Changes for the Better

MITSUBISHI ELECTRIC

CNC
MELDAS AC SERVO/SPINDLE
MDS-C1 Series

SPECIFICATIONS MANUAL

BNP-C3040E(ENG)

Introduction

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

Notes on Reading This Manual

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

Precautions for safety

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

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

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

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

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

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

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

⚠ 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 units is charged, and can cause electric shocks.


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


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


Wiring, maintenance and inspection work must be done by a qualified technician.


Wire the servo drive unit and servomotor after installation. Failure to observe this could lead to electric shocks.


Do not touch the switches with wet hands. Failure to observe this could lead to electric shocks.


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

⚠ CAUTION

1. Fire prevention


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


Shut off the power on the servo drive unit side if the servo drive unit fails. Fires could be caused if a large current continues to flow.


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


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

2. Injury prevention


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


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


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


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

⚠ CAUTION

3. Various precautions

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

(1) Transportation and installation


Correctly transport the product according to its weight.


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


Do not stack the products above the tolerable number.


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


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


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


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


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


Always observe the installation directions.


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


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


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


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


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

⚠ CAUTION

⚠ Store and use the units under the following environment conditions.

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

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

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

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

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

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

⚠ Store the motor in the package box.

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

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

⚠ CAUTION

(2) Wiring

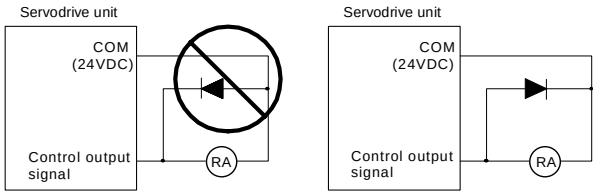
⚠ Correctly and securely perform the wiring. Failure to do so could lead to runaway of the servomotor.

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

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

⚠ Do not directly connect a commercial power supply to the servomotor. Failure to observe this could result in a fault.

⚠ When using an inductive load such as a relay, always connect a diode as a noise measure parallel to the load.



⚠ When using a capacitance load such as a lamp, always connect a protective resistor as a noise measure serial to the load.

⚠ Do not reverse the direction of a diode which connect to a DC relay for the control output signals to suppress a surge. Connecting it backwards could cause the drive unit to malfunction so that signals are not output, and emergency stop and other safety circuits are inoperable.

⚠ Do not connect/disconnect the cables connected between the units while the power is ON.

⚠ Securely tighten the cable connector fixing screw or fixing mechanism. An insecure fixing could cause the cable to fall off while the power is ON.

⚠ When using a shielded cable instructed in the connection manual, always ground the cable with a cable clamp, etc.

⚠ Always separate the signals wires from the drive wire and power line.

⚠ Use wires and cables that have a wire diameter, heat resistance and flexibility that conforms to the system.

⚠ CAUTION

(3) Trial operation and adjustment

⚠ Check and adjust each program and parameter before starting operation. Failure to do so could lead to unforeseen operation of the machine.

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

(4) Usage methods

⚠ Install an external emergency stop circuit so that the operation can be stopped and power shut off immediately.

⚠ Turn the power OFF immediately if smoke, abnormal noise or odors are generated from the servo drive unit or servomotor.


Unqualified persons must not disassemble or repair the unit.

⚠ Never make modifications.

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

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


The brake (magnetic brake) assembled into the servomotor 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.).

⚠ Set all bits to "0" if they are indicated as not used or empty in the explanation on the bits.

⚠ Do not use the dynamic brakes except during the emergency stop. Continuous use of the dynamic brakes could result in brake damage.

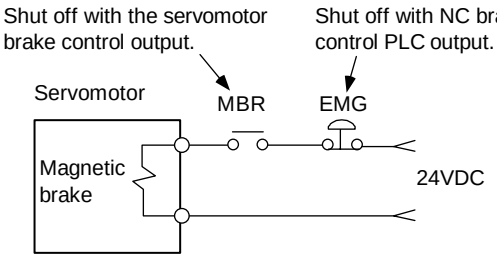
⚠ If a breaker is shared by several power supply units, the breaker may not activate when a short-circuit fault occurs in a small capacity unit. This is dangerous, so never share the breakers.

⚠ CAUTION

(5) Troubleshooting

⚠ If a hazardous situation is predicted during power failure or product trouble, use a servomotor with magnetic brakes or install an external brake mechanism.

⚠ Use a double circuit configuration that allows the operation circuit for the magnetic brakes to be operated even by the external emergency stop signal.



⚠ Always turn the input power OFF when an alarm occurs.

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

(6) Maintenance, inspection and part replacement

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

⚠ The capacity of the electrolytic capacitor will drop over time. To prevent secondary disasters due to failures, replacing this part every five years when used under a normal environment is recommended. Contact the Service Center or Service Station for replacement.

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

⚠ If the battery low warning is issued, save the machining programs, tool data and parameters with an input/output unit, and then replace the battery.

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

(7) Disposal

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

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

⚠ Dispose of the battery according to local laws.

(8) General precautions

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

CONTENTS

Appendix 8. EC Declaration of conformity

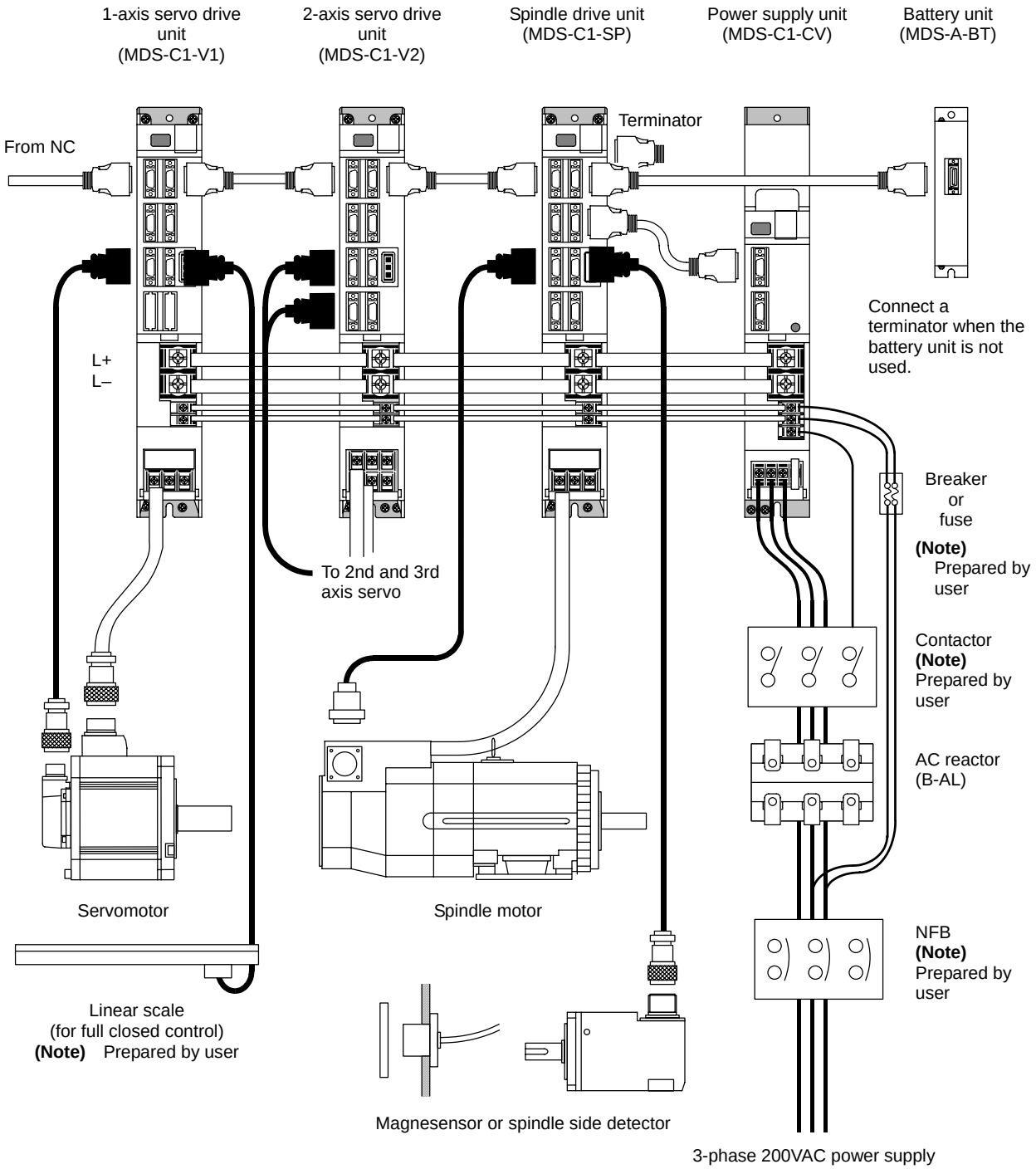
Appendix 9. Instruction Manual for Compliance with UL/c-UL Standard

Appendix 10. Compliance with China Compulsory Product Certification (CCC Certification) System

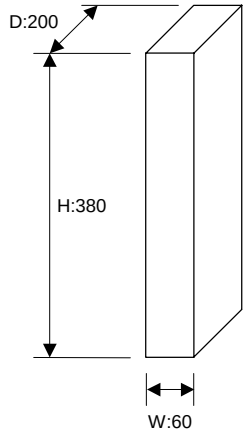
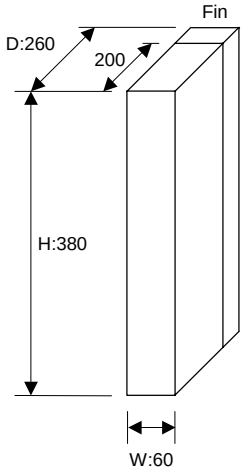
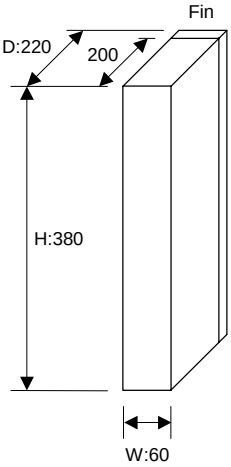
1. Introduction

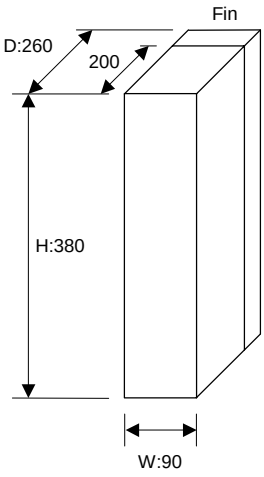
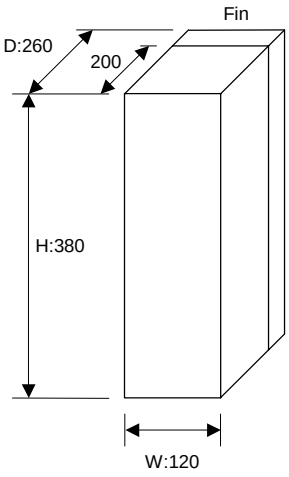
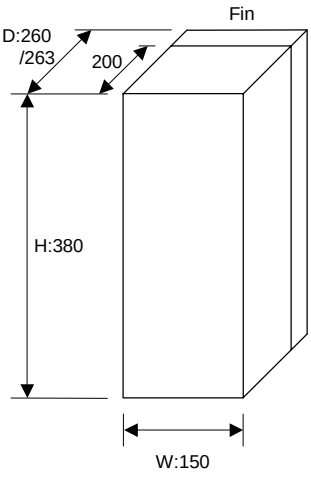
1-1 Servo/spindle drive system configuration

1-1-1 System configuration



1-1-2 Unit outline type

Unit outline type	A0	A1	A2
Outline dimensions [mm]	 Wiring allowance at front: 50mm A0 type does not have fins	 Wiring allowance at front: 50mm Required ventilation space at back: 15mm	 Wiring allowance at front: 50mm Heat radiation allowance at back: 15mm
Heat dissipation method	In-panel heat radiation	Heat radiated outside panel (forced wind cooling)	Heat radiated outside panel (natural air cooling)

Unit outline type	B1	C1	D1/D2
Outline dimensions [mm]	 Wiring allowance at front: 50mm Required ventilation space at back: 15mm	 Wiring allowance at front: 50mm Required ventilation space at back: 15mm	 Wiring allowance at front: 50mm Required ventilation space at back: 15mm (D2: 12mm)
Heat dissipation method	Heat radiated outside panel (forced wind cooling)	Heat radiated outside panel (forced wind cooling)	Heat radiated outside panel (forced wind cooling)

(Note) Refer to "Appendix 1 Outline dimension drawings" for detailed outline drawings.

(For customers switching from MDS-A/B Series)

The MDS-C1 Series incorporates a highly efficient heat dissipating structure, so the depth of the fin section is smaller than the MDS-A/B Series. Units with an "S" at the end of the type have a smaller unit width than the MDS-A/B Series.
When designing the control panel with these unit outline dimensions, it may not be possible to mount the conventional drive unit.

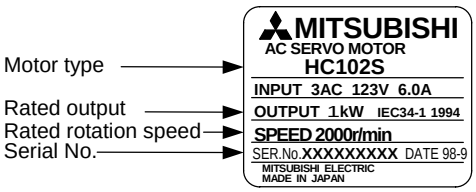
1-2 Explanation of type

1-2-1 Servomotor type

Motor series	Rated output capacity	Type
HC Series (Note 1)	0.5kW to 9.0kW	HC52, HC102, HC152, HC202, HC352, HC452, HC702, HC902
	0.5kW to 7.0kW	HC53, HC103, HC153, HC203, HC353, HC453, HC703
HC R Series (Note 1)	1.0kW to 5.0kW	HC103R, HC153R, HC203R, HC353R, HC503R
HA N Series (Note 2, 3)	0.05kW to 0.45kW	HA053N, HA13N, HA23N, HA33N
HA-LF Series (Note 1)	11kW to 15kW	HA-LF11K2-S8, HA-LF15K2-S8

(Note 1) The standard type complied with EN Standards and UL Standards.
(Note 2) The standard type complied with EN Standards.
(Note 3) Rated output capacity 0.5kW to 9kW motors are available with the HA□N Series.

(1) HC, HC□R Series



Motor rating nameplate

Detector rating nameplate

HC (1) (2) (3) (4) - (5)

(5) Detector

Sym-bol	Detection method	Resolution	Detector type
E42	Incremental	100,000p/rev	OSE104S2
E51		1,000,000p/rev	OSE105S2
A42	Absolute position	100,000p/rev	OSA104S2
A51		1,000,000p/rev	OSA105S2

(4) Protective structure

Sym-bol	Protective structure
None	IP65
W	IP67

(Note) HC R has only IP65 compliance.

(3) Shaft end structure

Sym-bol	Shaft end structure
S	Straight
T	Taper

(Note) Only the straight type is available for the HC 2kW and higher capacities and HC R 3.5kW and higher capacities.

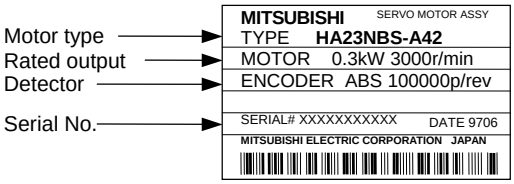
(2) Magnetic brakes

Sym-bol	Magnetic brakes
None	None
B	With magnetic brakes

(1) Rated output and rated rotation speed

HC□ Series				HC□R Series	
Rating 2000r/min		Rating 3000r/min		Rating 3000r/min	
Sym-bol	Rated output	Sym-bol	Rated output	Sym-bol	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□N Series



Rating nameplate

HA (1) **N** (2) (3) (4) **-** (5)

(5) Detector

Symbol	Detection method	Resolution	Detector type
E42	Incremental	100,000p/rev	OSE104S
E51		1,000,000p/rev	OSE105S
A42	Absolute position	100,000p/rev	OSA104S
A51		1,000,000p/rev	OSA105S

(4) Protective structure

Symbol	Protective structure
None	IP54
D5	IP65

(3) Shaft end structure

Symbol	Shaft end structure
S	Straight
T	Taper

(Note) Only the straight type is available for HA053N and 13N.

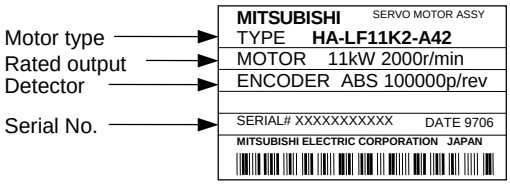
(2) Magnetic brakes

Symbol	Magnetic brakes
None	None
B	With magnetic brakes

(1) Rated output and rated rotation speed

Rating 3000r/min	
Symbol	**Rated output**
053	0.05kW
13	0.1kW
23	0.3kW
33	0.45kW

(3) HA-LF□ Series



Rating nameplate

HA-LF (1) (2) -S8- (3)

(3) Detector

	Detection method	Resolution	Detector type
E42	Incremental	100,000p/rev	OSE104S1
E51		1,000,000p/rev	OSE105S1
A42	Absolute position	100,000p/rev	OSA104S1
A51		1,000,000p/rev	OSA105S1

(2) Magnetic brakes

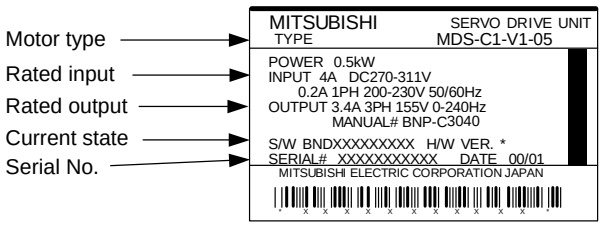
Sym-bol	Magnetic brakes
None	None
B	With magnetic brakes

(1) Rated output and rated rotation speed

Rating 2000r/min	
Sym-bol	**Rated output**
11K2	11kW
15K2	15kW

(Note 1) The protection structure is equivalent to IP44.
(Note 2) Only the straight type shaft end is available.

1-2-2 Servo drive unit type



Rating nameplate

MDS-C1- **(1)**

1-axis servo drive unit			Compatible motor																												
(1) Motor type MDS-C1-	Capa-city (kW)	Outline (width)	HA N				HC																HC R					HA-LF	
			053	13	23	33	52	53	102	103	152	153	202	203	352	353	452	453	702	703	902	103	153	203	353	503	11K2	15K2
V1-01	0.1	A0 (60mm)	●	●																								
V1-03	0.3				●	●																						
V1-05	0.5						●	●																				
V1-10	1.0								●	●												●	●					
V1-20	2.0	A1 (60mm)									●	●	●											●				
V1-35	3.5													●	●										●			
V1-45S	4.5															▲	▲											
V1-45	4.5	B1 (90mm)														●	●									●		
V1-70S	7.0																	▲	▲									
V1-70	7.0	C1 (120mm)																●	●									
V1-90	9.0																			●	●							
V1-110	11.0	D2 (150mm)																									●	
V1-150	15.0																											●

● or ▲ indicates the compatible motor for each servo drive unit.
Note continuous operation of ▲ (V1-45S, V1-70S) is limited.

CAUTION The dynamic brake unit (MDS-B-DBU) is required for the MDS-C1-V1-110/150.

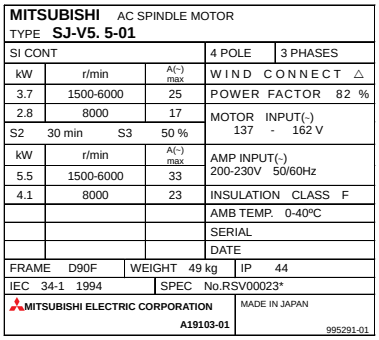
2-axis servo drive unit				Compatible motor																								
(1) Motor type MDS-C1-	Capa-city (kW)	Outline (width)	Axis	HA N				HC															HC R				
				053	13	23	33	52	53	102	103	152	153	202	203	352	353	452	453	702	703	902	103	153	203	353	503
V2-0101	0.1+0.1	A0 (60mm)	LM	●	●																							
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 (60mm)	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 (90mm)	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												●	●										●		
V2-4545S	4.5+4.5		LM														▲	▲										
V2-7070S	7.0+7.0		LM																▲	▲								
V2-4545	4.5+4.5	C1 (120mm)	LM														●	●										●
V2-7035	7.0+3.5		L																●	●								
			M												●	●												
V2-7045	7.0+4.5		L																●	●								
			M														●	●										
V2-7070	7.0+7.0	D2 (150mm)	LM																●	●								
V2-9090S	9.0+9.0		LM																		▲	●						

● or ▲ indicates the compatible motor for each servo drive unit.
Note continuous operation of ▲ (V2-4545S, V2-7070S, V2-9090S) is limited.

⚠ CAUTION

1. The MDS-C1-V2-3510/3520 shape is compatible with the MDS-B Series. When newly incorporating the MDS-C1 Series, use the MDS-C1-V2-3510S/3520S.
2. Limits apply to continuous operation of the MDS-C1-V2-4545S/9090S.

1-2-3 Spindle motor type



MITSUBISHI AC SPINDLE MOTOR				
TYPE **SJ-V5. 5-01**				
SI CONT			4 POLE	3 PHASES
kW	r/min	A(~) max	WIND CONNECT △	
3.7	1500-6000	25	POWER FACTOR 82 %	
2.8	8000	17	MOTOR INPUT(-) 137 - 162 V	
S2 30 min	S3	50 %		
kW	r/min	A(~) max	AMP INPUT(-) 200-230V 50/60Hz	
5.5	1500-6000	33		
4.1	8000	23	INSULATION CLASS F	
			AMB TEMP. 0-40ºC	
			SERIAL	
			DATE	
FRAME D90F	WEIGHT 49 kg		IP 44	
IEC 34-1 1994			SPEC No.RSV00023*	
MITSUBISHI ELECTRIC CORPORATION A19103-01			MADE IN JAPAN 995291-01	

Rating nameplate

(1) Standard spindle motor series

SJ- (1) (2) (3) (4) (5)

(5) Z-phase detection

Sym-bol	Z-phase presences
None	No Z-phase
M	Z-phase present

(Note) Presence of the Z-phase applies only to the SJ and SJ-V Series.

(4) Special specifications

Sym-bol	Special specifications
None	None
Z	High-speed
W	Wide-range constant output

(Note) A number indicating the constant output range is indicated after the symbol for the wide range output.

(3) Base speed

Sym-bol	Base speed
A	1500r/min
B	1150r/min
L	5000r/min
X	Special

(Note) The SJ-V Series is indicated with a specification code (–01 to –99).

(2) Short time rated output

Sym-bol	Short time rated output	Sym-bol	Short time rated output
2.2	2.2kW	22	22kW
3.7	3.7kW	26	26kW
5.5	5.5kW	30	30kW
7.5	7.5kW	37	37kW
11	11kW	45	45kW
15	15kW	55	55kW
18.5	18.5kW		

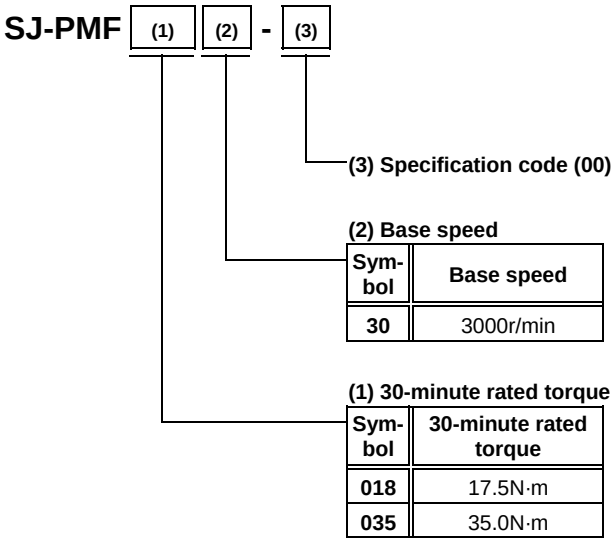
(Note) The 37kW and larger capacities are handled with the MDS-B-SP Series.
Refer to Appendix 5 for details.

(1) Motor series

Sym-bol	Motor series
None	Large capacity
V	Compact medium to large capacity
VS	Hollow shaft

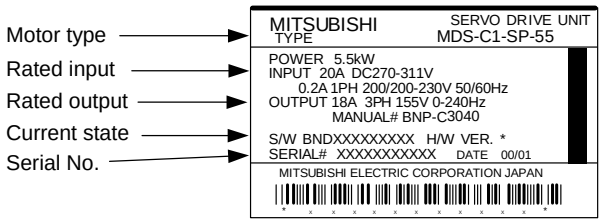
(Note) Refer to the "MELDAS AC Spindle Built-in Series Standard Specifications" (BFN-14118-04) for details on the built-in spindle motor.

(2) IPM spindle motor series



(Note) The built-in IPM spindle motor is available by special order.

1-2-4 Spindle drive unit type



Rating nameplate

MDS-C1- (1) - (2)

(2) Capacity

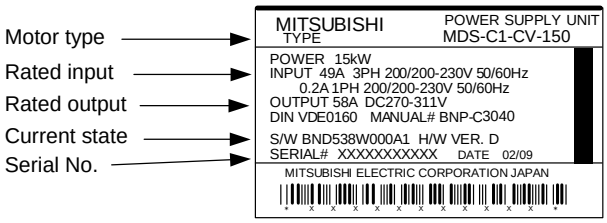
Symbol	Capacity (kW)	Outline type (unit width)
04	0.4	A0 (60mm wide)
075	0.75	
15	1.5	
22	2.2	A1 (60mm wide)
37	3.7	
55	5.5	B1 (90mm wide)
75	7.5	
110	11	
150S	15	
150	15	C1 (120mm wide)
185	18.5	
220	22	D1 (150mm wide)
260	26	D2 (150mm wide)
300	30	

(Note) The 37kW and larger capacities are available with the MDS-B-SP Series. Refer to Appendix 5 for details.

(1) Spindle drive unit series

Symbol	Compatible motor rotation speed	Details
SP	Less than 10,000r/min	IM standard specifications
SPH	10,000r/min or more	
SPX	Less than 10,000r/min	IM detector conversion unit compatible specifications (MDS-B-PJEX unit can be connected)
SPHX	10,000r/min or more	
SPM	All ranges	IPM motor compatible specifications (Use to drive the IPM spindle motor)

1-2-5 Power supply unit type



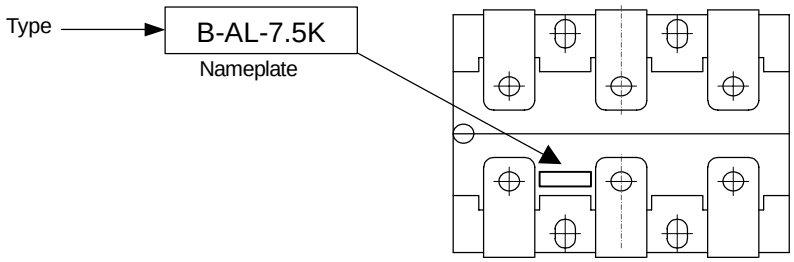
Rating nameplate

MDS-C1- **(1)**

Power supply unit			Compatible AC reactor	Compatible contactor (Mitsubishi) (Note 1)	Compatible NFB (Mitsubishi) (Note 1)
(1) Motor type MDS-C1-	**Capa-city (kW)**	**Outline type (unit width)**			
CV-37	3.7	A2 (60mm wide)	B-AL-7.5K	S-N25 200VAC	NF50CS3P-40A05
CV-55	5.5				
CV-75	7.5				
CV-110	11	B1 (90mm wide)	B-AL-11K	S-N35 200VAC	NF50CS3P-50A05
CV-150	15	C1 (120mm wide)	B-AL-18.5K	S-N50 200VAC	NF100CS3P-100A05
CV-185	18.5				
CV-220	22	D1 (150mm wide)	B-AL-30K	S-N80 200VAC	NF225CS3P-150A05
CV-260	26				
CV-300	30				
CV-370	37		B-AL-37K	S-N150 200VAC	NF225CS3P-175A05

(Note 1) This is an optional part, and must be prepared by the user.
(Note 2) The 45kW and larger capacities are available with the MDS-B-CVE Series. Refer to Appendix 4 for details.

1-2-6 AC reactor type



Top surface of AC reactor

B-AL- **(1)**

AC reactor		Compatible power supply unit
Motor type B-AL-	Capa-city (kW)	
7.5K	7.5	MDS-C1-CV-37
		MDS-C1-CV-55
		MDS-C1-CV-75
11K	11	MDS-C1-CV-110
18.5K	18.5	MDS-C1-CV-150
		MDS-C1-CV-185
30K	30	MDS-C1-CV-220
		MDS-C1-CV-260
		MDS-C1-CV-300
37K	37	MDS-C1-CV-370

2. Specifications

2-1 Servomotor

2-1-1 Specifications list

HC Series (Rated speed 2000r/min)

Servomotor type			HC Series (Rated speed 2000r/min)							
			INC specifications: HC□-E51/-E42, ABS specifications: HC□-A51/-A42							
			HC52	HC102	HC152	HC202	HC352	HC452	HC702	HC902
Compatible servo drive unit type MDS-C1-V1/V2-			05	10	20		35	45	70	90
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
	Rated torque	[N·m]	2.39	4.78	7.16	9.55	16.7	21.5	33.4	43.0
	Stall current	[A]	3.94	7.4	11.1	15.4	22.9	39.5 (31.5)	46.2 (41.0)	55.6 (55.6)
	Stall torque	[N·m]	2.94	5.88	8.82	13.7	22.5	37.2 (29.0)	49.0 (44.0)	58.8 (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		[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
Motor inertia		[kg·cm^2]	6.6	13.7	20.0	42.5	82	121	160	204
Motor inertia with brake		[kg·cm^2]	8.6	15.7	22.0	51.1	92	131	170	214
Maximum 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							
Motor side detector			Resolution per motor rotation E51/A51: 1,000,000 pulse/rev, E42/A42: 100,000 pulse/rev							
Structure			Fully closed, self-cooling (Protection method: IP65, IP67)							
Environment	Ambient temperature		Operation: 0 to 40°C (non freezing), Storage: –15 to 70°C (non freezing)							
	Ambient humidity		Operation: 80%RH or less (non condensing), Storage: 90%RH or less (non condensing)							
	Atmosphere		Indoors (no direct sunlight); no corrosive gas, inflammable gas, oil mist, or dust							
	Altitude		Operation: 1000 meters or less above sea level, Storage: 1000 meters or less above sea level							
	Vibration		X:9.8m/s^2 (1G) Y:24.5m/s^2 (2.5G)			X:19.6m/s^2 (2G) Y:49m/s^2 (5G)		X:11.7m/s^2 (1.2G) Y:24.5m/s^2 (2.5G)		X:19.6m/s^2 Y:49m/s^2
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) Values when combined with the S-type drive unit are shown in parentheses.

