, lmc2=0 In low-speed interpolation mode, compensation of this type eliminates bump. Setting "0" to this parameter indicates interpolation gain 0. Setting "100" indicates 100% compensation.	0 to 200 (%)
		Type 2 SV027 (SSF1) lmc1=0, lmc2=1 This is the standard type of MDS series. Use type 2 when type 1 is not enough for compensation such as in high-speed, high-accuracy interpolation. Set data in percentage to stall rated current.	0 to 100 (Stall rated current %)
		To change the compensation gain (type 1) or compensation amount (type 2) according to the direction. To set a different value according to the command direction, set this in addition to SV041 (LMC2). Set the value for changing the command speed from the – to + direction (during command direction CW) in SV016 (LMC1). Set the value for changing the command speed from the + to – direction (during command direction CW) in SV041 (LMC2). When "–1" is set, compensation will not be carried out when the command speed direction changes.	

Name	Abbr.	Details	Setting range (unit)
SV017	SPEC	Set the servo system specifications in bit units. F E D C B A 9 8: spm (F–C), drvall (B), drvup (A), mpt3 (9), mp (8) 7 6 5 4 3 2 1 0: abs, vmh, vdir, fdir, vfb, seqh, dfbx, fdir2 **(Note)** Always set to a "0" in a blank bit.	HEX setting
SV018	PIT	Set the ball screw pitch. Set "360" for a rotation axis. Refer to section "(2) Limitations to electronic gear setting value".	1 to 32767 (mm)

F	E	D	C	B	A	9	8
spm				drvall	drvup	mpt3	mp

7	6	5	4	3	2	1	0
abs	vmh	vdir	fdir	vfb	seqh	dfbx	fdir2

bit	Name	Meaning when set to 0	Meaning when set to 1
0	fdir2	Speed feedback forward polarity	Speed feedback reverse polarity
1	dfbx	Dual feedback control invalid	Dual feedback control valid
2	seqh	Ready/servo ON time normal mode	Ready/servo ON time reduced mode
3	vfb	Speed feedback filter invalid	Speed feedback filter valid
4	fdir	Position feedback forward polarity	Position feedback reverse polarity
5	vdir	Motor detector installation direction AC	Motor end detector installation direction BD
6	vmh	Normal performance mode	High-speed performance mode
7	abs	Relative position detection	Absolute position detection
8	mp	MP scale 360P (2mm pitch)	MP scale 720P (1mm pitch)
9	mpt3	MP scale absolute position detection type 1/2 selection	MP scale absolute position detection type 3 selection
A	drvup	Uses with the motor standard driver.	Uses with the driver which capacity is 1 rank upper/lower than the standard driver.
B	drvall	Normal setting.	Uses the motor standard driver and the driver of the other capacity together.
C D E F	spm	Special motor selection. Standard rotary motor : 0 Special rotary motor : 1 (For V2-0707s Amp) Refer to "(4) Motor type".	

Name	Abbr.	Details	Setting range (unit)
SV019	RNG1	Set the number of pulses (k pulse) per rotation of the detector used for position control.	1 to 9999
		<Semi-closed loop> Set the number of pulses per rotation of the motor. Set the same value to SV020 (RNG2).	(kp/rev)
		<Closed loop> Set the number of pulses per ball screw pitch. When using a linear scale, set the value obtained from the following calculation expression: $\text{Setting value} = \dfrac{\text{Ball screw pitch (mm)}}{\text{Linear scale resolution (mm)}} \times 10^{-3}$	(kp/rev)
SV020	RNG2	Set the number of pulses (k pulse) per rotation of the motor end detector.	1 to 9999 (kp/rev)
SV021	OLT	Set the time constant for detection of overload 1 (OL1) Normally, "60" is set. When using a 15kW driver (HA-A15KL), the upper limit value is 3 (s).	1 to 999 (s)
SV022	OLL	Set the current detection level of overload 1 (OL1) with respect to the stall rated current (%). Set "150" for ordinary operation.	110 to 500 (Stall rated current %)
SV023	OD1	Set the excessive detection error width at the time of servo ON. <Setting equation> $\text{OD1} = \text{OD2} = \text{OD3} = \dfrac{F}{60 \times \text{PGN1} \times 0.5}$ (mm)  F : Max. rapid traverse rate (mm/min) PGN1 : Position loop gain 1 (rad/s) When "0" is set, the excessive error at servo ON will not be detected.	0 to 32767 (mm)
SV024	INP	Set the in-position detection width value. Set "50" for ordinary operation.	0 to 32767 (µm)

<table>
<tr><th>Name</th><th>Abbr.</th><th>Details</th><th>Setting range (unit)</th></tr>
<tr><td>SV025</td><td>MTYP</td><td>Set the motor/detector and detector types.
<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">pen</td><td colspan="4">ent</td><td colspan="8">mtyp</td></tr>
</table>
<table>
<tr><th>bit</th><th>Name</th><th>Details</th></tr>
<tr><td>0</td><td rowspan="8">mtyp</td><td rowspan="8">Set the motor type.
(Refer to "(4) Motor type".)</td></tr>
<tr><td>1</td></tr>
<tr><td>2</td></tr>
<tr><td>3</td></tr>
<tr><td>4</td></tr>
<tr><td>5</td></tr>
<tr><td>6</td></tr>
<tr><td>7</td></tr>
<tr><td>8</td><td rowspan="4">ent</td><td rowspan="4">Set the speed detector type.
(Refer to "(5) Detector type".)</td></tr>
<tr><td>9</td></tr>
<tr><td>A</td></tr>
<tr><td>B</td></tr>
<tr><td>C</td><td rowspan="4">pen</td><td rowspan="4">Set the position detector type.
(Refer to "(5) Detector type".)</td></tr>
<tr><td>D</td></tr>
<tr><td>E</td></tr>
<tr><td>F</td></tr>
</table>
</td><td>HEX setting</td></tr>
<tr><td>SV026</td><td>OD2</td><td>Set the excessive detection error width at the time of servo OFF.
(Normally same data as for SV023(OD1).)
When "0" is set, the excessive error at servo OFF will not be detected.</td><td>0 to 32767 (mm)</td></tr>
</table>

<table>
<tr><th>Name</th><th>Abbr.</th><th>Details</th><th>Setting range (unit)</th></tr>
<tr><td>SV027</td><td>SSF1</td><td>Select the special servo functions 1.
<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></tr>
<tr><td>aflt</td><td>zrn2</td><td>afrg</td><td>afse</td><td>ovs2</td><td>ovs1</td><td>lmc2</td><td>lmc1</td></tr>
</table>
<table>
<tr><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>omr</td><td>zrn3</td><td>vfct2</td><td>vfct1</td><td></td><td>upc</td><td>vcnt2</td><td>vcnt1</td></tr>
</table>
<table>
<tr><th>bit</th><th>Name</th><th>Meaning when set to 0</th><th>Meaning when set to 1</th></tr>
<tr><td>0
1</td><td>vcnt1
vcnt2</td><td colspan="2">00: Delay compensation changeover invalid
01: Delay compensation changeover type 1
10: Delay compensation changeover type 2
11: Reserved</td></tr>
<tr><td>2</td><td>upc</td><td>Starting torque compensation invalid</td><td>Starting torque compensation valid</td></tr>
<tr><td>3</td><td></td><td></td><td></td></tr>
<tr><td>4
5</td><td>vfct1
vfct2</td><td colspan="2">00: Jitter compensation invalid
01: Jitter compensation 1 pulse
10: Jitter compensation 2 pulse
11: Jitter compensation 3 pulse</td></tr>
<tr><td>6</td><td>zrn3</td><td>Set for normal use</td><td>Special reference point return type</td></tr>
<tr><td>7</td><td>omr</td><td>Machine end compensation invalid.</td><td>Machine end compensation valid</td></tr>
<tr><td>8
9</td><td>lmc1
lmc2</td><td colspan="2">Set the compensation gain with SV016 (LMC1) and SV041 (LMC2).
00: Lost motion compensation invalid
01: Lost motion compensation type 1
10: Lost motion compensation type 2
11: Reserved</td></tr>
<tr><td>A
B</td><td>ovs1
ovs2</td><td colspan="2">00: Overshoot compensation invalid
01: Overshoot compensation type 1
10: Overshoot compensation type 2
11: Overshoot compensation type 3</td></tr>
<tr><td>C</td><td>afse</td><td>Adaptive filter sensivity :5</td><td>Adaptive filter sensitivity:16</td></tr>
<tr><td>D</td><td>afrg</td><td>Adaptive filter square wave:100</td><td>Adaptive filter square wave:1000</td></tr>
<tr><td>E</td><td>zrn2</td><td>Reference point return type 1</td><td>Reference point return type 2</td></tr>
<tr><td>F</td><td>aflt</td><td>Adaptive filter invalid</td><td>Adaptive filter valid.</td></tr>
</table></td><td>0000 to FFFF
HEX setting</td></tr>
<tr><td>SV028</td><td></td><td>Not used. Set "0"</td><td>0</td></tr>
<tr><td>SV029</td><td>VCS</td><td>If the noise is bothersome during high speeds, such as during rapid traverse, set the speed loop gain's drop start motor speed.
The speed loop gain drop target speed loop gain is set in SV006 (VGN2).
Set to "0" when not using this function.</td><td>0 to 9999 (r/min)</td></tr>
<tr><td>SV030</td><td>IVC</td><td>■ Voltage non-sensitive band compensation:
The low-order 8 bits are used.
Set to "1" when not used.
■ Current bias:
The high-order 8 digits are used. (Icx)
This is used in combination with the SV040 and SV045 high-order 8 bits.</td><td>–32768 to 32767</td></tr>
</table>

Name	Abbr.	Details	Setting range (unit)
SV031	OVS1	Set this parameter if overshooting occurs during deceleration/stop using submicron or closed loop control. The overshoot is improved more as the set value is larger. Set 2 to 10 (%) for ordinary operation. (Ratio to stall rated current) (Increase the set value in increments of 2% until a value which suppresses overshoot is found.) This is valid only when overshoot compensation SV027 (SSF1/ovs1, ovs2) is selected.	–1 to 100 (Stall rated current %)
SV032	TOF	Set the unbalance torque amount of an axis having an unbalanced torque such as a vertical axis, as a percentage in respect to the stall rated current (%). This is used when SV027 SSF1 lmc1, lmc2 or SV027 SSF1 vcnt1, vcnt2 is set.	–100 to 100
SV033	SSF2	Select the special servo functions 2.	0000 to FFFF HEX setting

F	E	D	C	B	A	9	8
dos						hvx	svx

7	6	5	4	3	2	1	0
nfd2			nf3	nfd1			zck

bit	Name	Meaning when set to 0	Meaning when set to 1
0	zck	Z phase check valid (part of alarm 42)	Z phase check invalid
1 2 3	nfd1	Adjust the damping amount of the machine resonance suppression filter 1. (The frequency should be set with SV038.) When the setting value is increased, the effect of the machine resonance suppression filter will drop, and the effect of onto the speed control will drop. 000: ∞ 001: –18dB 010: –12dB 011: –9dB 100: –6dB 101: –4dB 110: –3dB 111: –1dB	
4	nf3	Makes the machine resonance suppression filter 3 valid. (Main frequency is fixed to 1125 Hz.	
5 6 7	nfd2	Adjust the damping amount of the machine resonance suppression filter 2. (The frequency should be set with SV046.) When the setting value is increased, the effect of the machine resonance suppression filter will drop, and the effect of onto the speed control will drop. 000: ∞ 001: –18dB 010: –12dB 011: –9dB 100: –6dB 101: –4dB 110: –3dB 111: –1dB	
8 9	svx hvx	Control mode 00:Normal 01:Standard mode 10:High-gain mode 11:High-gain mode	
A B			
C D E F	dos	Digital signal output selection 0000: The MP scale absolute position detection system offset request signal is output. 0001: The specified speed signal is output.	

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

Name	Abbr.	Details	Setting range (unit)
SV034	SSF3	Select the special servo functions 3.	0000 to FFFF HEX setting

F	E	D	C	B	A	9	8
ovsn				linN			

7	6	5	4	3	2	1	0
toff	os2	zeg	dcd	test	mohn	has2	(has1)

bit	Name	Meaning when set to 0	Meaning when set to 1
0	(has1)	Setting for normal use	(HAS control 1 valid, high-speed compatible)
1	has2	Setting for normal use	HAS control 2 valid, overshooting compatible
2	mohn	Setting for normal use	Ignores the motor thermal error of MDS-B-HR
3	test	Setting for normal use	Test at shipping (Errors are detected more sensitively.)
4	dcd	Setting for normal use	Do not set. (For special applications.)
5	zeg	Setting for normal use	Z phase opposite edge detection **(Note 1)**
6	os2	Setting for normal use	Changes the overspeed detection level. **(Note 2)**
7	toff	Setting for normal use	Low-speed serial ABS scale communication OFF **(Note 3)**
8	linN	Not used.	
9			
A			
B			
C	ovsn	Set the overshoot compensation type 3 non-sensitive band.	
D			
E			
F			

(Note 1) This is valid only when the special reference point return type is selected.

(Note 2) The changeable overspeed detection level depends on the motor. Refer to "OS1" and "OS2" of "(10) Standard Parameters for Each Motor".

(Note 3) "toff" (Bit 7) is for testing purposes. When set to "1", the absolute position cannot be initialized.

<table>
<tr><th>Name</th><th>Abbr.</th><th>Details</th><th>Setting range (unit)</th></tr>
<tr><td>SV035</td><td>SSF4</td><td>Select the special servo functions 4.
<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></tr><tr><td>clt</td><td colspan="3">clG1</td><td>cl2n</td><td>clet</td><td colspan="2">cltq</td></tr></table><table><tr><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>iup</td><td colspan="6">tdt</td></tr></table><table><tr><th>bit</th><th>Name</th><th>Meaning when set to 0</th><th>Meaning when set to 1</th></tr><tr><td>0
1
2
3
4
5</td><td>tdt</td><td colspan="2">Td creation time setting (driver fixed)
Setting time (µs) = (tdt + 1) × 0.569
Setting time when "0" is set
Less than 7kW: 5.69µs 7kW or more: 8.52µs
When tdt<9, the setting is handled as tdt = 0.
Normally, set "0".</td></tr><tr><td>6</td><td>iup</td><td>Setting for normal use</td><td>Do not set.
(For special applications.)</td></tr><tr><td>7</td><td></td><td></td><td></td></tr><tr><td>8
9</td><td>cltq</td><td colspan="2">Set the deceleration torque for when a collision is detected.
00: 100% 01: 90% 10: 80% 11: 70%</td></tr><tr><td>A</td><td>clet</td><td>Setting for normal use</td><td>The past two-second estimated disturbance torque peak value is displayed at MPOF on the Servo Monitor screen.</td></tr><tr><td>B</td><td>cl2n</td><td>Setting for normal use</td><td>Collision detection method 2 is invalidated.</td></tr><tr><td>C
D
E</td><td>clG1</td><td colspan="2">Set the collision detection level for the collision detection method 1, G1 modal.
When 0 is set : The method 1, G1 modal collision detection will not be carried out.
When 1 to 7 is set : The method 1, G0 modal collision detection level (SV060: TLMT) will be multiplied by the set value.</td></tr><tr><td>F</td><td>clt</td><td>Setting for normal use</td><td>The guide value for the SV059 (TCNV) setting value is displayed at MPOF on the Servo Monitor screen.</td></tr></table>(Note) Set "0" in bits with no particular description.</td><td>0000 to FFFF
HEX setting</td></tr>
</table>

<table>
<tr><th>Name</th><th>Abbr.</th><th>Details</th><th>Setting range (unit)</th></tr>
<tr><td>SV036</td><td>PTYP</td><td>Power supply type
<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></tr>
<tr><td colspan="4">amp</td><td colspan="4">rtyp</td></tr>
</table>
<table>
<tr><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="8">ptyp</td></tr>
</table>
<table>
<tr><th>bit</th><th>Name</th><th>Meaning when set to 0</th><th>Meaning when set to 1</th></tr>
<tr><td>0</td><td rowspan="8">ptyp</td><td colspan="2" rowspan="8">Set the power supply type.
(Refer to "(7) Power supply type" for details.)</td></tr>
<tr><td>1</td></tr>
<tr><td>2</td></tr>
<tr><td>3</td></tr>
<tr><td>4</td></tr>
<tr><td>5</td></tr>
<tr><td>6</td></tr>
<tr><td>7</td></tr>
<tr><td>8</td><td rowspan="4">rtyp</td><td colspan="2" rowspan="4">Set "0" if the power supply unit is a current regeneration type.
If the power supply unit is a resistance regeneration type, set the type of resistor being used.
(Refer to "(8) Regenerative resistance type" for details.)</td></tr>
<tr><td>9</td></tr>
<tr><td>A</td></tr>
<tr><td>B</td></tr>
<tr><td>C</td><td rowspan="4">amp</td><td colspan="2" rowspan="4">Set the driver model number.
0: MDS-C1-V1/V2/SP, MDS-B-V14/V24, MDS-B-V1/V2/SP,MDS-A-V1/V2/SP
1: MDS-A-SVJ
2: MDS-A-SPJ</td></tr>
<tr><td>D</td></tr>
<tr><td>E</td></tr>
<tr><td>F</td></tr>
</table>
</td><td>0000 to FFFF
HEX setting</td></tr>
<tr><td>SV037</td><td>JL</td><td>Set the load inertia that includes the motor in respect to the motor inertia.
SV037 (JL) = (Jm + Jl)/Jm × 100
Jm : Motor inertia
Jl : Motor axis conversion load inertia</td><td>0 to 5000 (%)</td></tr>
<tr><td>SV038</td><td>FHz1</td><td>If machine vibration occurs, set the vibration frequency to be suppressed.
Note that the value 36Hz or more should be set.
Set "0" when not using this function.
Specially, set sv033 (SSF2/nfd1) together when setting the low frequency 100 Hz or less.</td><td>0 to 9000 (Hz)</td></tr>
<tr><td>SV039</td><td>LMCD</td><td>Set when the lost motion compensation timing is not suitable. Adjust upwards in increments of "10 ms".</td><td>0 to 2000 (ms)</td></tr>
</table>

Name	Abbr.	Details	Setting range (unit)
SV040	LMCT	■Set the lost motion compensation dead zone. Set in the low-order 8 bits. Normally set "0". Set only when the lost motion compensation timing is not proper during feed forward control. ■Current bias: Set in the high-order 8 bits. (Icy) This is used in combination with SV030 and SV045 high-order 8 bits.	–32768 to 32767 **(Note)** The setting range of the low-order 8 bits is 0 to 100 (µm).
SV041	LMC2	Normally set this to "0". Set this with SV016 (LMC1) when setting the lost motion compensation's gain (type 1) or compensation amount (type 2) to different values according to the command direction. • Set the value for changing the command speed from the – to + direction (during command direction CW) in SV016 (LMC1). • Set the value for changing the command speed from the + to – direction (during command direction CW) in SV041 (LMC2). • When "–1" is set, compensation will not be carried out when the command speed direction changes. This is valid only when lost motion compensation (SV027: lmc1, lmc2) is selected.	–1 to 200 (Stall rated current %)
SV042	OVS2	Overshoot compensation 2 Set the overshoot compensation amount for unidirectional movement (command direction CW). When "0" is set, the value set for SV031 (OVS1) will be set. When "–1" is set, compensation will not be carried out during unidirectional movement. This is valid only when overshoot compensation SV027 (SSF1/ovs1) is selected.	–1 to 100 (Stall rated current %)
SV043	OBS1	Observer1 Set the pole of the observer. Normally set approximately "628" (rad). To operate the observer function, also set the SV037 (JL) and SV044 (OBS2). Set to "0" when not used.	0 to 1000 (rad)
SV044	OBS2	Observer2 Set the execution gain of the observer. Normally set to "100". To operate the observer function, also set the SV037 (JL) and SV043 (OBS1). Set to "0" when not used.	0 to 500 (%)
SV045	TRUB	■When using the collision detection function, set the friction torque in the low-order 8 bits with a rate (%) for the stall rated current. Set to "0" when not using the collision detection function. ■Current bias : Set in the high-order 8 bits (Ib1). This is used in combination with SV030 and SV040 high-order 8 bits.	–32768 to 32767 **(Note)** The setting range of the low-order 8 bits is 0 to 100 (Stall rated current %).
SV046	FHz2	If machine vibration occurs, set the vibration frequency to be suppressed. Note that the value 36Hz or more should be set. Set "0" when not using this function. Specially, set sv033 (SSF2/nfd2) together when setting the low frequency 100 Hz or less.	0 to 9000 (Hz)

.

Name	Abbr.	Details	Setting range (unit)
SV047	EC1	Inductive voltage compensation Set the execution gain of the inductive voltage compensation. Normally, set to "100".	–32768 to 32767 (%)
SV048	EMGrt	Set the brake operation delay time when using the drop prevention function. Set a larger value than the actual brake operation time. Set a "0" when not using the drop prevention function. SV055 (EMGx) and SV056 (EMGt) must also be set when this function is used.	0 to 20000 (ms)
SV049	PGN1sp	Set the position loop gain for special operations (synchronous tap, interpolation with spindle C axis, etc.). Normally, set the spindle position loop gain.	1 to 200 (rad/s)
SV050	PGN2sp	Set this with SV058 (SHGCsp) when carrying out SHG control during special operations (synchronous tap, interpolation with spindle C axis, etc.). When this parameter is not used, set "0".	0 to 999 (rad/s)
SV051	DFBT	Set the compensation time constant for dual feedback control.	0 to 9999 (ms)
SV052	DFBN	Set the dead zone amount for dual feedback control.	0 to 9999 (µm)
SV053	OD3	Set the excessive error detection width at servo ON for special operations (absolute position initialization setting, stopper operation, etc.). When "0" is set, the excessive error will not be detected during special operations and servo ON.	0 to 32767 (mm)
SV054	ORE	Set the overrun detection width for the closed loop. For setting synchronous control slave axis, set the overrun detection width for master/slave axis. When "–1" is set, the overrun will not be detected. When "0" is set, the overrun will be detected with a 2 (mm) width.	–1 to 32767 (mm)
SV055	EMGx	Set the emergency stop maximum delay time when using the drop prevention function. Normally, set it to the same value as the SV056 (EMGt). Set to "0" when not using the drop prevention function.	0 to 20000 (ms)
SV056	EMGt	Set the deceleration time constant from the maximum rapid traverse speed when using the drop prevention function. Normally, the same value as the normal CNC G0 acceleration/deceleration time constant is set. Set "0" when not using the drop prevention function.	–20000 to 20000 (ms)
SV057	SHGC	Set this with SV004 (PGN2) when carrying out SGH control. Set 0 when not using this function.	0 to 1200 (rad/s)
SV058	SHGCsp	Set this with SV050 (PGN2sp) when carrying out SHG control during special operations (synchronous tap, interpolation with spindle C axis, etc.). Set 0 when not using this function.	0 to 1200 (rad/s)

Name	Abbr.	Details	Setting range (unit)
SV059	TCNV	When using the collision detection function, set the estimated torque gain. When "1" is set in SV035: SSF4/clt, the setting value guideline can be displayed in MPOF on the Servo monitor screen. Set to "0" when not using the collision detection function.	–32767 to 32767
SV060	TLMT	When using the collision detection function, set the collision detection level for the method 1·G0 modal with a rate for the stall rated current. Set to "0" when not using the collision detection function.	0 to 999 (Stall rated current %)
SV061	DA1NO	Set the output data number for channel 1 of the D/A output function. When "－1" is set, the D/A output of that axis will not be carried out.	–32767 to 32767
SV062	DA2NO	Set the output data number for channel 2 of the D/A output function. When "－1" is set, the D/A output of that axis will not be carried out.	–32767 to 32767
SV063	DA1MPY	Set the output magnification for channel 1 of the D/A output function. The output magnification will be the setting value/256. If "0" is set, the output magnification will be 1-fold, in the same manner as when "256" is set.	–32768 to 32767
SV064	DA2MPY	Set the output magnification for channel 2 of the D/A output function. The output magnification will be the setting value/256. If "0" is set, the output magnification will be 1-fold, in the same manner as when "256" is set.	–32768 to 32767
SV065	TLC	Set the spring constant of the machine end compensation. When the semi-closed system is applied, the machine end compensation amount is calculated with the following equation. Compensation amount (μm)= $\frac{F \times SV065}{R \times 10^9}$ F : Commanded speed (mm/min)^2 R : Radius (mm) Set to "0" when not used.	–32768 to 32767

(2) Limitations to electronic gear setting value

Refer to Page 104.

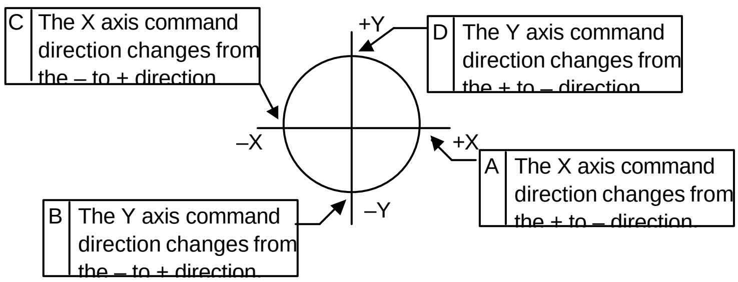
(3) Command polarity

When the motor is to rotate in the clockwise direction (looking from the load side) at the command for the + direction, the command direction is CW. Conversely, when the motor is to rotate in the counterclockwise direction, the command direction is CCW.
This rotation direction can be set with the CNC machine parameters. Note that the meaning of the ± will differ for some servo parameters according to this motor rotation direction. The servo parameters affected by CW/CCW are shown below.

SV016 (LMC1), SV041 (LMC2) (When different values are set for SV016 and SV041)
SV031 (OVS1), SV042 (OVS2) (When different values are set for SV031 and SV042)

<Example> If the lost motion compensation amount is to be changed according to the direction, the compensation amount at the quadrant changeover point of each arc where the lost motion compensation is applied will be as shown below according to the command polarity.

	CW	CCW
A	X: SV041	X: SV016
B	Y: SV016	Y: SV041
C	X: SV016	X: SV041
D	Y: SV041	Y: SV016



(4) Motor type

Set "mtyp" of SV025 (MTYP) combined with "spm" of SV017 (SPEC).

(a) Standard rotary motor (SV017(SPEC)=0xxx).

Motor series	2000r/min standard		2000r/min low inertia	3000r/min low inertia					3000r/min standard			HC 2000r/min medium inertia	HC 3000r/min medium inertia		HC 3000r/min ultra-low inertia	
No.	0x	1x	2x	3x	4x	5x	6x	7x	8x	9x	Ax	Bx	Cx	Dx	Ex	Fx
x0	HA40N		HA50L	HA53L					HA43N			HC52	HC53			
x1	HA80N		HA100L	HA103L					HA83N			HC102	HC103		HC103R	
x2	HA100N		HA200L	HA203L					HA103N			HC152	HC153		HC153R	
x3	HA200N		HA300L	HA303L					HA203N			HC202	HC203		HC203R	
x4	HA300N		HA500L	HA503L					HA303N			HC352	HC353		HC353R	
x5	HA700N								HA703N			HC452	HC453		HC503R	
x6	HA900N											HC702	HC703			
x7			HA-A11KL									HC902				
x8			HA-A15KL													
x9																
xA			HA150L	HA153L					HA93N							
xB																
xC									HA053							
xD									HA13							
xE									HA23N							
xF									HA33N							

(b) Special rotary motor (SV017(SPEC)=1xxx).

										HC 2000 r/min S drive unit	HC 3000 r/min S drive unit					
No.	0x	1x	2x	3x	4x	5x	6x	7x	8x	9x	Ax	Bx	Cx	Dx	Ex	Fx
x0																
x1																
x2																
x3																
x4											HC353					
x5										HC452	HC453					
x6										HC702						
x7																
x8																
x9																
xA																
xB																
xC																
xD																
xE																
xF																

(5) Detector type

Set "pen" / "ent" of SV025 (MTYP) from the following table.

No.	Detection method	Detector model name				Device	Remarks
0	High-speed serial	OSE104				Motor end detector	
1	High-speed serial	OSA104					
2	High-speed serial	OSE105	OSA105				
3							
4	ABZ	OHE25K-ET				Ball screw end detector	Cannot be set to speed detector type (ent).
	High-speed serial	OSE104-ET					
5	ABZ+low-speed serial	OHA25K-ET					
	High-speed serial	OSA104-ET					
6	High-speed serial	OSE105-ET	OSA105-ET				
7							
8	ABZ	SCALE				Machine end detector	
9	ABZ+low-speed serial	ABS SCALE **(Note 1)**					
A	High-speed serial	ABS SCALE **(Note 2)**	MDS-B-HR				
B							
C	High-speed serial	OSE104	OSE105	OSA104	OSA105	Synchronous control	
D	High-speed serial	ABS SCALE **(Note 2)**	MDS-B-HR				
E							
F							

⚠ CAUTION

With MDS-C1 series, only the serial encoder is applied as the motor end detector.
Thus, OHE/OHA type detector cannot be used as the motor end detector.

(Note 1) ABS SCALE corresponds to the following absolute position detection scales.

Mitutoyo Corporation	AT41
FUTABA Corporation	FME type, FLE type

(Note 2) ABS SCALE corresponds to the following absolute position detection scale.

Mitutoyo Corporation	AT342
HEIDENHAIN	LC19/M

(Note 3) Only the high-speed serial detector can be used for the motor end detector.

(Note 4) With synchronized control, normal setting for the master axis, and synchronized control setting for the slave axis.

Set "pen" / "ent" of SV025 (MTYP) as follows.

[Synchronized about speed]

C2xx : When the master axis is applied to semi-closed loop system.
Dxxx : When the master axis is applied to closed loop system.

[Synchronized about current]

CCxx : When the master axis is applied to semi-closed loop system.

(6) Detection system and MTYPSet SV025 (MTYP) from the following table.

(a) Semi-closed loop

Motor end detector	OSE104		OSA104		OSE105		OSA105		HA-FH		OBA13		OSA14		OBA17	
	MTYP	Detect system	MTYP	Detect system	MTYP	Detect system	MTYP	Detect system	MTYP	Detect system	MTYP	Detect system	MTYP	Detect system	MTYP	Detect system
	00xx	INC	11xx	ABS	22xx	INC	22xx	ABS	22xx	ABS	22xx	ABS	22xx	ABS	22xx	ABS

(b) Closed loop

Machine end detector / Motor end detector	OHE25K-ET		OHA25K-ET		OSE104-ET		OSA104-ET		OSE105-ET		OSA105-ET		SCALE		ABS SCALE low-speed serial		ABS SCALE high-speed serial	
	MTYP	Detect system	MTYP	Detect system	MTYP	Detect system	MTYP	Detect system	MTYP	Detect system	MTYP	Detect system	MTYP	Detect system	MTYP	Detect system	MTYP	Detect system
OSE104	40xx	INC	50xx	ABS	40xx	INC	50xx	ABS	60xx	INC	60xx	ABS	80xx	INC	90xx	ABS	A0xx	ABS
OSA104	41xx	INC	51xx	ABS	41xx	INC	51xx	ABS	61xx	INC	61xx	ABS	81xx	MP ABS	91xx	ABS	A1xx	ABS
OSE105	42xx	INC	52xx	ABS	42xx	INC	52xx	ABS	62xx	INC	62xx	ABS	82xx	INC	92xx	ABS	A2xx	ABS
OSA105	42xx	INC	52xx	ABS	42xx	INC	52xx	ABS	62xx	INC	62xx	ABS	82xx	MP ABS	92xx	ABS	A2xx	ABS
HA-FH	42xx	INC	52xx	ABS	42xx	INC	52xx	ABS	62xx	INC	62xx	ABS	82xx	MP ABS	92xx	ABS	A2xx	ABS
OBA13	42xx	INC	52xx	ABS	42xx	INC	52xx	ABS	62xx	INC	62xx	ABS	82xx	MP ABS	92xx	ABS	A2xx	ABS
OSA14	42xx	INC	52xx	ABS	42xx	INC	52xx	ABS	62xx	INC	62xx	ABS	82xx	MP ABS	92xx	ABS	A2xx	ABS
OBA17	42xx	INC	52xx	ABS	42xx	INC	52xx	ABS	62xx	INC	62xx	ABS	82xx	MP ABS	92xx	ABS	A2xx	ABS

(7) Power supply type

Set "ptyp" of SV036 (PTYP) from the following table.

No.	0xkW 0x	1xkW 1x	2xkW 2x	3xkW 3x	4xkW 4x	5xkW 5x	6x	7x	0xkW 8x
0	PS non-connect			CV-300					
1		CV-110							CR-10
2			CV-220						CR-15
3									CR-22
4	CV-37								CR-37
5		CV-150			CV-450	CV-550			
6	CV-55		CV-260						CR-55
7				CV-370					
8	CV-75								CR-75
9		CV-185							CR-90
A									
B									
C									
D									
E									
F									

(8) Regenerative resistance type

Set "port" of SV036 (PTYP) from the following table.

No.	Regenerative register type	Resistance value(W)	Watts(W)
0			
1	GZG200W260HMJ	26	80
2	GZG300W130HMJ×2	26	150
3	MR-RB30	13	300
4	MR-RB50	13	500
5	GZG200W200HMJ×3	6.7	350
6	GZG300W200HMJ×3	6.7	500
7	R-UNIT-1	30	700
8	R-UNIT-2	15	700
9	R-UNIT-3	15	2100
A			
B			
C			
D			
E			
F			

(9) Current limit value

Motor	Stall rated current A	Maximum current A	Maximum torque N·m	Torque limit %
HA40N	3.6	17	14.2	472
HA80N	6.6	28	25.5	424
HA100N	14	42	42	300
HA200N	22	57	60	260
HA300N	37	85	87	230
HA700N	49	113	120	231
HA900N	56	141	153	252
HA053	1.4	3.9	0.69	279
HA13	1.4	3.9	1.37	279
HA23N	3	8.1	2.75	270
HA33N	3	8.1	5.6	270
HA43N	5	17	10.2	340
HA83N	8.8	28	19.2	318
HA103N	19.6	57	40	291
HA203N	34.5	85	56	246
HA303N	55	113	80	205
HA703N	68	141	105	207
HA50NL	4	17	13.0	425
HA100NL	8	28	20.9	350
HA150NL	11.5	42	31	365
HA200NL	18.2	42	32	231
HA300NL	25	57	52	228
HA500NL	44	85	72	193
HA53NL	5.8	28	14.1	482
HA103NL	11.0	42	22.5	381
HA153NL	16.2	42	22.8	259
HA203NL	21	57	37	271
HA303NL	32	85	60	265
HA503NL	54	113	78	209
HA-LH11K2	84	204	158	242
HA-LH15K2	100	260	215	260

Motor	Stall rated current A	Maximum current A	Maximum torque N·m	Torque limit %
HC52	3.94	17	11.8	431
HC102	7.4	28	21.6	378
HC152	11.1	47	35.3	423
HC202	15.4	47	41.7	305
HC352	22.9	64	59.8	279
HC452	40.4	85	87.5	210
HC702	46.2	113	120	245
HC902	55.9	141	153	252
HC53	5.8	17	8.82	293
HC103	9.8	28	16.7	286
HC153	15.9	47	28.4	296
HC203	22.4	64	40.2	286
HC353	33.3	85	55.9	255
HC453	57.3	113	79.8	197
HC703	69.2	141	105	210
HC103R	6.1	18.4	7.95	459
HC153R	8.8	23.4	11.9	318
HC203R	14.0	37.0	15.9	300
HC353R	22.5	56.3	27.8	253
HC503R	28.0	70.0	39.8	303

(Note) When "500%" for SV013 ILMT1 is set, the current limit value is maximum current (torque) one shown in the table above.
Set a parameter at the rate (%) of the stall rated current to limit the current value (torque) less than the maximum current value.

(10) Standard Parameters for Each Motor

Motor	Standard motor																				
	HA 40N	HA 43N	HA 80N	HA 83N	HA 93N	HA 100N	HA 103N	HA 200N	HA 203N	HA 300N	HA 303N	HA 700N	HA 703N	HA 900N	HA 053	HA 13	HA 23N	HA 33N	HA-N23	HA-N33	HA-N43
Driver	05	05	10	10	20	20	35	35	45	45	70	70	90	90	01	01	03	03	03	03	05
sv001	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
sv002	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
sv003	33	33	33	33	33	33	33	33	33	33	33	25	25	25	33	33	33	33	33	33	33
sv004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sv005	150	150	150	150	150	150	150	150	150	150	150	250	250	250	70	70	100	100	70	70	35
sv006	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sv007	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sv008	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364
sv009	4096	4096	4096	4096	4096	4096	4096	4096	4096	4096	4096	4096	4096	4096	4096	4096	4096	4096	4096	4096	4096
sv010	4096	4096	4096	4096	4096	4096	4096	4096	4096	4096	4096	4096	4096	4096	4096	4096	4096	4096	4096	4096	4096
sv011	768	768	768	768	768	768	768	768	768	768	768	768	768	768	768	768	768	768	768	768	768
sv012	768	768	768	768	768	768	768	768	768	768	768	768	768	768	768	768	768	768	768	768	768
sv013	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500
sv014	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500
sv015	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sv016	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sv017	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
sv018	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
sv019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	10	-	-	-	-	-
sv020	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	10	-	-	-	-	-
sv021	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60
sv022	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150
sv023	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
sv024	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
sv025	xx00	xx80	xx01	xx81	xx8A	xx02	xx82	xx03	xx83	xx04	xx84	xx05	xx85	xx06	338C	338D	xx8E	xx8F	xx6E	xx6F	xx60
sv026	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
sv027	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000
sv028	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sv029	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sv030	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sv031	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sv032	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sv033	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
sv034	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
sv035	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
sv036	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
sv037	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sv038	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sv039	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sv040	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sv041	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sv042	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sv043	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sv044	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sv045	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sv046	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sv047	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
sv048	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sv049	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15
sv050	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sv051	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sv052	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sv053	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sv054	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sv055	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sv056	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sv057	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sv058	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sv059	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sv060	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sv061	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sv062	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sv063	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Motor	Standard motor																				
	HA 40N	HA 43N	HA 80N	HA 83N	HA 93N	HA 100N	HA 103N	HA 200N	HA 203N	HA 300N	HA 303N	HA 700N	HA 703N	HA 900N	HA 053	HA 13	HA 23N	HA 33N	HA-N23	HA-N33	HA-N43
sv064	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
sv065	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
OS1	2400	3600	2400	3600	3600	2400	3600	2400	3600	2400	3600	2400	3600	2400	3600	3600	3600	3600	3600	3600	3600
OS2	2400	3600	2400	3600	3600	2400	3600	3000	3600	3000	3600	2400	3600	2400	3600	3600	3600	3600	3600	3600	3600

OS1 indicates the rotation speed (r/min) of the motor to detect the overspeed.
OS2 indicates the rotation speed (r/min) of the motor to detect the overspeed when"os2" of SV034 (SSF3) is selected.

Motor	HC standard motor															For S type drive unit					
	HC 52	HC 53	HC 102	HC 103	HC 152	HC 153	HC 202	HC 203	HC 352	HC 353	HC 452	HC 453	HC 702	HC 703	HC 902	HC 353	HC 452	HC 453	HC 702		
Driver	05	05	10	10	20	20	20	35	35	45	45	70	70	90	90	45S	45S	70S	70S		
sv001	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
sv002	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
sv003	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47		
sv004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
sv005	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200		
sv006	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
sv007	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
sv008	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364	1364		
sv009	4096	4096	4096	4096	4096	4096	4096	4096	4096	4096	4096	4096	4096	4096	4096	4096	4096	4096	4096		
sv010	4096	4096	4096	4096	4096	4096	4096	4096	4096	4096	4096	4096	4096	4096	4096	4096	4096	4096	4096		
sv011	768	768	768	768	768	768	768	768	768	768	768	768	768	768	768	768	768	768	768		
sv012	768	768	768	768	768	768	768	768	768	768	768	768	768	768	768	768	768	768	768		
sv013	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500		
sv014	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500		
sv015	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
sv016	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
sv017	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	1000	1000	1000	1000		
sv018	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
sv019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
sv020	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
sv021	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60		
sv022	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150		
sv023	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6		
sv024	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50		
sv025	xxB0	xxC0	xxB1	xxC1	xxB2	xxC2	xxB3	xxC3	xxB4	xxC4	xxB5	xxC5	xxB6	xxC6	xxB7	xxA4	Xx95	xxA5	Xx96		
sv026	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6		
sv027	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000		
sv028	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
sv029	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
sv030	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
sv031	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
sv032	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
sv033	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000		
sv034	0003	0003	0003	0003	0003	0003	0003	0003	0003	0003	0003	0003	0003	0003	0003	0003	0003	0003	0003		
sv035	0000	0000	0000	0000	0040	0040	0040	0040	0040	0040	0040	0040	0040	0000	0000	0040	0040	0040	0040		
sv036	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000		
sv037	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
sv038	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
sv039	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
sv040	0	0	0	0	0	0	10240	10240	10240	10240	10240	10240	10240	10240	10240	10240	10240	10240	10240		
sv041	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
sv042	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
sv043	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
sv044	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
sv045	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
sv046	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
sv047	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100		
sv048	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
sv049	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15		
sv050	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
sv051	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
sv052	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
sv053	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
sv054	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
sv055	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
sv056	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
sv057	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
sv058	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
sv059	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
sv060	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
sv061	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		

Motor	HC standard motor															For S type drive unit					
	HC 52	HC 53	HC 102	HC 103	HC 152	HC 153	HC 202	HC 203	HC 352	HC 353	HC 452	HC 453	HC 702	HC 703	HC 902	HC 353	HC 452	HC 453	HC 702		
sv062	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
sv063	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
sv064	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
sv065	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
OS1	3600	3600	3600	3600	3600	3600	3000	3600	3000	3600	3000	3600	3000	3600	3000	3600	3000	3600	3000		
OS2	3600	4200	3600	4200	3600	4200	3000	4200	3000	4200	3000	4200	3000	4200	3000	4200	3000	4200	3000		

OS1 indicates the rotation speed (r/min) of the motor to detect the overspeed.
OS2 indicates the rotation speed (r/min) of the motor to detect the overspeed when"os2" of SV034 (SSF3) is selected.

Motor	HC**R standard motor																				
	HC 103R	HC 153R	HC 203R	HC 353R																	
Driver	10	10	20	35																	
sv001	-	-	-	-																	
sv002	-	-	-	-																	
sv003	33	33	33	33																	
sv004	0	0	0	0																	
sv005	15	15	20	40																	
sv006	0	0	0	0																	
sv007	0	0	0	0																	
sv008	1364	1364	1364	1364																	
sv009	4096	4096	4096	4096																	
sv010	4096	4096	4096	4096																	
sv011	256	256	256	256																	
sv012	512	512	512	512																	
sv013	500	500	500	500																	
sv014	500	500	500	500																	
sv015	0	0	0	0																	
sv016	0	0	0	0																	
sv017	0000	0000	0000	0000																	
sv018	-	-	-	-																	
sv019	-	-	-	-																	
sv020	-	-	-	-																	
sv021	60	60	60	60																	
sv022	150	150	150	150																	
sv023	6	6	6	6																	
sv024	50	50	50	50																	
sv025	xxE1	xxE2	xxE3	xxE4																	
sv026	6	6	6	6																	
sv027	4000	4000	4000	4000																	
sv028	0	0	0	0																	
sv029	0	0	0	0																	
sv030	0	0	0	0																	
sv031	0	0	0	0																	
sv032	0	0	0	0																	
sv033	0200	0200	0200	0200																	
sv034	0000	0000	0000	0000																	
sv035	0000	0000	0000	0000																	
sv036	0000	0000	0000	0000																	
sv037	0	0	0	0																	
sv038	0	0	0	0																	
sv039	0	0	0	0																	
sv040	0	0	0	0																	
sv041	0	0	0	0																	
sv042	0	0	0	0																	
sv043	0	0	0	0																	
sv044	0	0	0	0																	
sv045	0	0	0	0																	
sv046	0	0	0	0																	
sv047	100	100	100	100																	
sv048	0	0	0	0																	
sv049	15	15	15	15																	
sv050	0	0	0	0																	
sv051	0	0	0	0																	
sv052	0	0	0	0																	
sv053	0	0	0	0																	
sv054	0	0	0	0																	
sv055	0	0	0	0																	
sv056	0	0	0	0																	
sv057	0	0	0	0																	
sv058	0	0	0	0																	
sv059	0	0	0	0																	
sv060	0	0	0	0																	
sv061	0	0	0	0																	
sv062	0	0	0	0																	
sv063	0	0	0	0																	
sv064	0	0	0	0																	

5.7 Alarms and Warnings

⚠ CAUTION
When an alarm occurs, eliminate the cause and make sure that the operation signal is not input, secure the safety and reset the alarm before starting the operation again.

When an alarm occurs in the servo drive unit, the servo drive unit will carry out the base interception and the motor will coast to a stop. In such case, turn the power OFF with an external sequence. (Refer to "5.9 Main circuit and brake connection".)
To reset an alarm, remove the cause, and then turn the power ON.

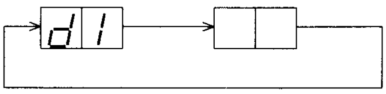
Important When an alarm related to overcurrent or overload occurs, do not repeat operation by turning the power OFF to ON without eliminating the cause of an alarm, otherwise the element may be damaged due to temperature rise.

The drive unit state is indicated by the code on the display of the servo drive unit, while the data is transmitted to the NC side. When an alarm occurs, the alarm is also indicated on the NC screen. (The alarm No. on the NC screen may differ from the alarm No. of the servo drive unit. For detail, refer to the Instruction Manual for NC.)
Refer to "MDS SERIES MAINTENANCE MANUAL" (BNP-B2046) for the troubleshooting.

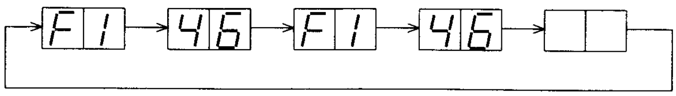
#	Status	Content
AA	INITIALIZE	Waiting for NC power start up (NC power ON → OFF).
Ab	INITIALIZE	Waiting for NC power start up
AC	INITIALIZE	Requesting parameter transfer
Ad	INITIALIZE	Waiting for parameter transfer
AE	INITIALIZE	Waiting for main servo IT start
b∗	READY OFF	Ready OFF
C∗	SERVO OFF	Servo OFF
d∗	SERVO ON	Servo ON
9∗	WARNING	Warning
E∗	WARNING	Warning (However, E6 and E7 indicate the status other than the alarm or warning)
∗∗	ALARM	Alarm

Display example (When the concerned drive unit is set to 1st axis.)

(1) At servo ON



(2) When alarm occurs (Displays by flickering)



(1) Details of alarm

Note 1. RS PR : Turn the CNC power OFF to reset.
AR : Turn the servo driver power OFF to reset.
∗ : This indicates the warning and does not turn the servo OFF.

Note 2. A/C A : Alarm that occurs per axis.
C : Common alarm in the driver.
V : Power supply regenerative power supply alarm
R : Resistance regenerative power supply alarm

Note 3. The servo alarms and servo warnings are also the same for the 2-axis servo drive unit.

<Servo Alarms>

Display	Abbr.	Name	Meaning
11	ASE	Spindle selection error	In MDS-B-B24 driver, the rotary switches for both axes are set to the same axis number when using the 2-axis integrated drive unit. Otherwise, the switches are set to an illegal value.
12	ME	Memory error	An error was detected in a memory IC or FB IC by self-check to be made during driver power-on.
13	SWE	S/W process error	The S/W process did not end within the specified time.
14	SWE2	S/W process error2	The processor of current does not work properly.
17	ADE	AD converter error	An error was detected in the A/D converter for current detection by self-check during driver power ON.
18	WAT	Initial communication error	Initial communication with the high-speed serial detector connected with the motor end could not be performed.
1A	Stei	Serial detector communication error (SUB)	Initial communication with the detector cannot be performed in the system that uses OHA25K-ET or high-speed serial detector as the machine end detector.
1B	Scpu	CPU error (SUB)	In the high-speed serial detector connected with the machine end, an error was detected in the data stored in an EEPROM. Refer to "(3)".
1C	Sled	EEPROM LED abnormality (SUB)	In the linear scale connected with the machine end, an error in an EEPROM was detected. Otherwise, in the high-speed serial detector connected with the machine end, a deteriorated LED was detected. Refer to "(3)".

Display	Abbr.	Name	Meaning
1D	Sdat	Data error (SUB)	In the high-speed serial detector connected with the machine end, an error was detected in a position within one rotation. Refer to "(3)".
1E	Sohe	ROM, RAM/ Thermal error (SUB)	In the linear scale connected with the machine end, an error on ROM or RAM was detected. Otherwise, in the high-speed serial detector connected with the machine end, the built-in thermal protector functioned. Refer to "(3)".
1F	Stre	Serial detector Communication error (SUB)	In the high-speed serial detector connected with the machine end, communication with the detector stopped.
21	NS2	No signal 2	An error was detected in the ABZ phase in a closed-loop system.
25	ABSE	Absolute position data lost	The backup voltage in the absolute position detector dropped. The absolute position cannot be compensated.
26	NAE	Unusable axis error	A power module error occurred in the axis set as "F" in the rotary switch.
27	SCcpu	Scale CPU error (SUB)	The CPU in the absolute position detection connected with the machine end does not work properly. Refer to "(3)".
28	Sosp	Scale overspeed (SUB)	In the absolute position linear scale connected with the machine end, the speed exceeding the maximum movement speed was detected. Refer to "(3)".
29	Sabs	Absolute position detector circuit error (SUB)	In the absolute position linear scale connected with the machine end, an error was detected in the scale or in the absolute detection circuit of the scale. Refer to "(3)".
2A	Sinc	Incremental position detector circuit error (SUB)	In the absolute position linear scale connected with the machine end, an error was detected in the scale or in the incremental detection circuit of the scale. Refer to "(3)".
2B	SCPU	CPU error	Detector circuit error in the motor end high-speed serial detector, an error was detected in the data stored in an EEPROM. Refer to "(3)".
2C	SLED	EEPROM/LED error	In the linear scale connected with the motor end, an error on an EEPROM was detected. Otherwise, in the high-speed serial detector connected with the motor end, a deteriorated LED was detected. Refer to "(3)".
2D	SDAT	Data error	In the high-speed serial detector connected with the motor end, an error was detected in a position within one rotation. Refer to "(3)".

Display	Abbr.	Name	Meaning
2E	SRRE	ROM, RAM error	The linear scale connected with the motor end detects an error on a ROM or RAM. Refer to "(3)".
2F	STRE	Serial detector Communication error	In the high-speed serial detector connected with the motor end, communication with the detector stopped.
31	OS	Overspeed	A speed exceeding the motor's tolerable speed was detected. (Motor maximum speed $*$ 1.2)
32	PMOC	Power module error (Overcurrent)	An overcurrent error occurred in the IPM used for the inverter.
34	DP	CNC communication CRC error	An error was detected in the communication data sent from the CNC to the driver.
35	DE	CNC communication Data error	An error was detected in the movement command data from the CNC.
36	TE	CNC communication error	Communication from the CNC stopped.
37	PE	Initial parameter error	An illegal parameter was detected among the parameters sent from the CNC during initialization by CNC power ON.
38	TP1	CNC communication Protocol error 1 (frame)	An error was detected in the communication frame sent from the CNC.
39	TP2	CNC communication Protocol error 2 (information)	An error was detected in the axis information data sent from the CNC.
3A	OC	Overcurrent	The motor drive current is too large.
3B	PMOH	Power module error (overheat)	An overheat was detected in the IPM used for the inverter.
42	FE1	Feedback error 1	A feedback pulse skip or Z-phase error was detected in the position detector.
43	FE2	Feedback error 2	Excessive difference was detected in the feedback amount between the motor end detector and the machine end detector during a closed loop. Otherwise, a Feed back IC error was detected during semi-closed loop.

Display	Abbr.	Name	Meaning
46	OHM	Motor overheat / thermal error	An overheat error was detected in the driving motor. Otherwise, a thermal protector functioned, which is built in the high-speed serial detector connected with the motor end.
50	OL1	Overload 1	The load level of the servomotor or servo driver can be calculated from the motor current. This load level has reached the overload level that is specified by the overload detection level (sv022: OLL) and overload-time constant (sv021: OLT).
51	OL2	Overload 2	A current command at least 95% of the maximum driver capacity continued for 1.0 second or more.
52	OD1	Excessive error 1	The difference between the ideal and actual positions has exceeded parameter setting value SV023 (OD1) or SV053 (OD3) when the servo was turned ON.
53	OD2	Excessive error 2	The difference between the ideal and actual positions has exceeded parameter setting value SV026 (OD2) when the servo was turned OFF.
54	OD3	Excessive error 3	When an excessive error 1 is detected, no motor current flows. This error occurs when the power cable is loose or disconnected or no voltage is applied to the bus.
58	CLE0	Collision detection0	A collision detection method 1 error was detected in G0 modal (rapid traverse feed) mode.
59	CLE1	Collision detection1	A collision detection method 1 error was detected in G1 modal (cutting speed) mode.
5A	CLE2	Collision detection2	A collision detection method 2 error was detected.
6F	PSE	Power supply alarm	The power supply unit is not connected. Otherwise, an error was detected in the AD converter of the power supply.
7F		Power turning ON request alarm	The control mode (Standard drive unit / High-gain drive unit) recognized by EEPROM is different from that designated by a parameter. The power need be turned ON again to change the mode set with the parameter.
80	HCN	HR unit Connection error	The errors such as illegal connection or disconnected cable are detected in MDS-B-HR which is connected with the motor end.
81	HHS	HR unit HSS communi-cation error	MDS-B-HR connected with the motor end detects a communication error between the absolute position detection scale.
83	HSC	HR unit Scale recognition error	MDS-B-HR connected with the motor end did not recognize the analog-wave cycle of the connected scale.
84	HCPU	HR unit CPU error	The CPU of MDS-B-HR connected with the motor end doesn’t operate properly.

Display	Abbr.	Name	Meaning
85	HDAT	HR unit Data error	In MDS-B-HR connected with the motor end, an error was detected in the analog data.
86	HMAG	HR unit Magnetic polarity error	In MDS-B-HR connected with the motor end, an error was detected in the magnetic polarity data.
88	WD	Watch dog	Servo system operation is abnormal.
89	Hcn	HR unit Connection error (SUB)	The errors such as illegal connection or dis-connected cable are detected in MDS-B-HR which is connected with the machine end.
8A	Hhs	HR unit HSS communication error (SUB)	MDS-B-HR connected with the machine end detects a communication error between the absolute position detection scale.
8C	Hsc	HR unit Scale recognition error (SUB)	MDS-B-HR connected with the machine end did not recognize the analog-wave cycle of the connected scale.
8D	Hcpu	HR unit CPU error (SUB)	The CPU of MDS-B-HR connected with the machine end doesn't operate properly.
8E	Hdat	HR unit Data error (SUB)	In MDS-B-HR connected with the machine end, an error was detected in the analog data.
8F	Hmag	HR unit Magnetic polarity error (SUB)	In MDS-B-HR connected with the machine end, an error was detected in the magnetic polarity data.

<Servo Warnings>

Display	Abbr.	Name	Meaning
90	WST	Initial communication error in low-speed serial format	Initial communication with the absolute position linear scale cannot be performed.
91	WAS	Communication error in low-speed serial format	An error was detected in communication with the detector in the absolute position detection system using OHA 25K/OHA 25K-ET/Absolute position linear scale.
92	WAF	Protocol error in low-speed serial format	An error was detected in the data from the detector in the absolute position detection system using OHA 25K/OHA 25K-ET/Absolute position linear scale.
93	WAM	Absolute position fluctuation	The absolute position to be detected at CNC power ON moves more than the tolerable amount.
96	MPE	MP scale feedback error	There is an excessive difference in the feedback amount between the motor end detector and the MP scale in the absolute position detector.
97	MPO	MP scale offset error	An error was detected in the offset data to be read during initialization by CNC power ON in the absolute position detector of the MP scale.
9E	WAn	High-speed serial detector Rotation count error	An error was detected in the rotation counter in OSE104/OSA104/OSE105/OSA105/OSE104-ET/ OSA104-ET/OSE105-ET/OSA105-ET. The absolute position cannot be corrected.
9F	WAB	Battery voltage drop	The voltage of the battery to be supplied to the absolute position detector dropped.
E1	WOL	Overload warning	An 80% level of the overload 1 alarm was detected.
E3	WAC	Absolute position counter warning	There is a difference between absolute and relative position data.
E4	WPE	Parameter warning	The parameter out of the setting range was set.
E6	AXE	Control axis removal	A control axis removal command has been issued.
E7	NCE	CNC emergency stop	CNC is in emergency stop state.

(2) Error parameter No. at initial parameter error

When the initial parameter error (alarm 37) occurs, the Diagnosis screen of CNC displays which parameter has caused an error. The display method differs according to the CNC type. Thus, refer to the instruction manuals for each CNC to be used.

The displayed No. at this time is normally indicated the parameter No. (svXXX).
In addition to this, there is a special 3-digit No. (Refer to the table below.)
In this case, the error occurrence is attributed to several parameters. Therefore, the related parameters must be properly set.

Display	Details	Related Parameters
69	The maximum rapid traverse feedrate set with CNC is illegal. Normally, this error does not occur. An error related to the CNC system S/W is considered.	CNC axis parameter "rapid".
71	The maximum cutting feedrate set with CNC is illegal. Normally, this error does not occur. An error related to the CNC system S/W is considered.	CNC axis parameter "clamp".
101	The number of constants to be used in the following functions is large: • Electronic gears • Position loop gain • Speed feedback conversion Check that all the related parameters are specified correctly.	sv001:PC1, sv002:PC2, sv003:PGN1 sv018:PIT, sv019:RNG1, sv020:RNG2 sv049:PGN1sp
102	Parameters for absolute position detection are set to ON during the high-speed serial incremental detector OSE104 or OSE105 is connected. Set the parameters for absolute position detection to OFF. To detect an absolute position, replace the incremental specification detector with an absolute position detector.	sv017:SPEC, sv025:MTYP
103	The servo option is not found. The closed loop (including the ball screw-end detector) or dual feedback control function is an optional function.	sv025:MTYP/pen sv017:SPEC/dfbx
104	The servo option is not found. The SHG control function is an optional function.	sv057:SHGC sv058:SHGCsp
105	The servo option is not found. The adaptive filtering function is an optional function.	sv027:SSF1/aflt
106	The servo option is not found. The absolute position detection system using MP scale is an optional function.	sv017:SPEC/mp, mpt3
107	2-axis control is running. The high-speed processing mode is exclusive for 1-axis control.	sv017:SPEC/vmh

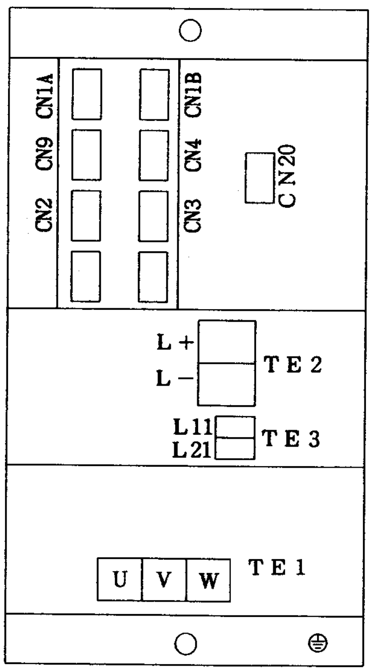
(3) Detector alarm

As the following alarms are detected by each detector, the details vary with the detector connected. Check the alarm details conforming to the detector being used.

No.	OSE104(-ET)/ OSA104(-ET) OSE105(-ET)/ OSA105(-ET)	FUTABA Linear scale FME/FLE type	Mitutoyo AT41	Mitutoyo AT342	HEIDENHAIN LC191M		Remarks
1B	Connection to CN3 CPU error			Connection to CN3 Initialization error	Connection to CN3 Initialization error		Error in the detector connected to CN3 (SUB)
1C	Connection to CN3 LED error			Connection to CN3 EEPROM error	Connection to CN3 EEPROM error		
1D	Connection to CN3 Data error			Connection to CN3 Unconformity of INC and ABS data	Connection to CN3 Unconformity of incremental and absolute data		
1E	Connection to CN3 Encoder thermal error			Connection to CN3 ROM/RAM error	Connection to CN3 ROM/RAM error		
27		Connection to CN3 Memory error	Connection to CN3 CPU error	Connection to CN3 CPU error	Connection to CN3 CPU error		
28				Connection to CN3 Photoelectric over speed	Connection to CN3 Over speed		
29		Connection to CN3 Absolute position detection circuit error	Connection to CN3 Absolute position detection circuit error	Connection to CN3 Capacitance error	Connection to CN3 Absolute data error		
2A		Connection to CN3 Relative position detection circuit error	Connection to CN3 Relative position detection circuit error	Connection to CN3 Photoelectric error	Connection to CN3 Incremental data error		
2B	Connection to CN2 CPU error			Connection to CN2 Initialization error	Connection to CN2 Initialization error		Error in the detector connected to CN2 (MAIN)
2C	Connection to CN2 LED error			Connection to CN2 EEPROM error	Connection to CN2 EEPROM error		
2D	Connection to CN2 Data error			Connection to CN2 Unconformity of photoelectric and electrostatic data	Connection to CN2 Unconformity of incremental and absolute data		
2E				Connection to CN2 ROM/RAM error	Connection to CN2 ROM/RAM error		
48				Connection to CN2 CPU error	Connection to CN2 CPU error		
49				Connection to CN2 Photoelectric over speed	Connection to CN2 Over speed		
4A				Connection to CN2 Capacitance error	Connection to CN2 Absolute data error		
4B				Connection to CN2 Photoelectric error	Connection to CN2 Incremental data error		

5.8 Explanation of connector and terminal block

		Name	Application	Remarks
Connector		CN1A	For connection with NC and high-order axis	
		CN1B	For connection with battery unit and low-order axis	
		CN9	For maintenance (not used normally)	
		CN4	For connection with power supply	
		CN2	For connection with motor end detector	
		CN3	For connection with machine end detector	
		CN20	External brake output contact point	For combination of V1-110/150 dynamic brake contact output
Terminal block	TE2	L+	Converter voltage input (+)	
		L–	Converter voltage input (–)	
	TE3	L11 L21	200VAC single-phase input	
	TE1	U	U-phase output for motor drive	
		V	V-phase output for motor drive	
		W	W-phase output for motor drive	
		⏚	Ground	



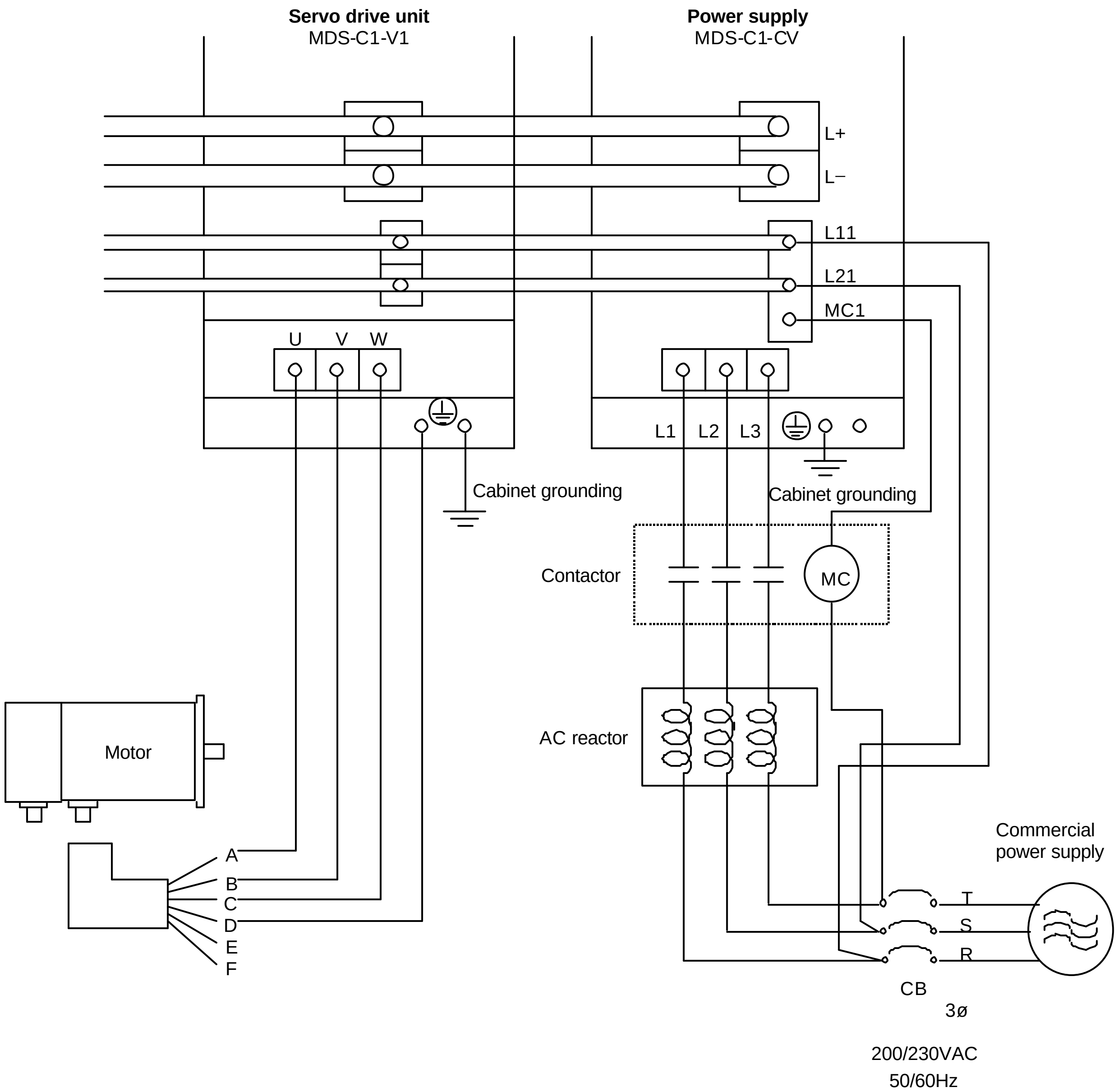
MDS – C1 – V1

5.9 Main circuit and brake connection

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

⚠ CAUTION
1. Correctly connect the output side (terminals U, V, W). Failure to do so could lead to abnormal operation of the servomotor. 2. 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.

5.9.1 Main circuit



Precautions for connections

(1) The wires and crimp terminals will differ according to the capacity.
(Refer to "8.5 Selection of wire size in the Chapter I Servo/Spindle System Configuration Section".)
(2) Always ground (⏚) the power supply.
(3) The phase order of the power supply terminals L1, L2, L3 is random.
(4) Precautions for connecting servo drive terminals U, V, W
  a. Always observe the phase order for the servo drive unit terminals U, V, W and motor side pins A, B, C. The motor may vibrate and rotate suddenly if the phase order is mistaken. <u>The phases cannot be reversed for reverse rotation</u>.
  b. Never perform connections that might apply the power on the servo drive output terminals U, V, W. Never ground the servo drive output terminals U, V, W or connect so that grounding may occur as this may destroy the servo drive.
(5) The Cannon plug used will differ according to the motor. Refer to section "2.9 (3)" for the connection drawing of the brake exciter circuit for motor with electromagnetic brake. Refer to section "2.8 (2)" for the terminal box type motor.
(6) Refer to the "I. Servo/Spindle System Configuration Section" for the selection of the contactor, AC reactor and Circuit Breaker connected to the power supply.
(7) Make sure that the specified power is supplied to the servo drive power terminals (L1, L2, L3). If the power does not have the specified voltage, use a transformer.
(8) Do not directly apply commercial power on the motor.
(9) Check once again that the wires are connected correctly as indicated in the wiring diagram.