HC Series (Rated speed 3000r/min)

Servomotor type			HC Series (Rated speed 3000r/min)						
			INC specifications: HC□-E51/-E42, ABS specifications: HC□-A51/-A42						
			HC53	HC103	HC153	HC203	HC353	HC453	HC703
Compatible servo drive unit type MDS-C1-V1/V2-			05	10	20	35	45	70	90
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
	Rated torque	[N·m]	1.59	3.18	4.77	6.37	11.1	14.3	22.3
	Stall current	[A]	5.8	9.8	15.9	22.4	33.3 (31.5)	55.6 (41.0)	66.7 (55.6)
	Stall torque	[N·m]	2.94	5.88	8.82	13.7	22.5 (21.2)	37.2 (30.4)	49.0 (40.8)
Rated rotation speed		[r/min]	3000						
Maximum rotation speed		[r/min]	3000						
Maximum current		[A]	17	28	47	64	85	113	141
Maximum torque		[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
Motor inertia		[kg·cm^2]	6.6	13.7	20.0	42.5	82	121	160
Motor inertia with brake		[kg·cm^2]	8.6	15.7	22.0	52.5	92	131	170
Maximum 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						
Motor side detector			Resolution per motor rotation E51/A51: 1,000,000 pulse/rev, E42/A42: 100,000 pulse/rev						
Structure			Fully closed, self-cooling (Protection method: IP65, IP67)						
Environment	Ambient temperature		Operation: 0 to 40°C (non freezing), Storage: –15 to 70°C (non freezing)						
	Ambient humidity		Operation: 80%RH or less (non condensing), Storage: 90%RH or less (non condensing)						
	Atmosphere		Indoors (no direct sunlight); no corrosive gas, inflammable gas, oil mist, or dust						
	Altitude		Operation: 1000 meters or less above sea level, Storage: 1000 meters or less above sea level						
	Vibration		X:9.8m/s^2 (1G) Y:24.5m/s^2 (2.5G)			X:19.6m/s^2 (2G) Y:49m/s^2 (5G)		X:11.7m/s^2 (1.2G) Y:24.5m/s^2 (2.5G)	
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) Values when combined with the S-type drive unit are shown in parentheses.

HC□R Series (Rated speed 3000r/min)

Servomotor type			HC□R Series (Rated speed 3000r/min) INC specifications: HC□R-E51/-E42/-E33, ABS specifications: HC□R-A51/-A42/-A33				
			HC103R	HC153R	HC203R	HC353R	HC503R
Compatible servo drive unit type MDS-C1-V1/V2-			10		20	35	45
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
	Rated torque	[N·m]	3.18	4.77	6.37	11.1	15.9
	Stall current	[A]	6.1	8.8	14.0	22.5	28.0
	Stall torque	[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		[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
Motor inertia		[kg·cm^2]	1.5	1.9	2.3	8.3	12.0
Motor inertia with brake		[kg·cm^2]	1.9	2.3	2.7	11.8	15.5
Maximum 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				
Motor side detector			Resolution per motor rotation E51/A51: 1,000,000 pulse/rev, E42/A42: 100,000 pulse/rev				
Structure			Fully closed, self-cooling (Protection method: IP65)				
Environment	Ambient temperature		Operation: 0 to 40°C (non freezing), Storage: –15 to 70°C (non freezing)				
	Ambient humidity		Operation: 80%RH or less (non condensing), Storage: 90%RH or less (non condensing)				
	Atmosphere		Indoors (no direct sunlight); no corrosive gas, inflammable gas, oil mist, or dust				
	Altitude		Operation: 1000 meters or less above sea level, Storage: 1000 meters or less above sea level				
	Vibration		X:9.8m/s^2 (1G) Y:24.5m/s^2 (2.5G)				
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) The above characteristics values are representative values. The maximum current and maximum torque are the values when combined with the drive unit.

HA□N Series (Rated speed 3000r/min)

Servomotor type			HA□N Series (Rated speed 3000r/min)			
			INC Specifications: HA□N-E51/-E42, ABS specifications: HA□N-A51/-A42			
			HA053N	HA13N	HA23N	HA33N
Compatible servo drive unit type MDS-C1-V1/V2-			01		03	
Continuous characteristics	Rated output	[kW]	0.05	0.1	0.3	0.45
	Rated current	[A]	0.95	0.95	2.9	2.2
	Rated torque	[N·m]	0.16	0.32	0.95	1.43
	Stall current	[A]	1.4	1.4	3.0	3.0
	Stall torque	[N·m]	0.25	0.49	0.98	1.96
Rated rotation speed		[r/min]	3000			
Maximum rotation speed		[r/min]	3000			
Maximum current		[A]	3.8	3.8	8.1	8.1
Maximum torque		[N·m]	0.69	1.37	2.7	5.6
Power rate at continuous rated torque		[kW/s]	1.4	2.8	9.3	10.4
Motor inertia		[kg·cm^2]	0.188	0.365	0.98	1.96
Motor inertia with brake		[kg·cm^2]	0.204	0.381	1.18	2.16
Maximum 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			
Motor side detector			Resolution per motor rotation E51/A51: 1,000,000 pulse/rev, E42/A42: 100,000 pulse/rev			
Structure			Fully closed, self-cooling (Protection method: IP54, IP65)			
Environment	Ambient temperature		Operation: 0 to 40°C (non freezing), Storage: –15 to 70°C (non freezing)			
	Ambient humidity		Operation: 80%RH or less (non condensing), Storage: 90%RH or less (non condensing)			
	Atmosphere		Indoors (no direct sunlight); no corrosive gas, inflammable gas, oil mist, or dust			
	Altitude		Operation: 1000 meters or less above sea level, Storage: 1000 meters or less above sea level			
	Vibration		X:19.6m/s^2 (2G) Y:19.6m/s^2 (2G)			
Weight Without/with brake		[kg]	2.1/2.5	2.5/2.9	3.5/4.5	4.5/5.5
Armature insulation class			Class F			

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

HA-LF Series (Rated speed 2000r/min)

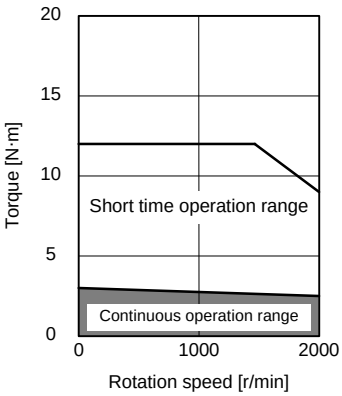
Servomotor type			HA-LF Series (Rated speed 2000r/min)	
			INC specifications: HA-LF□-E51/-E42, ABS specifications: HA-LF□-A51/-A42	
			HA-LF11K2-S8	HA-LF15K2-S8
Compatible servo drive unit type MDS-C1-V1/V2-			110	150
Continuous characteristics	Rated output	[kW]	11.0	15.0
	Rated current	[A]	63.0	77.0
	Rated torque	[N·m]	52.5	71.6
	Stall current	[A]	84.7	98.6
	Stall torque	[N·m]	70.6	91.7
Rated rotation speed		[r/min]	2000	
Maximum rotation speed		[r/min]	2000	
Maximum current		[A]	204	260
Maximum torque		[N·m]	170	240
Power rate at continuous rated torque		[kW/s]	263	233
Motor inertia		[kg·cm^2]	105	220
Motor inertia with brake		[kg·cm^2]	113	293
Maximum 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	
Motor side detector			Resolution per motor rotation E51/A51: 1,000,000 pulse/rev, E42/A42: 100,000 pulse/rev	
Structure			Fully closed, self-cooling (Protection method: IP44)	
Environment	Ambient temperature		Operation: 0 to 40°C (non freezing), Storage: –15 to 70°C (non freezing)	
	Ambient humidity		Operation: 80%RH or less (non condensing), Storage: 90%RH or less (non condensing)	
	Atmosphere		Indoors (no direct sunlight); no corrosive gas, inflammable gas, oil mist, or dust	
	Altitude		Operation: 1000 meters or less above sea level, Storage: 1000 meters or less above sea level	
	Vibration		X:11.7m/s^2 (1.2G) Y:29.4m/s^2 (3G)	
Weight Without/with brake		[kg]	55/70	95/126
Armature insulation class			Class F	

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

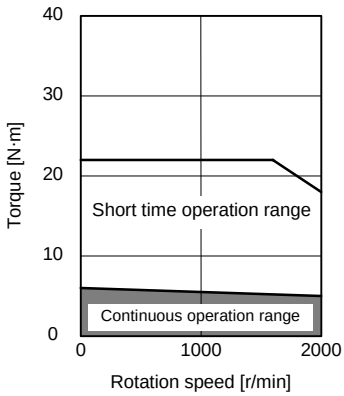
2-1-2 Torque characteristics

(1) HC Series

[HC52]



[HC102]



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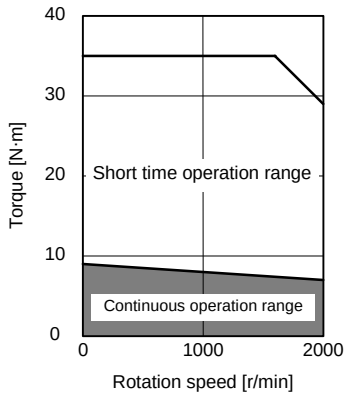

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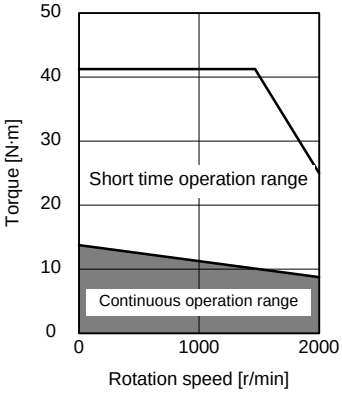

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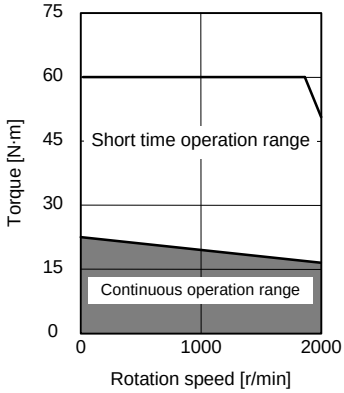
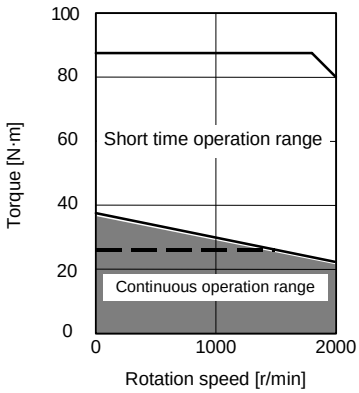


[HC452]



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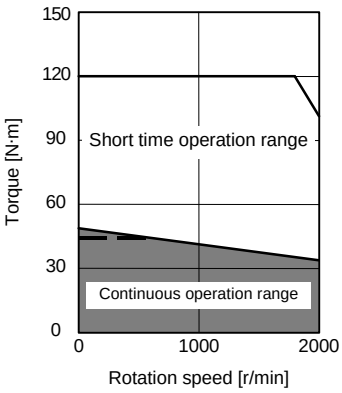
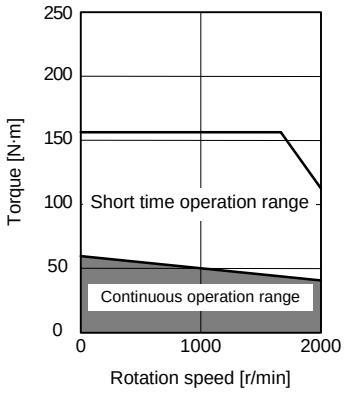
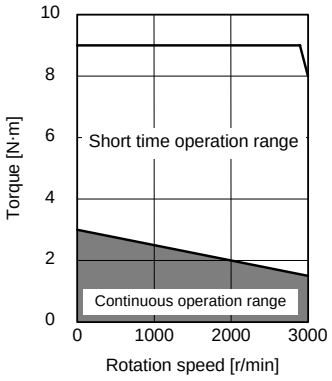


[HC902]



(Note 1) The above graphs show the data when applied the input voltage of 200VAC.
When the input voltage is 200VAC or less, the short time operation range is limited.
(Note 2) The dotted lines show the values when combined with the S-type drive unit.

[HC53]



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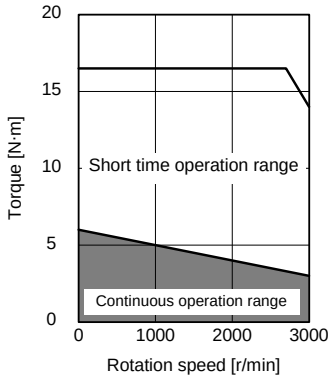
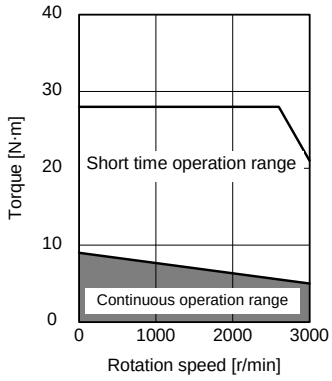


[HC153]



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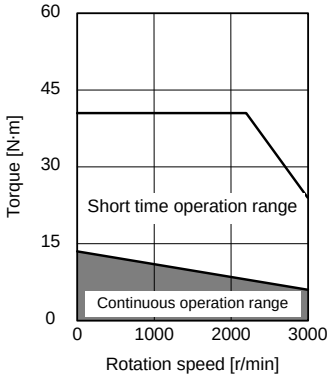

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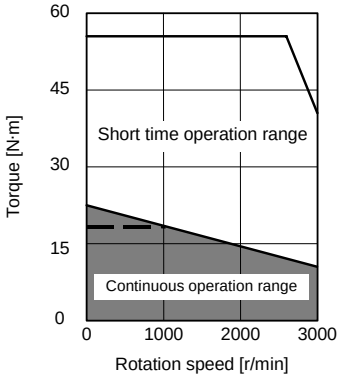

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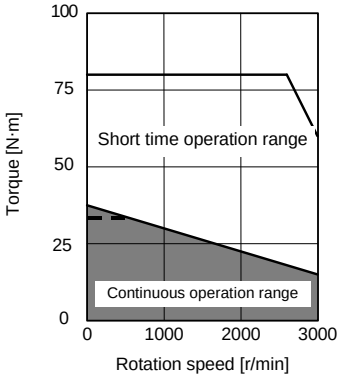

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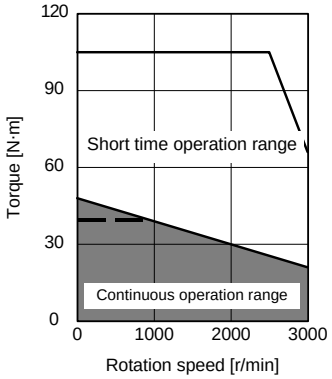

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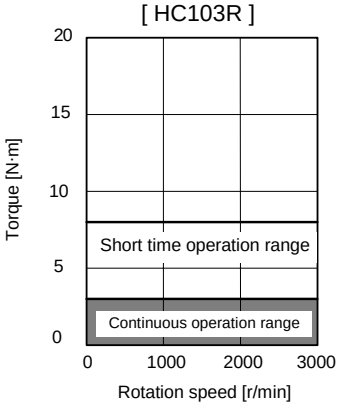

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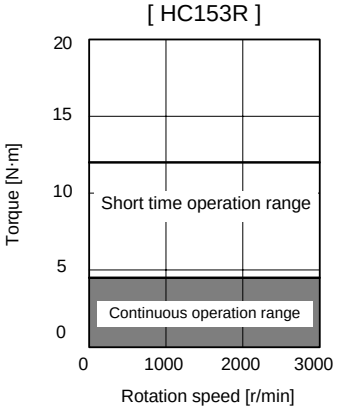

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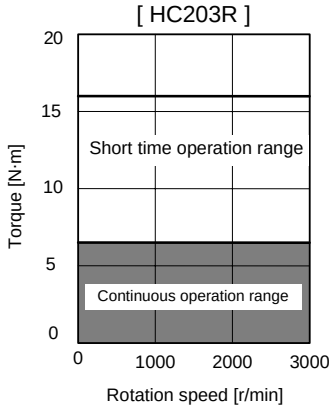

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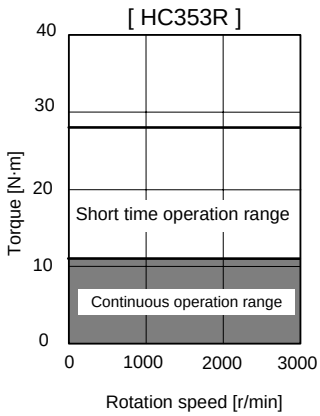

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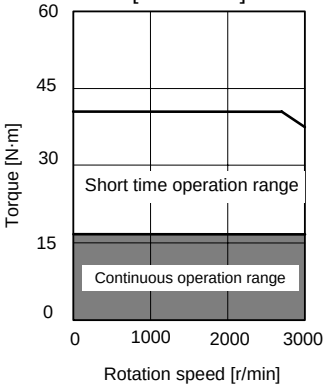
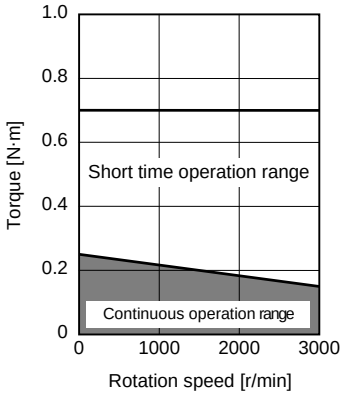


(Note 1) The above graphs show the data when applied the input voltage of 200VAC.
When the input voltage is 200VAC or less, the short time operation range is limited.

(Note 2) The dotted lines show the values when combined with the S-type drive unit.

(2) HA Series

[HA053N]



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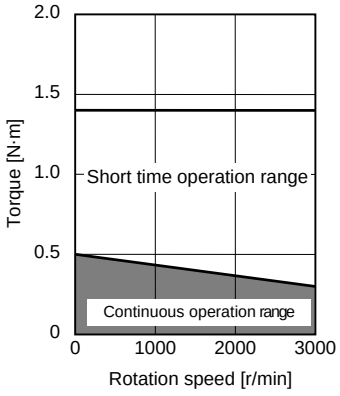

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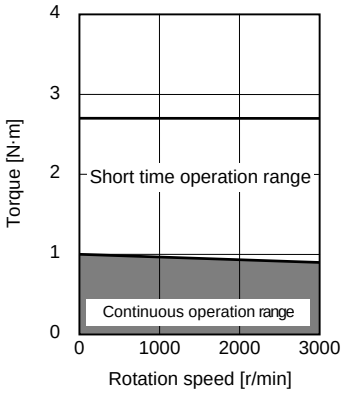

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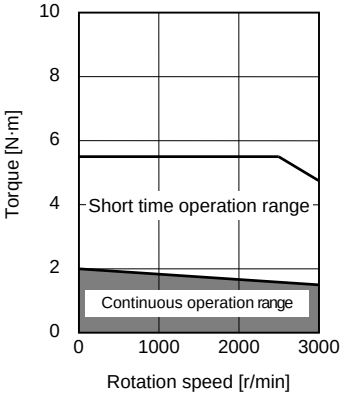

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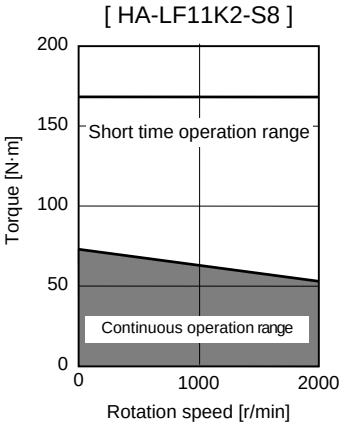

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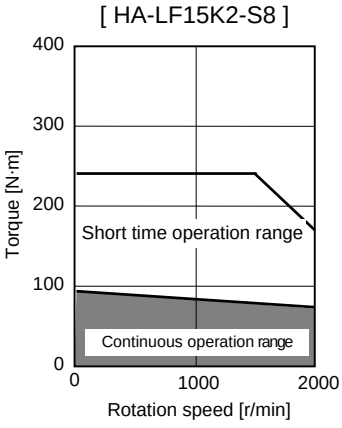


(Note) The above graphs show the data when applied the input voltage of 200VAC.
When the input voltage is 200VAC or less, the short time operation range is limited.

2-2 Spindle motor

2-2-1 Specifications

Spindle motor type		Base rotation speed 1500r/min Series								
		SJ-V								
		2.2-01	3.7-01	5.5-01	7.5-01	11-01	15-01	18.5-01	22-01	26-01
Compatible spindle drive unit type MDS-C1-		SPH-22	SPH-37	SP-55	SP-75	SP-110	SP-150	SP-185	SP-220	SP-300
Output capacity	Continuous rating [kW]	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22
	30-minute rating 50%ED rating [kW]	2.2	3.7	5.5	7.5	11	15	18.5	22	26
Base speed [r/min]		1500								
Maximum speed [r/min]		10000		8000		6000				
Frame No.		A90	B90	D90	A112	B112	A160		B160	C160
Continuous rated torque [N·m]		9.5	14.0	23.5	35.0	47.7	70.0	95.5	118	140
GD² [kg·m²]		0.027	0.035	0.059	0.098	0.12	0.23	0.23	0.32	0.38
Inertia [kg·m²]		0.007	0.009	0.015	0.025	0.03	0.06	0.06	0.08	0.10
Tolerable radial load [N]		980		1470	1960		2940			
Cooling fan	Input voltage	Single-phase 200V			3-phase 200V					
	Maximum power consumption	42W			40W		63W			
Environment	Ambient temperature	Operation: 0 to 40°C (non freezing), Storage: –20 to 65°C (non freezing)								
	Ambient humidity	Operation: 90%RH or less (non condensing), Storage: 90%RH or less (non condensing)								
	Atmosphere	Indoors (no direct sunlight); no corrosive gas, inflammable gas, oil mist, or dust								
	Altitude	Operation: 1000 meters or less above sea level, Storage: 1000 meters or less above sea level								
Weight [kg]		25	30	49	60	70	110		135	155
Insulation		Class F								

(Note 1) The rated output is guaranteed at the rated input voltage (200/220/230VAC) to the power supply unit. If the input voltage fluctuates and drops below 200VAC, the rated output may not be attained.

(Note 2) The 50%ED rating applies for a 10-minute cycle time consisting of ON for five minutes and OFF for five minutes.

CAUTION When replacing the SJ-V series by the conventional SJ series, the shorter L dimension is applied.

Spindle motor type		Large capacity series			
		SJ-			SJ-V
		30A	37BP	45BP	55-01
Compatible spindle drive unit type MDS-B-		SP-370		SP-450	SP-550
Output capacity	Continuous rating [kW]	22	30	37	45
	30-minute rating 50%ED rating [kW]	30	37	45	55
Base speed [r/min]		1500	1150		
Maximum speed [r/min]		4500	3450		
Frame No.		B160	B180	A200	A225
Continuous rated torque [N·m]		140	249	307	374
GD^2 [kg·m^2]		0.69	1.36	2.19	3.39
Inertia [kg·m^2]		0.17	0.34	0.55	0.85
Tolerable radial load [N]		2940	4900	5880	5880
Cooling fan	Input voltage	Single-phase 200V		3-phase 200V	
	Maximum power consumption	130W		60W	115W
Environment	Ambient temperature	Operation: 0 to 40°C (non freezing), Storage: –20 to 65°C (non freezing)			
	Ambient humidity	Operation: 90%RH or less (non condensing), Storage: 90%RH or less (non condensing)			
	Atmosphere	Indoors (no direct sunlight); no corrosive gas, inflammable gas, oil mist, or dust			
	Altitude	Operation: 1000 meters or less above sea level, Storage: 1000 meters or less above sea level			
Weight [kg]		200	300	390	450
Insulation		Class F			

(Note 1) The rated output is guaranteed at the rated input voltage (200/220/230VAC) to the power supply unit.
If the input voltage fluctuates and drops below 200VAC, the rated output may not be attained.
(Note 2) The 50%ED rating applies for a 10-minute cycle time consisting of ON for five minutes and OFF for five minutes.
(Note 3) The 37kW and larger capacities are available with the MDS-B-SP Series. Refer to Appendix 4 for details.

Spindle motor type		Wide range (1:8) constant output series					Wide range constant output series	
		SJ-V					SJ-	
		11-01	11-09	15-03	18.5-03	22-05	22XW5	22XW8
Compatible spindle drive unit type MDS-C1-		SP-110		SP-185	SP-220	SP-260	SP-300	SP-300
Output capacity	Continuous rating [kW]	3.7	5.5	7.5	9	11	15	18.5
	30-minute rating 50%ED rating [kW]	5.5	7.5	9	11	15	18.5	22
Base speed [r/min]		750					500 (600)	550 (600)
Maximum speed [r/min]		6000					4500	4000
Frame No.		B112	A160		B160		B180	A200
Continuous rated torque [N·m]		47.1	70.0	95.5	115	140	239	294
GD² [kg·m²]		0.12	0.23	0.23	0.32	0.32	1.36	2.19
Inertia [kg·m²]		0.03	0.06	0.06	0.08	0.08	0.34	0.55
Tolerable radial load [N]		1960	2940				3920	5880
Cooling fan	Input voltage	3-phase 200V					Single-phase 200V	3-phase 200V
	Maximum power consumption	40W	63W				180W	60W
Environment	Ambient temperature	Operation: 0 to 40°C (non freezing), Storage: –20 to 65°C (non freezing)						
	Ambient humidity	Operation: 90%RH or less (non condensing), Storage: 90%RH or less (non condensing)						
	Atmosphere	Indoors (no direct sunlight); no corrosive gas, inflammable gas, oil mist, or dust						
	Altitude	Operation: 1000 meters or less above sea level, Storage: 1000 meters or less above sea level						
Weight [kg]		70	110		135		300	390
Insulation		Class F						

(Note 1) The rated output is guaranteed at the rated input voltage (200/220/230VAC) to the power supply unit. If the input voltage fluctuates and drops below 200VAC, the rated output may not be attained.

(Note 2) The 50%ED rating applies for a 10-minute cycle time consisting of ON for five minutes and OFF for five minutes.

Spindle motor type		High-speed series					
		SJ-V					
		3.7-02ZM	7.5-03ZM	11-06ZM	11-08ZM	22-06ZM	30-02ZM
Compatible spindle drive unit type MDS-C1-		SPH-37	SPH-110	SPH-150	SP-185	SP-220	SP-300
Output capacity	Continuous rating [kW]	2.2	5.5	5.5	7.5	11	18.5
	30-minute rating 50%ED rating [kW]	3.7 (15min. rating)	7.5	7.5	11	15	22
Base speed [r/min]		3000	1500				
Maximum speed [r/min]		15000	12000		8000		
Frame No.		A90	A112		B112	A160	B160
Continuous rated torque [N·m]		7.0	35.0	35.0	47.7	70.0	118
GD² [kg·m²]		0.027	0.098	0.098	0.12	0.23	0.32
Inertia [kg·m²]		0.007	0.025	0.025	0.03	0.06	0.08
Tolerable radial load [N]		490	980		1470	1960	
Cooling fan	Input voltage	Single-phase 200V	3-phase 200V				
	Maximum power consumption	42W	40W			63W	
Environment	Ambient temperature	Operation: 0 to 40°C (non freezing), Storage: –20 to 65°C (non freezing)					
	Ambient humidity	Operation: 90%RH or less (non condensing), Storage: 90%RH or less (non condensing)					
	Atmosphere	Indoors (no direct sunlight); no corrosive gas, inflammable gas, oil mist, or dust					
	Altitude	Operation: 1000 meters or less above sea level, Storage: 1000 meters or less above sea level					
Weight [kg]		25	60		70	125	155
Insulation		Class F					

(Note 1) The rated output is guaranteed at the rated input voltage (200/220/230VAC) to the power supply unit. If the input voltage fluctuates and drops below 200VAC, the rated output may not be attained.

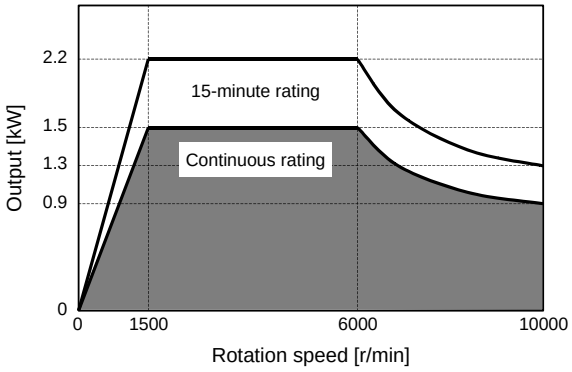
(Note 2) The 50%ED rating applies for a 10-minute cycle time consisting of ON for five minutes and OFF for five minutes.