5.9.2 Brake

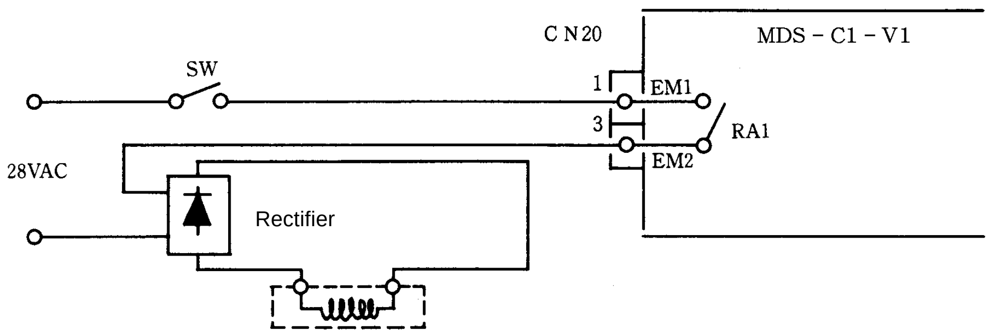
Contact connection terminals for brake (EM1, EM2)
A contact for the brake has been newly installed on the MDS-C1-V1 servo drive unit. This contact can be used for exciting the motor with brake. Connect the electromagnetic brake cable to connector CN20.

Contact for brake specifications

Type	Specifications
Rated control capacity (resistance load)	8A 250V AC/ 5A 30V DC
Contact max. tolerable electricity (resistance load)	2000VA 150WA
Contact max. tolerable voltage/current	380V AC /8A

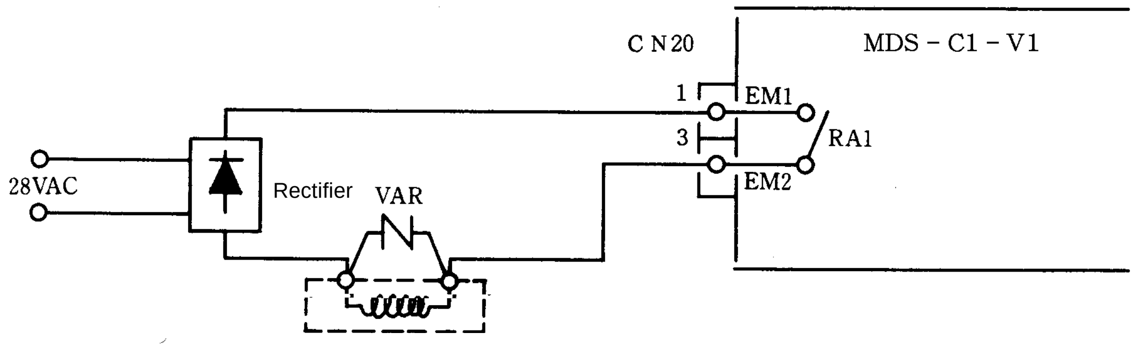
Examples of connection with contact for brake

(1) For AC OFF



Brake excitation

(2) For DC OFF

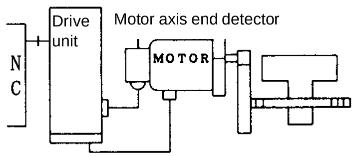
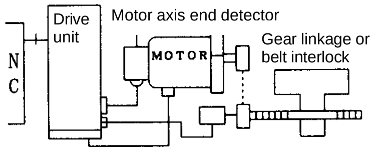
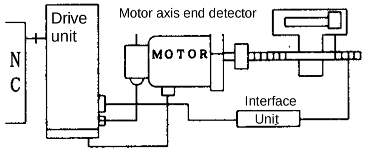
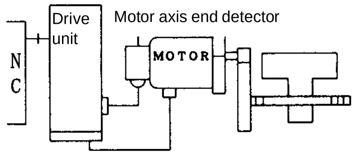
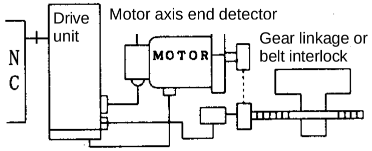
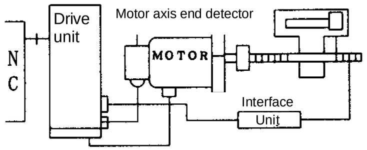


Brake excitation

Refer to "2.9 Motors with electromagnetic brake" for the electromagnetic brake specifications and application.

5.10 Wiring system diagrams for systems

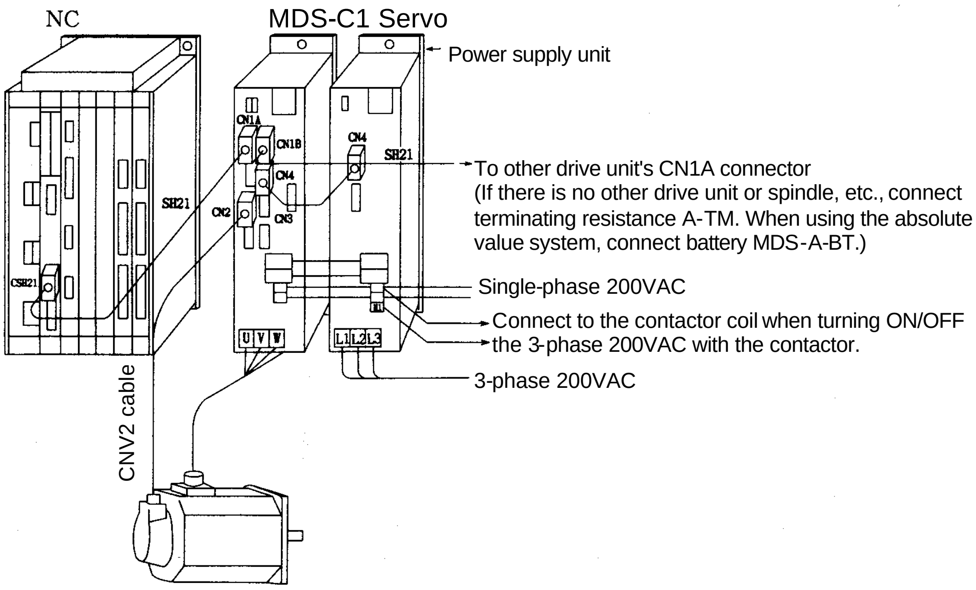
(1) Servo system configuration table

System			Configuration	Performance	Servo drive unit: No. of axes	Servo drive unit: Model	Detector: Motor end detector	Detector: Machine end detector	F/B cable connecting connector: Motor end	F/B cable connecting connector: Machine end
Relative position detection	Semi-closed loop			• Max. tracking performance: 5MPPS • Min. resolution: 0.0036° • Max. speed: 3000r/min	1	MDS-C1-V1-□	OSE104 OSE104S		CN2	—
					2	MDS-C1-V2-□	OSE104S Built-in encoder			
	Closed loop	Ball screw end		• Max. tracking performance: 5MPPS • Min. resolution: 0.0036° • Max. speed: 3000r/min	1	MDS-C1-V1-□	OSE104 OSE104S	OSE104ET	CN2	CN3
					2	MDS-C1-V2-□	OSE104S Built-in encoder			
		Scale		• Max. tracking performance: (according to manufacturer) • Min. resolution: (according to manufacturer)	1	MDS-C1-V1-□	OSE104 OSE104S	Various scales of pulse F/B outputs of 1µ and 0.5µ specifications can be connected. Example: MP scale (Mitsubishi Heavy Industries)	CN2	CN3
					2	MDS-C1-V2-□	OSE104S Built-in encoder			
Absolute position detector	Semi-closed loop			• Max. tracking performance: 5MPPS • Min. resolution: 0.0036° • Max. speed: 3000r/min	1	MDS-C1-V1-□	OSA104		CN2	—
					2	MDS-C1-V2-□	OSA104S OSA104S			
	Closed loop	Ball screw end		• Max. tracking performance: 5MPPS • Min. resolution: 0.0036° • Max. speed: 3000r/min	1	MDS-C1-V1-□	OSE104 OSE104S	OSA104ET OHA25K-ET	CN2	CN3
					2	MDS-C1-V2-□	OSE104S Built-in encoder			
		Scale		• Max. tracking performance: 0.83MPPS • Min. resolution: 1µm • Max. speed: 50m/min	1	MDS-C1-V1-□	OSE104 OSE104S	Absolute value linear scale AT-41 (Mitsutoyo)	CN2	CN3
					2	MDS-C1-V2-□	OSE104S Built-in encoder			

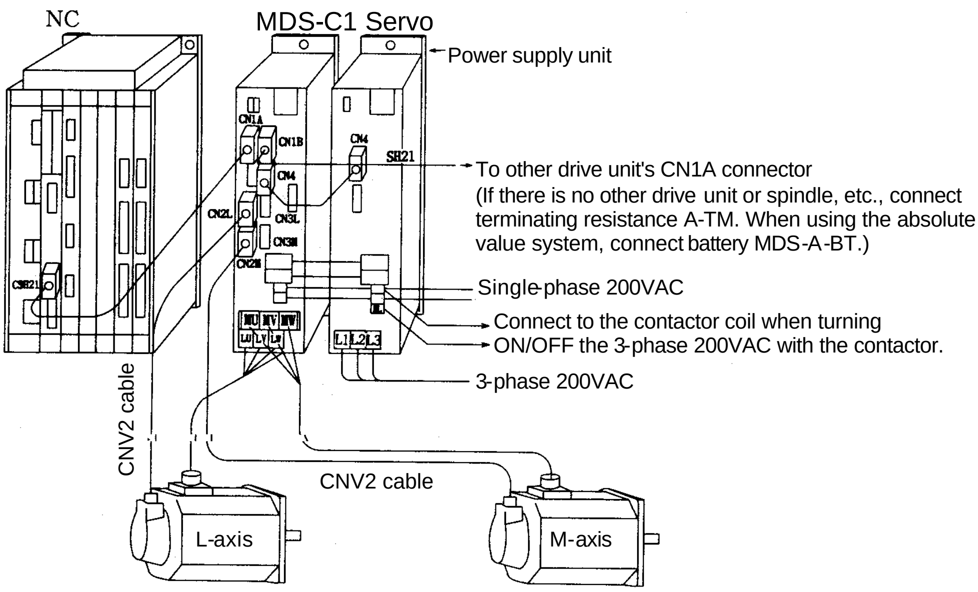
(2) Cable system drawings for each specification

■ Semi-closed loop position detection system

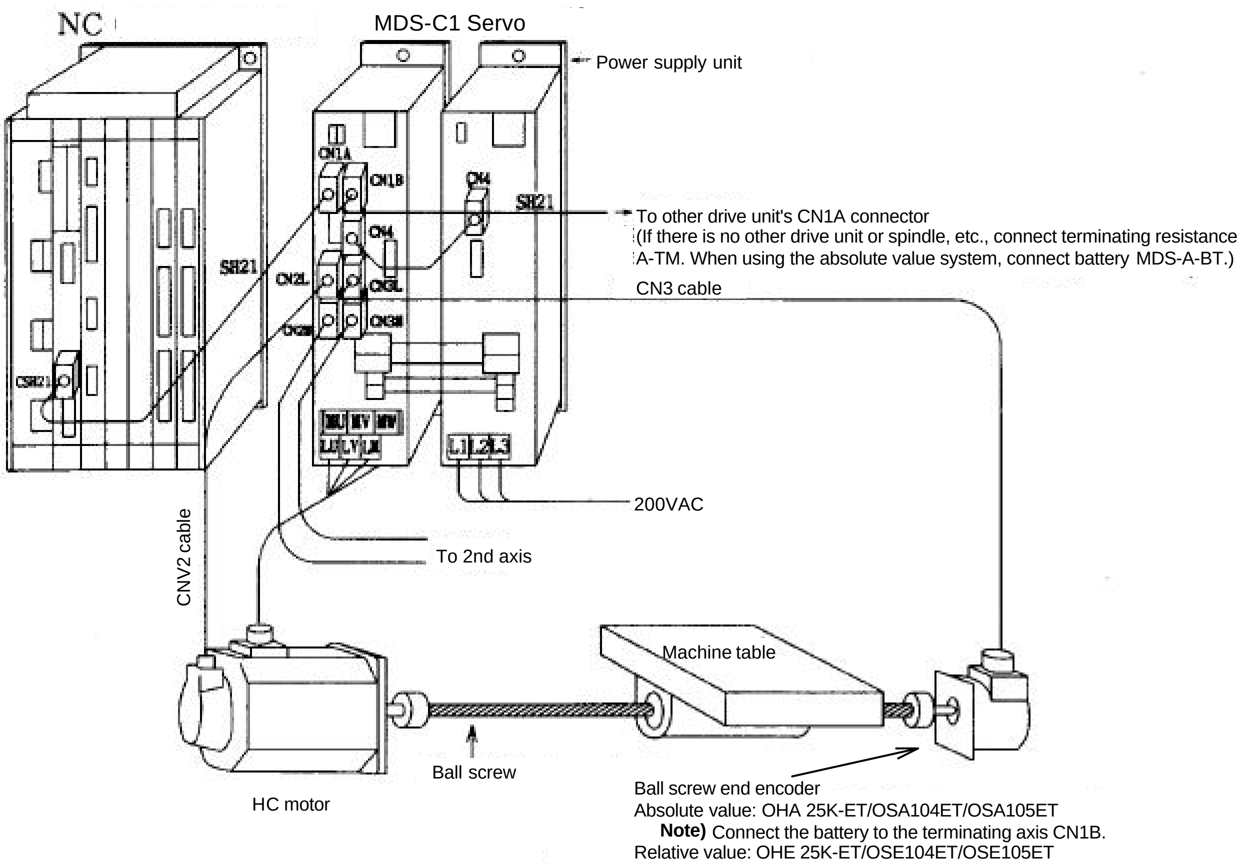
(a) 1-axis servo drive unit



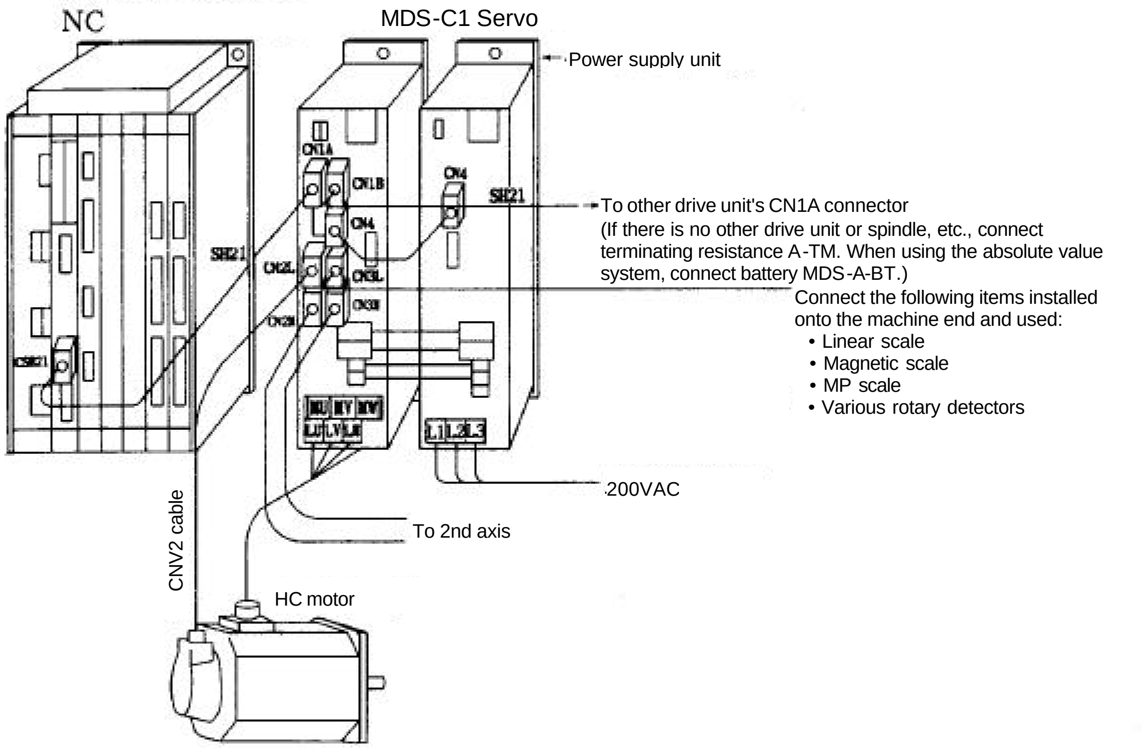
(b) 2-axis servo drive unit



■ Ball screw end position detection system

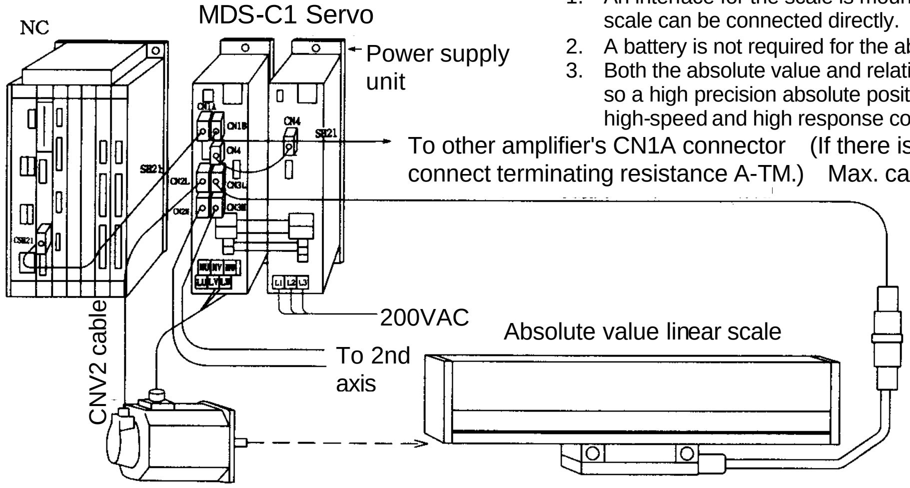


■ Machine end detection system



■ Absolute position linear scale detection system

Features
1. An interface for the scale is mounted as a standard, so the scale can be connected directly.
2. A battery is not required for the absolute value detection.
3. Both the absolute value and relative value signals are detected, so a high precision absolute position detection is possible and high-speed and high response control is possible.



Absolute value linear scale specifications (Contact the maker for details.)

(Note) Refer to "3.1 List of detector specifications".

5.11 D/A output function

5.11.1 Outline

The D/A output function is mounted in the standard system of the MDS Series. Thus, the PCB for analog monitoring required in the conventional digital servo system is not longer required.

5.11.2 Hardware specifications

MDS-C1-VX	
8-bit 0 ~ 5V	
2 channels	
Output pins	CH1 : CN9-9 pin CH2 : CN9-19 pin GND : CN9-1 pin

∗ The 0 level (center) of the data is 2.5V.

5.11.3 Parameters

The data No. and output magnification for each channel is set with the following parameters.

Name	Description
SV061	D/A channel 1 data No.
SV062	D/A channel 2 data No.
SV063	D/A channel 1 output magnification
SV064	D/A channel 2 output magnification

5.11.4 Output data No.

The data to be output to SV061 and SV062 is set. When –1 is set for the output data No., D/A output will not take place at that channel.

No.	CH1		CH2	
	Output data	Unit	Output data	Unit
– 1	D/A output not selected		D/A output not selected	
0	Speed feedback	r/min	Current command	Stall rated current %
1	Current command	Stall rated current %	Current command	Stall rated current %
2	Current command	Stall rated current %	Current command	Stall rated current %
3	Current feedback	Stall rated current %	Current feedback	Stall rated current %
4	Speed feedback low-order	r/min	Speed feedback low-order	r/min
5	Speed feedback high-order	r/min	Speed feedback high-order	r/min
6	Position droop low-order	Interpolation unit	Position droop low-order	Interpolation unit
7	Position droop high-order	Interpolation unit	Position droop high-order	Interpolation unit
8	Position F△T low-order	Interpolation unit/ NC communication cycle	Position F△T low-order	Interpolation unit/ NC communication cycle
9	Position F△T high-order	Interpolation unit/ NC communication cycle	Position F△T high-order	Interpolation unit/ NC communication cycle
10	Position command low-order	Interpolation unit	Position command low-order	Interpolation unit
11	Position command high-order	Interpolation unit	Position command high-order	Interpolation unit
12	Feedback position low-order	Interpolation unit	Feedback position low-order	Interpolation unit
13	Feedback position high-order	Interpolation unit	Feedback position high-order	Interpolation unit
125	Test output saw-tooth wave	± 5V	Test output saw-tooth wave	± 5V
126	Test output rectangular wave	± 5V	Test output rectangular wave	± 5V
127	Test output 0V	± 5V	Test output 0V	± 5V

5.11.5 Setting of output magnification

The output magnification is set in SV063 and SV064. When "256" is set, the magnification will be 1-fold. When the parameter is set to "A", A/256 will be the magnification.
Since the D/A converter input is 7bit excluding the sign bit, fix the magnification parameter A as (Input data) ∗ A/256 ≤ 127. The output polarity will be reversed if a negative value is set.

$$\text{DATA}\ast \boxed{\frac{A}{256}} \rightarrow \boxed{\begin{matrix}\text{D/A}\\ \text{128 division}\end{matrix}} \rightarrow \text{Analog output}$$

A : Parameter setting value

$$\text{Analog output voltage (V)} = \left\{ \text{DATA} \ast \frac{A}{256} \ast \frac{\text{Output max. voltage}}{} \right\} \text{--------}$$

+ Offset voltage

Set the value in { } to the value less than the D/A output max. voltage in the table below.

D/A output max. voltage	Offset voltage
2.5 (V)	2.5 (V)

(Example) Speed feedback

The output value is r/min. Thus, 2000 will be output at a speed of 2000r/min. When the parameter is set to 256 (magnification 1), the D/A output voltage will be 39.06V as shown below, exceeding the D/A output voltage 2.5V.

2000 / 128 ∗ 2.5 (V) = 39.06 (V)

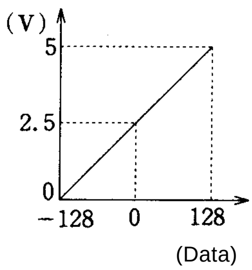
In this case, set the parameter to 16 (magnification 1/16) to obtain the D/A output voltage as shown below.

2000 ∗ 2.5 / (128 ∗ 16) = 2.44 (V)

Thus, the analog output voltage will be 2.94V.

2.44 (V) + 2.5 (V) = 2.94 (V)

Analog output voltage



5.11.6 Others

The D/A output channel has two channels even in the 2-axis servo drive. Thus, set the output No. for the axis not to be observed in the 2-axis servo drive to –1. If the D/A output of each channel is set for both axes, the L-axis data will be output. If –1 is set in the D/A output No. for both axes, the output will be 2.5V.

6. MDS-C1-V2 Servo Drive

6.1 Model configuration

2-axis servo drive unit model designation

MDS – C1 – V2 – [ ][ ]

M-axis servo drive capacity class signal
L-axis servo drive capacity class signal

The power class symbols are the same as for the MDS-C1-V1 servo drive.

Symbol	Capacity	Applicable motor			
		Standard 2000r/min	Standard 3000r/min	Low inertia L-type 2000r/min	Low inertia L-type 3000r/min
01	0.1 kW		HA053 HA13		
03	0.3 kW		HA23N HA33N		
05	0.5 kW	HC52 (HA40N)	HC53 (HA43N)	HA50NL	
10	1.0 kW	HC102 (HA80N)	HC103 (HA83N)	HA100NL	HA53NL (HC103R) (HC153R)
20	2.0 kW	HC152, HC202 (HA100N)	HC153	HA150NL HA200NL	HA103NL HA153NL (HC203R)
35	3.5 kW	HC352 (HA200N)	HC203 (HA103N)	HA300NL	HA203NL (HC353R)
45	4.5 kW	HC452 (HA300N)	HC353 (HA203N)	HA500NL	HA303NL (HC503R)
45S (With specifi-cations limit)	4.5 kW	HC452 * Specification limit: 78% of the motor stall rating	HC353 * Specification limit: 94% of the motor stall rating		
70S (With specifi-cations limit)	7.0 kW	HC702 * Specification limit: 90% of the motor stall rating	HC453 * Specification limit: 82% of the motor stall rating		

6.2 Servo drive unit specifications

		2-axis integrated servo drive unit MDS-C1-V2 Series												
Model	**MDS-C1-V2-**	0101	0301	0303	0501	0503	0505	1003	1005	1010	2010	2020	3510S	3510
Rated output	**[kW]**	0.1+0.1	0.3+0.1	0.3+0.3	0.5+0.1	0.5+0.3	0.5+0.5	1.0+0.3	1.0+0.5	1.0+1.0	2.0+1.0	2.0+2.0	3.5+1.0	3.5+1.0
Output	**Rated voltage [V]**	155VAC												
	Rated current [A]	0.95+0.95	2.9+0.95	2.9+29	3.4+0.95	3.4+2.9	3.4+3.4	6.8+2.9	6.8+3.4	6.8+6.8	13.0+6.8	13.0+13.0	16.0+6.8	16.0+6.8
Input	**Rated voltage [V]**	270-311VDC												
	Rated current [A]	2	4	6	5	7	8	10	11	14	21	28	24	24
Control power supply	**Voltage [V]**	200/200-230VAC												
	Frequen-cy [Hz]	50/60Hz												
	Curren [A]	Max. 0.2A												
Control system		Sine-wave PWM control system/current control system												
Braking		Regeneration braking and dynamic braking												
	Dynamic	Built-in												
Structure		Fully enclosed, self-cooling (Protective degree: IP65, IP67)												
Environ-ment	**Ambient temper [°C]**	Operation: 0 to 55°C (non freezing), Storage/transportation: –15 to 70°C (non freezing)												
	Ambient humidity [%RH]	Operation: 90%RH or less (non condensing), Storage/transportation: 90%RH or less (non condensing)												
	Atmosphere	Indoors (no direct sunlight); no corrosive gas, inflammable gas, oil mist, or dust												
	Eleva-tion [m]	Operation/storage: 1000 meters or less above sea level, Transportation: 10000 meters or less above sea level												
	Vibration/ Impact [m/s^2]	4.9m/s^2 (0.5G)/49m/s^2 (5G)												
Cooling type		Self-cooling									Forced air cooling			
Weight	**[kg]**	2.3									4.5			5.2
Maximum heating value	**[W]**	38	41	43	46	52	62	68	78	96	155	178	190	
Noise		Less than 55dB												

(Note 1) The same capacity drive units with a smaller width are indicated with an "S" at the end of the type. Note that limits will apply to continuous operation.

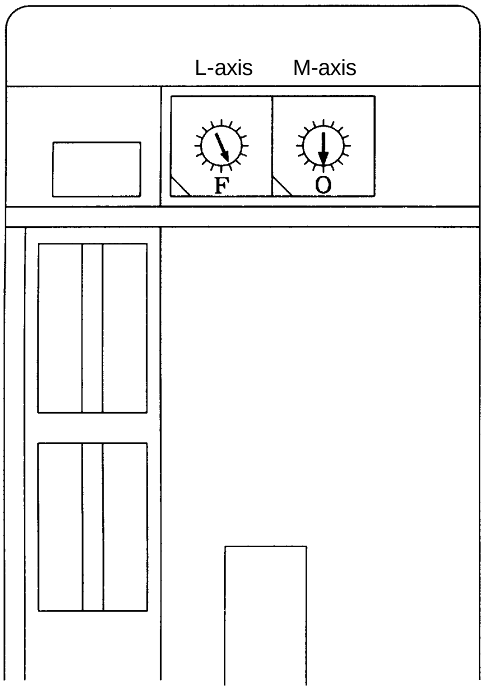
			2-axis integrated servo drive unit MDS-C1-V2 Series												
Model	**MDS-C1-V2-**		3520S	3520	3535	4520	4535	4545	7035	7045	7070S	7070			
Rated output		**[kW]**	3.5+2.0	3.5+2.0	3.5+3.5	4.5+2.0	4.5+3.5	4.5+4.5	7.0+3.5	7.0+4.5	7.0+7.0	7.0+7.0			
Output	**Rated voltage**	**[V]**	155VAC												
	Rated curren	**[A]**	16.0+13.0	16.0+13.0	16.0+16.0	28.0+16.0	28.0+16.0	28.0+28.0	33.5+16.0	33.5+28	33.5+33.5	33.5+33.5			
Input	**Rated voltage**	**[V]**	270-311VDC												
	Rated current	**[A]**	31	31	34	44	47	60	52	64	70	70			
Control power supply	**Voltag**	**[V]**	200/200-230VAC												
	Frequen-cy	**[Hz]**	50/60Hz												
	Curren	**[A]**	Max. 0.2A												
Control system			Sine-wave PWM control system/current control system												
Braking			Regeneration braking and dynamic braking												
	Dynamic		Built-in												
Structure			Fully enclosed, self-cooling (Protective degree: IP65, IP67)												
Environ-ment	**Ambient tempera-ture**	**[°C]**	Operation: 0 to 55°C (non freezing), Storage/transportation: –15 to 70°C (non freezing)												
	Ambient humidity	**[%RH]**	Operation: 90%RH or less (non condensing), Storage/transportation: 90%RH or less (non condensing)												
	Atmosphere		Indoors (no direct sunlight); no corrosive gas, inflammable gas, oil mist, or dust												
	Eleva-tion	**[m]**	Operation/storage: 1000 meters or less above sea level, Transportation: 10000 meters or less above sea level												
	Vibration/ Impact	**[m/s²]**	4.9m/s^2 (0.5G)/49m/s^2 (5G)												
Cooling type			Forced air cooling												
Weight		**[kg]**	4.5	5.2				6.0	6.7		5.9	7.3			
Maximum heating value		**[W]**	213		260	266	307	359	406	459	365	558			
Noise			Less than 55dB												

(Note 1) The same capacity drive units with a smaller width are indicated with an "S" at the end of the type. Note that limits will apply to continuous operation.

	Unit	2-axis drive unit model name MDS-C1-																							
		V2-0101	V2-0301		V2-0303	V2-0501		V2-0503		V2-0505	V2-1005		V2-1010	V2-2010		V2-2020	V2-3510		V2-3510S		V2-3520		V2-3520S		V2-3535
Applicable motor		L/M	L	M	L/M	L	M	L	M	L/M	L	M	L/M	L	M	L/M	L	M	L	M	L	M	L	M	L/M
		HA053N HA13N	HA23N HA33N	HA053 HA13	HA23N HA33N	HC52 HC53 HA50NL (HA40N) (HA43N)	HA053 HA13	HC52 HC53 HA50NL (HA40N) (HA43N)	HA23N HA33N	HC52 HC53 HA50NL (HA40N) (HA43N)	HC102 HC103 HA100NL HA53NL (HA80N) (HA83N) (HC103R) (HC153R)	HC52 HC53 HA50NL (HA40N) (HA43N)	HC102 HC103 HA100NL HA53NL (HA80N) (HA83N) (HC103R) (HC153R)	HC152 HC202 HC153 HA150NL HA200NL HA103NL HA153NL (HA100N) (HC203R)	HC102 HC103 HA100NL HA53NL (HA80N) (HA83N) (HC103R) (HC153R)	HC152 HC202 HC153 HA150NL HA200NL HA103NL HA153NL (HA100N)	HC352 HC203 HA300NL HA203NL (HA200N) (HA103N) (HC353R)	HC102 HC103 HA100NL HA53NL (HA80N) (HA83N) (HC103R) (HC153R)	HC352 HC203 HA300NL HA203NL (HA200N) (HA103N) (HC353R)	HC102 HC103 HA100NL HA53NL (HA80N) (HA83N) (HC103R) (HC153R)	HC352 HC203 HA300NL HA203NL (HA200N) (HA103N) (HC353R)	HC152 HC202 HC153 HA150NL HA200NL HA103NL HA153NL (HA100N) (HC203R)	HC352 HC203 HA300NL HA203NL (HA200N) (HA103N) (HC353R)	HC152 HC202 HC153 HA150NL HA200NL HA103NL HA153NL (HA100N) (HC203R)	HC352 HC203 HA300NL HA203NL (HA200N) (HA103N) (HC353R)
Output voltage	V	155V																							
Rated output current	A	0.95	2.9	0.95	2.9	3.4	0.95	3.4	2.9	3.4	6.8	3.4	6.8	13	6.8	13	16	6.8	16	6.8	16	13	16	13	16
Continuous output current	A	1.4	3.0	1.4	3.0	5.0	1.4	5.0	3.0	5.0	8.8	5.0	8.8	18.2	8.8	18.2	25	8.8	25	8.8	25	18.2	25	18.2	25
Maximum output current	A	3.9	8.1	3.9	8.1	17	3.9	17	8.1	17	28	17	28	42	28	42	57	28	57	28	57	42	57	42	57
Maximum output torque (During combination with motor) Refer to "5.3 Servo drive specifications" for the applicable motor.	N·m	0.68 1.37	2.74 5.59	0.68 1.37	2.74 5.59	11.8 8.82 13.0 (14.2) (10.2)	0.68 1.37	11.8 8.82 13.0 (14.2) (10.2)	2.74 5.59	11.8 8.82 13.0 (14.2) (10.2)	21.6 16.7 20.8 14.2 (25.4) (19.2) (7.95) (11.9)	11.8 8.82 13.0 (14.2) (10.2)	21.6 16.7 20.8 14.2 (25.4) (19.2) (7.95) (11.9)	35.3 41.7 28.4 31.3 31.6 22.4 22.8 (41.9) (15.9)	21.6 16.7 20.8 14.1 (25.4) (19.2) (7.95) (11.9)	35.3 41.7 28.4 31.3 31.6 22.4 22.8 (41.9)	59.8 40.2 51.9 37.0 (59.8) (40.2) (27.8)	21.6 16.7 20.8 14.1 (25.4) (19.2) (7.95) (11.9)	59.8 40.2 51.9 37.0 (59.8) (40.2) (27.8)	21.6 16.7 20.8 14.1 (25.4) (19.2) (7.95) (11.9)	59.8 40.2 51.9 37.0 (59.8) (40.2) (27.8)	35.3 41.7 28.4 31.3 31.6 22.4 22.8 (41.9) (15.9)	59.8 40.2 51.9 37.0 (59.8) (40.2) (27.8)	35.3 41.7 28.4 31.3 31.6 22.4 22.8 (41.9) (15.9)	59.8 40.2 51.9 37.0 (59.8) (40.2) (27.8)

	Unit	2-axis drive unit model name MDS-C1-										
		V2-4520		V2-4535		V2-4545	V2-7035		V2-7045		V2-7070	V2-7070S
		L	M	L	M	L/M	L	M	L	M	L/M	L/M
Applicable motor		HC452 HC353 HA500NL HA303NL (HA300N) (HA203N) (HC503R)	HC152 HC202 HC153 HA150NL HA200NL HA103NL HA153NL (HA100N) (HC203R)	HC452 HC353 HA500NL HA303NL (HA300N) (HA203N) (HC503R)	HC352 HC203 HA300NL HA203NL (HA200N) (HA103N) (HC353R)	HC452 HC353 HA500NL HA303NL (HA300N) (HA203N) (HC503R)	HC702 HC453 HA503NL (HA700N) (HA303N)	HC352 HC203 HA300NL HA203NL (HA200N) (HA103N) (HC353R)	HC702 HC453 HA503NL (HA700N) (HA303N)	HC452 HC353 HA500NL HA303NL (HA300N) (HA203N) (HC503R)	HC702 HC453 HA503NL (HA700N) (HA303N)	HC702 HC453
Output voltage	V	155V										
Rated output current	A	28	13	28	16	28	33.5	16	33.5	28	33.5	33.5
Continuous output current	A	44	18.2	44	25	44	55	25	55	44	55	41
Maximum output current	A	85	42	85	57	85	113	57	113	85	113	113
Maximum output torque (During combination with motor) Refer to "5.3 Servo drive specifications" for the applicable motor.	N·m	87.5 55.9 72.5 60.0 (87.5) (55.8) (39.8)	35.3 41.7 28.4 31.3 31.6 22.4 22.8 (41.9) (15.9)	87.5 55.9 72.5 60.0 (87.5) (55.8) (39.8)	59.8 40.2 51.9 37.0 (59.8) (40.2) (27.8)	87.5 55.9 72.5 60.0 (87.5) (55.8) (39.8)	120 79.8 78 (120) (80)	59.8 40.2 51.9 37.0 (59.8) (40.2) (27.8)	120 79.8 78 (120) (80)	87.5 55.9 72.5 60.0 (87.5) (55.8) (39.8)	120 79.8 78 (120) (80)	120 79.8

6.3 Hardware setting



Function	Setting	Meaning
Axis No. setting CS	0	1st axis
	1	2
	2	3
	3	4
	4	5
	5	6
	6	7
	7 ~ E	Not usable
	F	Not used axis selection

The servo drive axis No. can be set by opening the upper lid (at the right of the LED status display window) on the top of the MDS-C1-V2 servo drive unit, and turning the rotary switch. When the rotary switch is set to "F" and the servo drive power is turned on, that axis will not be controlled. Thus, set axes that are not being used to "F". (The communication with the NC will not take place during initialization, and an alarm will not occur.)

6.4 Status display

⚠ WARNING
1. Do not operate the switches with wet hands. Failure to observe this could lead to electric shocks. 2. Do not operate the unit with the front cover removed. The high voltage terminals and charged sections will be exposed, and could lead to electric shocks. 3. Do not open the front cover while the power is ON or during operation. Failure to observe this could lead to electric shocks.

⚠ CAUTION
1. Check and adjust each program and parameter before starting operation. Failure to do so could lead to unforeseen operation of the machine. 2. Do not touch the fin on the servo drive unit, regenerative resistor or servomotor, etc., while the power is turned ON or immediately after turning the power OFF. These parts may reach high temperatures, and can cause burns.

The state is displayed on the servo drive display with codes and the data is transferred to the NC side.

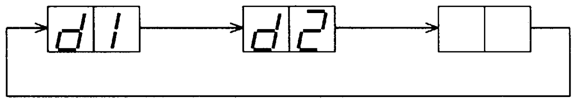
Display	Status	Description
AA	INITIALIZE	Waiting for NC power start up (NC power ON → OFF).
Ab	INITIALIZE	Waiting for NC power start up (When the drive unit power is turned OFF and ON and the NC power is OFF)
AC	INITIALIZE	Requesting parameter transfer
Ad	INITIALIZE	Waiting for parameter transfer
AE	INITIALIZE	Waiting for main servo IT start
b#	READY OFF	Ready OFF
c#	SERVO OFF	Servo OFF
d#	SERVO ON	Servo ON
F# → 9∗	WARNING	Warning being generated
F# → E∗	WARNING	Warning being generated
F# → ∗∗	ALARM	Alarm being generated

: Axis number
∗ : Warning number
∗∗ : Alarm number (Refer to servo alarm and warning)

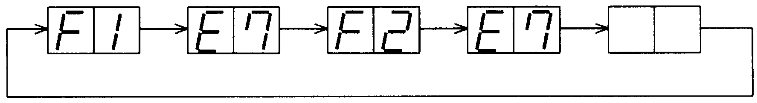
Examples of MDS-C1-V2 drive unit status displays

We will assume that the L-axis is the 1st axis and the M-axis is the 2nd axis.

(Example 1) Display when both L-axis and M-axis are in servo ON state.

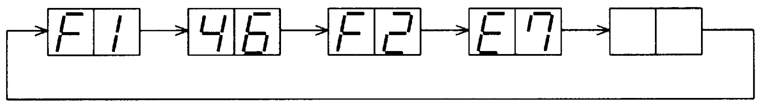


(Example 2) Display when both L-axis and M-axis are in emergency stop state.



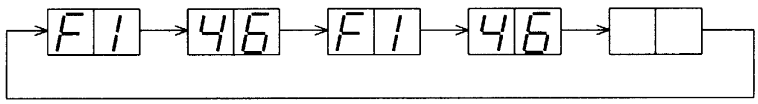
(Example 3) Display when the MOTOR OVERHEAT ALARM (46) occurred in the L-axis.

The alarm flickers.

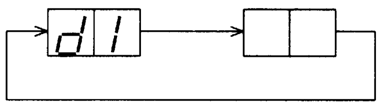


(Example 4) State when the M-axis changeover rotary switch is set to "F" and the MOTOR OVERHEAT ALARM (46) occurred in the L-axis.

The alarm flickers.

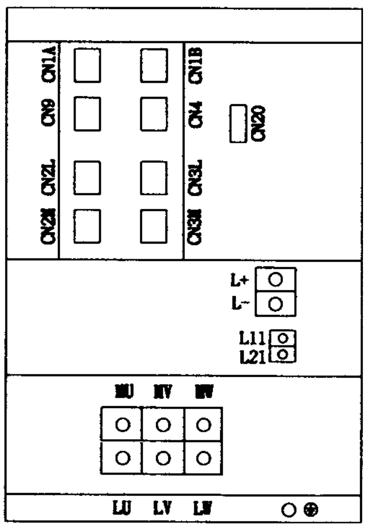


(Example 5) Display when M-axis is set to "F" and the L-axis is in the servo ON state.



6.5 Explanation of terminal block and connectors

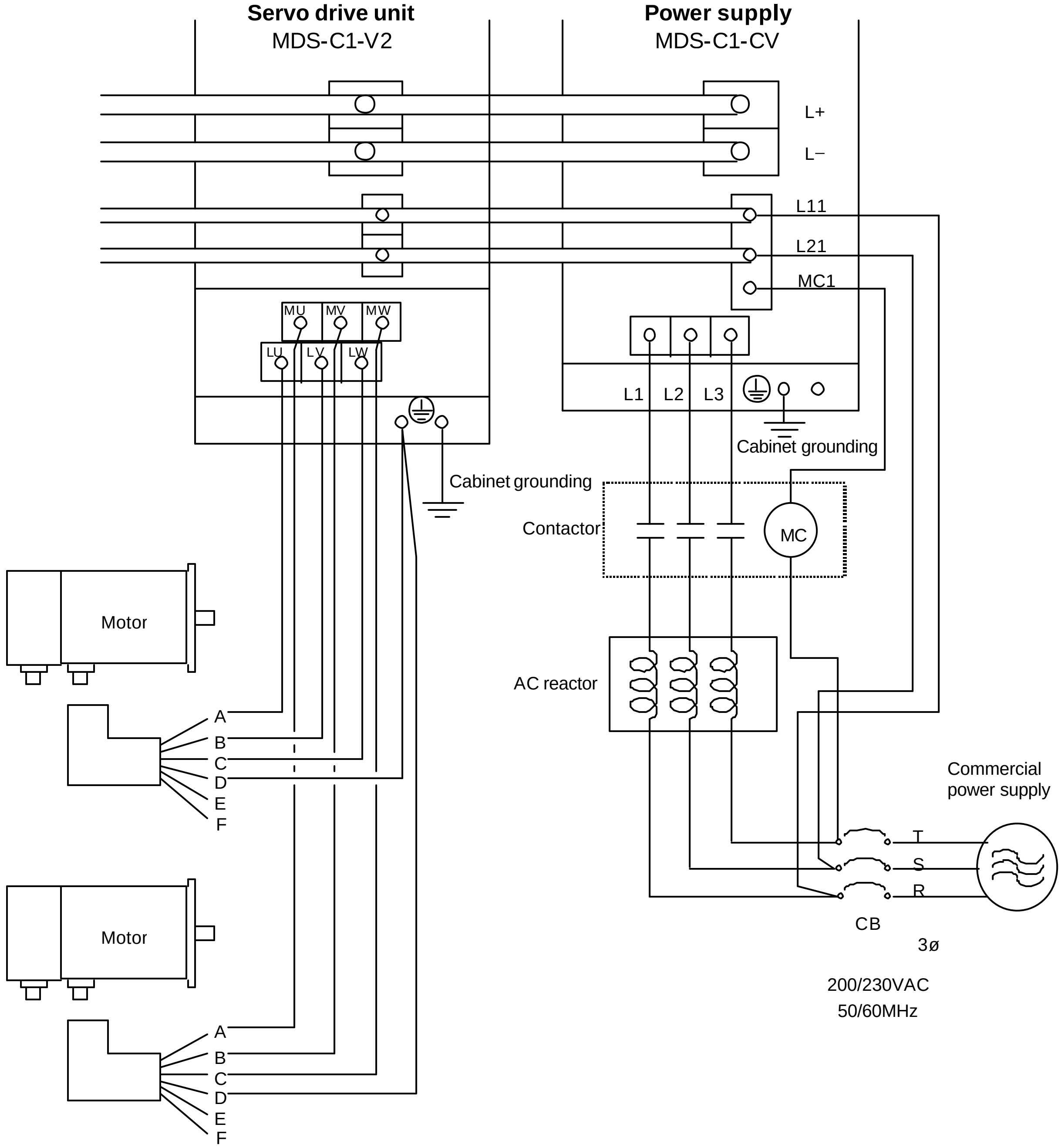
		Name	Application	Remarks
Connector		CN1A CN1B CN9 CN4 CN2L CN3L CN2M CN3M CN20	For connection with NC and high-order axis For connection with battery unit and low-order axis For maintenance (not used normally) For connection with power supply unit For connection with L-axis motor end detector For connection with L-axis machine end detector For connection with M-axis motor end detector For connection with M-axis machine end detector External brake output contact point	
Terminal block	TE2	L+ L–	Converter voltage input (+) Converter voltage input (–)	
	TE3	L11 L21	200VAC single-phase input	
	TE1	MU MV MW LU LV LW ⏚	U-phase output for M-axis motor drive V-phase output for M-axis motor drive W-phase output for M-axis motor drive U-phase output for L-axis motor drive V-phase output for L-axis motor drive W-phase output for L-axis motor drive Ground	



6.6 Main circuit connection

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

⚠ CAUTION
1. Correctly connect the output side (terminals U, V, W). Failure to do so could lead to abnormal operation of the servomotor. 2. 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.



Precautions for connections

(1) The wires and crimp terminals will differ according to the capacity.
(Refer to "8.5 Selection of wire size in the Chapter I Servo/Spindle System Configuration Section".)
(2) Always ground the power supply.
(3) The phase order of the power supply unit's power supply terminals L1, L2, L3 is random.
(4) Precautions for connecting servo drive terminals U, V, W
  a. Always observe the phase order for the servo drive terminals U, V, W and motor side pins A, B, C. The motor may vibrate and rotate suddenly if the phase order is mistaken. <u>The phases cannot be reversed for reverse rotation</u>.
  b. Never perform connections that might apply the power on the servo drive output terminals U, V, W. The servo drive may be damaged.
  c. Never ground the servo drive output terminals U, V, W or connect so that grounding may occur. The servo drive may be damaged.
  d. Do not reverse the connections for the servo drive output terminals L-axis (LU, LV, LW) and M-axis (MU, MV, MW). Make sure that the following is established: L-axis motor capacity ≥ M-axis motor capacity.
(5) The Cannon plug used will differ according to the motor. Refer to section "2.9 (3)" for the connection drawing of the brake exciter circuit for motor with electromagnetic brake. Refer to section "2.8 (2)" for the terminal box type motor.
(6) Refer to the "I. Servo/Spindle System Configuration Section" for the selection of the contactor, AC reactor and Circuit Breaker connected to the power supply.
(7) Make sure that the specified power is supplied to the servo drive power terminals (L1, L2, L3). If the power does not have the specified voltage, use a transformer.
(8) Do not directly apply commercial power on the motor.
(9) Check once again that the wires are connected correctly as indicated in the wiring diagram.

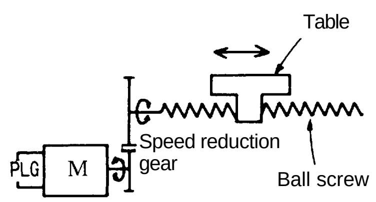
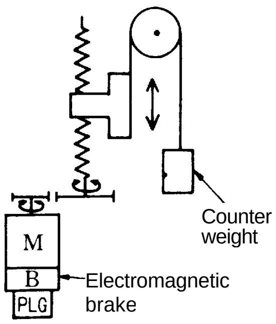
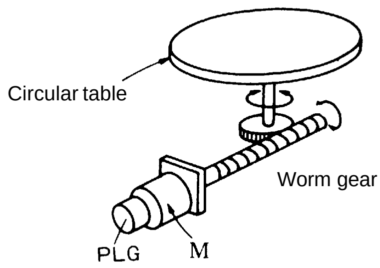
7. Selection of Capacity

7.1 Selection of servo system

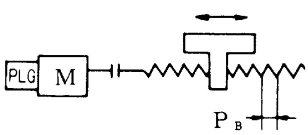
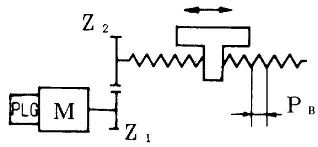
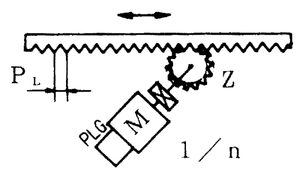
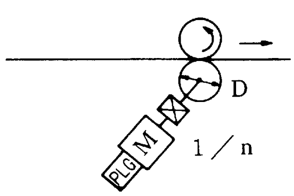
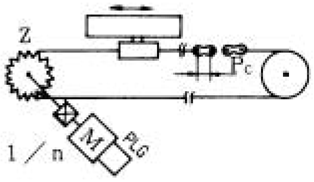
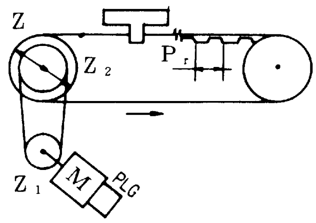
7.1.1 Types of drive systems

Examples of the drive system format are shown below.

Types of motion directions

Linear		3. Rotating
1. Horizontal	**2. Vertical**	
		

Type of drive systems

Drive systems	1. Ball screw (direct connection)	2. Ball screw (gear linkage)	3. Rack and pinion
			
Moving amount per motor rotation	$\Delta S = P_B$	$\Delta S = P_B \bullet \frac{Z_1}{Z_2} = P_B \bullet \frac{1}{n}$	$\Delta S = P_L \bullet Z \bullet \frac{1}{n}$
Drive systems	**4. Roll feed**	**5. Chain drive (direct connection)**	**6. Chain and timing belt drive**
			
Moving amount per motor rotation	$\Delta S = \pi \bullet D \bullet \frac{1}{n}$	$\Delta S = P_c \bullet Z \bullet \frac{1}{n}$	$\Delta S = P_r \bullet Z \bullet \frac{Z_1}{Z_2} = P_r \bullet Z \bullet \frac{1}{n}$

7.1.2 Selection of servomotor

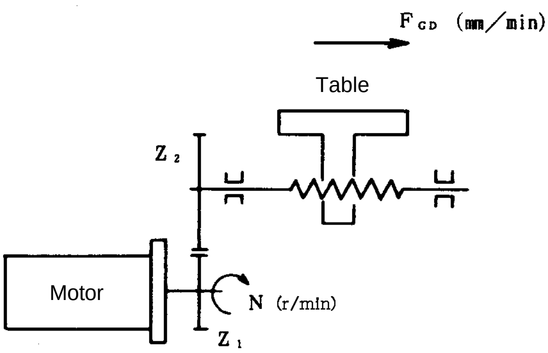
Select a motor that satisfies the following five items so that the performance of the AC servo system can be brought out to the fullest.

(1) Maximum speed

The motor speed during rapid traverse must be within the motor's maximum speed.

$\boxed{N_{max} \geq N}$ Nmax : Motor maximum speed

If the drive system is the gear linkage ball screw, calculate the motor speed with the following equation, and confirm that the calculated value is less than the motor's maximum speed. Note that the maximum speed may be restricted by the detector.

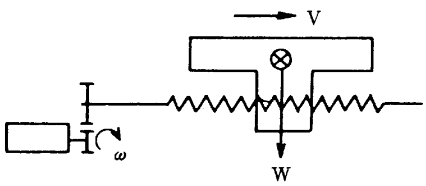
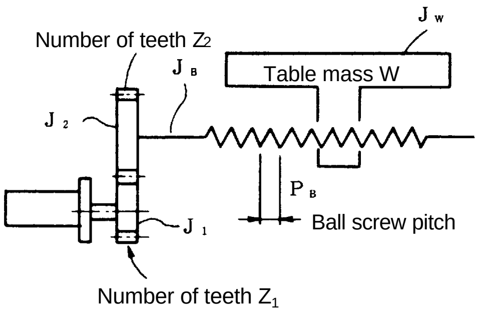
Configuration on machine side	Calculation equation
	$N = \frac{F_{GO}}{P_B} \times n \leq N\ max$ Nmax : Motor maximum speed (r/min) N : Motor speed (r/min) F_{GO} : Rapid traverse rate (mm/min) P_B : Feed screw pitch (mm/rev) n : Drive gear ratio Z_1 : Number of gear teeth on motor shaft Z_2 : Number of gear teeth on feed screw shaft n : $\frac{\text{Motor speed}}{\text{Feed screw speed}} = \frac{Z_2}{Z_1}$

(2) Motor shaft conversion load inertia

The load inertia should be within 2.5 times the motor inertia. Use is possible if it exceeds 2.5 times, but the servo adjustment range will be reduced, and the time constants must be increased.

$$\boxed{J_M \times 2.5 \geq J_L}$$

J_L : Maximum load inertia (motor shaft conversion) [$\times 10^{-4}$kg·m^2]
J_M : Motor inertia [$\times 10^{-4}$kg·m^2]
J_M : Find the motor inertia from the motor data sheet. When using the brakes, add the brake inertia.
J_L : Obtain the maximum load inertia with the following equation. The example shows the ball screw drive system.

Item	Configuration on machine side	Calculation equation
Load inertia of substance linearly moved (Motor shaft conversion)		$J_L = W \cdot \left[\frac{10V}{60\omega}\right]^2 = W \cdot \left[\frac{10V}{2\pi N}\right]^2$ $= W \cdot \left[\frac{P}{2\pi \times 10}\right]^2$ where J_L : Load inertia ($\times 10^{-4}$kg·m^2) V : Speed of substance linearly moved (mm/min) ω : Angular speed of motor (rad/s) N : Motor speed (r/min) P : Moving amount of substance linearly moved per motor rotation (mm) W : Mass of substance linearly moved (kg)
Example of calculating load inertia		$J_L = J_1 + \left[\frac{Z_1}{Z_2}\right]^2 (J_2 + J_B + J_W)$ $= J_1 + \left[\frac{Z_1}{Z_2}\right]^2 \left\{ J_2 + J_B + W \cdot \left[\frac{P_B}{2\pi \times 10}\right]^2 \right\}$ where J_L : Load inertia ($\times 10^{-4}$kg·m^2) J_1 : Pinion inertia ($\times 10^{-4}$kg·m^2) J_2 : Gear inertia ($\times 10^{-4}$kg·m^2) J_B : Ball screw inertial ($\times 10^{-4}$kg·m^2) J_W : Inertia adjacent to ball screw on table ($\times 10^{-4}$kg·m^2) P_B : Ball screw pitch (mm) W : Table mass (kg) Z_1 : Number of gear teeth on motor shaft Z_2 : Number of gear teeth on feed screw shaft

(3) Acceleration/deceleration torque

The acceleration/deceleration torque should be within 80% of the driver unit's maximum output torque. The following calculation equation is used for the acceleration/deceleration torque regardless of the index acceleration or linear acceleration.

$$T_A\max \times 0.8 \geq \frac{2\pi N\,(J_L + J_M)\times 10^{-4}}{60T_S} + T_F$$

N	:	Motor speed during rapid traverse [r/min]
T_S	:	Acceleration/deceleration time constant during rapid traverse [s]
T_F	:	Motor conversion load torque during rapid traverse [N·m]
$T_A$max	:	Driver unit maximum output torque (when used in combination with motor) [N·m]
$T_A$max	:	Find the driver unit maximum output torque from the servo drive unit specifications.

(4) Continuous effective load torque

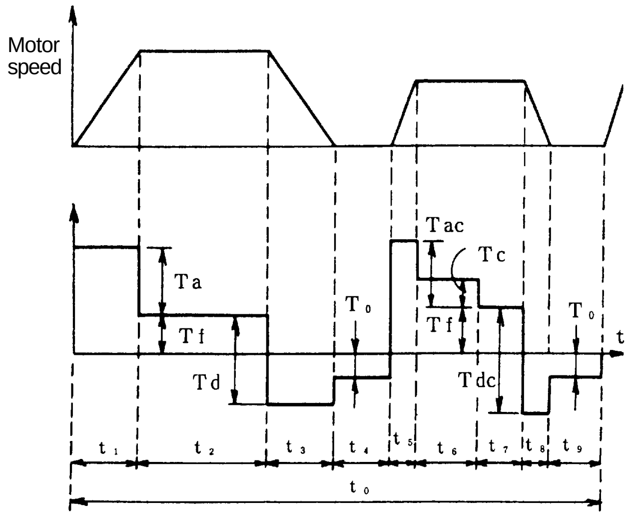
The continuous effective load torque should be within 80% of the motor rated torque (during normal stall).

$$T_{MS} \times 0.8 \geq \mathrm{Trms}$$

T_{MS}	:	Motor rated torque [N·m]
Trms	:	Continuous effective load torque [N·m]

The continuous effective load torque is calculated as shown below from the machine's operation pattern.

Operation pattern



Calculation equation

$$\mathrm{Trms} = \sqrt{\frac{X}{to}}$$

$$X = (Ta + Tf)^2 t_1 + Tf^2 t_2 + (Td - Tf)^2 t_3 + To^2 t_4 + (Tac + Tf)^2 t_5 + (Tc + Tf)^2 t_6 + Tf^2 t_7 + (Tdc - Tf)^2 t_8 + To^2 t_9$$

where

Trms	: Continuous effective load torque [N·m]
Ta	: Acceleration torque [N·m]
Td	: Deceleration torque [N·m]
Tf	: Frictional load torque [N·m]
To	: Load torque in stop state [N·m]
Tac	: Acceleration torque in cutting state [N·m]
Tdc	: Deceleration torque in cutting state [N·m]
Tc	: Cutting torque [N·m]

However, if the cutting maximum torque and maximum duty (%) are known, the selection conditions can be found easily with the following equation.

$$T_{MS} \times 0.8 \geq Trms = Tc\sqrt{\frac{D}{100}}$$

T_{MS}	:	Motor rated torque [N·m]
Trms	:	Continuous effective torque [N·m]
Tc	:	Operational maximum torque [N·m]
D	:	Maximum duty [%]

(5) Duty ON time

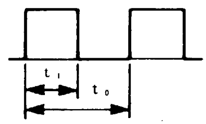
The maximum duty ON time should be within the tolerable time listed in the motor data sheet. However, this does not need to be checked if the cutting maximum torque is less than the rated torque of 100%.

$$T_{LOn} \leq T_{MOn}$$

T_{LOn}	:	ON time of maximum duty [min] (machine manufacturer specification)
T_{MOn}	:	ON time of motor tolerable duty [min] (data sheet)

Example)

In HA23N, when the maximum cutting torque Tc is 1.37 [N·m] and the duty D is 40 [%], the ON time of the tolerable duty becomes:



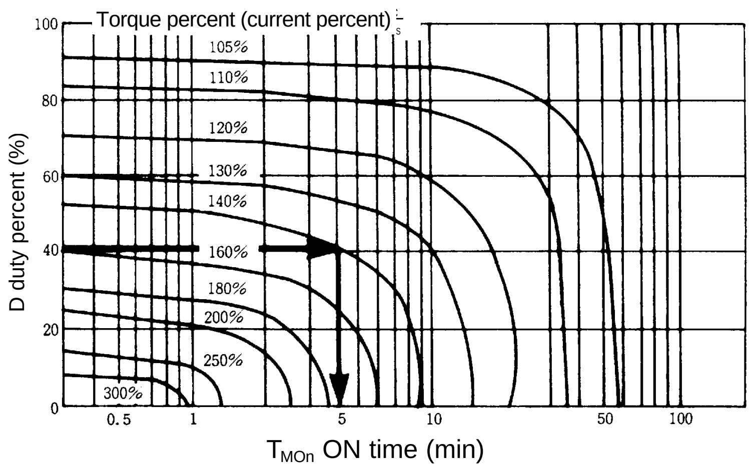
Torque percent = $\frac{1.37}{0.98}$ = 1.4 → 140%

From the chart, T_{MOn} = 5 [min]

Duty percent = $\frac{t_1}{t_0} \times 100\%$

t_1 : ON time (min)

HA23/t   th = 20.25min



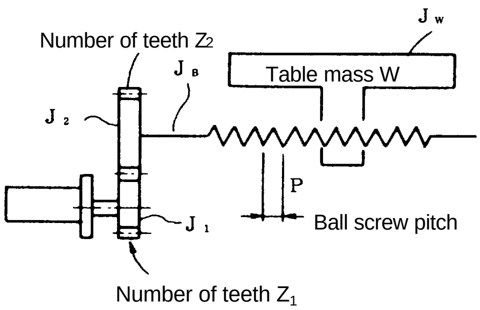
(6) Unbalance load torque

The unbalance load torque must be kept to within 50% of the motor rated torque (at normal stall).

$$\boxed{T_{MS} \times 0.5 \geq To}$$

T_{MS} : Motor rated torque [kg•cm]
To : Unbalance load torque when stopped

(7) Example of selection



When the following data is known for the above drive system:

Gear ratio	N = 3/5
Ball screw pitch	P = 10mm
Rapid traverse rate	F = 12000mm/min
Table mass	W = 170kg
Ball screw inertia	$J_B = 7.45\times10^{-4}$kg·m^2
Gear inertia	$J_2 = 45.11\times10^{-4}$kg·m^2
Pinion inertia	$J_1 = 6.28\times10^{-4}$kg·m^2
Motor shaft conversion torque during rapid traverse	T_F = 2.94N·m
Motor shaft conversion torque during maximum cutting	T_C = 31.58N·m
Maximum cutting duty	D = 20%

The motor maximum speed is :

$$12000 \times \frac{1}{10} \times \frac{5}{3} = 2000 \text{ r/min}$$

The motor shaft conversion load inertia is:

$$J_L = J_1 + N^2 \bullet \left\{ J_2 + J_B + W\left(\frac{P}{2\pi\times10}\right)^2 \right\} = 180.22\times10^{-4}\text{kg}\cdot\text{m}^2$$

Thus, the motor inertia J_M must satisfy the following:

$$J_M \geq \frac{J_L}{2.5} = 72.09\times10^{-4}\text{kg}\cdot\text{m}^2$$

From this, HA200N (inertia = 131.0×10^{-4}kg·m^2) can be selected.
The maximum torque Tmax during acceleration/deceleration is :

$$Tmax = \frac{2\pi N\,(J_L + J_M) \times 10^{-4}}{60T_s} + T_F$$

$$= \frac{6.52}{T_s} + 2.94$$

The drive unit that corresponds to HA200N is ~~A~~V1-35, and the drive unit's maximum output torque is 59.820N·m (TAmax) as found in the drive unit specifications.

From TAmax $\times$ 0.8 $\geq$ Tmax :

$$47.86 \geq \frac{6.52}{T_s} + 2.94$$

Therefore, Ts $\geq$ 145ms

Thus, the rapid traverse acceleration/deceleration time constant is 150ms:
The continuous effective load torque Trms is :

$$Trms = Tc\sqrt{\frac{D}{100}}$$

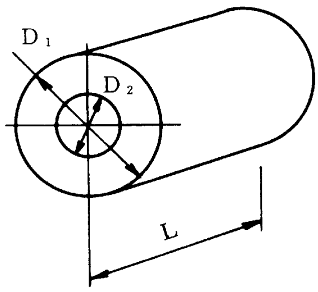
$$= 31.58\sqrt{\frac{20}{100}}$$

$$= 14.12$$

The rated torque T_{MS} for HA200N is 22.6N·m.
So the $T_{MS} \times 0.8 \geq$ Trms conditions are satisfied.
The maximum cutting torque Tc (31.58N·m) is 140% of the rated torque (22.6N·m), so the duty cycle ON time is 40 minutes or longer from the HA200N characteristic graph.
Thus, it can be seen that the V1-35 and motor HA200N are compatible.

(8) Reference

1. Calculation of load inertia

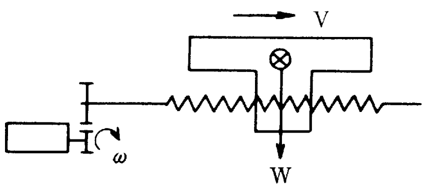
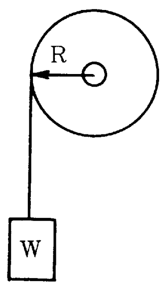
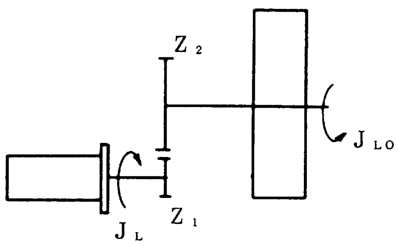
Item	Configuration on machine side	Calculation equation
Cylinder load inertia		$J_L = \frac{\pi \cdot \rho \cdot L}{32} (D_1^4 - D_2^4)$ $= \frac{W}{8} (D_1^2 + D_2^2)$ where J_L : Load inertia ($\times 10^{-4}$kg·m^2) ρ : Specific gravity (kg/m^3) L : Length of cylinder (cm) D_1 : Outer diameter of cylinder (cm) D_2 : Inner diameter of cylinder (cm) W : Mass (kg) Specific gravities of materials Steel : 7.8×10^{-3}kg/cm^3 Aluminum : 2.7×10^{-3}kg/cm^3 Copper : 8.96×10^{-3}kg/cm^3

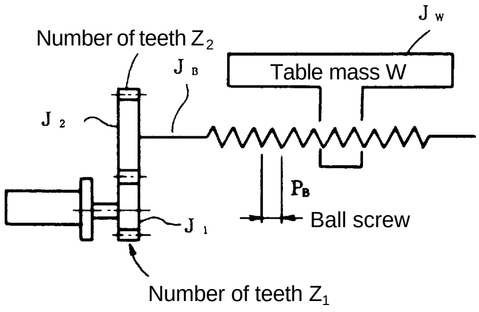
Although the inertia is expressed by inertia moment, or GD^2, their concept is the same. In this chapter, the relation of the moment of inertia and GD^2 is as follows for convenience.

Inertia moment (J kg·m^2) = (mass kg) $\times$ (rotation radius m)^2

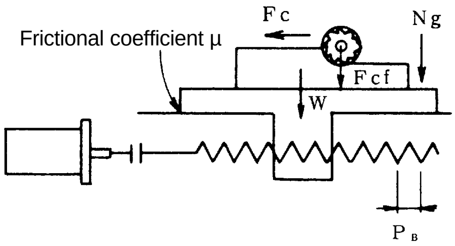
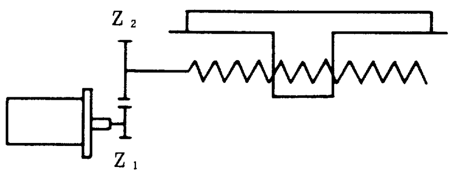
GD^2 (GD^2 kg·m^2) = (mass kg) $\times$ (rotation diameter m)^2

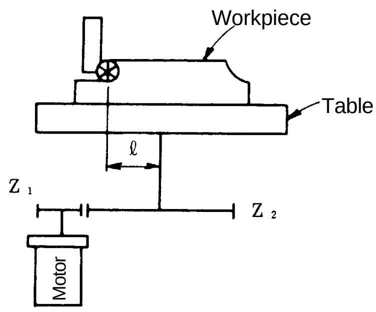
Conversion equation of J and GD^2 $J = \frac{GD^2}{4}$

Item	Configuration on machine side	Calculation equation
Load inertia of substance linearly moved (Motor shaft conversion)		$J_L = W \cdot \left[\frac{10V}{60\omega}\right]^2 = W \cdot \left[\frac{10V}{2\pi N}\right]^2$ $= W \cdot \left[\frac{P}{2\pi \times 10}\right]^2$ where J_L : Load inertia ($\times 10^{-4}$kg·m^2) V : Speed of substance linearly moved (mm/min) ω : Angular speed of motor (rad/s) N : Motor speed (r/min) P : Moving amount of substance linearly moved per motor rotation (mm) W : Mass of substance linearly moved (kg)
Load inertia of substance lifted up		$J_L = W \cdot R^2 + J_P$ where J_L : Load inertia ($\times 10^{-4}$kg·m^2) J_P : Inertia of pulley ($\times 10^{-4}$kg·m^2) R : Radius of pulley (mm) W : Mass of substance linearly moved (kg)
Load inertia J_{LO} is decelerated (accelerated) and connected to motor shaft		$J_L = \left[\frac{Z_1}{Z_2}\right]^2 \times J_{LO}$ where J_L : Load inertia ($\times 10^{-4}$kg·m^2) (Motor shaft conversion) J_{LO} : Load inertia at rotation center of rotating substance ($\times 10^{-4}$kg·m^2) Z_1 : Number of gear teeth on motor shaft side Z_2 : Number of gear teeth on deceleration (acceleration) side

Item	Configuration on machine side	Calculation equation
Example of calculating load inertia	 	$J_L = J_1 + \left[\frac{Z_1}{Z_2}\right]^2 (J_2 + J_B + J_W)$ $= J_1 + \left[\frac{Z_1}{Z_2}\right]^2 \left\{ J_2 + J_B + W \cdot \left[\frac{P_B}{2\pi\times10}\right]^2 \right\}$ where J_L : Load inertia ($\times10^{-4}$kg·m^2) J_1 : Pinion inertia ($\times10^{-4}$kg·m^2) J_2 : Gear inertia ($\times10^{-4}$kg·m^2) J_B : Ball screw inertial ($\times10^{-4}$kg·m^2) J_W : Inertia adjacent to ball screw on table ($\times10^{-4}$kg·m^2) P_B : Ball screw pitch (mm) W : Table mass (kg) Z_1 : Number of gear teeth on motor shaft Z_2 : Number of gear teeth on feed screw shaft

2. Example of load torque calculation

Item	Configuration on machine side	Calculation equation
Load torque of machine linearly moved (motor shaft conversion)	 	$T_L = \frac{F \cdot P}{2\times10^3 \cdot \pi\eta} + T_F$ where T_L : Motor shaft conversion load torque (N・m) F : Axial force of machine linearly moved (N) P : Movement of machine per motor rotation (mm/rev) η : Ball screw efficiency T_F : Motor shaft conversion frictional load torque (N・m)
	• When a drive gear is used:  	$T_L = \frac{F \cdot P_B}{2\times10^3\pi\eta} \cdot \frac{Z_1}{Z_2} + T_F$ where T_L : Load torque converted into motor shaft (N・m) F : Axial force of machine linearly moved (N) P_B : Ball screw pitch (mm/rev) η : Efficiency of ball screw and drive gear Z_1,Z_2 : Number of drive gear teeth T_F : Load torque converted into motor shaft (N・m) F = Fc + μ (W + Ng + Fcf) where Fc : Axial component force in cutting state (N) W : Full mass of table (kg) Ng : Gib tightening force on table guide surface (kg) Fcf : Component force perpendicular to shaft in cutting state (back component) (kg) μ : Dynamic friction coefficient

<table>
<tr><th>Item</th><th>Configuration on machine side</th><th>Calculation equation</th></tr>
<tr><td>Load torque of rotating machine (motor shaft conversion)</td><td>
</td><td>$T_L = F \cdot \frac{\lambda}{10^3} \cdot \frac{Z_1}{Z_2} \cdot \frac{1}{\eta} + T_F$

where
T_L : Motor shaft conversion load torque (N·m)
F : Tangential direction force of rotating machine (N)
λ : Distance from rotation center to working point of F (mm)
Z_1 : Number of gear teeth on motor side
Z_2 : Number of gear teeth on table side
η : Efficiency of drive system
T_F : Motor shaft conversion frictional load torque (N·m)</td></tr>
</table>

Precautions for calculating load torque

(1) The maximum value of the load torque should be selected in the actual machine operation state. When the selected load torque is actually smaller than that used, an overload may occur.

(2) When the machine table is separated from the cutting position, the frictional load torque may be momentarily varied by the cutting force on the table guide surface.

7.2 Determining the coasting amount with emergency stop

When the system detects an abnormality, the machine's motor is stopped by a dynamic brake. The coasting amount of the machine can be obtained by the following equation.

$$Lmax = \frac{F_{GO} \times 10^3}{60} \left\{ 0.03 + (AN^2 + B)\left(1 + \frac{J_L}{J_M}\right) \times 1.1 \right\}$$

where

- Lmax : Coasting amount of machine (mm)
- F_{GO} : Feedrate (rapid traverse) (m/min)
- N : Motor speed (maximum speed) (r/min)
- A : Coefficient (see the following table)
- B : Coefficient (see the following table)
- J_L : Motor shaft conversion load inertia ($\times 10^{-4}$kg·m^2)
- J_M : Motor shaft rotor inertia ($\times 10^{-4}$kg·m^2)

Note : Lmax deviates for ±10% depending on the induced voltage constant.

Motor model	Motor inertia $J_M \times 10^{-4}$kg·m^2	Coefficients A	Coefficients B
HA053	0.18	0.13×10^{-9}	13.18×10^{-3}
HA13	0.36	0.15×10^{-9}	8.39×10^{-3}
HA23N	0.98	0.25×10^{-9}	6.66×10^{-3}
HA33N	1.96	0.39×10^{-9}	4.28×10^{-3}
HA40N	9.8	2.07×10^{-9}	11.47×10^{-3}
HA43N	9.8	1.79×10^{-9}	13.48×10^{-3}
HA80N	19.6	1.77×10^{-9}	9.73×10^{-3}
HA83N	19.6	1.44×10^{-9}	12.54×10^{-3}
HA100N	68.6	4.82×10^{-9}	16.68×10^{-3}
HA103N	68.6	3.87×10^{-9}	27.72×10^{-3}
HA200N	131.0	2.65×10^{-9}	22.61×10^{-3}
HA203N	131.0	1.24×10^{-9}	49.97×10^{-3}
HA300N	192.0	1.71×10^{-9}	31.05×10^{-3}
HA700N	254.0	1.31×10^{-9}	37.84×10^{-3}
HA900N	319.0	1.39×10^{-9}	44.01×10^{-3}
HA303N	192.0	0.68×10^{-9}	62.16×10^{-3}
HA703N	254.0	0.69×10^{-9}	73.15×10^{-3}
HA50NL	2.75	2.31×10^{-9}	2.56×10^{-3}
HA100NL	5.49	2.04×10^{-9}	2.92×10^{-3}
HA150NL	8.24	3.54×10^{-9}	3.26×10^{-3}
HA200NL	19.6	1.90×10^{-9}	6.56×10^{-3}
HA300NL	29.4	1.88×10^{-9}	6.42×10^{-3}
HA500NL	88.3	2.12×10^{-9}	19.40×10^{-3}
HA53NL	2.7	1.57×10^{-9}	3.17×10^{-3}
HA103NL	5.5	1.16×10^{-9}	3.85×10^{-3}
HA153NL	8.2	0.89×10^{-9}	4.81×10^{-3}
HA203NL	19.6	1.17×10^{-9}	7.46×10^{-3}
HA303NL	29.4	1.04×10^{-9}	9.58×10^{-3}
HA503NL	88.3	1.32×10^{-9}	26.25×10^{-3}
HA-LH11K2-S1	118.0	2.31×10^{-9}	11.32×10^{-3}
HA-LH15K2-S1	290.0	3.73×10^{-9}	20.36×10^{-3}

IV. MDS-C1-SP

Spindle System Section

1. Outline

1.1 Features of the MDS-C1-SP spindle system

(1) The converter that was conventionally built into the spindle controller has been installed in the unit (MDS-C1-SP), and can be used commonly with the other axis drive units.
This allows great reductions in size and weight.
(2) The speed response has been improved by using a high-speed CPU, and the cutting performance and cutting precision during positioning control has been improved.
(3) A high-speed orientation method that allows direct orientation from high-speeds has been incorporated allowing smooth operations and minimum orientation times.
(4) All spindle parameters can be set from the NC CRT screen thus enhancing the operability.

1.2 Precautions for use

(1) The motor rated output is guaranteed with the controller rated input voltage (200/220/230VAC). The rated output may not be achieved if the input voltage fluctuates and drops to 200VAC or less.
(2) A harmonic chopper voltage that is PWM controlled is applied on the motor so a harmonic leakage current will flow during motor operation.
If a general-purpose leakage breaker is used, the operation may malfunction due to this harmonic, so use a leakage breaker for inverters. (Refer to the Maintenance Manual BNP-B2046 for details.)
(3) A harmonic leakage current will also flow to the grounding wire between the motor and controller, and if this grounding wire is placed near the NC CRT screen, the CRT screen may malfunction due to the magnetic field of the leakage current.
Separate the grounding wire and NC CRT screen as far as possible.
(4) Noise may occur in AM radio broadcasts due to the electromagnetic wave noise generated from the motor and controller.
Separate radios and the motor and controller as far as possible.
A filter for radio noise measures is available as an option, so use one if necessary.

1.3 Model configuration

<table>
<tr>
<td>Motor</td>
<td>
SJ — [ ] 5.5 A [ ] [ ] [ ]

Name for AC spindle motor series

Motor type
None: Mid-large capacity
N : Small capacity
V : Small size mid-large capacity

15 min. (or 30 min.) rated output capacity (kW)

Basic speed
A : 1500r/min
B : 1150r/min
L : 5000r/min
X : Special speed

Special specification
H : High-speed type
Z : Special max. speed
W : Wide range constant output

M : With Z-phase

(Note) Refer to the separate Built-in Motor Standard Specifications (BFN-14118-04) for details on the built-in motor models.
</td>
</tr>
<tr>
<td>Controller</td>
<td>
MDS-C1-SP (H) — [ ] [ ]

Name for AC spindle inverter (Spindle drive unit)

Motor max. speed When 1000r/min or more

Output capacity

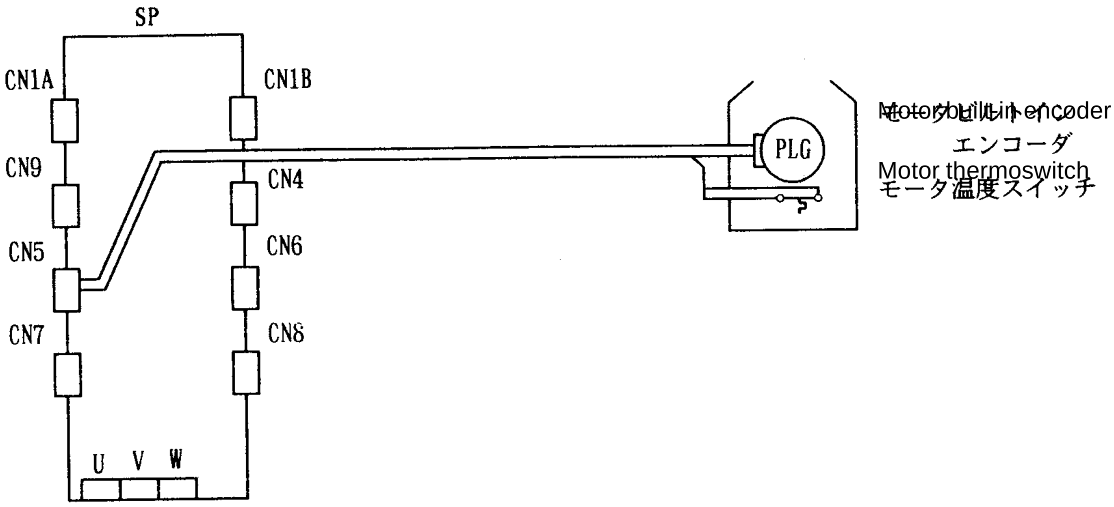
None : Standard type
S : Slim type

(1) When between 0.1kW or more and less than 1kW
0 [ ] [ ]
0.01kW will be 1. (Leave blank when 0.)
0.1kW will be 1.
(Example) For 0.4kW — 04
For 0.75kW — 075

(2) When 1kW or more
0.1kW will be 1.
(Example) For 3.7kW → 37
For 30kW → 300
</td>
</tr>
</table>

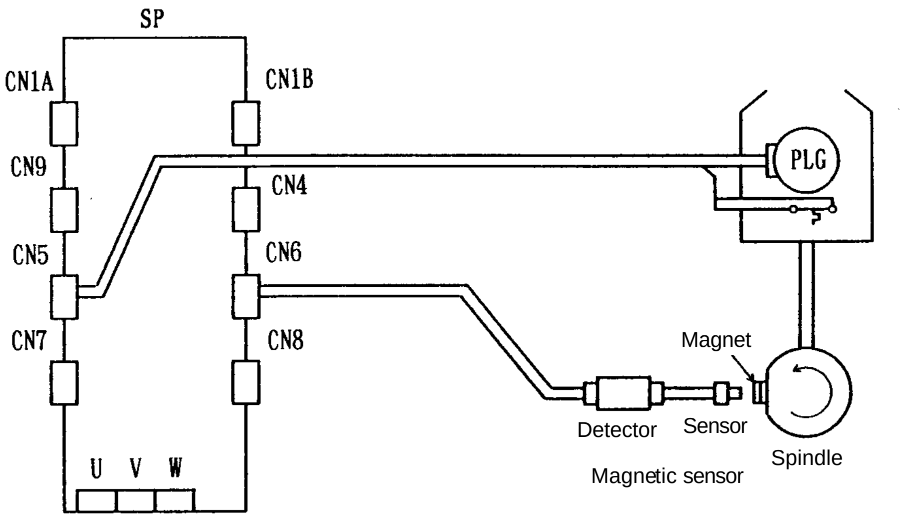
1.4 Configuration

1.4.1 Basic configuration (no added functions)

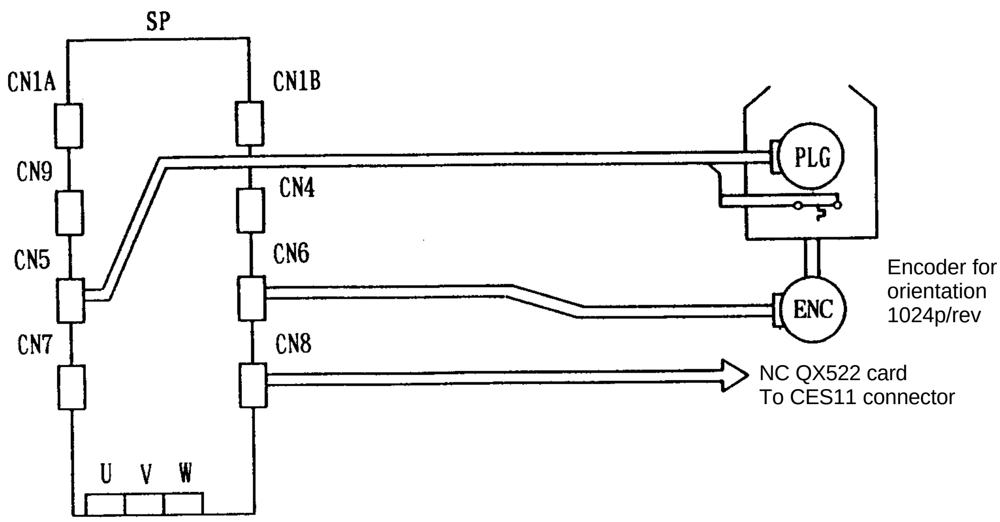


1.4.2 With orientation function

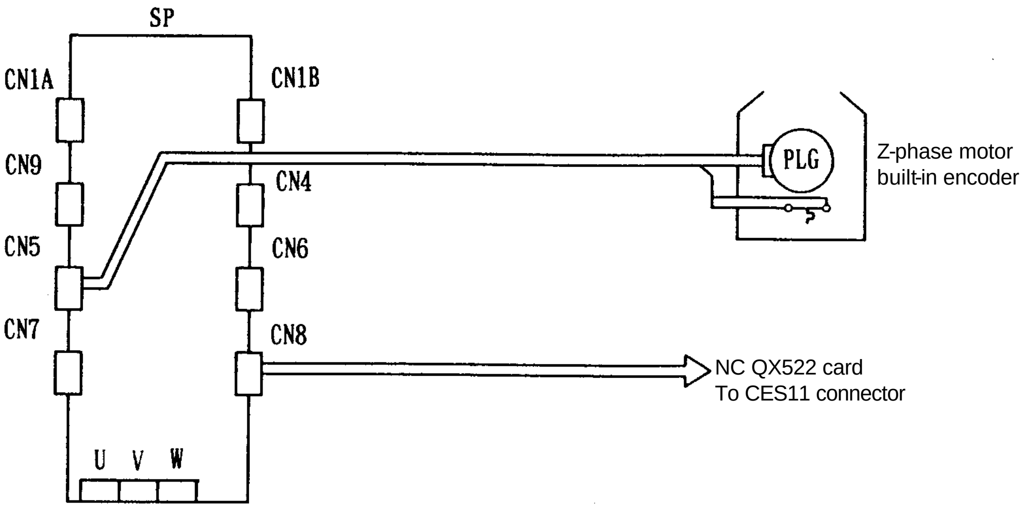
(1) Magnetic sensor orientation (1-point) specifications



(2) Encoder orientation (4096-point) specifications/with index function

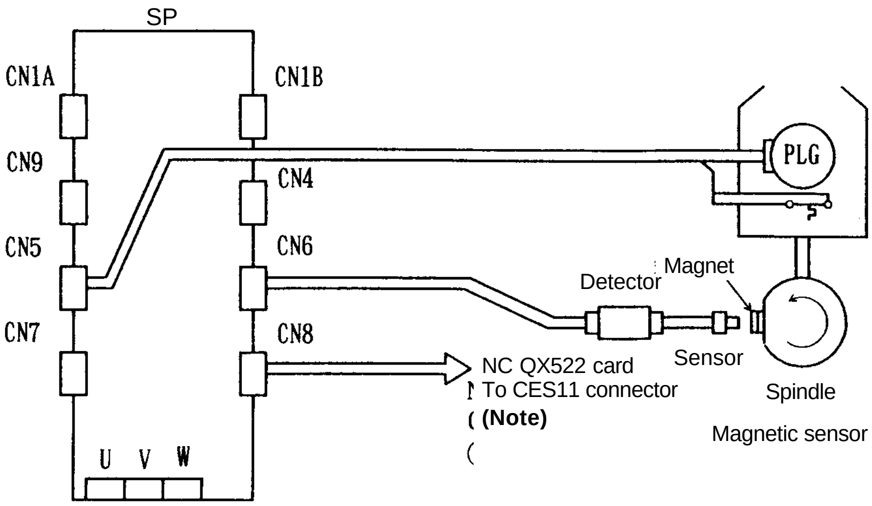


(3) Z-phase motor built-in encoder orientation (4096-point) specifications/with index function



(Note) Multipoint orientation using the Z-phase motor built-in encoder is applicable only when spindle to motor shaft speed ratio is 1:1.

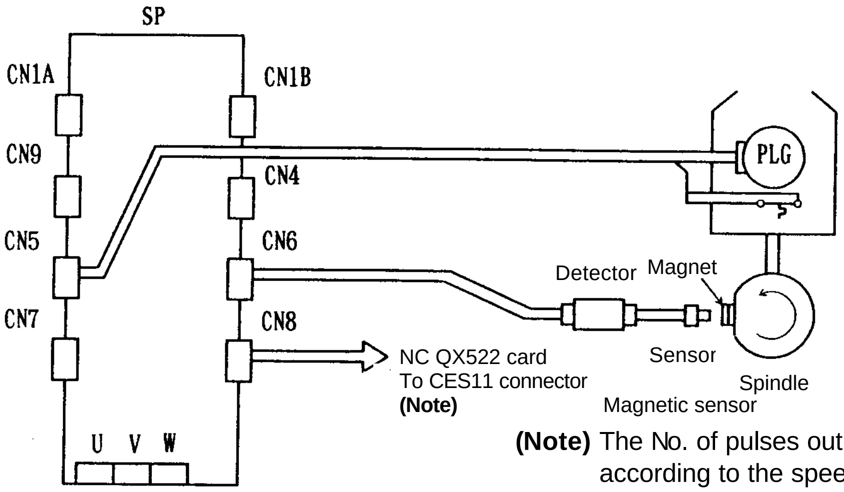
(4) Magnetic sensor orientation (1-point) specifications + motor speed feedback output (for spindle speed indication and synchronous speed signal)



(Note) The No. of pulses output to NC will differ according to the speed ratio between the spindle and motor shaft.

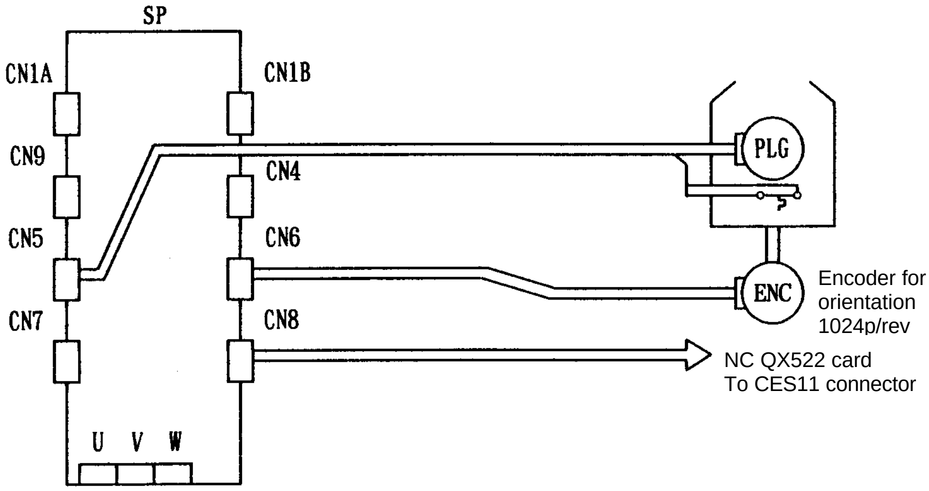
1.4.3 High-speed synchronous tap/spindle synchronization/with orientation function

(1) Motor built-in encoder high-speed synchronous tap/spindle synchronization and magnetic sensor orientation (1-point) specifications

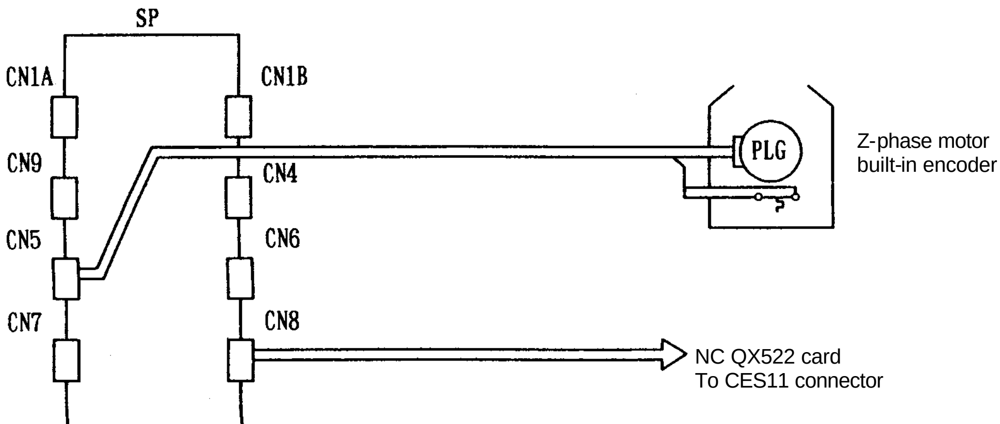


(Note) The No. of pulses output to NC will differ according to the speed ratio between the spindle and motor shaft.

(2) Encoder high-speed synchronous tap/spindle synchronization and orientation (4096-point) specifications/with index function



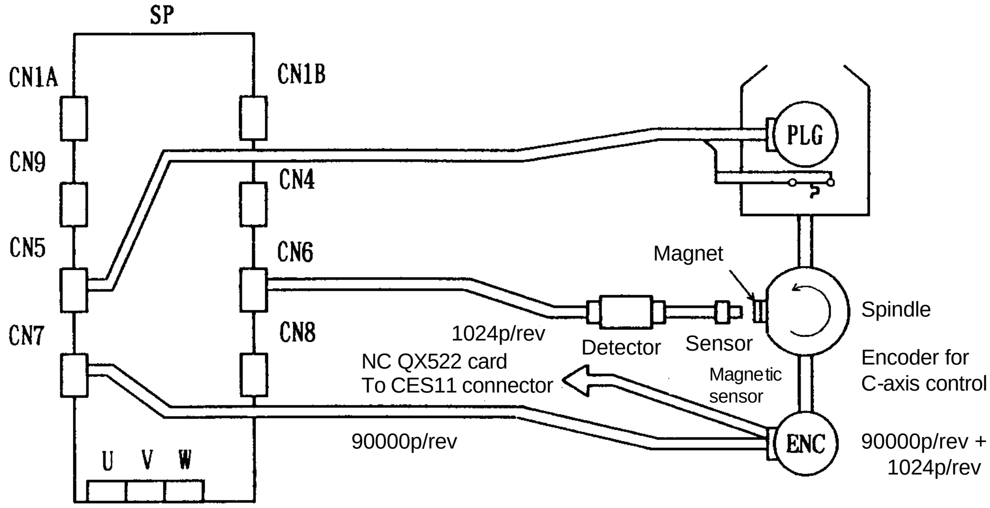
(3) Z-phase motor built-in encoder high-speed synchronous tap/spindle synchronization and orientation (4096-point) specifications/with index function



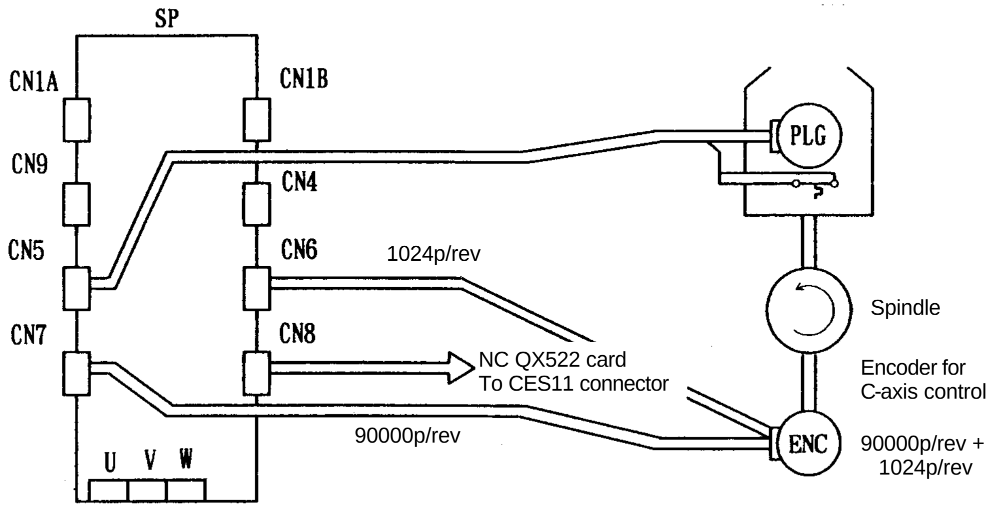
(Note) Multipoint orientation using the Z-phase motor built-in encoder is applicable only when spindle to motor speed ratio is 1:1

1.4.4 OSE90K+1024 encoder C-axis control/with orientation function

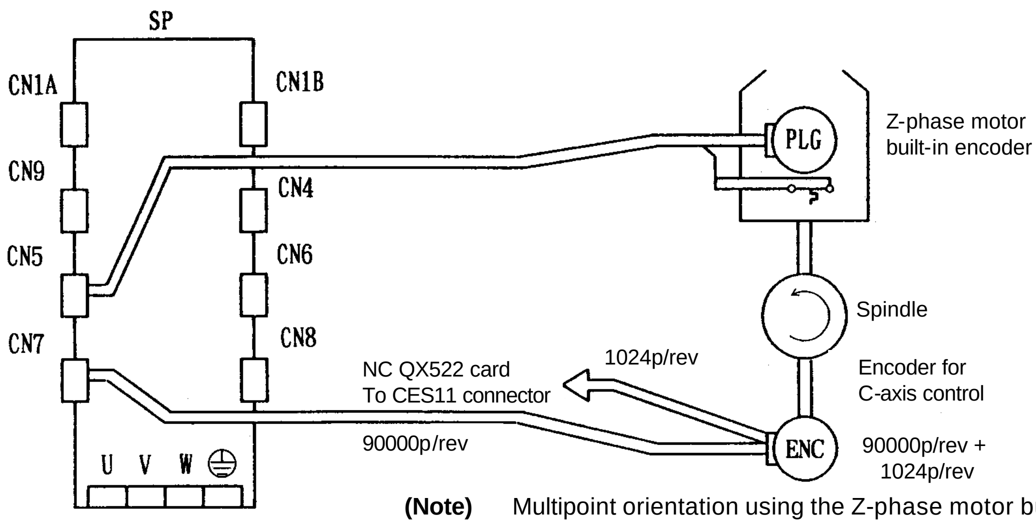
(1) OSE90K+1024 encoder C-axis control and magnetic sensor orientation (1-point) specifications



(2) OSE90K+1024 encoder C-axis control and orientation (4096-point) specifications/with index function



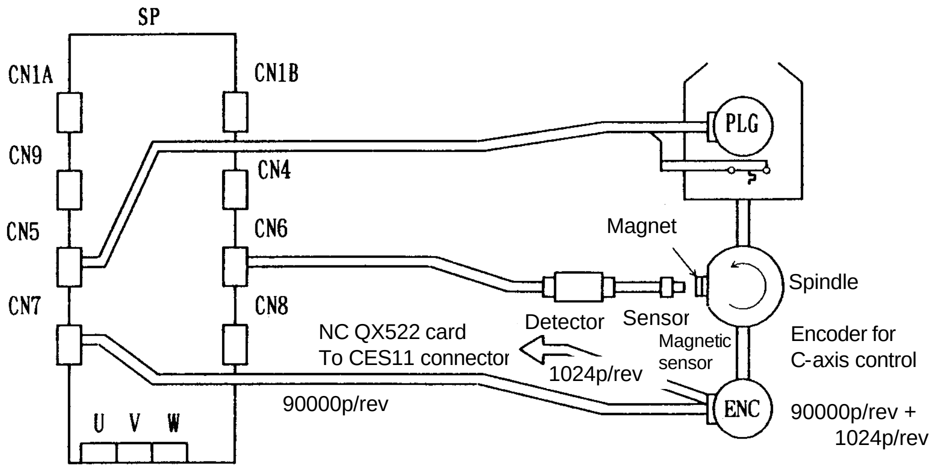
(3) OSE90K+1024 encoder C-axis control and Z-phase motor built-in encoder orientation (4096-point) specifications/with index function



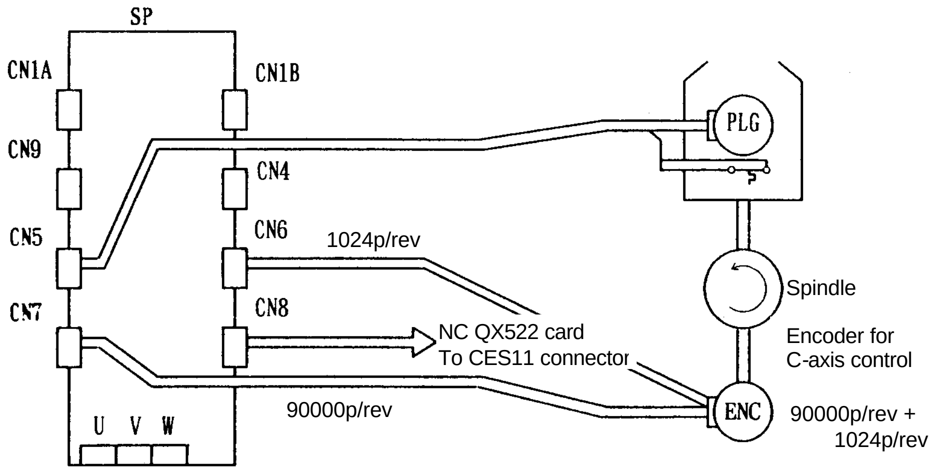
(Note) Multipoint orientation using the Z-phase motor built-in encoder is applicable only when spindle to motor speed ratio

1.4.5 OSE90K+1024 encoder C-axis control and high-speed synchronous tap/spindle synchronization/with orientation function

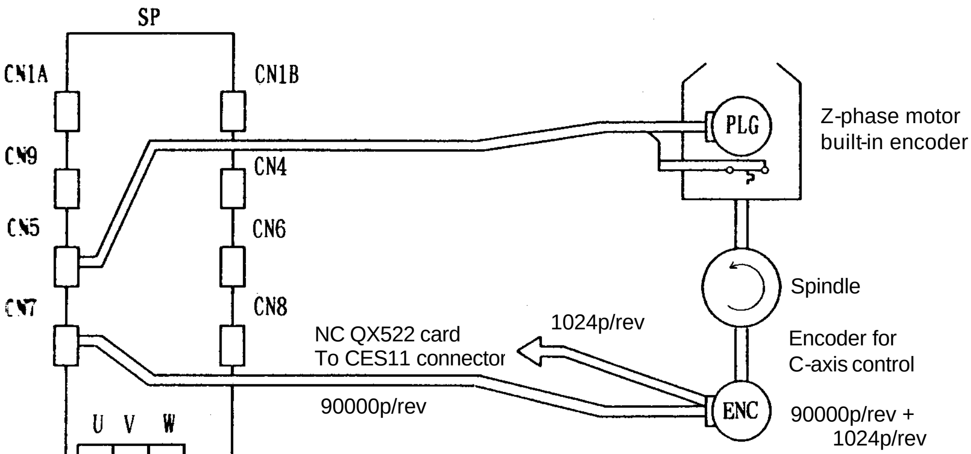
(1) OSE90K+1024 encoder C-axis control and high-speed synchronous tap/spindle synchronization and magnetic sensor orientation (1-point) specifications



(2) OSE90K+1024 encoder C-axis control and high-speed synchronous tap/spindle synchronization and magnetic sensor orientation (4096-point) specifications/with index function



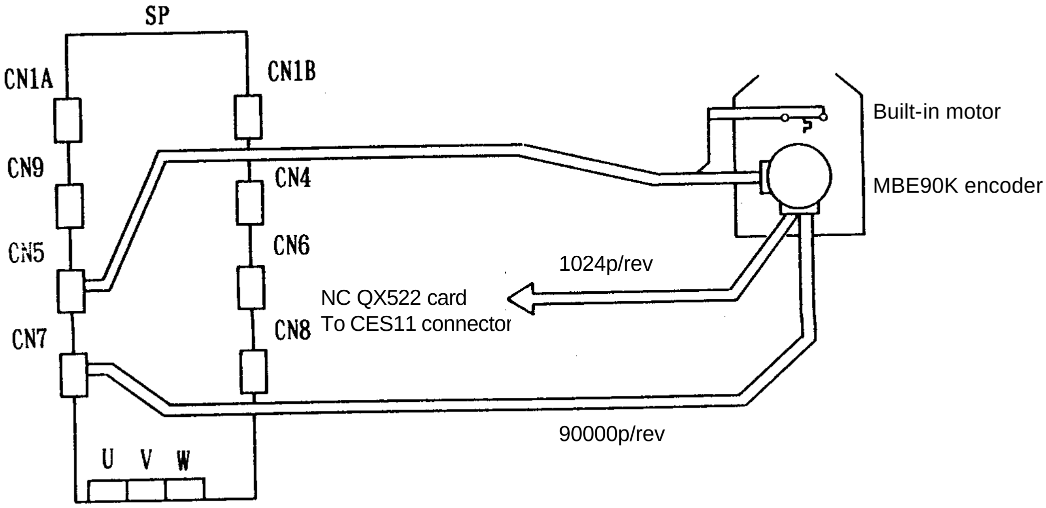
(3) OSE90K+1024 encoder C-axis control and high-speed synchronous tap/spindle synchronization and Z-phase motor built-in encoder orientation (4096-point) specifications/with index function



(Note) Multipoint orientation using the Z-phase motor built-in encoder is applicable only when spindle to motor speed ratio is 1:1.

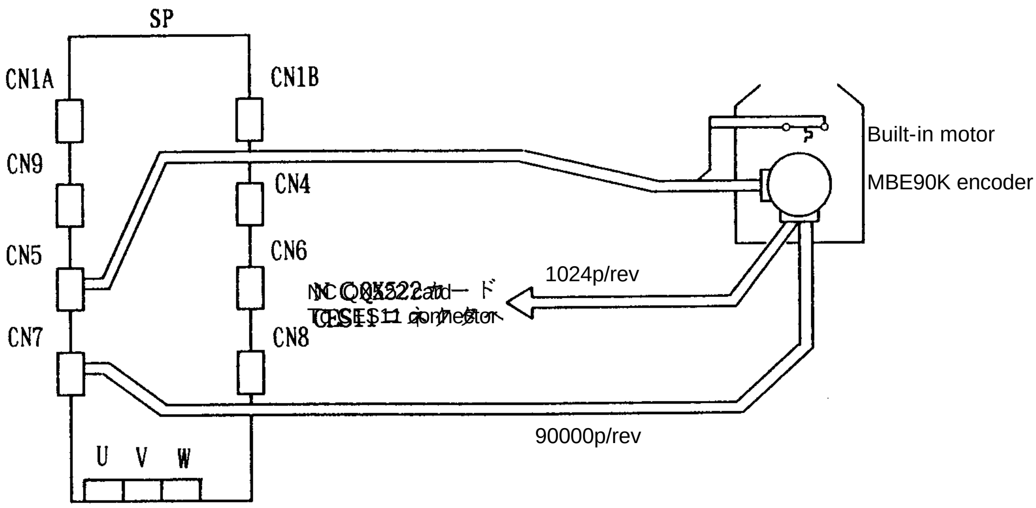
1.4.6 MBE90K encoder C-axis control/with orientation function

(1) MBE90K encoder C-axis control and orientation (4096-point) specifications/with index function



1.4.7 MBE90K encoder C-axis control and high-speed synchronous tap/ spindle synchronization/with orientation function

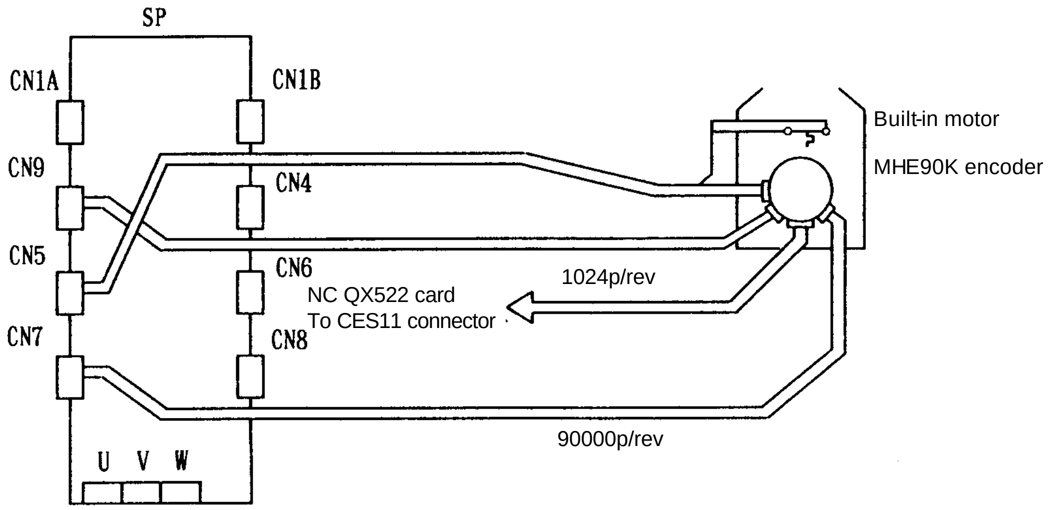
(1) MBE90K encoder C-axis control and high-speed synchronous tap/spindle synchronization and orientation (4096-point) specifications/with index function



(Note) Refer to the MBE90K (built-in C-axis encoder) Specifications and Instruction Manual [BNP-A2993-41] for details on the MBE90K wiring.

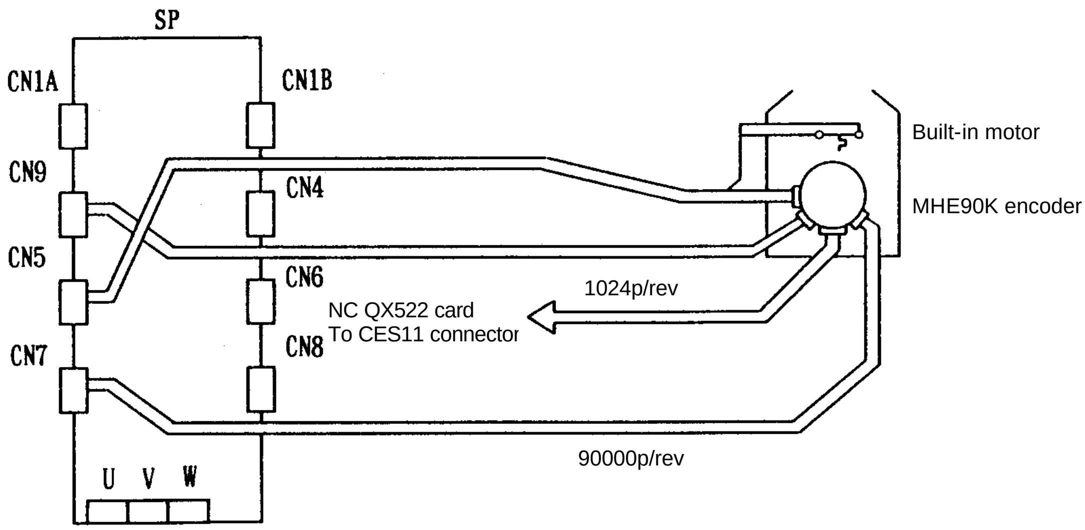
1.4.8 MHE90K encoder C-axis control/with orientation function

(1) MHE90K encoder C-axis control and orientation (4096-point) specifications/with index function



1.4.9 MHE90K encoder C-axis control and high-speed synchronous tap/ spindle synchronization/with orientation function

(1) MHE90K encoder C-axis control and high-speed synchronous tap/spindle synchronization and orientation (4096-point) specifications/with index function

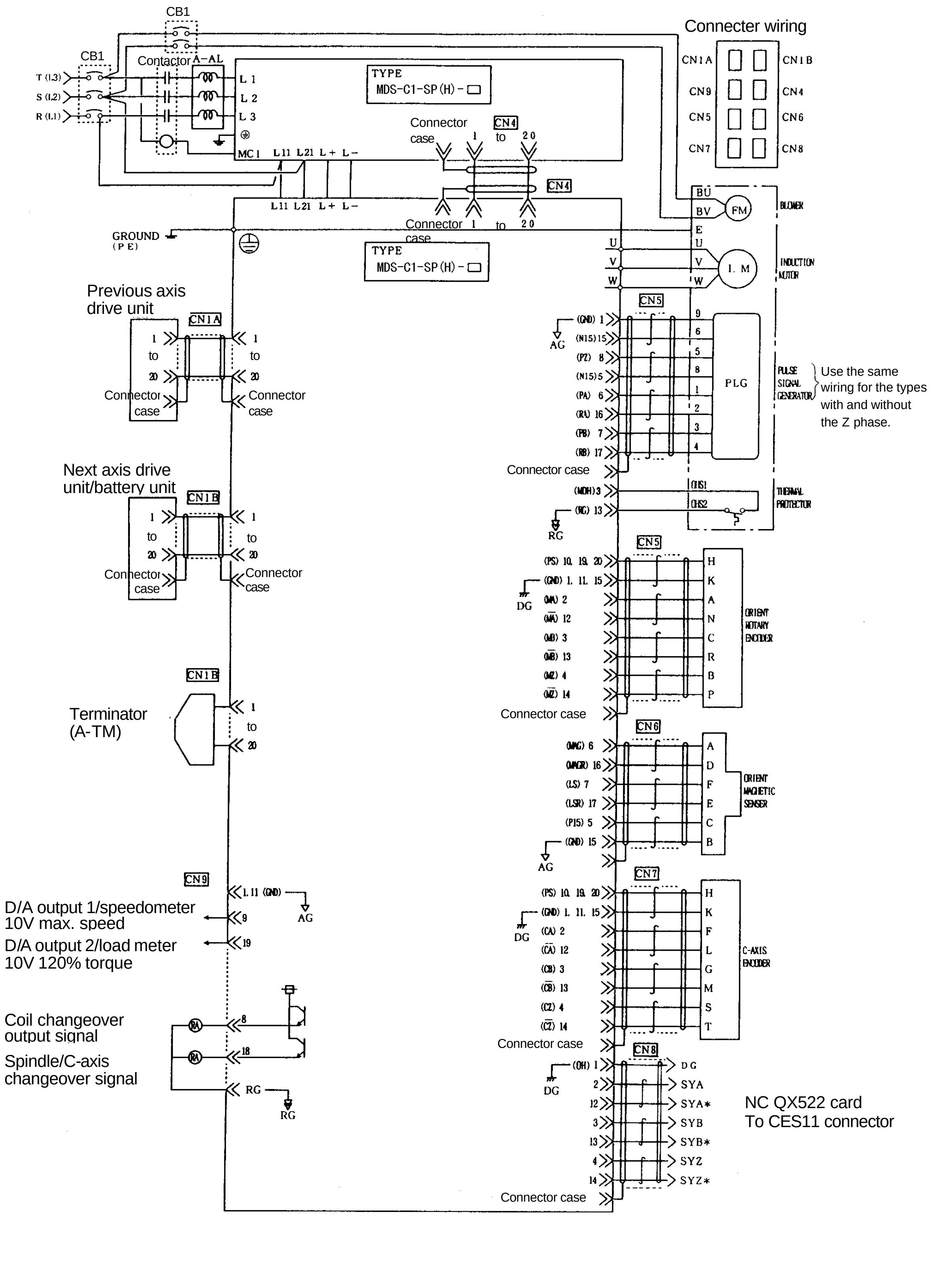


(Note) Refer to the MHE90K (built-in C-axis encoder) Specifications and Instruction Manual [BNP-A2993-44] for details on the MHE90K wiring.

* The cable for outputting signals from CN8 to NC and the cable for directly connecting the detector and NC are not necessarily required for "1.4.1" to "1.4.9".
Connect only when required due to the applications. (Spindle speed indication and synchronous speed signal)

1.5 Device-to-device connections

⚠ CAUTION
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.



2. Specifications

2.1 AC spindle motor and controller specifications

AC spindle motor

Item \ Series	Base speed 1500r/min Series									
Model	SJ-									
	5.5A	7.5A	11AP	11A	15A	18.5A	22AP	22A	26A	30A
Output capacity: Cont. rating (HP)/(kW)	5/3.7	7/5.5	9/7	10/7.5	15/11	20/15	20/15	25/18.5	30/22	30/22
Output capacity: 30 min. rating (HP)/(kW) 50% ED rating	7/5.5	10/7.5	15/11	15/11	20/15	25/18.5	30/22	30/22	35/26	40/30
Speed: Basic speed [r/min]	1500									
Speed: Max. speed [r/min]	8000		6000					4500		
Frame No.	A112	B112		B132		C132		A160		B160
Cont. rated torque N·m [kg·m]	23.5/ 2.40	35.0/ 3.57	44.5/ 4.54	47.7/ 4.87	70.1/ 7.15	95.5/ 9.74	95.5/ 9.74	118/ 12.0	140/ 14.3	
GD^2 [kg·m^2]	0.08	0.10	0.12	0.17	0.21	0.27	0.32	0.55		0.69
Weight [kg]	60	70	75	100	110	130	150	175		200
Tolerable radial load [kg]	150	200		300						
Cooling fan [W]	35							130		
Vibration	V5							V10		
Noise [dB]	75							80		
Installation	Horizontal or vertical (output shaft down)									
Overload withstand level	120% of 30 min. rated output, 1 min.									
Ambient temperature (°C)	0 to 40									
Insulation class	F class									
Paint color	Munsell 5.27G 2.46/0.21									
Accessories	Pulse generator and overheat detector									
Lubrication of bearings	Grease									
Output characteristic	Fig.1		Fig.2					Fig.3		

Controller (drive unit)

Item \ Series	MDS-C1-SP-							
Model	55	75	110	150	185	220	260	300
Main circuit	IGBT IPM sinusoidal wave PWM inverter							
Control circuit	Pulse generator speed feedback, digital closed-loop control, vector control							
Braking	Power regenerative braking							
Speed control range [r/min]	35 to 8000		35 to 6000			35 to 4500		
Speed fluctuation rate	Max. 0.2% of maximum speed (under load varying from 10% to 100%)							
Speed command	Serial connection with M500/M50 and above CNC							
Ambient temperature/humidity	0°C to 55°C / 90%RH or less (with no dew condensation)							
Storage temperature/humidity	–15°C to 70°C / 90%RH or less (with no dew condensation)							
Atmosphere	To be free from detrimental gas and dust (to conform with "grade C" environmental resistance specified by JEM1103)							
Vibration	4.90m/s^2 (0.5G) or less							
Noise	Less than 55dB							

(Note 1) The motor rated output is guaranteed with the power supply unit rated input voltage (200/220/230VAC). The rated output may not be achieved if the input voltage fluctuates and drops to 200VAC or less.
(Note 2) Contact Mitsubishi when a rated output range other than 1:8, or 1:12 is required.
(Note 3) The 50% ED rating is ON for five minutes and OFF for five minutes in the 10 minute cycle time.

	Item \ Series	Base speed 1500r/min Series							
AC spindle motor	Model	SJ-V							
		2.2-01	3.7-01	5.5-01	7.5-01	11-01	15-01	18.5-01	22-01
Output capacity	Cont. rating (HP)/(kW)	2/1.5	3/2.2	5/3.7	7/5.5	10/7.5	15/11	20/15	25/18.5
	30 min. rating (HP)/(kW) 50% ED rating	3/2.2	5/3.7	7/5.5	10/7.5	15/11	20/15	25/18.5	30/22
Speed	Basic speed [r/min]	1500							
	Max. speed [r/min]	10000		8000		6000			
	Frame No.	A90	B90	D90	A112	B112	A160	A160	B160
	Cont. rated torque N·m [kg·m]	9.5/ 0.97	14.0/ 1.43	23.5/ 2.40	35.0/ 3.57	47.7/ 4.87	70.0/ 7.14	95.5/ 9.74	118/ 12.0
	GD^2 [$kg \cdot m^2$]	0.027	0.035	0.059	0.098	0.12	0.23	0.23	0.32
	Weight [kg]	25	30	49	60	70	110	110	140
	Tolerable radial load [kg]	100		150	200		300		
	Cooling fan [W]	42			3Ø 40		3Ø 63		
	Vibration	V5							
	Noise [dB]	75							
	Installation	Horizontal or vertical (output shaft down)							
	Overload withstand level	120% of 30 min. rated output, 1 min.							
	Ambient temperature (°C)	0 to 40							
	Insulation class	F class							
	Paint color	Munsell 5.27G 2.46/0.21							
	Accessories	Pulse generator and overheat detector							
	Lubrication of bearings	Grease							
	Output characteristic	Fig.4		Fig.5		Fig.6			
Controller (drive unit)	Item \ Series	MDS-C1-							
	Model	SPH-22	SPH-37	SP-55	SP-75	SP-110	SP-150	SP-185	SP-220
	Main circuit	IGBT IPM sinusoidal wave PWM inverter							
	Control circuit	Pulse generator speed feedback, digital closed-loop control, vector control							
	Braking	Power regenerative braking							
	Speed control range [r/min]	35 to 10000		35 to 8000		35 to 6000			
	Speed fluctuation rate	Max. 0.2% of maximum speed (under load varying from 10% to 100%)							
	Speed command	Serial connection with M500/M50 and above CNC							
	Ambient temperature/humidity	0°C to 55°C / 90%RH or less (with no dew condensation)							
	Storage temperature/humidity	–15°C to 70°C / 90%RH or less (with no dew condensation)							
	Atmosphere	To be free from detrimental gas and dust (to conform with "grade C" environmental resistance specified by JEM1103)							
	Vibration	$4.90 m/s^2$ (0.5G) or less							
	Noise	Less than 55dB							

(Note 1) The motor rated output is guaranteed with the power supply unit rated input voltage (200/220/230VAC). The rated output may not be achieved if the input voltage fluctuates and drops to 200VAC or less.
(Note 2) Contact Mitsubishi when a rated output range other than 1:8, or 1:12 is required.
(Note 3) The 50% ED rating is ON for five minutes and OFF for five minutes in the 10 minute cycle time.

	Item \ Series	Wide (1:8) rated output Series					Wide rated output Series	
AC spindle motor	Model	SJ-V					SJ-	
		11-01	11-09	15-03	18.5-03	22-05	22XW5	22XW8
	Output capacity: Cont. rating (HP)/(kW)	5/3.7	7/5.5	10/7.5	12/9	15/11	20/15	25/18.5
	Output capacity: 30 min. rating 50% ED rating (HP)/(kW)	7/5.5	10/7.5	12/9	15/11	20/15	25/18.5	30/22
	Speed: Basic speed [r/min]	750					500(600)	
	Speed: Max. speed [r/min]	6000					4500	4000
	Frame No.	B112	A160	A160	B160	B160	B180	A200
	Cont. rated torque N·m (kg·m)	47.1/ 4.81	70.0/ 7.14	95.5/ 9.74	115/ 11.7	140/ 14.3	239/ 24.4	294/ 30.0
	GD^2 [kg·m^2]	0.12	0.23	0.23	0.32	0.32	1.36	2.19
	Weight [kg]	70	125	125	155	155	300	390
	Tolerable radial load [kg]	200	300				400	600
	Cooling fan [W]	3Ø 40	3Ø 63				180	3Ø60
	Vibration	V5					V10	
	Noise [dB]	75					80	85
	Installation	Horizontal or vertical (output shaft down)						
	Overload withstand level	120% of 30 min. rated output, 1 min.						
	Ambient temperature (°C)	0 to 40						
	Insulation class	F class						
	Paint color	Munsell 5.27G 2.46/0.21						
	Accessories	Pulse generator and overheat detector						
	Lubrication of bearings	Grease						
	Output characteristic	Fig.7					Fig.8	Fig.9
Controller (drive unit)	Item \ Series	MDS-C1-						
	Model	SP-110		SP-185	SP-220	SP-260	SP-300	SP-300
	Main circuit	IGBT IPM sinusoidal wave PWM inverter						
	Control circuit	Pulse generator speed feedback, digital closed-loop control, vector control						
	Braking	Power regenerative braking						
	Speed control range [r/min]	35 to 6000					35 to 4500	35 to 4000
	Speed fluctuation rate	Max. 0.2% of maximum speed (under load varying from 10% to 100%)						
	Speed command	Serial connection with M500/M50 and above CNC						
	Ambient temperature/humidity	0°C to 55°C / 90%RH or less (with no dew condensation)						
	Storage temperature/humidity	–15°C to 70°C / 90%RH or less (with no dew condensation)						
	Atmosphere	To be free from detrimental gas and dust (to conform with "grade C" environmental resistance specified by JEM1103)						
	Vibration	4.90m/s^2 (0.5G) or less						
	Noise	Less than 55dB						

(Note 1) The motor rated output is guaranteed with the power supply unit rated input voltage (200/220/230VAC). The rated output may not be achieved if the input voltage fluctuates and drops to 200VAC or less.

(Note 2) Contact Mitsubishi when a rated output range other than 1:8, or 1:12 is required.

(Note 3) The 50% ED rating is ON for five minutes and OFF for five minutes in the 10 minute cycle time.

	Item / Series		High-speed Series					
AC spindle motor	Model		SJ-V					
			3.7-02ZM	7.5-03ZM	11-06ZM	11-08ZM	22-06ZM	30-02ZM
	Output capacity	Cont. rating (HP)/(kW)	3/2.2	7/5.5	7/5.5	10/7.5	15/11	25/18.5
		30 min. rating 50% ED rating (HP)/(kW)	5/3.7 (15 min. rating)	10/7.5	10/7.5	15/11	20/15	30/22
	Speed	Basic speed [r/min]	3000	1500				
		Max. speed [r/min]	15000	12000		8000		
	Frame No.		A90	A112	A112	B112	A160	B160
	Cont. rated torque N·m (kg·m)		7.0/ 0.71	35.0/ 3.57	35.0/ 3.57	47.7/ 4.87	70.0/ 9.14	118/ 12.0
	GD^2 [$kg \cdot m^2$]		0.027	0.098	0.098	0.12	0.23	0.32
	Weight [kg]		25	60	60	70	125	155
	Tolerable radial load [kg]		50	100		150	200	
	Cooling fan [W]		42	3Ø 40			3Ø 63	
	Vibration		V5					
	Noise [dB]		75					
	Installation		Horizontal or vertical (output shaft down)					
	Overload withstand level		120% of 30 min. rated output, 1 min.					
	Ambient temperature (°C)		0 to 40					
	Insulation class		F class					
	Paint color		Munsell 5.27G 2.46/0.21					
	Accessories		Pulse generator and overheat detector					
	Lubrication of bearings		Grease					
	Output characteristic		Fig.10	Fig.11	Fig.12	Fig.13		
Controller (drive unit)	Item / Series		MDS-C1-					
	Model		SPH-37	SPH-110	SPH-150	SP-185	SP-220	SP-300
	Main circuit		IGBT IPM sinusoidal wave PWM inverter					
	Control circuit		Pulse generator speed feedback, digital closed-loop control, vector control					
	Braking		Power regenerative braking					
	Speed control range [r/min]		35 to 15000	35 to 12000		35 to 8000		
	Speed fluctuation rate		Max. 0.2% of maximum speed (under load varying from 10% to 100%)					
	Speed command		Serial connection with M500/M50 and above CNC					
	Ambient temperature/humidity		0°C to 55°C / 90%RH or less (with no dew condensation)					
	Storage temperature/humidity		–15°C to 70°C / 90%RH or less (with no dew condensation)					
	Atmosphere		To be free from detrimental gas and dust (to conform with "grade C" environmental resistance specified by JEM1103)					
	Vibration		$4.90 m/s^2$ (0.5G) or less					
	Noise		Less than 55dB					

(Note 1) The motor rated output is guaranteed with the power supply unit rated input voltage (200/220/230VAC). The rated output may not be achieved if the input voltage fluctuates and drops to 200VAC or less.
(Note 2) Contact Mitsubishi when a rated output range other than 1:8, or 1:12 is required.
(Note 3) The 50% ED rating is ON for five minutes and OFF for five minutes in the 10 minute cycle time.

AC spindle motor

Item \ Series	SJ-N Series							
Model	SJ-N							
	0.75A	1.5A	2.2X	2.2A	3.7A	5.5AP	5.5A	7.5A
Output capacity: Cont. rating (HP)/(kW)	0.5/0.4	1.0/0.75	2.0/1.5	2.0/1.5	3.0/2.2	4.0/3.0	5.0/3.7	7.4/5.5
Output capacity: 30 min. rating 50% ED rating (HP)/(kW)	1.0/0.75 10min	2.0/1.5 10min	3.0/2.2 15min	3.0/2.2 15min	5.0/3.7 15min	7.4/5.5 15min	7.4/5.5 30min	10.1/7.5 30min
Speed: Basic speed [r/min]	1500		3000	1500				
Speed: Max. speed [r/min]	10000						8000	
Frame No.	B71	C71	C71	A90	B90	C90	A112	B112
Cont. rated torque N·m (kg·m)	2.55/ 0.26	4.70/ 0.48	3.53/ 0.36	9.51/ 0.97	14.0/ 1.43	23.5/ 2.4	23.5/ 2.4	35.0/ 3.57
GD^2 [$kg \cdot m^2$]	0.0045	0.0086	0.0086	0.017	0.021	0.045	0.058	0.071
Weight [kg]	15	20	20	33	37	45	63	74
Tolerable radial load [kg]	50			100			150	200
Cooling fan [W]	20			40		55	35	
Vibration	V5							
Noise [dB]	75							
Installation	Horizontal or vertical (output shaft down)							
Overload withstand level	120% of 30 min. rated output, 1 min.							
Ambient temperature (°C)	0 to 40							
Insulation class	F class							
Paint color	Munsell 5.27G 2.46/0.21							
Accessories	Pulse generator and heat detector							
Lubrication of bearings	Grease							
Output characteristic	Fig. 14							

Controller (drive unit)

Item \ Series	MDS-C1-							
Model	SPH-075	SPH-15	SPH-22		SPH-37	SPH-55	SP-55	SP-75
Main circuit	IGBT IPM sinusoidal wave PWM inverter							
Control circuit	Pulse generator speed feedback, digital closed-loop control, vector control							
Braking	Regenerative braking (resistance discharged)							
Speed control range [r/min]	35 to 10000						35 to 8000	
Speed fluctuation rate	Max. 0.2% of maximum speed (under load varying from 10% to 100%)							
Speed command	Serial connection with M500/M50 and above CNC							
Ambient temperature/humidity	0°C to 55°C / 90%RH or less (with no dew condensation)							
Storage temperature/humidity	–15°C to 70°C / 90%RH or less (with no dew condensation)							
Atmosphere	To be free from detrimental gas and dust (to conform with "grade C" environmental resistance specified by JEM1103)							
Vibration	$4.90m/s^2$ (0.5G) or less							
Noise	Less than 55dB							

(Note 1) The motor rated output is guaranteed with the power supply unit rated input voltage (200/220/230VAC). The rated output may not be achieved if the input voltage fluctuates and drops to 200VAC or less.

(Note 2) For speeds faster than $6000 min^{-1}$, the speed will be the reduced output calculated with rated output $\times \frac{6000}{speed}$

(Note 3) The 50% ED rating is ON for five minutes and OFF for five minutes in the 10 minute cycle time.