Spindle motor type		Hollow shaft series			IPM Series	
		SJ-VS			SJ-PM	
		7.5-03ZM	22-06ZM	30-02ZM	F01830-00	F03530-00
Compatible spindle drive unit type MDS-C1-		SPH-110	SP-220	SP-300	SPM-110	SPM-185
Output capacity	Continuous rating [kW]	5.5	11	18.5	3.7	7.5
	30-minute rating 50%ED rating [kW]	7.5	15	22	5.5	11.0
Base speed [r/min]		1500	1500		3000	
Maximum speed [r/min]		12000	8000		8000	
Frame No.		A112	A160	B160	71	90
Continuous rated torque [N·m]		35.0	70.0	118	11.8	23.9
GD^2 [kg·m^2]		0.099	0.23	0.32	0.015	0.034
Inertia [kg·m^2]		0.025	0.058	0.08	0.004	0.009
Tolerable radial load [N]		0 (Note 3)	0 (Note 3)	0 (Note 3)	1470	1960
Cooling fan	Input voltage	Single-phase 200V	3-phase 200V			
	Maximum power consumption	40W	40W		38W	32W
Environment	Ambient temperature	Operation: 0 to 40°C (non freezing), Storage: –20 to 65°C (non freezing)				
	Ambient humidity	Operation: 90%RH or less (non condensing), Storage: 90%RH or less (non condensing)				
	Atmosphere	Indoors (no direct sunlight); no corrosive gas, inflammable gas, oil mist, or dust				
	Altitude	Operation: 1000 meters or less above sea level, Storage: 1000 meters or less above sea level				
Weight [kg]		65	115	140	23	35
Insulation		Class F				

(Note 1) The rated output is guaranteed at the rated input voltage (200 to 230VAC) to the power supply unit.
(Note 2) The 50%ED rating applies for a 10-minute cycle time consisting of ON for five minutes and OFF for five minutes.
(Note 3) Do not apply a radial load.

2-2-2 Output characteristics

[Base rotation speed 1500r/min series SJ-V2.2-01]



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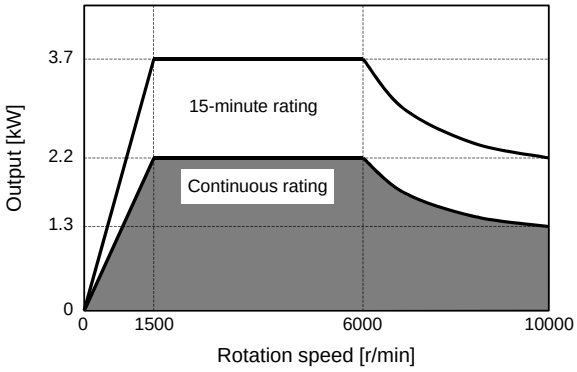

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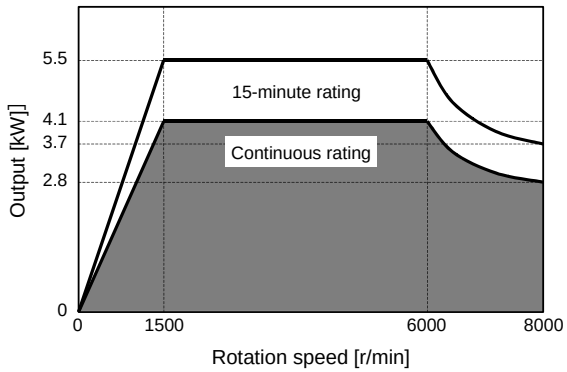

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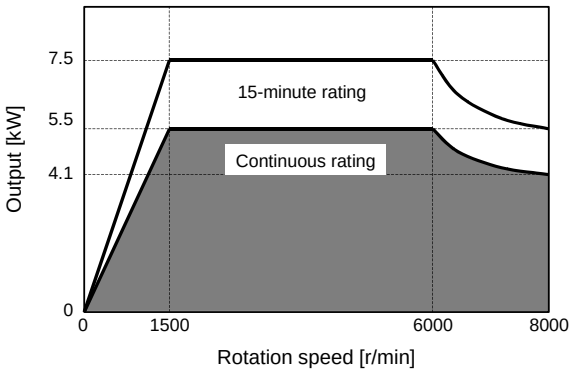

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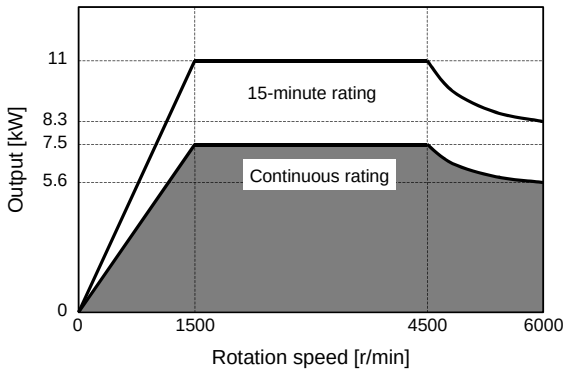

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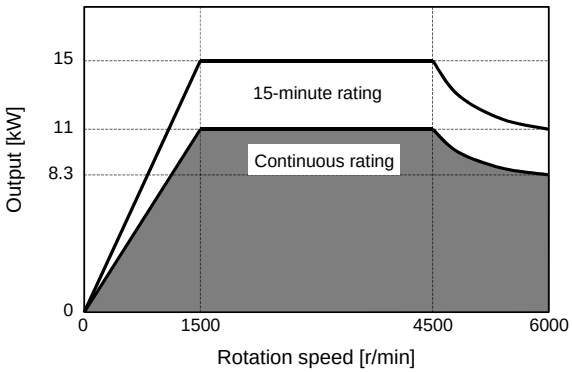
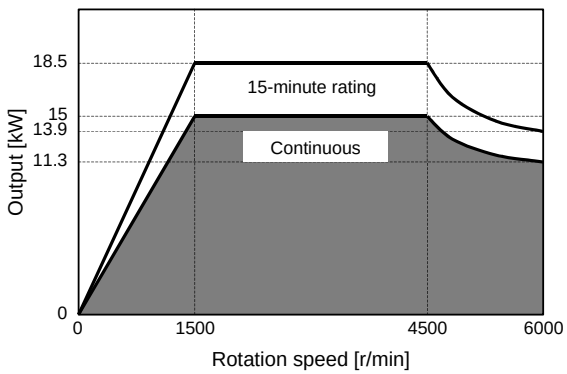
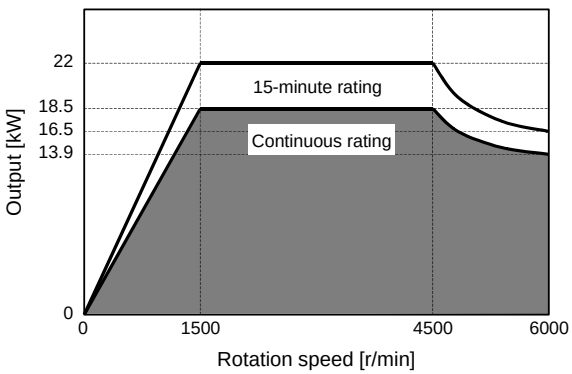


[Base rotation speed 1500r/min series SJ-V18.5-01]



[Base rotation speed 1500r/min series SJ-V22-01]



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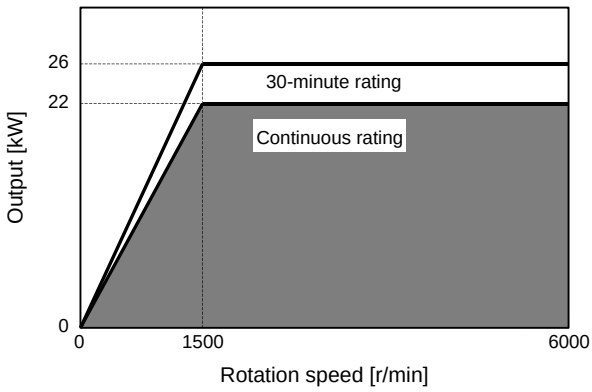
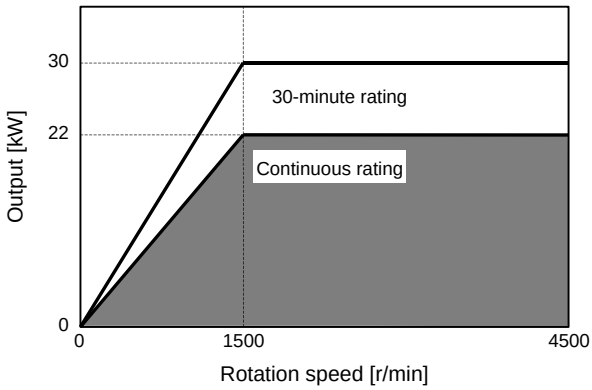
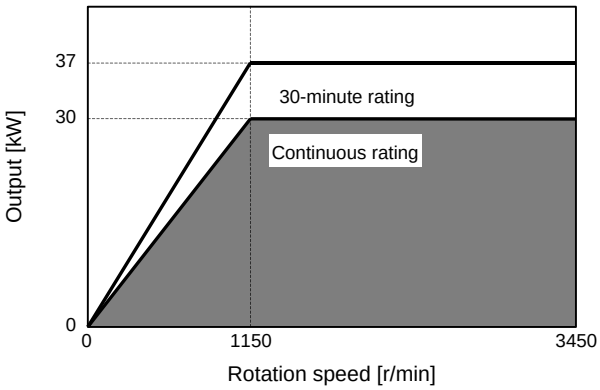


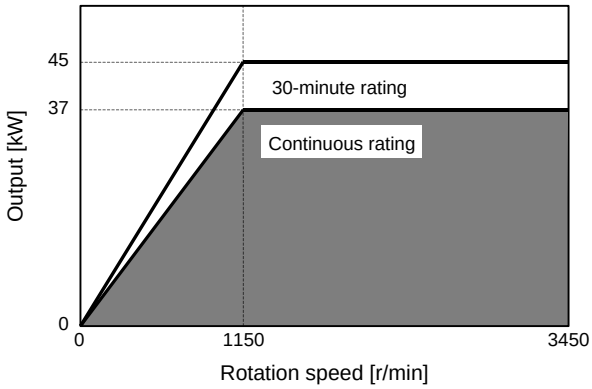
[Large capacity series SJ-30A]



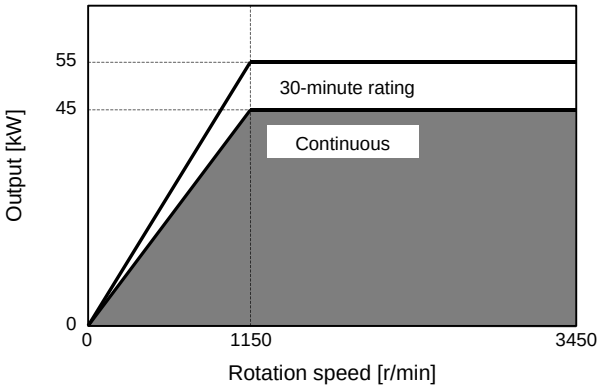
[Large capacity series SJ-37BP]



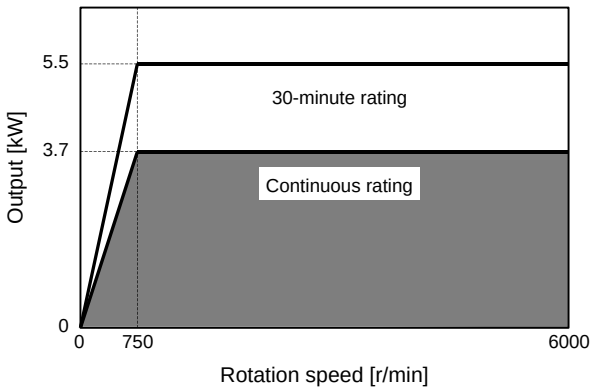
[Large capacity series SJ-45BP]



[Large capacity series SJ-V55-01]



[Wide range (1:8) constant output series SJ-V11-01]



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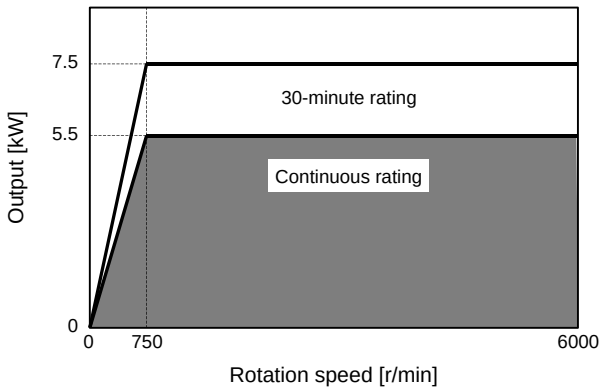

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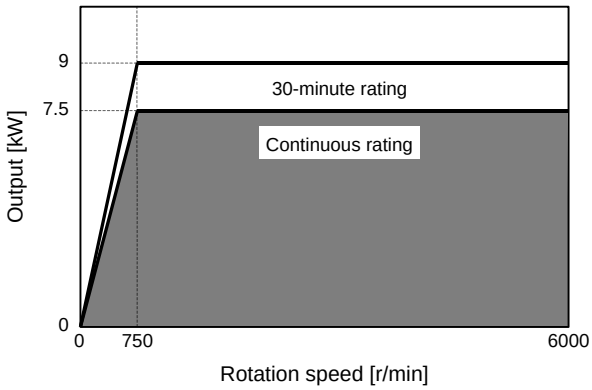

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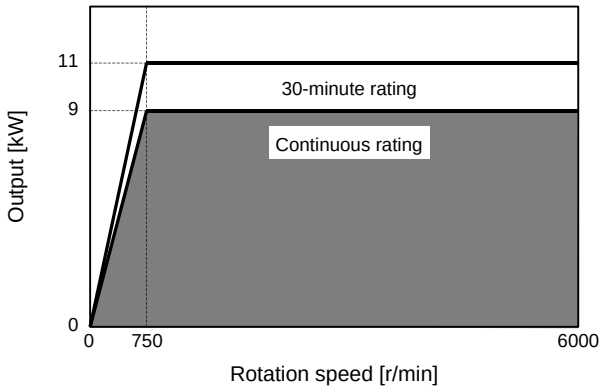

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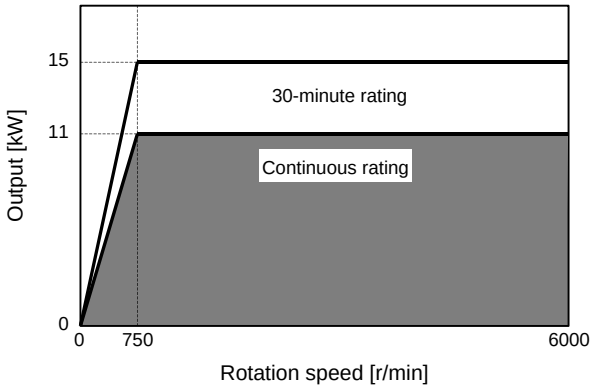

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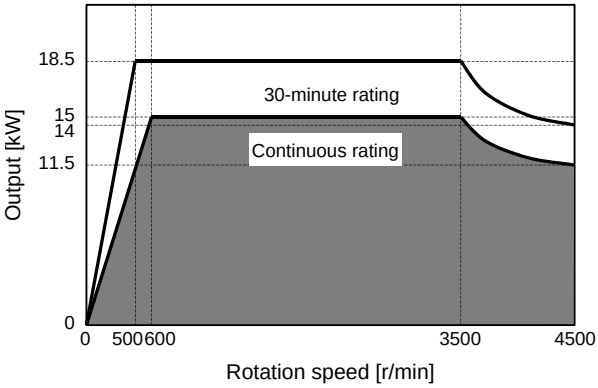

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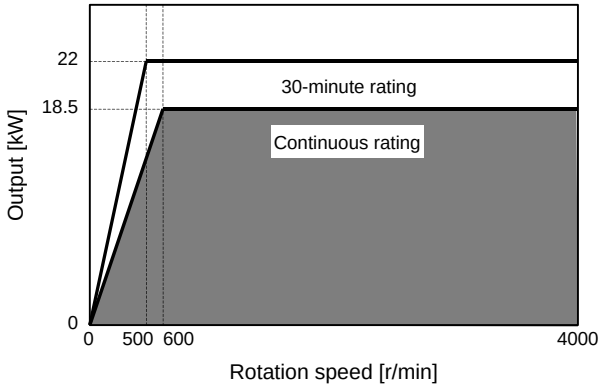

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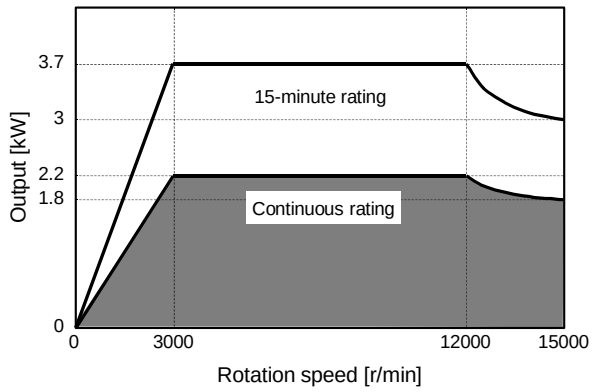

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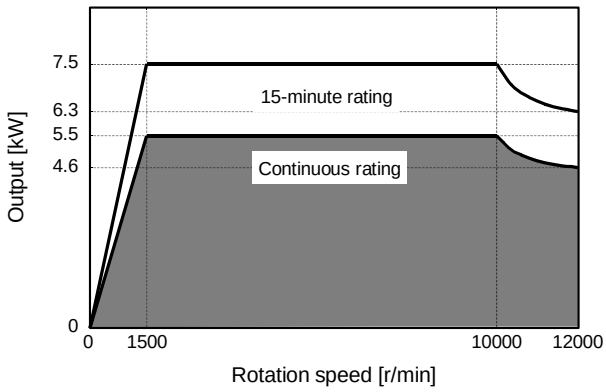

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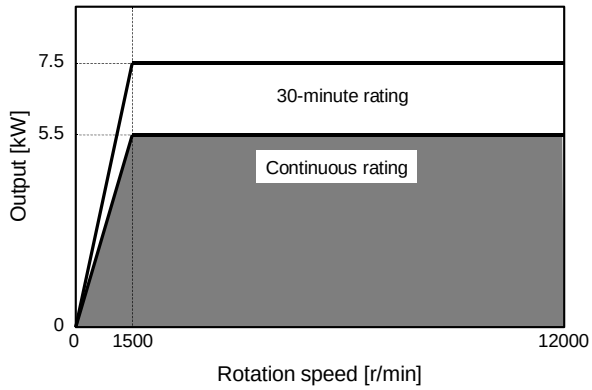

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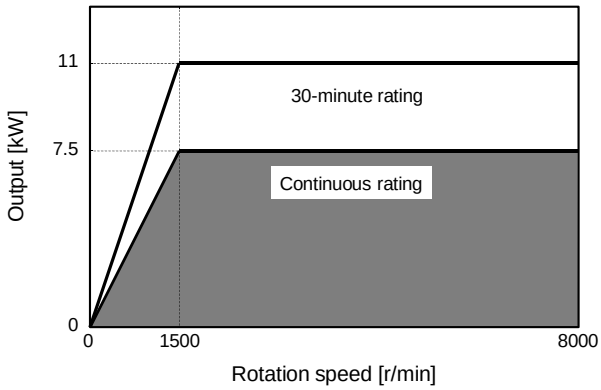

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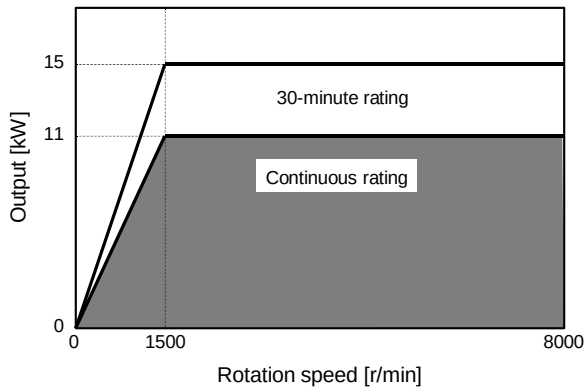

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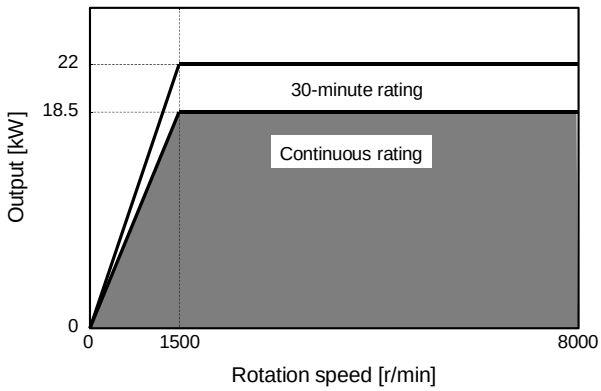
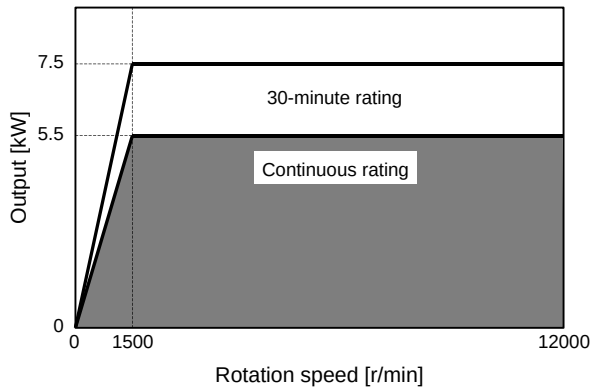


[Hollow shaft series SJ-V7.5-03ZM]



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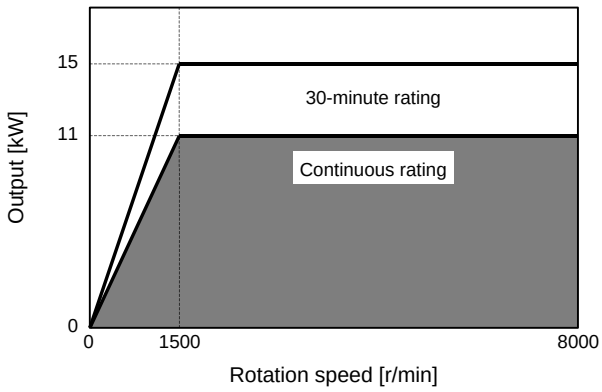

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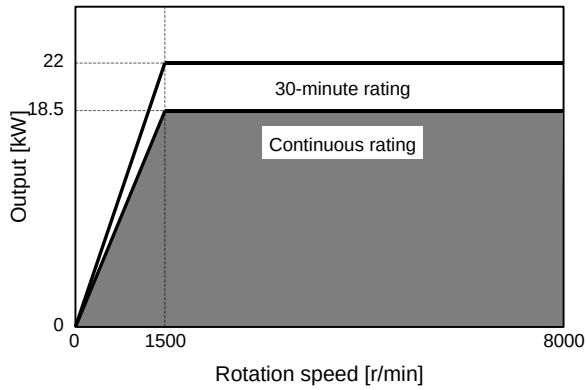

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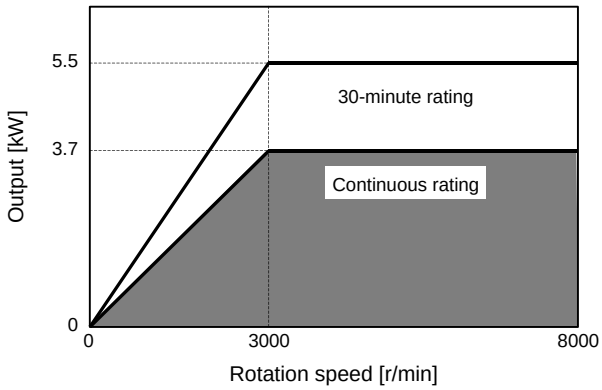

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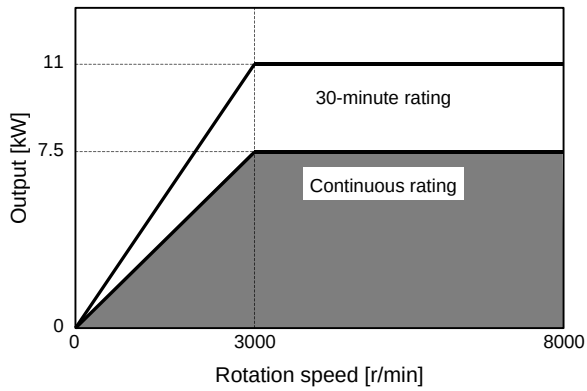


2-3 Drive unit

2-3-1 Installation environment conditions

Common installation environment conditions for servo, spindle and power supply unit are shown below.

Environment	Ambient temperature	Operation: 0 to 55°C (with no freezing), Storage / Transportation: -15°C to 70°C (with no freezing)
	Ambient humidity	Operation: 90%RH or less (with no dew condensation) Storage / Transportation: 90%RH or less (with no dew condensation)
	Atmosphere	Indoors (no direct sunlight) With no corrosive gas, inflammable gas, oil mist or dust
	Altitude	Operation/Storage: 1000 meters or less above sea level, Transportation: 10000 meters or less above sea level
	Vibration/impact	4.9m/s^2 (0.5G) / 49m/s^2 (5.0G)

2-3-2 Servo drive unit

1) 1-axis servo drive unit

			1-axis servo drive unit MDS-C1-V1 Series												
Servo drive unit type	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]	155AC												
	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 to 311DC												
	Rated current	[A]	1	3	4	7	14	17	30	30	35	35	45	55	75
Control power	Voltage	[V]	200/200 to 230AC												
	Frequency	[Hz]	50/60												
	Current	[A]	Max. 0.2												
	Rush current	[A]	MAX. 35												
	Rush conductivity time	[ms]	MAX. 6												
Earth leakage current		[mA]	1（MAX. 2）												
Control method			Sine wave PWM control method, current control method												
Braking			Regenerative braking and dynamic brakes												
	Dynamic brakes		Built-in												External
External analog output			0 to +5V,2ch (data for various adjustments)												
Structure			Protection type (Protection method: IP20 [over all] / IP00 [Terminal block TE1])												
Cooling method			Self-cooling		Forced wind cooling (internal)		Forced wind cooling (fin)								
Weight		[kg]	2.1				3.8			4.5	4.9	5.8		6.4	
Heat radiated at rated output		[W]	21	27	37	53	91	132	158	185	189	284	331	465	641
Noise			Less than 55dB												

(Note) The drive unit, within the same capacity, which has a shorter width is indicated with an "S" at the end of the type. Note that limits apply to continuous operation of the 45S and 70S types.

2) 2-axis servo drive unit

Servo drive unit type MDS-C1-V2-		2-axis servo drive unit MDS-C1-V2 Series												
		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]	155AC												
	Rated current [A]	0.95 + 0.95	2.9 + 0.95	2.9 + 2.9	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 to 311DC												
	Rated current [A]	2	4	6	5	7	8	10	11	14	21	28	24	24
Control power	Voltage [V]	200/200 to 230AC												
	Frequency [Hz]	50/60												
	Current [A]	Max. 0.2												
	Rush current [A]	MAX. 35												
	Rush conductivity time [ms]	MAX. 6												
Earth leakage current [mA]		1（MAX.4 For 2 axes）												
Control method		Sine wave PWM control method, current control method												
Braking		Regenerative braking and dynamic brakes												
	Dynamic brakes	Built-in												
External analog output		0 to +5V,2ch (data for various adjustments)												
Structure		Protection type (Protection method: IP20 [over all] / IP00 [Terminal block TE1])												
Cooling method		Forced wind cooling (internal)									Forced wind cooling (fin)			
Weight	[kg]	2.3									4.5			5.2
Heat radiated at rated output	[W]	38	41	43	46	52	62	68	78	96	155	178	190	190
Noise		Less than 55dB												

Servo drive unit type MDS-C1-V2-		2-axis servo drive unit MDS-C1-V2 Series											
		3520S	3520	3535	4520	4535	4545S	4545	7035	7045	7070S	7070	9090S
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	4.5 + 4.5	7.0 + 3.5	7.0 + 4.5	7.0 + 7.0	7.0 + 7.0	9.0 + 9.0
Output	Rated voltage [V]	155AC											
	Rated current [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	28.0 + 28.0	33.5 + 16.0	33.5 + 28	33.5 + 33.5	33.5 + 33.5	40.8 + 40.8
Input	Rated voltage [V]	270 to 311DC											
	Rated current [A]	31	31	34	44	47	60	60	52	64	70	70	90
Control power	Voltage [V]	200/200 to 230AC											
	Frequency [Hz]	50/60											
	Current [A]	Max. 0.2											
	Rush current [A]	MAX. 35											
	Rush conductivity time [ms]	MAX. 6											
Earth leakage current [mA]		1 （MAX. 4 For 2 axes）											
Control method		Sine wave PWM control method, current control method											
Braking		Regenerative braking and dynamic brakes											
	Dynamic brakes	Built-in											
External analog output		0 to +5V,2ch (data for various adjustments)											
Structure		Protection type (Protection method: IP20 [over all] / IP00 [Terminal block TE1])											
Cooling method		Forced wind cooling (fin)											
Weight	[kg]	4.5	5.2	5.2	5.2	5.2	5.2	6.0	6.7	6.7	5.9	7.3	7.3
Heat radiated at rated output	[W]	213	213	260	266	307	280	359	406	459	365	558	558
Noise		Less than 55dB											

(Note) The drive unit, within the same capacity, which has a shorter width is indicated with an "S" at the end of the type. Note that limits apply to continuous operation of the 4545S, 7070S and 9090S types.

2-3-3 Spindle drive unit

		Spindle drive unit MDS-C1-SP Series												
Spindle drive unit type	MDS-C1-SP- MDS-C1-SPH- MDS-C1-SPX- MDS-C1-SPHX- MDS-C1-SPM-	04	075	15	22	37	55	75	110	150S	150	185	220	260	300
Rated output	[kW]	0.1	0.3	0.5	1.5	2.2	3.7	5.5	7.5	11		15	18.5	22	26
Output	Rated voltage [V]	155AC													
	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 to 311DC													
	Rated current [A]	1	4	7	13	17	20	30	41	58		76	95	115	144
Control power	Voltage [V]	200/200 to 230AC													
	Frequency [Hz]	50/60													
	Current [A]	Max. 0.2													
	Rush current [A]	MAX. 35													
	Rush conductivity time [ms]	MAX. 6													
Earth leakage current	[mA]	6（MAX. 15）													
Control method		Sine wave PWM control method, current control method													
Braking		Regenerative braking													
External analog output		0 to +10V, 2ch (speed meter output, load meter output, data for various adjustments)													
Structure		Protection type (Protection method: IP20 [over all] / IP00 [Terminal block TE1])													
Cooling method		Self-cooling		Forced wind cooling (internal)	Forced wind cooling (fin)										
Weight	[kg]	2.1			3.8		4.4			4.7	5.7		6.5	6.3	
Heat radiated at rated output	[W]	30	40	49	69	79	108	137	181	188	235	342	366	483	620
Noise		Less than 55dB													

(Note) The drive unit, within the same capacity, which has a shorter width is indicated with an "S" at the end of the type. Note that limits apply to continuous operation of the150S types.