2.2 Output characteristics

Fig.1

Output P1/P2/P3/P4			
SJ-5.5A	SJ-7.5A		
5.5/3.7/3/2(kW)	7.5/5.5/4/3(kW)		
7/5/4/2.5(HP)	10/7/5/4(HP)		

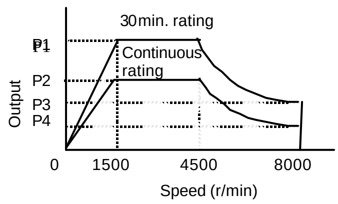


Fig.2

Output P1/P2/P3/P4			
SJ-11AP	SJ-11A	SJ-15A	SJ-18.5A
11/7/8/5(kW)	11/7.5/8/5.5(kW)	15/11/11/8(kW)	18.5/15/13.5/11(kW)
15/9/10/7(HP)	15/10/10/7(HP)	20/15/15/10(HP)	25/20/18/15(HP)

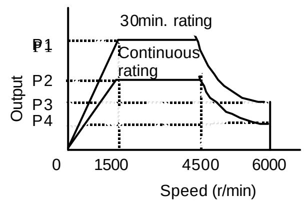


Fig.3

Output P1/P2			
SJ-22AP	SJ-22A	SJ-26A	SJ-30A
22/15(kW)	22/18.5(kW)	26/22(kW)	30/22(kW)
30/20(HP)	30/25(HP)	35/30(HP)	40/30(HP)

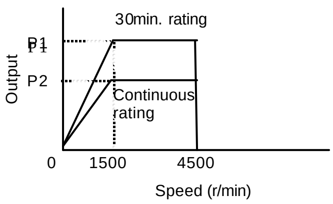


Fig.4

Output P1/P2/P3/P4			
SJ-V2.2-01	SJ-V3.7-01		
2.2/1.5/1.3/0.9(kW)	3.7/2.2/2.2/1.3(kW)		
3/2/1.8/1.2(HP)	5/3/3/2(HP)		

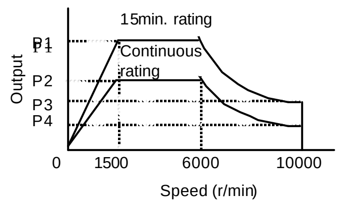


Fig.5

Output P1/P2/P3/P4			
SJ-V5.5-01	SJ-V7.5-01		
5.5/3.7/4.1/2.8(kW)	7.5/5.5/5.6/4.1(kW)		
7/5/5.5/3.4(HP)	10/7/7.5/5.5(HP)		

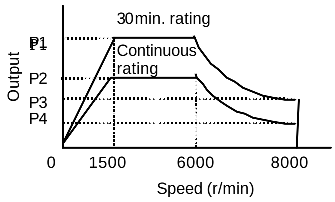


Fig.6

Output P1/P2/P3/P4			
SJ-V11-01	SJ-V15-01	SJ-V18.5-01	SJ-V22-01
11/7.5/8.3/5.6(kW)	15/11/11.3/8.3(kW)	18.5/15/13.9/11.3(kW)	22/18.5/16.5/13.9(kW)
15/10/11/7.6(HP)	20/15/15/11(HP)	25/20/19/15(HP)	30/25/22/19(HP)

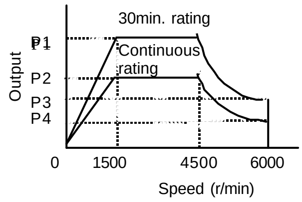


Fig.7

Output P1/P2				
SJ-V11-01	SJ-V11-09	SJ-V15-03	SJ-V18.5-03	SJ-V22-05
5.5/3.7(kW)	7.5/5.5(kW)	9/7.5(kW)	11/9(kW)	15/11(kW)
7/5(HP)	10/7(HP)	12/10(HP)	15/12(HP)	20/15(HP)

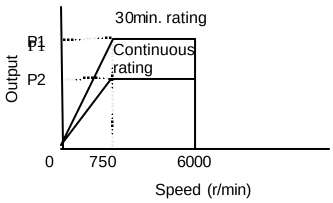


Fig.8

Output P1/P2/P3/P4			
SJ-22XW5			
18.5/15/14/11.5(kW)			
25/20/19/16(HP)			

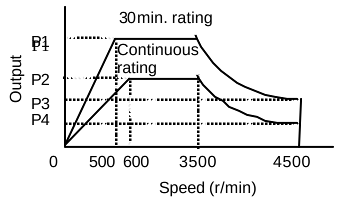


Fig.9

Output P1/P2			
SJ-22XW8			
22/18.5(kW)			
30/25(HP)			

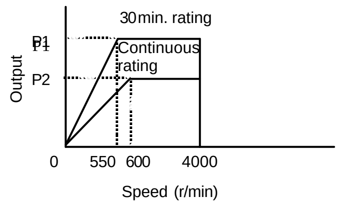


Fig.10

Output P1/P2/P3/P4			
SJ-V3.7-02ZM			
3.7/2.2/3/1.8(kW)			
5/3/4/2.5(HP)			

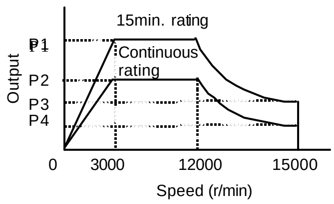


Fig.11

Output P1/P2/P3/P4			
SJ-V7.5-03ZM			
7.5/5.5/6.3/4.6(kW)			
10/7/8/6(HP)			

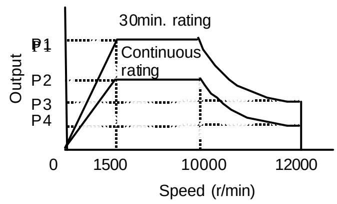


Fig.12

Output P1/P2			
SJ-V11-06ZM			
7.5/5.5(kW)			
10/7(HP)			

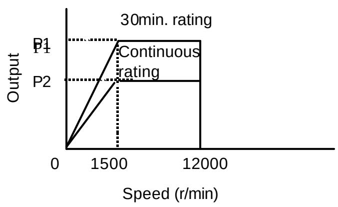


Fig.13

Output P1/P2			
SJ-V11-08ZM	SJ-V22-06ZM	SJ-V30-02ZM	
11/7.5(kW)	15/11(kW)	22/18.5(kW)	
15/10(HP)	20/15(HP)	30/25(HP)	

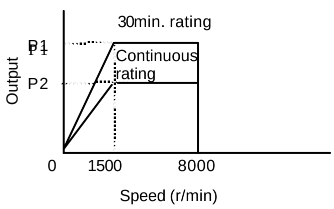
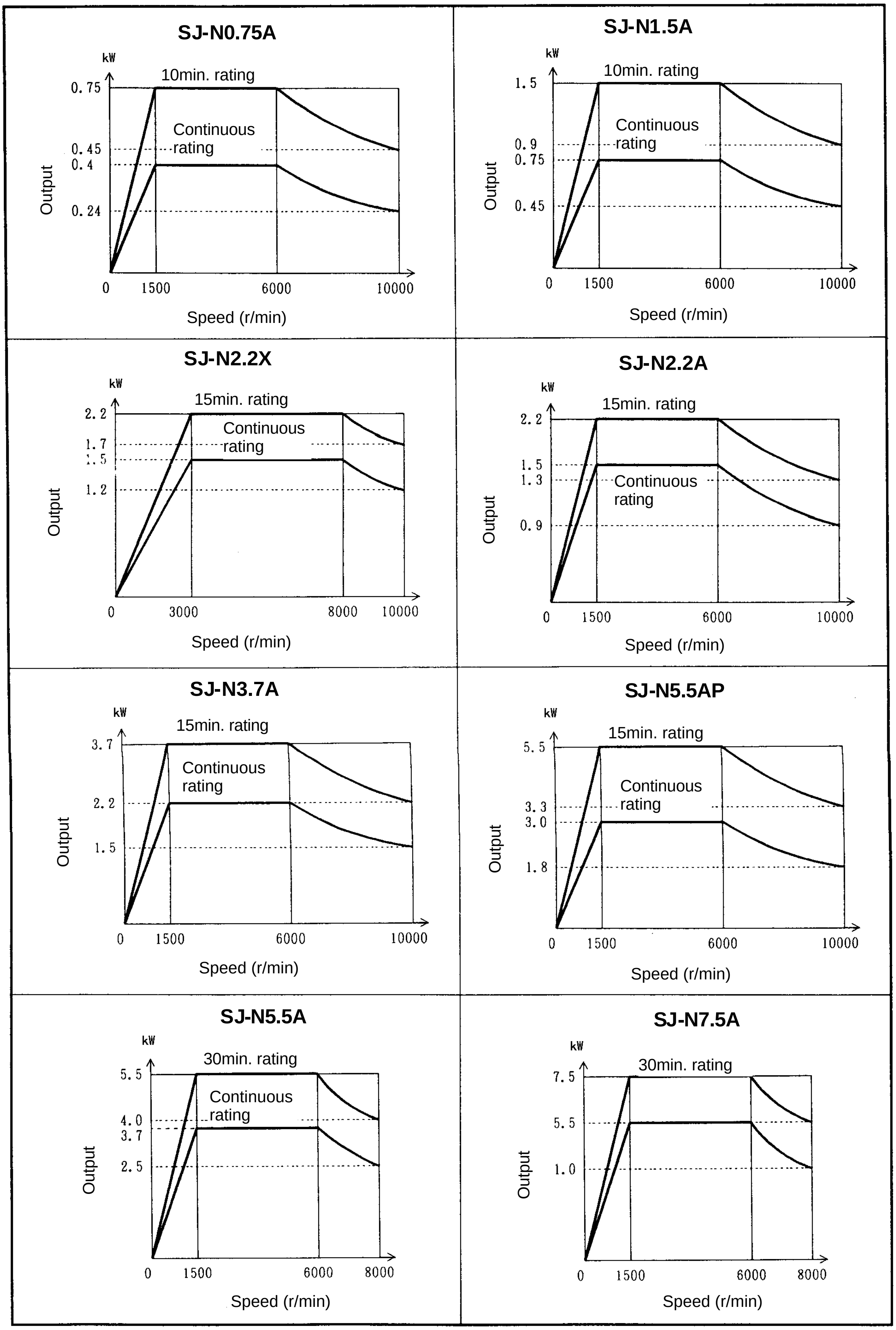


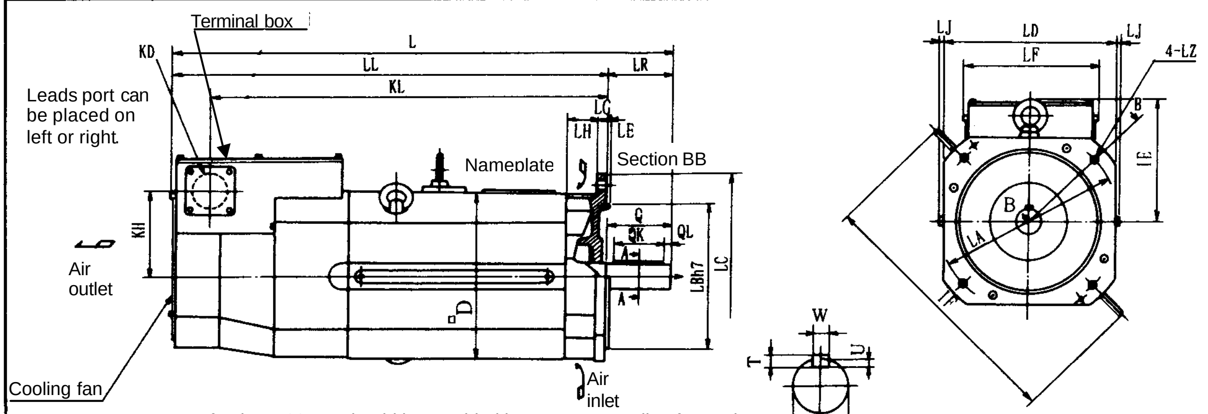
Fig.14


SJ-N0.75A
kW
10min. rating
Continuous rating
0.75
0.45
0.4
0.24
Output
0
1500
6000
10000
Speed (r/min)
SJ-N1.5A
kW
10min. rating
Continuous rating
1.5
0.9
0.75
0.45
Output
0
1500
6000
10000
Speed (r/min)
SJ-N2.2X
kW
15min. rating
Continuous rating
2.2
1.7
1.5
1.2
Output
0
3000
8000
10000
Speed (r/min)
SJ-N2.2A
kW
15min. rating
Continuous rating
2.2
1.5
1.3
0.9
Output
0
1500
6000
10000
Speed (r/min)
SJ-N3.7A
kW
15min. rating
Continuous rating
3.7
2.2
1.5
Output
0
1500
6000
10000
Speed (r/min)
SJ-N5.5AP
kW
15min. rating
Continuous rating
5.5
3.3
3.0
1.8
Output
0
1500
6000
10000
Speed (r/min)
SJ-N5.5A
kW
30min. rating
Continuous rating
5.5
4.0
3.7
2.5
Output
0
1500
6000
8000
Speed (r/min)
SJ-N7.5A
kW
30min. rating
7.5
5.5
1.0
Output
0
1500
6000
8000
Speed (r/min)

2.3 Outline dimension drawings

2.3.1 Motor

Standard flange type 112 to 200 frame

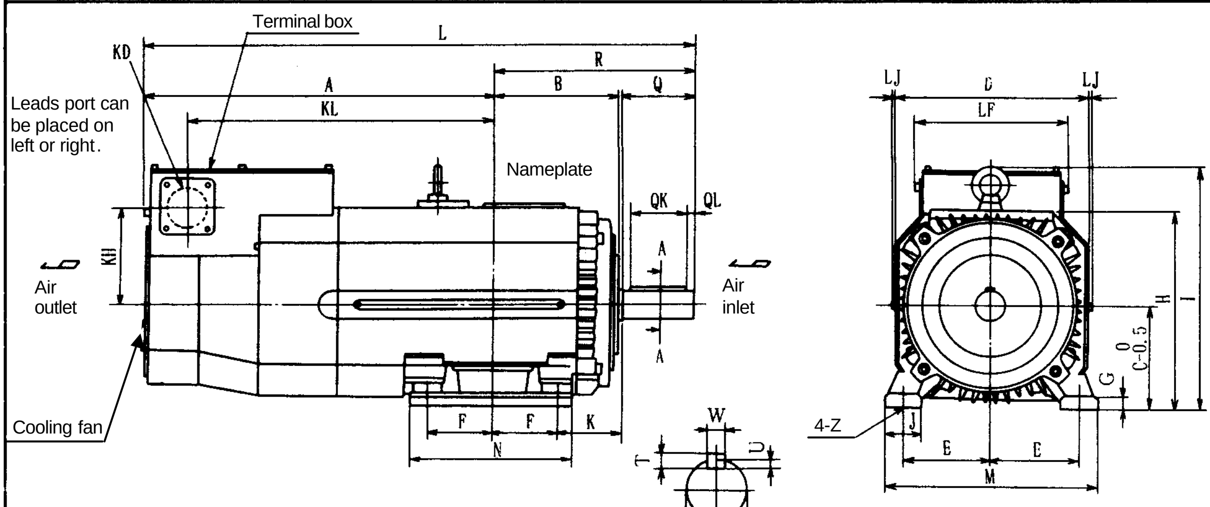


Notes:
1. A space of at least 30mm should be provided between the cooling fan and nearby located wall.
2. It can be installed vertically with the shaft down.

DIM IN mm

Frame No.	Motor																		Shaft end								
	D	L	IE	KD	KL	KH	LA	LB	LC	LD	LE	LF	LG	LH	LJ	LL	LZ	IF	LR	Q	QK	S	T	U	W	QL	※
A112F	208	549	152	44	438	102	215	180	250	204	5	164	13	52	7	489	15	317	60	60	45	28	7	4	7	7.5	h6
B112F	208	614	152	44	483	102	215	180	250	204	5	164	13	52	7	534	15	317	80	80	63	32	8	5	10	8	h6
B132F	254	677	180	44	516	117	265	230	300	250	5	164	20	55	7	567	15	376	110	110	80	48	9	5.5	14	10	h6
C132F	254	742	180	44	581	117	265	230	300	250	5	164	20	55	7	632	15	376	110	110	80	48	9	5.5	14	10	h6
A160F	314	785	206	51	600.5	133	300	250	350	310	5	189	20	60	7	675	19	438	110	110	90	55	10	6	16	10.5	m6
B160F	314	850	206	51	665.5	133	300	250	350	310	5	189	20	60	7	740	19	438	110	110	90	55	10	6	16	10.5	m6
B180F	354	909	238	51	701.5	160	350	300	400	350	5	224	25	68	7	769	19	509	140	140	110	60	11	7	18	15	m6
A200F	380	932	272	63	733	202	400	350	450	378	5	278	30	73	7	792	19	581	140	140	110	60	11	7	18	15	m6

Standard leg installation type 112 to 200 frame

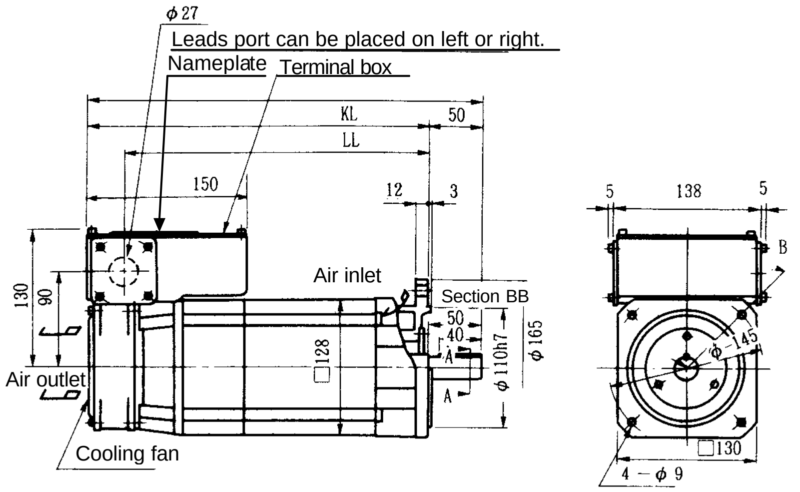


Notes:
1. A space of at least 30mm should be provided between the cooling fan and nearby located wall.

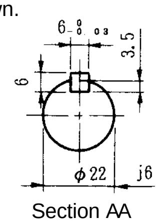
Section AA

DIM IN mm

Frame No.	Motor																			Shaft end								
	A	B	C	D	E	F	G	H	I	J	K	KD	KL	KH	LF	LJ	L	M	N	Z	Q	QK	R	S	T	U	W	QL	※
A112M	349	135	112	206	95	70	15	215	264	40	70	44	298	102	164	6	549	230	180	12	60	45	200	28	7	4	7	7.5	h6
B112M	394	135	112	206	95	70	15	215	264	40	70	44	343	102	164	6	614	230	180	12	80	63	220	32	8	5	10	8	h6
B132M	389	173	132	252	108	89	17	258	312	45	89	44	338	117	164	6	677	260	218	12	110	80	288	48	9	5.5	14	10	h6
C132L	441.5	185.5	132	252	108	101.5	17	258	312	45	89	44	390.5	117	164	6	742	260	243	12	110	80	300.5	48	9	5.5	14	10	h6
A160L	440	230	160	312	127	127	20	316	366	55	108	51	365.5	133	189	6	785	310	304	15	110	90	345	55	10	6	16	10.5	m6
B160L	505	230	160	312	127	127	20	316	366	55	108	51	430.5	133	189	6	850	310	304	15	110	90	345	55	10	6	16	10.5	m6
B180L	508.5	247.5	180	352	139.5	139.5	22	356	418	70	121	51	441	160	224	6	909	350	338	19	140	110	400.5	60	11	7	18	15	m6
A200L	506.5	272.5	200	380	159	152.5	25	390	472	85	133	63	447.5	202	278	6	932	400	385	19	140	110	425.5	60	11	7	18	15	m6

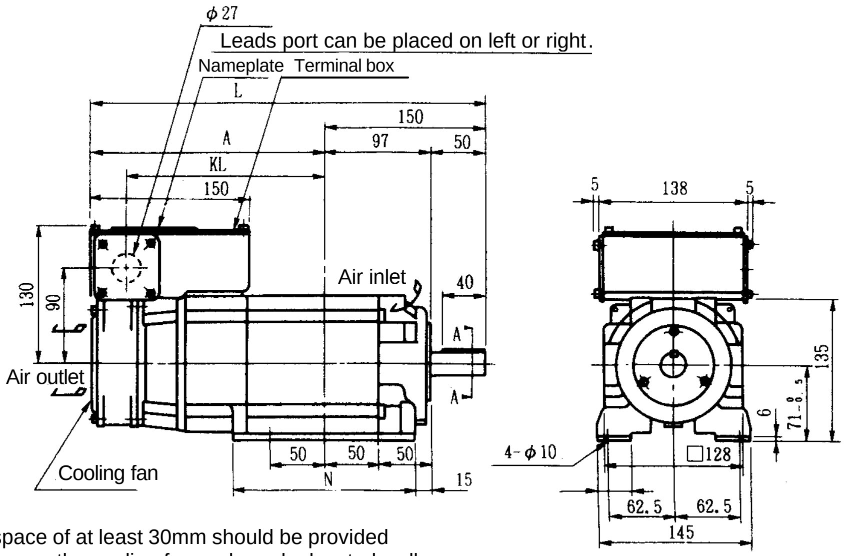


Notes: 1. A space of at least 30mm should be provided between the cooling fan and nearby located wall.
2. It can be installed vertically with the shaft down.

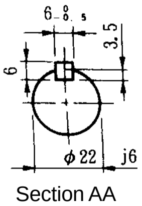


Frame No.	Motor		
	L	KL	LL
B71F	308.5	223.5	258.5
C71F	368.5	283.5	318.5

DIM IN mm

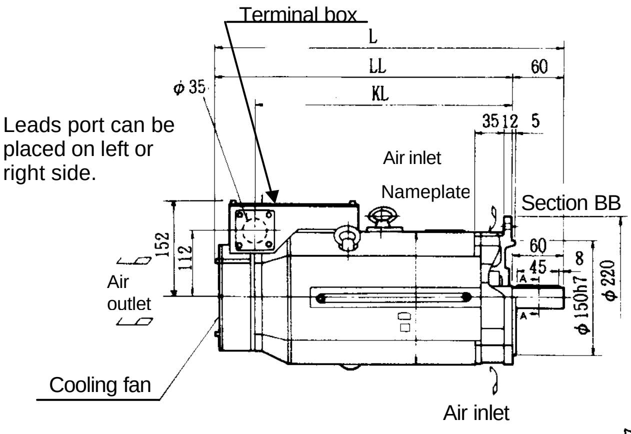


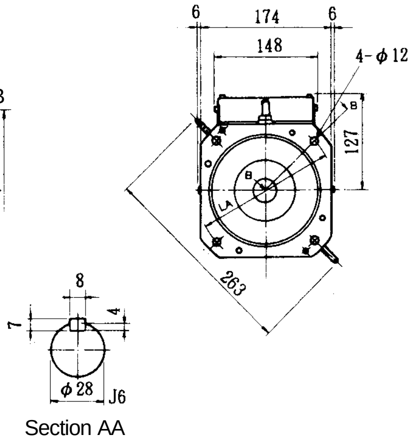
Notes: 1. A space of at least 30mm should be provided between the cooling fan and nearby located wall.



Frame No.	Motor			
	A	KL	L	N
B71	158.5	123.5	308.5	150
C71	218.5	183.5	368.5	170

DIM IN mm

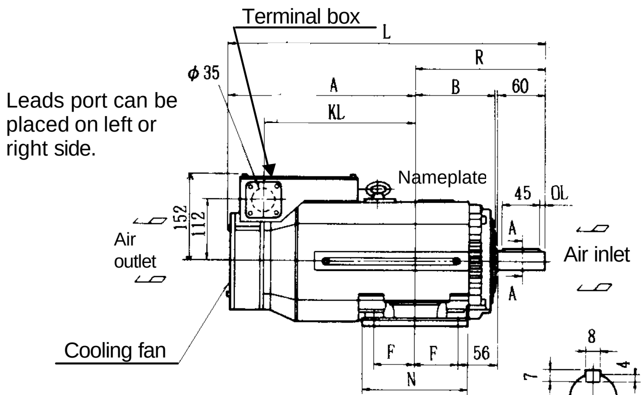


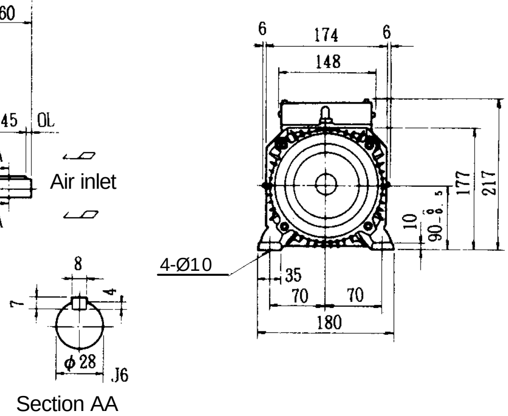


Notes:
1. A space of at least 30mm should be provided between the cooling fan and nearby located wall.
2. It can be installed vertically with the shaft down.

Frame No.	Motor		
	L	KL	LL
A90F	401	290	341
B90F	431	320	371

DIM IN mm

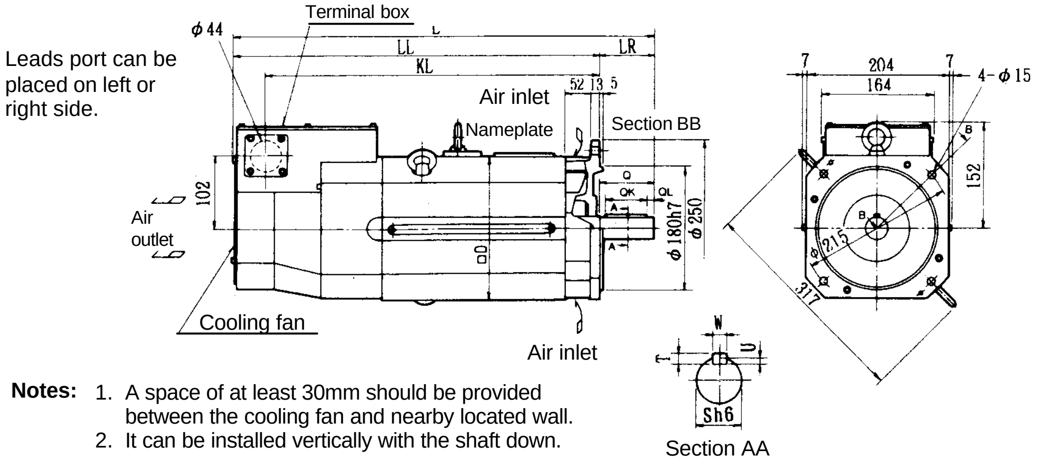




Notes:
1. A space of at least 30mm should be provided between the cooling fan and nearby located wall.

Frame No.	Motor						Shaft end
	A	B	F	KL	L	N	R
A90S	235	101	50	184	401	130	166
B90L	252.5	113.5	62.5	201.5	431	155	178.5

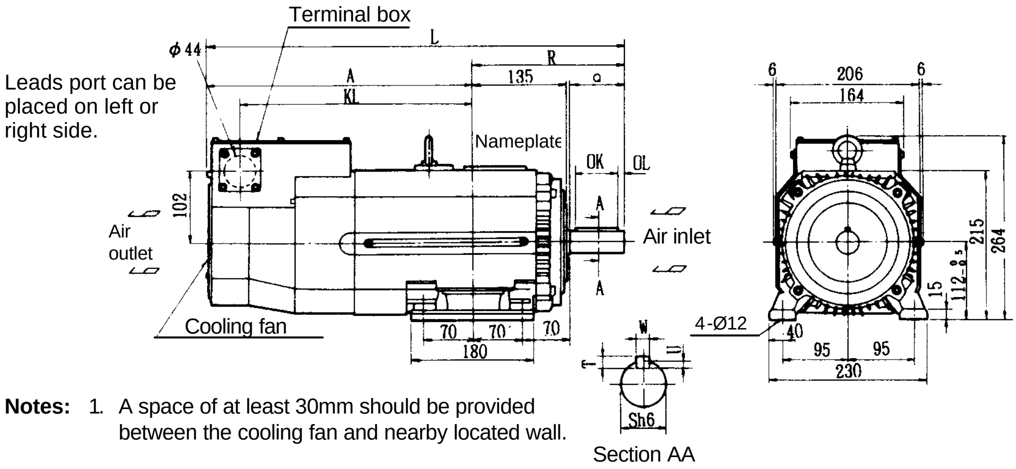
DIM IN mm



Notes:
1. A space of at least 30mm should be provided between the cooling fan and nearby located wall.
2. It can be installed vertically with the shaft down.

Frame No.	Motor			Shaft end							
	L	KL	LL	LR	Q	QK	S	T	U	W	QL
A112F	549	438	489	60	60	45	28	7	4	7	7.5
B112F	614	483	534	80	80	63	32	8	5	10	8

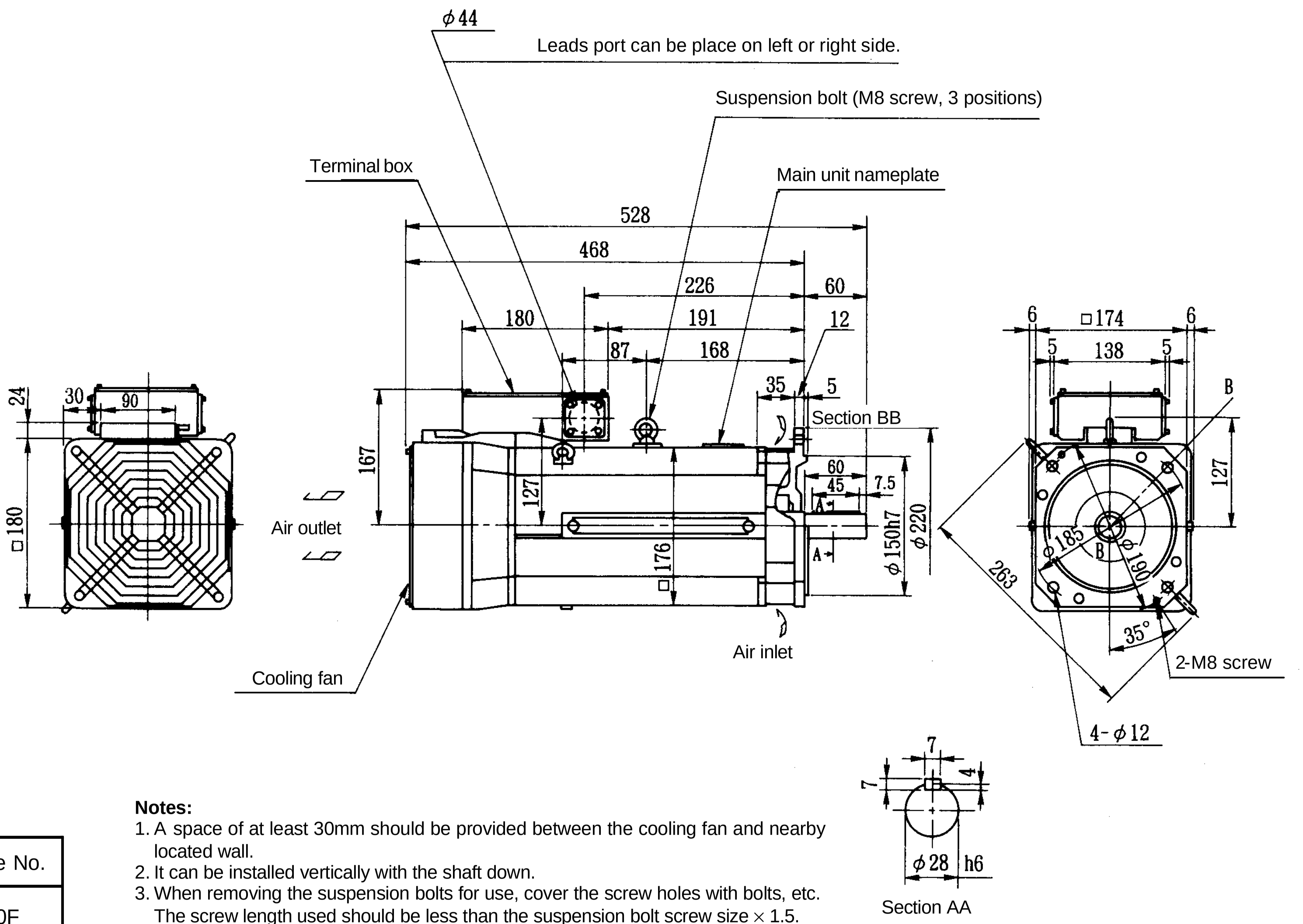
DIM IN mm



Notes: 1. A space of at least 30mm should be provided between the cooling fan and nearby located wall.

Frame No.	Motor			Shaft end							
	A	KL	L	Q	QK	R	S	T	U	W	QL
A112M	349	298	549	60	45	200	28	7	4	7	7.5
B112M	394	343	614	80	63	220	32	8	5	10	8

DIM IN mm



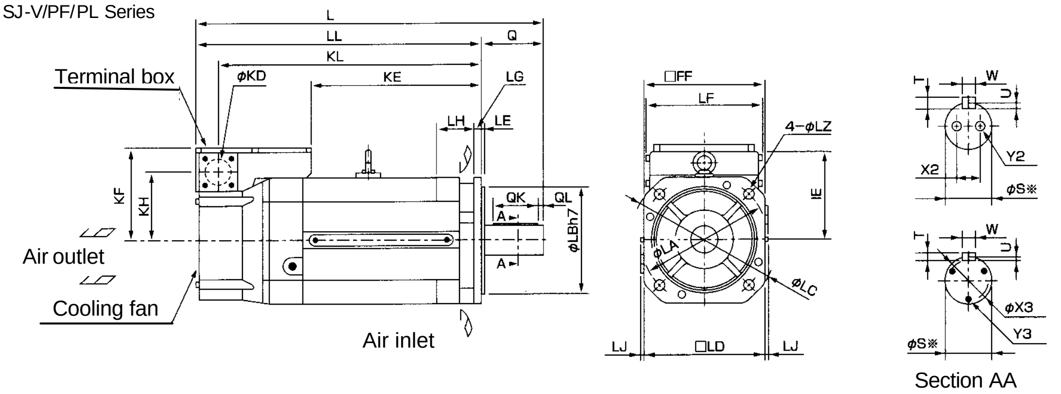
Notes:
1. A space of at least 30mm should be provided between the cooling fan and nearby located wall.
2. It can be installed vertically with the shaft down.
3. When removing the suspension bolts for use, cover the screw holes with bolts, etc. The screw length used should be less than the suspension bolt screw size × 1.5.

Frame No.
C90F

SJ-V Series: Standard flange type 90 to 160 frame

SJ-V/PF/PL Series

Notes:
1. A space of at least 30mm should be provided between the cooling fan and nearby located wall.
2. It can be installed vertically with the shaft down.
3. When removing the suspension bolts for use, cover the screw holes with bolts, etc.



(Unit: mm)

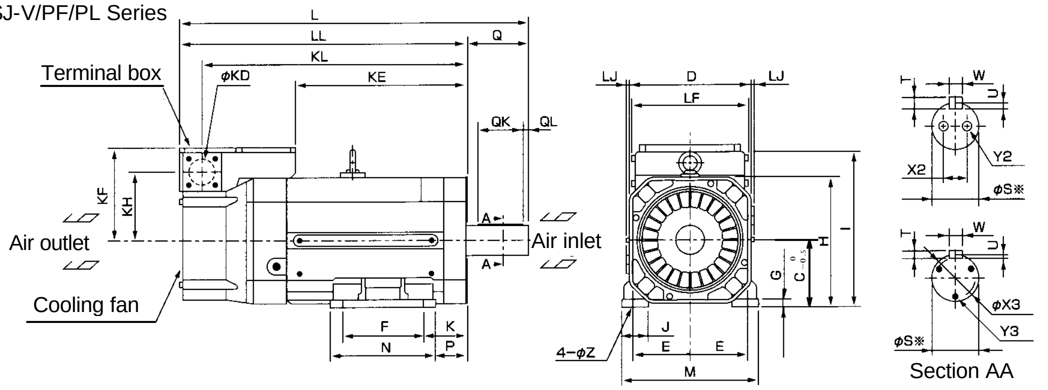
Frame No.	FF	IE	KD	KE	KF	KH	KL	L	LA	LB	LC	LD	LE	LF	LG	LH	LJ	LL	LZ	Q	QK	QL	S	※	T	U	W	X2	X3	Y2	Y3
A90F	174	127	35	130	145	104	265	360	185	150	220	176	5	168	12	48	5	300	12	60	45	8	28	j6	7	4	8	16	–	M6	–
B90F	174	127	35	160	145	104	295	390	185	150	220	176	5	168	12	48	5	330	12	60	45	8	28	j6	7	4	8	16	–	M6	–
D90F	174	127	44	255	145	104	390	485	185	150	220	176	5	168	12	48	5	425	12	60	45	7.5	28	h6	7	4	7	–	22	–	M4
A112F	204	152	44	238	160	118	403	520	215	180	250	208	5	198	13	47	5	440	15	80	63	8	32	h6	8	5	10	–	22	–	M5
B112F	204	152	44	288	160	118	453	600	215	180	250	208	5	198	13	65	5	490	15	110	80	10	48	h6	9	5.5	14	–	40	–	M5
A160F	250	192	44	259.5	187	143	434.5	579.5	265	230	300	262	5	198	20	65	5	469.5	15	110	80	10	48	h6	9	5.5	14	–	40	–	M5
* B160F	250	192	51	329.5	196	139	499.5	649.5	265	230	300	262	5	238	20	65	5	539.5	15	110	80	10	48	h6	9	5.5	14	–	40	–	M5
B160F	250	192	51	329.5	196	139	499.5	649.5	265	230	300	262	5	238	20	65	5	539.5	15	110	90	10.5	55	m6	10	6	16	–	45	–	M5

* is only applicable to motor model SJ-V30-02ZM.

SJ-V Series: Standard leg installation type 90 to 160 frame

SJ-V/PF/PL Series

Notes:
1. A space of at least 30mm should be provided between the cooling fan and nearby located wall.
2. It can be installed vertically with the shaft down.
3. When removing the suspension bolts for use, cover the screw holes with bolts, etc.



(Unit: mm)

Frame No.	C	D	E	F	G	H	I	J	K	KD	KE	KF	KH	KL	L	LF	LJ	LL	M	N	P	Q	QK	QL	S	※	T	U	W	X2	X3	Y2	Y3	Z
A90T	90	176	70	75	10	178	217	35	56	35	130	145	104	265	360	168	5	300	180	105	41	60	45	8	28	j6	7	4	8	16	–	M6	–	10
B90T	90	176	70	100	10	178	217	35	56	35	160	145	104	295	390	168	5	330	180	130	41	60	45	8	28	j6	7	4	8	16	–	M6	–	10
D90T	90	176	70	159	10	178	217	35	56	44	255	145	104	390	485	168	5	425	180	190	41	60	45	7.5	28	h6	7	4	7	–	22	–	M4	10
A112T	112	208	95	140	12	216	264	45	70	44	238	160	118	403	520	198	5	440	230	180	50	80	63	8	32	h6	8	5	10	–	22	–	M5	12
B112T	112	208	95	140	12	216	264	45	70	44	288	160	118	453	600	198	5	490	230	180	50	110	80	10	48	h6	9	6	14	–	40	–	M5	12
A160T	160	262	127	178	18	291	352	55	108	44	259.5	187	143	434.5	579.5	198	5	470	310	250	60	110	80	10	48	h6	9	6	14	–	40	–	M5	15
* B160T	160	262	127	178	18	291	352	55	108	51	329.5	196	139	499.5	649.5	238	5	540	310	250	60	110	80	10	48	h6	9	6	14	–	40	–	M5	15
B160T	160	262	127	178	18	291	352	55	108	51	329.5	196	139	499.5	649.5	238	5	540	310	250	60	110	90	10.5	55	m6	10	6	16	–	45	–	M5	15

* is only applicable to motor model SJ-V30-02ZM.

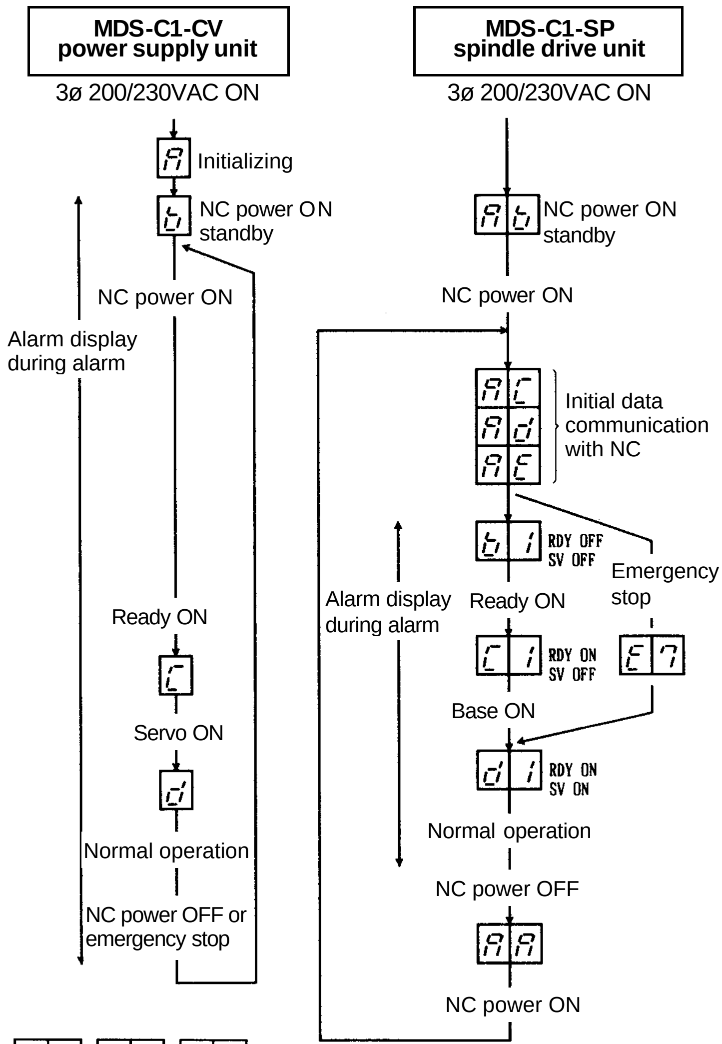
3. Status Display and Parameter Settings

⚠ WARNING
1. Do not operate the switches with wet hands. Failure to observe this could lead to electric shocks. 2. Do not operate the unit with the front cover removed. The high voltage terminals and charged sections will be exposed, and could lead to electric shocks. 3. Do not open the front cover while the power is ON or during operation. Failure to observe this could lead to electric shocks.

⚠ CAUTION
1. Check and adjust each program and parameter before starting operation. Failure to do so could lead to unforeseen operation of the machine. 2. Do not touch the fin on the servo drive unit, regenerative resistor or servomotor, etc., while the power is turned ON or immediately after turning the power OFF. These parts may reach high temperatures, and can cause burns.

3.1 Status display with 7-segment LED

The status can be displayed on the 7-segment LED on the power supply and spindle drives when the power is turned ON.



The right segment of b 1 C 1 d 1 indicates the axis No.

(This example shows the 1st axis.)

3.2 Spindle parameters

CAUTION
Do not make remarkable adjustments and changes as the operation could become unstable.

(1) Parameters

For parameters marked with an "*" in the tables, turn the CNC power OFF after setting. The parameters will be valid after the power is turned ON again.
The "fixed control constants" and "fixed control bits" in this section are set by Mitsubishi. Set these to "0" unless designated in particular.

Items			Details	Setting range (Unit)	Standard setting
SP001	PGM	Magnetic sensor and motor built-in encoder orientation position loop gain	As the set value is larger, the orientation time becomes shorter and servo rigidity is increased. However, vibration is increased and the machine becomes likely to overshoot.	0 to 1000 (0.1 1/s)	100
SP002	PGE	Encoder orientation position loop gain	As the set value is larger, the orientation time becomes shorter and servo rigidity is increased. However, vibration is increased and the machine becomes likely to overshoot.	0 to 1000 (0.1 1/s)	100
SP003	PGC0	C-axis non-cutting position loop gain	Set the position loop gain in C-axis non-cutting mode. During non-cutting (rapid traverse, etc.) with the C-axis control, this position loop gain setting is valid.	1 to 100 (1/s)	15
SP004	OINP	Orientation in-position width	Set the position error range in which an orientation completion signal is output.	1 to 2880 (1/16°)	16
SP005	OSP*	Orientation mode changing speed limit value	Set the motor speed limit value to be used when the speed loop is changed to the position loop in orientation mode. When this parameter is set to "0", SP017 (TSP) becomes the limit value.	0 to 32767 (r/min)	0
SP006	CSP	Orientation mode deceleration rate	As the set value is larger, the orientation time becomes shorter. However, the machine becomes likely to overshoot.	1 to 1000	20
SP007	OPST	Position shift amount for orientation	Set the stop position for orientation. (1) Motor built-in encoder, encoder: 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
SP008			Not used. Set "0".	0	0
SP009	PGT	Synchronized tapping position loop gain	Set the spindle position loop gain in synchronized tapping mode.	1 to 100 (1/s)	15
SP010	PGS	Spindle synchronous position loop gain	Set the spindle position loop gain in spindle synchronization mode.	1 to 100 (1/s)	15
SP011 to SP016			Use not possible.	0	0

Items			Details	Setting range (Unit)	Standard setting
SP017	TSP*	Maximum motor speed	Set the maximum motor speed of the spindle.	1 to 32767 (r/min)	6000
SP018	ZSP*	Motor zero speed	Set the motor speed for which zero-speed output is performed.	1 to 1000 (r/min)	50
SP019	CSN1*	Speed cushion 1	Set the time constant for a speed command from "0" to the maximum speed. (This parameter is invalid in position loop mode.)	0 to 32767 (10ms)	30
SP020	SDTS*	Speed detection set value	Set the motor speed for which speed detection output is performed. Usually, the setting value is 10% of SP017 (TSP).	0 to 32767 (r/min)	600
SP021	TLM1	Torque limit 1	Set the torque limit rate for torque limit signal 001.	0 to 120 (%)	10
SP022	VGNP1*	Speed loop gain proportional term under speed control	Set the speed loop proportional gain in speed control mode. When the gain is increased, response is improved but vibration and sound become larger.	0 to 1000 (1/s)	63
SP023	VGNI1*	Speed loop gain integral term under speed control	Set the speed loop integral gain in speed control mode. Usually, set a value in proportion to SP022 (VGNP1).	0 to 1000 (0.1 1/s)	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

<table>
<tr><th colspan="3">Items</th><th>Details</th><th>Setting range (Unit)</th><th>Standard setting</th></tr>
<tr><td>SP033</td><td>SFNC1*</td><td>Spindle function 1</td><td>Set the spindle function 1 in bit units.
<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></tr>
<tr><td>poff</td><td>hzs</td><td></td><td>ront</td><td></td><td></td><td></td><td></td></tr>
</table>
<table>
<tr><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>sftk</td><td>dflt</td><td>1a2m</td></tr>
</table>
(Note) Always set "0" for the empty bits.
<table>
<tr><th>bit</th><th>Name</th><th>Meaning when set to 0</th><th>Meaning when set to 1</th></tr>
<tr><td>0</td><td>1a2m</td><td>1 drive unit
2 motor function: Invalid</td><td>1 drive unit
2 motor function: Valid</td></tr>
<tr><td>1</td><td>dflt</td><td>Default motor: Main</td><td>Default motor: Sub</td></tr>
<tr><td>2</td><td>sftk</td><td>SF-TK card invalid</td><td>SF-TK card valid</td></tr>
<tr><td>3</td><td></td><td></td><td></td></tr>
<tr><td>4</td><td></td><td></td><td></td></tr>
<tr><td>5</td><td></td><td></td><td></td></tr>
<tr><td>6</td><td></td><td></td><td></td></tr>
<tr><td>7</td><td></td><td></td><td></td></tr>
<tr><td>8</td><td></td><td></td><td></td></tr>
<tr><td>9</td><td></td><td></td><td></td></tr>
<tr><td>A</td><td></td><td></td><td></td></tr>
<tr><td>B</td><td></td><td rowspan="5">This is a fixed control bit.</td><td rowspan="5"></td></tr>
<tr><td>C</td><td>ront</td></tr>
<tr><td>D</td><td></td></tr>
<tr><td>E</td><td>hzs</td></tr>
<tr><td>F</td><td>poff</td></tr>
</table>
When SPH is used, bit 0 and bit 1 will be invalid.</td><td>0000 to FFFF
HEX setting</td><td>0000</td></tr>
<tr><td>SP034</td><td>SFNC2*</td><td>Spindle function 2</td><td>Set the spindle function 2 in bit units.
<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></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>
<table>
<tr><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>mkc2</td><td>mkch</td><td>invm</td><td>mts1</td></tr>
</table>
(Note) Always set "0" for the empty bits.
<table>
<tr><th>bit</th><th>Name</th><th>Meaning when set to 0</th><th>Meaning when set to 1</th></tr>
<tr><td>0</td><td>mts1</td><td>Special motor constant invalid</td><td>Special motor constant setting valid</td></tr>
<tr><td>1</td><td>invm</td><td>A general-purpose motor FV control invalid</td><td>A general-purpose motor FV control valid</td></tr>
<tr><td>2</td><td>mkch</td><td>Winding switch function invalid</td><td>Winding switch function valid</td></tr>
<tr><td>3</td><td>mkc2</td><td>This is a fixed control bit.</td><td></td></tr>
<tr><td>4</td><td></td><td></td><td></td></tr>
<tr><td>5</td><td></td><td></td><td></td></tr>
<tr><td>6</td><td></td><td></td><td></td></tr>
<tr><td>7</td><td></td><td></td><td></td></tr>
<tr><td>8</td><td></td><td></td><td></td></tr>
<tr><td>9</td><td></td><td></td><td></td></tr>
<tr><td>A</td><td></td><td></td><td></td></tr>
<tr><td>B</td><td></td><td></td><td></td></tr>
<tr><td>C</td><td></td><td></td><td></td></tr>
<tr><td>D</td><td></td><td></td><td></td></tr>
<tr><td>E</td><td></td><td></td><td></td></tr>
<tr><td>F</td><td></td><td></td><td></td></tr>
</table></td><td>0000 to FFFF
HEX setting</td><td>0000</td></tr>
</table>

Items			Details	Setting range (Unit)	Standard setting
SP035	SFNC3*	Spindle function 3	Set the spindle function 3 in bit units.	0000 to FFFF HEX setting	0000
SP036	SFNC4*	Spindle function 4	Set the spindle function 4 in bit units.	0000 to FFFF HEX setting	0000

SP035 SFNC3* Spindle function 3

Set the spindle function 3 in bit units.

F	E	D	C	B	A	9	8

7	6	5	4	3	2	1	0
				lbsd	hbsd	lwid	hwid

(Note) Always set "0" for the empty bits.

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

SP036 SFNC4* Spindle function 4

Set the spindle function 4 in bit units.

F	E	D	C	B	A	9	8
						dslm	dssm

7	6	5	4	3	2	1	0
		enc2	enc1	mag2	mag1	plg2	plg1

(Note) Always set "0" for the empty bits.

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

Items			Details	Setting range (Unit)	Standard setting
SP037	SFNC5*	Spindle function 5	Set the spindle function 5 in bit units.	0000 to FFFF HEX setting	0000

F	E	D	C	B	A	9	8
splg	dplg				noplg	nsno	nosg

7	6	5	4	3	2	1	0
					plgo	mago	enco

(Note) Always set "0" for the empty bits.

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

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

Items			Details	Setting range (Unit)	Standard setting
SP038	SFNC6*	Spindle function 6	Set the spindle function 6 in bit units.	0000 to FFFF HEX setting	0000

F	E	D	C	B	A	9	8
oplp	lmx	iqsv	XFzs	dcsn	lmnp	pl80	sdt2

7	6	5	4	3	2	1	0
vfbs	orm	adin	tdn	plg2	pftm		alty

(Note) Always set "0" for the empty bits.

bit	Name	Meaning when set to 0	Meaning when set to 1
0	alty	Deceleration stop during special alarm invalid	Deceleration stop during special alarm valid
1			
2	pftm	Encoder feedback serial communication invalid	Encoder feedback serial communication valid
3	plg2	Semi-closed pulse output signal×2 invalid	Semi-closed pulse output signal×2 valid
4	tdn	Fixed control bit	
5	adin		
6	orm	Orientation start memo invalid	Orientation start memo valid
7	vfbs	Fixed control bit	
8	sdt2		
9	pl80		
A	lmnp		
B	dcsn		
C	XFzs		
D	iqsv		
E	lmx		
F	oplp	Open loop operation invalid	Open loop operation valid

Items			Details	Setting range (Unit)	Standard setting
SP039	ATYP*	Drive unit type	Set the drive unit type. Set each drive unit type or "0"	0000 to FFFF HEX setting	0000

Parameter setting	Drive unit type
0000	——
0001	SP − 075
0002	SP − 15
0003	SP − 22
0004	SP − 37
0005	SP − 55
0006	SP − 75
0007	SP − 110
0008	SP − 150
0009	SP − 185
000A	SP − 220
000B	SP − 260
000C	SP − 300

<table>
<tr><th colspan="3">Items</th><th>Details</th><th>Setting range (Unit)</th><th>Standard setting</th></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".
Set the appropriate motor number from the standard motors listed below.
<table>
<tr><th>Parameter setting</th><th>Motor type</th><th>Maximum speed</th><th>Corre-sponding 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>SP – 22</td></tr>
<tr><td>0002</td><td>SJ – 3.7A</td><td>10000 r/min</td><td>SP – 37</td></tr>
<tr><td>0003</td><td>SJ – 5.5A</td><td>8000 r/min</td><td>SP – 55</td></tr>
<tr><td>0004</td><td>SJ – 7.5A</td><td>8000 r/min</td><td>SP – 75</td></tr>
<tr><td>0005</td><td>SJ – 11A</td><td>6000 r/min</td><td>SP – 110</td></tr>
<tr><td>0006</td><td>SJ – 15A</td><td>6000 r/min</td><td>SP – 150</td></tr>
<tr><td>0007</td><td>SJ – 18.5A</td><td>6000 r/min</td><td>SP – 185</td></tr>
<tr><td>0008</td><td>SJ – 22A</td><td>4500 r/min</td><td>SP – 220</td></tr>
<tr><td>0009</td><td>SJ – 26A</td><td>4500 r/min</td><td>SP – 260</td></tr>
<tr><td>000A</td><td>SJ – 30A</td><td>4500 r/min</td><td>SP – 300</td></tr>
<tr><td>000B</td><td></td><td></td><td></td></tr>
<tr><td>000C</td><td></td><td></td><td></td></tr>
<tr><td>000D</td><td></td><td></td><td></td></tr>
<tr><td>000E</td><td></td><td></td><td></td></tr>
<tr><td>000F</td><td></td><td></td><td></td></tr>
<tr><td>0010</td><td></td><td></td><td></td></tr>
<tr><td>0011</td><td>SJ – N0.75A</td><td>10000 r/min</td><td>SP – 075</td></tr>
<tr><td>0012</td><td>SJ – N1.5A</td><td>10000 r/min</td><td>SP – 15</td></tr>
<tr><td>0013</td><td>SJ – N2.2A</td><td>10000 r/min</td><td>SP – 22</td></tr>
<tr><td>0014</td><td>SJ – N3.7A</td><td>10000 r/min</td><td>SP – 37</td></tr>
<tr><td>0015</td><td>SJ – N5.5A</td><td>8000 r/min</td><td>SP – 55</td></tr>
<tr><td>0016</td><td>SJ – N7.5A</td><td>8000 r/min</td><td>SP – 75</td></tr>
<tr><td>0017</td><td></td><td></td><td></td></tr>
<tr><td>0018</td><td></td><td></td><td></td></tr>
<tr><td>0019</td><td></td><td></td><td></td></tr>
<tr><td>001A</td><td></td><td></td><td></td></tr>
<tr><td>001B</td><td>SJ – J2.2A</td><td>10000 r/min</td><td>SP – 22</td></tr>
<tr><td>001C</td><td>SJ – J3.7A</td><td>10000 r/min</td><td>SP – 37</td></tr>
<tr><td>001D</td><td>SJ – J5.5A</td><td>8000 r/min</td><td>SP – 55</td></tr>
<tr><td>001E</td><td>SJ – J7.5A</td><td>8000 r/min</td><td>SP – 75</td></tr>
<tr><td>001F</td><td></td><td></td><td></td></tr>
</table>
</td><td>0000 to FFFF
HEX setting</td><td>0000</td></tr>
</table>

Items			Details	Setting range (Unit)	Standard setting
SP041	PTYP*	Power supply type	When this unit is a signal connection axis with power supply unit, set this parameter. Set "0" for this parameter for the unit which is not a signal connection axis.	0000 to FFFF HEX setting	0000

bit	Name	Meaning when set to 0	Meaning when set to 1
0–7	ptyp	Set the power supply type. (Select the model from the following table and set.)	

ptyp	Power supply type
00	Not connected
04	CV－37
06	CV－55
08	CV－75
11	CV－110
15	CV－150
19	CV－185
22	CV－220
26	CV－260
30	CV－300
37	CV－370

(Note 1) When using an external emergency stop in the MDS-C1-CV, set a value of the above setting values with "40" added.
(Example) When using an external emergency stop in CV-260,
setting value = 0026 + 0040 = 0066
(Note 2) When using CV of 22kW or more with a spindle of large capacity (37kW or more), also turn the bit 8 ON.
(Example) Setting value = CV370 + SP370 = 0137

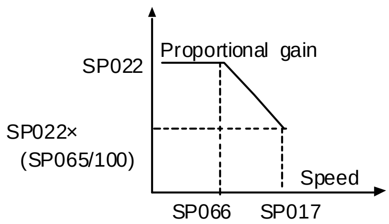
bit	Name	Meaning
8–B	rtyp	Set "0" if the power supply unit is a current regeneration type. If the power supply unit is a resistance regeneration type, set the type of resistance being used.

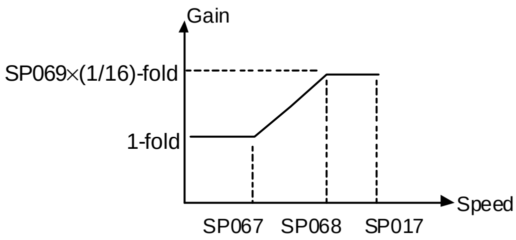
No.	Regenerative resistance type	Resistance value(Ω)	Watts(W)
0			
1	GZG200W260HMJ	26	80
2	GZG300W130HMJ x 2	26	150
3	MR-RB30	13	300
4	MR-RB50	13	500
5	GZG200W200HMJ x 3	6.7	350
6	GZG300W200HMJ x 3	6.7	500
7	R-UNIT-1	30	700
8	R-UNIT-2	15	700
9	R-UNIT-3	15	2100
A			
B			
C			
D			
E			
F			

bit	Name	Meaning
C–F	amp	Set the driver model number. 0: MDS-C1-V1/V2/SP, MDS-B-V1/V2/SP,MDS-A-V1/V2/SP 1: MDS-B-SVJ2, MDS-A-SVJ 2: MDS-B-SPJ2, MDS-A-SPJ

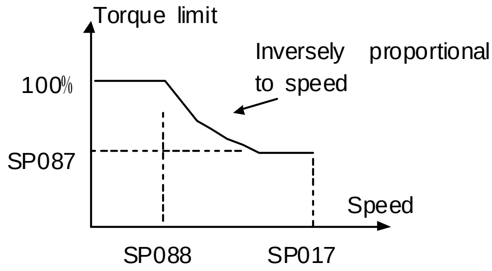
Items			Details	Setting range (Unit)	Standard setting
SP042	CRNG*	C-axis detector range	This parameter is used to set the C-axis detector range. Set "0" for this parameter.	0 to 7	0
SP043	TRNG*	Synchronous tapping, spindle synchronous detector range	This parameter is used to set the synchronous tapping or spindle synchronous detector range. Set "0" for this parameter.	0 to 7	0

Items			Details	Setting range (Unit)	Standard setting
SP044	TRANS*	NC communi-cation frequency	Set a frequency of data communication with NC.	0 to 32767	Standard: 0 Special: 1028
SP045	CSNT	Dual cushion timer	Set the cycle to add the increment values in the dual cushion process. When this setting value is increased, the dual cushion will increase, and the changes in the speed during acceleration/deceleration will become gradual.	0 to 1000 (ms)	0
SP046	CSN2*	Speed command dual cushion	For an acceleration/deceleration time constant defined in SP019 (CSN1), this parameter is used to provide smooth movement only at the start of acceleration/deceleration. As the value of this parameter is smaller, it moves smoother but the acceleration/deceleration time becomes longer. To make this parameter invalid, set "0".	0 to 1000	0
SP047	SDTR*	Speed detection reset value	Set the reset hysteresis width for a speed detection set value defined in SP020 (SDTS).	0 to 1000 (r/min)	30
SP048	SUT*	Speed reach range	Set the speed deviation rate with respect to the commanded speed for output of the speed reach signal.	0 to 100 (%)	15
SP049	TLM2	Torque limit 2	Set the torque limit rate for the torque limit signal 010.	1 to 120 (%)	20
SP050	TLM3	Torque limit 3	Set the torque limit rate for the torque limit signal 011.	1 to 120 (%)	30
SP051	TLM4	Torque limit 4	Set the torque limit rate for the torque limit signal 100.	1 to 120 (%)	40
SP052	TLM5	Torque limit 5	Set the torque limit rate for the torque limit signal 101.	1 to 120 (%)	50
SP053	TLM6	Torque limit 6	Set the torque limit rate for the torque limit signal 110.	1 to 120 (%)	60
SP054	TLM7	Torque limit 7	Set the torque limit rate for the torque limit signal 111.	1 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 60 (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. However, a larger value is effective for impact response.	0 to 100 (%)	50
SP057	STOD*	Fixed control constant	Set by Mitsubishi. Set "0" unless designated in particular.	0	0
SP058	SDT2*	Fixed control constant	Set by Mitsubishi. Set "0" unless designated in particular.	0	0
SP059	MKT*	Winding changeover base interception timer	Set the base interception time for contactor switching at winding 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 winding changeover	Set the current limit time to be taken after completion of contactor switching at winding changeover.	0 to 10000 (ms)	500

Items			Details	Setting range (Unit)	Standard setting
SP061	MKIL*	Current limit value after winding changeover	Set the current limit value during a period defined in SP060 (MKT2) after completion of contactor switching at winding 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.	0 to 1000 (s)	60
SP064	OLL*	Overload alarm detection level	Set the detection level of the motor overload alarm.	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
SP066	VCSN1*	Change starting speed of variable speed loop proportional gain	Set the speed when the speed loop proportional gain change starts. 	0 to 32767 (r/min)	0
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

<table>
<tr><th colspan="3">Items</th><th>Details</th><th>Setting range (Unit)</th><th>Standard setting</th></tr>
<tr><td>SP069</td><td>VIGN*</td><td>Target value of variable current loop gain</td><td>Set the magnification of current loop gain (torque component and excitation component) for a change ending speed defined in SP068 (VIGWB).
When this parameter is set to "0", the magnification is 1.
<table>
<tr><th>SP017 (TSP) Maximum motor speed</th><th>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 rowspan="5">Fixed control constant</td><td rowspan="5">Set by Mitsubishi.
Set "0" unless designated in particular.</td><td rowspan="5">0</td><td rowspan="5">0</td></tr>
<tr><td>SP072</td><td>VR2WB*</td></tr>
<tr><td>SP073</td><td>VR2GN*</td></tr>
<tr><td>SP074</td><td>IGDEC*</td></tr>
<tr><td>SP075</td><td>R2KWS</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>0</td><td>14</td></tr>
<tr><td>SP078</td><td>FPWM*</td><td rowspan="5">Fixed control constant</td><td rowspan="5">Set by Mitsubishi.
Set "0" unless designated in particular.</td><td rowspan="5">0</td><td rowspan="5">0</td></tr>
<tr><td>SP079</td><td>ILMT*</td></tr>
<tr><td>SP080</td><td></td></tr>
<tr><td>SP081</td><td>LMCA</td></tr>
<tr><td>SP082</td><td>LMCB</td></tr>
<tr><td>SP083
to
SP086</td><td></td><td></td><td>Not used. Set to "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>
</table>

<table>
<tr><th colspan="3">Items</th><th>Details</th><th>Setting range (Unit)</th><th>Standard setting</th></tr>
<tr><td>SP088</td><td>DIQN*</td><td>Speed for starting change of variable torque limit magnification at deceleration</td><td>Set the speed where the torque limit value at deceleration starts to change.