2-3-4 Power supply unit

		Power supply unit MDS-C1-CV Series									
Power supply unit type	MDS-C1-CV-	37	55	75	110	150	185	220	260	300	370
Rated output	[kW]	3.7	5.5	7.5	11.0	15.0	18.5	22.0	26.0	30.0	37.0
Input	Rated voltage [V]	200/200 to 230AC									
	Frequency [Hz]	50/60 Frequency fluctuation within ±3%									
	Rated current [A]	16	20	26	35	49	66	81	95	107	121
Output	Rated voltage [V]	270 to 311DC									
	Rated current [A]	17	20	30	41	58	76	95	115	144	164
Control power	Voltage [V]	200/200 to 230AC									
	Frequency [Hz]	50/60									
	Current [A]	Max.0.2									
	Rush current [A]	MAX.35									
	Rush conductivity time [ms]	MAX.6									
Main circuit method		Converter with power regeneration circuit									
Structure		Protection type (Protection method: IP20 [over all] / IP00 [Terminal block TE1])									
Cooling method		Self-cooling	Forced wind cooling (internal)		Forced wind cooling (fin)						
Weight	[kg]	3.4			4.6	5.8	6.0	8.3	8.4	8.6	8.8
Heat radiated at rated output	[W]	55	65	80	125	155	195	210	260	320	400
Noise		Less than 55dB									

2-3-5 AC reactor

An AC reactor must be installed for each power supply unit.

(1) Specifications

		AC reactor				
AC reactor type	**B-AL-**	**7.5K**	**11K**	**18.5K**	**30K**	**37K**
Compatible power supply unit type	**MDS-C1-CV-**	37,55,75	110	150,185	220,260,300	370
Rated capacity (30-minute rating)	**[kW]**	7.5	11	18.5	30	37
Rated voltage	**[V]**	200/200 to 230AC				
Rated current	**[A]**	27	33	66	110	129
Frequency	**[Hz]**	50/60 Frequency fluctuation within ±3%				
Environ-ment	**Ambient temperature**	Operation: -10 to 60°C (with no freezing), Storage/Transportation: -10°C to 60°C (with no freezing)				
	Ambient humidity	Operation: 80%RH or less (with no dew condensation), Storage/Transportation: 80%RH or less (with no dew condensation)				
	Atmosphere	Indoors (no direct sunlight) With no corrosive gas, inflammable gas, oil mist or dust				
	Altitude	Operation/Storage: 1000 meters or less above sea level, Transportation: 10000 meters or less above sea level				
	Vibration/impact	9.8m/s2 (1G) / 98m/s2 (10G)				
Weight	**[kg]**	3.6	3.0	5.2	6.0	10

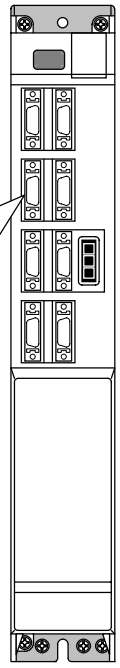
2-3-6 D/A output specifications for servo drive unit

(1) D/A output specifications

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

CN9 connector

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



MDS-C1-V2

(2) Output data settings

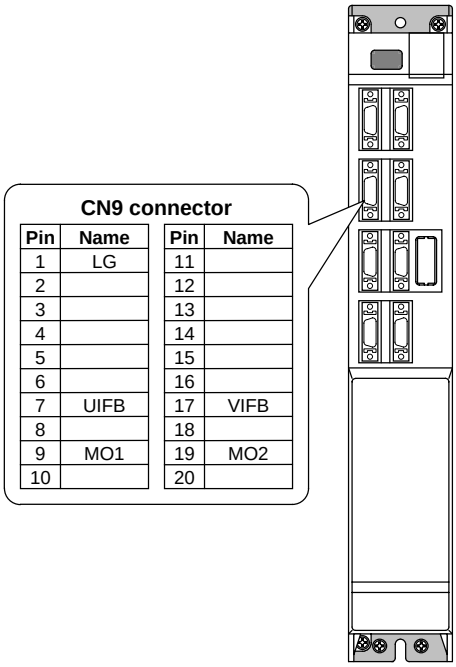
No.	Abbrev.	Parameter name	Explanation
SV061	DA1NO	D/A output channel 1 data No.	Input the No. of the data to be output to each D/A output channel.
SV062	DA2NO	D/A output channel 2 data No.	

No.	Output data	Original data unit	Output magnification standard setting value (SV063, SV064)	Output unit for standard setting	Output cycle
-1	**D/A output not selected**	For 2-axis drive unit (MDS-C1-V2). Set the parameters to another axis in the drive unit that is not D/A output.			
0	**ch1: Speed feedback**	r/min	13 (2000rpm)	1000rpm/V	3.5ms
			9 (3000rpm)	1500rpm/V	3.5ms
	ch2: Current command	Stall %	131	Stall 100%/V	3.5ms
1	**Current command**	Stall %	131	Stall 100%/V	3.5ms
2	**–**				
3	**Current feedback**	Stall %	131	Stall 100%/V	3.5ms
4	**–**				
5	**–**				
6	**Position droop**	NC display unit/2	328 (Display unit = 1µm)	10µm/0.5V	3.5ms
7	**–**				
8	**Feedrate (FΔT)**	(NC disiplay unit/2)/ Communication cycle	55 (1µm, 3.5ms)	1000 (mm/min)/0.5V	3.5ms
9	**–**				
10	**Position command**	NC display unit/2	328 (Display unit = 1µm)	10µm/0.5V	3.5ms
11	**–**				
12	**Position feedback**	NC display unit/2	328 (Display unit = 1µm)	10µm/0.5V	3.5ms
13	**–**				
14	**Collision detection estimated torque**	Stall %	131	Stall 100%/V	3.5ms
15	**Collision detection disturbance torque**	Stall %	131	Stall 100%/V	3.5ms
64	**Current command (high-speed)**	Internal unit	8 (adjustments required)	–	0.8µs
65	**Current feedback (high-speed)**	Internal unit	8 (adjustments required)	–	0.8µs
77	**Estimated disturbance torque**	Internal unit	8 (adjustments required)	–	0.8µs
125	**Test output saw tooth wave**	0V to 5V	0 (256)	Cycle: 227.5ms	0.8µs
126	**Test output oblong wave**	0V to 5V	0 (256)	Cycle 1.7ms	0.8µs
127	**Test output 2.5V (data 0)**	2.5V	0 (256)	-	0.8µs

2-3-7 D/A output specifications for spindle drive unit

(1) D/A output specifications

Item	Explanation
No. of channels	2ch
Output cycle	444µs (min. value)
Output precision	8bit
Output voltage range	0V to +5V (zero) to +10V, 0V to +10V for meter output
Output magnification setting	±1/256 to ±128-fold
Output pin	CN9 connector MO1 = Pin 9 MO2 = Pin 19 GND = Pin 1
Function	Phase current feedback output function U phase current FB : Pin 7 V phase current FB : Pin 17



MDS-C1-SP

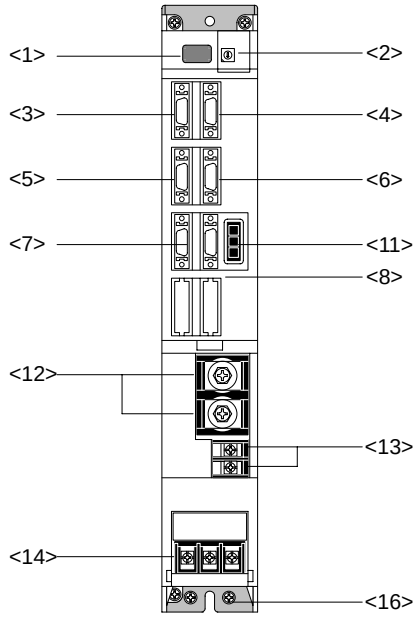
(2) Setting the output data

No.	Abbrev.	Parameter name	Explanation
SP253	DA1NO	D/A output channel 1 data No.	Input the No. of the data to be output to each D/A output channel.
SP254	DA2NO	D/A output channel 2 data No.	1deg=(64000÷65536)

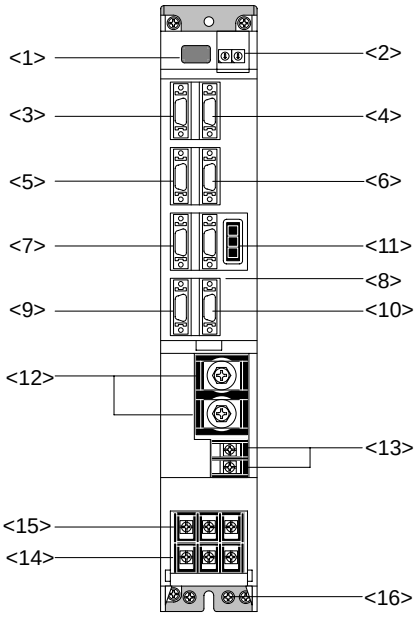
No.	Output data	Original data unit	Output magnification standard setting value (SP255, SP256)	Output unit for standard setting	Output cycle
0	**ch1: Speedometer output**	10V=max. speed (Zero=0V)	0	Depends on maximum speed	3.5ms
	ch2: Load meter output	10V=120% load (Zero=0V)	0	30-minute rating 12%/V	3.5ms
1	**–**				
2	**Current command**	Rated 100%=4096	8	30-minute rating 20%/V	3.5ms
3	**Current feedback**	Rated 100%=4096	8	30-minute rating 20%/V	3.5ms
4	**Speed feedback**	r/min	13	500rpm/V	3.5ms
5	**–**				
6	**Position droop (lower order 16bit)**	0.001deg=64	10 (10.24)	0.01deg/V	0.8µs
7	**Position droop (higher order 16bit)**	1deg=(64000÷65536)	671	10deg/V	0.8µs
8	**Feedrate (FΔT) (lower order 16bit)**	0.001deg=64	173 (at 3.5ms communication)	10deg/min/V	0.8µs
9	**Feedrate (FΔT) (higher order 16bit)**	1deg=(64000÷65536)	629 (at 3.5ms communication)	500rpm/V	0.8µs
10	**Position command (lower order 16bit)**	0.001deg=64	10 (10.24)	0.01deg/V	0.8µs
11	**Position command (higher order 16bit)**	1deg=(64000÷65536)	19 (18.64)	360deg/V	0.8µs
12	**Position feedback (lower order 16bit)**	0.001deg=64	10 (0.24)	0.01deg/V	0.8µs
13	**Position feedback (higher order 16bit)**	1deg=(64000÷65536)	19 (18.64)	360deg/V	0.8µs
80	**Control input 1**	HEX	Bit correspondence		3.5ms
81	**Control input 2**				
82	**Control input 3**				
83	**Control input 4**				
84	**Control output 1**				
85	**Control output 2**				
86	**Control output 3**				
87	**Control output 4**				

2-3-8 Explanation of each part

(1) Explanation of each servo drive unit part



MDS-C1-V1 (1-axis servo drive unit)



MDS-C1-V2 (2-axis servo drive unit)

The connector layout differs according to the unit being used. Refer to each unit's outline drawing for details.

Each part name

		Name		Description
<1>	**Control circuit**	LED	---	Unit status indication LED
<2>		SW1	---	Axis No. setting switch (Left: L axis, Right: M axis)
<3>		CN1A	---	NC or upward axis communication connector
<4>		CN1B	---	Battery unit/Terminator/Lower axis communication connector
<5>		CN9	---	Analog output connector
<6>		CN4	---	Power supply communication connector
<7>		CN2L	---	Motor side detector connection connector (L axis)
<8>		CN3L	---	Machine side detector connection connector (L axis)
<9>		CN2M	---	Motor side detector connection connector (M axis)
<10>		CN3M	---	Machine side detector connection connector (M axis)
<11>		CN20	---	Electromagnetic/dynamic brake connector
<12>	**Main circuit**	TE2	L+, L–	Converter voltage input terminal (DC input)
<13>		TE3	L11, L21	Control power input terminal (single-phase AC input)
<14>		TE1	LU,LV,LW	Motor power output terminal (3-phase AC output)
<15>			MU,MV,MW	
<16>		PE	⏚	Grounding terminal

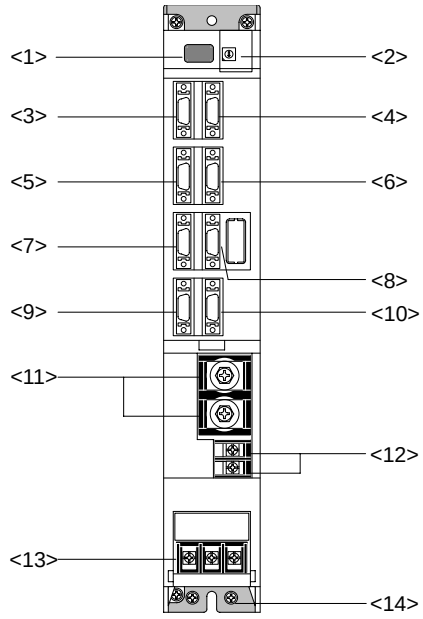
(Note) The connector names differ for the V1 drive unit. (CN2L/CN3L → CN2/CN3, CN2M/CN3M → Not mounted)
The MU, MV and MW terminals are not provided. The LU, LV and LW terminals are named U, V and W.

Screw size

	1-axis servo drive unit MDS-C1-V1-				2-axis servo drive unit MDS-C1-V2-			
Type	**01 to 35, 45S**	**45,70S**	**70 to 90**	**110 to 150**	**0101 to 2020 3510S, 3520S**	**3510 to 4545S, 7070S**	**4545 to 7045**	**7070**
Unit width (mm)	60	90	120	150	60	90	120	150
<12> L+, L–	M6 x 14							
<13> L11,L21	M4 x 10							
<14> LU, LV, LW **<15> MU, MV, MW**	M4 x 12 **(Note)**	M5 x 12		M8 x 14	M4 x 12			
<16> ⏚	M4 x 8	M5 x 12		M8 x 14	M4 x 8			

(Note) The V1-45S UVW terminal screw size is M5, the same as V1-45.

(2) Explanation of each spindle drive unit part



MDS-C1-SP

The connector layout differs according to the unit being used. Refer to each unit's outline drawing for details.

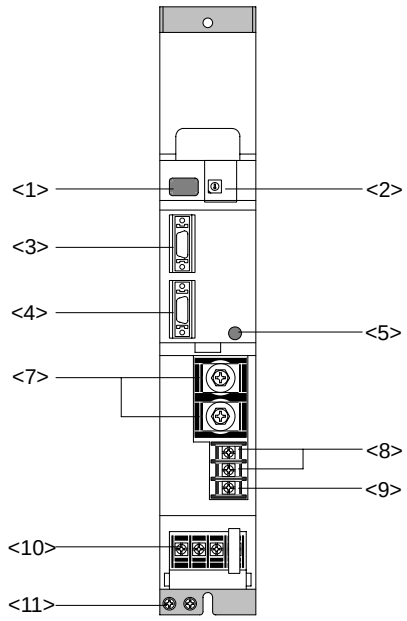
Each part name

		Name		Description
<1>	**Control circuit**	LED	---	Unit status indication LED
<2>		SW1	---	Axis No. setting switch
<3>		CN1A	---	NC or upward axis communication connector
<4>		CN1B	---	Battery unit/Terminator/Lower axis communication connector
<5>		CN9	---	Analog output connector
<6>		CN4	---	Power supply communication connector
<7>		CN5	---	Internal PLG encoder connection connector
<8>		CN6	---	Magnetic sensor connection connector
<9>		CN7	---	C axis control encoder connection connector
<10>		CN8	---	CNC connection connector
<11>	**Main circuit**	TE2	L+, L–	Converter voltage input terminal (DC input)
<12>		TE3	L11, L21	Control power input terminal (single-phase AC input)
<13>		TE1	U, V, W	Motor power output terminal (3-phase AC output)
<14>		PE	⏚	Grounding terminal

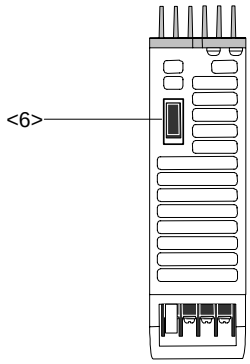
Screw size

	Spindle drive unit MDS-C1-SP-			
Type	**04 to 37**	**55 to 110,150S**	**150 to 185**	**220 to 300**
Unit width (mm)	60	90	120	150
<11> L+, L–	M6 x 14			
<12> L11,L21	M4 x 10			
<13> U, V, W	M4 x 12	M5 x 12		M8 x 14
<14> ⏚	M4 x 8	M5 x 12		M8 x 14

(3) Explanation of each power supply unit part



MDS-C1-CV



Bottom view

The connector layout differs according to the unit being used. Refer to each unit's outline drawing for details.

Each part name

		Name		Description
<1>	**Control circuit**	LED	---	Power supply status indication LED
<2>		SW1	---	Power supply setting switch
<3>		CN4	---	Servo/spindle communication connector (master)
<4>		CN9	---	Servo/spindle communication connector (slave)
<5>		---	CHARGE LAMP	TE2 output charging/discharging circuit indication LED
<6>		CN23	---	External emergency stop input connector
<7>	**Main circuit**	TE2	L+, L–	Converter voltage output terminal (DC output)
<8>		TE3	L11, L21	Control power input terminal (single-phase AC input)
<9>			MC1	External contactor control terminal
<10>		TE1	L1, L2, L3	Power input terminal (3-phase AC input)
<11>		PE	⏚	Grounding terminal

(Note) CN23 is located at the bottom of the power supply unit.

Screw size

	Power supply unit MDS-C1-CV-			
Type	**37 to 75**	**110**	**150 to 185**	**220 to 370**
Unit width (mm)	60	90	120	150
<7> L+, L–	M6 x 16			
<8> L11, L21	M4 x 10			
<9> MC1	M4 x 10			
<10> L1, L2, L3	M4 x 10	M5 x 12		M8 x 14
<11> ⏚	M4 x 8	M5 x 8		M8 x 14

2-4 Restrictions on servo control

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

2-4-1 Restrictions of electronic gear setting value

The servo drive unit has internal electronic gears. The command value from the NC is converted into a detector resolution unit to carry out position control. The electronic gears are single gear ratios calculated from multiple parameters as shown below, and each value (ELG1, ELG2) must be 32767 or less.
If the value overflows, the initial parameter error (alarm 37) or error parameter No. 101 (2301 with M60S/E60 Series NC) will be output.
If an alarm occurs, the mechanical specifications and electrical specifications (such as resolution of the detector) must be revised so that the electronic gears are within the specifications range.

(1) For semi-closed loop control

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

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

When the above is calculated, the following conditions must be satisfied.
ELG1 ≤ 32767
ELG2 ≤ 32767

(2) For full-closed loop control

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

When the above is calculated, the following conditions must be satisfied.
PGNX ≤ 32767
PGNY ≤ 32767

And,

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

When the above is calculated, the following conditions must be satisfied.
PGNXsp ≤ 32767
PGNYsp ≤ 32767

POINT

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

(3) Electronic gear related parameters

<table>
<tr><th>No.</th><th>Abbrev.</th><th>Parameter name</th><th>Explanation</th><th>Setting range (Unit)</th></tr>
<tr><td>SV001</td><td>PC1</td><td>Motor side gear ratio</td><td rowspan="2">Set the motor side and machine side gear ratio.
For the rotary axis, set the total deceleration (acceleration) ratio.
Even if the gear ratio is within the setting range, the electronic gears may overflow and cause an alarm.</td><td>1 to 32767</td></tr>
<tr><td>SV002</td><td>PC2</td><td>Machine side gear ratio</td><td>1 to 32767</td></tr>
<tr><td>SV003</td><td>PGN1</td><td>Position loop gain 1</td><td>Set the position loop gain. The standard setting is "33".
The higher the setting value is, the more precisely the command can be followed and the shorter the positioning time gets, however, note that a bigger shock is applied to the machine during acceleration/deceleration.
When using the SHG control, also set SV004 (PGN2) and SV057 (SHGC).</td><td>1 to 200 (rad/s)</td></tr>
<tr><td>SV018</td><td>PIT</td><td>Ball screw pitch</td><td>Set the ball screw pitch. Set to "360" for the rotary axis.</td><td>1 to 32767 (mm/rev)</td></tr>
<tr><td rowspan="2">SV019</td><td rowspan="2">RNG1</td><td rowspan="2">Position detector resolution</td><td>In the case of the semi-closed loop control
Set the same value as SV020 (RNG2). (Refer to the explanation of SV020.)</td><td>1 to 9999 (kp/rev)</td></tr>
<tr><td>In the case of the full-closed loop control
Set the number of pulses per ball screw pitch.
<table>
<tr><th>Detector model name</th><th>Resolution</th><th>SV019 setting</th></tr>
<tr><td>OHE25K-ET, OHA25K-ET</td><td>100,000 (p/rev)</td><td>100</td></tr>
<tr><td>OSE104-ET,OSA104-ET</td><td>100,000 (p/rev)</td><td>100</td></tr>
<tr><td>OSE105-ET,OSA105-ET</td><td>1,000,000 (p/rev)</td><td>1000</td></tr>
<tr><td>RCN723 (Heidenhain)</td><td>8,000,000 (p/rev)</td><td>8000</td></tr>
<tr><td>Relative position detection scale</td><td>Refer to specification manual for each detector</td><td>PIT/Resolution (μm)</td></tr>
<tr><td>AT41 (Mitsutoyo)</td><td>1 (μm/p)</td><td>The same as SV018 (PIT)</td></tr>
<tr><td>FME type, FLE type (Futaba)</td><td>Refer to specification manual for each detector</td><td>PIT/Resolution (μm)</td></tr>
<tr><td>MP type (Mitsubishi Heavy Industries)</td><td>Refer to specification manual for each detector</td><td>PIT/Resolution (μm)</td></tr>
<tr><td>AT342 (Mitsutoyo)</td><td>0.5 (μm/p)</td><td>Twice as big as SV018 (PIT)</td></tr>
<tr><td>AT343 (Mitsutoyo)</td><td>0.05 (μm/p)</td><td>20 times as big as SV018 (PIT)</td></tr>
<tr><td>LC191M (Heidenhain)</td><td>Refer to specification manual for each detector.</td><td>PIT/Resolution (μm)</td></tr>
<tr><td>LC491M (Heidenhain)</td><td>Refer to specification manual for each detector.</td><td>PIT/Resolution (μm)</td></tr>
</table></td><td>1 to 9999 (kp/pit)</td></tr>
<tr><td>SV020</td><td>RNG2</td><td>Speed detector resolution</td><td>Set the number of pulses per one revolution of the motor side detector.
<table>
<tr><th>Detector model name</th><th>SV020 setting</th></tr>
<tr><td>OSE104, OSA104</td><td>100</td></tr>
<tr><td>OSE105, OSA105</td><td>1000</td></tr>
</table></td><td>1 to 9999 (kp/rev)</td></tr>
<tr><td>SV049</td><td>PGN1sp</td><td>Position loop gain 1 in spindle synchronous control</td><td>Set the position loop gain during the synchronous tapping control.
Set the same value as the value of the spindle parameter, position loop gain in synchronous control.
When performing the SHG control, set this with SV050 (PGN2sp) and SV058 (SHGCsp).</td><td>1 to 200 (rad/s)</td></tr>
</table>

2-4-2 Restrictions on absolute position control

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

(1) For linear axis

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

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

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

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

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

(b) For full-closed loop control

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

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

(2) For rotary axis

The following conditions must be satisfied.

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

3. Characteristics

3-1 Servomotor

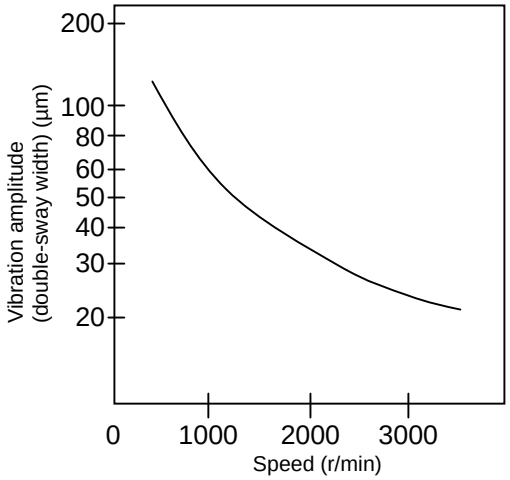
3-1-1 Environmental conditions

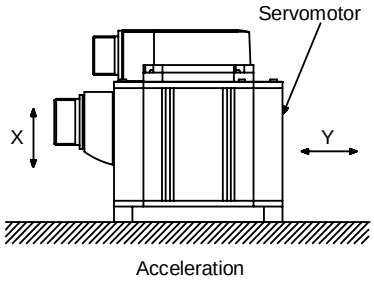
Environment	Conditions
Ambient temperature	0°C to +40°C (with no freezing)
Ambient humidity	80%RH or less (with no dew condensation)
Storage temperature	–15°C to +70°C (with no freezing)
Storage humidity	90%RH or less (with no dew condensation)
Atmosphere	Indoors (Where unit is not subject to direct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

3-1-2 Quakeproof level

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

The vibration conditions are as shown below.



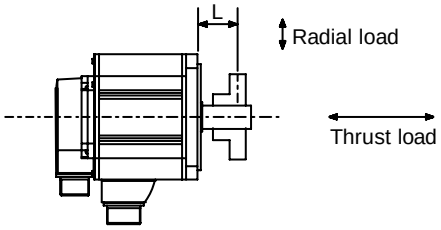


3-1-3 Shaft characteristics

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

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

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



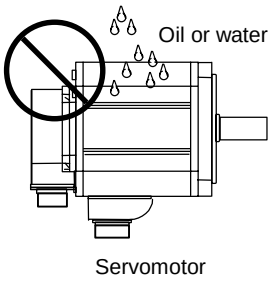
L : Length from flange installation surface to center of load weight [mm]

⚠ CAUTION

1. Use a flexible coupling when connecting with a ball screw, etc., and keep the shaft core deviation to below the tolerable radial load of the shaft.
2. When directly installing the gear on the motor shaft, the radial load increases as the diameter of the gear decreases. This should be carefully considered when designing the machine.
3. When directly installing the pulley on the motor shaft, carefully consider so that the radial load (double the tension) generated from the timing belt tension is less than the values shown in the table above.
4. In machines where thrust loads such as a worm gear are applied, carefully consider providing separate bearings, etc., on the machine side so that loads exceeding the tolerable thrust loads are not applied to the motor.
5. Do not use a rigid coupling as an excessive bending load will be applied on the shaft and could cause the shaft to break.

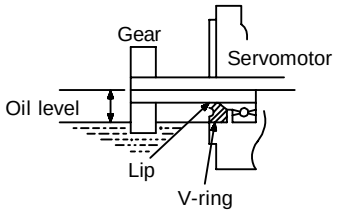
3-1-4 Oil/water standards

(1) The motor protective format (refer to "2-1-1 Specifications list.") uses the IP type, which complies with IE Standard. However, these Standards are short-term performance specifications. They do not guarantee continuous environmental protection characteristics. Measures such as covers, etc., must be taken if there is any possibility that oil or water will fall on the motor, and the motor will be constantly wet and permeated by water. Note that the motor's IP-type is not indicated as corrosion-resistant.

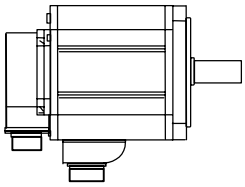


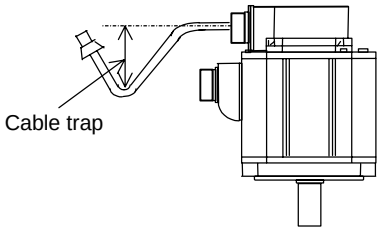
(2) When a gear box is installed on the servomotor, make sure that the oil level height from the center of the shaft is higher than the values given below. Open a breathing hole on the gear box so that the inner pressure does not rise.

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



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





⚠ CAUTION

1. The servomotors, including those having IP65 specifications, do not have a completely waterproof (oil-proof) structure. Do not allow oil or water to constantly contact the motor, enter the motor, or accumulate on the motor. Oil can also enter the motor through cutting chip accumulation, so be careful of this also.
2. When the motor is installed facing upwards, take measures on the machine side so that gear oil, etc., does not flow onto the motor shaft.
3. Do not remove the detector from the motor. (The detector installation screw is treated for sealing.)

3-1-5 Magnetic 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 magnetic brakes are used for holding, and must not be used for normal braking. There may be cases when holding is not possible due to the life or machine structure (when ball screw and servomotor are coupled with a timing belt, etc.). Provide a stop device on the machine side to ensure safety.
3. When operating the brakes, always turn the servo OFF (or ready OFF). When releasing the brakes, always confirm that the servo is ON first. Sequence control considering this condition is possible by using the motor brake control output (CN20) on the servo drive unit.
4. When the vertical axis drop prevention function is used, the drop of the vertical axis during an emergency stop can be suppressed to the minimum.

(1) Motor with magnetic brake

(a) Types

The motor with a magnetic brake is set for each motor. The "B" following the standard motor model stands for the motor with a brake.

(b) Applications

When this type of motor is used for the vertical feed axis in a machining center, etc., slipping and dropping of the spindle head can be prevented even when the hydraulic balancer's hydraulic pressure reaches zero when the power turns OFF. When used with a robot, deviation of the posture when the power is turned OFF can be prevented.

When used for the feed axis of a grinding machine, a double safety measures is formed with the deceleration stop (dynamic brake stop) during emergency stop, and the risks of colliding with the grinding stone and scattering can be prevented.