</td><td>0 to 32767 (r/min)</td><td>3000</td></tr>
<tr><td>SP089</td><td></td><td></td><td>Not used. Set to "0".</td><td>0</td><td>0</td></tr>
<tr><td>SP090</td><td></td><td></td><td>Not used. Set to "0".</td><td>0</td><td>0</td></tr>
<tr><td>SP091</td><td>OFSN</td><td>Motor PLG forward rotation offset compensation</td><td>Set the PLG offset value for the forward rotation.
Normally set to "0".</td><td>–2048 to 2047 (–1mv)</td><td>0</td></tr>
<tr><td>SP092</td><td>OFSI</td><td>Motor PLG reverse rotation offset compensation</td><td>Set the PLG offset value for the reverse rotation.
Normally set to "0".</td><td>–2048 to 2047 (–1mv)</td><td>0</td></tr>
<tr><td>SP093</td><td>ORE*</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>SP094</td><td>LMAV*</td><td>Load meter output filter</td><td>Set the filter time constant of load meter output.
When "0" is set, a filter time constant is set to 100ms.</td><td>0 to 32767 (2ms)</td><td>0</td></tr>
<tr><td>SP095</td><td>VFAV*</td><td>Fixed control constant</td><td>Set by Mitsubishi.
Set "0" unless designated in particular.</td><td>0</td><td>0</td></tr>
<tr><td>SP096</td><td>EGAR*</td><td>Encoder gear ratio</td><td>Set the gear ratio between the spindle end and the encoder end (except for the motor-built-in encoder) as indicated below.
<table><tr><th>Setting value</th><th>Gear ratio (deceleration)</th><th>Setting value</th><th>Gear ratio (acceleration)</th></tr><tr><td>0</td><td>1 : 1</td><td>–1</td><td>1 : 2</td></tr><tr><td>1</td><td>1 : 1/2</td><td>–2</td><td>1 : 4</td></tr><tr><td>2</td><td>1 : 1/4</td><td>–3</td><td>1 : 3</td></tr><tr><td>3</td><td>1 : 1/8</td><td></td><td></td></tr><tr><td>4</td><td>1 : 1/16</td><td></td><td></td></tr></table></td><td>–3 to 4</td><td>0</td></tr>
</table>

<table>
<tr><th colspan="3">Items</th><th>Details</th><th>Setting range (Unit)</th><th>Standard setting</th></tr>
<tr><td>SP097</td><td>SPECO*</td><td>Orientation specification</td><td>
Set the orientation specifications in bit units.
<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></tr>
<tr><td>ostp</td><td>orze</td><td>ksft</td><td>gchg</td><td></td><td>ips2</td><td>zdir</td><td></td></tr>
</table>
<table>
<tr><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>vg8x</td><td>mdir</td><td>fdir</td><td>osc1</td><td>pyfx</td><td>dmin</td><td>odi2</td><td>odi1</td></tr>
</table>
(Note) Always set "0" for the empty bits.
<table>
<tr><th>bit</th><th>Name</th><th>Meaning when set to 0</th><th>Meaning when set to 1</th></tr>
<tr><td>0</td><td>odi1</td><td colspan="2" rowspan="2">Orientation rotation direction
00: Previous (the direction in which the motor has so far rotated under speed control)
01: Forward rotation
10: Backward rotation
11: Prohibited (Same as setting value = 10)</td></tr>
<tr><td>1</td><td>odi2</td></tr>
<tr><td>2</td><td>dmin</td><td>Orientation in-position advance invalid</td><td>Orientation in-position advance valid</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></tr>
<tr><td>4</td><td>osc1</td><td>Fixed control bit</td><td></td></tr>
<tr><td>5</td><td>fdir</td><td>Encoder detector polarity: +</td><td>Encoder detector polarity: –</td></tr>
<tr><td>6</td><td>mdir</td><td>Magnetic sensor polarity: +</td><td>Magnetic sensor polarity: –</td></tr>
<tr><td>7</td><td>vg8x</td><td>Fixed control bit</td><td></td></tr>
<tr><td>8</td><td></td><td></td><td></td></tr>
<tr><td>9</td><td>zdir</td><td>Fixed control bit</td><td></td></tr>
<tr><td>A</td><td>ips2</td><td>2nd in-position invalid</td><td>2nd in-position valid</td></tr>
<tr><td>B</td><td></td><td></td><td></td></tr>
<tr><td>C</td><td>gchg</td><td rowspan="4">Fixed control bit</td><td rowspan="4"></td></tr>
<tr><td>D</td><td>ksft</td></tr>
<tr><td>E</td><td>orze</td></tr>
<tr><td>F</td><td>ostp</td></tr>
</table>
<table>
<tr><td></td><td></td><td colspan="2">In-position advance (bit 2)</td></tr>
<tr><td></td><td></td><td>0 (invalid)</td><td>1 (valid)</td></tr>
<tr><td rowspan="2">Second in-position</td><td>0 (Invalid)</td><td rowspan="2">In-position signal in OINP width=1
Control output 4/ bit 4=1
Second in-position signal=0
Control output 4/ bit F=1</td><td>In-position signal in OINP width=1
Control output 4/ bit 4=1
Second in-position signal=0
Control output 4/ bit F=0</td></tr>
<tr><td>1 (Valid)</td><td>In-position signal in DINP width=1
Control output 4/ bit 4=1
Second in-position signal in OINP width = 1
Control output 4/ bit F=1</td></tr>
</table>
</td><td>0000 to FFFF
HEX setting</td><td>0000</td></tr>
<tr><td>SP098</td><td>VGOP*</td><td>Speed loop gain proportional term in orientation mode</td><td>Set the speed loop proportional gain in orientation mode.
When the gain is increased, rigidity is improved in the orientation stop but vibration and sound become larger.</td><td>0 to 1000
(1/s)</td><td>63</td></tr>
<tr><td>SP099</td><td>VGOI*</td><td>Speed loop gain integral term in orientation mode</td><td>Set the speed loop integral gain in orientation mode.</td><td>0 to 1000
(0.1 1/s)</td><td>60</td></tr>
<tr><td>SP100</td><td>VGOD*</td><td>Speed loop gain delay advance term in orientation mode</td><td>Set the speed loop gain delay advance gain in orientation mode.
When this parameter is set to "0", PI control is applied.</td><td>0 to 1000
(0.1 1/s)</td><td>15</td></tr>
</table>

Items			Details	Setting range (Unit)	Standard setting
SP101	DINP*	Orientation advance in-position width	When using the orientation in-position 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°)	16
SP102	OODR*	Excessive error value in orientation mode	Set the excessive error width in orientation mode.	0 to 32767 (1/4 pulse) (1 pulse= 0.088°)	32767
SP103	FTM*	Index positioning completion OFF time timer	Set the time for forcedly turning 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 for orientation servo locking	Set the torque limit value for orientation in-position output. If the external torque limit signal is input, the torque limit value set with this parameter becomes invalid.	0 to 120 (%)	100
SP105	IQG0*	Current loop gain magnification 1 in orientation mode	Set the magnification for current loop gain (torque component) at orientation completion.	1 to 1000 (%)	100
SP106	IDG0*	Current loop gain magnification 2 in orientation mode	Set the magnification for current loop gain (excitation component) at orientation completion.	1 to 1000 (%)	100
SP107	CSP2	Deceleration rate 2 in orientation mode	Set the deceleration rate in orientation mode corresponding to the gear 001. When this parameter is set to "0", the rate will be the same as SP006 (CSP).	0 to 1000	0
SP108	CSP3	Deceleration rate 3 in orientation mode	Set the deceleration rate in orientation mode corresponding to the gear 010. When this parameter is set to "0", the rate will be the same as SP006 (CSP).	0 to 1000	0
SP109	CSP4	Deceleration rate 4 in orientation mode	Set the deceleration rate in orientation mode corresponding to the gear 011. When this parameter is set to "0", the rate will be the same as SP006 (CSP).	0 to 1000	0
SP110	WCML	Fixed control constants	Set by Mitsubishi. Set "0" unless designated in particular.	0	0
SP111	WDEL	Fixed control constants	Set by Mitsubishi. Set "0" unless designated in particular.	0	0
SP112	WCLP	Fixed control constants	Set by Mitsubishi. Set "0" unless designated in particular.	0	0
SP113	WINP	Fixed control constants	Set by Mitsubishi. Set "0" unless designated in particular.	0	0

Items			Details	Setting range (Unit)	Standard setting
SP114	OPER	Orientation 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°/4096)	0
SP115 to SP118			Set by Mitsubishi. Set "0" unless designated in particular.	0	0
SP119	MPGH	Orientation position gain H winding compensation magnification	Set the compensation magnification of the orientation position loop gain for the H winding. H winding orientation position loop gain = SP001 (or SP002) × SP119/256 When this parameter is set to "0", the magnification will become the same as SP001 or SP002.	0 to 2560 (1/256-fold)	0
SP120	MPGL	Orientation position gain L winding compensation magnification	Set the compensation magnification of the orientation position loop gain for the L winding. L winding orientation position loop gain = SP001 (or SP002) × SP120/256 When this parameter is set to "0", the magnification will become the same as SP001 or SP002.	0 to 2560 (1/256-fold)	0
SP121	MPCSH	Orientation deceleration rate H winding compensation magnification	Set the compensation magnification of the orientation deceleration rate for the H winding. Orientation deceleration rate for the H winding = SP006 × SP121/256 When this parameter is set to "0", the magnification will become the same as SP006.	0 to 2560 (1/256-fold)	0
SP122	MPCSL	Orientation deceleration rate L winding compensation magnification	Set the compensation magnification of the orientation deceleration rate for the L winding. Orientation deceleration rate for the L winding = SP006 × SP122/256 When this parameter is set to "0", the magnification 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 adjustment of orientation operation of the magnetic sensor. Set the output peak value of the magnetic sensor. If a gap between the sensor and the magnetizing element is small, increase the value of this parameter. If it is large, decrease the value of this parameter.	1 to 10000	Standard magnetizing element: 542 Small magnetizing element: 500
SP124	MGD1	Magnetic sensor linear zone width	This parameter is used for adjustment of orientation operation of the magnetic sensor. Set the linear zone width of the magnetic sensor. If the radius of the mounted magnetizing element is large, decrease the value of this parameter. If it is small, increase the value of this parameter.	1 to 10000	Standard magnetizing element: 768 Small magnetizing element: 440
SP125	MGD2	Magnetic sensor switching point	This parameter is used for adjustment of orientation operation of the magnetic sensor. Set the distance dimension from the target stop point at switching from position feedback to magnetic sensor output. Normally, set a value that is approx. 1/2 of the value defined in SP124.	1 to 10000	Standard magnetizing element: 384 Small magnetizing element: 220

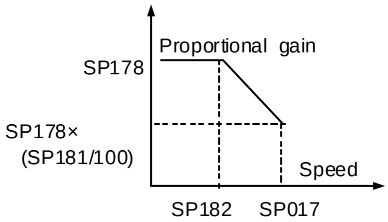
<table>
<tr><th colspan="3">Items</th><th>Details</th><th>Setting range (Unit)</th><th>Standard setting</th></tr>
<tr><td>SP126
to
SP128</td><td></td><td></td><td>Not used. Set to "0".</td><td>0</td><td>0</td></tr>
<tr><td>SP129</td><td>SPECC*</td><td>C-axis specifications</td><td>Set the C-axis specifications in bit units.
<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></tr>
<tr><td>zrtn</td><td>ptyp</td><td>fb9x</td><td>zrtd</td><td>zrn2</td><td></td><td>zdir</td><td>ztyp</td></tr>
</table>
<table>
<tr><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>vg8x</td><td></td><td>fdir</td><td></td><td></td><td></td><td>adin</td><td>fclx</td></tr>
</table>
(Note) Always set "0" for the empty bits.
<table>
<tr><th>bit</th><th>Name</th><th>Meaning when set to 0</th><th>Meaning when set to 1</th></tr>
<tr><td>0</td><td>fclx</td><td>Closed loop</td><td>Semi-closed loop (Gear 1 : 1 only)</td></tr>
<tr><td>1</td><td>adin</td><td>Interpolation A/D compensation invalid</td><td>Interpolation A/D compensation valid</td></tr>
<tr><td>2</td><td></td><td></td><td></td></tr>
<tr><td>3</td><td></td><td></td><td></td></tr>
<tr><td>4</td><td></td><td></td><td></td></tr>
<tr><td>5</td><td>fdir</td><td>Position detector direction (+)</td><td>Position detector direction (–)</td></tr>
<tr><td>6</td><td></td><td></td><td></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></tr>
<tr><td>8</td><td>ztyp</td><td>Z-phase type: Normal start up</td><td>Z-phase type: Start up only</td></tr>
<tr><td>9</td><td>zdir</td><td>Z-phase rising polarity (+)</td><td>Z-phase rising polarity (–)</td></tr>
<tr><td>A</td><td></td><td></td><td></td></tr>
<tr><td>B</td><td>zrn2</td><td>Fixed control bit</td><td></td></tr>
<tr><td>C</td><td>zrtd</td><td>Fixed control bit</td><td></td></tr>
<tr><td>D</td><td>fb9x</td><td>Speed feedback Standard (PLG)</td><td>Speed feedback 90,000 pulse detector</td></tr>
<tr><td>E</td><td>ptyp</td><td>Position control switch type: After zero point return</td><td>Position control switch type: After deceleration stop</td></tr>
<tr><td>F</td><td>zrtn</td><td>Zero point return direction: CCW</td><td>Zero point return direction: CW</td></tr>
</table></td><td></td><td>0000</td></tr>
<tr><td>SP130</td><td>PGC1</td><td>First position loop gain for cutting on C-axis</td><td>Set the position loop gain when the first gain is selected for C-axis cutting.</td><td>1 to 100
(1/s)</td><td>15</td></tr>
<tr><td>SP131</td><td>PGC2</td><td>Second position loop gain for cutting on C-axis</td><td>Set the position loop gain when the second gain is selected for C-axis cutting.</td><td>1 to 100
(1/s)</td><td>15</td></tr>
<tr><td>SP132</td><td>PGC3</td><td>Third position loop gain for cutting on C-axis</td><td>Set the position loop gain when the third gain is selected for C-axis cutting.</td><td>1 to 100
(1/s)</td><td>15</td></tr>
<tr><td>SP133</td><td>PGC4</td><td>Stop position loop gain for cutting on C-axis</td><td>Set the position loop gain for stopping when carrying out C-axis cutting.</td><td>1 to 100
(1/s)</td><td>15</td></tr>
<tr><td>SP134</td><td>VGCP0*</td><td>C-axis non-cutting speed loop gain proportional item</td><td>Set the speed loop proportional gain in C-axis non-cutting mode.</td><td>0 to 5000
(1/s)</td><td>63</td></tr>
</table>

Items			Details	Setting range (Unit)	Standard setting
SP135	VGCI0*	C-axis non-cutting speed loop gain integral item	Set the speed loop integral gain in C-axis non-cutting mode.	0 to 5000 (0.1 1/s)	60
SP136	VGCD0*	C-axis non-cutting speed loop gain delay advance item	Set the speed loop delay advance gain in C-axis non-cutting mode. When this parameter is set to "0", PI control is applied.	0 to 5000 (0.1 1/s)	15
SP137	VGCP1*	First speed loop gain proportional item for C-axis cutting	Set the speed loop proportional gain when the first gain is selected for C-axis cutting.	0 to 5000 (1/s)	63
SP138	VGCI1*	First speed loop gain integral item for cutting on C-axis	Set the speed loop integral gain when the first gain is selected for C-axis cutting.	0 to 5000 (0.1 1/s)	60
SP139	VGCD1*	First speed loop gain delay advance item for cutting on C-axis	Set the speed loop delay advance gain when the first gain is selected for C-axis cutting. When this parameter is set to "0", PI control is applied.	0 to 5000 (0.1 1/s)	15
SP140	VGCP2*	Second speed loop gain proportional item for cutting on C-axis	Set the speed loop proportional gain when the second gain is selected for C-axis cutting.	0 to 5000 (1/s)	63
SP141	VGCI2*	Second speed loop gain integral item for cutting on C-axis	Set the speed loop integral gain when the second gain is selected for C-axis cutting.	0 to 5000 (0.1 1/s)	60
SP142	VGCD2*	Second speed loop gain delay advance item for cutting on C-axis	Set the speed loop delay advance gain when the second gain is selected for C-axis cutting. When this parameter is set to "0", PI control is applied.	0 to 5000 (0.1 1/s)	15
SP143	VGCP3*	Third speed loop gain proportional item for cutting on C-axis	Set the speed loop proportional gain when the third gain is selected for C-axis cutting.	0 to 5000 (1/s)	63
SP144	VGCI3*	Third speed loop gain integral item for cutting on C-axis	Set the speed loop integral gain when the third gain is selected for C-axis cutting.	0 to 5000 (0.1 1/s)	60

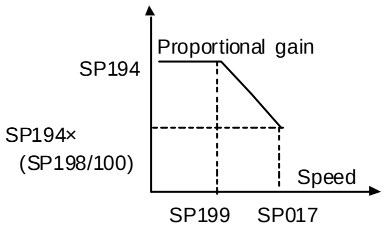
Items			Details	Setting range (Unit)	Standard setting
SP145	VGCD3*	Third speed loop gain delay advance item for cutting on C-axis	Set the speed loop delay advance gain when the third gain is selected for C-axis cutting. When this parameter is set to "0", PI control is applied.	0 to 5000 (0.1 1/s)	15
SP146	VGCP4*	Speed loop gain proportional item for stop of cutting on C-axis	Set the speed loop proportional gain when C-axis cutting is stopped.	0 to 5000 (1/s)	63
SP147	VGCI4*	Speed loop gain integral item for stop of cutting on C-axis	Set the speed loop integral gain when C-axis cutting is stopped.	0 to 5000 (0.1 1/s)	60
SP148	VGCD4*	Speed loop gain delay advance item for stop of cutting on C-axis	Set the speed loop delay advance gain when C-axis cutting is stopped. When this parameter is set to "0", PI control is applied.	0 to 5000 (0.1 1/s)	15
SP149	CZRN	C-axis zero point return speed	This parameter is valid when SP129 (SPECC) bitE is set to "0". Set the zero point return speed used when the speed loop changes to the position loop.	1 to 500 (r/min)	50
SP150	CPDT	C-axis zero point return deceleration point	This parameter is valid when SP129 (SPECC) bitE is set to "0". Set the deceleration rate where the machine starts to decelerate when it returns to the target stop point during C-axis zero point return. When the machine tends to overshoot at the stop point, set a smaller value.	1 to 10000	1
SP151	CPSTL	C-axis zero point return shift amount (low byte)	This parameter is valid when SP129 (SPECC) bitE is set to "0". Set the C-axis zero point position.	HEX setting 00000000 to FFFFFFFF (1/1000°)	H: 0000 L: 0000
SP152	CPSTH	C-axis zero point return shift amount (high byte)			
SP153	CINP	C-axis in-position width	Set the position error range in which the in-position signal is output on the C-axis.	0000 to FFFF (1/1000°) HEX setting	03E8
SP154	CODRL*	Excessive error width on C-axis (low byte)	Set the excessive error width on the C-axis.	HEX setting 00000000 to FFFFFFFF (1/1000°)	H: 0001 L: D4C0
SP155	CODRH*	Excessive error width on C-axis (high byte)			
SP156 to SP158			Not used. Set to "0".	0	0

Items			Details	Setting range (Unit)	Standard setting
SP159	CPY0	C-axis non-cutting variable excitation ratio	Set the minimum value of variable excitation ratio for non-cutting on the C-axis.	0 to 100 (%)	50
SP160	CPY1	C-axis cutting variable excitation ratio	Set the minimum variable excitation ratio for cutting on the C-axis.	0 to 100 (%)	100
SP161	IQGC0*	Current loop gain magnification 1 for non-cutting on C-axis	Set the magnification of current loop gain (torque component) for C-axis non-cutting.	1 to 1000 (%)	100
SP162	IDGC0*	Current loop gain magnification 2 for non-cutting on C-axis	Set the magnification of current loop gain (excitation component) for C-axis non-cutting.	1 to 1000 (%)	100
SP163	IQGC1*	Current loop gain magnification 1 for cutting on C-axis	Set the magnification of current loop gain (torque component) for C-axis cutting.	1 to 1000 (%)	100
SP164	IDGC1*	Current loop gain magnification 2 for cutting on C-axis	Set the magnification of current loop gain (excitation component) for C-axis cutting.	1 to 1000 (%)	100
SP165	PG2C	C-axis position loop gain 2	Set the second position loop gain when high-gain control is carried out for control of the C-axis. This parameter is applied to all the operation modes of C-axis control. When this function is not used, assign "0".	0 to 999 (1/s)	0
SP166	PG3C	C-axis position loop gain 3	Set the third position loop gain when high-gain control is carried out for control of the C-axis. This parameter is applied to all the operation modes of C-axis control. When this function is not used, assign "0".	0 to 999 (1/s)	0
SP167	PGU*	Position loop gain for increased spindle holding force	Set the position loop gain for when the disturbance observer is valid.	0 to 100 (1/s)	15
SP168	VGUP*	Speed loop gain proportional item for increased spindle holding force	Set the speed loop gain proportional item for when the disturbance observer is valid.	0 to 5000 (1/s)	63
SP169	VGUI*	Speed loop gain integral item for increased spindle holding force	Set the speed loop gain integral item for when the disturbance observer is valid.	0 to 5000 (0.1 1/s)	60

<table>
<tr><th colspan="3">Items</th><th>Details</th><th>Setting range (Unit)</th><th>Standard setting</th></tr>
<tr><td>SP170</td><td>VGUD*</td><td>Speed loop gain delay advance item for increased spindle holding force</td><td>Set the speed loop gain delay advance item for when the disturbance observer is valid.</td><td>0 to 5000
(0.1 1/s)</td><td>15</td></tr>
<tr><td>SP171
to
SP176</td><td></td><td></td><td>Not used. Set to "0".</td><td>0</td><td>0</td></tr>
<tr><td>SP177</td><td>SPECS*</td><td>Spindle synchronous specifications</td><td>Set the spindle synchronous specifications in bit units.
<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></tr>
<tr><td></td><td></td><td>odx8</td><td></td><td></td><td></td><td></td><td></td></tr>
</table>
<table>
<tr><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>fdir</td><td></td><td>pyfx</td><td></td><td>adin</td><td>fclx</td></tr>
</table>
(Note) Always set "0" for the empty bits.
<table>
<tr><th>bit</th><th>Name</th><th>Meaning when set to 0</th><th>Meaning when set to 1</th></tr>
<tr><td>0</td><td>fclx</td><td>Closed loop</td><td>Semi-closed loop</td></tr>
<tr><td>1</td><td>adin</td><td>Interpolation A/D compensation invalid</td><td>Interpolation A/D compensation valid</td></tr>
<tr><td>2</td><td></td><td></td><td></td></tr>
<tr><td>3</td><td>pyfx</td><td>Normal excitation</td><td>Position loop excitation fixed (strong)</td></tr>
<tr><td>4</td><td></td><td></td><td></td></tr>
<tr><td>5</td><td>fdir</td><td>Position detector polarity (+)</td><td>Position detector polarity (–)</td></tr>
<tr><td>6</td><td></td><td></td><td></td></tr>
<tr><td>7</td><td></td><td></td><td></td></tr>
<tr><td>8</td><td></td><td></td><td></td></tr>
<tr><td>9</td><td></td><td></td><td></td></tr>
<tr><td>A</td><td></td><td></td><td></td></tr>
<tr><td>B</td><td></td><td></td><td></td></tr>
<tr><td>C</td><td></td><td></td><td></td></tr>
<tr><td>D</td><td>odx8</td><td>Magnification of excessive error width × 8 times invalid</td><td>Magnification of excessive error width × 8 times valid</td></tr>
<tr><td>E</td><td></td><td></td><td></td></tr>
<tr><td>F</td><td></td><td colspan="2">(Used with SPJ)</td></tr>
</table></td><td>0000 to FFFF
HEX setting</td><td>0000</td></tr>
<tr><td>SP178</td><td>VGSP*</td><td>Spindle synchronous speed loop gain proportional term</td><td>Set the speed loop proportional gain in spindle synchronous mode.</td><td>0 to 1000
(1/s)</td><td>63</td></tr>
<tr><td>SP179</td><td>VGSI*</td><td>Spindle synchronous speed loop gain integral term</td><td>Set the speed loop integral gain in spindle synchronous mode.</td><td>0 to 1000
(0.1 1/s)</td><td>60</td></tr>
<tr><td>SP180</td><td>VGSD*</td><td>Spindle synchronous speed loop gain delay advance term</td><td>Set the speed loop delay advance gain in spindle synchronous mode.
When this parameter is set to "0", PI control is applied.</td><td>0 to 1000
(0.1 1/s)</td><td>15</td></tr>
<tr><td>SP181</td><td>VCGS*</td><td>Spindle synchronous target value of variable speed loop proportional gain</td><td>Set the magnification of speed loop proportional gain with respect to SP178 (VGSP) at the maximum speed defined in SP017 (TSP) in spindle synchronous mode.</td><td>0 to 100 (%)</td><td>100</td></tr>
</table>

Items			Details	Setting range (Unit)	Standard setting
SP182	VCSS*	Spindle synchronous change starting speed of variable speed loop proportional gain	Set the speed when the speed loop proportional gain change starts in the spindle synchronous mode.  	0 to 32767 (r/min)	0
SP183	SYNV	Spindle synchronous sync matching speed	For changeover from the speed loop to the position loop in the spindle synchronous mode, set a speed command error range for output of the synchronous speed matching signal.	0 to 1000 (r/min)	20
SP184	FFCS*	Spindle synchronous acceleration rate feed forward gain	Set the acceleration rate feed forward gain in the spindle synchronous mode. This parameter is used only with the SPJ2.	0 to 1000 (%)	0
SP185	SINP	Spindle synchronous in-position width	Set the position error range for output of the in-position signal in the spindle synchronous mode.	1 to 2880 (1/16°)	16
SP186	SODR*	Spindle synchronous excessive error width	Set the excessive error width in the spindle synchronous mode.	1 to 32767 (pulse) (1 pulse =0.088°)	32767
SP187	IQGS*	Spindle synchronous current loop gain magnification1	Set the magnification of current loop gain (torque component) in the spindle synchronous mode.	1 to 1000 (%)	100
SP188	IDGS*	Spindle synchronous current loop gain magnification 2	Set the magnification of current loop gain (excitation component) in the spindle synchronous mode.	1 to 1000 (%)	100
SP189	PG2S	Spindle synchronous position loop gain 2	Set the second position loop gain when high-gain control is carried out in the spindle synchronous mode. When this parameter function is not used, set to "0".	0 to 999 (1/s)	0
SP190	PG3S	Spindle synchronous position loop gain 3	Set the third position loop gain when high-gain control is carried out in the spindle synchronous mode. When this parameter function is not used, set to "0".	0 to 999 (1/s)	0
SP191 to SP192			Not used. Set to "0".	0	0

<table>
<tr><th colspan="3">Items</th><th>Details</th><th>Setting range (Unit)</th><th>Standard setting</th></tr>
<tr><td>SP193</td><td>SPECT*</td><td>Synchronized tapping specifications</td><td>Set the synchronized tapping specifications in bit units.
<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></tr>
<tr><td>zrtn</td><td>ptyp</td><td>od8x</td><td></td><td></td><td></td><td></td><td>phos</td></tr>
</table>
<table>
<tr><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>fdir</td><td>cdir</td><td>pyfx</td><td></td><td>adin</td><td>fclx</td></tr>
</table>
(Note) Always set "0" for the empty bits.
<table>
<tr><th>bit</th><th>Name</th><th>Meaning when set to 0</th><th>Meaning when set to 1</th></tr>
<tr><td>0</td><td>fclx</td><td>Closed loop</td><td>Semi-closed loop (Gear 1 : 1 only)</td></tr>
<tr><td>1</td><td>adin</td><td>Interpolation A/D compensation invalid</td><td>Interpolation A/D compensation valid</td></tr>
<tr><td>2</td><td></td><td></td><td></td></tr>
<tr><td>3</td><td>pyfx</td><td>Normal excitation</td><td>Position loop excitation fixed (strong)</td></tr>
<tr><td>4</td><td>cdir</td><td>Command polarity (+)</td><td>Command polarity (–)</td></tr>
<tr><td>5</td><td>fdir</td><td>Position detector polarity (+)</td><td>Position detector polarity (–)</td></tr>
<tr><td>6</td><td></td><td></td><td></td></tr>
<tr><td>7</td><td></td><td></td><td></td></tr>
<tr><td>8</td><td>phos</td><td>Normal (no compensation)</td><td>Synchronized tapping position compensation valid</td></tr>
<tr><td>9</td><td></td><td></td><td></td></tr>
<tr><td>A</td><td></td><td></td><td></td></tr>
<tr><td>B</td><td></td><td></td><td></td></tr>
<tr><td>C</td><td></td><td></td><td></td></tr>
<tr><td>D</td><td>od8x</td><td>Magnification of excessive error width × 8 times invalid</td><td>Magnification of excessive error width × 8 times valid</td></tr>
<tr><td>E</td><td>ptyp</td><td>Position control switch type: After zero point return</td><td>Position control switch type: After deceleration stop</td></tr>
<tr><td>F</td><td>zrtn</td><td>Zero point return direction: CCW</td><td>Zero point return direction: CW</td></tr>
</table>
</td><td>0000 to FFFF
HEX setting</td><td>0000</td></tr>
<tr><td>SP194</td><td>VGTP*</td><td>Synchronized tapping speed loop gain proportional term</td><td>Set the speed loop proportional gain in synchronized tapping mode.</td><td>0 to 1000
(1/s)</td><td>63</td></tr>
<tr><td>SP195</td><td>VGTI*</td><td>Synchronized tapping speed loop gain integral term</td><td>Set the speed loop integral gain in synchronized tapping mode.</td><td>0 to1000
(0.1 1/s)</td><td>60</td></tr>
<tr><td>SP196</td><td>VGTD*</td><td>Synchronized tapping speed loop gain delay advance term</td><td>Set the speed loop delay advance gain in synchronized tapping mode.
When this parameter is set to "0", PI control is applied.</td><td>0 to 1000
(0.1 1/s)</td><td>15</td></tr>
<tr><td>SP197</td><td></td><td></td><td>Not used. Set "0".</td><td>0</td><td>0</td></tr>
<tr><td>SP198</td><td>VCGT*</td><td>Synchronized tapping target value of variable speed loop proportional gain</td><td>Set the magnification of speed loop proportional gain with respect to SP194 (VGTP) at the maximum motor speed defined in SP017 (TSP) in synchronized tapping mode.</td><td>0 to 100 (%)</td><td>100</td></tr>
</table>

Items			Details	Setting range (Unit)	Standard setting
SP199	VCST*	Synchronized tapping change starting speed of variable speed loop proportional gain	Set the speed where the speed loop proportional gain change starts during synchronized tapping.  	0 to 32767 (r/min)	0
SP200	FFC1*	Synchronized tapping acceleration feed forward gain (gear 1)	Set the acceleration feed forward gain for selection of gear 000 at synchronized tapping. This parameter should be used when an error of relative position to Z-axis servo is large.	0 to 1000 (%)	0
SP201	FFC2*	Synchronized tapping acceleration feed forward gain (gear 2)	Set the acceleration feed forward gain for selection of gear 001 at synchronized tapping.	0 to 1000 (%)	0
SP202	FFC3*	Synchronized tapping acceleration feed forward gain (gear 3)	Set the acceleration feed forward gain for selection of gear 010 at synchronized tapping.	0 to 1000 (%)	0
SP203	FFC4*	Synchronized tapping acceleration feed forward gain (gear 4)	Set the acceleration feed forward gain for selection of gear 011 at synchronized tapping.	0 to 1000 (%)	0
SP204 to SP213			Not used. Set "0".	0	0
SP214	TZRN	Synchronized tapping zero point return speed	This parameter is valid when SP193 (SPECT) bitE is set to "0". Set the zero point return speed used when the speed loop changes to the position loop.	0 to 500 (r/min)	50
SP215	TPDT	Synchronized tapping zero point return deceleration rate	This parameter is valid when SP193 (SPECT) bitE is set to "0". Set the deceleration rate where the machine starts to decelerate when it returns to the target stop point during synchronized tapping zero point return. When the machine tends to overshoot at the stop point set a smaller value.	0 to 10000 (pulse)	1
SP216	TPST	Synchronized tapping zero point return shift amount	This parameter is valid when SP193 (SPECT) bitE is set to "0". Set the synchronized tapping zero point position.	0 to 4095	0
SP217	TINP	Synchronized tapping in-position width	Set the position error range for output of the in-position signal during synchronized tapping.	1 to 2880 (1/16°)	16

Items			Details	Setting range (Unit)	Standard setting
SP218	TODR*	Synchronized tapping excessive error width	Set the excessive error width during synchronized tapping.	1 to 32767 (pulse) (1 pulse =0.088°)	32767
SP219	IQGT*	Synchronized tapping current loop gain magnification 1	Set the magnification of current loop gain (torque component) during synchronized tapping.	1 to 1000 (%)	100
SP220	IDGT*	Synchronized tapping current loop gain magnification 2	Set the magnification of current loop gain (excitation component) during synchronized tapping.	1 to 1000 (%)	100
SP221	PG2T	Synchronized tapping position loop gain 2	Set the second position loop gain when high-gain control is applied during synchronized tapping. When this parameter is not used, set to "0".	0 to 999 (1/s)	0
SP222	PG3T	Synchronized tapping position loop gain 3	Set the third position loop gain when high-gain control is applied during synchronized tapping. When this parameter is not used, set to "0".	0 to 999 (1/s)	0
SP223 to SP224			Not used. Set to "0".	0	0
SP225	OXKPH	Fixed control constant	Set by Mitsubishi. Set "0" unless designated in particular.	0	0
SP226	OXKPL				
SP227	OXVKP				
SP228	OXVKI				
SP229	OXSFT				
SP230					
SP231					
SP232					
SP233	JL*	Disturbance observer general inertia scale	Set the ratio of the motor inertia + load inertia and motor inertia. $\text{Setting value} = \dfrac{\text{Motor inertia + load inertia}}{\text{Motor inertia}} \times 100$ (Normally, set "0", "100" or more. When less than "50" is set, the setting will be invalid.)	0 to 5000 (%) "0", "100" or more	0
SP234	OBS1*	Disturbance observer low path filter frequency	Set the frequency of the low path filter for when the disturbance observer is valid. Setting (1/s) = $2\pi f$ f: Approx. 1.5 times the disturbance frequency	0 to 1000 (1/s)	0
SP235	OBS2*	Disturbance observer gain	Set the gain for the disturbance observer.	0 to 500 (%)	0

Items			Details	Setting range (Unit)	Standard setting
SP236 to SP248			Not used. Set to "0".	0	0
SP249	SM0	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	LM0	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 to SP252			Not used. Set to "0".	0	0
SP253	DA1NO	D/A output channel 1 data number	Set the output data number for channel 1 of the D/A output function. When this parameter is set to "0", the output is speedometer. Refer to "3.2 (2) D/A output functions".	–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 this parameter is set to "0", the output is load meter. Refer to "3.2 (2) D/A output functions".	–32768 to 32767	0
SP255	DA1MPY	D/A 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 this parameter is set to "0", the output magnification becomes 1-fold, in the same manner as when "256" is set. Refer to "3.2 (2) D/A output functions".	–32768 to 32767 (1/256-fold)	0
SP256	DA2MPY	D/A 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 this parameter is set to "0", the output magnification becomes 1-fold, in the same manner as when "256" is set. Refer to "3.2 (2) D/A output functions".	–32768 to 32767 (1/256-fold)	0
SP257 to SP320	RPM* BSD*	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.	0000 to FFFF HEX setting	0000

Items			Details	Setting range (Unit)	Standard setting
SP321 to SP384	RPML* BSDL*	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.	0000 to FFFF HEX setting	0000
SP385 to SP400		Fixed control constant	Not used. Set to "0".	0	0

(2) D/A output functions

(a) Outline

The D/A output function is mounted in the standard system in the MDS-C1-SP.
Using this D/A output function, the drive unit status and each data can be confirmed.

(b) Hardware specifications

- 2 channels
- 8 bit 0 to +10V
- Output pin CH 1: CN9-9 pin
  CH 2: CN9-19 pin
  GND: CN9-1.11 pin

(c) Parameters

Set the data No. and output magnification of each channel according to the parameters below.

Name	Details
SP253	D/A channel 1 data No.
SP254	D/A channel 2 data No.
SP255	D/A channel 1 output magnification
SP256	D/A channel 2 output magnification

(d) Output data No.

Set the No. of the data to be output in SP253 and SP254. A correlation of the output data and the data No. is shown below.

No. (setting value)	CH1		CH2	
	Output data	Units	Output data	Units
0	Speedometer output	Maximum speed at 10V	Load meter output	120% load at 10V
2	Current command	When the actual data is 4096, the current command data is regarded as 100%.	Same as CH1	
3	Current feedback	When the actual data is 4096, the current feedback data is regarded as 100%.		
4	Speed feedback	Actual data r/min		
6	Position droop low -order	Interpolation units When the actual data is 23040000, the position droop data is regarded as 360°.		
7	Position droop high-order			
8	Position F△T low-order	Interpolation units/NC communication cycle		
9	Position F△T high-order			
10	Position command low-order	Interpolation units When the actual data is 23040000, the position command data is regarded as 360°.		
11	Position command high-order			
12	Feedback position low-order	Interpolation units When the actual data is 23040000, the feedback position data is regarded as 360°.		
13	Feedback position high-order			
80	Control input 1	Bit correspondence		
81	Control input 2			
82	Control input 3			
83	Control input 4			
84	Control output 1	Bit correspondence		
85	Control output 2			
86	Control output 3			
87	Control output 4			

(Note) The % of the current command and current feedback indicate 30min. rating = 100%.

(e) Setting the output magnification

Set the output magnification in SP255 and SP256.

$$\text{DATA} = \text{actual data} \times \frac{\text{SP255 or SP256}}{256}$$

Using the expression above,

(i) Output data other than speedometer output and load meter output carries out the D/A output in Fig. 1.

(ii) Speedometer output data and load meter output data carries out the D/A output in Fig. 2.

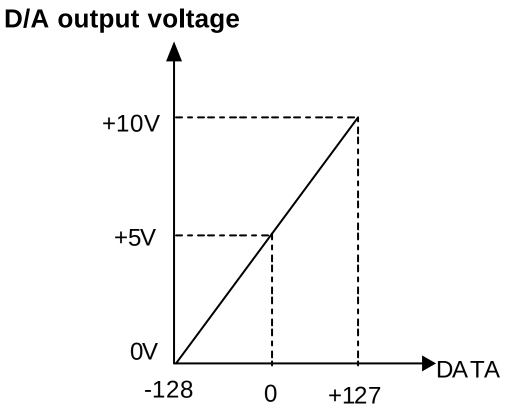


Fig. 1

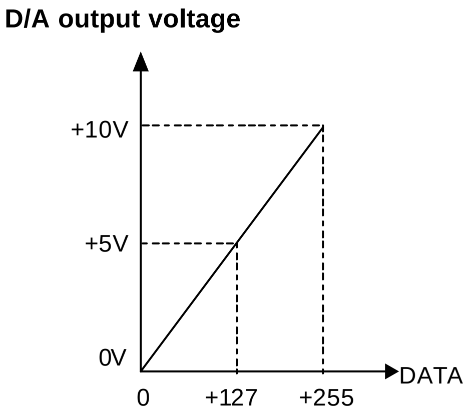


Fig. 2

(Example 1) Current command, current feedback

The data is regarded as 100% when the actual data is 4096.

Therefore, for example, the actual data is output as shown below during +120% current feedback.

Actual data = 4096 × 1.2 = 4915

If "256" is set (magnification 1) in parameter SP255 (SP256), from Fig.1, the D/A output voltage will be as shown below, exceeding the D/A output voltage maximum value.

5V + {4915 × 1 × (5V/128)} = 197V > 10V

Therefore, if "6" is set in parameter SP255 (SP256), the D/A output voltage will become as shown below, and data confirmation will be possible.

5V + {4915 × 6/256 × (5V/128)} = 9.5V < 10V

(Example 2) Speed feedback
Data unit is r/min.
Therefore, at +2000r/min, the motor speed will be output as "2000".
If "256" (magnification 1) is set in parameter SP255 (SP256), from Fig.1, the D/A output voltage will be as shown below, exceeding the D/A output voltage maximum value.

5V + {2000 × 1 × (5V/128)} = 83.125V > 10V

Therefore, if "16" is set in parameter SP255 (SP256), the D/A output voltage will become as shown below, and data confirmation will be possible.

5V + {2000 × 16/256 × (5V/128)} = 9.88V < 10V

(Example 3) Position droop
The data unit is r/min. Data is regarded as 100% when the actual data is 4096.
Therefore, for example, the actual data is output as shown below during the +0.1° position droop.

Actual data = 0.1 × 23040000/360 = 6400

If "256" (magnification 1) is set in parameter SP255 (SP256), from Fig.1, the D/A output voltage will be as shown below, exceeding the D/A output voltage maximum value.

5V + {6400 × 1 × (5V/128)} = 255V > 10V

Therefore, if "5" is set in parameter SP255 (SP256), the D/A output voltage will become as shown below, and data confirmation will be possible.

5V + {2000 × 5/256 × (5V/128)} = 9.88V < 10V

(Example 4) Confirm the orientation complete signal (ORCF) with the control output 4L.
The data unit is bit corresponding data.
Refer to the Instruction Manual for the meanings of the control output 4L bit corresponding signals.
The orientation complete signal (ORCF) corresponds to the control output 4L/bit 4.
Therefore, for example, the actual data is output as shown below when ORCF= ON.

bit 4 corresponding actual data = 2^4 = 16

If "256" is (magnification 1) set in parameter SP255 (SP256), from Fig.1, the D/A output voltage will be as shown below, and data confirmation will be possible.

5V + {16 × 1 × (5V/128)} = 5.625V < 10V

Note that, if bits other than bit4 are ON, the current of that bit will be added to the 5.625V shown above, and at the actual ORCF signal measurement will be as shown below, so confirm the changed voltage.

(5.625 V – 5V) = 0.625 V

3.3 Spindle specification parameters screen

The spindle parameters are divided into those transmitted to the spindle drive unit from the NC and those used on the NC side.

(1) Parameters transmitted to the spindle drive unit from the NC

The 384 parameters shown in section "3.2.(1)" are those transmitted from the NC to the spindle drive unit.

(2) Parameters used on NC side

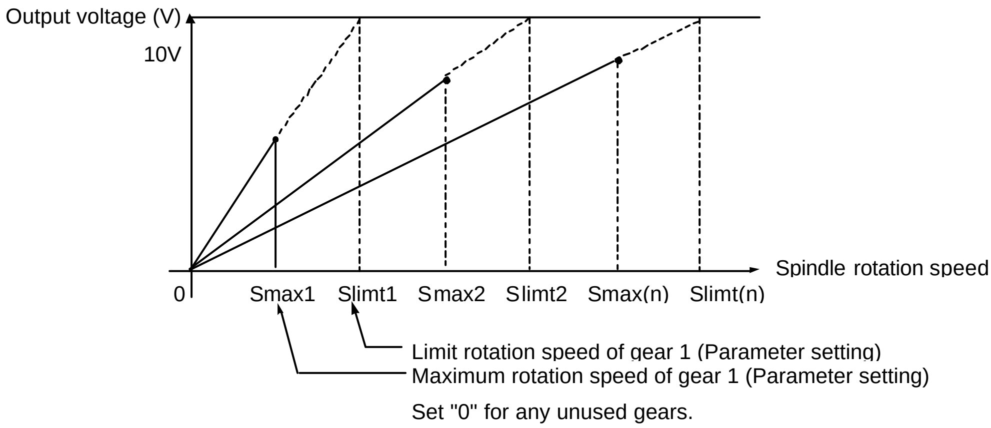
The spindle specifications parameters shown on this page are used on the NC side.

For parameters indicated with an "*" in the table, turn the CNC power OFF after setting. The setting is validated after the power is turned ON again.
In the bit explanation below, set all bits not used, including empty bits, to "0".

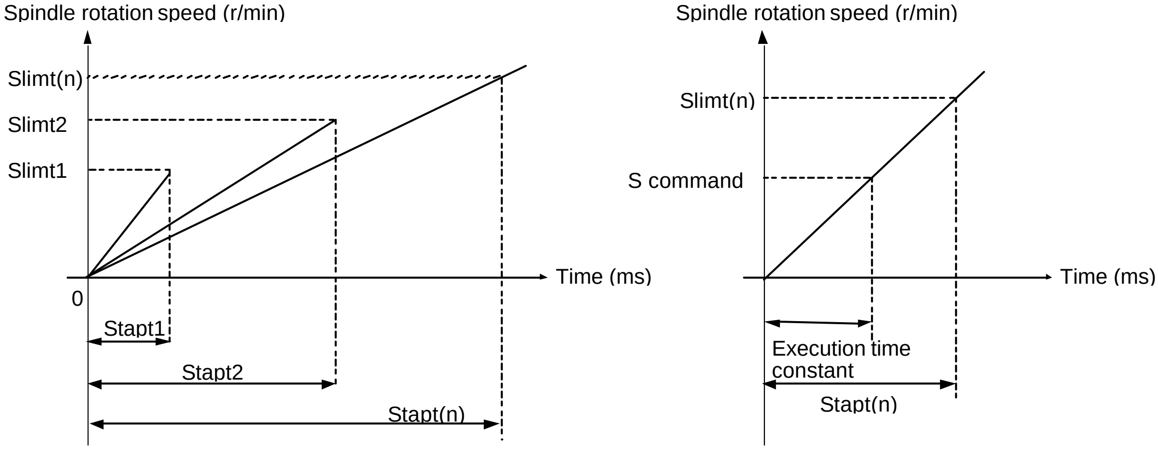
No.	Items		Details	Setting range (Unit)
1	Sp_axis_num*	Axis No.	Set the spindle control axis number. (When using analog spindle, set to "0".	0 to max. number of control axes
2	Slimit 1	Limit rotation speed Gear 00	Set spindle rotation speed for maximum motor rotation speed with gears 00, 01, 10, 11. (Set the spindle rotation speed for the S analog output 10V.)	0 to 99999 (r/min)
3	Slimit 2	Limit rotation speed Gear 01		
4	Slimit 3	Limit rotation speed Gear 10		
5	Slimit 4	Limit rotation speed Gear 11		
6	Smax 1	Maximum rotation speed Gear 00	Set maximum spindle rotation speed with gears 00, 01, 10, 11. Set the value that is equal to or larger than "Slimit" value.	0 to 99999 (r/min)
7	Smax 2	Maximum rotation speed Gear 01		
8	Smax 3	Maximum rotation speed Gear 10		
9	Smax 4	Maximum rotation speed Gear 11		
10	Ssift 1	Shift rotation speed Gear 00	Set spindle rotation speed for gear shifting with gears 00, 01, 10, 11.	0 to 32767 (r/min)
11	Ssift 2	Shift rotation speed Gear 01		
12	Ssift 3	Shift rotation speed Gear 10		
13	Ssift 4	Shift rotation speed Gear 11		
14	Stap 1	Tap rotation speed Gear 00	Set maximum spindle rotation speed during tap cycle with gears 00, 01, 10, 11.	0 to 999999 (r/min)
15	Stap 2	Tap rotation speed Gear 01		
16	Stap 3	Tap rotation speed Gear 10		
17	Stap 4	Tap rotation speed Gear 11		

No.	Items		Details	Setting range (Unit)
18	Stapt 1	Tap time constant Gear 00	Set time constants for constant inclination synchronized tapping for gears 00, 01, 10, 11.	1 to 5000 (ms)
19	Stapt 2	Tap time constant Gear 01		
20	Stapt 3	Tap time constant Gear 10		
21	Stapt 4	Tap time constant Gear 11		

Relationship between spindle limit rotation speed and maximum spindle rotation speed



Relation between the spindle limit rotation speed and the spindle tap time constant (for the constant inclination synchronized tapping)



No.	Items		Details	Setting range (unit)
22	Sori	Orientation rotation speed	Set the spindle orientation rotation speed. Set the rotation speed for rotating the spindle at the constant rotation speed.	0 to 32767 (r/min)
23	Sgear	Encoder gear ratio	Set the gear ratio of the spindle to the encoder.	0: 1/1 1: 1/2 2: 1/4 3: 1/8
24	Smini	Minimum rotation speed	Set the minimum rotation speed of the spindle. If an S command instructs the rotation speed below this setting, the spindle rotates at the minimum rotation speed set with this parameter.	0 to 32767 (r/min)
25	Serr	Spindle speed arrival detection range	Set the spindle speed arrival detection width. The detection range is obtained by the commanded rotation speed and the rate set with this parameter. When the actual spindle rotation speed is out of range, an upper or lower limit error signal is output to the PLC.	0: Not check 1 to 99 (%)
26	Senc_pno	Encoder port number	Set the port number of a connection card for an encoder.	1 to 7 : DIO 8 to 16 : RIO 17 : IOC
27	Sana_pno	Analog output port number (Not used.)	Set the port number of an analog output card.	1 to 7 : DIO 8 to 16 : RIO 17 : IOC
28	Spflg	Spindle connection information	bit0 1: HDLC connection 0: Analog connection bit2 1: Direct connection to encoder 0: Via passing HDLC connection axis bit3 Sub-motor spindle designation 1: Sub 0: Main It is no use specifying sub-motor for the spindle which the 1 drive unit 2 motor function is invalid. bit4 1: SPJ Spindle/C-axis control valid 0: SPJ Spindle/C-axis control invalid	00 to FF
29	Sana_no	Analog output number	Set the connection card number for an encoder. (Not used.)	0 to FF

No.	Items		Details	Setting range (unit)
30	Sana_ofs	Offset for spindle analog output adjustment	Set the offset voltage for spindle analog output. <Adjustment method > 1) Command the spindle speed "0" with S command. 2) Measure the output voltage of the designated port. 3) Set the value obtained in the following equation to this parameter. Set value = –8191 × Offset voltage (V)/10.56 4) After setting this parameter, confirm that the output voltage is "0V" again.	-4095 to 4095
31	Sana_gin	Gain for spindle analog output adjustment	Set the data for gain adjustment for analog output. <Adjustment method > 1) Set the standard set value "4095" to the No. of the designated file register R. 2) Measure the output voltage of the designated port. 3) Set the value obtained in the following equation to this parameter. Set value = Proper voltage (V)/ Measured voltage (V) × 4096 4) After setting this parameter, confirm that the output voltage is "10.0V" again.	0 to 9999

3.4 Spindle monitor screen

The current state of the spindle can be confirmed on the NC screen.
The monitor screen is shown on this page.

```
[SPINDLE MONITOR]

GAIN      (1/s)      0   D/I   1L 00000000 UNIT TYP        00000000
DROOP       (i)    160          H 00000000 UNIT NO         00000000
SPEED   (r/min)      0         2L 00000000 S/W VER         00000000
LOAD        (%)      0          H 00000000 1 WORK TIME     00000000
AMP DISP            D4         3L 00000000 2 ALM HIST 1    00000000
ALARM                           H 00000000            2    00000000
CYC CNT     (P) -10240         4L 00000000            3    00000000
                                H 00000000            4    00000000
                                                      5    00000000
                         D/O   1L 00000000            6    00000000
                                H 00000000            7    00000000
                               2L 00000000            8    00000000
                                H 00000000
                               3L 00000000   MNT           00000000
                                H 00000000     /SYS        00000000
                               4L 00000000
                                H 00000000
```

Data	Unit	Display details
GAIN	1/s	The position loop gain during operation of the spindle with the position command is displayed.
DROOP	pulse	The position deflection during operation of the spindle with the position command is displayed.
SPEED	r/min	The motor rotation speed is displayed.
LOAD	%	The motor load (load ratio) is displayed. The 30 min. rating is 100%.
AMP DISP		The data of the 7-segment LED display for the spindle drive unit is displayed.
ALARM		The alarm No. is displayed when an alarm other than that displayed on the spindle drive unit's 7-segment LED.
CYC CNT		The current position from the position detector's reference position (Z-phase) when operating the spindle with the position command is displayed.
D/I 1L H		The control input signal 1 input from the NC to the spindle drive unit is displayed in correspondence to the bits. (Refer to section "(1-1)" for details.)
D/I 2L H		Same as above (control input signal 2)
D/I 3L H		Same as above (control input signal 3)
D/I 4L H		Same as above (control input signal 4)
D/O 1L H		The control output signal 1 output from the spindle drive unit to the NC is displayed in correspondence to the bits. (Refer to section "(2-1)" for details.)
D/O 2L H		Same as above (control output signal 2)
D/O 3L H		Same as above (control output signal 3)
D/O 4L H		Same as above (control output signal 4)
UNIT TYP		The spindle drive unit type is displayed.
UNIT NO		The spindle drive unit serial No. is displayed.
S/W VER		The main software version in the spindle drive unit is displayed.
1 WORK TIME		The cumulative working time of the spindle drive unit is displayed.
2 ALM HIST 1~8		The alarm history is displayed. 1 is the latest alarm.

(1-1) D/I (Control input) 1L H

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
G1					TL3	TL2	TL1	ALMR	PRM					SRV	RDY

bit	Name	Description
0	RDY	Ready ON command
1	SRV	Servo ON command
2		
3		
4		
5		
6	PRM	Parameter conversion command
7	ALMR	Servo alarm reset command
8	TL1	Torque limit 1
9	TL2	Torque limit 2
A	TL3	Torque limit 3
B		
C		
D		
E		
F	G1	Cutting

(1-2) D/I (Control input) 2L H

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

* Not used at this time.?

(1-3) D/I (Control input) 3L H

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
	MS	LCS	ORC	WRI	WRN	SRI	SRN	GR3	GR2	GR1	SC5	SC4	SC3	SC2	SC1

bit	Name	Description
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	GR3	Gear selection command 3
8	SRN	Forward run start command
9	SRI	Reverse run start command
A	WRN	Index forward run command
B	WRI	Index reverse run command
C	ORC	Orientation start command
D	LCS	L coil selection command (during coil changeover)
E	MS	Sub-motor selection command (during 1-drive unit 2-motor changeover)
F		

(1-4) D/I (Control input) 4L H

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

＊ Not used at this time.

(2-1) D/O (Control output) 1L H

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
	INP	ZFIN			TL3A	TL2A	TL1A	ALM	PRM		DWN			SON	RON

bit	Name	Description
0	RON	In ready ON
1	SON	In servo ON
2		
3		
4	DWN	In drive unit warning
5		
6	PRM	In parameter conversion
7	ALM	In alarm
8	TL1A	In torque limit 1
9	TL2A	In torque limit 2
A	TL3A	In torque limit 3
B		
C		
D	ZFIN	Z-phase passed
E	INP	In position loop in-position
F		

(2-2) D/O (Control output) 2L H

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

＊ Not used at this time.

(2-3) D/O (Control output) 3L H

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
	MSA	LCSA	ORCA	WRIA	WRNA	SRIA	SRNA	GR3A	GR2A	GR1A	SC5A	SC4A	SC3A	SC2A	SC1A

bit	Name	Description
0	SC1A	In spindle control mode s election command 1
1	SC2A	In spindle control mode selection command 2
2	SC3A	In spindle control mode selection command 3
3	SC4A	In spindle control mode selection command 4
4	SC5A	In spindle control mode selection command 5
5	GR1A	In gear selection command 1
6	GR2A	In gear selection command 2
7	GR3A	In gear selection command 3
8	SRNA	In forward run start command
9	SRIA	In reverse run start command
A	WRNA	In index forward run command
B	WRIA	In index reverse run command
C	ORCA	In orientation start command
D	LCSA	In L coil selection command (during coil changeover)
E	MSA	In sub-motor selection command (during 1-drive unit 2-motor changeover)
F		

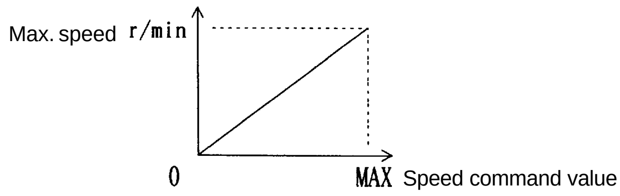
(2-4) D/O (Control output) 4L H

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
								WRCF	MKC	SYSA	ORCF	ZS	US	SD	CD

bit	Name	Description
0	CD	Current detection
1	SD	Speed detection
2	US	Speed reached
3	ZS	Zero speed
4	ORCF	Orientation complete
5	SYSA	Synchronous speed match
6	MKC	In coil changeover
7	WRCF	Index positioning complete
8		
9		
A		
B		
C		
D		
E		
F		

3.5 Control input signals

(1) Speed command input



(a) When the speed command value is 0, the motor speed will be 0; and when the speed command value is the maximum value, the motor speed will be the maximum motor speed set in parameter SP017 (TSP).
(b) The motor will forward run and reverse run with the forward run and reverse run start commands. (The motor will not rotate with only the speed command value.)

(2) Forward run start command (SRN)

(a) When SRN is ON, the motor will run in the clockwise direction (CW) from the shaft side according to the commanded speed.
(b) When SRN is OFF, the motor will decelerate to a stop, the transistor base interception will be carried out and the motor will stop.
(c) The orientation movement will be a priority when the orientation command is input.

(3) Reverse run start command (SRI)

(a) When SRI is ON, the motor will run in the counterclockwise direction (CCW) from the shaft side according to the commanded speed.
(b) When SRI is OFF, the motor will decelerate to a stop, the transistor base interception will be carried out and the motor will stop.
(c) The orientation movement will be a priority when the orientation command is input.

(4) Torque limit 1, 2, 3 input (TL1, TL2, TL3)

(a) The torque limit will temporarily reduce the motor output torque during mechanical spindle orientation or gear shift, etc., and will rotate the motor.
(b) The following seven torque limit values can be used according to the combination of the TL1, TL2 and TL3 bit inputs.

TL3	TL2	TL1	Torque limit value
0	0	1	Torque limit value (%) set with parameter 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

(Note) % indicates the percentage to the motor 30 min. rating torque.

(5) Orientation start command input (ORC)

(a) This is the orientation movement start signal. When ORC is ON, the orientation will start regardless of the operation command (SRN, SRI).
(b) When ORC is OFF, the motor will start rotating at the commanded speed again if either forward run (SRN) or reverse run (SRI) is input.
(c) The orientation movement will be a priority when the orientation command is input.

(6) Gear selection command 1, 2, 3 input (GR1, GR2, GR3)

(a) The spindle gear step for orientation movement or various position control movements is selected.
(b) The following eight gear steps can be selected according to the combination of the GR1, GR2 and GR3 3bit inputs.
(c) Do not change the signal while the orientation command or servo ON command is input.

GR3	GR2	GR1	Parameters used to set the gear ratio
0	0	0	SP025 (GRA1), SP029 (GRB1)
0	0	1	SP026 (GRA2), SP030 (GRB2)
0	1	0	SP027 (GRA3), SP031 (GRB3)
0	1	1	SP028 (GRA4), SP032 (GRB4)
1	0	0	SP225 (GRA5), SP229 (GRB5)
1	0	1	SP226 (GRA6), SP230 (GRB6)
1	1	0	SP227 (GRA7), SP231 (GRB7)
1	1	1	SP228 (GRA8), SP232 (GRB8)

(7) Index forward run command input (WRN), reverse run command input (WRI)

(a) This is the command input for forward run index or reverse run index during multipoint orientation. This will be valid only when the orientation start signal is ON.
(b) The forward run index will start from the CCW direction from the motor shaft end and the reverse run index will start from the CW direction.

(8) L coil selection command input (LCS)

(a) This is the command input signal for selecting the low-speed coil or high-speed coil when changing the coils.
(b) The high-speed coil is selected when LCS is OFF, and the low-speed coil is selected when LCS is ON.

(9) Sub-motor selection command input (MS)

(a) This is the command input signal for selecting the main spindle motor or sub general-purpose motor during the 1-drive unit 2-motor specifications changeover.
(b) The main motor is selected when MS is OFF, and the sub-motor is selected when MS is ON.

(10) Cutting input (G1)

This signal determines whether cutting is being performed during C-axis control.
The operation will be determined as cutting when G1 is ON.

(11) Spindle control mode selection command 1, 2, 3, 4, 5 input (SC1, SC2, SC3, SC4, SC5)

The operation mode during spindle drive unit position control is selected with the bits.
The selections shown below are used.

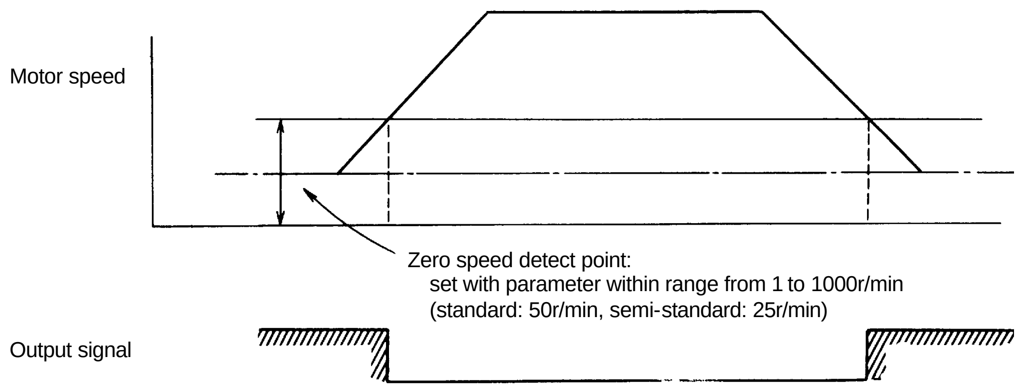
SC5	SC4	SC3	SC2	SC1	Operation mode
0 0	1 1	0 ≀ 0	0 1	0 1	Synchronous tap operation mode
0 0	1 1	1 ≀ 1	0 1	0 1	C-axis operation mode
1 1	0 0	0 ≀ 0	0 1	0 1	Spindle synchronous operation mode

(Note) The normal speed operation mode will be entered when bits other than the above are selected.

3.6 Control output signals

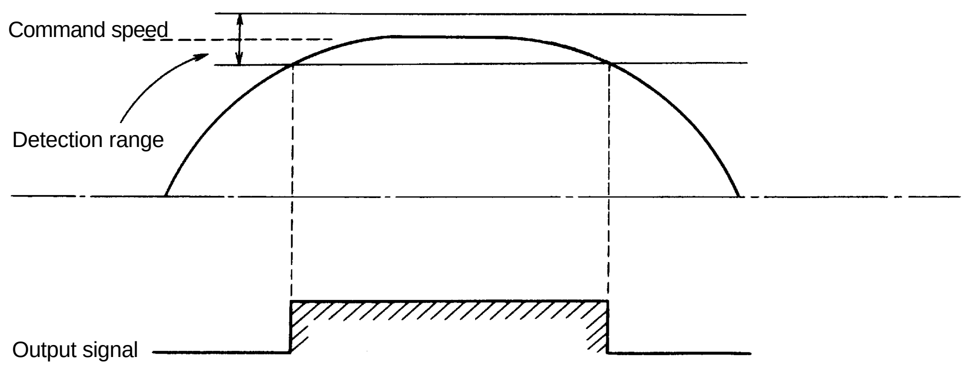
(1) Zero speed output signal (ZS)

(a) ZS will turn ON if the actual motor rotation speed drops below the zero speed detection point in regard to the stop command.
(b) The signal is output whether run command signal is SRN (forward run) or SRI (reverse run).
(c) The minimum output pulse width is about 200ms.
(d) The zero speed detection speed is set with parameter SP018 (ZSP) in the range of 1 to 1000r/min.

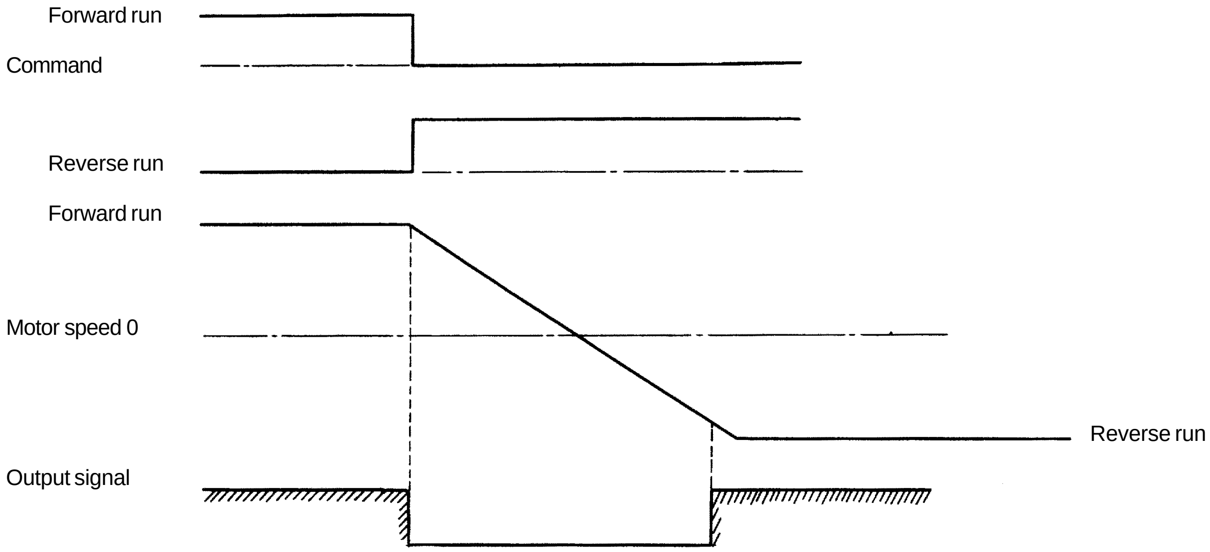


(2) Up-to-speed output signal (US)

(a) US will turn ON when the actual motor rotation speed reaches ±15% of the commanded speed.

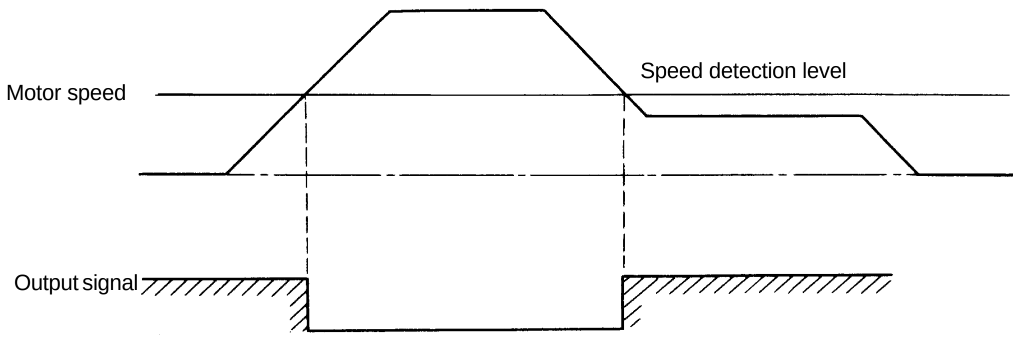


(b) The signal is not output unless either SRN or SRI will turn ON.
(c) The signal can be used to verify implementation of forward run (M03) or reverse run (M04) command.
(d) If the reverse run command will turn ON, the motor will start deceleration. The US signal will turn OFF, and after confirming that the reached signal will turn ON, the reverse run command will be completed.



(3) Speed detection output (SD)

(a) SD will turn ON when the speed drops below the speed set in parameter SP020 (SDTS).
(b) The SD signal will turn ON when the motor speed's absolute value drops below the set detection level regardless of the run command (SRN, SRI).



(4) Orientation complete output (ORCF)

ORCF will turn ON when the spindle position is currently within the in-position range set with parameter SP004 (OINP) during orientation.

(5) Current detect output (CD)

CD will turn ON when the current value is 110% or more than the rated current.

(6) Forward run starting command output (SRNA)

This is the answer output to the forward run start command input (SRN).

(7) Reverse run starting command output (SRIA)

This is the answer output to the reverse run start command input (SRI).

(8) Torque limiting 1, 2, 3 output (TL1A, TL2A, TL3A)

This is the answer output to the torque limit 1, 2, 3 input (TL1, TL2, TL3).

(9) Orientation starting command output (ORCA)

This is the answer output to the orientation start command input (ORC).

(10) Gear selecting command 1, 2, 3 output (GR1A, GR2A, GR3A)

This is the answer output to the gear selection command 1, 2, 3 input (GR1, GR2, GR3).

(11) Index forward run command output (WRNA), reverse run command output (WRIA)

This is the answer output to the index forward run command (WRN) and reverse run command (WRI).

(12) L coil selection command output (LCSA)

This is the answer output to the L coil selection command input (LCS).

(13) Sub-motor selection command output (MSA)

This is the answer output to the sub-motor selection command (MS).

(14) Synchronous speed match output (SYSA)

SYSA will turn ON when the movement from the speed operation mode to the spindle synchronous operation mode becomes possible during spindle synchronous operation.

(15) Coil changeover output (MKC)

MKC will turn ON for a set time when changing over from the L coil to the H coil or the H coil to the L coil during coil changeover.

(16) Index positioning complete output (WRCF)

WRCF will turn ON when indexing is completed during indexing.

(17) Drive unit warning output (DWN)

DWN will turn ON when any warning occurs in the spindle drive unit.

(18) Alarm output (ALM)

ALM will turn ON when any alarm occurs in the spindle drive unit.

(19) Z-phase passed output (ZFIN)

ZFIN will turn ON when the Z-phase is passed for the first time after the servo will turn ON during position control.

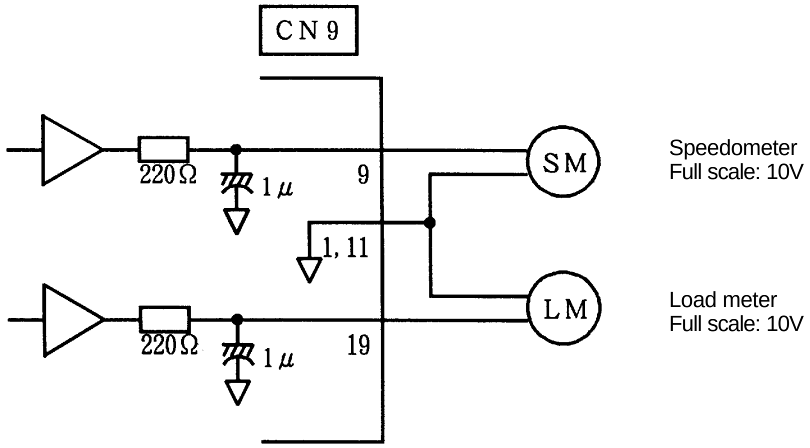
(20) Position loop in-position output (INP)

INP will turn ON when the current position is within the in-position range set with parameters during positioning other than orientation. INP will turn OFF when the servo turns OFF.

(21) Spindle control mode selection command 1, 2, 3, 4, 5 output (SC1A, SC2A, SC3A, SC4A, SC5A)

This is the answer output to the spindle control mode selection command 1, 2, 3, 4, 5 input (SC1, SC2, SC3, SC4, SC5).

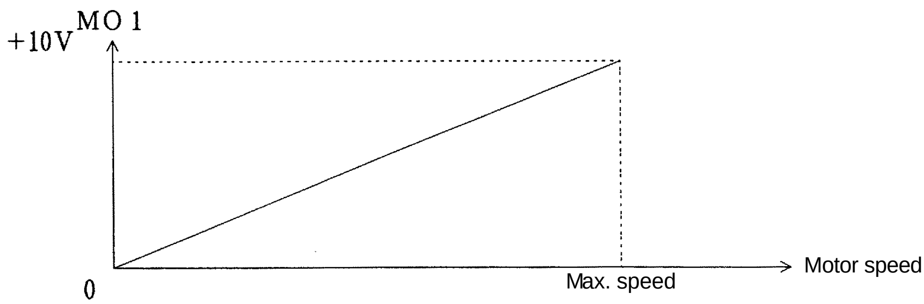
3.7 Meter outputs



(1) Speedometer output

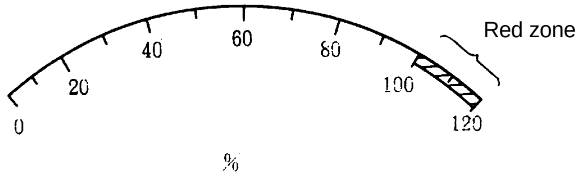
(a) The following specification is recommended for speedometer.
- (i) Model : YM-8G DC voltmeter (Mitsubishi)
- (ii) Rating : 10VDC full scale
- (iii) Internal impedance : About 10kΩ

(b) +10VDC is output at the motor max speed, regardless of rotation direction.

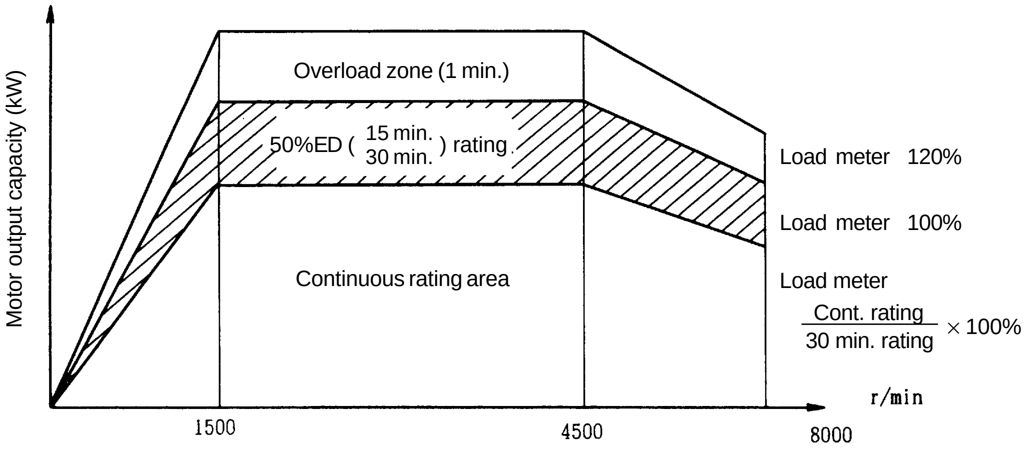


(2) Load meter output

(a) The following specification is recommended for load meter.
- (i) Model : YM-8G DC voltmeter (Mitsubishi)
- (ii) Rating : 10VDC full scale
- (iii Internal impedance : About 10kΩ
- (iv) Scale



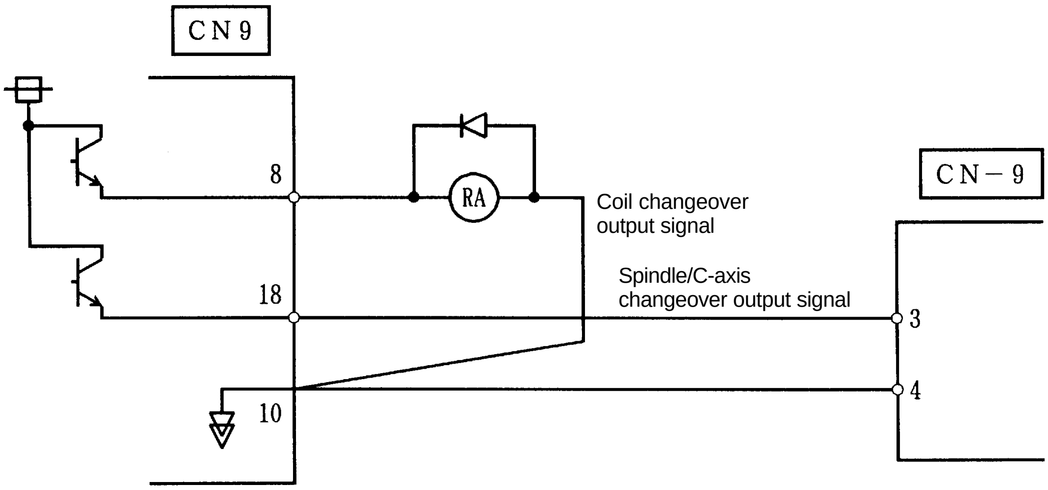
(b) Reading of load meter is percent (%) of load to the rated motor output. The relationship between motor output capacity [kW] and load meter reading [r/min] is as follows:



3.8 Output interface

Open emitter output

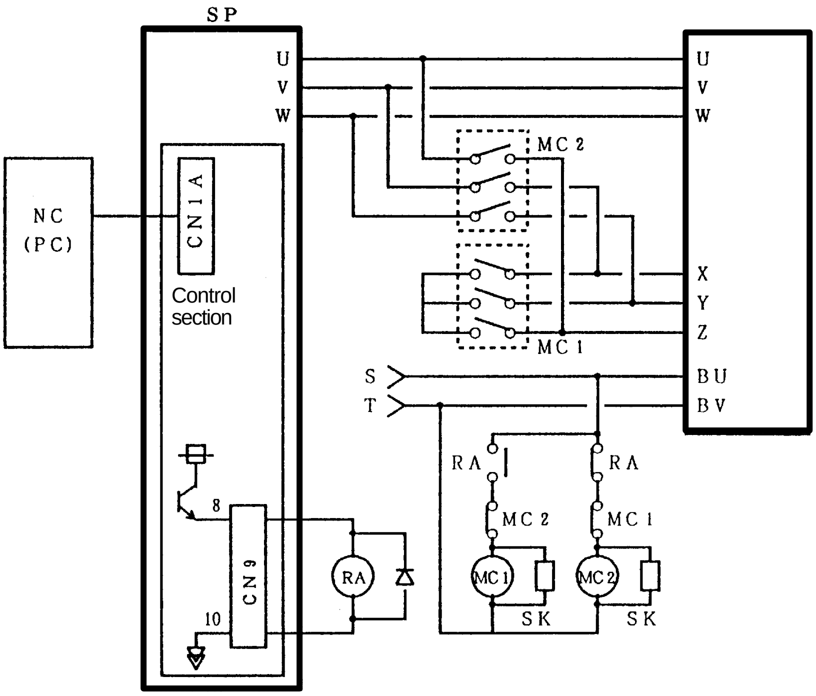
Output transistor rating
M54630P TR array
Tolerable voltage : 24VDC or less
Tolerable current : 50mA or less (per output)



<Spindle drive unit> **<MHE90K (AD converter)>**

(Note 1) Connect the spindle/C-axis changeover output signal only when using the MHE90K detector.
(Note 2) The changeover circuit configuration for coil changeover is as shown below.