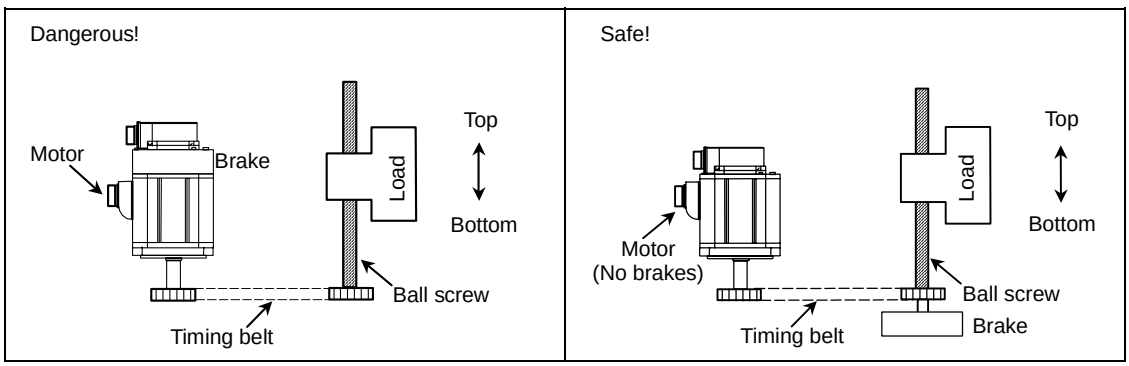
This motor cannot be used for the purposes other than holding and braking during a power failure (emergency stop). (This cannot be used for normal deceleration, etc.)

(c) Features

1) The magnetic brakes use a DC excitation method, thus:
   - The brake mechanism is simple and the reliability is high.
   - There is no need to change the brake tap between 50Hz and 60Hz.
   - There is no rush current when the excitation occurs, and shock does not occur.
   - The brake section is not larger than the motor section.
2) The magnetic brake is built into the motor, and the installation dimensions are the same as the motor without brake.

(d) Considerations to safety

1) When using a timing belt, connecting the motor with magnetic brakes and the load (ball screw, etc.) with a timing belt as shown on the left below could pose a hazard if the belt snaps. Even if the belt's safety coefficient is increased, the belt could snap if the tension is too high or if cutting chips get imbedded. Safety can be maintained by applying the configuration shown on the right below.



(2) Magnetic brake characteristics

Item \ Motor model			HC52B HC53B HC102B HC103B HC152B HC153B	HC202B HC203B HC352B HC353B HC452B HC453B HC702B HC703B HC902B	HC103RB HC153RB HC203RB	HC353RB HC503RB
Type (Note 1)			Spring braking type safety brakes			
Rated voltage			24VDC			
Rated current at 20°C		(A)	0.80	1.43	0.8	0.96
Excitation coil resistance at 20°C		(Ω)	29	16.8	30	25
Capacity		(W)	19	34	19	23
Attraction current		(A)	0.2	0.4	0.25	0.24
Dropping current		(A)	0.08	0.2	0.085	0.10
Static friction torque		(N·m)	8.3	43.1	6.8	16.7
Inertia (Note 2)		($kg \cdot cm^2$)	2.0	10	0.35	3.5
Release delay time (Note 3)		(s)	0.04	0.1	0.03	0.04
Braking delay time (Note 3)	AC OFF	(s)	0.12	0.12	0.12	0.12
	DC OFF	(s)	0.03	0.03	0.03	0.03
Tolerable braking work amount	Per braking	(J)	400	4,500	400	400
	Per hour	(J)	4,000	45,000	4,000	4,000
Brake play at motor axis		(degree)	0.2 to 0.6	0.2 to 0.6	0.2 to 0.6	0.2 to 0.6
Brake life (Note 4)	No. of braking operations	(times)	20,000	20,000	20,000	20,000
	Work amount per braking	(J)	200	1,000	200	200

Item \ Motor model			HA053B HA13B	HA23NB HA33NB	HA-LF11K2B-S8	HA-LF15K2B-S8
Type (Note 1)			Spring braking type safety brakes			
Rated voltage			24VDC			
Rated current at 20°C		(A)	0.5	0.7	1.3	1.9
Excitation coil resistance at 20°C		(Ω)	111	49	19	12.4
Capacity		(W)	12	17	30	46
Attraction current		(A)	0.15	0.2	0.50	0.65
Dropping current		(A)	0.06	0.06	0.20	0.25
Static friction torque		(N·m)	0.39	1.96	82	160.5
Inertia (Note 2)		($kg \cdot cm^2$)	0.02	0.20	11.1	54
Release delay time (Note 3)		(s)	0.03	0.05	0.25	0.30
Braking delay time (Note 3)	AC OFF	(s)	0.20	0.10	0.15	0.20
	DC OFF	(s)	0.03	0.02	0.04	0.04
Tolerable braking work amount	Per braking	(J)	49.0	5.6	3,000	5,000
	Per hour	(J)	490.3	55.9	30,000	50,000
Brake play at motor axis		(degree)	0.25 to 2.5	0.2 to 1.5	0.05 to 0.26	0.03 to 0.18
Brake life (Note 4)	No. of braking operations	(times)	30,000	30,000	20,000	20,000
	Work amount per braking	(J)	49.0	5.6	1,000	3,000

Notes:

1. There is no manual release mechanism. If handling is required such as during the machine core alignment work, prepare a separate 24VDC power supply, and electrically release a brake.
2. These are the values added to the servomotor without a brake.
3. This is the representative value for the initial attraction gap at 20°C.
4. The brake gap will widen through brake lining wear caused by braking. However, the gap cannot be adjusted. Thus, the brake life is considered to be reached when adjustments are required.
5. A leakage flux will be generated at the shaft end of the servomotor with a magnetic brake.
6. When operating in low speed regions, the sound of loose brake lining may be heard. However, this is not a problem in terms of function.

(3) Magnetic brake power supply

⚠ CAUTION

1. Always install a surge absorber on the brake terminal when using DC OFF.
2. Do not pull out the cannon plug while the brake power is ON. The cannon plug pins could be damaged by sparks.

(a) Brake excitation power supply

1) Prepare a brake excitation power supply that can accurately ensure the attraction current in consideration of the voltage fluctuation and excitation coil temperature.
2) The brake terminal polarity is random. Make sure not to mistake the terminals with other circuits.

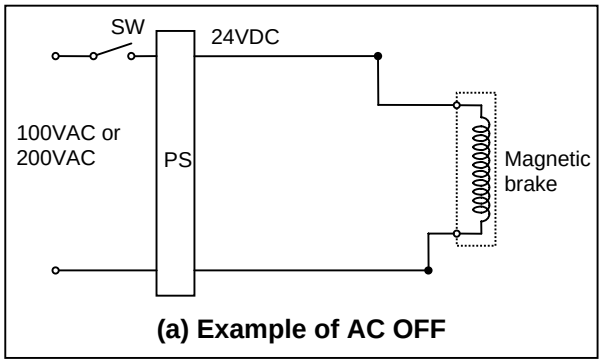
(b) Brake excitation circuit

1) AC OFF and 2) DC OFF can be used to turn OFF the brake excitation power supply (to apply the brake).

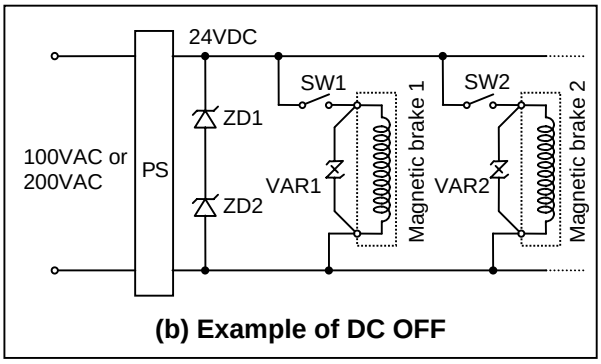
1) AC OFF
The braking delay time will be longer, but the excitation circuit will be simple, and the relay cut off capacity can be decreased.

2) DC OFF
The braking delay time can be shortened, but a surge absorber will be required and the relay cut off capacity will be increased.

<Cautions>
- Provide sufficient DC cut off capacity at the contact.
- Always use a surge absorber.
- When using the cannon plug type, the surge absorber will be further away, so use shielded wires between the motor and surge absorber.



(a) Example of AC OFF



(b) Example of DC OFF

PS : 24VDC stabilized power supply
ZD1, ZD2 : Zener diode for power supply protection (1W,24V)
ex. made by Renesas HZ24
VAR1, VAR2 : Surge absorber (220V)

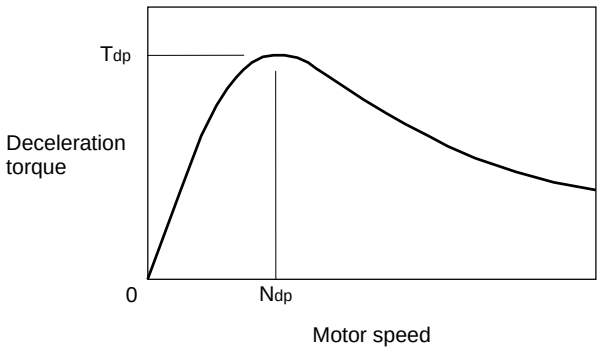
Magnetic brake circuits

3-1-6 Dynamic brake characteristics

If a servo alarm that cannot control the motor occurs, the dynamic brakes will function to stop the servomotor regardless of the parameter settings.

(1) Deceleration torque

The dynamic brake uses the motor as a generator, and obtains the deceleration torque by consuming that energy with the dynamic brake resistance. The characteristics of this deceleration torque have a maximum deceleration torque (Tdp) regarding the motor speed as shown in the following drawing. The torque for each motor is shown in the following table.



Deceleration torque characteristics of a dynamic brake

Max. deceleration torque of a dynamic brake

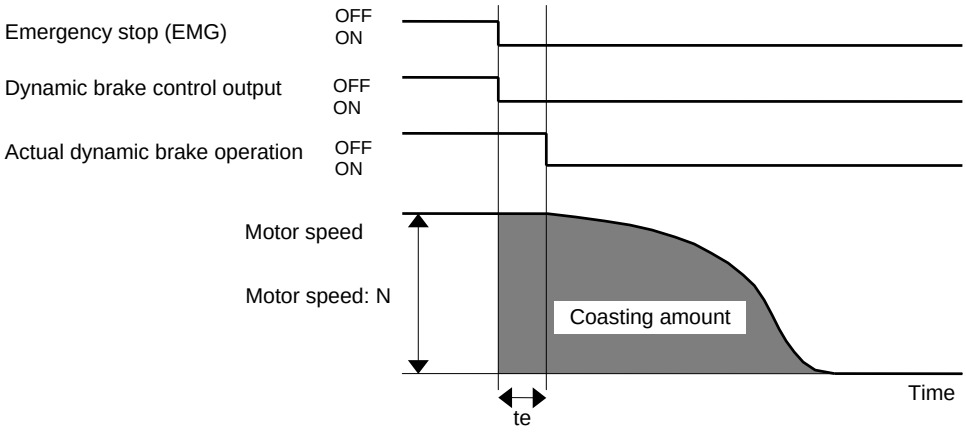
Motor type	Stall torque (N·m)	T_{dp} (N·m)	N_{dp} (r/min)
HC52	2.94	4.79	669
HC102	5.88	11.19	884
HC152	8.82	18.49	1062
HC202	13.72	10.56	457
HC352	22.50	23.79	716
HC452	37.20	47.88	1459
HC702	49.00	62.05	1641
HC902	58.80	85.36	2109
HC53	2.94	5.08	899
HC103	5.88	10.72	1045
HC153	8.82	18.88	1676
HC203	13.72	9.85	728
HC353	22.50	21.67	1215
HC453	37.20	40.63	2109
HC703	49.00	57.91	2531
HC103R	3.18	3.67	582
HC153R	4.78	5.44	668
HC203R	6.37	7.16	973
HC353R	11.10	10.18	1215
HC503R	15.90	15.97	1432
HA053N	0.25	0.21	2686
HA13N	0.49	0.49	2056
HA23N	0.98	1.14	1205
HA33N	1.96	2.30	823
HA-LF11K2-S8	70.60	72.22	1225
HA-LF15K2-S8	91.70	110.19	1494

(2) Coasting rotation distance during emergency stop

The distance that the motor coasts (angle for rotary axis) when stopping with the dynamic brakes can be approximated with the following expression.

$$L_{MAX} = \frac{F}{60} \cdot \{te + (1 + \frac{J_L}{J_M}) \cdot (A \cdot N^2 + B)\}$$

L_{MAX}	:	Motor coasting distance (angle)	[mm, (deg)]
F	:	Axis feedrate	[mm/min, (deg/min)]
N	:	Motor speed	[r/m]
J_M	:	Motor inertia	[kg·cm^2]
J_L	:	Motor shaft conversion load inertia	[kg·cm^2]
te	:	Brake drive relay delay time	(s) (Normally, 0.03s)
A	:	Coefficient A (Refer to the table below)	
B	:	Coefficient B (Refer to the table below)	



Dynamic brake braking diagram

Coasting amount calculation coefficients table

Motor type	J_M (kg·cm^2)	A	B
HC52	6.6	3.59×10^{-9}	4.83×10^{-3}
HC102	13.6	2.40×10^{-9}	5.63×10^{-3}
HC152	20.0	1.78×10^{-9}	6.02×10^{-3}
HC202	42.5	15.36×10^{-9}	9.64×10^{-3}
HC352	82.0	8.40×10^{-9}	12.93×10^{-3}
HC452	121.0	3.02×10^{-9}	19.30×10^{-3}
HC702	160.0	2.74×10^{-9}	22.16×10^{-3}
HC902	204.0	1.98×10^{-9}	26.39×10^{-3}
HC53	6.6	2.52×10^{-9}	6.11×10^{-3}
HC103	13.6	2.12×10^{-9}	6.95×10^{-3}
HC153	20.0	1.10×10^{-9}	9.29×10^{-3}
HC203	42.5	10.34×10^{-9}	16.45×10^{-3}
HC353	82.0	5.43×10^{-9}	24.08×10^{-3}
HC453	121.0	2.46×10^{-9}	32.88×10^{-3}
HC703	160.0	1.91×10^{-9}	36.61×10^{-3}

Motor type	J_M (kg·cm^2)	A	B
HC103R	1.5	1.23×10^{-9}	1.24×10^{-3}
HC153R	1.9	0.91×10^{-9}	1.22×10^{-3}
HC203R	2.3	0.58×10^{-9}	1.64×10^{-3}
HC353R	8.3	1.17×10^{-9}	5.19×10^{-3}
HC503R	12.0	0.92×10^{-9}	5.64×10^{-3}
HA053N	0.19	0.15×10^{-9}	13.01×10^{-3}
HA13N	0.37	0.16×10^{-9}	8.18×10^{-3}
HA23N	0.98	0.31×10^{-9}	5.43×10^{-3}
HA33N	1.96	0.45×10^{-9}	3.67×10^{-3}
HA-LF11K2-S8	105	2.07×10^{-9}	9.32×10^{-3}
HA-LF15K2-S8	220	2.33×10^{-9}	15.62×10^{-3}

3-2 Spindle motor

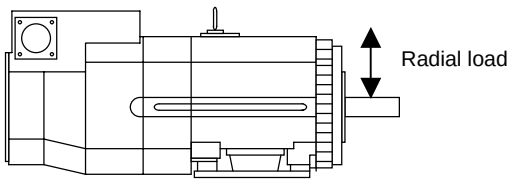
3-2-1 Environmental conditions

Environment	Conditions
Ambient temperature	0°C to +40°C (with no freezing)
Ambient humidity	90%RH or less (with no dew condensation)
Storage temperature	–20°C to +65°C (with no freezing)
Storage humidity	90%RH or less (with no dew condensation)
Atmosphere	Indoors (no direct sunlight); no corrosive gases, inflammable gases, oil mist or dust
Altitude	Operation/storage: 1000m or less above sea level Transportation: 10000m or less above sea level

3-2-2 Shaft characteristics

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

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



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

3-3 Drive unit characteristics

3-3-1 Environmental conditions

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

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

3-3-2 Heating value

Each heating value is calculated with the following values.
The values for the servo drive unit apply at the stall output. The values for the spindle drive unit apply for the continuous rated output. The values for the power supply unit include the AC reactor's heating value.

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

(Note 1) The values for the spindle drive unit are the heating value at the continuous rated output, and the values for the servo drive unit are the heating values at the stall output when operating in the high-gain mode. The heating value when operating the servo drive unit in the standard mode (MDS-B compatible mode) is lower than the MDS-B series heating value. However, with the new design, the standard operation mode will not presumably be used, so the data has been eliminated.

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

(Note 3) The total heating value for the unit is the total sum of the heating values for the above corresponding units which are mounted in the actual machine.

Example) When the CV-185, SP-110, V1-35, V2-2020 units are mounted
Unit total heating value (W) =195+181+132+178=686 (W)

(Note 4) When designing the panel for sealed mounting, take the actual load rate into consideration, and calculate the heating value inside the servo drive unit panel with the following expression:

Heating value inside servo drive unit panel (considering load rate) = Heating value in panel obtained from above table × 0.5

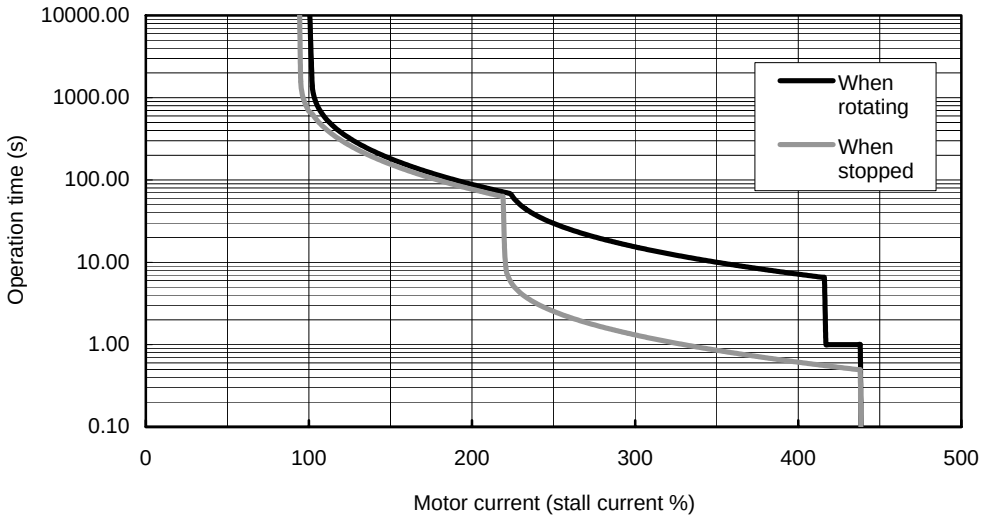
(Note that this excludes the power supply unit and spindle drive unit.)
If the load rate is clearly larger than 0.5, substitute that load rate for (× 0.5) in the above expression.

Example) When the V1-35 servo drive unit is mounted
Heating value in panel (at rated output) = 30(W)
Thus, the heating value in the panel (considering the load rate) is 30 × 0.5 = 15 (W)

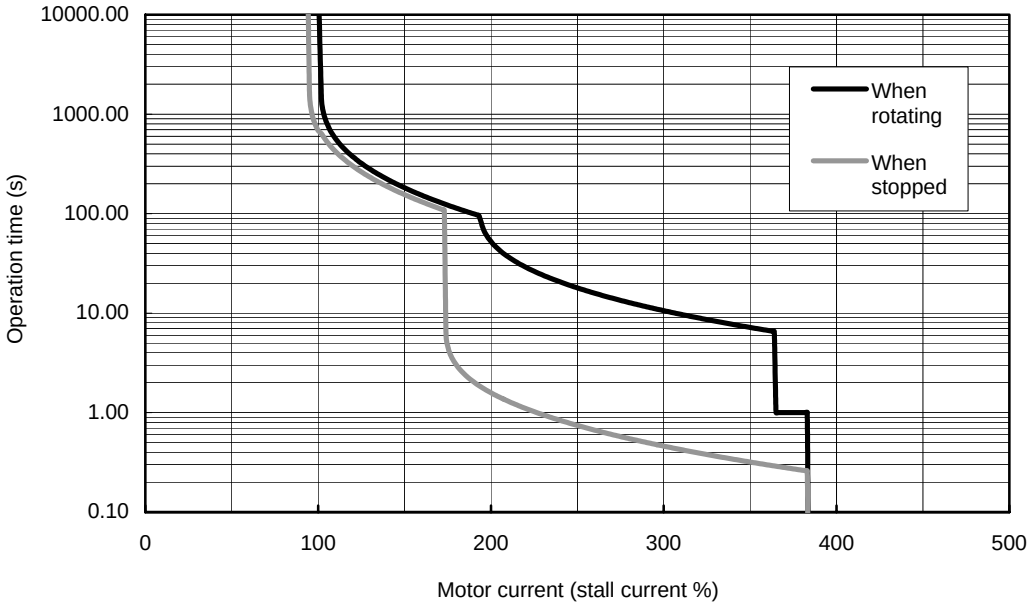
3-3-3 Overload protection characteristics

The servo drive unit has an electronic thermal relay to protect the servomotor and servo drive unit from overloads. The operation characteristics of the electronic thermal relay are shown below when standard parameters (SV021=60, SV022=150) are set.
If overload operation over the electronic thermal relay protection curve shown below is carried out, overload 1 (alarm 50) will occur. If the maximum current is commanded at 95% or higher continuously for one second or more due to a machine collision, etc., overload 2 (alarm 51) will occur.