<Spindle drive unit> **<AC spindle motor>**



- The relays, contactors, cables, etc., for the spindle drive unit and AC spindle motor that are not enclosed in the bold line must be prepared by the machine maker.
- The relay (RA) must be connected in parallel with the flywheel diode; and the contactors (MC1, MC2) must be connected in parallel with the CR surge absorber coil.

* During low-speed coil selection .... 人 connection (Turn MC1 ON, MC2 OFF)
During high-speed coil selection .... Λ connection (Turn MC1 OFF, MC2 ON)

3.9 Spindle protection/warning functions

Reset methods are indicated as follows:

AR: Turn ON the spindle drive unit again.
PR: Turn ON the CNC again.
NR: Reset the CNC.

Alarm No.	Abbr.	Name	Meaning	Reset method
12	ME1	Memory error 1	A check sum in the ROM or a RAM check error occurred in the spindle drive's control card.	AR
13	SWE	S/W process error	The S/W process did not end within the specified time.	PR
17	ADE	AD error	The AD converter for current detection did not function normally during initialization.	PR
21	NS2	No signal (Spindle encoder)	A signal was not input from the spindle encoder (for orientation, C-axis), or was not at a normal level.	PR
23	OSE	Speed excessive error	The command speed and motor speed difference was above the specified value, and the state continued for the specified time.	PR
31	OS	Overspeed	The motor speed exceeded 115% of the set max. speed.	PR
32	PMOC	Overcurrent	A current exceeding the specified value flowed to the IMP used for spindle drive's main circuit.	PR
34	DP	CRC error	A CRC error occurred in the communication data from the NC.	PR
35	DE	Data error	The movement command data from the NC is abnormally high during position control.	PR
36	TE	Transmission error	The periodic data transmission from the NC was stopped.	PR
37	PE	Initial parameter error	The parameter is out of the tolerable range.	PR
38	TP1	Protocol error 1 (frame)	There was a protocol error in the communication with the NC. (Frame error)	PR
39	TP2	Protocol error 2 (information)	There was a protocol error in the communication with the NC. (Information error)	PR
3B	PMOH	Power module overheat	An overheat in the IPM used for the drive's main circuit was detected.	PR
40	KE1	TK unit changeover error	The procedure for changing the signal during use of the TK unit is wrong.	PR
41	KE2	TK communications error	Communication with the TK unit during use of the TK unit was not performed correctly.	PR
43	FE	Feedback error	A deviation occurred in the feedback from the spindle encoder and motor built-in encoder.	PR
44	CAXE	C-axis changeover alarm	When using the coil changeover motor, the C-axis was controlled with the H coil.	NR
46	OHM	Motor overheat	The motor overheated and the built-in thermal protector functioned because an overload occurred or the motor cooling blower stopped.	NR
50	OL	Overload	The time that the motor current exceeded the overload detection level is more than the detection time constant.	NR
52	OD	Excessive error	The position tracking error exceeded the specified value during position loop operation.	NR
5C	ORFE	Orientation feedback error	When the orientation in-position was completed, the pulse miss value was higher than the parameter setting value (SP114:OPER).	NR

Alarm No.	Abbr.	Name	Meaning	Reset method
6F	PALM	Power supply alarm	An alarm related to the power supply has been generated.	AR
88	WD	Watch dog	88 is the watch dog alarm. Refer to the section "Servo alarms" for details.	AR
E1	WOL	Overload warning	The time that the motor current exceeded the overload detection level was 80% or more of the detection time constant.	AR
E4	WPE	Parameter error warning	A parameter out of the setting range was set. The illegal parameter will be ignored, and the value before the illegal parameter setting will be retained.	–
E7	NCE	CNC emergency stop	An emergency stop command was input form CNC.	–
E8	O	Power supply Auxiliary regeneration frequency over	The regeneration at the limit of regeneration capacity occurs frequently.	–
E9	P	Power supply Instantaneous stop warning	An Instantaneous power stop occurred for 25ms or more. (As the main circuit voltage has not dropped, an alarm has not occurred.)	NR
EA	Q	Power supply External emergency stop input	An external emergency stop signal for the power supply was input. Thus, 24V is not added to the CN23 connector.	–
EB	R	Power supply Excessive-regeneration alarm	The regeneration amount reached to 80% level of the Excessive-regeneration alarm.	–

4. Optional Specifications and Parts

⚠ WARNING
Always wait at least 15 minutes after turning the power OFF before connecting options or peripheral devices. Failure to observe this could lead to electric shocks.

⚠ CAUTION
Always use the designated peripheral devices and options. Failure to observe this could lead to faults or fires.

4.1 Orientation specifications (optional)

The following three types of orientation specifications are available:

(1) 1-point orientation using magnetic sensor
(2) 4096-point orientation using encoder
(3) 4096-point orientation using motor built-in encoder

4.1.1 1-point orientation using magnetic sensor

(1) Connection

Refer to "1.4 Configuration" for the connection of the magnetic sensor and spindle drive unit.

(2) Magnet and detection head installation direction

The magnet and detection head should be installed in the specified orientation.

Standard type and high-speed standard type

.... The <u>center reference hole</u> of magnet and <u>the reference notch</u> of detection head should come to <u>the same side</u>.

Refer to CASE 1 , CASE 2 , CASE 3 and UNACCEPTABLE EXAMPLE 1.

High-speed small type

.... The <u>reference notch</u> of detection head <u>should be positioned</u> in reference with <u>polarity (N, S)</u> of magnet.

Refer to CASE 4 , CASE 5 and UNACCEPTABLE EXAMPLE 2 .

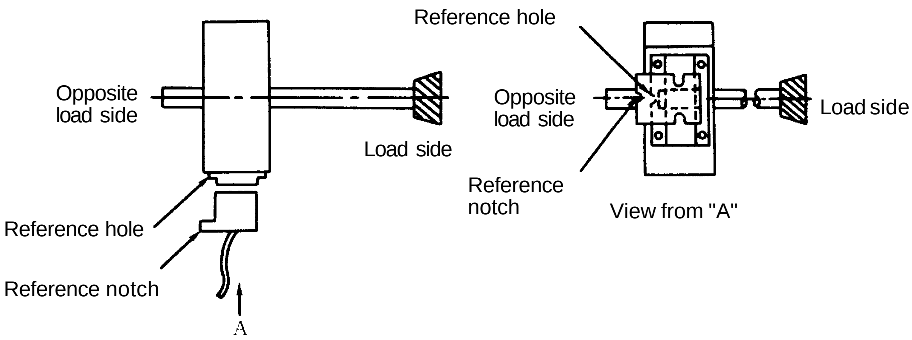
High-speed ring type

.... The <u>reference notch</u> of detection head <u>should be positioned</u> in reference with <u>polarity (N, S)</u> of magnet.

Refer to CASE 6 , CASE 7 and UNACCEPTABLE EXAMPLE 3 .

CASE 1 Magnet is installed on the circumferential surface of rotating body. (Circumferential mounting)

The reference hole of magnet and the reference notch of detection head should come to the opposite load side, as shown below.

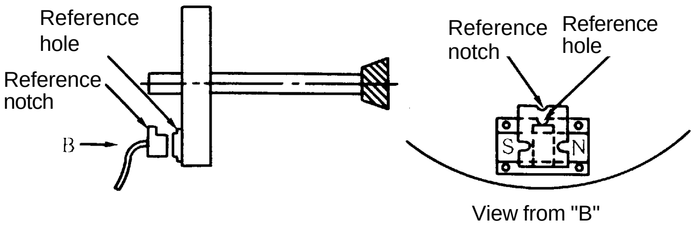


Magnet is installed on circumferential surface of rotating body.

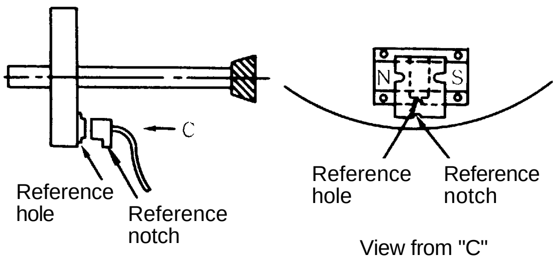
CASE 2 Magnet is installed on the front or back flat surface of rotating body. (Flat mounting)

(1) When the magnet is installed on the opposite load side of spindle, the reference hole of magnet and reference notch of detection head should face inward, as shown below.

(2) When the magnet is installed on the load side of spindle, the reference hole of magnet and reference notch of detection head should face outward, as shown below.

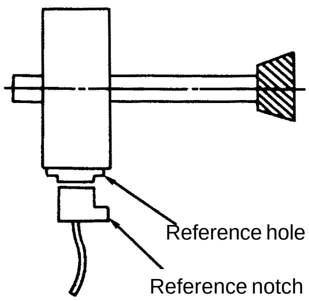


Magnet is installed on the opposite load side.



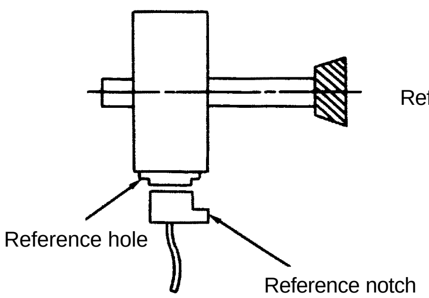
Magnet is installed on the load side.

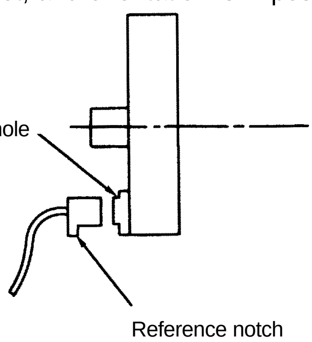
CASE 3 In regard to CASE 1 , the magnet and detection head can be changed to the following position as long as the reference hole and reference notch are aligned. With this, normal orientation can be carried out.
(However, the parameter SP097 orientation detector installation direction bit must be changed in this case.)

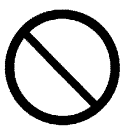


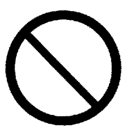
UNACCEPTABLE EXAMPLE 1

If the magnet reference hole and detection head reference notch are not aligned, intense vibration will occur on both ends of the magnet, and orientation is impossible.

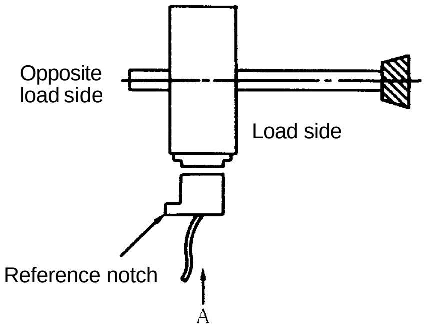


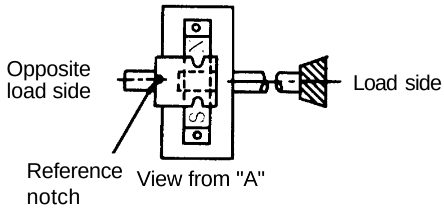






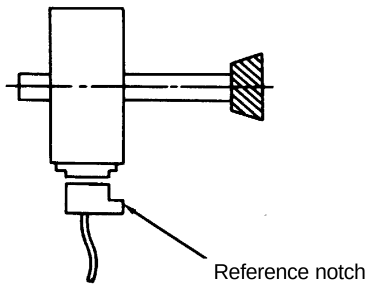
CASE 4 Magnet is installed on the circumferential surface of rotating body. (Circumferential mounting)
The detection head reference notch should be on the opposite load side and the magnet should be installed in the polarity shown below.

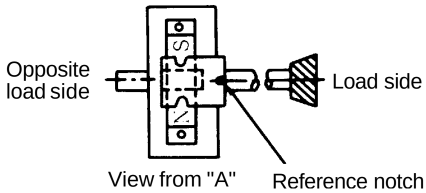




Magnet is installed on the circumferential surface of rotating body.

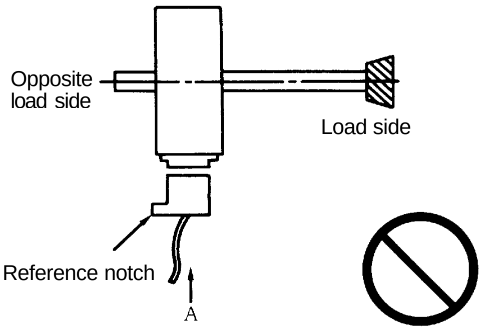
CASE 5 As long as the relation between location of the detection head reference notch and the polarity of the magnet are aligned, the detection head and the magnet can be installed as shown below in CASE 4, and normal orientation can be carried out.
(However, the parameter SP097 orientation detector installation direction bit must be changed in this case.)

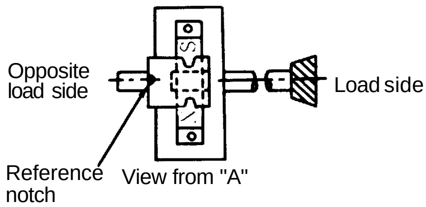




UNACCEPTABLE EXAMPLE 2

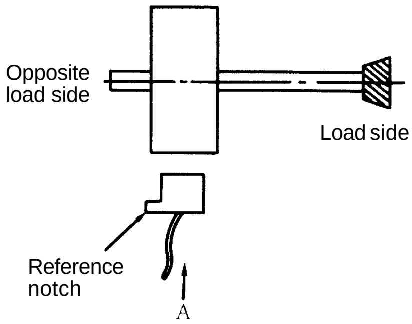
If the detection head reference notch is not aligned properly in reference to polarity of the magnet, intense vibration occurs on both ends of the magnet, and orientation is impossible.

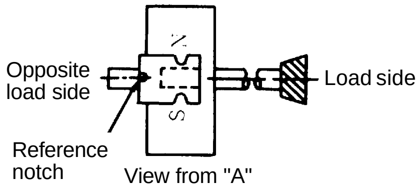




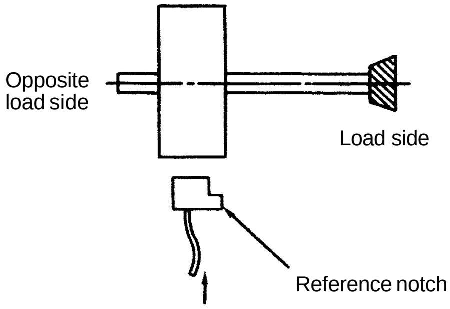
In this example, polarity (N, S) of magnet is inverse to that in CASE 4.

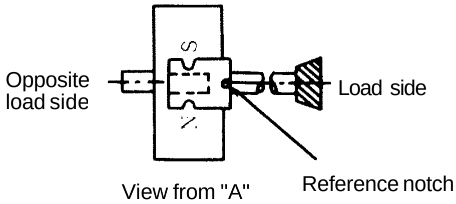
CASE 6 The detection head reference notch is on the opposite load side of spindle and the polarity of the magnet is as shown below.





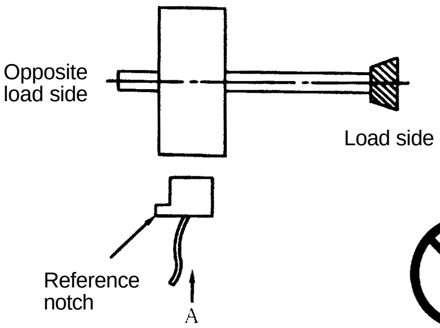
CASE 7 As long as the relation between location of detection head reference notch and the polarity of the magnet are aligned, the detection head and the magnet can be installed as shown below in CASE 4 , and normal orientation can be carried out.
(However, the parameter SP097 orientation detector installation direction bit must be changed in this case.)

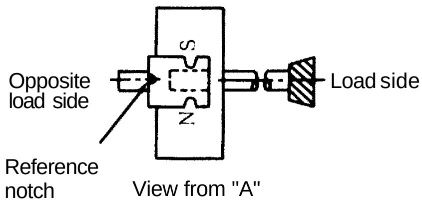


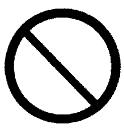


UNACCEPTABLE EXAMPLE 3

<u>If the detection head reference notch is not aligned properly in reference to polarity of the magnet</u>, intense vibration occurs on both ends of the magnet, and <u>orientation is impossible</u>.







In this example, polarity (N, S) of magnet is inverse to that in CASE 4.

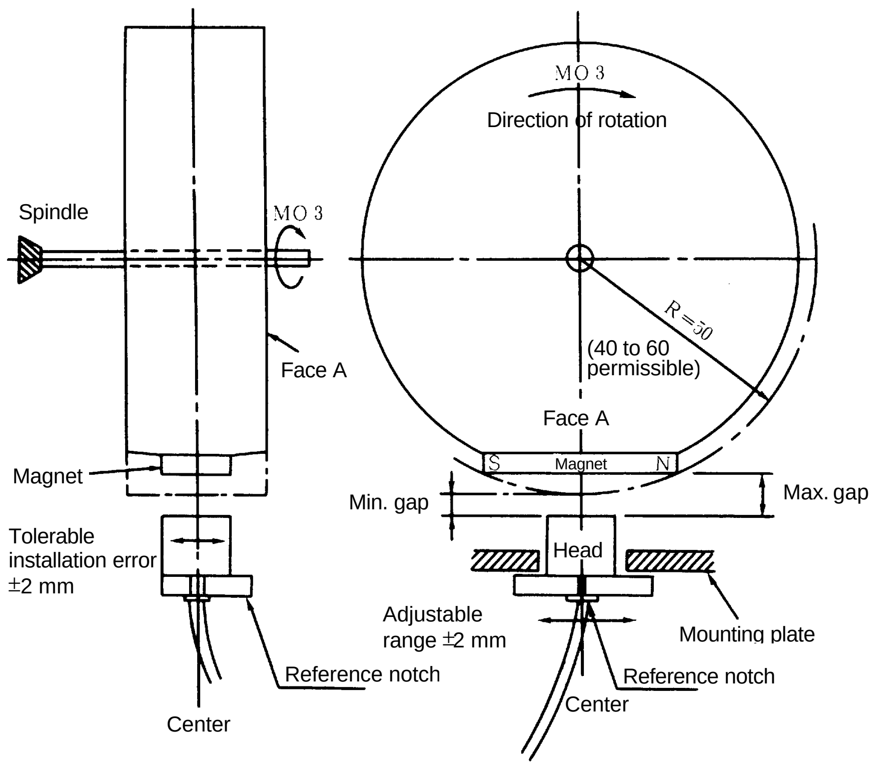


Table 1

	BKO-C1810H03 Standard		BKO-C1730H06 High-speed standard	
R (Radius) mm	**Max. gap mm**	**Min. gap mm**	**Max. gap mm**	**Min. gap mm**
40	11.5 ± 0.5	2.7 ± 0.5	10 ± 0.5	1.22 ± 0.5
50	9.5 ± 0.5	2.8 ± 0.5	8 ± 0.5	1.31 ± 0.5
60	8.5 ± 0.5	3.0 ± 0.5	7 ± 0.5	1.5 ± 0.5
70	8.0 ± 0.5	3.4 ± 0.5	7 ± 0.5	2.38 ± 0.5

Table 2

	BKO-C1810H03 Standard	BKO-C1730H06 High-speed standard
R (Radius) mm	**Gap mm**	**Gap mm**
40	6 ± 0.5	5 ± 0.5
50	6 ± 0.5	5 ± 0.5
60	6 ± 0.5	5 ± 0.5

Table 3

	BKO-C1730H09 High-speed standard	
R (Radius) mm	**Max. gap mm**	**Min. gap mm**
40	6.25 ± 0.5	3.3 ± 0.5
50	6.0 ± 0.5	3.7 ± 0.5
60	5.75 ± 0.5	3.85 ± 0.5
70	5.5 ± 0.5	3.87 ± 0.5

(3) Caution on installation of magnet

When the magnet is installed to the spindle, pay attention to the following:

(a) Do not place an intense magnetic source near the magnet.
(b) Carefully handle the magnet, avoiding mechanical shock to the magnet.
(c) Secure the magnet to the spindle with M4 screws.
(d) After the magnet is installed, balance the entire spindle.
(e) Align the center of the magnet (between N and S) with the center line of the rotating disk on the spindle.
(The position relation should be as shown in CASE 1 to CASE 7 on the previous pages.)
(f) Keep the magnet and its peripheral clean from iron particles (iron particles may cause malfunction).
(g) Apply lock paint, or other suitable means, to prevent installation screws from becoming loose.
(h) If the magnet is installed on a ground rotating disk, demagnetize the disk.
(i) Diameter of rotating disk on which the magnet is installed should be within the range from 80mm to 120mm.
(j) If rotation speed of the spindle on which the magnet is installed exceeds 6000r/min, use a high-speed type magnet (applicable up to 12000r/min of rotation speed). If rotation speed exceeds 12000r/min, use a ring type magnet.
(k) When installing the magnet on a rotating body plane, keep the speed below 6,000r/min.

(4) Caution on installation of sensor

Observe the following cautions when installing the sensor.

(a) The position relation of the magnet and detection head should follow CASE 1 to CASE 7 .
(b) The center line of detection head should be in line with the center of magnet.
(c) The gap between the magnet and detection head should be as follows:
- Table 1 on previous page when using standard magnet and installation CASE 1 or CASE 3
- Table 1 on previous page when using high-speed standard magnet and installation CASE 1 or CASE 3
- Table 2 on previous page when using standard magnet and installation CASE 2
- Table 2 on previous page when using high-speed standard magnet and installation CASE 2
- Table 3 on previous page when using high-speed compact magnet and installation CASE 1 or CASE 3
- An example of the high-speed ring magnet is shown in the outline drawing in section "4.1.1 (5)".
  ∗ Manufacturing a jig is recommended for mass production.

(d) Connector used in preamplifier
BKO-C1810 : Oil proof-type
BKO-C1730 : Not oil proof-type
Install both type at a place not subject to oil.
(e) The cable between the preamplifier and the controller should be laid down apart from high-voltage cables.
(f) Check the connector wiring, securely engage the receptacle and tighten connector lock screws.

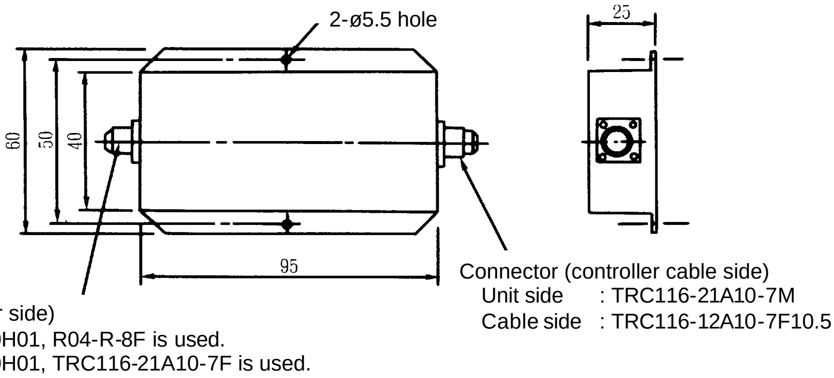
(5) Magnetic sensor orientation parts (Optionally supplied parts)

Select the combination of the magnetic sensor parts for magnetic sensor orientation from the table below.

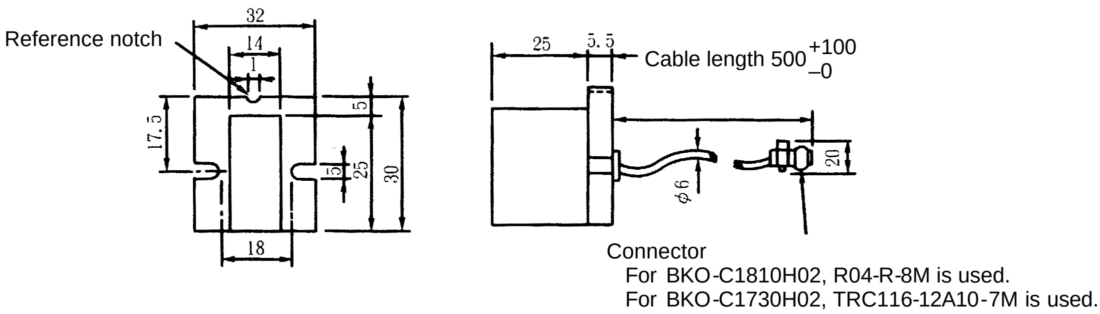
Type	Tolerable speed [r/min]	Model	Combination		
			Pre-amplifier	Sensor	Magnet
Standard	0 to 6000	MAGSENSOR BKO-C1810H01 to 3	H01	H02	H03
High-speed standard	0 to 12000	MAGSENSOR BKO-C1730H01.2.6	H01	H02	H06
High-speed small	0 to 12000	MAGSENSOR BKO-C1730H01.2.9	H01	H02	H09
High-speed ring	0 to 25000	MAGSENSOR BKO-C1730H01.2.11	H01	H02	H41
High-speed ring	0 to 25000	MAGSENSOR BKO-C1730H01.2.12	H01	H02	H42
High-speed ring	0 to 30000	MAGSENSOR BKO-C1730H01.2.13	H01	H02	H43
High-speed ring	0 to 30000	MAGSENSOR BKO-C1730H01.2.14	H01	H02	H44

Outline dimensions:

- **Preamplifier H01**



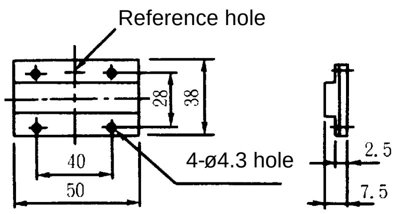
- **Sensor H02**



- **Magnet**

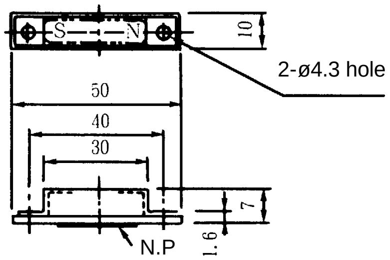
Part No.	Tolerable speed [r/min]	Outline drawings
H03	0 to 6000	Weight: 40 ± 1.5g (Drawing 1) Installation screw: M4
H06	0 to 12000	
H09	0 to 12000	Weight: 14.8 ± 0.7g (Drawing 2) Installation screw: M4
H41	0 to 25000	(Drawing 3, Magnet table, Installation of magnet)
H42	0 to 25000	
H43	0 to 30000	
H44	0 to 30000	

Weight: 40 ± 1.5g

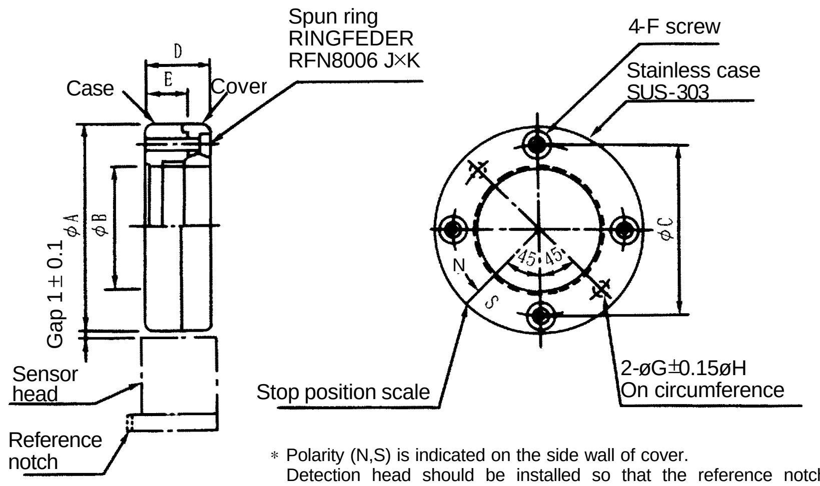


Installation screw: M4

Weight: 14.8 ± 0.7g



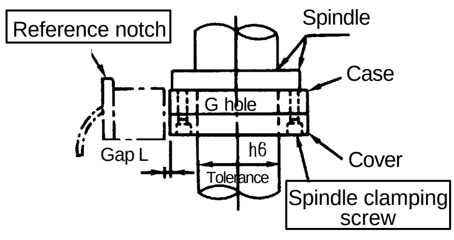
Installation screw: M4



＊ Polarity (N,S) is indicated on the side wall of cover.
Detection head should be installed so that the reference notch of sensor head comes on the case side.

Magnet DIM IN mm

Model	Dimensions										
	A	B	C	D	E	F	G	H	J´X	L	Weight (g)
BKO-C1730H11	105	70H7+0.030 –0	90	28	19	M6×1.0	5	90	70×79	1	1024±4
BKO-C1730H12	94	60H7+0.030 –0	79	25	17	M5×0.8	5	79	60×68	1	768±4
BKO-C1730H13	78	50H7+0.025 –0	66	23	15	M5×0.8	5	66	50×57	1	478±4
BKO-C1730H14	66	40H7+0.025 –0	54	20	13	M4×0.7	5	54	40×45	1	322±4



Installation of magnet

Caution on installation of H41 to H44

1. Tolerance to shaft dimension should be "h6".
2. 2-øG hole can be used for positioning of spindle and magnet.
3. Magnet shall be installed as shown to the left.
4. Misalignment between sensor head and magnetic center line shall be within ±2mm.
5. Reference notch of sensor head shall come on the case side.

4.1.2 4096-point orientation using encoder

(1) Connection

Refer to "1.4 Configuration" for the connection of the encoder and spindle drive unit.

(2) Installation conditions

Mechanical characteristics for rotation

a. Inertia	: 0.1×10^{-4}kg·m^2 or less
b. Shaft friction torque	: 0.98N·m or less
c. Shaft angle acceleration	: 10^4rad/s^2 or less
d. Tolerable speed	: 7,030r/min

Mechanical configuration

a. Bearings	: Non-lubricated for 100,000 hours or more rotations (at 2,000r/min) Non-lubricated for 20,000 hours or more at 6,000r/min
b. Shaft amplitude	: 0.02mm or less at 15mm from end
c. Tolerable load	: Thrust direction 10kg (5kg during operation) Radial direction 20kg (10kg during operation)
d. Weight	: 1.5kg max
e. Squareness of flange to shaft	: 0.05mm or less
f. Flange matching eccentricity	: 0.05mm or less

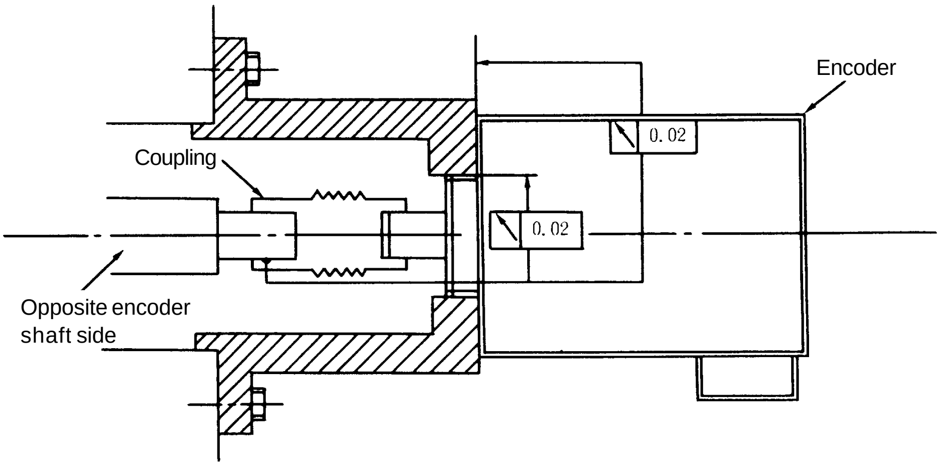
Working conditions

a. Working temperature range	: –5°C to +55°C
b. Storage temperature range	: –20°C to +85°C
c. Humidity range	: 95% RH (at 40°C) for 8 hours
d. Vibration resistance	: 5 to 50Hz, total vibration width 1.5mm, each shaft for 30 min.
e. Impact resistance	: 294.0m/s^2 (30G)

(3) Handling

a. Use of a flexible coupling is recommended for the coupling of the encoder and spindle shaft in terms of improving the encoder life and performance.

b. Installation precision
The precision shown below should be secured for the encoder installation section engaging section and installation surface sway in order to maximize the coupling life.



c. Recommended coupling

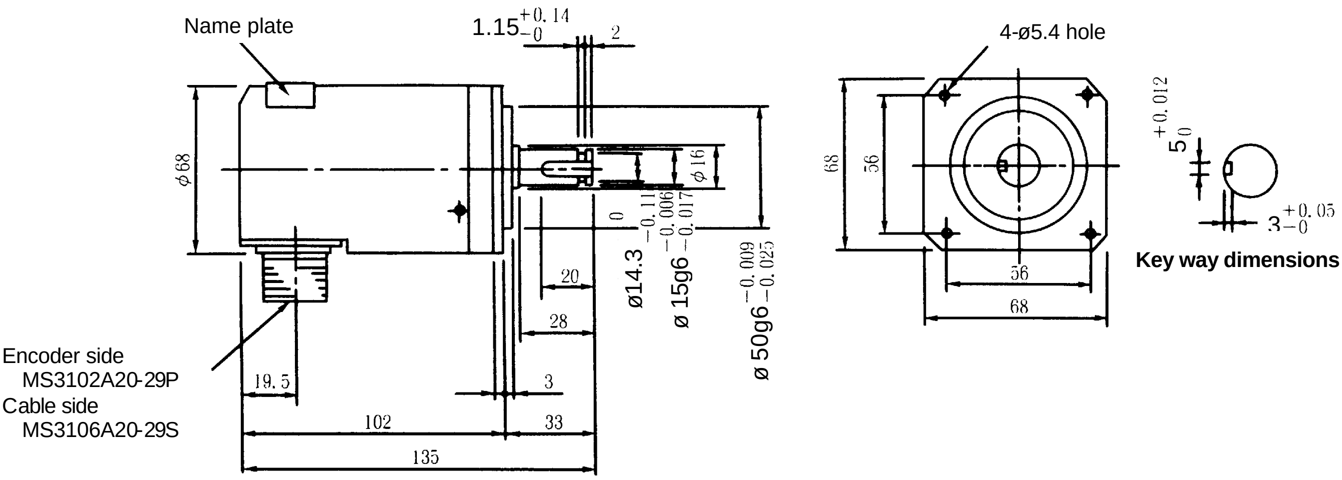
		Recommendation 1	Recommendation 2
Manufacturer		Tokushu Seiko	Eagle
Model		Model M1	FCS38A
Resonance frequency		1374Hz	3515Hz
Position detection error		0.8×10^{-3} °	1.2×10^{-3} °
Tolerable speed		20000r/min	10000 r/min
Mis-alignment	Core deviation	0.7mm	0.16mm
	Angle displacement	1.5°	1.5°
Outline dimensions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

Refer to the coupling catalogue for details on the coupling.

(4) Encoder orientation parts (Optionally supplied parts)

Encoder (1024p/rev)

Encoder model	Tolerable speed
RFH-1024-22-1M-68	6000r/min
RFH-1024-22-1M-68-8	8000r/min



Pin	Function	Pin	Function
A	1chA	K	0V
B	2chZ	L	
C	1chB	M	
D		N	1ch$\overline{A}$
E	Case earth	P	2ch$\overline{Z}$
F		R	1ch$\overline{B}$
G		S	
H	+5V	T	
J			

4.1.3 4096-point orientation using motor built-in encoder

The motor built-in encoder built-in motor with Z-phase signal is required for this specification.
This can be used only when the motor and spindle coupling is the direction coupling or when the timing belt with a reduction ratio of 1 is used.

(1) Connection

Refer to "1.4 Configuration" for the connection of the signal wires.

(2) Installation

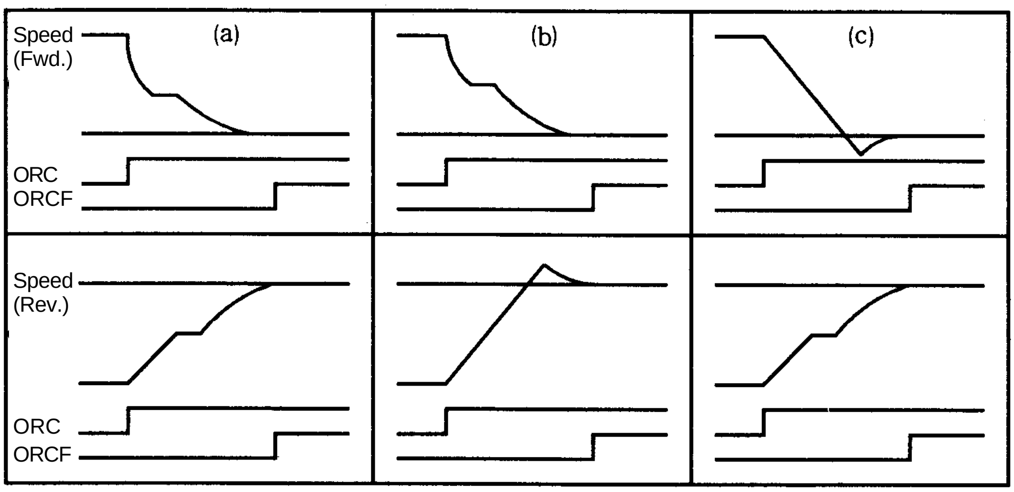
The encoder is built into the motor so no special detector needs to be installed.

4.1.4 Operation of orientation

(1) Operation modes

There are three modes of orientation stop. Desired mode can be selected by setting parameter SPECO.

1. PRE :
   .... (a) Spindle approaches the stop position in the direction of on-going rotation.
2. Forward orientation :
   .... (b) Spindle approaches the stop position in forward direction of rotation, regardless of direction of on-going rotation.
3. Reverse orientation :
   .... (c) Spindle approaches the stop position in the reverse direction of rotation, regardless of direction of on-going rotation.

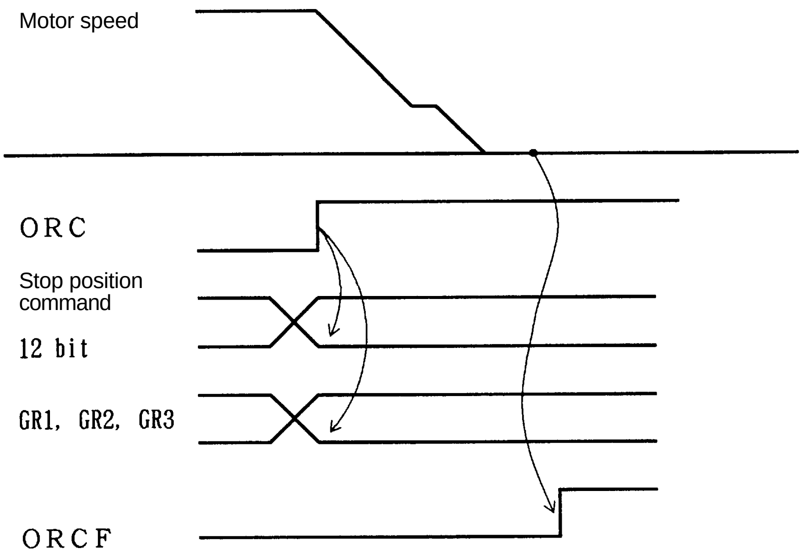


(2) Operation sequence

(a) When orientation command ORC is given, motor speed changes from the steady run speed to "Position loop changeover speed" and at the same time the multi-point orientation stop position is read.

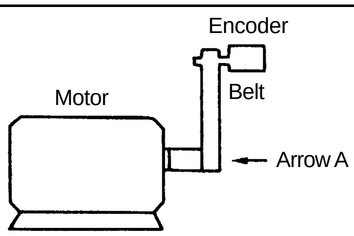
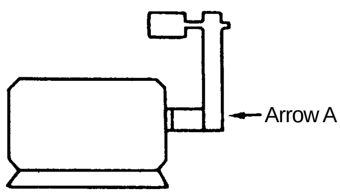
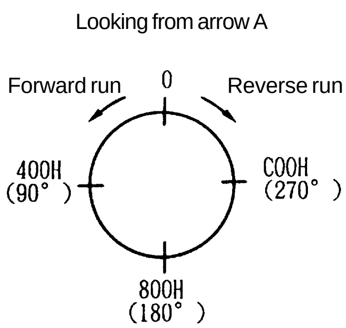
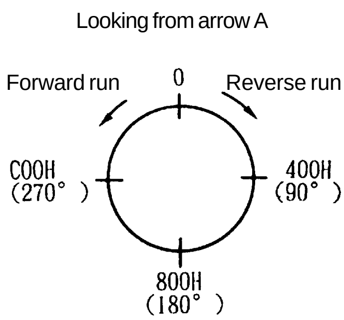
(b) When motor speed reaches the "Position loop changeover speed", control mode changes from speed control to positioning control (position loop gain parameter **(Note 1)**).
("Position loop changeover speed" is automatically set when position loop gain is specified by parameter.)

(c) When control mode changes, distance to the orientation stop position is calculated and the motor is decelerated in the set pattern (specified by parameter CSP) to enter the orientation mode.
(d) When the spindle enters the in-position range (set by parameter OINP), "oriented spindle stop complete signal (in-position)" ORCF turns ON.
(e) The stop position zero point can be shifted by setting parameter OPST.
(f) When orientation command (ORC) is removed, the motor is returned to the previously specified run speed.

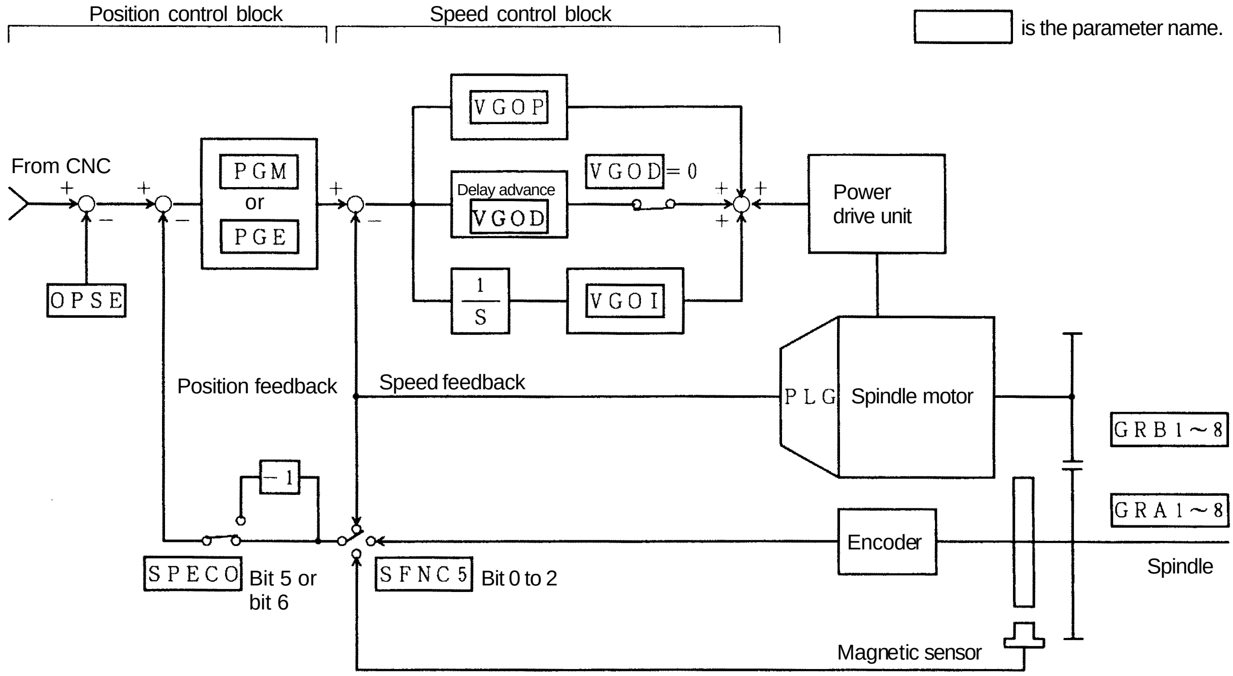


(Note 1) PGM is used for the magnetic sensor and motor built-in encoder orientation and PGE is used for the encoder orientation.

The stopping position according to the encoder installation direction is as shown below:

<table>
<tr><th></th><th>Case 1</th><th>Case 2</th></tr>
<tr><td>Installation direction</td><td>
</td><td>
</td></tr>
<tr><td>Normal orientation</td><td>
</td><td>
</td></tr>
</table>

(3) Diagram of relation of parameters for orientation



4.2 Synchronous tap function (option)

There are two types of synchronous tap.
1. Closed type synchronous tap
2. Semi-closed type synchronous tap

4.2.1 Closed type synchronous tap

A position loop can be built up with position signal from an encoder installed on spindle.

(1) Connection

Refer to "1.4 Configuration" for the connection of the encoder and spindle drive unit.

(2) Installation of encoder

For installation of encoder, refer to the pages related to encoder orientation.

4.2.2 Semi-closed type synchronous tap

A position loop can be built up with position signal from motor built-in encoder.
A special detector is not required for synchronous tap if the spindle is coupled to the motor shaft directly or through gears.
(When belt or timing belt is used, closed type synchronous tap is applicable.)
It is also applicable to standard motor having no Z-phase control.

(1) Connection

No additional connection is required for semi-closed type synchronous tap.

4.2.3 Operation of synchronous tap

One of synchronous tap operation modes can be selected with parameter.
(1) Synchronous tap starts after zero point return (parameter SPECT-bitE is set to "0").
(2) Synchronous tap starts after deceleration and stop (parameter SPECT-bitE is set to "1").

The operation of synchronous tap is conditioned as shown below.

○ : Available　　×: Not available

	Without orientation	Magnetic sensor orientation	Encoder orientation	Motor built-in encoder orientation
Synchronous tap after zero point return	×	○	○	○
Synchronous tap after deceleration and stop	○	○	○	○

4.3 C-axis control (optional)

4.3.1 When using encoder (OSE90K+1024 BKO-NC6336H01)

(1) Connection

Refer to page "1.4 Configuration" for the connection of the encoder and spindle drive unit.

(2) Installation conditions

Mechanical characteristics for rotation

a. Inertia	: 0.1×10^{-4}kg·m^2 or less
b. Shaft friction torque	: 0.98N·m or less
c. Shaft angle acceleration	: 10^5rad/s^2 or less
d. Tolerable speed	: 7,030r/min

Mechanical configuration

a. Bearings	: Non-lubricated for 100,000 hours or more rotations (at 2,000r/min) Non-lubricated for 20,000 hours or more at 6,000r/min
b. Shaft amplitude	: 0.02mm or less at 15mm from end
c. Tolerable load	: Thrust direction 10kg (5kg during operation) Radial direction 20kg (10kg during operation)
d. Weight	: 2kg max
e. Squareness of flange to shaft	: 0.05mm or less
f. Flange matching eccentricity	: 0.05mm or less

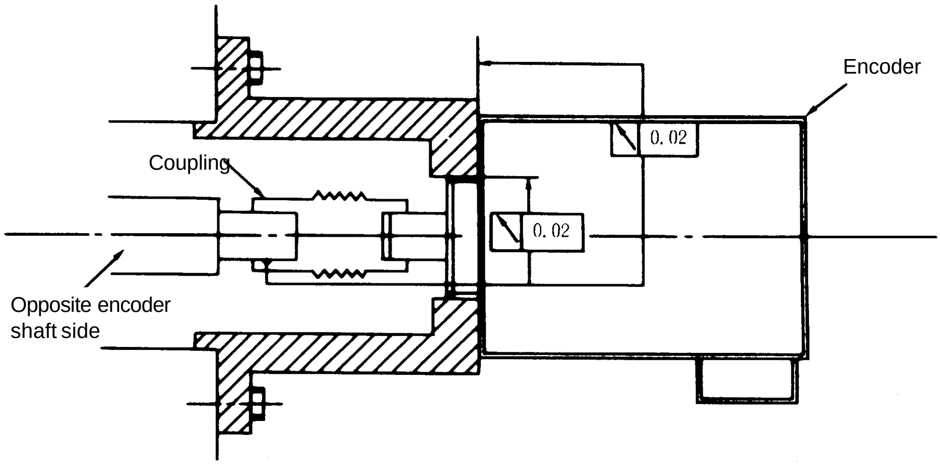
Working conditions

a. Working temperature range	: –5°C to +55°C
b. Storage temperature range	: –20°C to +85°C
c. Humidity range	: 95% RH (at 45°C) for 8 hours
d. Vibration resistance	: 5 to 50Hz, total vibration width 1.5mm, each shaft for 30 min.
e. Impact resistance	: 294.0m/s^2 (30G)

(3) Handling

a. Installation of encoder
Use of a flexible coupling is recommended for the coupling of the encoder and spindle shaft in terms of improving the encoder life and performance.

b. Installation precision
The precision shown below should be secured for the encoder installation section engaging section and installation surface sway to secure the coupling life.



c. Recommended coupling

		Recommendation 1	Recommendation 2
Manufacturer		Tokushu Seiko	Eagle
Model		Model M1	FCS38A
Resonance frequency		1374 Hz	3515 Hz
Position detection error		0.8×10^{-3} °	1.2×10^{-3} °
Tolerable speed		20000 r/min	10000 r/min
Mis-alignment	Core deviation	0.7 mm	0.16 mm
	Angle displacement	1.5°	1.5°
Dimensions	Max. length	74.5 mm	33 mm
	Max. diameter	ø57 mm	ø38 mm

Refer to the coupling catalogue for details on the coupling.

d. Cable

1) Consider the following points to allow the encoder to be used to its fullest.

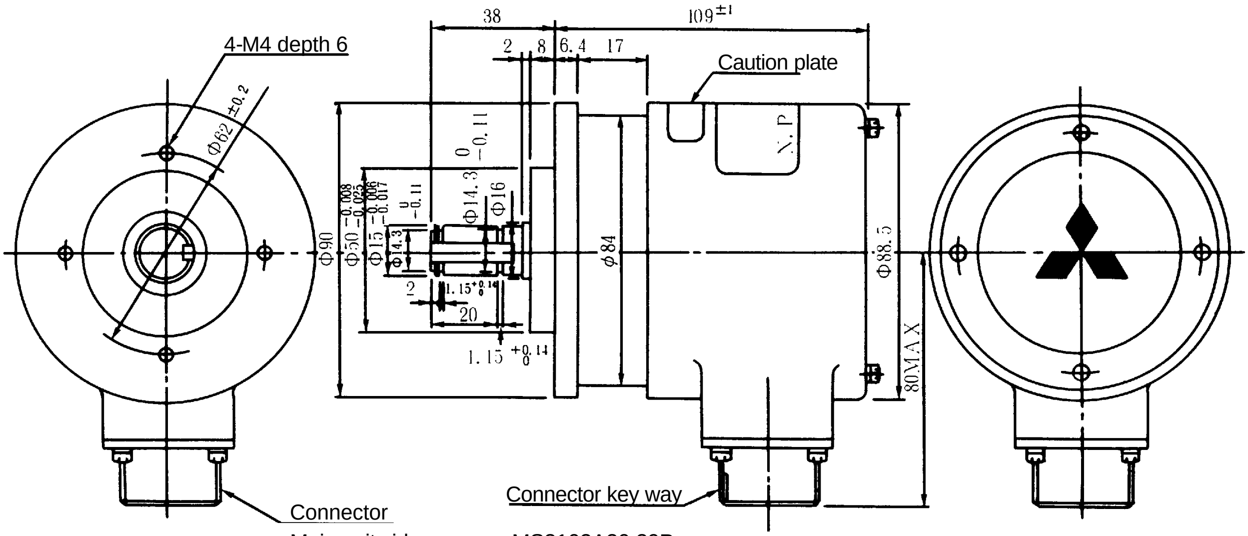
A $\boxed{4.5V}$ or higher power supply must be secured for the encoder.

For example:
(i) Increase the +5V, 0V wire size.
(ii) Use two or more wires for +5V, 0V.
(iii) Keep the cable length as short as possible.

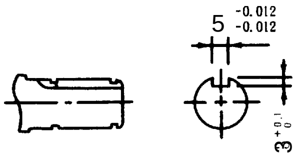
2) Others
The encoder is a precision device so do not apply strong impact, etc., to it.
Incorrect wiring will cause trouble. Always confirm the connector name and pin No., etc., before wiring.

(4) C-axis control parts (Optionally supplied parts)

- Encoder OSE90K+1024 BKO-NC6336H01



Connector
Main unit side : MS3102A20-29P
Controller cable side : MS3102A20-29S (The connector on the controller cable side must be prepared by the user.)



Note 1. The max. encoder speed must be 6000r/min or less.
Note 2. The dimensional tolerance that is not specified is ±0.5mm.

Signal

	Generated signals	Remarks
1ch	1024 C/T	A • B-phase, $\overline{A}$ • $\overline{B}$ -phase
2ch	1 C/T	Z-phase • $\overline{Z}$ -phase
3ch	90000 C/T	C • D-phase, $\overline{C}$ • $\overline{D}$ -phase
4ch	1 C/T	Y-phase • $\overline{Y}$ •B-phase

Connector pin assignment

Pin	Function
A	1ch A-phase
B	2ch Z-phase
C	1ch B-phase
D	——
E	Case grounding
F	3ch C-phase
G	3ch D-phase
H	+5V DC $^{+5\%}_{-10\%}$
J	0V

Pin	Function
K	0V
L	3ch $\overline{C}$ -phase
M	3ch $\overline{D}$ -phase
N	1ch $\overline{A}$ -phase
P	2ch $\overline{Z}$ -phase
R	1ch $\overline{B}$ -phase
S	4ch Y-phase
T	4ch $\overline{Y}$ -phase

- Grounding plate and cable clamp fittings
  Refer to "4.4 Single parts".

4.3.2 When using built-in encoder (MBE90K)

Refer to the MBE90K (built-in C-axis encoder) Specifications and Instruction Manual [BNP-A2993-41].

4.3.3 When using built-in encoder (MHE90K)

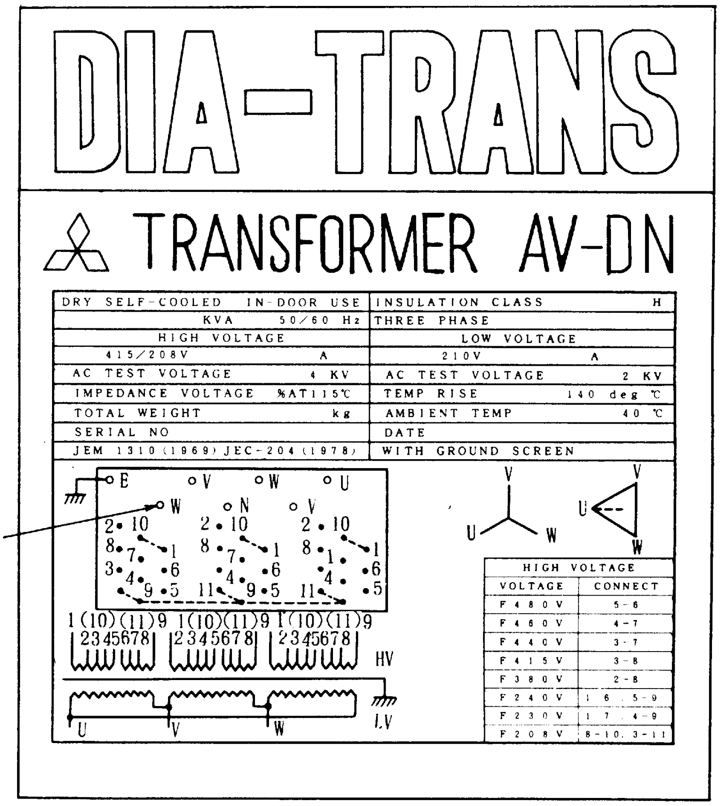
Refer to the MHE90K (built-in C-axis encoder) Specifications and Instruction Manual [BNP-A2993-44].

4.4 Single parts (optionally supplied parts)

4.4.1 Power step-down transformer

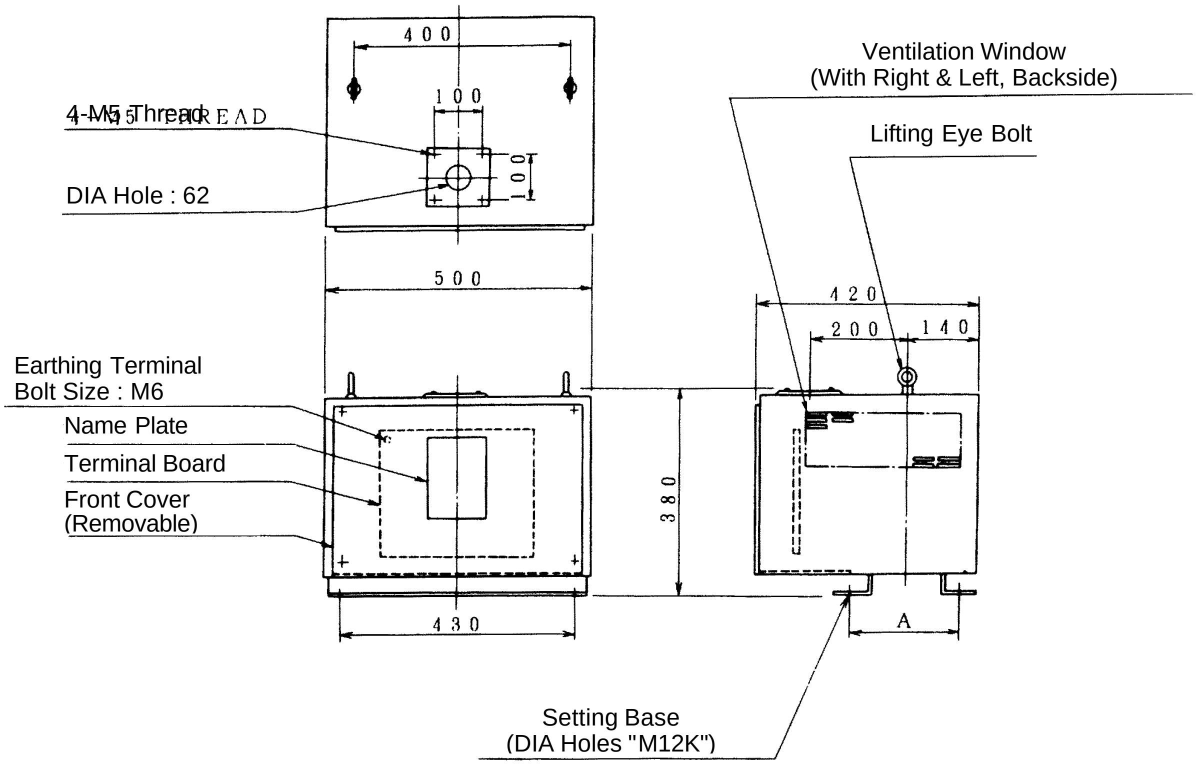
When available power supply is at 400V, use this optional step-down transformer.

(1) 12-23kVA (ITEM1 to 3)

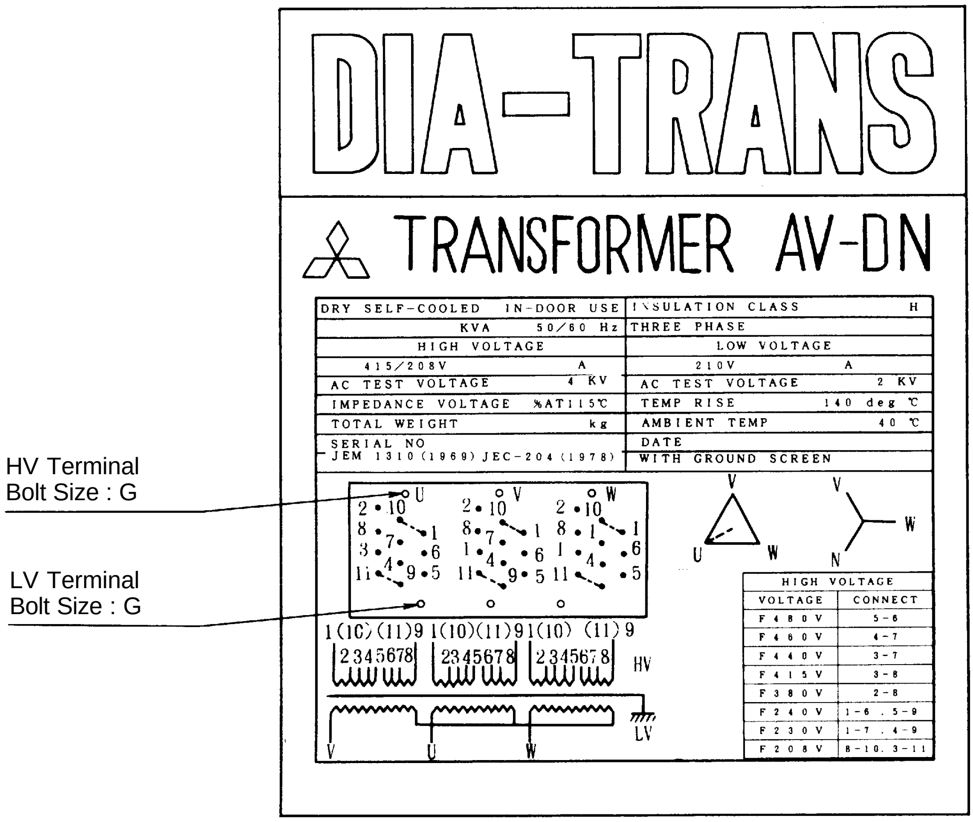


ITEM	Capacity (kVA)	Dimensions A		Weight (kg)	Remarks
1	12	230		90	7.5K
2	17	175		115	11K
3	23	215		130	15K

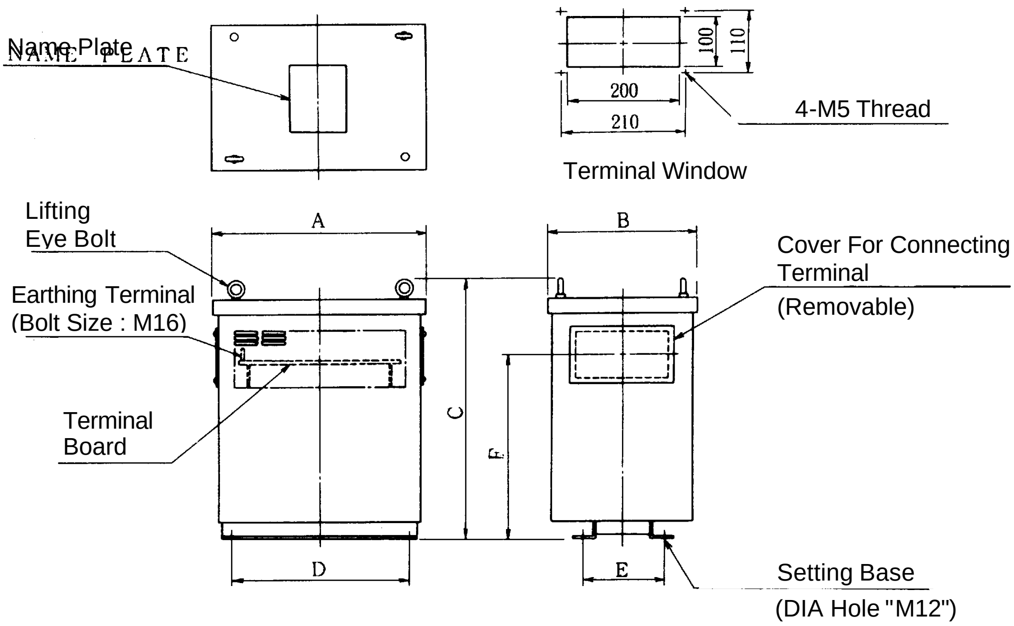
Name Plate



(2) 30kVA to 75kVA (ITEM4 to 8)



ITEM	Capacity (kVA)	Dimensions							Weight (kg)	Remarks
		A	B	C	D	E	F	G		
4	30	535	395	625	460	250	445	M12	165	18.5K
5	37	535	395	665	460	250	485	M12	185	22K, 26K
6	44	535	425	665	460	265	485	M12	205	30K
7	60	625	425	815	540	255	625	M16	280	37K
8	75	625	425	840	540	270	650	M16	320	45K



4.4.2 Noise filter

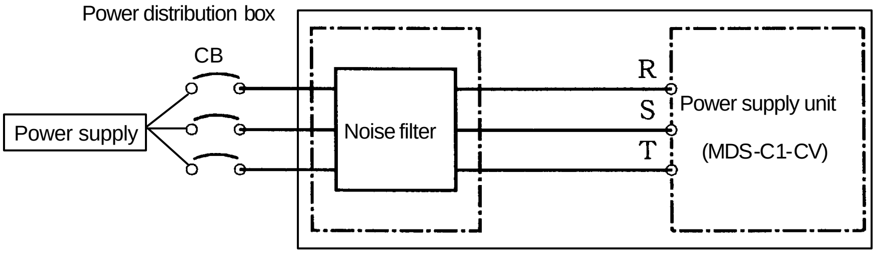
(1) Selection

If radio noise must be reduced, select a noise filter from the following table according to the power supply unit model:

MDS-C1-CV-	Noise filter name (Tohoku Kinzoku)
37	LF-330
55	LF-340
75	LF-350
110	LF-360
150, 185	LF-380K
220, 260, 300	Two LF-380K units in parallel

(2) Noise filter installation position

Insert the noise filter in the unit input.



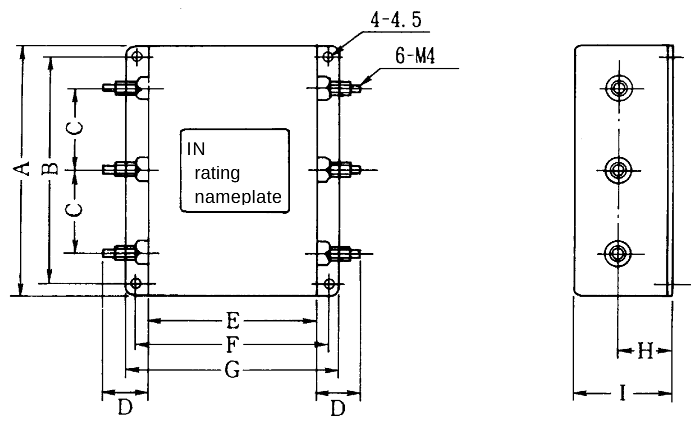
* Connect to the transformer input in power supply units that use the transformer.

(3) Specifications

Name	Rated voltage AC/DC (V)	Rated current AC/DC (A)	Tested voltage AC 1 min. (V) Between case terminals	Insulation resistance (MW) 500VDC	Leakage current (mA) 250V 60Hz	Working temperature range (°C)
330	200V	30A	1500	> 300	< 1	–20 to +55
340	200V	40A	1500	> 300	< 1	–20 to +45
350	200V	50A	1500	> 300	< 1	–20 to +45
360	200V	60A	1500	> 300	< 1	–20 to +45
380K	200V	80A	2000	> 300	< 5	–25 to +55

(4) Shape and dimensions

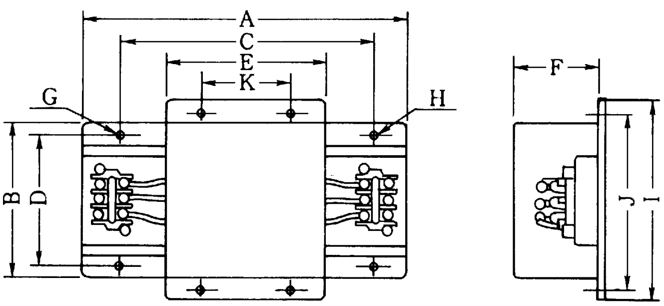
LF-300 Series



Part name	A	B	C	D	E	F	G	H	I
LF-330	180	170	60	29	120	135	150	35	65
LF-340	180	160	50	30	200	220	240	40	80
LF-350	180	160	50	30	200	220	240	40	80
LF-360	200	180	60	30	300	320	340	50	100

(mm)

LF-K Series



Name	Terminal plate	A	B	C	D	E	F	G	H
LF-380K	TE-K22 M6	670	400	560	380	500	170	9×6.5ø	6.5ø

4.5 Other optional specifications

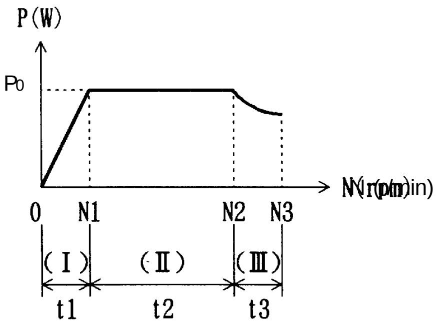
Refer to the following optional specifications for each model shown below for optional specifications not explained in this manual.