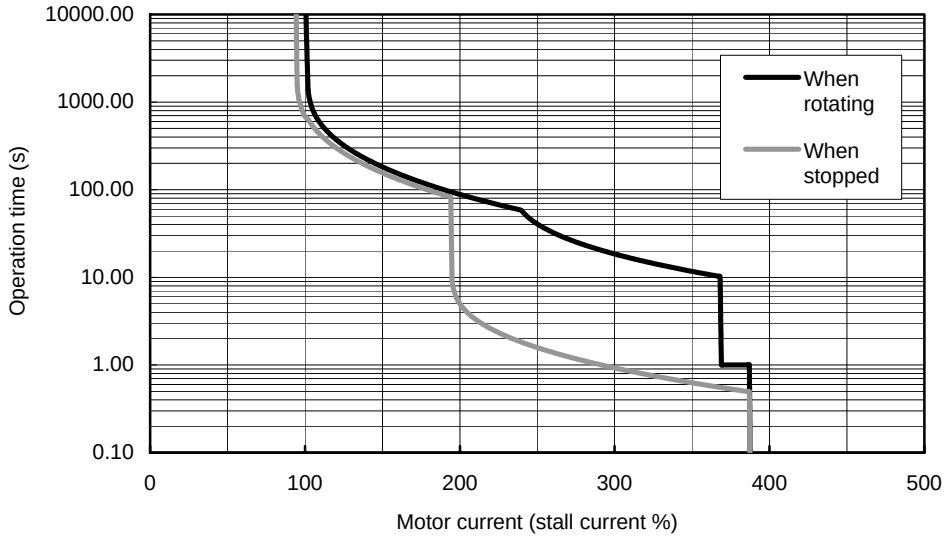
(1) Motor HC52



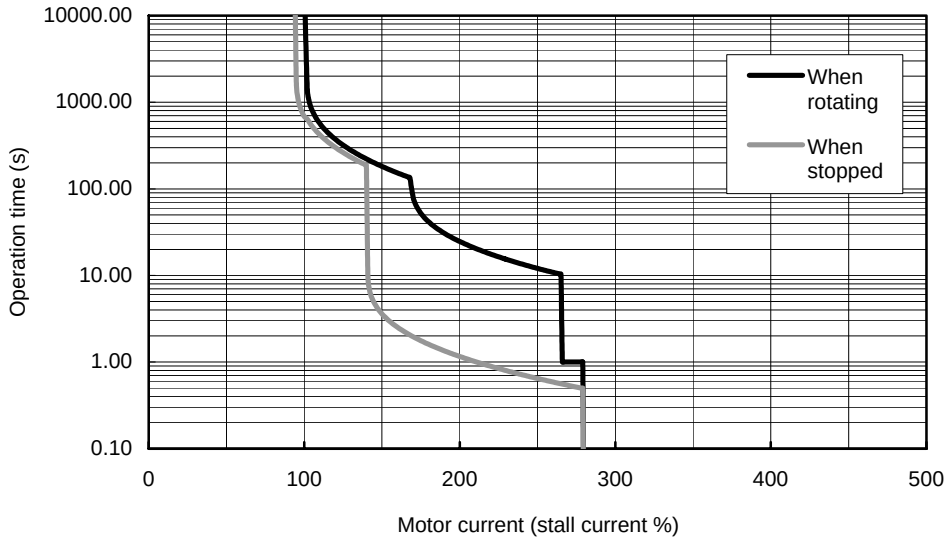
(2) Motor HC102



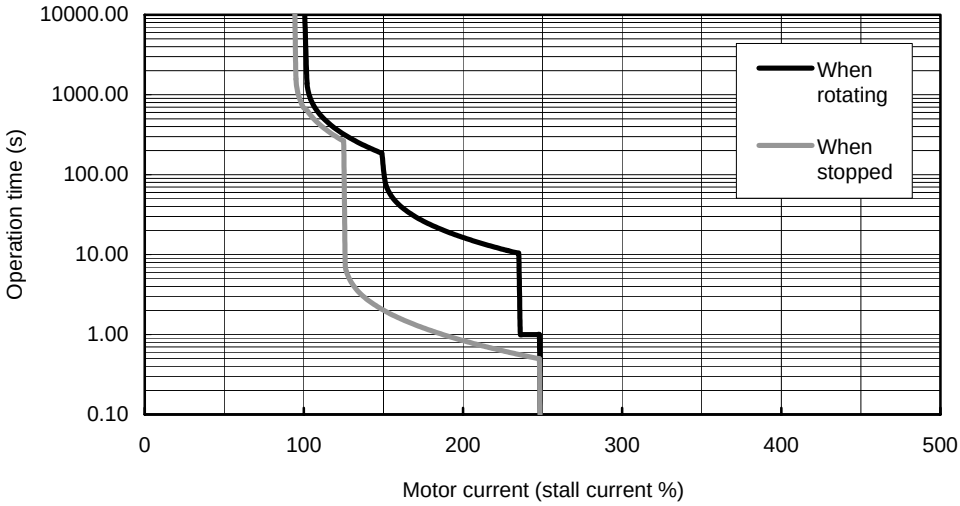
(3) Motor HC152



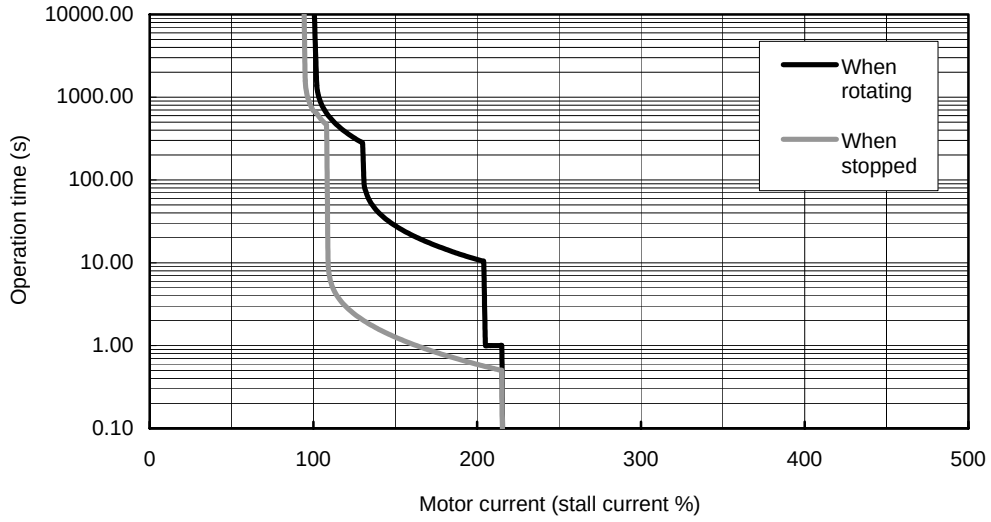
(4) Motor HC202



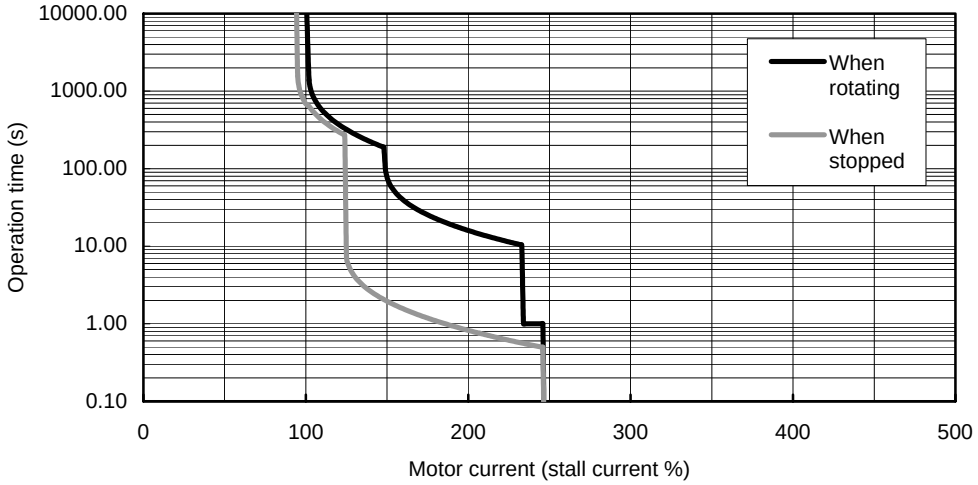
(5) Motor HC352



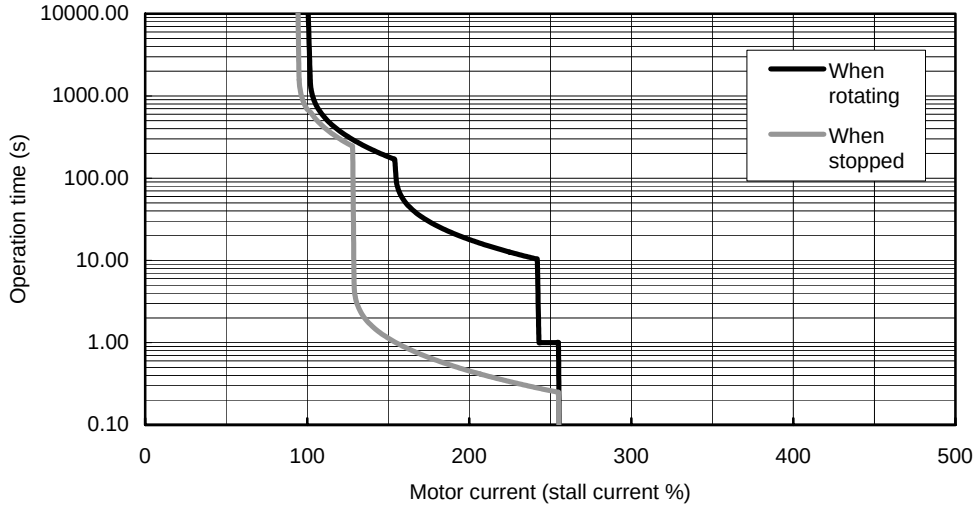
(6) Motor HC452



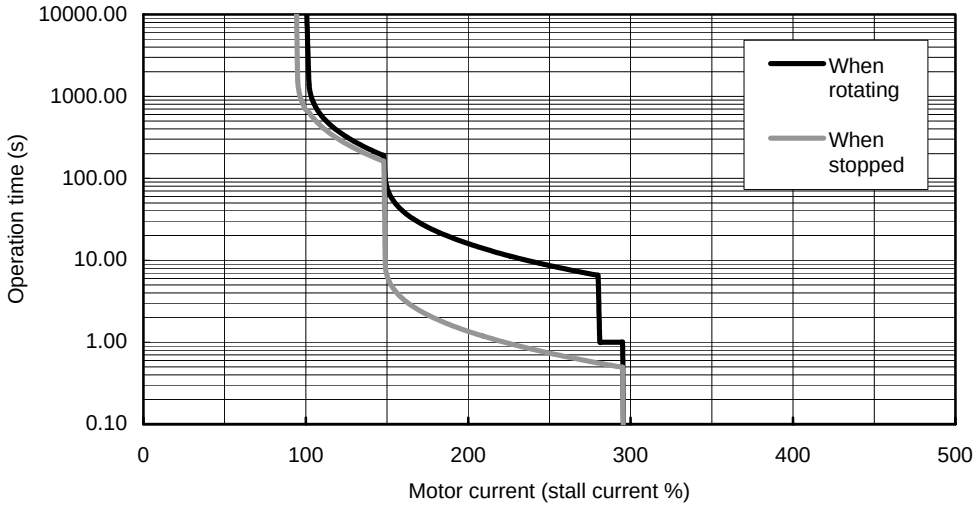
(7) Motor HC702



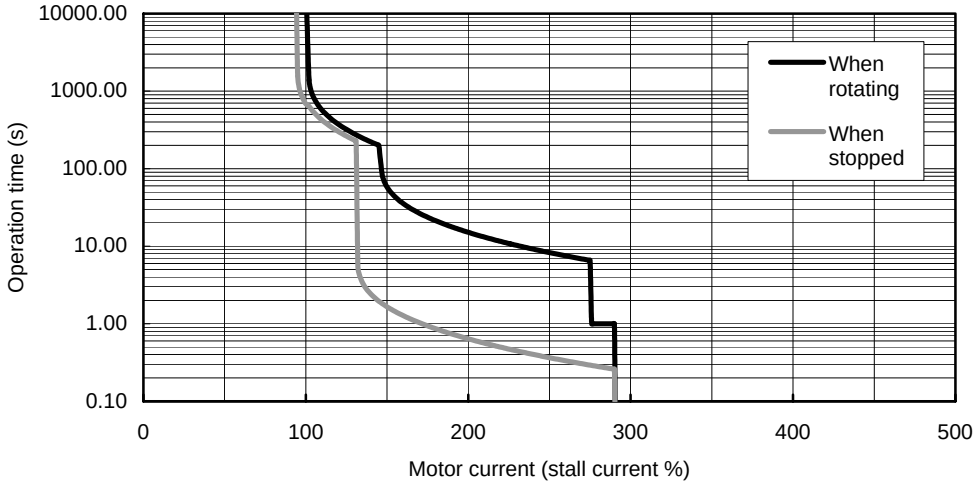
(8) Motor HC902



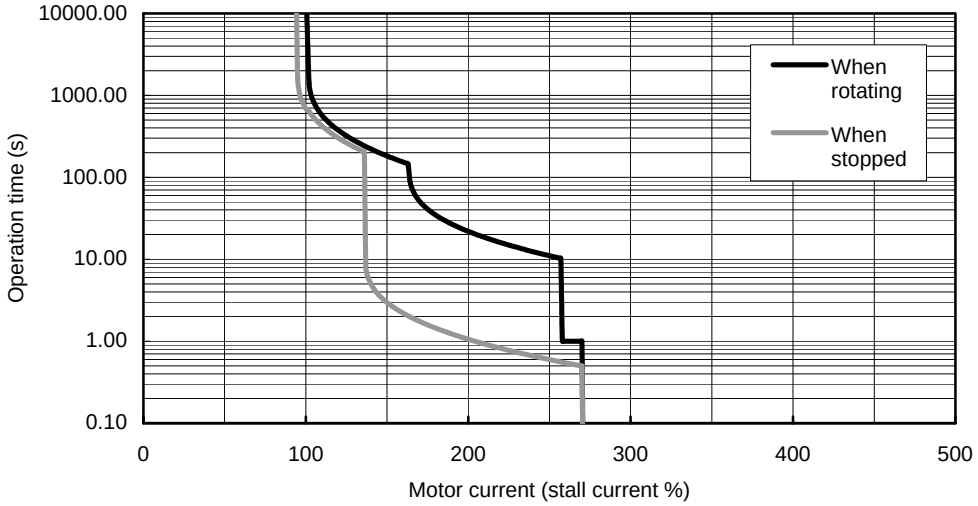
(9) Motor HC53



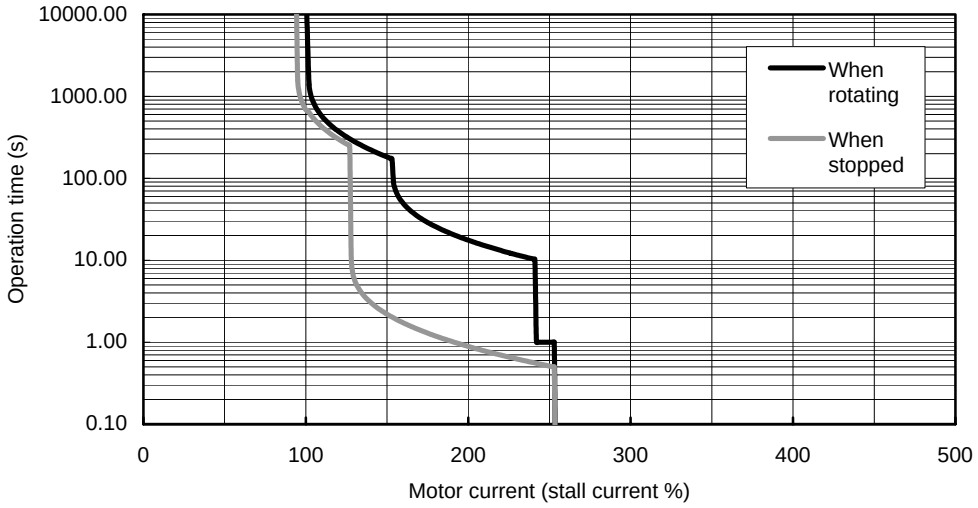
(10) Motor HC103



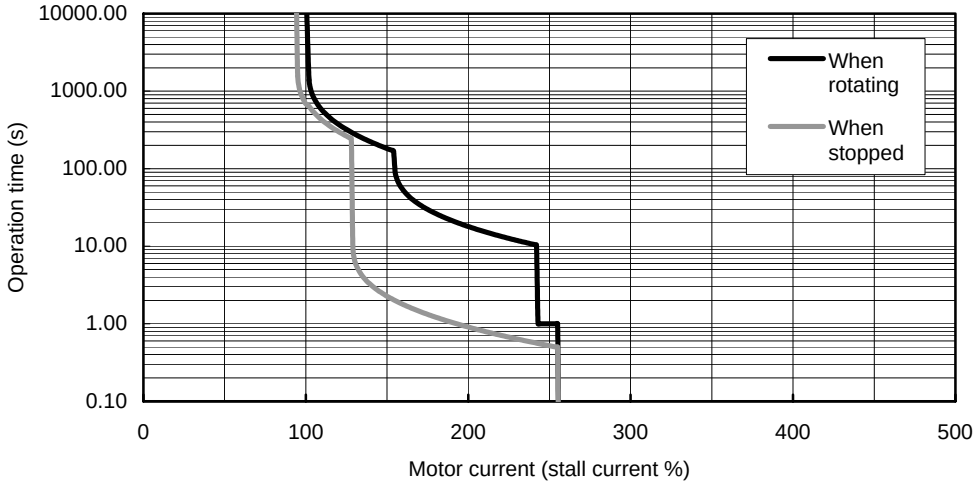
(11) Motor HC153



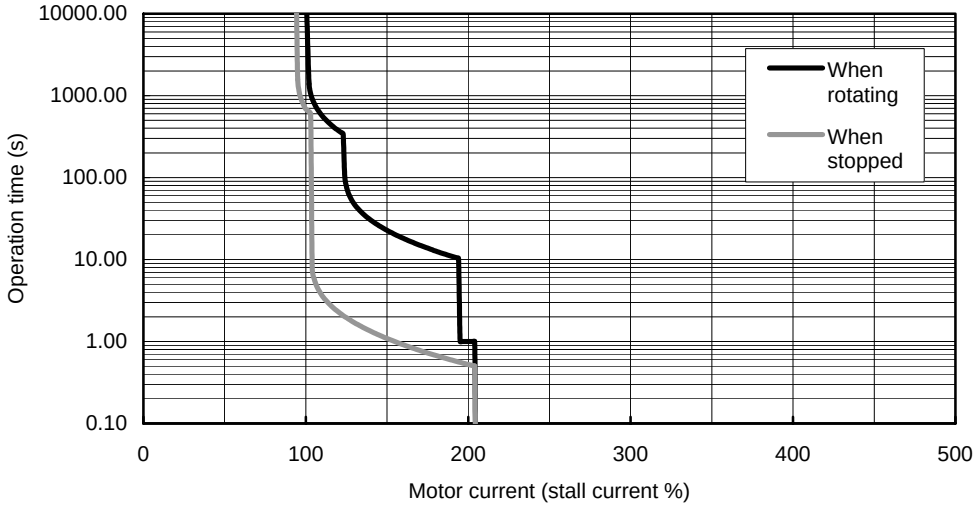
(12) Motor HC203



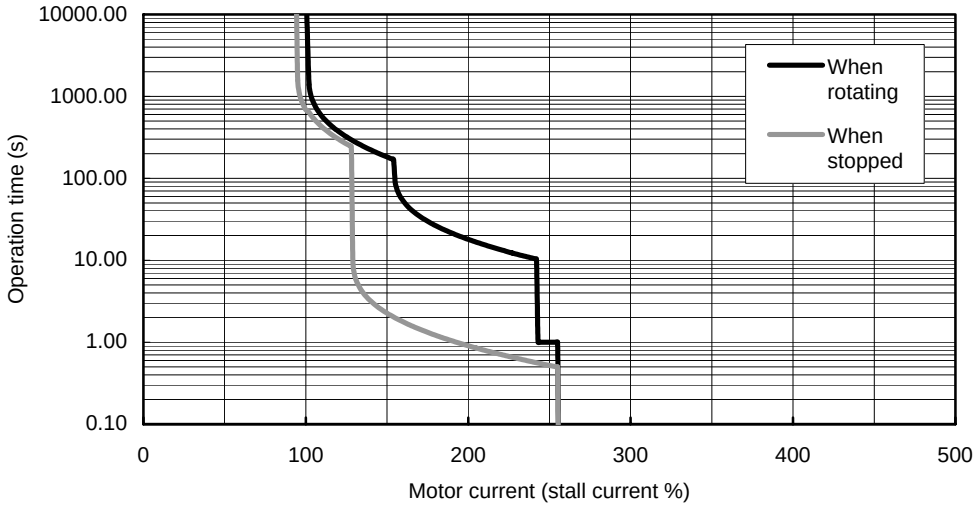
(13) Motor HC353



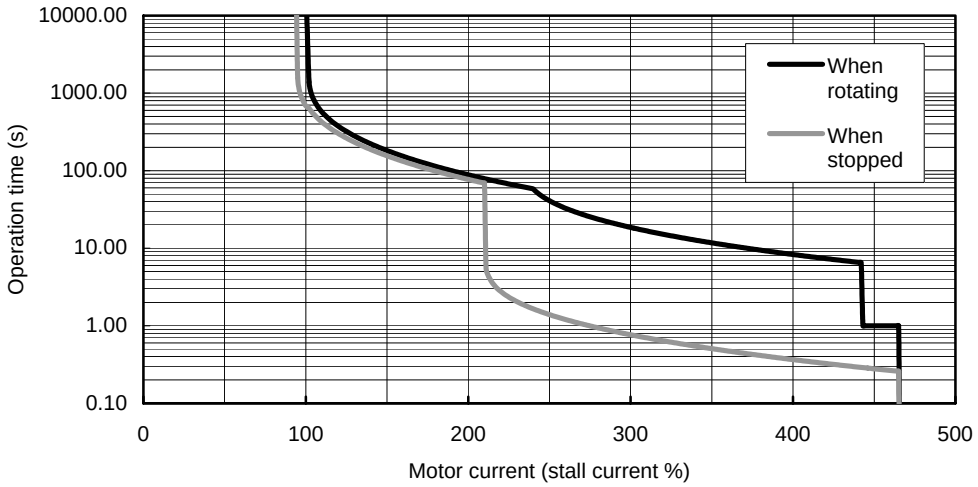
(14) Motor HC453



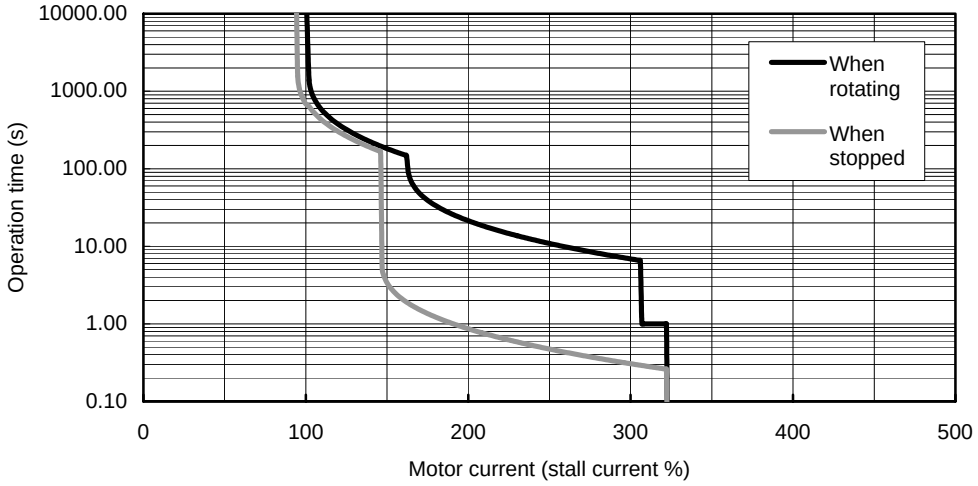
(15) Motor HC703



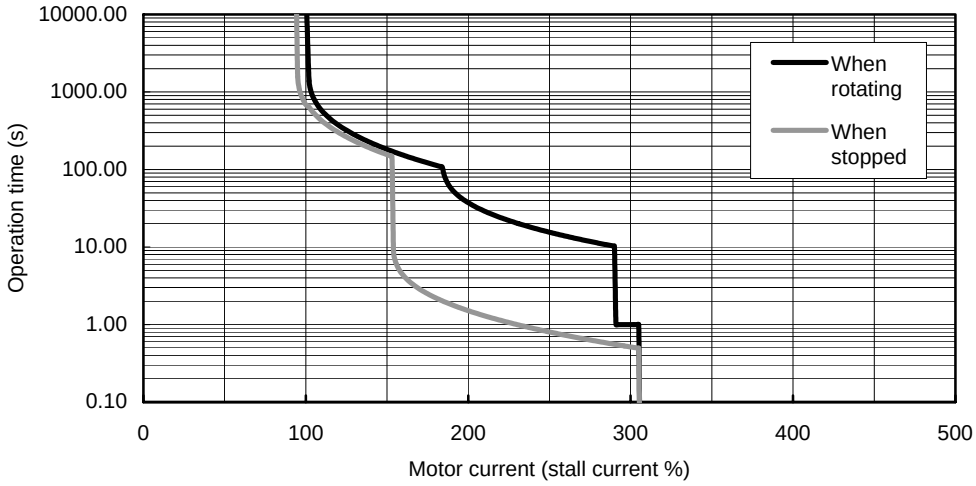
(16) Motor HC103R



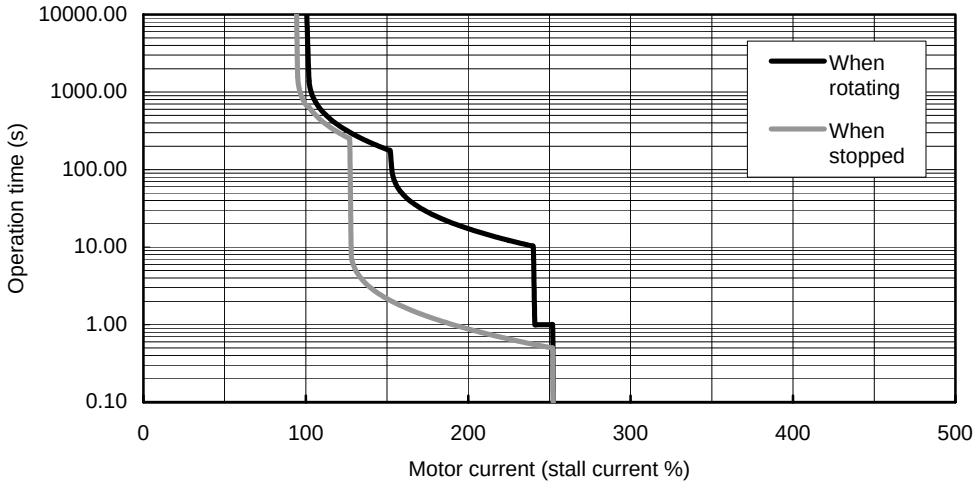
(17) Motor HC153R



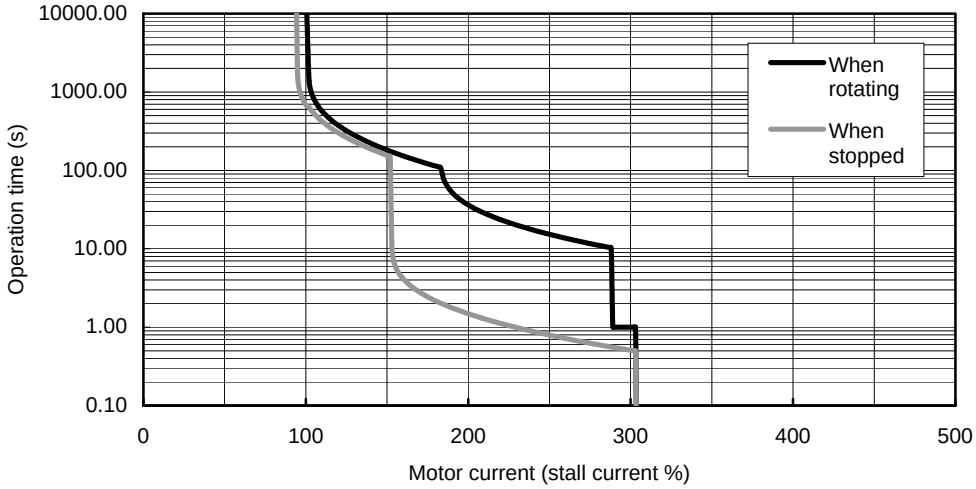
(18) Motor HC203R



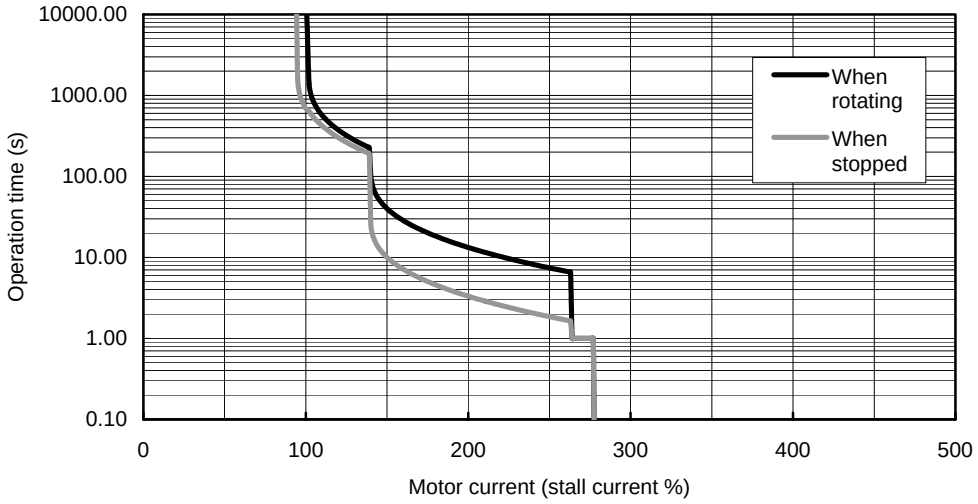
(19) Motor HC353R



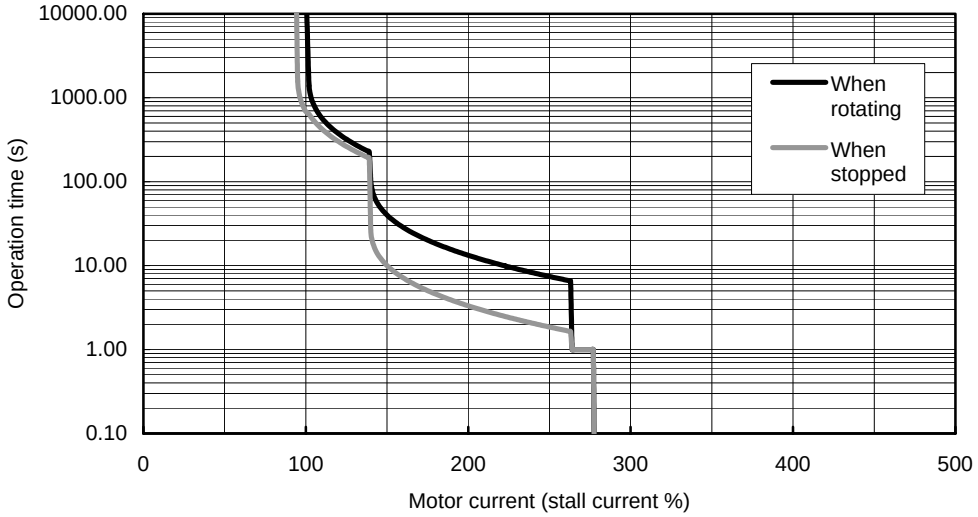
(20) Motor HC503R



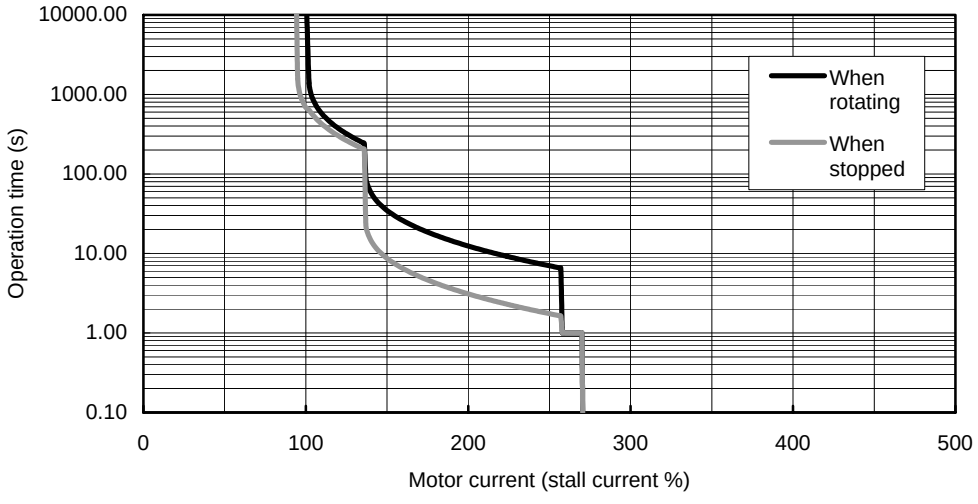
(21) Motor HA053N



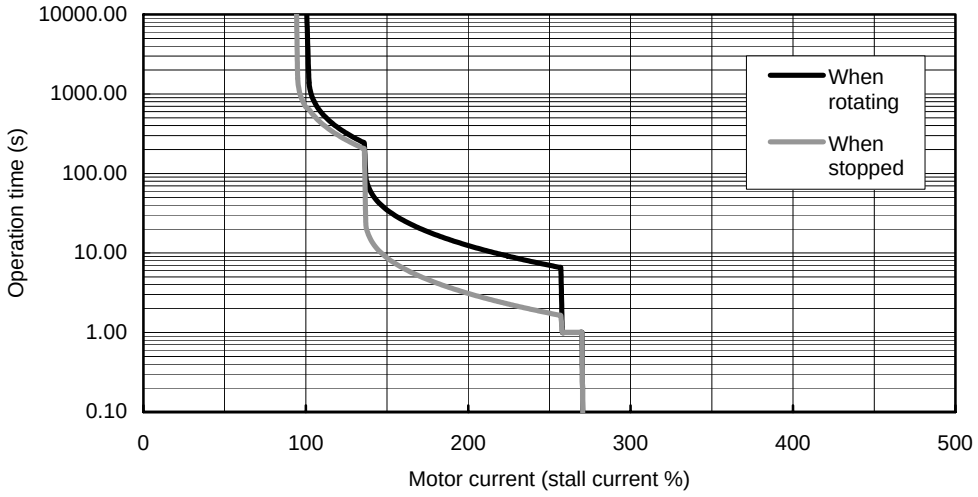
(22) Motor HA13N



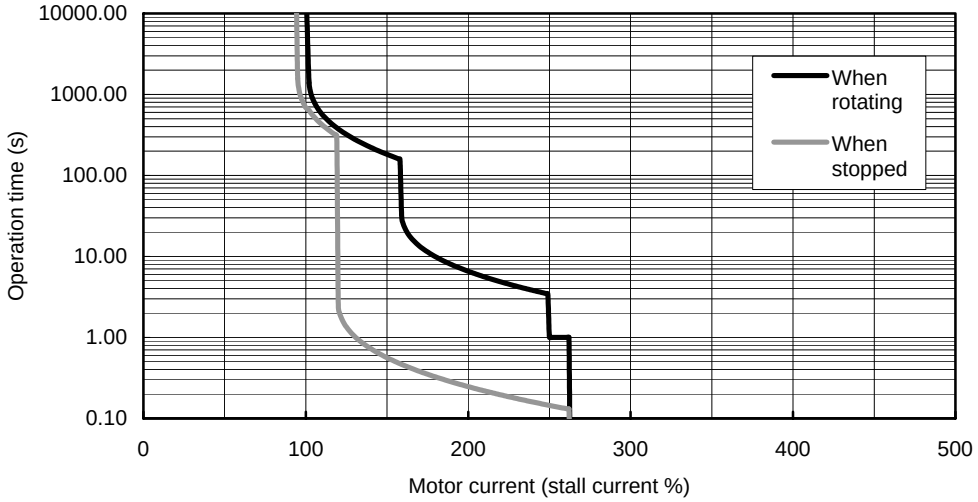
(23) Motor HA23N



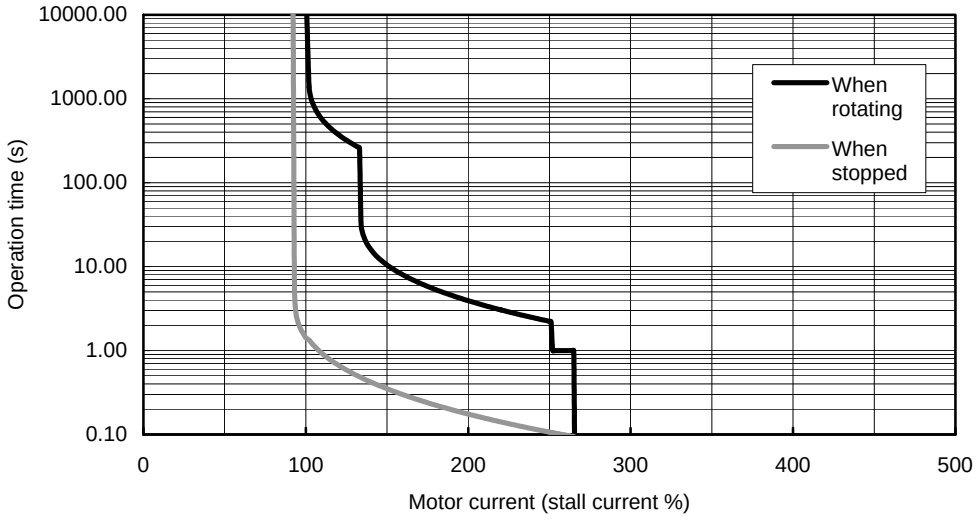
(24) Motor HA33N



(25) Motor HA-LF11K2-S8



(26) Motor HA-LF15K2-S8



4. Dedicated Options

4-1 Servo options

The option units are required depending on the servo system configuration. Check the option units to be required referring the following items.

(1) System configuration in the full closed loop control

Check the servo options required to execute the full closed loop control based on the following table.

System configuration	Motor side detector specifications	Need for detector conversion unit (MDS-B-HR)	Need for battery unit (MDS-A-BT)	Servo system specifications
OSE104-ET, OSE105-ET	Incremental	×	×	Incremental
OSA104-ET, OSA105-ET	Incremental	×	○	Absolute position
Relative position linear scale (Oblong wave signal output)	Incremental	×	×	Incremental
Relative position linear scale (SIN wave signal output)	Incremental	○	×	Incremental
AT41 (Mitsutoyo)	Incremental	×	×	Absolute position
FME, FML type (Futaba corporation)	Incremental	×	×	Absolute position
MP scale (Mitsubishi Heavy Industries)	Absolute position	×	○	Absolute position
AT342, AT343 (Mitsutoyo)	Incremental	×	×	Absolute position
LC191M, LC491M (HEIDENHAIN)	Incremental	×	×	Absolute position
RCN223, RCN723 (HEIDENHAIN)	Incremental	×	×	Absolute position

POINT

The absolute position system cannot be established in combination with the relative position (incremental) machine side detector and absolute position motor side detector.

(2) System configuration in the synchronous control

(a) For position command synchronous control

The synchronous control is all executed in the NC, and the each servo is controlled as an independent axis. Therefore, preparing special options for the synchronous control is not required on the servo side.

(b) For speed/current command synchronous control

The signal divider unit (MDS-B-SD) may be required because two axes share the FB signal of the motor detector or linear scale. Check whether the signal divider unit is required based on the following table.

System configuration	For control with MDS-C1-V2 (small capacity)		For control with MDS-C1-V1 × 2 units (large capacity)	
	Need for signal divider unit (MDS-B-SD)	Need for detector conversion unit (MDS-B-HR)	Need for signal divider unit (MDS-B-SD)	Need for detector conversion unit (MDS-B-HR)
Semi closed control (only for motor side detector)	×	×	○	×
Relative position linear scale (Oblong wave signal output)	×	×	○	×
Relative position linear scale (SIN wave signal output)	×	○	×	○
AT41 (Mitsutoyo)	×	×	○	×
FME, FML type (Futaba corporation)	×	×	○	×
MP scale (Mitsubishi Heavy Industries)	×	×	○	×
AT342, AT343 (Mitsutoyo)	×	×	○	×
LC191M, LC491M (HEIDENHAIN)	×	×	○	×

POINT

When executing the synchronous control, use the servomotors of which the type and detector specifications are same.

4-1-1 Battery and terminator option (mandatory selection)

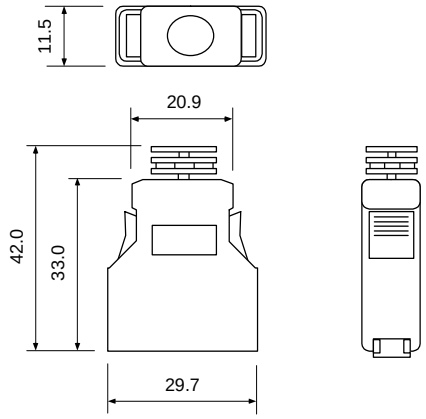
A battery unit or terminator must be connected on each NC communication bus line. Select the unit according to the system specifications.

(1) Terminator (A-TM)

Always connect the terminator to the last unit connected to the NC communication bus line. If there are many axes and two NC communication bus line systems are in use, connect a terminator per each system.

(a) Outline dimension drawing

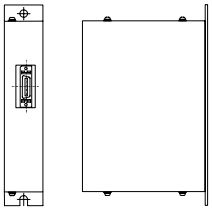
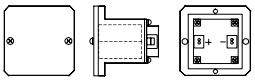
- A-TM



[Unit: mm]

(2) Battery unit

This battery option may be required to establish absolute position system. Select a battery option from the table below depending on the servo system.

Type	MDS-A-BT-□□	FCU6-BTBOX-36
Installation type	Unit and battery integration type	Unit and battery integration type
Hazard class	Class9 (excluding MDS-A-BT-2)	Not applicable
Number of connectable axes	2 to 8 axes	Up to 6 axes
Battery change	Not possible	Possible
Appearance	(3) 	(4) 

(a) Battery unit (MDS-A-BT-☐)

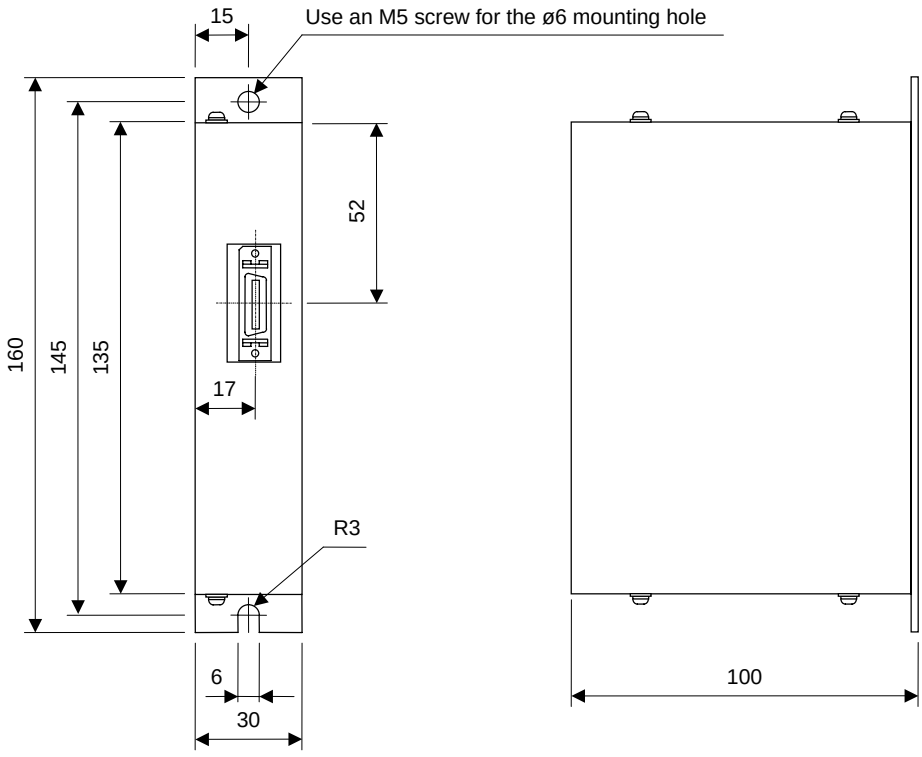
< Specifications >

Battery option type		Battery unit			
		MDS-A-BT-2	MDS-A-BT-4	MDS-A-BT-6	MDS-A-BT-8
Lithium battery series		ER6V			
Nominal voltage		3.6V			
Nominal capacity		4000mAh	8000mAh	12000mAh	16000mAh
Battery safety	Hazard class	Class 9			
	Battery shape	Set battery			
	Number of batteries used	ER6V x 2	ER6V x 4	ER6V x 6	ER6V x 8
	Lithium alloy content	1.3g	2.6g	3.9g	5.2g
	Mercury content	1g or less			
Number of connectable axes		Up to 2 axes	Up to 4 axes	Up to 6 axes	Up to 8 axes
Battery continuous backup time		Approx. 30000 hours			
Battery useful life (From date of unit manufacture)		7 years			
Data save time in battery replacement		HF/HP series: approx. 20 hours at time of delivery, approx. 10 hours after 5 years			
Back up time from battery warning to alarm occurrence (Note)		Approx. 100 hours			
Weight		600g			

(Note) This time is a guideline, so does not guarantee the back up time. Replace the battery with a new battery as soon as a battery warning occurs.

< Outline dimension drawings >

- **MDS-A-BT-2/-4/-6/-8**



[Unit: mm]

(b) Battery unit (FCU6-BTBOX-36)

< Specifications >

Battery option type		Battery unit
		FCU6-BTBOX-36 (Note1)
Lithium battery series		2CR5
Nominal voltage		6.0V (Lithium battery), 3.6V (Output)
Nominal capacity		2600mAh
Battery safety	Hazard class	-
	Battery shape	Single battery
	Number of batteries used	2CR5×2
	Lithium alloy content	1.96g
	Mercury content	1g or less
Number of connectable axes		Up to 6 axes
Battery continuous backup time		Approx. 5000 hours (when 6 axes are connected)
Battery useful life (From date of unit manufacture)		5 years Note2
Data save time in battery replacement		HF/HP series: approx. 20 hours at time of delivery, approx. 10 hours after 5 years
Back up time from battery warning to alarm occurrence (Note3)		Approx. 30 hours (when 6 axes are connected)
Weight		200g

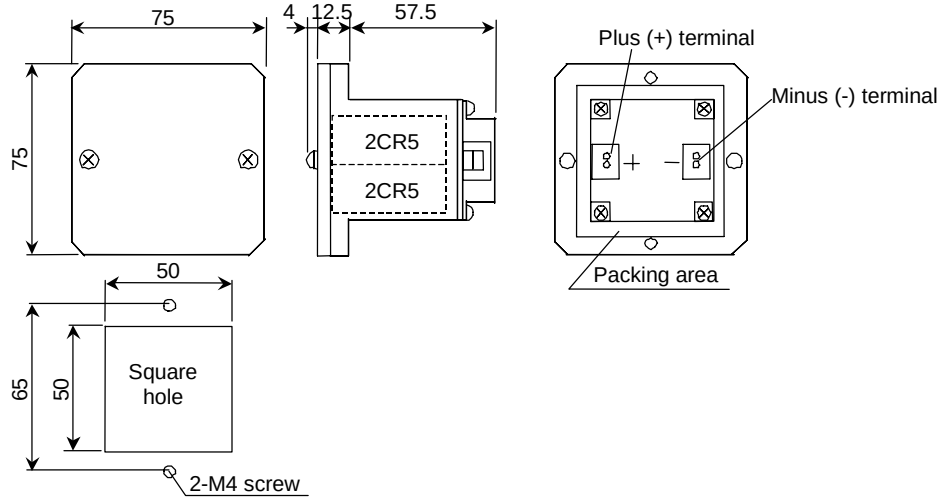
(Note1) A lithium battery in FCU6-BTBOX-36 is commercially available. The battery for replacement has to be prepared by the user.

(Note2) Use new batteries (nominal capacity 1300mAh or more) within five years from the date of manufacture. The batteries should be replaced once a year.

(Note3) This time is a guideline, so does not guarantee the back up time. Replace the battery with a new battery as soon as a battery warning occurs.

< Outline dimension drawings >

• FCU6-BTBOX-36



Panel cut drawing

[Unit: mm]

⚠ CAUTION

1. On January 1, 2003, new United Nations requirements, "United Nations Dangerous Goods Regulations Article 12", became effective regarding the transportation of lithium batteries. The lithium batteries are classified as hazardous materials (Class 9) depending on the unit. (Refer to Appendix 4.)
2. The lithium battery must be transported according to the rules set forth by the International Civil Aviation Organization (ICAO), International Air Transportation Association (IATA), International Maritime Organization (IMO), and United States Department of Transportation (DOT), etc. The packaging methods, correct transportation methods, and special regulations are specified according to the quantity of lithium alloys. The battery unit exported from Mitsubishi is packaged in a container (UN approved part) satisfying the standards set forth in this UN Advisory.
3. To protect the absolute value, do not shut off the servo drive unit control power supply if the battery voltage becomes low (warning 9F).
4. Contact the Service Center when replacing the MDS-A-BT Series and cell battery.
5. Replace the FCU6-BTBOX-36 battery with a new battery (2CR5) within the recommended service period. This battery is commercially available for use in cameras, etc.
6. The battery life (backup time) is greatly affected by the working ambient temperature. The above data is the theoretical value for when the battery is used 8 hours a day/240 days a year at an ambient temperature of 25°C. Generally, if the ambient temperature increases, the backup time and useful life will both decrease.

4-1-2 Dynamic brake unit (MDS-B-DBU) (mandatory selection for large capacity)

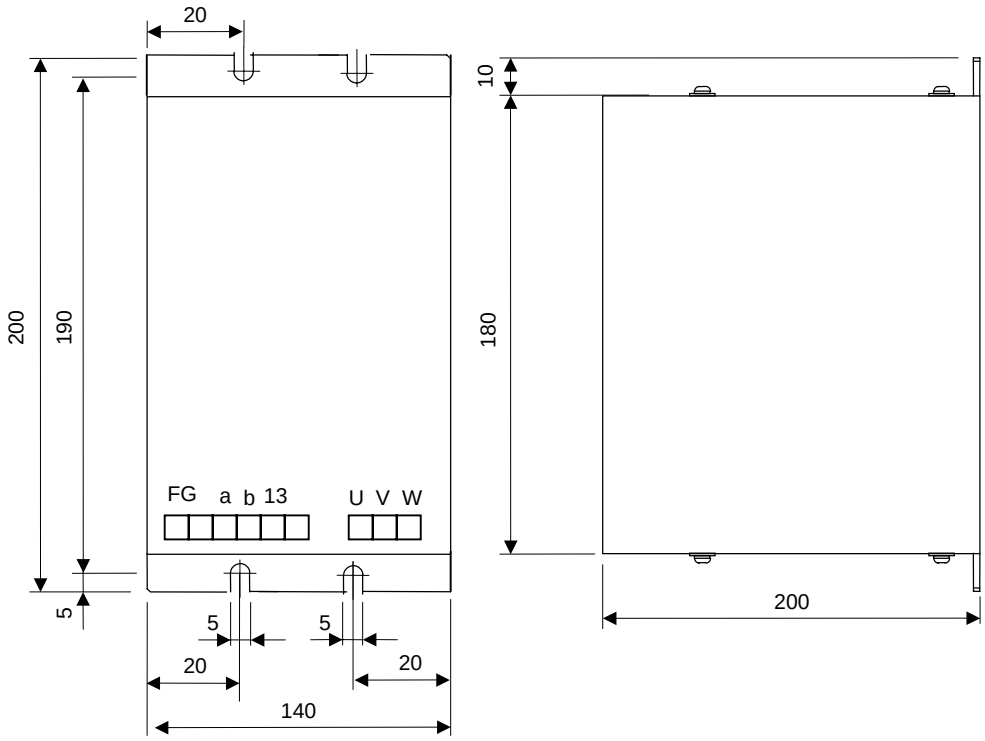
The MDS-C1-V1-110/150 units do not have dynamic brakes built in, so install an external dynamic brake unit.

(1) Specifications

Type	Coil specifications	Compatible drive unit	Weight (kg)
MDS-B-DBU-150	24VDC 160mA	MDS-C1-V1-110/150	2

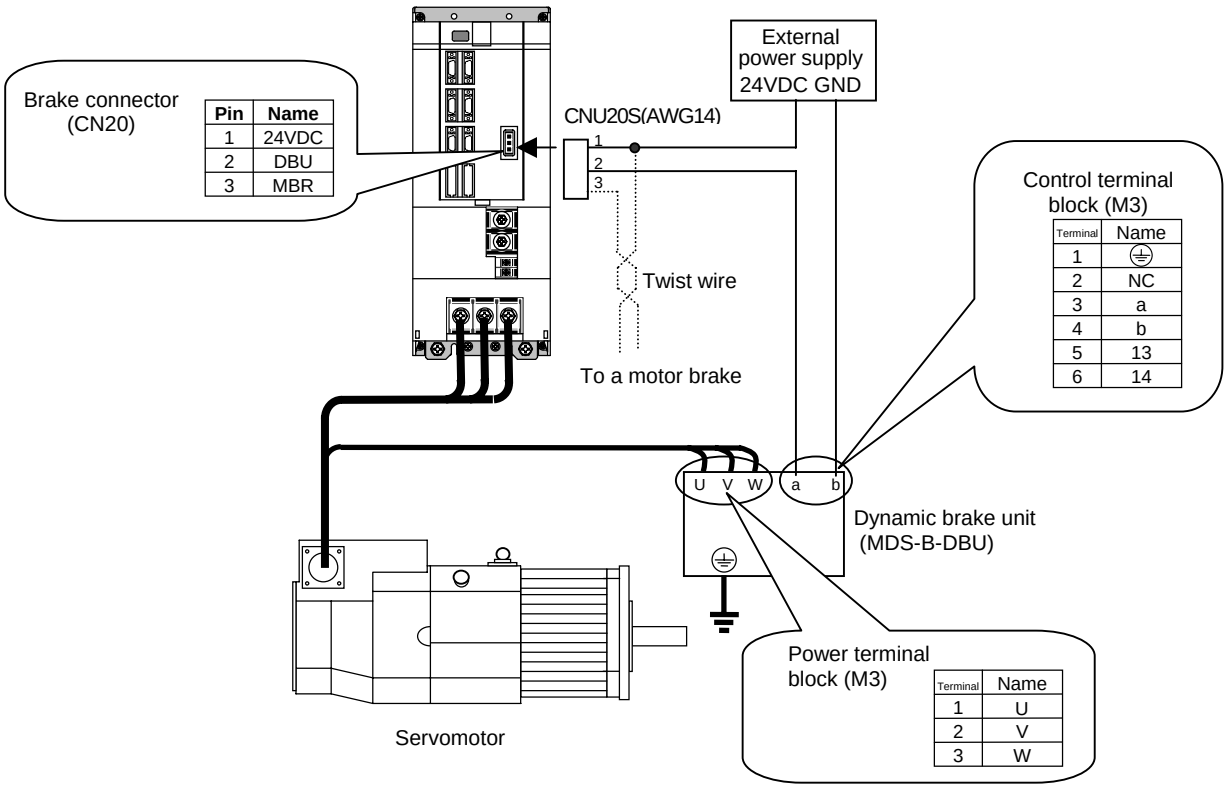
(2) Outline dimension drawings

- **MDS-B-DBU-150**

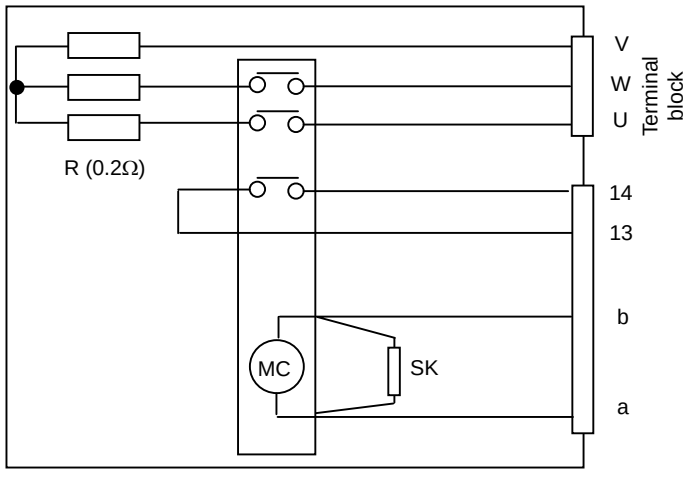


[Unit: mm]

(3) Connecting with the servo drive unit



Internal circuit diagram



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

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

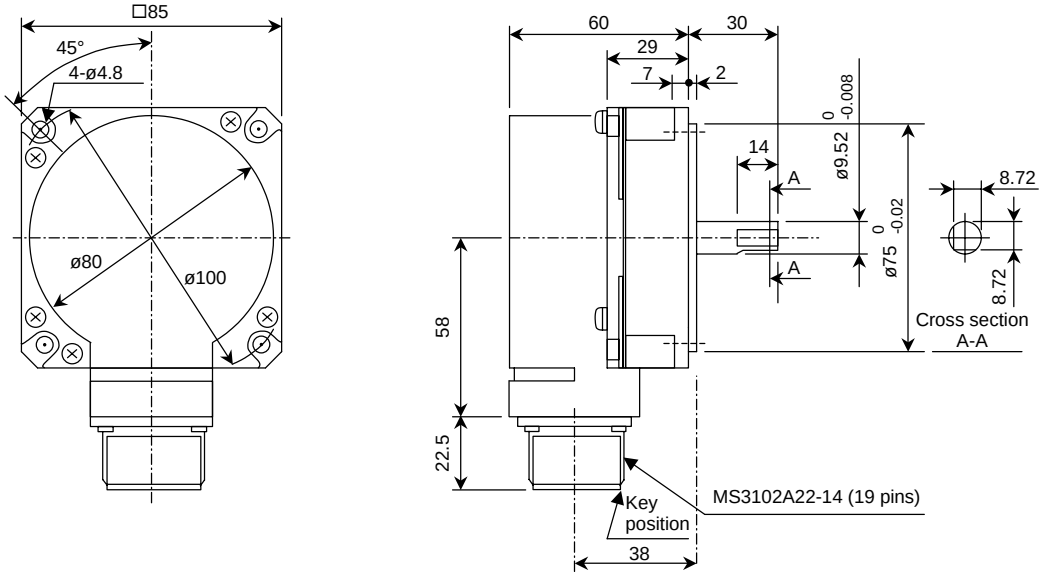
4-1-3 Ball screw side detector

(1) Specifications

Type	Type	Maximum feedrate	Detector output	Detector resolution
Relative position detector	OSE104-ET	3000r/min	Serial data	100,000p/rev
	OSE105-ET	3000r/min	Serial data	1,000,000p/rev
Absolute position detector	OSA104-ET	3000r/min	Serial data	100,000p/rev
	OSA105-ET	3000r/min	Serial data	1,000,000p/rev

(2) Outline dimension drawings

- **OSA□-ET/OSE□-ET Series**



[Unit: mm]

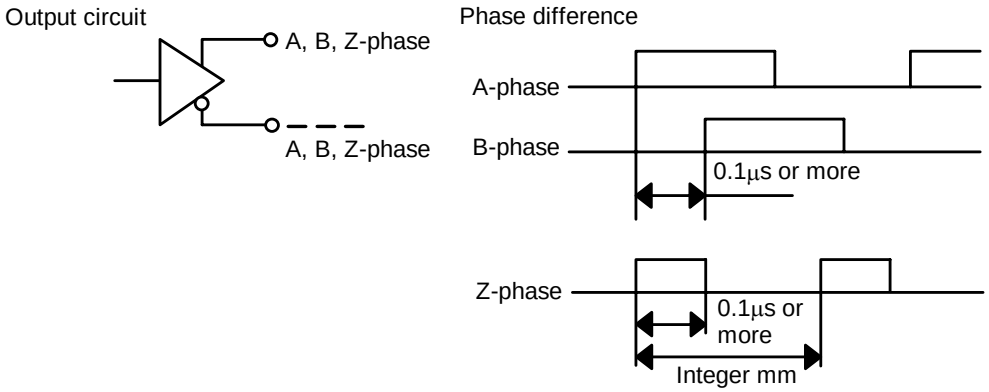
4-1-4 Machine side detector

All machine side detectors are optional parts, and must be prepared by the user.

(1) Relative position detector

Use a relative position detector for the machine side that satisfies the following "(a)" and "(b)" according to the output signal specifications.

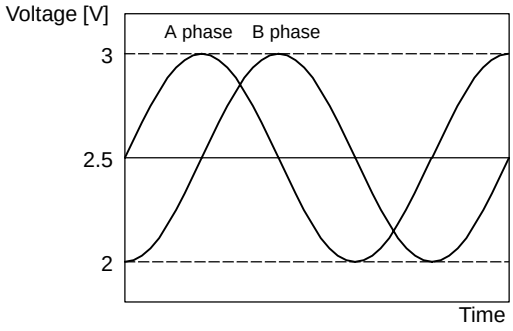
(a) Oblong wave output
Select a relative position detector with an A/B phase difference and Z-phase width at the maximum feedrate that satisfies the following conditions.
Use an A, B, Z-phase signal type with differential output (RS-422 standard product) for the output signal.



For a scale having multiple Z phases, select the neighboring Z phases whose distance is an integral mm.

(b) Analog wave output (using MDS-B-HR)
When using a relative position detector that the signal is the analog (SIN wave) output, the detector output signal is converted in the detector conversion unit (MDS-B-HR), and then the signal is transmitted to the drive unit in the serial communication. Select a relative position detector with A/B phase SIN wave signal that satisfies the following conditions.

(Output signal)
- 2.5V reference 1Vp-p analog A-phase, B-phase, Z-phase differential output
- Output signal frequency max 200kHz



A/B phase output signal waveform during forward run

(2) Absolute position detector

The applicable absolute position detectors are as follows.

Applicable absolute position detectors for the machine side

Type	Manufacturer	Maximum feedrate	Detector output	Detector resolution
AT41	Mitsutoyo	50m/min	A, B-phase	1μm/p after multiplying by four
			Z-phase	Zero point indexing 10mm spacing
			Serial data	Absolute position 1μm/p
FME, FML	FUTABA	5.1 to 120m/min Differs according to the resolution.	A, B-phase	0.1 to 10μm/p after multiplying by four
			Serial data	
MP scale * **Motor side detector also needs an absolute position encoder.**	Mitsubishi Heavy Industries	30m/min	A, B-phase	1μm/p after multiplying by four
			Z-phase	Zero point indexing 2mm spacing
AT342	Mitsutoyo	110m/min	Serial data	0.5μm/p
AT343	Mitsutoyo	120m/min	Serial data	0.05μm/p
LC191M	HEIDENHAIN	120m/min	Serial data	0.1μm/p
LC491M	HEIDENHAIN	120m/min	Serial data	0.05μm/p/0.1μm/p
RCN723 for rotating axis	HEIDENHAIN	300r/min	Serial data	8,000,000p/rev
RCN223 for rotating axis	HEIDENHAIN	1500r/min	Serial data	8,000,000p/rev

⚠ CAUTION Confirm each manufacturer specifications before using the machine side detector.

4-1-5 Detector conversion unit (MDS-B-HR)

This unit superimposes the scale analog output raw waves, and generates high resolution position data. Increasing the detector resolution is effective for the servo high-gain. MDS-B-HR-12(P) is used for the synchronous control system that 1-scale 2-drive operation is possible.

(1) Type configuration

MDS-B-HR- **(1)** **(2)**

(2) Protective structure

Symbol	Protective structure
None	IP65
P	IP67

(1) Signal division function class

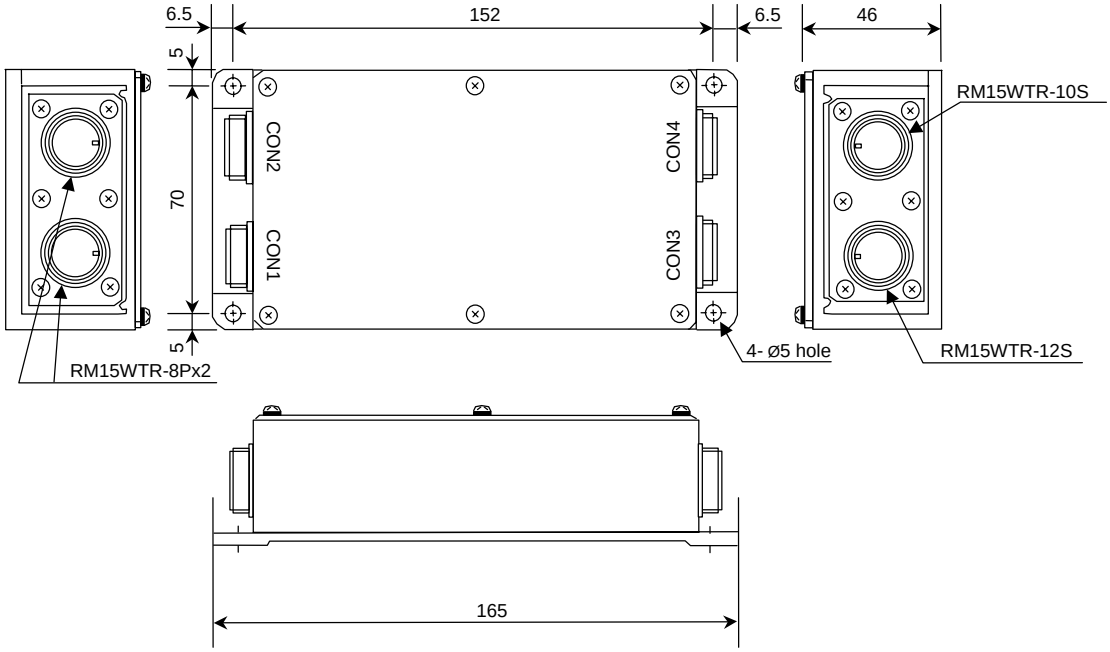
Symbol	Scale output voltage class
11	Output number 1
12	Output number 2 (with division)

(2) Specifications

Type MDS-B-HR-	11	12	11P	12P
Compatible scale (example)	LS186 / LIDA181 / LIF181 (HEIDENHAIN)			
Signal 2-division function	×	○	×	○
Analog signal input specifications	A-phase, B-phase, Z-phase (2.5V reference Amplitude $1V_{P-P}$)			
Compatible frequency	Analog raw waveform max. 200kHz			
Scale resolution	Analog raw waveform/512 division			
Input/output communication style	High-speed serial communication I/F, RS485 or equivalent			
Working ambient temperature	0 to 55°C			
Working ambient humidity	90%RH or less (with no dew condensation)			
Atmosphere	No toxic gases			
Tolerable vibration	98.0 m/s^2 (10G)			
Tolerable impact	294.0 m/s^2 (30G)			
Tolerable power voltage	5VDC±5%			
Maximum heating value	2W			
Weight	0.5kg or less			
Protective structure	IP65		IP67	

(3) Unit outline dimension drawings

- **MDS-B-HR**



Unit [mm]

(3) Explanation of connectors

Connector name	Application	Remarks
CON1	For connection with servo drive unit (2nd system)	Not provided for 1-part system specifications
CON2	For connection with servo drive unit	
CON3	For connection with scale	
CON4	For connection with pole detection unit (MDS-B-MD)	*Used for linear servo system

Connector pin layout

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

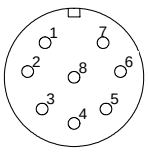
CON3

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

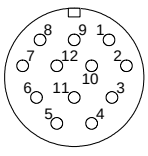
CON4

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

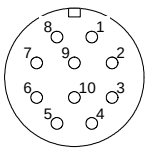
Connector	Type
CON1	RM15WTR- 8P (Hirose Electric)
CON2	
CON3	RM15WTR-12S (Hirose Electric)
CON4	RM15WTR-10S (Hirose Electric)



CON1
CON2



CON3



CON4

4-1-6 Signal divider unit (MDS-B-SD)

This unit has a function to divide the position and speed signals fed back from the high-speed serial detector and high-speed serial linear scale. This unit is used to carry out synchronized control of the motor with two MDS-C1-V1 drive units.