	Title of optional specifications	Specifications No.
(1)	MDS-C1 Series coil changeover function optional specifications	BNP-A2993-23
(2)	MBE90K (built-in C-axis encoder) specifications and instruction manual	BNP-A2993-41
(3)	MHE90K (built-in C-axis encoder) specifications and instruction manual	BNP-A2993-44

4.6 Theoretical acceleration and deceleration times

In the calculation described below, load torque is assumed to be zero. Therefore, acceleration and deceleration times determined here somewhat differ from actual acceleration and deceleration times.

(1) Definition



(Note) 1) "P_0" is (Rated power $\times$ 1.2).
Example : For spindle of 2.2/3.7kW,
$P_0 = 3700 \times 1.2 = 4440$ (W)
2) GD^2 = (Motor GD^2) + (Motor shaft conversion load GD^2) ($kg \cdot m^2$)

(2) Acceleration/deceleration time "t"

(a) Constant torque zone

$$t1 = \frac{1.03 \times GD^2 \times N1^2}{375 \times P_0} \quad (s)$$

(b) Constant output (power) zone

$$t2 = \frac{1.03 \times GD^2 \times (N2^2 - N1^2)}{2 \times 375 \times P_0} \quad (s)$$

(c) Reduced output zone

$$t3 = \frac{1.03 \times GD^2 \times (N3^3 - N2^3)}{3 \times 375 \times P_0 \times N2}$$

Therefore, acc./dec. time t (0 $\rightarrow$ N_3) is,
$t = t_1 + t_2 + t_3$ (s)

Example: $\begin{cases} GD_L^2 = 0.123 kg \cdot m^2 \\ \text{For motor SJ-N3.7A} \end{cases}$

From specification 2, $GD_M^2 = 0.021 kg \cdot m^2$
thus, $GD^2 = 0.021 + 0.123 = 0.144\ kg \cdot m^2$

$$t_1 = \frac{1.03 \times 0.144 \times 1500^2}{375 \times 3700 \times 1.2} = 0.200 \ (s)$$

$$t_2 = \frac{1.03 \times 0.144 \times (6000^2 - 1500^2)}{2 \times 375 \times 3700 \times 1.2} = 1.503 \ (s)$$

$$t_3 = \frac{1.03 \times 0.144 \times (8000^3 - 6000^3)}{3 \times 375 \times 3700 \times 1.2 \times 6000} = 1.465 \ (s)$$

Acc./dec. time for 0 $\rightarrow$ 8000r/min
t = 0.200 + 1.503 + 1.465 = 3.168 (s)

Unit conversion :

Speed : 1r/min = $\frac{2\pi}{60}$ rad/s
Output (power) : 1kW = 1/1.3596HP

Formula :

$$P = \omega T_0 = (2\pi \frac{N}{60}) \times T$$

P : Output [W]
ω : Angular velocity [rad/s]
T_0 : Torque [N·m]
N : Speed [r/min]
T : Torque [N·m]

Ⅴ. IPM　Spindle Drive System Section

1. Outline

1.1 Outline

The MDS-C1-SPM Series is a spindle drive unit developed to drive the IPM (internal permanent magnet) spindle motor, a version of the conventional spindle motor that is more compact, has a higher efficiency and generates less heat.
Refer to "IV. MDS-C1-SP Spindle System Section" for any matters not described in this section.

1.2 Features of MDS-C1-SPM Series

The IPM spindle system, which combines the IPM spindle drive unit and IPM spindle motor, has the following features in addition to those described in the "MDS-B Series" and "MDS-C1 Series" Specifications Manuals.

(1) High efficiency

By incorporating the IPM type spindle motor, the efficiency has been greatly improved compared to the conventional IM type spindle motor drive.

(2) Compact spindle motor

By incorporating the IPM type spindle motor, the size has been downsized compared to the conventional spindle motor.

(3) Low spindle motor heat generation

By incorporating the IPM type spindle motor, the heat generated at the spindle rotor has been greatly reduced. It is also possible to downsize the spindle cooling units, etc.

1.3 Precautions for use

(1) The motor rated output is guaranteed at the power supply unit's rated input (200/230VAC).
If the input voltage fluctuates below this, the rated output may not be achieved with the IPM spindle drive unit.

(2) A higher harmonic chopper voltage, which is PWM-controlled, is applied on the motor so a higher harmonic leakage current will flow during motor operation. If a common earth leakage breaker is used, it could malfunction due to the higher harmonics. Use the earth leakage breaker for inverters (Mitsubishi: Progressive Super NV Series, etc.).

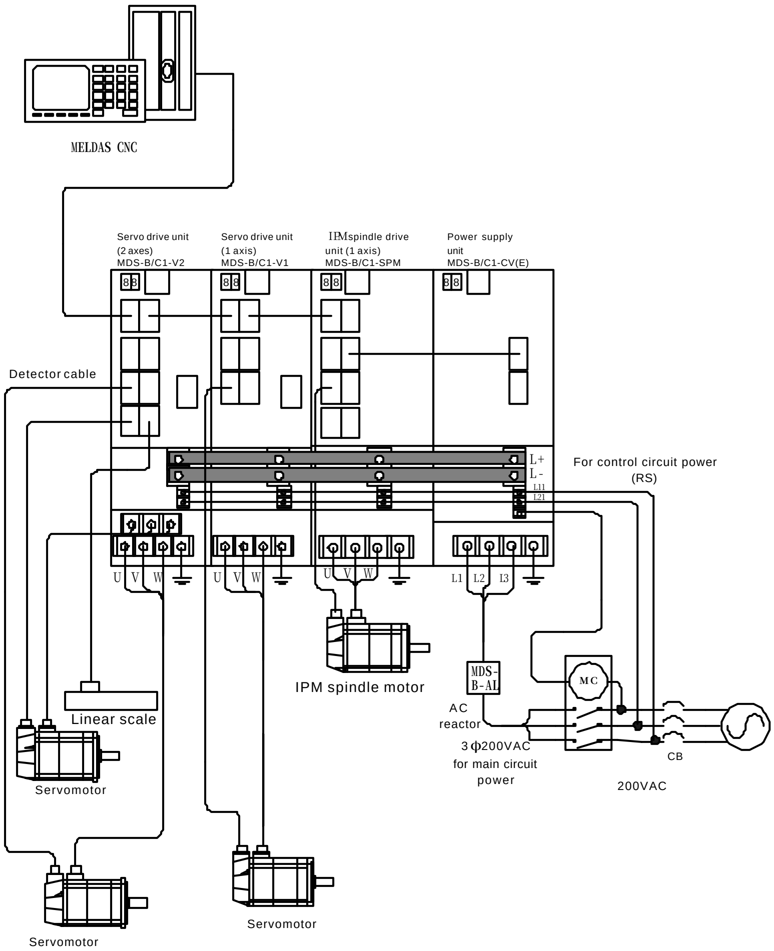
(3) The higher harmonic leakage current, explained above, also flows to the grounding wire between the motor and drive unit. If a CRT is used for the NC display unit, the screen image could be affected by the leakage current (magnetic field). Keep the grounding wire on the drive unit as far away from the CRT display unit as possible.

(4) A radio filter is installed in the AC reactor, but the motor and drive unit must always be grounded. If the units are insufficiently grounded, the AM radio reception may be inhibited.

2. Configuration of Drive System

2.1 Basic system configuration drawing

Example: One spindle axis + three servo axes



(Note 1) Set the IPM spindle drive unit next to the power supply unit.
(Note 2) Set the drive units in order of unit capacity from the power supply unit side.
(Note 3) Always install the AC reactor. Wire to the front step (breaker side) of the contactor.

2.2 Combination with power supply unit

No	IPM spindle drive unit type	Compatible power supply unit type	Remarks
1	MDS-B/C1-SPM-110	MDS-C1-CV-75	
2	MDS-B/C1-SPM-150	MDS-C1-CV-110	
3	MDS-B/C1-SPM-185	MDS-C1-CV-150	
5	MDS-C1-SPM-220	MDS-C1-CV-185	
6	MDS-C1-SPM-260	MDS-C1-CV-220	
7	MDS-C1-SPM-300	MDS-C1-CV-260	

(Note) The above combinations are standard for a one-on-one combination. The power supply unit's capacity is determined by the IPM spindle motor output. Note that the difference of the IPM spindle drive unit and power supply unit capacity must be within two ranks.
Refer to "8. Selection of Capacity" in the "I. MDS-C1 Series Servo/Spindle System Configuration Section" for details on making a selection.

2.3 List of IPM spindle drive units

The following IPM spindle drive units are available.

Drive unit type		MDS-B/C1- SPM-110	MDS-B/C1- SPM-150	MDS-B/C1- SPM-185	MDS-C1- SPM-220	MDS-C1- SPM-260
Rated output current [A]		54	67	85	94	115
Control method		Sinusoidal wave PWM control, current control type vector control method				
Braking method		Power regenerative braking				
Speed control range [r/min]		35 to 8000				
Speed fluctuation rate		Max. 0.2% of maximum speed (under load varying from 10% to 100%)				
Tolerable load moment of inertia		As a reference, 5-times or less of motor GD^2				
Connection with NC		MELDAS dedicated serial communication				
Environ-ment	Ambient temperature	Operation: 0 to 55°C (with no freezing), Storage/transportation: –15 to 70°C				
	Ambient humidity	90%RH (with no dew condensation)				
	Atmosphere	No corrosive gas, dust				
	Altitude	Operation/storage: 1000m or less, Transportation: 10000m or less				
	Vibration	$4.9m/s^2$ (0.5G) or less/$49m/s^2$ (5G) or less				

Drive unit type		MDS-C1- SPM-300	MDS-B- SPM-370	MDS-B- SPM-450	
Rated output current [A]		130	180	210	
Control method		Sinusoidal wave PWM control, current control type vector control method			
Braking method		Power regenerative braking			
Speed control range [r/min]		35 to 8000			
Speed fluctuation rate		Max. 0.2% of maximum speed (under load varying from 10% to 100%)			
Tolerable load moment of inertia		As a reference, 5-times or less of motor GD^2			
Connection with NC		MELDAS dedicated serial communication			
Environ-ment	Ambient temperature	Operation: 0 to 55°C (with no freezing), Storage/transportation: –15 to 70°C			
	Ambient humidity	90%RH (with no dew condensation)			
	Atmosphere	No corrosive gas, dust			
	Altitude	Operation/storage: 1000m or less, Transportation: 10000m or less			
	Vibration	$4.9m/s^2$ (0.5G) or less/$49m/s^2$ (5G) or less			

The unit outline is the same as the SP Series.

Note 1) The rated output is guaranteed in the rated input voltage to the power supply unit (AC200 to 230V). If the input voltage changes and becomes less than that, the rated output may not appear.

Note 2) When the load exceeds 50% ED, the overload alarm will occur.
(50% ED :ON for five minutes/OFF for five minutes in 10-minute cycle time)

3. Setting the IPM Spindle Drive Unit Parameters

The parameters unique to the MDS-B/C1-SPM unit are explained below. Refer to the "IV. MDS-C1-SP Spindle System Section" for details on any parameters not explained in this section.

3.1 Bit selection parameters

<table>
<tr><th>No.</th><th>Abbrev.</th><th>Details</th><th>TYP</th></tr>
<tr><td>SP033</td><td>SFNC1</td><td><table><tr><td>F</td><td>E</td><td>D</td><td>C</td><td>B</td><td>A</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr><tr><td>poff</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table>[poff] Contactor hold at NC power OFF (0: Invalid/1: Valid)</td><td>HEX setting</td></tr>
<tr><td>SP034</td><td>SFNC2</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></td><td>mach</td><td>mk3c</td><td>mtsl</td></tr></table>[mtsl] Motor constant (0: Standard/1: Special)
[mk3c] 3-step coil changeover function (0: Invalid/1: Valid) ... Set SP038_bit8 to 1 at the same time.
[mach] Coil changeover function (0: Invalid/1: Valid)</td><td>HEX setting</td></tr>
<tr><td>SP035</td><td>SFNC3</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></td><td></td><td>lwid</td><td>hwid</td></tr></table>[hwid] H coil output characteristics change (0: Invalid/1: Valid)
[lwid] L coil output characteristics change (0: Invalid/1: Valid)</td><td>HEX setting</td></tr>
<tr><td>SP036</td><td>SFNC4</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></td><td></td><td></td><td></td></tr></table>Not used.</td><td>HEX setting</td></tr>
<tr><td>SP037</td><td>SFNC5</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>nstv</td><td></td><td></td><td></td><td></td><td></td><td>plgo</td><td></td><td>enco</td></tr></table>[enco] Encoder orientation (0: Invalid/1: Valid)
[plgo] PLG orientation (0: Invalid/1: Valid)
[nstv] No signal detection type (0: Constant monitor/1: Only at position loop or orientation)</td><td>HEX setting</td></tr>
<tr><td>SP038</td><td>SFNC6</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>XFzs</td><td></td><td></td><td>p180</td><td>sdt2</td><td></td><td></td><td></td><td></td><td></td><td>pftm</td><td></td><td>alty</td></tr></table>[alty] Deceleration stop at alarm (0: Invalid/1: Valid) ... Note that this is only for specific alarms.
[pftm] Thread cutting position data (0: Invalid/1: Valid)
[sdt2] General-purpose output 2 setting (0: bit_C setting/1: Output 2nd speed detection)
[p180] 180 wave PLG (0: MHE90K/1: other than MHE90K)
[XFzs] General-purpose output 2 setting
(0: C axis detector MHE90K C axis mode changeover/1: Output zero speed detection)</td><td>HEX setting</td></tr>
</table>

<table>
<tr><th>No.</th><th>Abbrev.</th><th>Details</th><th>TYP</th></tr>
<tr><td>SP097</td><td>SPECO</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>vg8x</td><td></td><td>fdir</td><td></td><td></td><td>dmin</td><td>odi2</td><td>odi1</td></tr>
</table>
Orientation control
[odi2,odi1] Orientation rotation direction
0 0 Pre (direction rotating in during speed control)
0 1 Motor forward run
1 0 Motor reverse run
1 1 (Prohibit)
[dmin] Dummy in-position (0: Invalid/1: Valid)
[fdir] Encoder detector polarity (0: (+)/1: (–))
[vg8x] Speed loop gain 1/8 during torque limit (0: Valid/1: Invalid)
</td><td>HEX setting</td></tr>
<tr><td>SP129</td><td>SPECC</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>zrtn</td><td>ptyp</td><td>fb9x</td><td></td><td></td><td></td><td>zdir</td><td>ztyp</td><td></td><td></td><td>fdir</td><td></td><td>phos</td><td></td><td></td><td>fclx</td></tr>
</table>
C axis control
[fclx] Semi-closed loop control (0: Invalid/1: Valid)
[phos] High-gain servo synchronization (0: Invalid/1: Valid)
[fdir] Position detector polarity (0: (+)/1: (–))
[ztyp] Z-phase detection type (0: Standard/1: Special)
[zdir] Z-phase detector polarity (0: Rising edge/1: Falling edge)
[fb9x] Speed feedback during C axis control (0: PLG/1: 90,000 pulse detector)
[ptyp] Position control changeover type (0: After zero point return/1: After deceleration stop)
[zrtn] Zero point return direction (0: CCW/1: CW)
</td><td>HEX setting</td></tr>
<tr><td>SP177</td><td>SPECS</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>odl</td><td></td><td></td><td></td><td></td><td>phos</td><td></td><td></td><td>fdir</td><td></td><td>mach</td><td></td><td></td><td>fclx</td></tr>
</table>
Spindle synchronization control
[fclx] Semi-closed loop control (0: Invalid/1: Valid)
[mach] Automatic coil changeover during spindle synchronization (0: random/1: High-speed coil fixed)
[fdir] Position detector polarity (0: (+)/1: (–))
[phos] High-gain servo synchronization (0: Invalid/1: Valid)
[odl] Excessive error width scale (0: 1-fold/1: 8-fold)
</td><td>HEX setting</td></tr>
<tr><td>SP193</td><td>SPECT</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>zrtn</td><td>ptyp</td><td>odl</td><td></td><td></td><td></td><td></td><td>phos</td><td></td><td></td><td>fdir</td><td>cdir</td><td></td><td></td><td></td><td>fclx</td></tr>
</table>
Synchronous tap control
[fclx] Semi-closed loop control (0: Invalid/1: Valid)
[cdir] Command polarity (0: CCW/1: CW)
[fdir] Position detector polarity (0: (+)/1: (–))
[phos] High-gain servo synchronization (0: Invalid/1: Valid)
[odl] Excessive error width scale (0: 1-fold/1: 8-fold)
[ptyp] Position control changeover type (0: After zero point return/1: After deceleration stop)
[zrtn] Zero point return direction (0: CCW/1: CW)
</td><td>HEX setting</td></tr>
</table>

3.2 Setting the unit type, motor and power supply unit

<table>
<tr><th>No.</th><th>Abbrev.</th><th>Details</th><th>TYP</th></tr>
<tr><td>SP039</td><td>ATYP</td><td>Select the capacity of the drive unit to be used.
<table>
<tr><th>Setting value</th><th>Drive unit type</th></tr>
<tr><td>0 0 0 0</td><td></td></tr>
<tr><td>0 0 0 1</td><td></td></tr>
<tr><td>0 0 0 2</td><td></td></tr>
<tr><td>0 0 0 3</td><td></td></tr>
<tr><td>0 0 0 4</td><td></td></tr>
<tr><td>0 0 0 5</td><td></td></tr>
<tr><td>0 0 0 6</td><td></td></tr>
<tr><td>0 0 0 7</td><td>MDS-B/C1-SPM-110</td></tr>
<tr><td>0 0 0 8</td><td>MDS-B/C1-SPM-150</td></tr>
<tr><td>0 0 0 9</td><td>MDS-B/C1-SPM-185</td></tr>
<tr><td>0 0 0 A</td><td>MDS-C1-SPM-220</td></tr>
<tr><td>0 0 0 B</td><td>MDS-C1-SPM-260</td></tr>
<tr><td>0 0 0 C</td><td>MDS-C1-SPM-300</td></tr>
<tr><td>0 0 0 D</td><td>MDS-B-SPM-370</td></tr>
<tr><td>0 0 0 E</td><td>MDS-B-SPM-450</td></tr>
<tr><td>0 0 0 F</td><td></td></tr>
</table></td><td>HEX setting</td></tr>
<tr><td>SP040</td><td>MTYP</td><td>Set the motor to be used. Note that this parameter is valid only when SP034 (SFNC2)-bit0 is set to "0".
Refer to the individual parameter setting list, enclosed at delivery, and set the motor type.</td><td>HEX setting</td></tr>
<tr><td>SP041</td><td>PTYP</td><td>Select the power supply to be used from the following values.
<table>
<tr><th>Setting value</th><th>Power supply type</th><th>Capacity [kW]</th></tr>
<tr><td>0 0 0 0</td><td></td><td>–</td></tr>
<tr><td>0 0 0 4</td><td>MDS-C1-CV-37</td><td>3.7</td></tr>
<tr><td>0 0 0 8</td><td>MDS-C1-CV-75</td><td>7.5</td></tr>
<tr><td>0 0 1 1</td><td>MDS-C1-CV-110</td><td>11</td></tr>
<tr><td>0 0 1 5</td><td>MDS-C1-CV-150</td><td>15</td></tr>
<tr><td>0 0 1 9</td><td>MDS-C1-CV-185</td><td>18.5</td></tr>
<tr><td>0 0 2 2</td><td>MDS-C1-CV-220</td><td>22</td></tr>
<tr><td>0 0 2 6</td><td>MDS-C1-CV-260</td><td>26</td></tr>
<tr><td>0 0 3 0</td><td>MDS-C1-CV-300</td><td>30</td></tr>
<tr><td>0 0 3 7</td><td>MDS-C1-CV-370</td><td>37</td></tr>
<tr><td>0 0 4 5</td><td>MDS-B-CVE-450</td><td>45</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
</table>
Note 1) When the power supply external emergency stop function (CN23) is valid, set "1∗∗" with the 3rd digit set to 1. (Example) For MDS-C1-CV-110, set "0111".
Note 2) Even when using in combination with a spindle drive unit higher than SPM-370, set "1∗∗" with the 3rd digit set to 1.</td><td>HEX setting</td></tr>
</table>

3.3 Spindle monitor screen

The current state of the spindle can be confirmed on the NC screen.
The monitor screen is shown on this page.

```
[SPINDLE MONITOR]

GAIN     (1/s)      0    D/I   1L 00000000 UNIT TYP       00000000
DROOP      (i)    160           H 00000000 UNIT NO        00000000
SPEED  (r/min)      0          2L 00000000 S/W VER        00000000
LOAD       (%)      0           H 00000000 1 WORK TIME    00000000
AMP DISP           D4          3L 00000000 2 ALM HIST 1   00000000
ALARM                           H 00000000            2   00000000
CYC CNT    (P) -10240          4L 00000000            3   00000000
                                H 00000000            4   00000000
                                                      5   00000000
                         D/O   1L 00000000            6   00000000
                                H 00000000            7   00000000
                               2L 00000000            8   00000000
                                H 00000000
                               3L 00000000   MNT          00000000
                                H 00000000     /SYS       00000000
                               4L 00000000
                                H 00000000
```

Data	Unit	Display details
GAIN	1/s	The position loop gain during operation of the spindle with the position command is displayed.
DROOP	pulse	The position deflection during operation of the spindle with the position command is displayed.
SPEED	r/min	The motor rotation speed is displayed.
LOAD	%	The motor load (load ratio) is displayed. The 30 min. rating is 100%.
AMP DISP		The data of the 7-segment LED display for the spindle drive unit is displayed.
ALARM		The alarm No. is displayed when an alarm other than that displayed on the spindle drive unit's 7-segment LED.
CYC CNT		The current position from the position detector's reference position (Z-phase) when operating the spindle with the position command is displayed.
D/I 1L H		The control input signal 1 input from the NC to the spindle drive unit is displayed in correspondence to the bits. (Refer to section (1-1) for details.)
D/I 2L H		Same as above (control input signal 2)
D/I 3L H		Same as above (control input signal 3)
D/I 4L H		Same as above (control input signal 4)
D/O 1L H		The control output signal 1 output from the spindle drive unit to the NC is displayed in correspondence to the bits. (Refer to section (2-1) for details.)
D/O 2L H		Same as above (control output signal 2)
D/O 3L H		Same as above (control output signal 3)
D/O 4L H		Same as above (control output signal 4)
UNIT TYP		The spindle drive unit type is displayed.
UNIT NO		The spindle drive unit serial No. is displayed.
S/W VER		The main software version in the spindle drive unit is displayed.
1 WORK TIME		The cumulative working time of the spindle drive unit is displayed.
2 ALM HIST 1~8		The alarm history is displayed. 1 is the latest alarm.

(1-1) D/I (Control input) 1L
H

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
G1					TL3	TL2	TL1	ALMR	PRM					SRV	RDY

bit	Name	Description
0	RDY	Ready ON command
1	SRV	Servo ON command
2		
3		
4		
5		
6	PRM	Parameter conversion command
7	ALMR	Servo alarm reset command
8	TL1	Torque limit 1
9	TL2	Torque limit 2
A	TL3	Torque limit 3
B		
C		
D		
E		
F	G1	Cutting

(1-2) D/I (Control input) 2L
H

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

∗ Not used at this time.

(1-3) D/I (Control input) 3L
H

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
	MCS	LCS	ORC	WRI	WRN	SRI	SRN	GR3	GR2	GR1	SC5	SC4	SC3	SC2	SC1

bit	Name	Description
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	GR3	Gear selection command 3
8	SRN	Forward run start command
9	SRI	Reverse run start command
A	WRN	Index forward run command
B	WRI	Index reverse run command
C	ORC	Orientation start command
D	LCS	L coil selection command (during coil changeover)
E	MCS	(M coil selection command)
F		

(1-4) D/I (Control input) 4L
H

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

∗ Not used at this time.

(2-1) D/O (Control output) 1L
H

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
	INP	ZFIN			TL3A	TL2A	TL1A	ALM	PRM		DWN			SON	RON

bit	Name	Description
0	RON	In ready ON
1	SON	In servo ON
2		
3		
4	DWN	In drive unit warning
5		
6	PRM	In parameter conversion
7	ALM	In alarm
8	TL1A	In torque limit 1
9	TL2A	In torque limit 2
A	TL3A	In torque limit 3
B		
C		
D	ZFIN	Z-phase passed
E	INP	In position loop in-position
F		

(2-2) D/O (Control output) 2L
H

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

∗ Not used at this time.

(2-3) D/O (Control output) 3L H

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
	MCSA	LCSA	ORCA	WRIA	WRNA	SRIA	SRNA	GR3A	GR2A	GR1A	SC5A	SC4A	SC3A	SC2A	SC1A

bit	Name	Description
0	SC1A	In spindle control mode selection command 1
1	SC2A	In spindle control mode selection command 2
2	SC3A	In spindle control mode selection command 3
3	SC4A	In spindle control mode selection command 4
4	SC5A	In spindle control mode selection command 5
5	GR1A	In gear selection command 1
6	GR2A	In gear selection command 2
7	GR3A	In gear selection command 3
8	SRNA	In forward run
9	SRIA	In reverse run
A	WRNA	In index forward run command
B	WRIA	In index reverse run command
C	ORCA	In orientation start command
D	LCSA	In L coil selection command (during coil changeover)
E	MCSA	(M coil selection command)
F		

(2-4) D/O (Control output) 4L H

F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
		ATA				SD2		WRCF	MKC	SYSA	ORCF	ZS	US	SD	CD

bit	Name	Description
0	CD	Current detection
1	SD	Speed detection
2	US	Speed reached
3	ZS	Zero speed
4	ORCF	Orientation complete
5	SYSA	Synchronous speed match
6	MKC	In coil changeover
7	WRCF	Index positioning complete
8		
9	SD2	Speed detection 2
A		
B		
C		
D	ATA	In automatic adjustment
E		
F		

3.4 List of spindle protection functions and warning functions

Refer to "3.9 Spindle protection/warning functions" in the "IV. MDS-C1-SP Spindle System Section" for details on numbers not listed here.

No.	Abbrev.	Name	Details	Operation
16	RD	Magnetic pole position detection error	This occurs when the start signal was input before Z-phase automatic adjustment was executed (SP205=0), or when the number of initial magnetic pole estimation retries was exceeded.	PR
3A	OC	Overcurrent	This occurs when the current command reached the spindle drive's maximum output current value and continued for more than 1 second.	PR
3D	SPHD	Spindle speed lock	This occurs when the motor speed feedback was less than 45 rotations, and the maximum motor torque command continued for longer than the detection time (SP230, 0:3000ms).	PR
3E	SPOS	Spindle speed overrun	(1) This occurs when the motor speed continued to accelerate past the 112.5% of the commanded value. (2) This occurs when the motor rotated more than 10° during the position/speed stop command.	PR
3F	OSE2	Excessive speed deflection 2	This occurs when the speed deflection exceeded the detection range (SP238, 0:30%) for longer than the detection time (SP239: 0:3000ms).	PR
42	PLE	Feedback error (PLG)	(1) This occurs when an excessive offset was detected in the AD input value during PLG automatic adjustment. (2) This occurs when an abnormal number of feedback pulses was continuously detected between the Z-phase pulses.	PR
51	OL2	Overload 2	This occurs when the motor output reached the overload level set with overload detection level (SP313, 0: Invalid) and detection time constant (SP314, 0: Invalid).	NR

4. Setup Procedures

4.1 Wiring the drive unit

The wiring is the same as the "MDS-B/C1-SP Series" spindle drive unit. Refer to "3.8 Output interface" in the "IV. MDS-C1-SP Spindle System Section" for the coil changeover specifications.

4.2 Setting the parameters

<Parameters used for adjustment>

SP205 (ZCHS)····· Validate the PLG Z-phase automatic adjustment function (0: Invalid/1: Valid)
SP245 (PGHS)···· Validate the MDS-B/C1-SPM PLG automatic adjustment function (0: Invalid/1: Valid)

4.3 PLG Z-phase automatic adjustment

Z-phase automatic adjustment is a function that automatically adjusts the relative position of the motor magnetic pole and the PLG Z-phase pulse signal input into the MDS-B/C1-SPM, and then saves and validates the adjustment data. This function is used to increase the output torque accuracy, and must always be carried out when the machine is started up. Execute this function with the following procedures.

(Note)

*1. The mechanical adjustments (gear – sensor gap, etc.) must already be completed.
*2. When using this function, set the spindle load GD^2 (max.: approx. 5-fold of the motor GD^2) and the frictional load as low as possible.
*3. The motor will automatically rotate at the adjustment speed during the Z-phase automatic adjustment. Do not touch the rotating sections, as these are hazardous.
*4. If START (ON) is executed before the adjustment is completed, alarm 16 will occur, and the protection function will activate.

(1) Change SP205 from 0 to 1, and start forward run operation. (The power does not need to be turned OFF and ON.)
The control output 4H bit "D" will be set to 1 until the unit power is turned ON again.

(Note) The spindle motor will automatically rotate at the adjustment speed (two steps for Z-phase pulse detection and magnetic pole position detection).
The adjustment results will be calculated approximately 90 seconds after forward run is started (this time will differ slightly according to the magnetic pole position). Then operation will stop automatically.

(2) Confirm that the motor has automatically stopped. Leave parameter SP205 set to 1, turn START OFF, and turn the power OFF and ON. (When SP205 is set to 1, the adjustment data saved in SPM will be used.)

(Note) If START is turned OFF during automatic rotation, reset SP205 to 0, and turn the power OFF and ON. Then, repeat the procedure from step (1).

(Note) If the drive unit or motor is replaced, if the PLG is reinstalled, or if the signals are readjusted, etc., always reset SP205 to 0, and turn the power OFF and ON. Then, repeat the procedure from step (1). Failure to observe this will prevent correct operation due to invalid adjustment data.

4.4 PLG automatic adjustment of SPM unit

PLG automatic adjustment is a function that automatically adjusts the PLG A and B-phase sinusoidal wave signals input into the SPM unit. (Adjusts the offset and gain, etc.) The adjustment data is then saved and validated.
This function is used to improve the position data accuracy, and must always be carried out when the machine is started up.

(Note)

*1. As a condition, the PLG Z-phase automatic adjustment described in "4.3" must be completed.
*2. The motor will automatically rotate at the adjustment speed during the PLG automatic adjustment. Do not touch the rotating sections of the spindle motor or spindle end, as these are hazardous.

(1) Change parameter (SP245) from 0 to 1, and start forward run operation.
The control output 4H bit "D" will be set to 1 from when the parameter is changed to when the power is turned ON again.

(Note) The spindle motor will automatically rotate at the adjustment speed (two steps for offset adjustment and gain adjustment).
The adjustment results will be calculated within several seconds after forward run is started. Then operation will stop automatically.

(2) Leave parameter (SP245) set to 1, turn START OFF, and turn the drive unit power OFF and ON.
(When SP245 is set to 1, the adjustment data saved in SPM will be used.)
(If SP245 is set to 0, the adjustment data will be invalidated.)

To carry out PLG automatic adjustment again (when the unit has been replaced, the PLG has been reinstalled, or the signals have been readjusted, etc.), reset parameter (SP245) to 0, and then repeat the procedure from step (1).

4.5 Alarms

The alarms related to setup are shown below.

AL16: Magnetic pole position detection error ·········· This occurs if START is turned ON before Z-phase automatic adjustment is carried out.
→ Carry out the PLG Z-phase automatic adjustment explained in "4.3".
AL42: Feedback error ·· This occurs when there is an excessive offset in the PLG A and B phases.
→ Mechanically adjust the PLG A and B phases.
AL42: Feedback error ·· This occurs when the correct Z-phase pulses were not detected.
→ Check that the Z-phase pulse and number of teeth are correct.

4.6 Handling the motor

4.6.1 Storage

Store the motor in the package box. This motor has a powerful permanent magnet in the rotor section. If the rotor is left standing outside of the package box, the built-in type parts could attract magnetic objects in the area, and could cause clock's to lose time, etc.

4.6.2 Assembly (built-in type)

(1) The rotor section's powerful permanent magnet will attract magnetic objects. Thus, when inserting the shaft into the rotor or inserting the rotor in the machine, take care not to catch hands or fingers.
(2) Do not apply impacts on the stator or rotor. If impact is applied on the stator, the insulation will drop and could lead to burning, etc. If impact is applied on the rotor, the magnet could crack and the specified characteristics may not be realized.
(3) When inserting the shaft into the rotor, <u>the maximum rotor heating temperature must be 130°C</u>.
→ If the rotor is heated too high, the magnet will be demagnetized, and the specified characteristics may not be realized.

5. IPM Spindle Motor Specifications

5.1 IPM spindle motor specifications

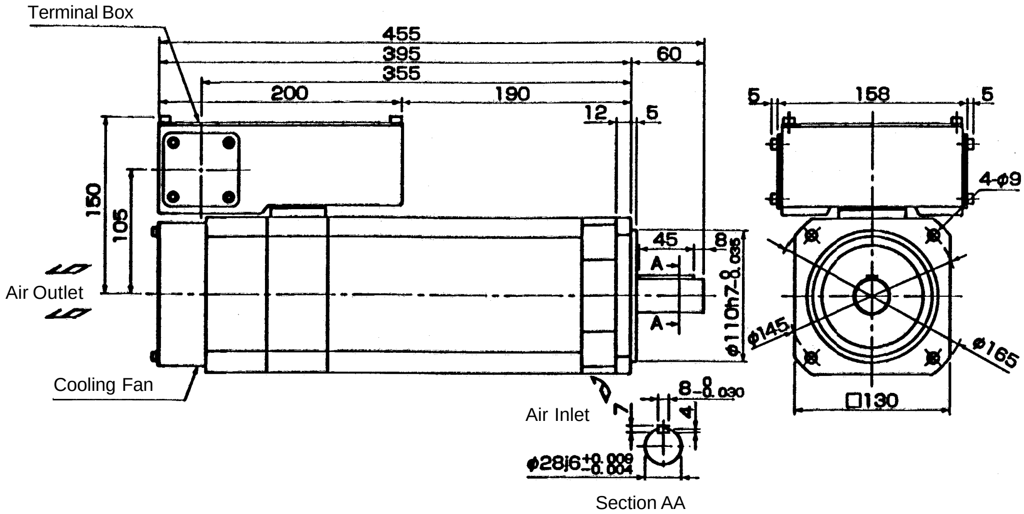
Spindle motor model		SJ-PMF 01830-00	SJ-PMF 03530-00	SJ-PMF 07030-00		
Continuous characteristics	Rated output [kW]	3.7	7.5	18.5		
	Rated torque [Nm]	11.8	23.9	58.9		
Short-time rated characteristics	Rated output [kW]	5.5	11.0	22.0		
	Rated torque [Nm]	17.5	35.0	70.0		
Rated rotation speed [r/min]		3000				
Maximum rotation speed [r/min]		8000				
Frame number		7.1	90	112		
GD^2 [kgm^2]		0.013	0.027	0.063		
Weight [kg]		23	40	60		
Cooling method		Forced wind cooling				
Ambient temperature [°C]		Operation: 0 to 40/Storage: –15 to 70				
Accessories		Pulse generator, thermal protector				
Vibration		$19.6m/s^2$ (2G) or less				
Standard combination drive unit type		MDS-C1-SPM-110	MDS-C1-SPM-185	MDS-C1-SPM-300		

Note 1) The rated output is guaranteed in the rated input voltage to the power supply unit (AC200 to 230V).

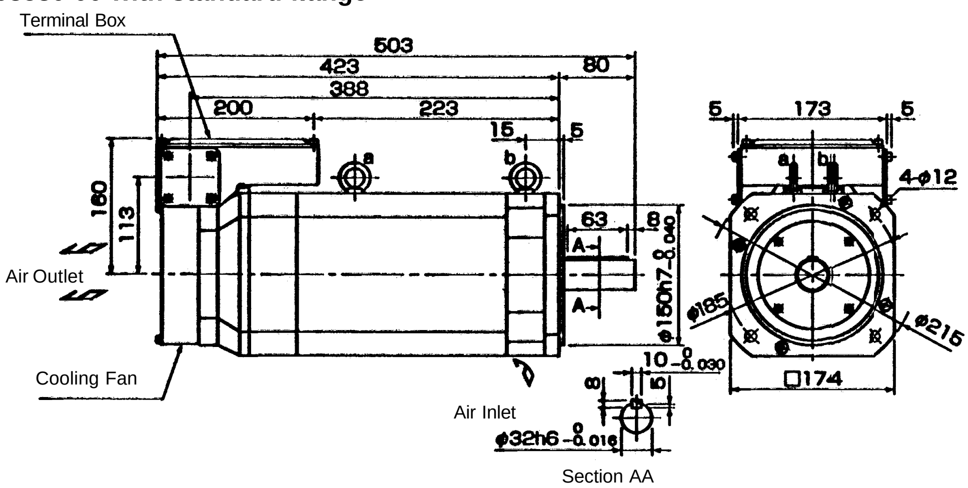
Note 2) The short-time rating is 50% ED (ON for five minutes/OFF for five minutes in 10-minute cycle time).

5.2 Motor outline drawings

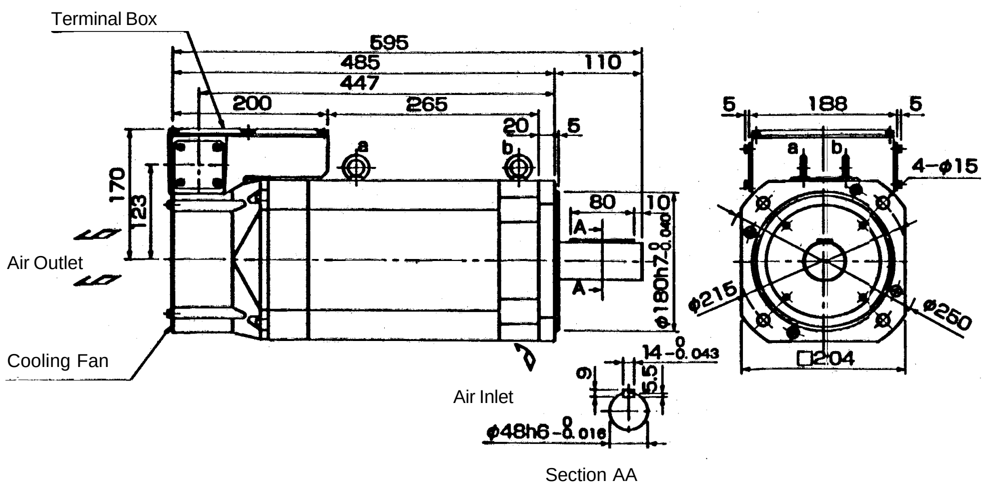
SJ-PMF01830-00 with standard flange



SJ-PMF03530-00 with standard flange



SJ-PMF07030-00 with standard flange



Note 1) A space of at least 30mm should be provided between the cooling fan and nearby located wall.
Note 2) It can be installed vertically with the shaft down.
Note 3) When removing the suspension bolts for use, cover the screw holes with bolts, etc.

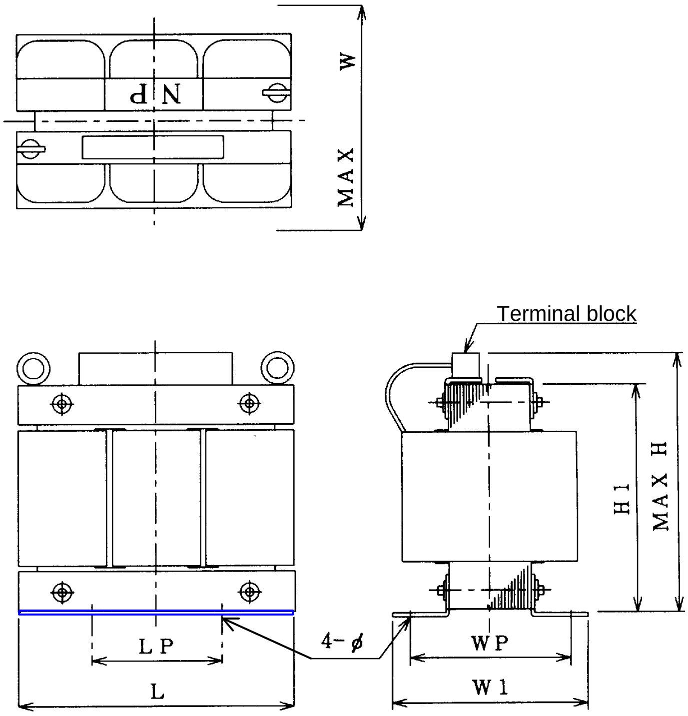
Appendix 1　EN Standards Step-down Insulation Transformer

The following transformer is available as an EN Standards step-down insulation transformer.
Contact the manufacturer directly to purchase.

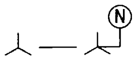
- Manufacturer :　Nunome Electric

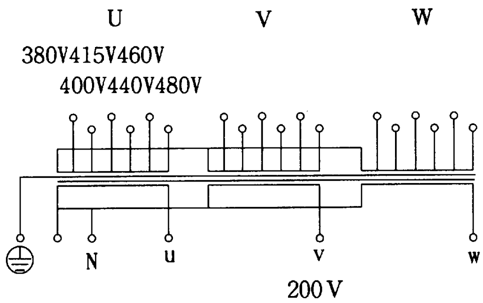
Insulation transformer

Type　　　: NETxxxxTUV
Approval No. : B94 10 21343 002



■ **Standard specifications**

- Rating : Continuous
- Capacity : Refer to following table
- Rated frequency : 50/60Hz
- Primary voltage : 380 400 415 440 460 480V
- Secondary voltage : 200V
- Insulation Class : Class H
- Connection : 
- Max. ambient temperature: 50°C



■ **Product outline dimensions**

Type	Capacity	Secondary current (A)	L	LP	W	WP	W1	H	H1	Ø	kg	Terminal connection wire range (mm²)
NET 3460TUV	3460VA	10A	250	120	210	154	174	310	240	10×12	36	0.33 to 6
NET 5200TUV	5200VA	15A	320	180	240	153	185	355	285	10	50	0.33 to 6
NET 6930TUV	6930VA	20A	360	250	240	160	190	410	340	13	64	P0.5 to 10 S1.5 to 16
NET 010.4TUV	10.4kVA	30A	360	250	280	200	230	410	340	13	93	1.5 to 16
NET 013.9TUV	13.9kVA	40A	500	330	300	205	245	455	370	13×15	120	2.5 to 16
NET 017.3TUV	17.3kVA	50A	500	330	330	225	265	455	370	13×15	143	2.5 to 16
NET 026TUV	26kVA	75A	530	305	400	222	280	535	450	13	206	P2.5 to 16 S6 to 50
NET 034.6TUV	34.6kVA	100A	550	270	440	305	355	575	490	13	273	P2.5 to 16 S6 to 50

Appendix 2 EMC Installation Guidelines

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 that it is not a 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).

2. EMC Instructions

The EMC Instructions largely regulate the following two withstand levels.

(1) Emission....... Capacity to prevent output of obstructive noise that adversely affects external sources.
(2) 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 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	EN50081-2 EN61800-3 (Industrial environment)	EN55011
	Conductive noise	Electromagnetic noise discharged from power supply line		
Immunity	Static electricity electrical discharge	**Example)** Withstand level of static electricity discharge from a charged human body	EN61000-6-2 :1999 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

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.

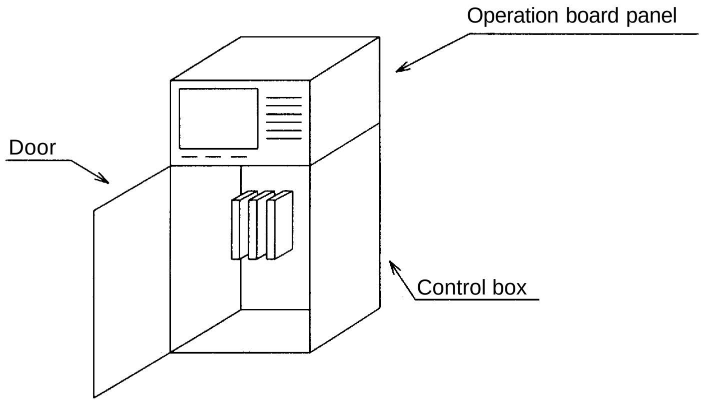
Take caution to the following items to suppress noise radiated outside of the panel.

(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.

4. Measures for panel structure

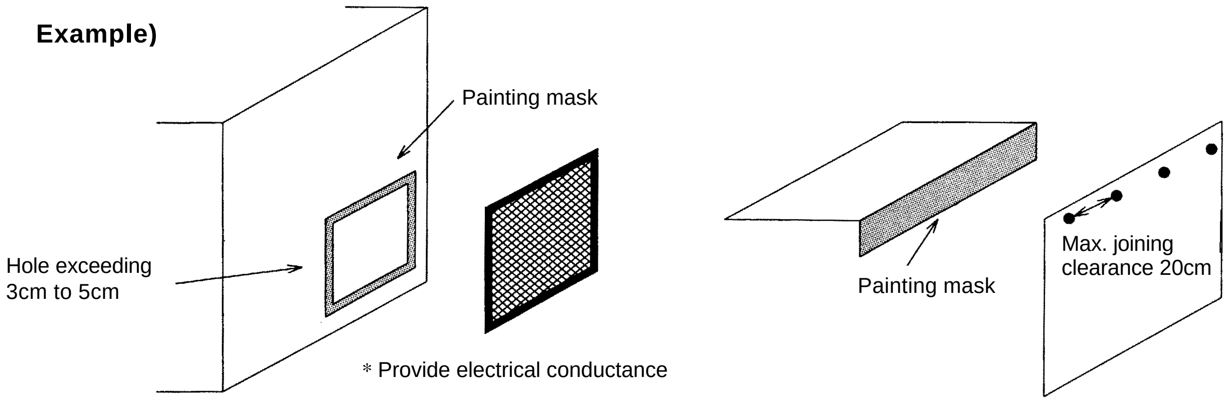
The design of the panel is a very important factor for the EMC measures, so take the following measures into consideration.



4.1 Measures for control box 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, keeping 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 tolerance, use a measure to cover it. Note that even when the clearance is less than 3cm to 5cm, noise may still leak if the clearance is long.

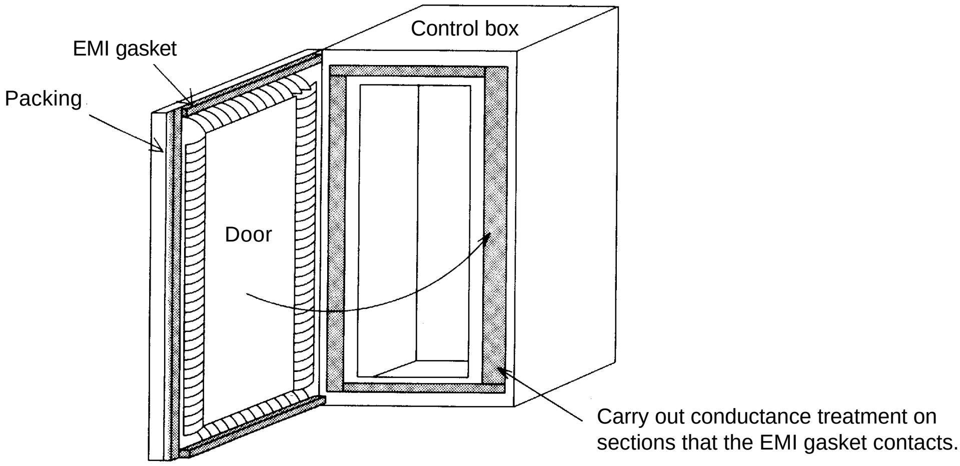
Example)



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 box unit.
(3) The EMI gasket or conductive packing must contact at a uniform and correct position of the metal surface of the control box unit.
(4) The surface of the control box unit contacted with the EMI gasket or conductive packing must have conductance treatment.

Example) Weld (or screw) a welded plate that is plated (with nickel, tin).



(5) As a method other than the above, the control box unit and door can be connected with a plain braided wire. In this case, the box and door should be contacted at as many points as possible.

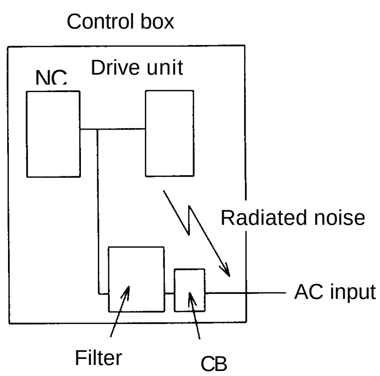
4.3 Measures for operation board panel

(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 box.
(3) Connect the operation board panel and control box with a sufficiently thick and short earthing wire.

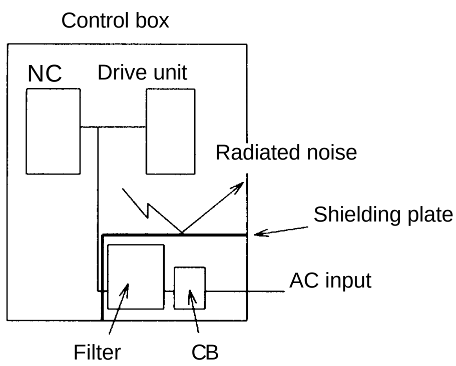
Refer to the "EMC INSTALLATION GUIDELINES" BNP-B2230 for the NC for more details.

4.4 Shielding of the power supply input section

(1) Separate the input power supply section from other parts of the control box so that the input power supply line 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 box.



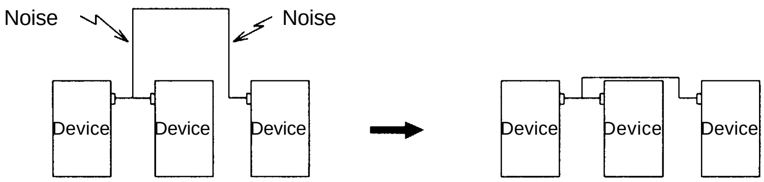
Use a metal plate, etc., for the shielding partition. Make sure not to create a clearance.

5. Measures for various cables

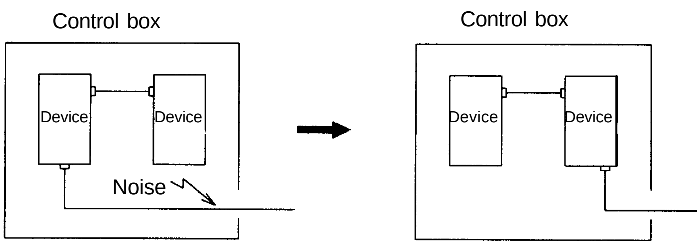
The various cables act as antennas for the noise and discharge the noise externally. Thus appropriate treatment is required to avoid the noise. The wiring between the drive unit and motor act as an extremely powerful noise source, so apply the following measures.

5.1 Measures for wiring in box

(1) If the cables are led unnecessarily in the box, 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.

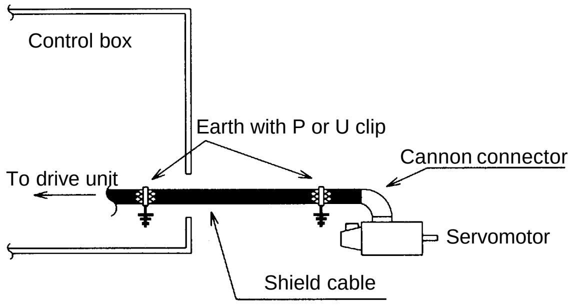


(3) Connect the control device earthing terminal and earthing plate with a thick wire. Take care to the leading of the wire.

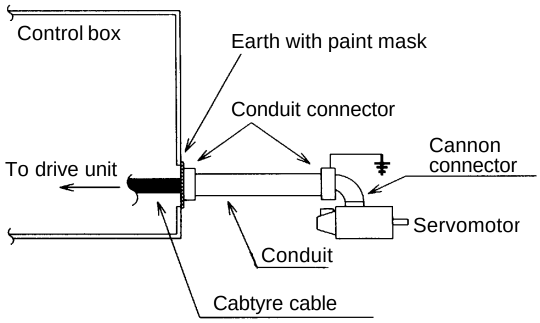
5.2 Measures for shield treatment

Use of shield clamp fittings is recommended for treating the shields. The fittings are available as options, so order as required. (Refer to section "6.1 Shield clamp fitting".)
Clamp the shield at a position within 10cm from the panel lead out port.

5.3 Servomotor power cable

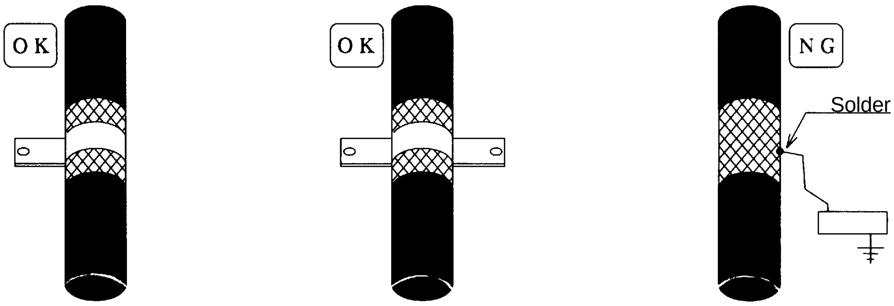


Using shield cable

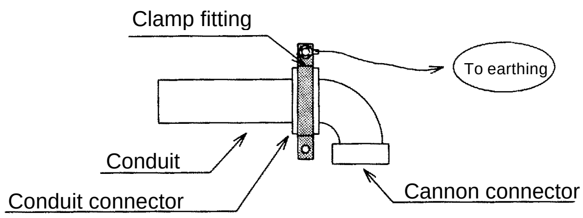


Using conduit

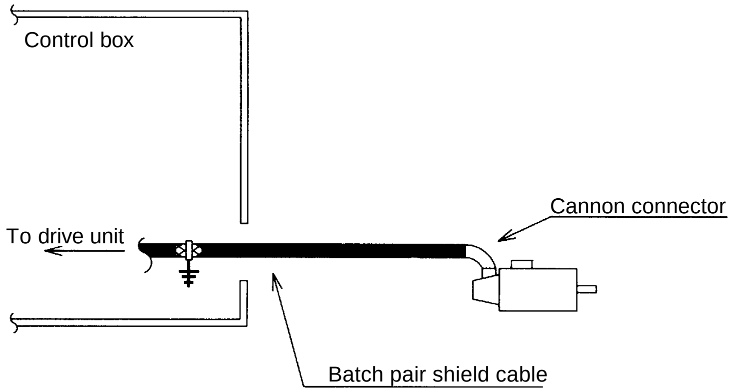
(1) Use four wires (3-phase + earthing) for the power line that are completely shielded and free from breaks.
(2) Earth the shield on both the control box side and motor chassis side.
(3) Earth the shield with a metal P clip or U clip.
(4) Directly earth the shield. Do not solder the braided shield onto a wire and earth the end of the wire.



(5) When not using a shield cable for the power line, use a conventional cabtyre cable. Use a metal conduit outside the cable.
(6) Earth the power line on the control box side at the contact surface of the conduit connector and control box. (Mask the side wall of the control box with paint.)
(7) Follow the treatment shown in the example for the conduit connector to earth the power line on the motor side. (Example: Use a clamp fitting, etc.)

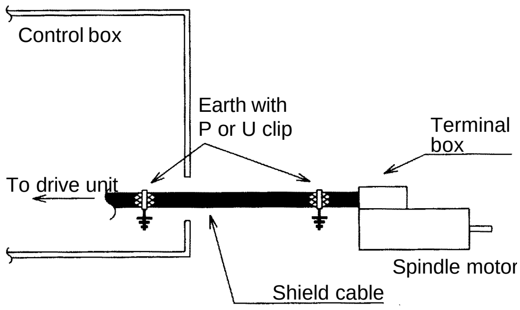


5.4 Servomotor feedback cable

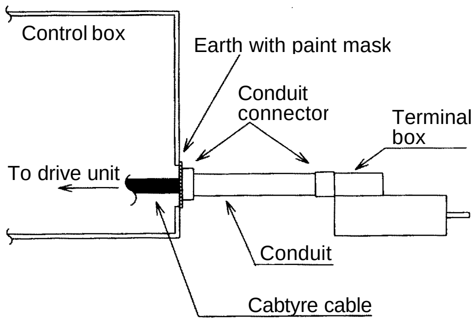


Use a conventional batch pair shield cable for the servomotor's feedback cable, and earth to the NC side (inside the control box).

5.5 Spindle motor power cable



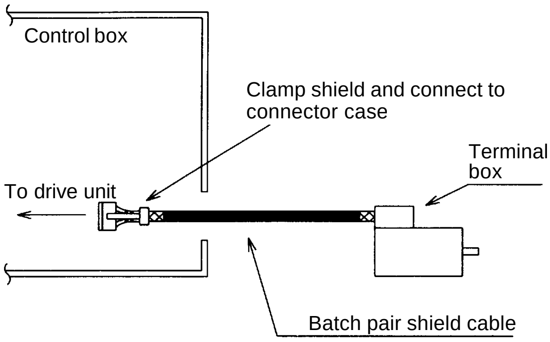
Using shield cable

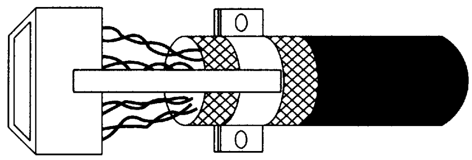


Using conduit

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

5.6 Spindle motor feedback cable



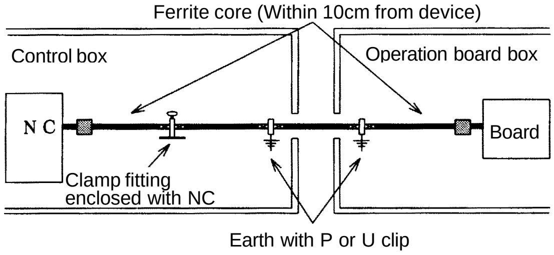


Spindle drive side connector
(View of state with cover removed)

(1) Use the conventional batch pair shield cable for the spindle motor's feedback cable.
Note) The shield of the spindle motor feedback cable is not FG, so do not earth it.

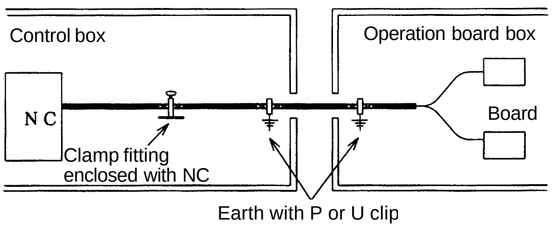
5.7 Cable between control box and operation board panel

SH11 cable (signal line)



(1) Use a shield cable for the cable between the control box and operation board.
(2) Earth the shield in the same manner as the other cables.
(3) Insert a ferrite core in the SH11 cable at a position within 10cm from the device.
(This provides a better effect.)

PD05 cable (power supply line)

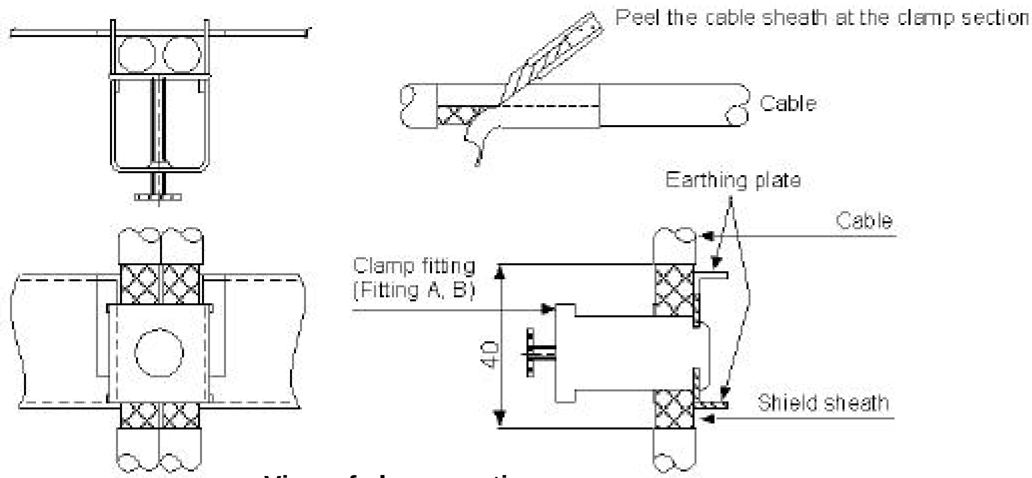


The PD05 cable is used with the MELDAS500 Series.
Refer to the EMC INSTALLATION GUIDELINES for each NC for details.

6. EMC Countermeasure Parts

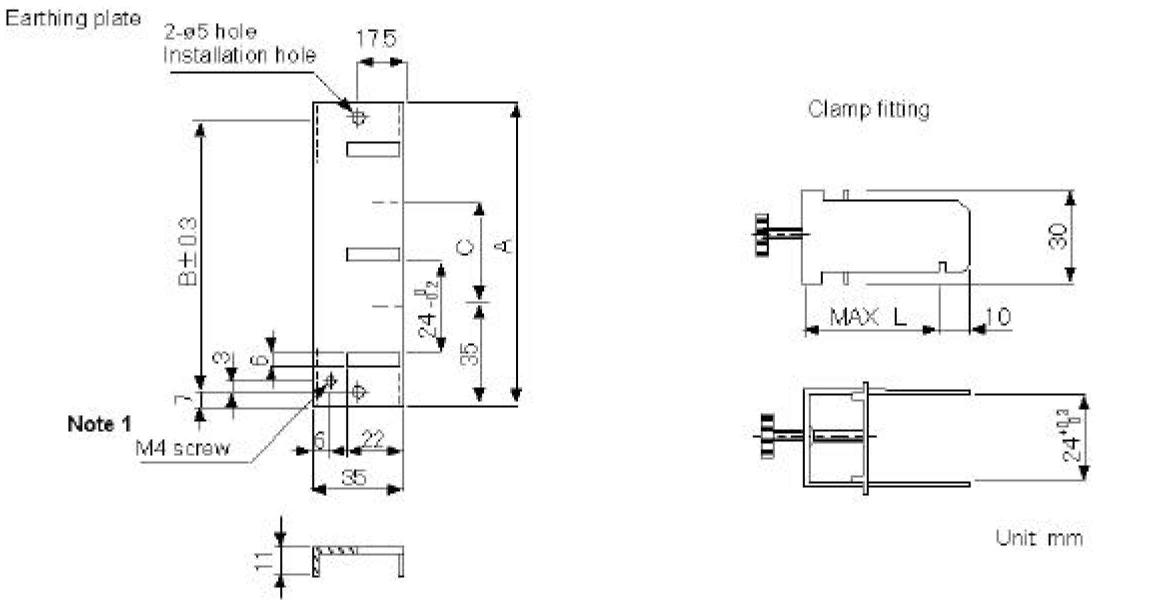
6.1 Shield clamp fitting

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	Two clamp fittings A
AERSBAN-ESET	70	56	–	One clamp fitting B

	L
Clamp fitting A	70
Clamp fitting B	45

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 supply line.
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

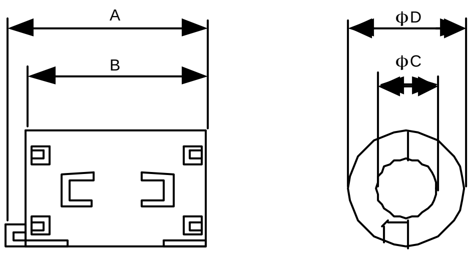


Fig. 1

ZCAT-A type

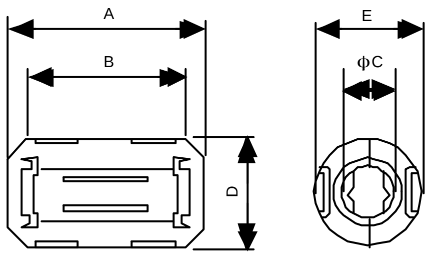


Fig. 2

ZCAT-B type

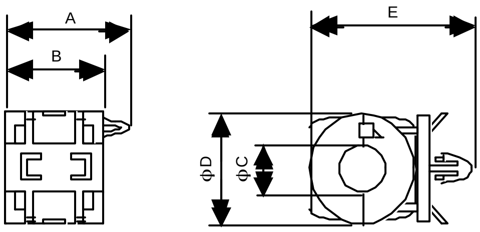


Fig. 3

ZCAT-C type

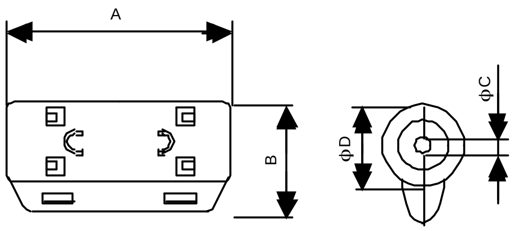


Fig. 4

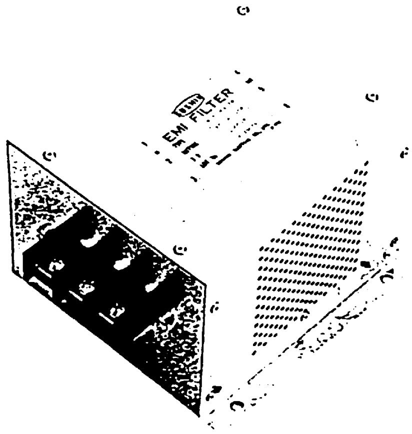
· **Recommended ferrite core** Unit [mm]

Part name	Fig.	A	B	C	D	E	Applicable cable outline	Weight
● 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
ZCAT2017-0930B-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.

HF3000A-TM/HF3000C-TM Series



- 3-phase, 3-wire type (250V system, 500V system)
- Noise Standards [German Official Report Vfg243, European Standards EN55011 (Class B)] compatible part.
- Effective as an IGBT inverter and MOS-FET inverter.
- Installation is easy with terminal block structure, and reliability is outstanding.

<Application>

- Products that must satisfy Noise Standards [German Official Report Vfg243, European Standards EN55011 (Class B)].
- For input of electricity converter using the latest advanced high-speed power device such as IGBT MOS-FET.

<Performance>

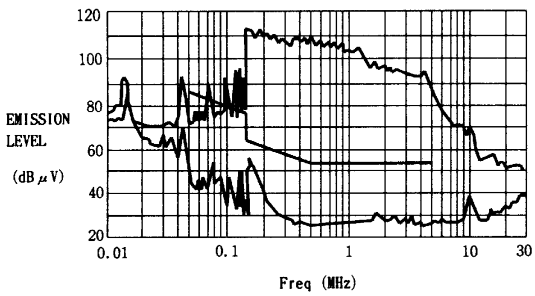
<250V system>

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										

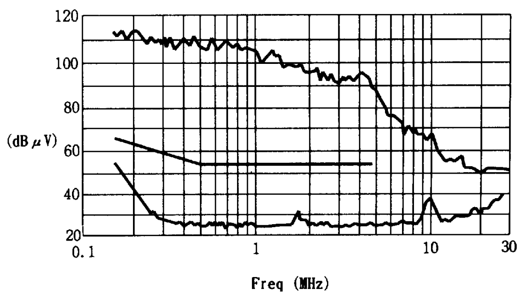
<500V system>

Part name	HF3005C -TM	HF3010C -TM	HF3015C -TM	HF3020C -TM	HF3030C -TM	HF3040C -TM	HF3050C -TM	HF3060C -TM	HF3080C -TM	HF3100C -TM
Rated voltage	500VAC									
Rated current	5A	10A	15A	20A	30A	40A	50A	60A	80A	100A
Leakage current	3mA MAX 500VAC 60Hz									

<Noise terminal voltage measurement example> ..... Measured with IGBT inverter

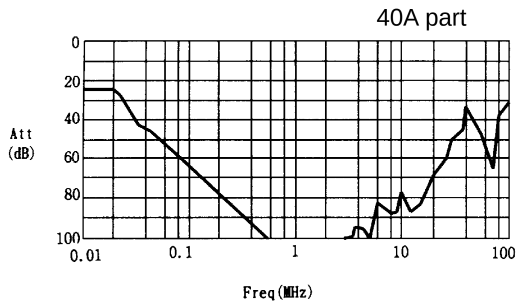


German Official Report Vfg243 measurement data

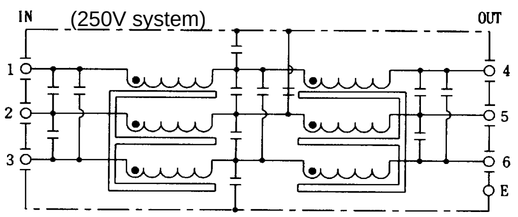


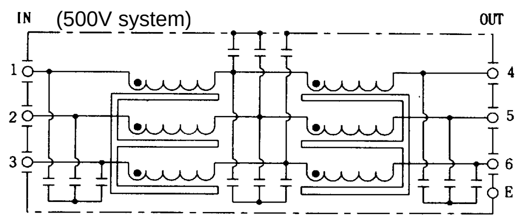
European Standards EN55011 Class B measurement data

<Main characteristics>



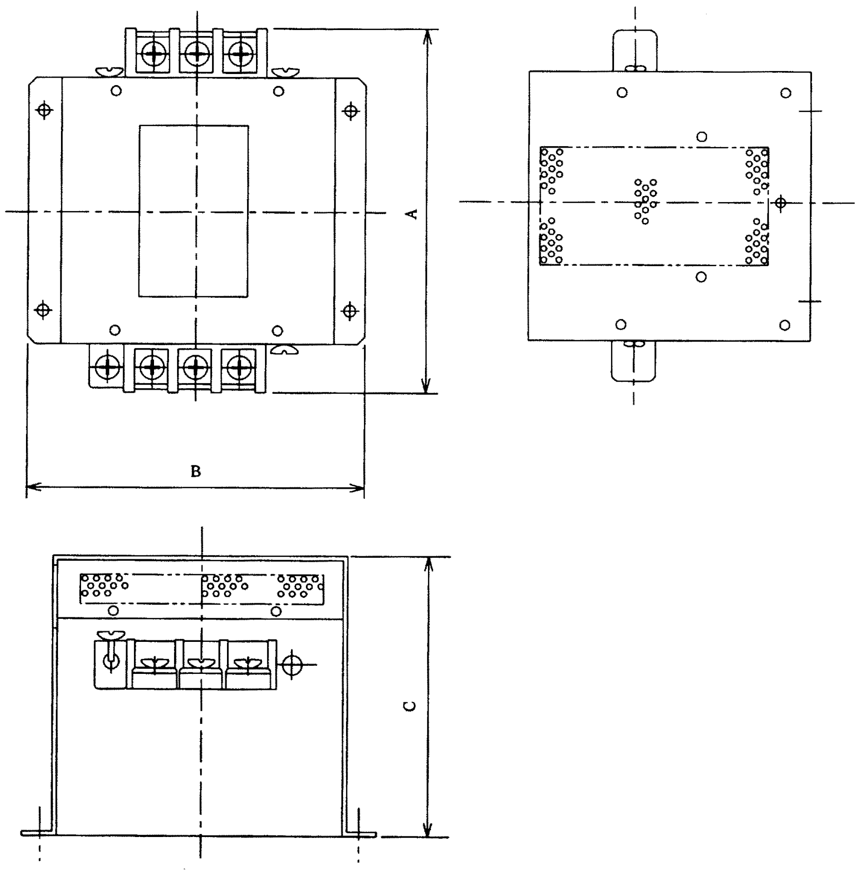
<Circuit diagram>



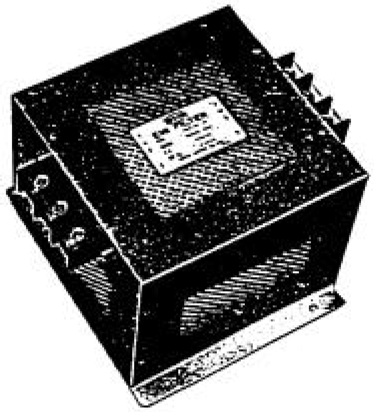


<Outline dimensions>

Part name	Dimensions (unit: mm)			Part name	Dimensions (unit: mm)		
	A	B	C		A	B	C
HF3005A-TM	175	170	130	HF3005C-TM	170	170	150
HF3010A-TM				HF3010C-TM			
HF3015A-TM				HF3015C-TM			
HF3020A-TM				HF3020C-TM			
HF3030A-TM	260	155	140	HF3030C-TM	260	155	160
HF3040A-TM				HF3040C-TM			
HF3050A-TM	290	190	230	HF3050C-TM	290	190	250
HF3060A-TM				HF3060C-TM			
HF3080A-TM	405	220	240	HF3080C-TM	405	220	260
HF3100A-TM				HF3100C-TM			



CC3000C-AZ Series Terminal block type



- 3-phase, 3-wire type (500V system)
- Dedicated reactor type for inverter secondary side (load side).
- Noise radiated on the inverter output side is dampened.
- Series is available up to 150A.

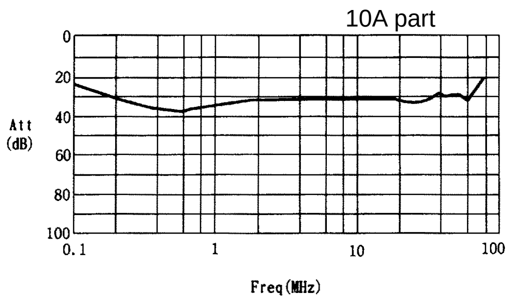
<Application>

- For secondary side (load side) of general-purpose and large capacity inverter powers.

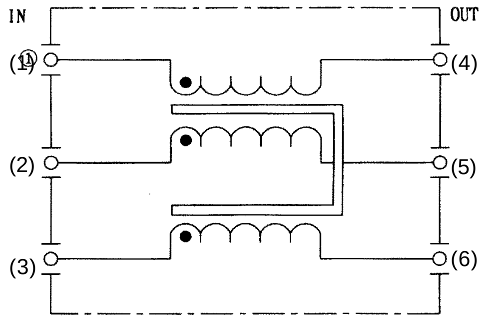
<Performance> (500V system)

Part name	CC3005C-AZ	CC3010C-AZ	CC3015C-AZ	CC3020C-AZ	CC3030C-AZ	CC3040C-AZ	CC3050C-AZ	CC3060C-AZ	CC3080C-AZ	CC3100C-AZ	C3115C-AZ	CC3150C-AZ
Rated voltage	500VAC											
Rated current	5A	10A	15A	20A	30A	40A	50A	60A	80A	100A	115A	150A

<Main characteristics>



<Circuit diagram>



<Outline dimensions>

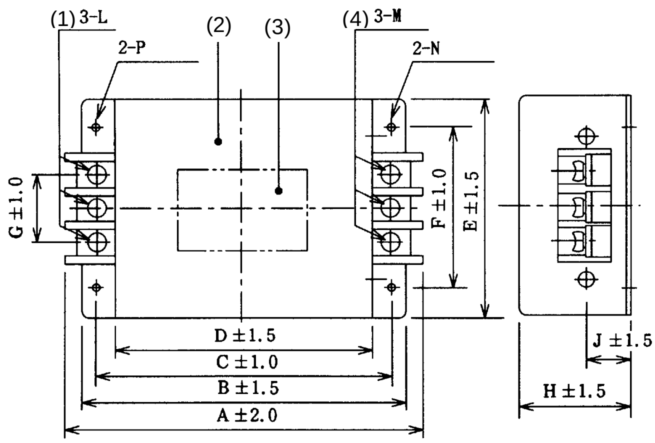
(1)

Part name	Dimensions (Unit: mm)											
	A	B	C	D	E	F	G	H	J	L	N	P
CC3005C-AZ	154.5	140	125	110	95	70	32	50	20	M4	ø4.5	R2.25 length 6
CC3010C-AZ												
CC3015C-AZ												
CC3020C-AZ	174.5	160	145	130	110	80		70	25			
CC3030C-AZ												

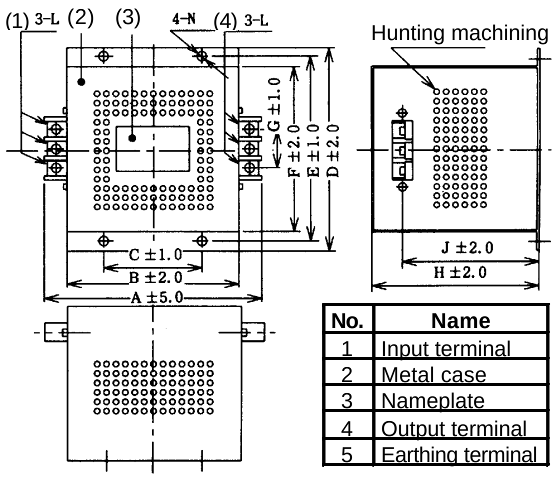
(2)

Part name	Dimensions (Unit:mm)										
	A	B	C	D	E	F	G	H	J	L	N
CC3035C-AZ	170	120	80	150	135	120	44	120	90	M5	ø5.5
CC3045C-AZ	230	180	100	220	200	180	44	170	140	M6	ø6.5
CC3060C-AZ											
CC3080C-AZ	260	210	150	250	230	210	57	170	140	M8	ø6.5
CC3100C-AZ											
CC3115C-AZ											
CC3150C-AZ	277	220	160	260	240	220	57	170	140	M8	ø6.5

5A to 30A



35A to 150A



No.	Name
1	Input terminal
2	Metal case
3	Nameplate
4	Output terminal
5	Earthing terminal

MX13-SERIES 3-phase high-attenuation noise filter (for FA and servo systems)

■ Features

- Optimum for installation in control panel:
  New shape with uniform height and depth
- Easy installation and maintenance:
  Terminals are grouped on the front panel
- NC servo and AC servo noise compatible:
  High-attenuation of 40dB at 150kHz
- Safety Standards:
  UL1283, CSA22.2 No.8, EN133200
- Patent and registration of design pending

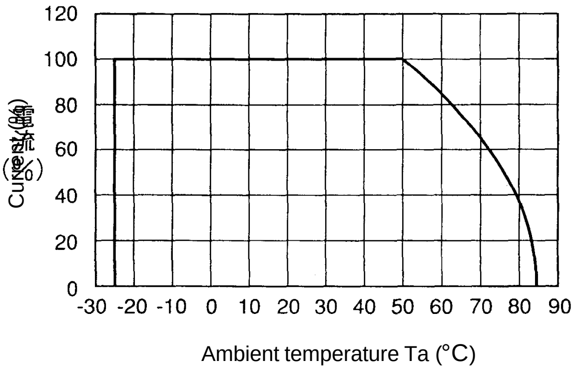
■ Specifications and standards

	Item / Type	MX13030	MX13050	MX13100	MX13150
1	Rated voltage (AC)	3-phase 250VAC (50/60Hz)			
2	Rated current (AC) **(Note)**	30A	50A	100A	150A
3	Test voltage (AC for one minute between terminal and case)	2500VAC (100mA) at 25℃, 70% RH			
4	Insulation resistance (500VDC between terminal and case)	100MO min. at 25℃, 70% RH			
5	Leakage current (250V, 60Hz)	3.5 mA max.		8 mA max.	
6	DC resistance	30 mO max.	11 mO max.	5.5 mO max.	3.5 mO max.
7	Temperature rise	30℃max			
8	Working ambient temperature	-25℃ to +85℃			
9	Working ambient humidity	30% to 95% RH (With no dew condensation)			
10	Storage ambient temperature	-40℃ to +85℃			
11	Storage ambient humidity	10% to 95% RH (With no dew condensation)			
12	Weight (typ)	2.8 kg	3.9 kg	11.5 kg	16 kg

(Note) This is the value at Ta ≤ 50°C.

Refer to the following output derating when Ta > 50°C.

■ Output derating



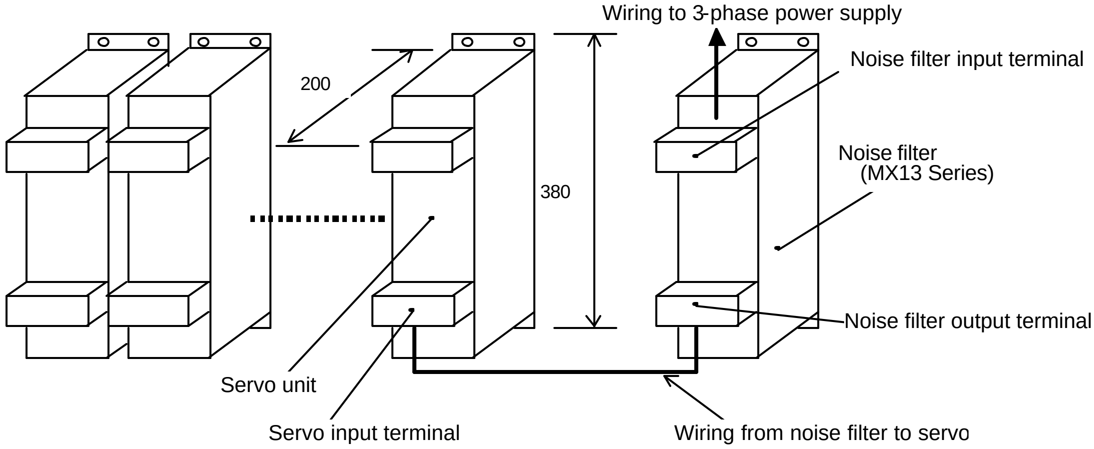
■ Examples of using MX13 Series

This noise filter has the same dimensions as the general servo unit's depth (200mm) and height (380mm).

The system layout can be simplified by arranging this unit with the servo unit.

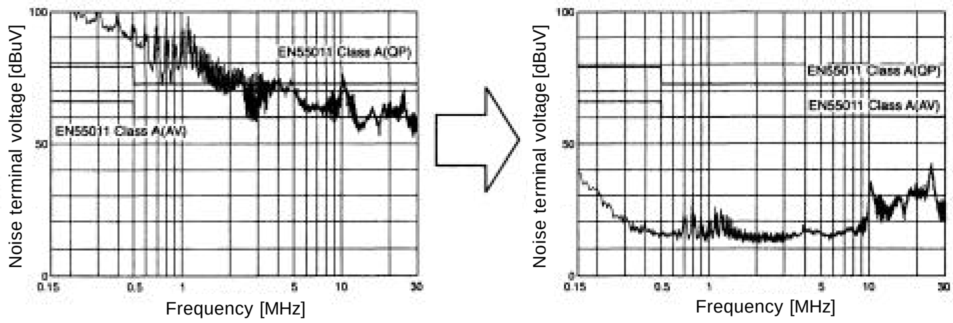
As with the servo unit, the terminals are arranged on the front panel, so ideal wiring leading can be realized.

Refer to the following usage example for details.



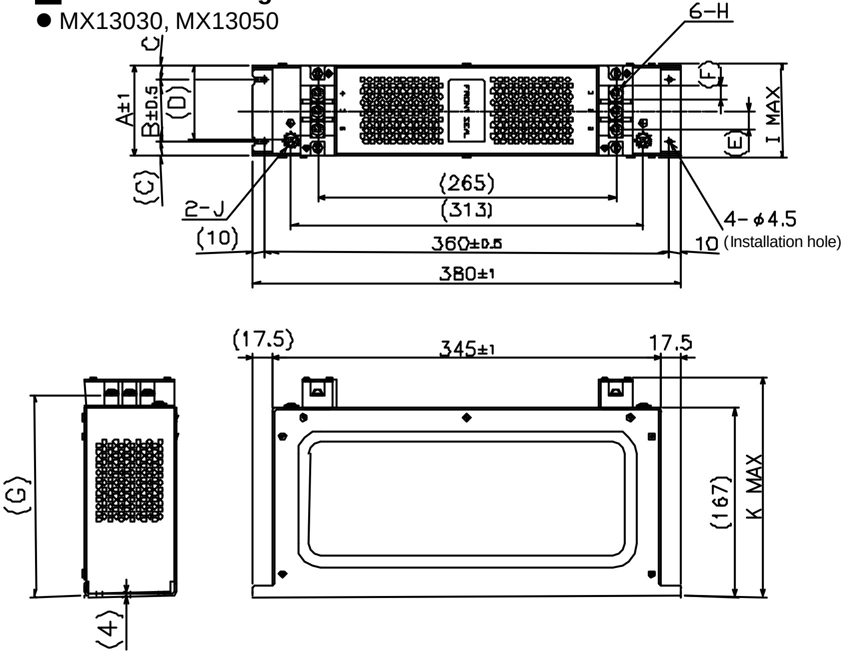
Example of attenuation of noise terminal voltage

- EMI data for single control panel (with six-axis servo unit)
- EMI data for control panel + noise filter (MX13030)



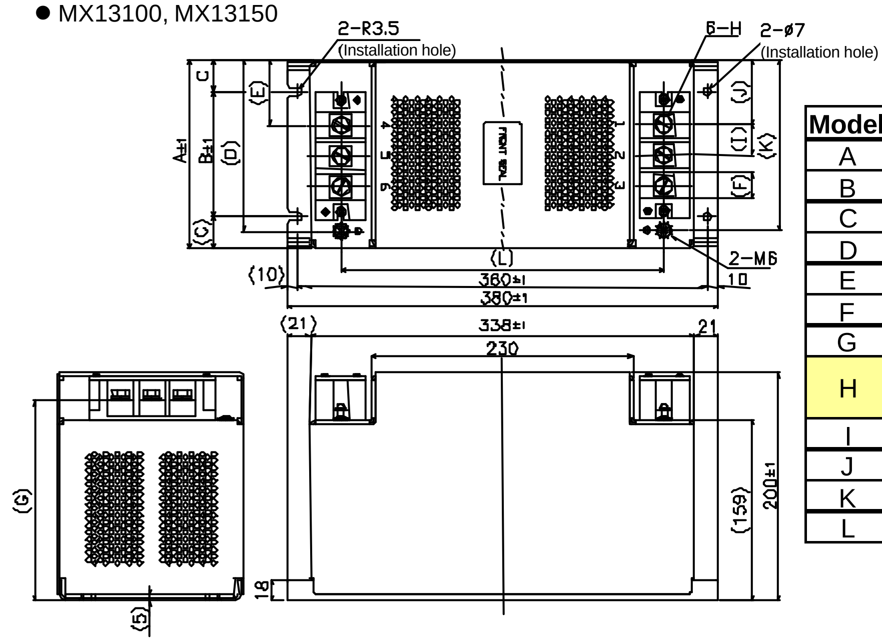
Outline drawing

- MX13030, MX13050



Model	MX13030	MX13050
A	66	81
B	45	55
C	10.5	13
D	50	67
E	13	16
F	10	13
G	177	179
H	M4 cross-head screw	M6 cross-head screw
I	70	85
J	M4 cross-head screw	M6 cross-head screw
K	195	200

- MX13100, MX13150



Model	MX13100	MX13150
A	130	165
B	90	110
C	20	27.5
D	115	150.5
E	37.5	57.5
F	18	23
G	174	176
H	M6 cross-head screw	M8 minus screw (hexagon)
I	21	27
J	37.5	56.5
K	115	149.5
L	276	284

Contact:

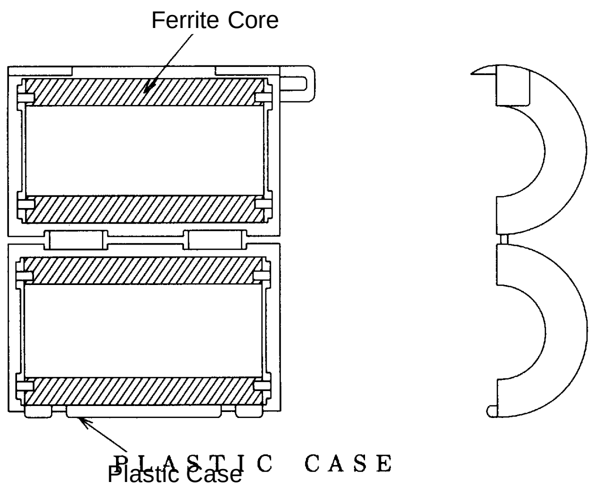
DENSEI-LAMBDA K.K.

Product Identification

ZCAT	20	35	–	09	30	A	–	BK
(1)	(2)	(3)		(4)	(5)	(6)		(7)

(1) Series name
(2) Outside diameter in mm
(3) Length in mm
(4) Inside diameter in mm
(5) Material
(6) A : Self-hold (cable-rock mechanism) type
B : Self-hold (chassis-hold mechanism) type
None : Band-hold type
(7) Color BK : Black
None : Gray

Construction



Appendix 3 Unit system

The correspondence of the conventional unit symbols used in this manual and the international unit system (SI) is shown below.

Name of amount	Conventional unit's symbol	SI unit and common unit symbols	Conversion value
Weight/load (expresses weight)	kgf	——	The value is the same
Weight	——	kg	
Wight/load (concept of force)	kgf	N	1kgf=9.80665N
Force	kgf	N	1kgf=9.80665N
Torque	kgf • cm	N • m	1kgf • cm=9.80665×10^{-2}N • m
Inertia (J)	kgf • cm • S^2	kg • m^2	1kgf •cm •S^2=9.80665×10^{-2}kg •m^2
GD^2	kgf • cm^2	——	$J = \frac{GD^2}{4g}$ (g: Gravitational acceleration 980cm/s^2)
Rotation speed, speed	rpm	r/min or min^{-1}	1rpm=1r/min=1min^{-1}

Appendix 4 Classification of Servo/Spindle Drive Unit Circuits Based on Higher Harmonic Suppression Countermeasures Guidelines

Calculate the circuit class (conversion coefficient) and power capacity based on the Higher Harmonic Suppression Countermeasures Guidelines using the following table.

Circuit class

Name	Model	Circuit class	Circuit type	Conversion coefficient
AC servo drive unit	TRS Series	3	3-phase bridge (with smoothing capacitor) Without reactor	K31=3.4
	MR-S1/S2/S3 MR-S11/S12 Series	3	3-phase bridge (with smoothing capacitor) Without reactor	K31=3.4
	MDS-A-SVJ MDS-B-SJV2 MR-J2-CT Series	3	3-phase bridge (with smoothing capacitor) Without reactor	K31=3.4
	MDS-A-V1/V2 MDS-B-V1/V14/V2/V24 MDS-C1-V1/V2 Series	3	3-phase bridge (with smoothing capacitor) With AC reactor	K32=1.8
AC spindle drive unit	SFJ/SGJ Series	3	3-phase bridge (with smoothing capacitor) Without reactor	K31=3.4
	MDS-A-SPJ MDS-B-SPJ2 Series	3	3-phase bridge (with smoothing capacitor) Without reactor	K31=3.4
	MDS-A-CSP-370/450	3	3-phase bridge (with smoothing capacitor) Without reactor	K31=3.4
	MDS-A-SP/SPA MDS-B-SP/SPA/SPH/SPM/SPX MDS-C1-SP/SPH/SPM/SPX Series	3	3-phase bridge (with smoothing capacitor) Without AC reactor	K32=1.8

Working conditions

1. The power supply unit (MDS-A/B/C1-CV Series) applies when using the AC reactor (B-AL Series). When the MDS-A-CR Series is used, calculate with the conversion coefficient as K31=3.4 (without 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

Appendix 5 Explanation of Large Capacity Spindle Unit Specifications

1. Outline

The MDS-B-SP Series large capacity spindle unit (37kW, 45kW, 55kW) is an increased capacity version of the MDS-B-SP Series standard spindle unit (30kW or less).
Thus, the items other than those related to the increased capacity are the same as the 30kW or less capacity.
The matters required for the increased capacity are explained in these specifications.
Refer to the "AC Servo/Spindle MDS-A Series/B Series Specifications Manual" (BNP-B3759) for details on the other specifications.

2. List of units

Power supply unit
DC power supply/regeneration control to drive unit

No.	Type	Capa-city (kW)	Weight (kg)	Outline drawing
(1)	B-CVE-370	37	9.5	"6.(1)"
(2)	B-CVE-450	45	20	"6.(2)"
(3)	B-CVE-550	55	21	"6.(3)"

Spindle drive unit
Spindle motor control

No.	Type	Capa-city (kW)	Weight (kg)	Outline drawing
(1)	B-SP-370	37	20	"6.(4)"
(2)	B-SP-450	45	21	"6.(5)"
(3)	B-SP-550	55	21	"6.(5)"

3. Selection of AC reactor (B-AL), contactor and CB

Always install the following AC reactor and contactor on the input side of each power supply unit (B-CVE-370/450/550). Note that only the contactor can be omitted for the B-CVE-370.

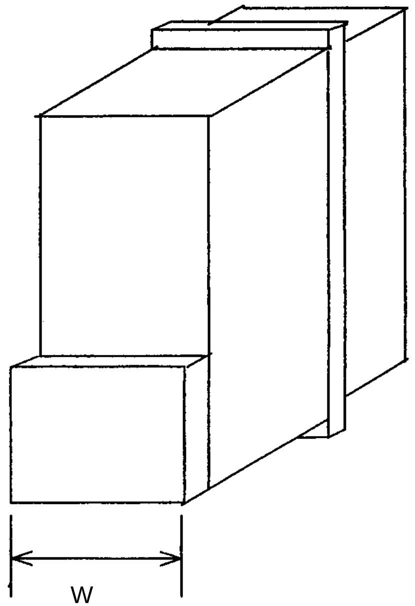
(Note 1) When using the MDS-B-CVE-450 or 550, always install one contactor for one power supply unit. The power supply unit will be damaged if this contactor is omitted or shared.
(Note 2) Always install one ACL for one power supply unit. The power supply unit will be damaged if this ACL is omitted or shared.

Selection of the CB when using only one power supply unit is shown below as reference.

Power supply unit type	B-CVE-370	B-CVE-450	B-CVE-550	Outline drawing
AC reactor (ordered part)	B-AL-37K	B-AL-45K	B-AL-55K	"6 (6)"
Recommended contactor (non-ordered part)	SN150-AC200V	SN150-AC200V	SN180-AC200V	
Recommended CB (non-ordered part)	NF225CS3P-175A05	NF225CS3P-200A05	NF400CS3P-300A05	

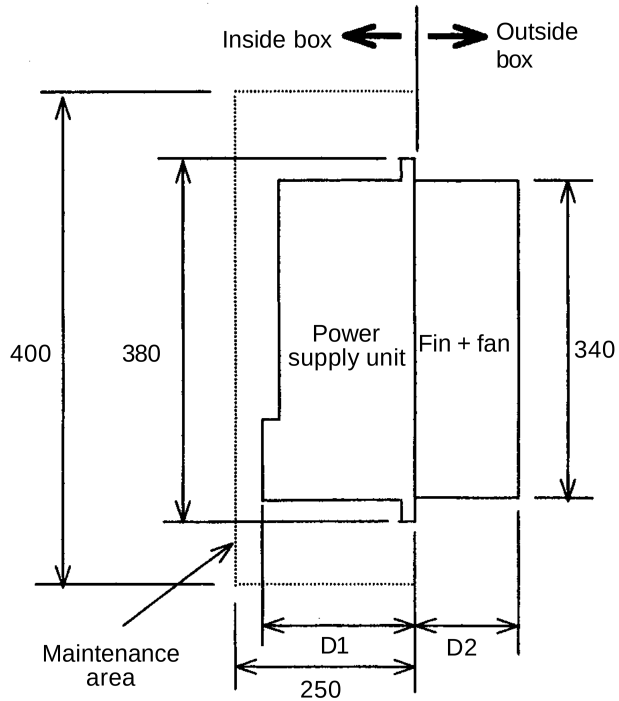
(Note) Even when OFF, a leakage current of 15mA or less flows at the coil connection terminal MC1 for the power supply unit's external contactor. Thus, when using a contactor other than that recommended above, do not use a connector that turns ON at 15mA or less or a contactor that cannot be turned OFF at 15mA. When using a contactor with an internal electronic circuit, consult with the contactor maker and make sure that the contactor will operate correctly even if a leakage current of 15mA or less flows.

4. Outline of units



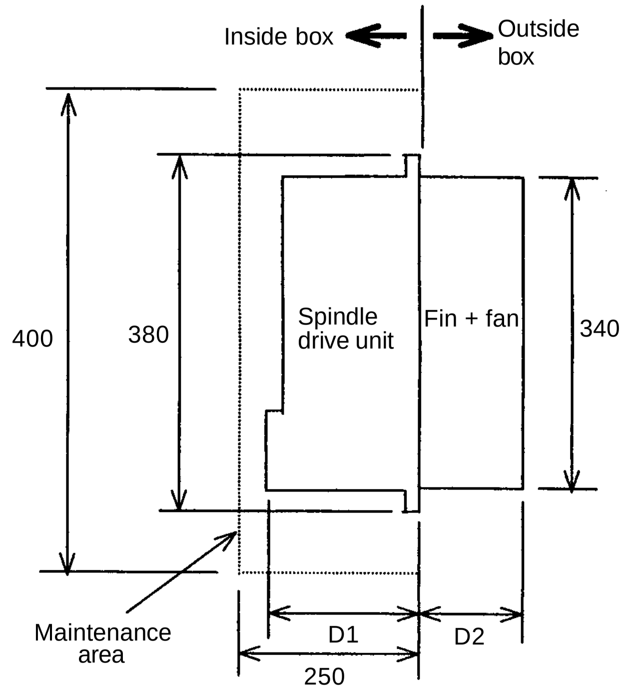
(Front)

[Power supply unit]



(Side)

[Spindle drive unit]



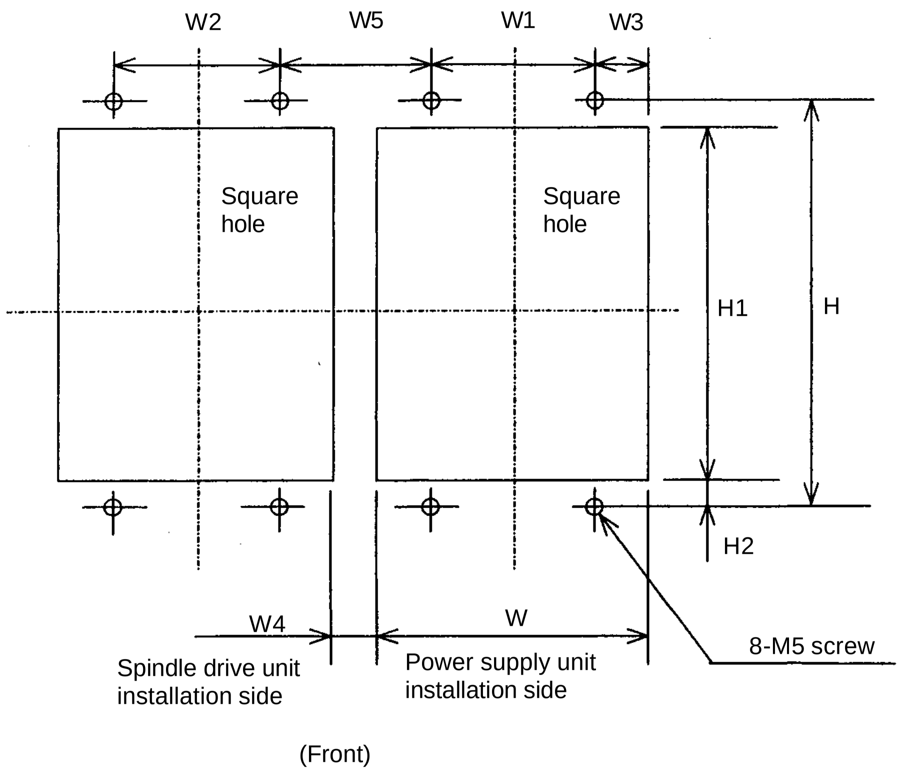
(Side)

	Power supply unit			Spindle drive unit		
Type	**MDS-B-CVE-370**	**MDS-B-CVE-450**	**MDS-B-CVE-550**	**MDS-B-SP-370**	**MDS-B-SP-450**	**MDS-B-SP-550**
W	150	240	300	240	300	300
D1	200	210	210	210	210	210
D2	120	115	120	115	120	120

Note) The D1 value includes the terminal block cover.

5. Panel cut dimension drawing

Panel cut dimension drawing



Note 1) Looking from the front of the unit, the spindle drive unit must be installed to the left of the power supply unit.
The panel must be cut taking this into consideration.

Note 2) L+ and L- connection conductors are enclosed with the CVE-450 and 550 capacities, so provide the dimensions shown below between the units.

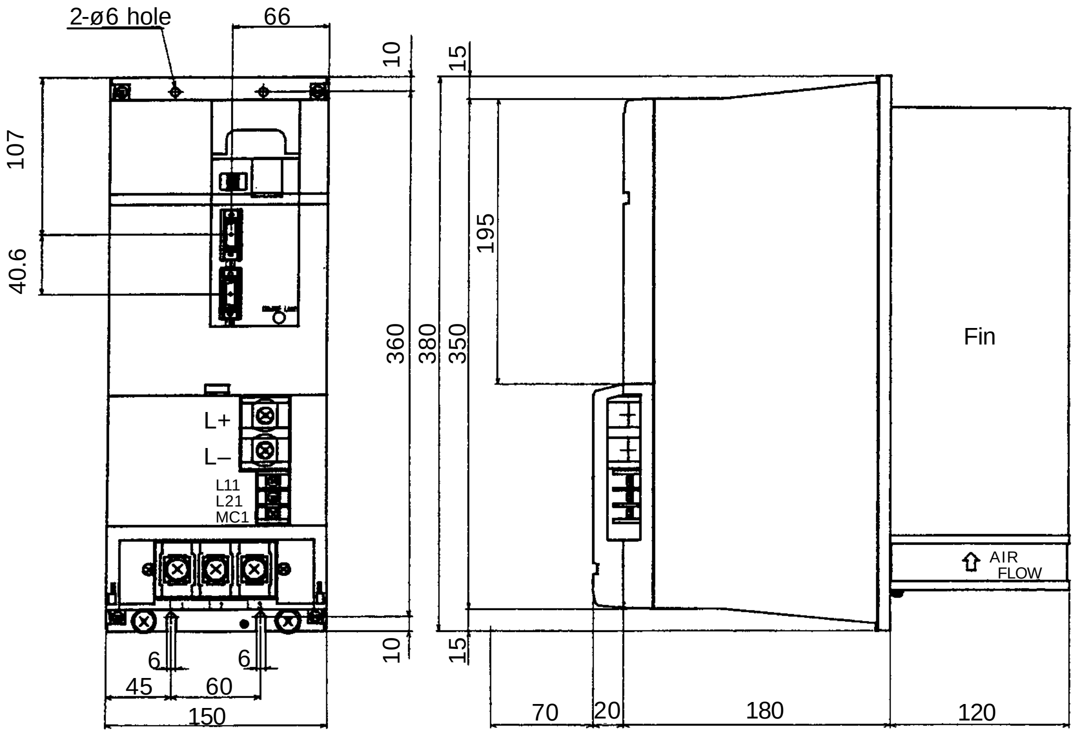
Note 3) When using the CVE-260 to 300 capacities, cut the panel in the same manner as for the CVE-370 capacity.

	Power supply unit			Spindle drive unit		
Type	**MDS-B-CVE-370**	**MDS-B-CVE-450**	**MDS-B-CVE-550**	**MDS-B-SP-370**	**MDS-B-SP-450**	**MDS-B-SP-550**
H	360±0.3	360±0.3	360±0.3	360±0.3	360±0.3	360±0.3
W	142±1	222±1	282±1	222±1	282±1	282±1
H1	341±1	341±1	341±1	341±1	341±1	341±1
H2	10±0.5	10±0.5	10±0.5	10±0.5	10±0.5	10±0.5
W1	60±0.3	120±0.3	180±0.3	–	–	–
W2	–	–	–	120±0.3	180±0.3	180±0.3
W3	41±0.5	51±0.5	51±0.5	51±0.5	51±0.5	51±0.5
W4	13±0.5	18±0.5	18±0.5	–		
W5	105±0.5	120±0.5	120±0.5	–		

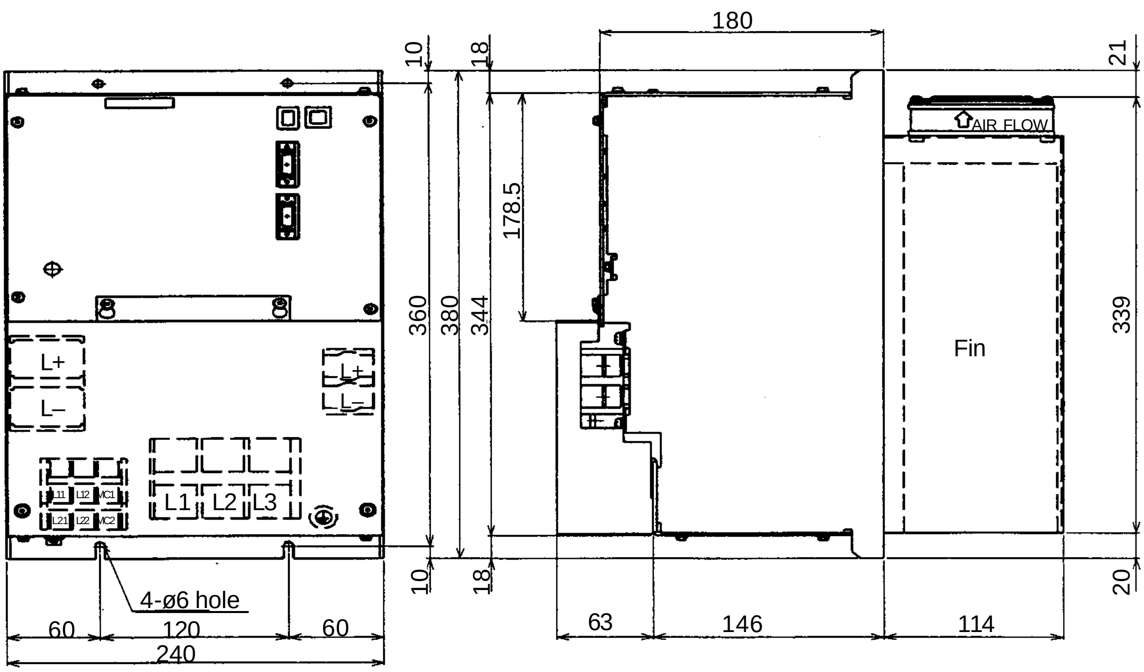
6. Detailed outline drawing

Note) The I-bolt installation hole is provided only on the top of the MDS-B-CVE-550 and MDS-B-SP-450/550 models.
The I-bolt (size: M10) is not enclosed, and must be prepared by the user. Use an I-bolt that is between 13mm and 25mm long.

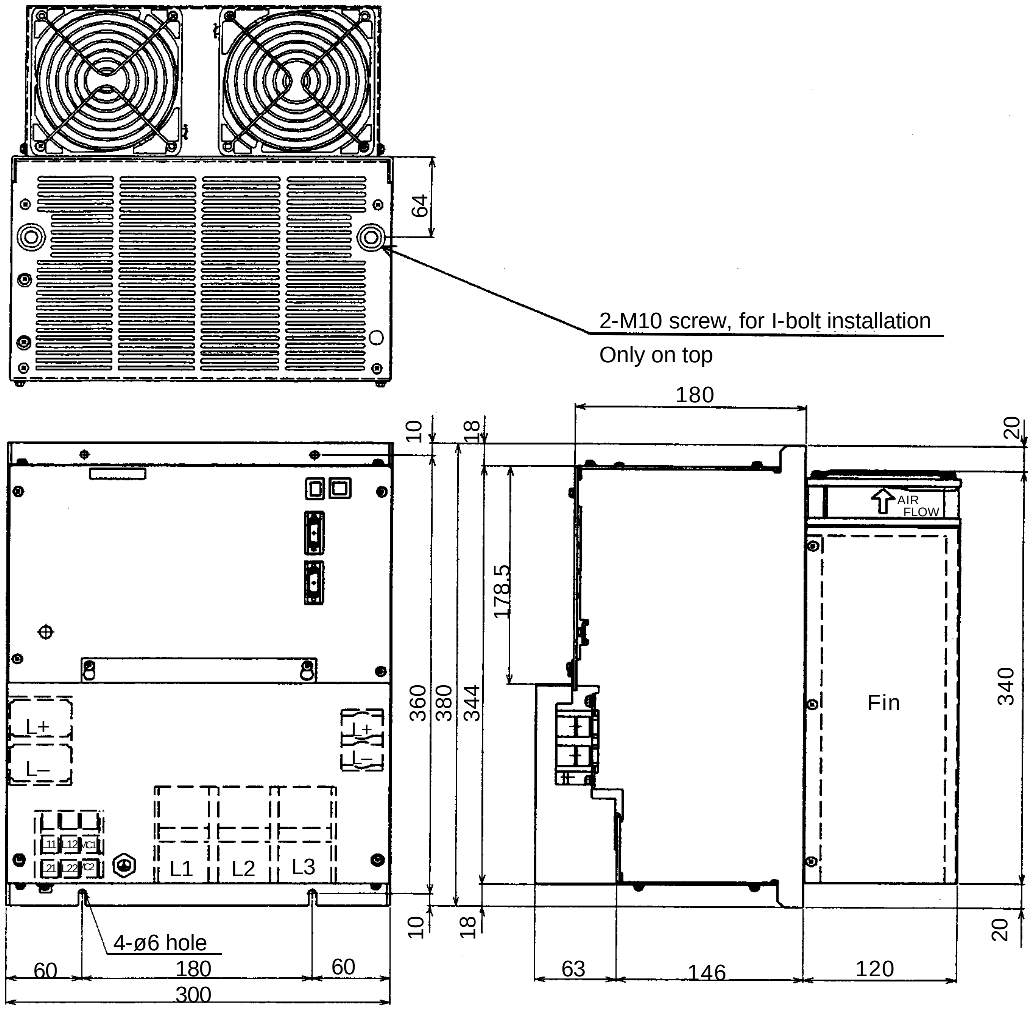
(1) MDS-B-CVE-370



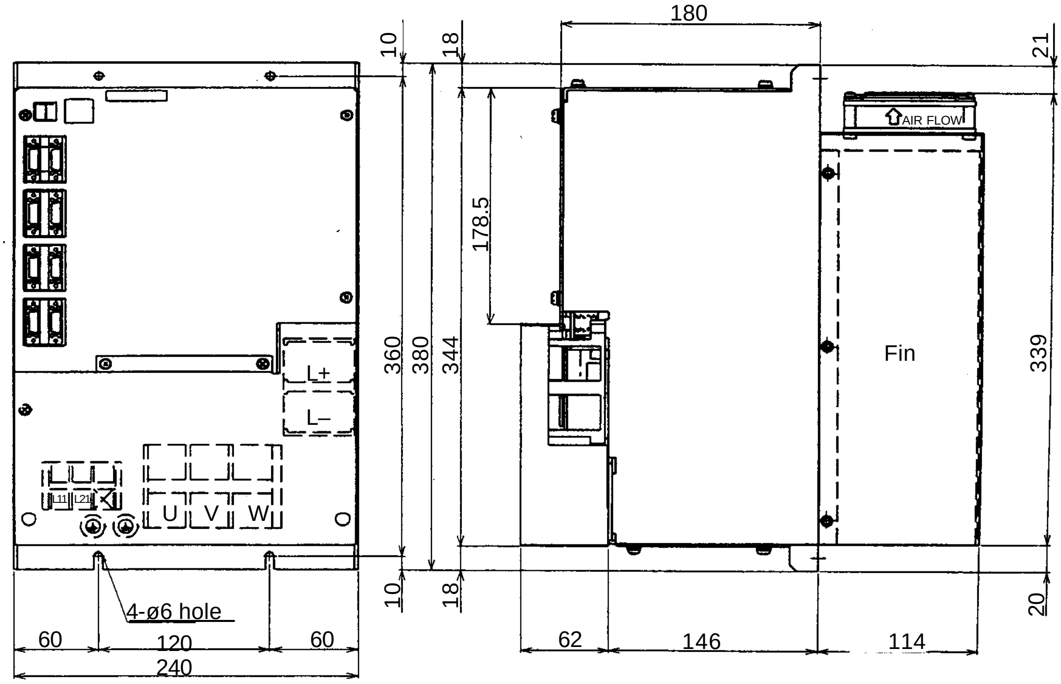
(2) MDS-B-CVE-450



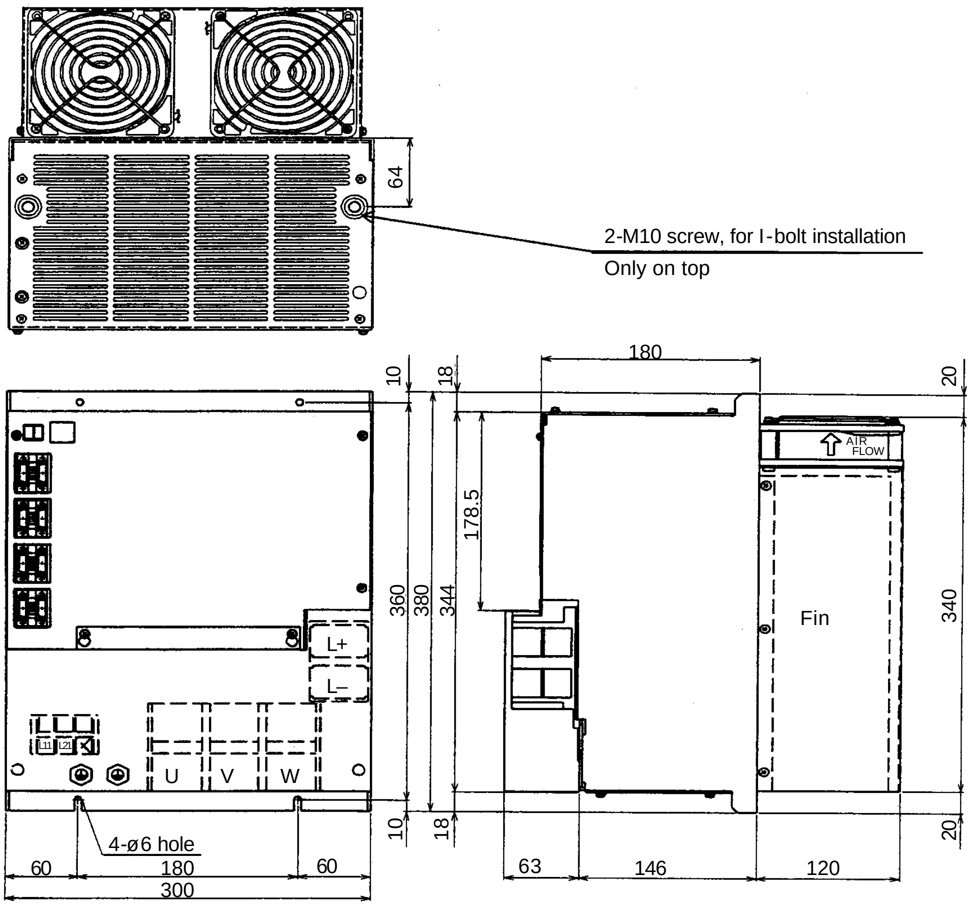
(3) MDS-B-CVE-550



(4) MDS-B-SP-370

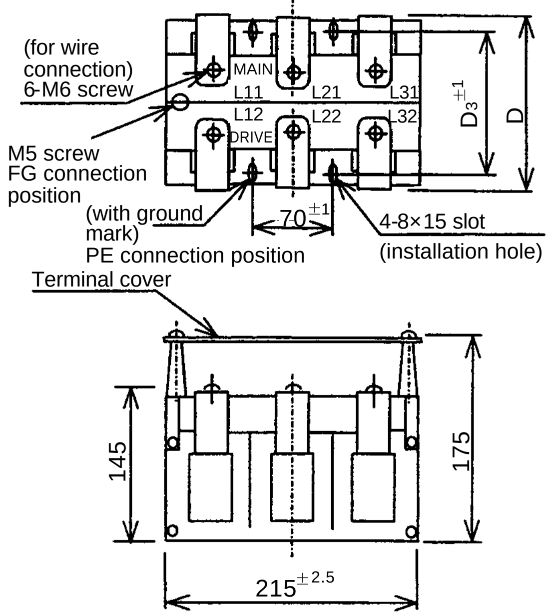


(5) MDS-B-SP-450/550



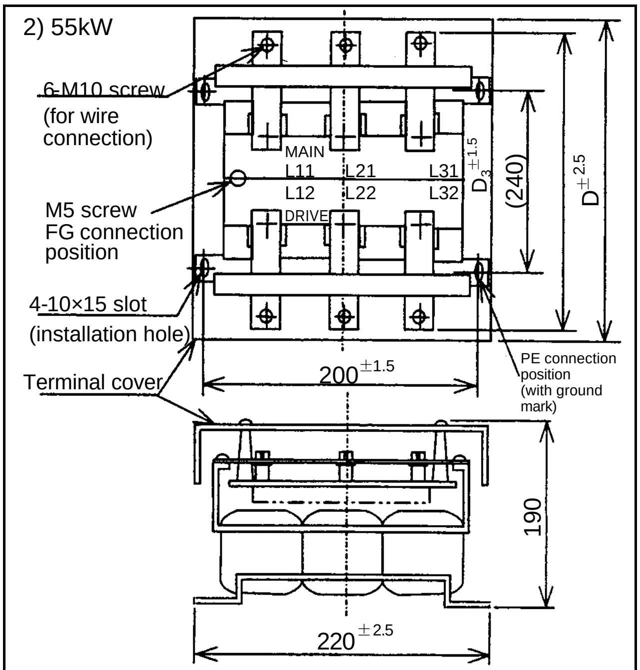
(6) ACL

1) 37kW, 45kW



ACL model	Compatible power supply unit	D_3	D	Weight
B-AL-37K	B-CVE-370	110	150	10.0kg
B-AL-45K	B-CVE-450	120	160	12.8kg

2) 55kW



ACL model	Compatible power supply unit	D_3	D	Weight
B-AL-55K	B-CVE-550	200	320	10.0kg

7. Heating value

(1) Power supply unit

Model	Heating value (W)
B-CVE-370	400
B-CVE-450	500
B-CVE-550	600

(2) Spindle drive unit

Model	Heating value (W)
B-SP-370	850
B-SP-450	1000
B-SP-550	1200

Note 1) The heating value is the value at the continuous rated output.
Note 2) Use the following expressions as a guide for the heating value outside the unit when installing in an enclosed structure.

Unit	Heating value outside unit
B-CVE-370	Heating value outside unit = (B-CVE heating value – 15) × 0.75
B-CVE-450,550	Heating value outside unit = (B-CVE heating value – 30) × 0.75
B-SP-370,450,550	Heating value outside unit = (B-SP heating value – 40) × 0.75

8. Selection of power capacity

The power capacity required for the power supply unit is shown below.

Power supply unit model	Power capacity (kVA)
B-CVE-370	54
B-CVE-450	63
B-CVE-550	77

9. Selecting of wire size

(1) Recommended power lead-in wire size

Select the wire size based on the power supply unit capacity as shown below regardless of the motor type.

Power supply unit model	Recommended power-lead-in wire size
B-CVE-370	HIV50mm^2
B-CVE-450	HIV60mm^2
B-CVE-550	HIV80mm^2

(2) Recommended wire size for spindle motor output wire

Select the wire size based on the spindle drive unit capacity as shown below regardless of the motor type.

Spindle drive unit model	Recommended wire size for spindle motor output wire
B-SP-370	HIV50mm^2
B-SP-450	HIV60mm^2
B-SP-550	HIV80mm^2

(3) L+, L– link bar wire size

Power supply unit model	L+, L– link bar wire size
B-CVE-370	HIV50mm^2
B-CVE-450	Dedicated link bars are enclosed as accessories (always use accessories)
B-CVE-550	Dedicated link bars are enclosed as accessories (always use accessories)

(4) L11, L21, MC1

Regardless of the spindle drive unit and power supply unit capacities, use an IV2mm^2 or more wire size.

10. Drive unit connection screw size

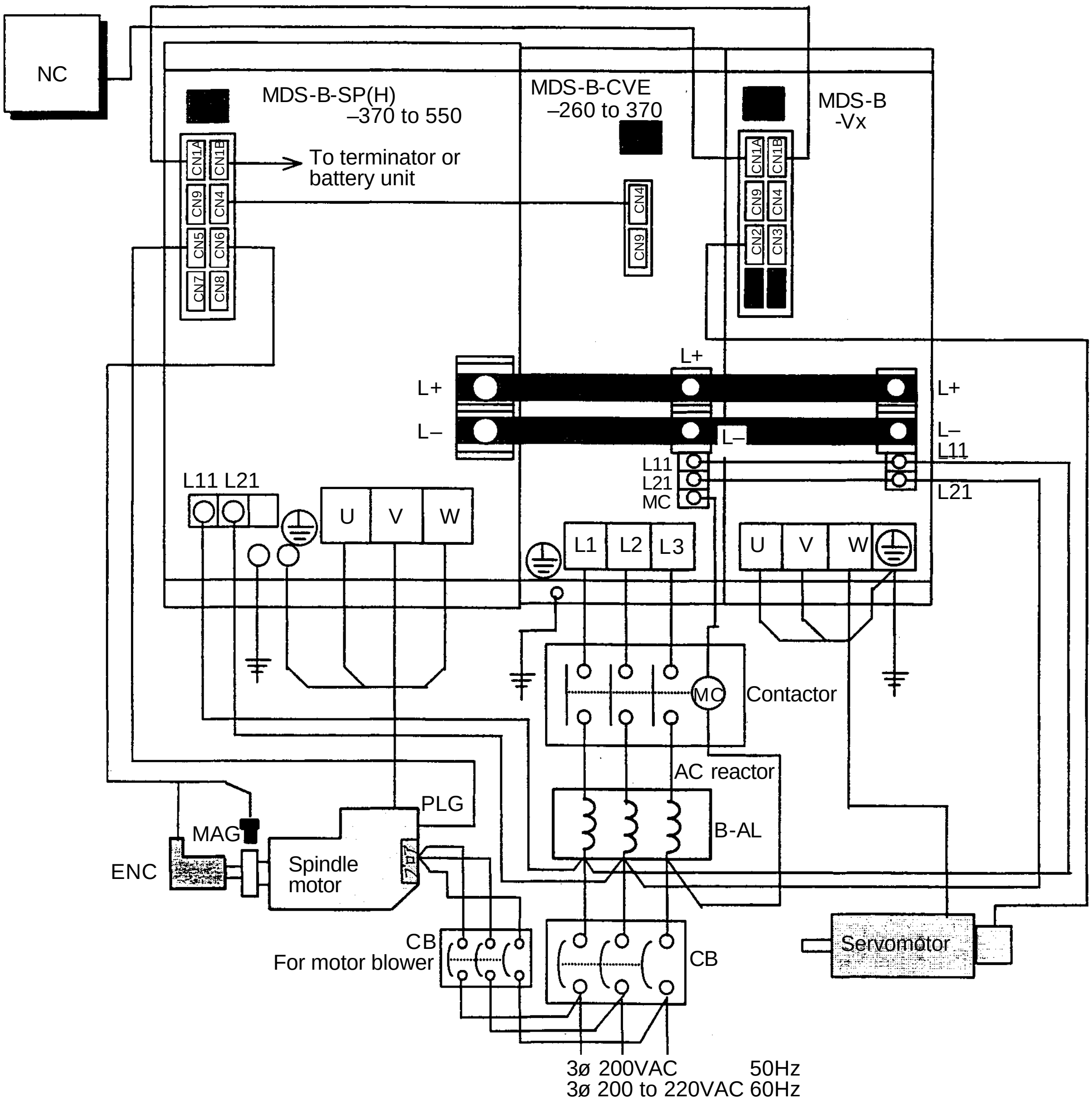
	Power supply unit					Spindle drive unit	
Type	B-CVE-370	B-CVE-450		B-CVE-550		B-SP-370	B-SP-450 B-SP-550
		Left side	Right side	Left side	Right side		
L1, L2, L3	M8	M8		M10		–	–
U, V, W	–	–		–		M8	M10
L+, L–	M6	M10	M6	M10	M6	M10	M10
L11, L21	M4	M4		M4		M4	M4
MC1	M4	M4		M4		–	–

11. Connection of Each Unit

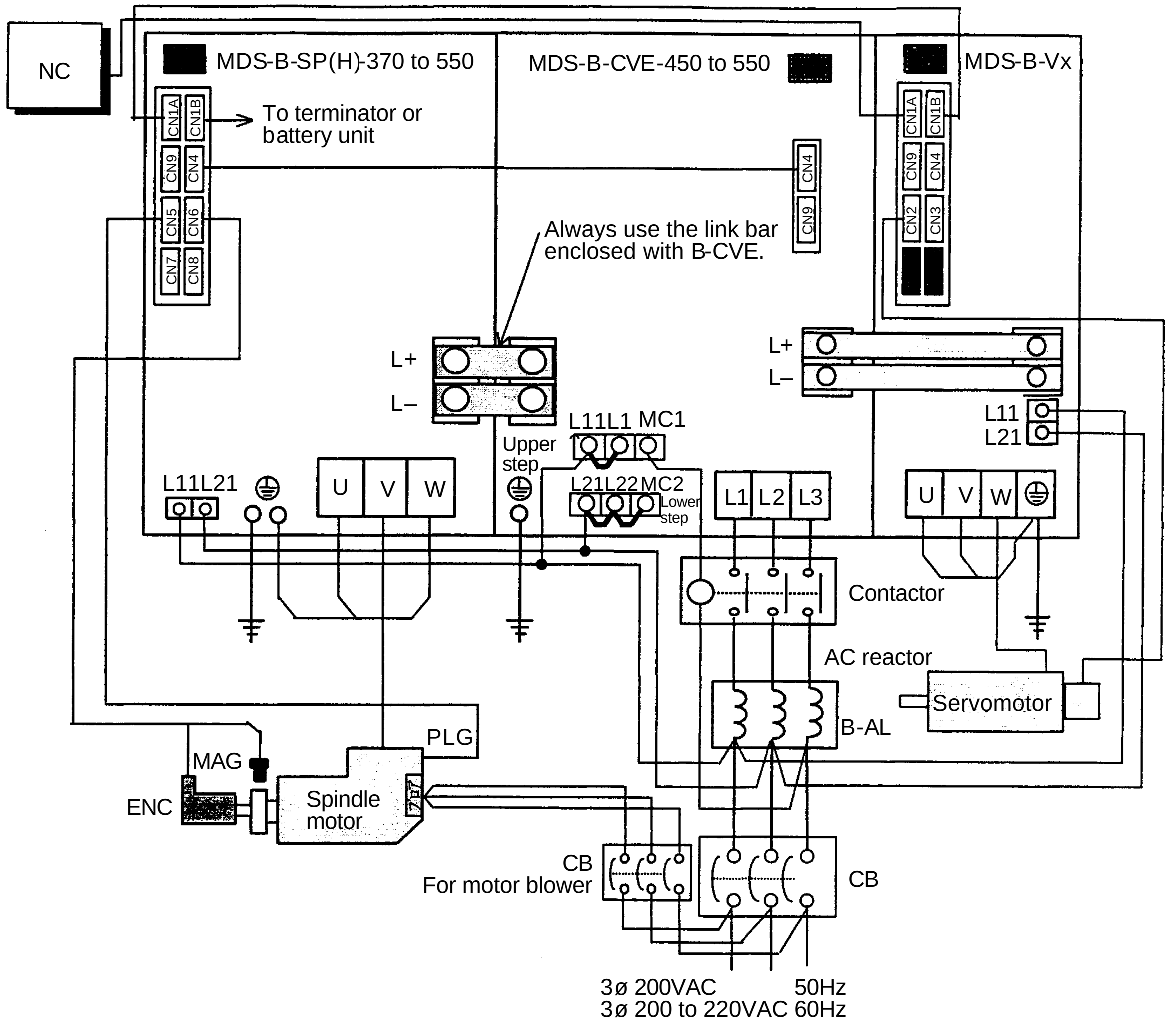
(1) Wiring system

The wiring system is the same as the standard MDS-A/B-SP Series (30kW or less). (Refer to the wiring system example below.)
Note that there are restrictions to the installation and selection, so refer to the Restrictions given in "12".

(a) When using MDS-B-CVE-370 or less



(b) When using MDS-B-CVE-450 or 550



(Note 1) Connect the L11, L21 and MC1 external connections without removing the conductors connected between L21 and L22, L22 and MC2, and L11 and L12 of the B-CVE-450/550.
(L12, L22 and MC2 are for special specifications, and normally, the external connection is not required.)

(Note 2) Always connect the contactor to MC1 so that it can be controlled with the drive unit's internal signal. The power supply unit could be damaged if the contactor is turned ON and OFF with a separate user-prepared sequence.

12. Restrictions

(1) Installation

Always install the B-SP-370/450/550 to the left of the B-CVE-260 to 550.
When using B-CVE-450/550, always use the enclosed link bar to connect L+ and L– on the B-SP-370/450/550.

(a) Layout when connecting only one spindle drive unit to power supply unit
Install the B-CVE-260 to 370/450/550 to the right, and the B-SP-370/450/550 to the left.
Always cut the panel according to the panel cut dimension drawings shown in "5".
<Refer to Example 1.>

(b) Layout when connecting multiple drive units to a large capacity power supply unit
The following number of servo/spindle drive units can be additionally connected.
- When B-CVE-450 and B-SP-370 are combined, 9kW (=45kW–37kW+1kW) worth of units.
- When B-CVE-550 and B-SP-450 are combined, 11kW (=55kW–45kW+1kW) worth of units.
- When B-CVE-450 and B-SP-370 are combined, 19kW (=55kW–37kW+1kW) worth of units.

In this case, install the B-SP-370/450 to the left of B-CVE-450/550 as shown in the panel cut dimension drawings in "5". Install the additional drive units to the right of the B-CVE-450/550.
If the spindle motor output differs from the spindle drive unit output, the above, excluding the layout, may not always apply. (This is because the power supply unit output is determined by the motor output.)
<Refer to Example 2.>

(2) Selection

(a) When using the B-CVE-450/550, one of the B-SP-370/450/550 units must be selected for the drive units connected to this power supply unit.
Only one B-SP-370/450/550 can be connected to one B-CVE-450/550.

(b) When using B-SP-370/450/550, the following power supply unit must be selected.
- When using B-SP-370: Select B-CVE-260 or more
- When using B-SP-450: Select B-CVE-300 or more
- When using B-SP-550: Select B-CVE-370 or more

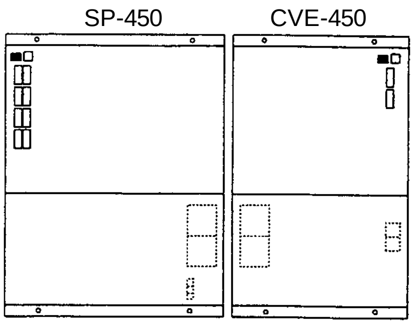
Note that if the total of the servo/spindle motor output corresponds to the above power supply unit with the normal selection method, that capacity power supply unit can be selected.

Example 3) When using B-SP-370
When total of servo/spindle motor output is 23kW or less: Select B-CVE-260
When total of servo/spindle motor output is 23.1kW or more:
Select power supply unit selected with normal selection method.

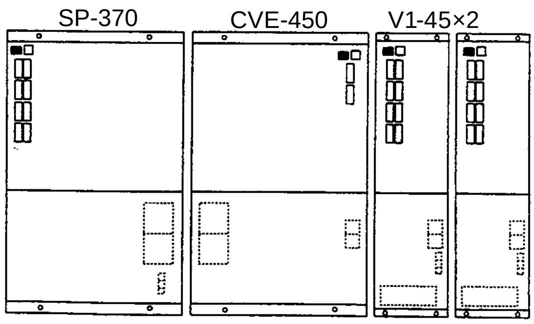
Example 4) When using B-SP-450
When total of servo/spindle motor output is 27kW or less: Select B-CVE-300
When total of servo/spindle motor output is 27.1kW or more:
Select power supply unit selected with normal selection method.

Example 5) When using B-SP-550
When total of servo/spindle motor output is 31kW or less: Select B-CVE-370
When total of servo/spindle motor output is 31.1kW or more:
Select power supply unit selected with normal selection method.

<Example 1>



<Example 2>



13. Parameters

The parameters added and changed from the 30kW or less drive unit are shown below. The parameters other than those shown below are the same as the 30kW or less capacity. Refer to the "AC Servo/Spindle MDS-A Series/B Series Specifications Manual" (BNP-B3759) for details.

<table>
<tr><th>No.</th><th>Abbrev.</th><th>Details</th><th>TYP</th></tr>
<tr><td>SP039</td><td>ATYP</td><td>Select the capacity of the drive unit to be used.
<table><tr><th>Setting value</th><th>Drive unit type</th></tr><tr><td>000D</td><td>MDS-B-SP-370</td></tr><tr><td>000E</td><td>MDS-B-SP-450</td></tr><tr><td>0010</td><td>MDS-B-SP-550</td></tr></table></td><td>HEX setting</td></tr>
<tr><td>SP041</td><td>PTYP</td><td>Select the capacity of the power supply unit to be used.
<table><tr><th>Setting value</th><th>Power supply unit type</th></tr><tr><td>0126</td><td>MDS-B-CVE-260</td></tr><tr><td>0130</td><td>MDS-B-CVE-300</td></tr><tr><td>0137</td><td>MDS-B-CVE-370</td></tr><tr><td>0145</td><td>MDS-B-CVE-450</td></tr><tr><td>0155</td><td>MDS-B-CVE-550</td></tr></table>
Note 1) When using the external emergency stop function, add 40 to the above setting value.
Example) When using external emergency stop function with B-CVE-450
0145+0040=0185</td><td>HEX setting</td></tr>
</table>

14. Precautions

(1) After turning the power OFF, wait at least 15 seconds before turning it ON again.
If the power is turned ON within 15 seconds, the drive unit's control power may not start up correctly.

Revision history

Sub-No.	Date of revision	Revision details
A	December 2000	First edition created.
	April 2001	Revised errors. Changed outside dimension of AC reactor. Revised outside dimension of HA053N.
C	March 2002	• Contents of "MDS-B/C1-SPM Series Specifications and Instruction Manual (Provisional Version) BNP-B3979E" combined with "MDS-C1 Series Specifications Manual BNP-C3000". • Corrections made to match level with "MDS-C1 Series Specifications Manual BNP-C3000". • Design of the cover and the back cover were changed. • Place of contact on back cover corrected. • MODEL, MODEL CODE, and Manual No. were added on the back cover.

Notice

Every effort has been made to keep up with software and hardware revisions in the contents described in this manual. However, please understand that in some unavoidable cases simultaneous revision is not possible.
Please contact your Mitsubishi Electric dealer with any questions or comments regarding the use of this product.

MITSUBISHI ELECTRIC CORPORATION

HEAD OFFICE : MITSUBISHI DENKI BLDG., 2-2-3, MARUNOUCHI, CHIYODA-KU, TOKYO 100-8310, JAPAN

MODEL	MDS-C1 Series
MODEL CODE	008−142
Manual No.	BNP-C3000C(ENG)

(0203) MEE

Specifications subject to change without notice.

Printed in Japan on recycled paper.