(1) Specifications

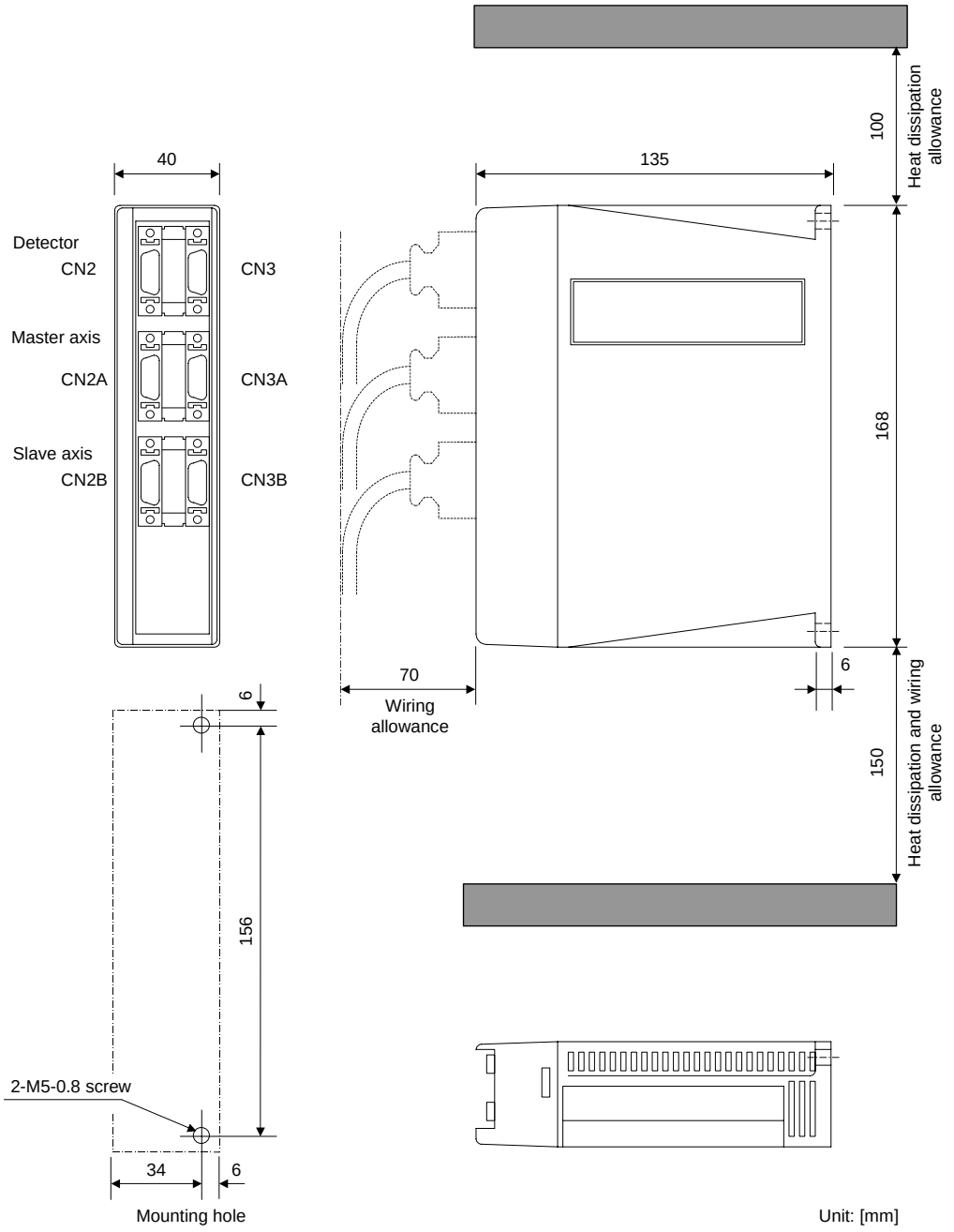
Type	MDS-B-SD
Compatible servo drive unit	MDS-C1-V1-☐
Input/output communication style	High-speed serial communication I/F, RS485 or equivalent
Working ambient temperature	0 to 55°C
Working ambient humidity	90%RH or less (with no dew condensation)
Atmosphere	No toxic gases
Tolerable vibration	98.0 m/s2 (10G)
Tolerable impact	294.0 m/s2 (30G)
Tolerable power voltage	5VDC±10%
Maximum heating value	4W
Weight	0.5kg or less
Protective structure	Protective type (protection method: IP20)

POINT

1. The MDS-B-SD unit divides the feed back signals from a motor side detector (CN2 system) and from a machine side detector (CN3 system).
2. Always make sure that the CN2 system's CN2A and the CN3 system's CN3A are always connected to the same servo drive unit. The CN2 system's CN2A and the CN3 system's CN3A cannot be connected to different servo drive units.
3. Always provide one MDS-B-SD unit for one current/speed command synchronous control operation.

(2) Outline dimension drawings

- **MDS-B-SD**



4-2 Spindle option

Select the spindle option to be required for the spindle control based on the following table.

(a) No-variable speed control
(When spindle and motor are directly coupled or coupled with a 1:1 gear ratio)

Spindle control item	Control specifications	Without spindle option		With spindle option			
		Motor side PLG	Motor side PLG with Z-phase	Magnetic sensor	Spindle side PLG (MDS-C1-SPX)	Spindle side detector	C-axis detector
Speed control	Normal cutting control	○	○	This normally is not used for no-variable speed control.			○
	Constant surface speed control (lathe)	○	○				○
	Thread cutting (lathe)	×	○				○
Orientation control	1-point orientation control	×	○				○
	Multi-point orientation control	×	○				○
	Orientation indexing	×	○				○
Synchronous tap control	Standard synchronous tap	○	○				○
	Synchronous tap after zero point return	×	○				○
Spindle synchronous control	Without phase alignment function	○	○				○
	With phase alignment function	×	○				○
C-axis control	Simple C-axis control (without zero point return)	○	○				Not used
	Simple C-axis control (with zero point return)	×	○				
	Standard C-axis control	×	×				○

(Note) ○ : Control possible
× : Control not possible

(b) Variable speed control (When using V-belt, or when spindle and motor are connected with a gear ratio other than 1:1)

Spindle control item	Control specifications	Without spindle option		With spindle option			
		Motor side PLG	Motor side PLG with Z-phase	Magnetic sensor	Spindle side PLG (MDS-C1-SPX)	Spindle side detector	C-axis detector
Speed control	Normal cutting control	○	○	○	○	○	○
	Constant surface speed control (lathe)	△	△	△	○	○	○
	Thread cutting (lathe)	×	×	×	○	○	○
Orientation control	1-point orientation control	×	×	○	○	○	○
	Multi-point orientation control	×	×	×	○	○	○
	Orientation indexing	×	×	×	○	○	○
Synchronous tap control	Standard synchronous tap	▲	▲	▲	○	○	○
	Synchronous tap after zero point return	×	×	▲	○	○	○
Spindle synchronous control	Without phase alignment function	△	△	△	○	○	○
	With phase alignment function	×	×	×	○	○	○
C-axis control	Simple C-axis control (without zero point return)	Simple C-axis control is not possible when using variable speed control.					
	Simple C-axis control (with zero point return)						
	Standard C-axis control	×	×	×	×	×	△

(Note) ○ : Control possible

× : Control not possible

△ : Control not possible when using V-belt

▲ : Control not possible when varying the speed with a method other than the gears (when using V-belt or timing belt).

4-2-1 Magnetic sensor

Prepare the magnetic sensor parts with the following types. When purchasing independently, always prepare with the required configuration part types.

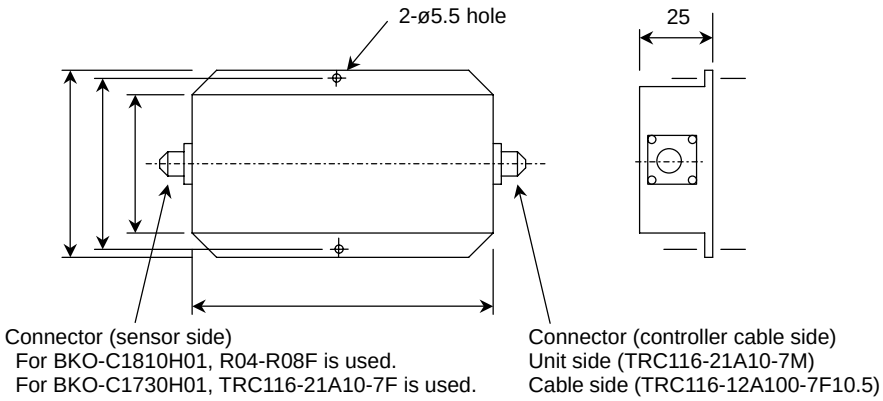
(1) Type

Type	Type	Tolerable speed [r/min]	Independent type		
			Drive unit	Sensor	Magnet
Standard	**MAGSENSOR BKO-C1810H01-3**	0 to 6000	H01	H02	H03
High-speed standard	**MAGSENSOR BKO-C1730H01.2.6**	0 to 12000	H01	H02	H06
High-speed small	**MAGSENSOR BKO-C1730H01.2.9**	0 to 12000	H01	H02	H09
High-speed ring	**MAGSENSOR BKO-C1730H01.2.41**	0 to 25000	H01	H02	H41
	MAGSENSOR BKO-C1730H01.2.42	0 to 25000	H01	H02	H42
	MAGSENSOR BKO-C1730H01.2.43	0 to 30000	H01	H02	H43
	MAGSENSOR BKO-C1730H01.2.44	0 to 30000	H01	H02	H44

(Note) When preparing with independent types, replace the section following the H in the prepared type with the independent type.
Example: When preparing only the standard magnetic sensor's sensor section, the type will be MAGSENSOR BKO-C1810H02.

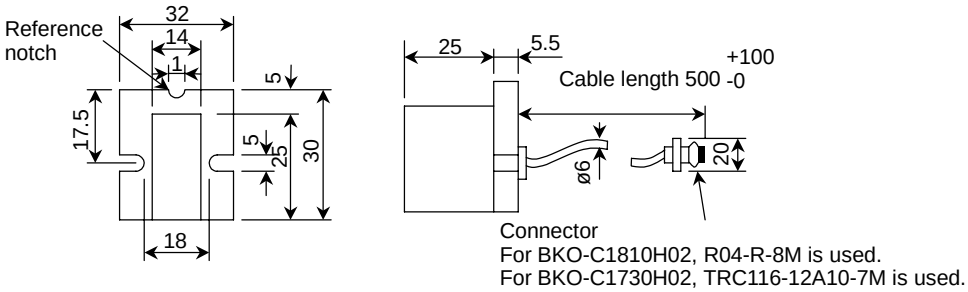
(2) Outline dimension drawing:

● **Drive unit H01**



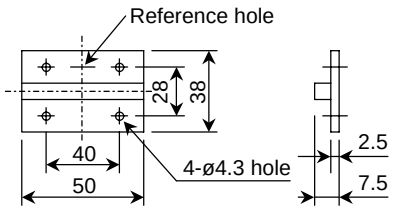
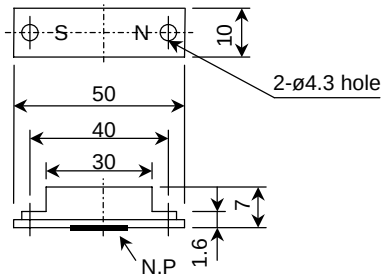
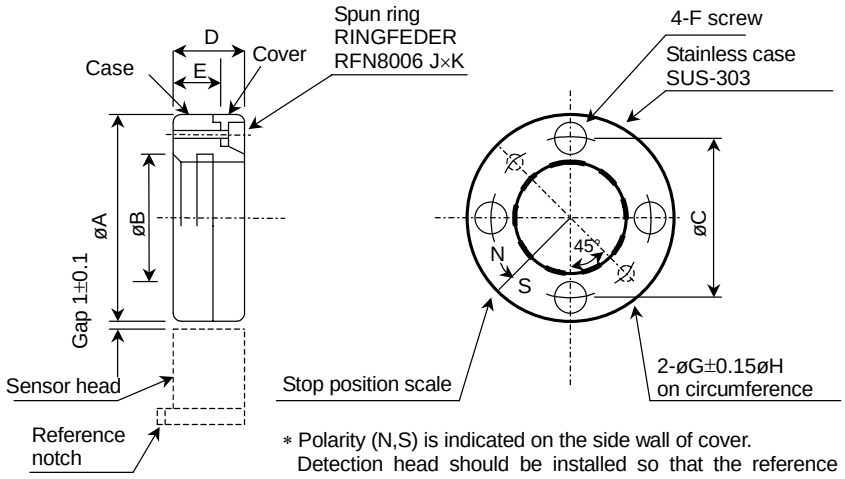
[Unit: mm]

● **Sensor H02**



[Unit: mm]

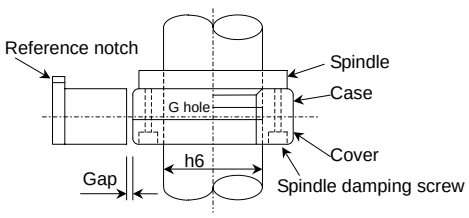
● Magnet

Part No.	Tolerable speed	Outline drawings
H03	0 to 6000 r/min	 Weight: 40 ± 1.5g Installation screw: M4 [Unit: mm]
H06	0 to 12000 r/min	
H09	0 to 12000 r/min	 Weight: 14.8 ± 0.7g Installation screw: M4 [Unit: mm]
H41	0 to 25000 r/min	 ∗ 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.
H42	0 to 25000 r/min	
H43	0 to 30000 r/min	
H44	0 to 30000 r/min	

[Unit: mm]

Magnet

Model	Dimensions										
	A	B	C	D	E	F	G	H	J × X	L	Weight (g)
BKO-C1730H41	105	70H7$^{+0.030}_{-0}$	90	28	19	M6×1.0	5	90	70×79	1	1024±4
BKO-C1730H42	94	60H7$^{+0.030}_{-0}$	79	25	17	M5×0.8	5	79	60×68	1	768±4
BKO-C1730H43	78	50H7$^{+0.025}_{-0}$	66	23	15	M5×0.8	5	66	50×57	1	478±4
BKO-C1730H44	66	40H7$^{+0.025}_{-0}$	54	20	13	M4×0.7	5	54	40×45	1	322±4



Installation of magnet

Cautions on installation of H41 to H44

1. Tolerance to shaft dimension should be "h6" on the part for installing a magnet.
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. There is an NS indication on the side of the cover. Install so that the reference notch on the sensor head comes to the case side.

4-2-2 Spindle side detector (OSE-1024-3-15-68, OSE-1024-3-15-68-8)

When a spindle and motor are connected with a V-belt, or connected with a gear ratio other than 1:1, use this spindle side detector to detect the position and speed of the spindle. Also use this detector when orientation control and synchronous tap control, etc are executed under the above conditions.

(2) Specifications

Detector type		OSE-1024-3-15-68	OSE-1024-3-15-68-8
Mechanical characteristics for rotation	Inertia	0.1×10^{-4}kgm^2 or less	0.1×10^{-4}kgm^2 or less
	Shaft friction torque	0.98Nm or less	0.98Nm or less
	Shaft angle acceleration	10^4 rad/s^2 or less	10^4 rad/s^2 or less
	Tolerable continuous rotation speed	6000 r/min	8000 r/min
	Maximum rotation speed	7030 r/min	8030 r/min
Mechanical configuration	Bearing maximum non-lubrication time	20000h/6000r/min	20000h/8000r/min
	Shaft amplitude (position 15mm from end)	0.02mm or less	0.02mm or less
	Tolerable load (thrust direction/radial direction)	10kg/20kg Half of value during operation	10kg/20kg Half of value during operation
	Weight	1.5kg	1.5kg
	Squareness of flange to shaft	0.05mm or less	
	Flange matching eccentricity	0.05mm or less	
Working environment	Ambient temperature range	–5°C to +55°C	
	Storage temperature range	–20°C to +85°C	
	Humidity	95%Ph	
	Vibration resistance	5 to 50Hz, total vibration width 1.5mm, each shaft for 30min.	
	Impact resistance	294.20m/s^2 (30G)	

(2) Detection signals

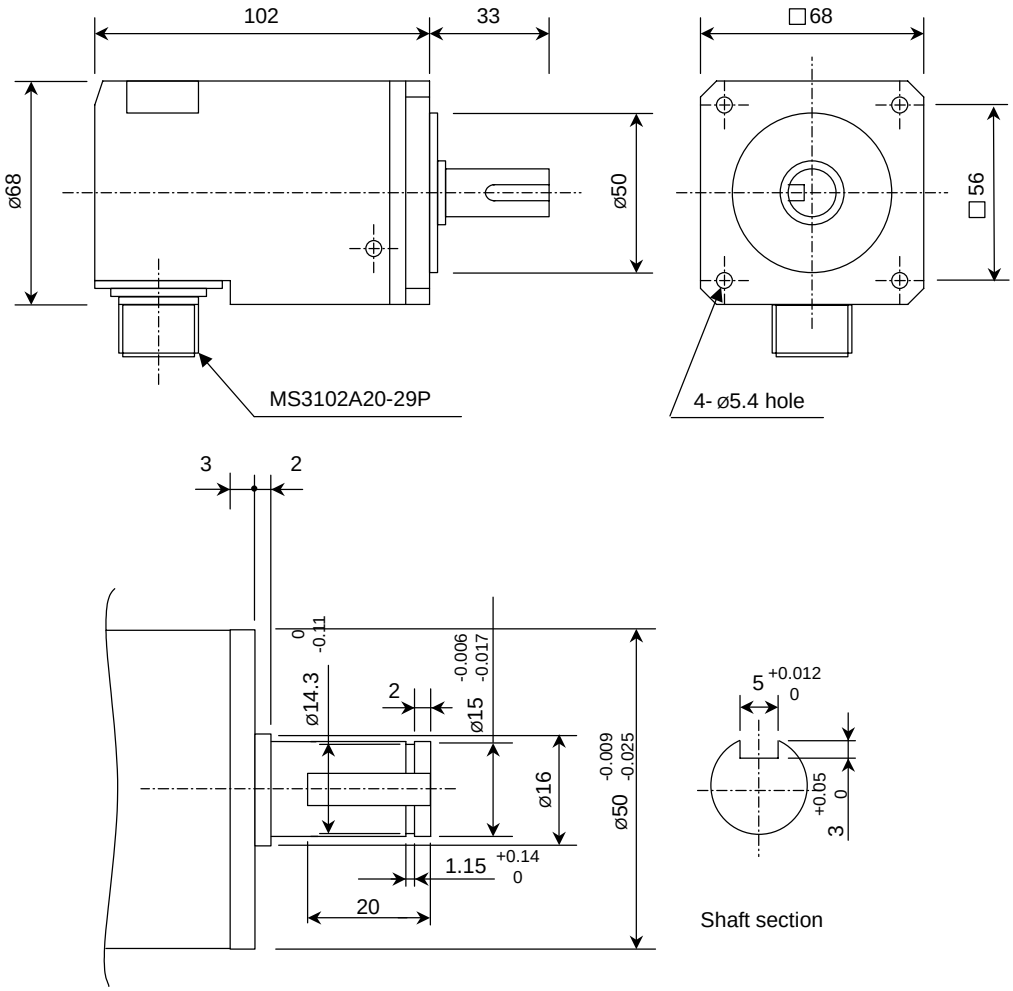
Signal name	Number of detection pulses
A, B phase	1024p/rev
Z phase	1p/rev

Connector pin layout

Pin	Function
A	A phase
B	Z phase
C	B phase
D	-
E	Case earth
F	-
G	-
H	+5V
J	-

Pin	Function
K	0V
L	-
M	-
N	$\overline{A}$ phase
P	$\overline{Z}$ phase
R	$\overline{B}$ phase
S	-
T	-

(3) Outline dimension drawings



Spindle side detector (OSE-1024-3-15-68, OSE-1024-3-15-68-8)

4-2-3 C-axis detector (OSE90K)

This is a high-resolution spindle side detector for contouring control (C-axis control). This detector has not only a 90,000p/rev signal used for C-axis control but also 1024p/rev signal used for orientation control and spindle speed detection.

(1) Specifications

Detector type		OSE90K+1024 BKO-NC6336H01
Mechanical characteristics for rotation	**Inertia**	0.1×10^{-4}kgm^2 or less
	Shaft friction torque	0.98Nm or less
	Shaft angle acceleration	10^5rad/s^2 or less
	Continuous tolerable rotation speed	6000r/min
	Maximum rotation speed	7030r/min
Mechanical configuration	**Bearing maximum non-lubrication time**	20000hr/6000r/min
	Shaft amplitude (position 15mm from end)	0.02mm or less
	Tolerable load (thrust direction/radial direction)	10kg/20kg Half of value during operation
	Weight	2.0kg
	Squareness of flange to shaft	0.05mm or less
	Flange matching eccentricity	0.05mm or less
Working environment	**Working temperature range**	–5°C to +55°C
	Storage temperature range	–20°C to +85°C
	Humidity range	95%Ph
	Vibration resistance	5 to 50Hz, total vibration width 1.5mm, each shaft for 30 min.
	Impact resistance	294.20m/s^2 (30G)

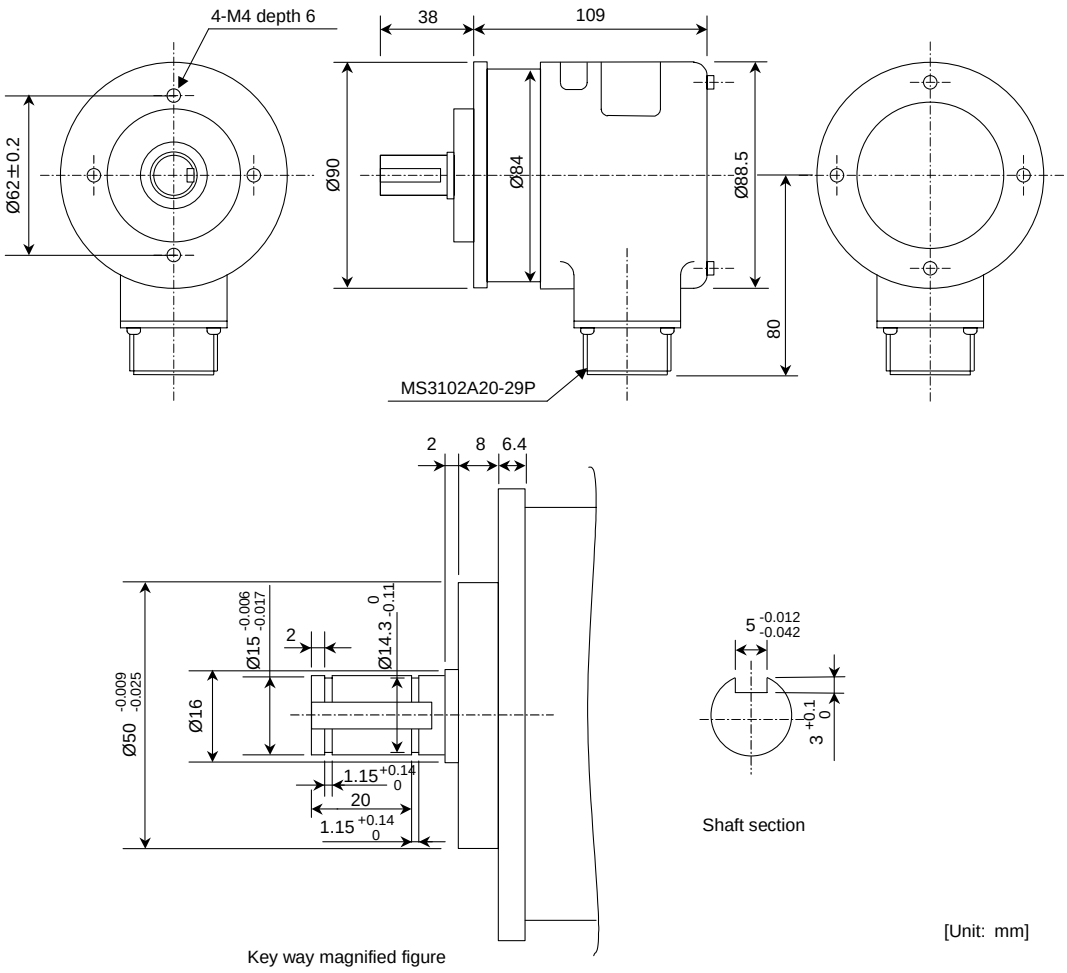
(2) Detection signals

Signal name	Number of detection pulses
A, B phase	1024p/rev
Z phase	1p/rev
C,D phase	90,000p/rev
Y phase	1p/rev

Connector pin layout

Pin	Function	Pin	Function
A	A phase	**K**	0V
B	Z phase	**L**	$\overline{C}$ phase
C	B phase	**M**	$\overline{D}$ phase
D	—	**N**	$\overline{A}$ phase
E	Case earth	**P**	$\overline{Z}$ phase
F	C phase	**R**	$\overline{B}$ phase
G	D phase	**S**	Y phase
H	+5V	**T**	$\overline{Y}$ phase
J	0V		

(3) Outline dimension drawings



Spindle C-axis detector (OSE90K＋1024)

(Note 1) The max. detector speed must be 6000r/min or less.
(Note 2) The dimensional tolerance that is not specified is ±0.5mm.

4-2-4 C-axis detector (MBE90K)

This is a high-resolution spindle side detector for contouring control (C-axis control). This detector has not only a 90,000p/rev or 1024p/rev oblong wave signal but also a SIN wave output that is equivalent to PLG. So, this detector can be also used for built-in motors.

(1) Specifications

Detector type	MBE90K-01A	MBE90K-02A	MBE90K-03A	MBE90K-04A	MBE90K-05A
Inner diameter of detector gear	ø 80mm	ø 110mm	ø 140mm	ø 70mm	ø 95mm
SIN wave output	256 w/rev	1024 w/rev	512 w/rev	256 w/rev	1024 w/rev
C/D phase electrically tolerable rotation speed	100r/min				
Operating temperature range	0°C to +70°C				
Storage temperature range	-20°C to +110°C (Sensor section: +120°C, 12Hr)				
Humidity	5 to 95%Rh				
Vibration resistance	5 to 50Hz, total vibration width 1.5mm (0.5Hr for each shaft), continuous 1G				
Impact resistance	294m/s^2 (30G), 11ms (10 times for each shaft)				

(2) Detection signals

Signal name	Number of detection pulses
A, B phase	1024p/rev
Z phase	1p/rev
C,D phase	90,000p/rev
Y phase	1p/rev
E,F phase	256/512/1024wave/rev
X phase	1p/rev

(3) Detail specifications

For other detail specifications, refer to "C-Axis Position Detector MBE90K SPECIFICATION AND INSTRUCTION MANUAL" (BNP-A2993-41).

4-2-5 C-axis detector (MHE90K)

This is a high-resolution spindle side detector for contouring control (C-axis control). This detector has not only oblong wave signals with 90,000p/rev and 1024p/rev but also a SIN wave signal output that is equivalent to PLG. So, this detector can be also used for built-in motors. This detector has a ring-type sensor, which eliminates the gap adjustment process.

(1) Specifications

Detector type	MHE90K-01A	MHE90K-02A	MHE90K-03A	MHE90K-04A	MHE90K-05A
Inner diameter of detector	ø 80mm	ø 110mm	ø 140mm	ø 70mm	ø 95mm
Mechanical maximum rotation speed	6000r/min	4000r/min	3000r/min	6000r/min	4000r/min
SIN wave signal output	180 w/rev				
Operating temperature range	0°C to +70°C (A/D converter and pre-amp section: 0°C to +55°C)				
Storage temperature range	-20°C to +85°C				
Humidity	5 to 95%Rh (with no dew condensation)				
Vibration resistance	10 to 50Hz, total vibration width 1.5mm (2Hr for each shaft), continuous 1G				
Impact resistance	294m/s^2 (30G), 11ms (10 times for each shaft)				

(2) Detection signals

Signal name	Number of detection pulses
A,B phase	1024p/rev
Z phase	1p/rev
C,D phase	90,000p/rev
Y phase	1p/rev
E,F phase	180wave/rev
X phase	1p/rev

(3) Detail specifications

For other detail specifications, refer to "C-Axis Position Detector MHE90K SPECIFICATION AND INSTRUCTION MANUAL" (BNP-A2993-44).

4-2-6 Spindle side PLG (MXE128/180/256/512)

A detector equivalent to the spindle motor side detector can be installed on the spindle side. Note, however, that a detector conversion unit (MDS-B-PJEX) will be required outside the drive unit. Consequently, the type of spindle drive unit will be changed to MDS-C1-SPX/SPHX series.

(1) Environmental conditions

Environment	Conditions
Ambient temperature	Sensor section: -10°C to +80°C (With no freezing) PCB section : -10°C to +75°C (With no freezing)
Atmosphere	Indoors (Where unit is not subject to direct sunlight) With no corrosive gas, inflammable gas, oil mist, dust or conductive fine particles

(2) Specifications

The detector is configured of the encoder section (combination of sensor section and PCB section) and the detection gear section. Six types of combinations with different output signals and mounting dimensions are available. The user is responsible for assembly and adjustment of the detector.

Type	No. of AB phase pulses	Z phase	Detector gears		Detector	Reference speed at signal confirmation (r/min)
			Outer diameter (mm)	Inner diameter (mm)	Length of lead between sensor and intermediate connector (mm)	
MXE128-G40-04	128	Provided	ø 52	ø 40	400	3600
MXE128-G40-08					800	
MXE180-G55-04	180	Provided	ø 72.8	ø 55	400	2560
MXE180-G55-08					800	
MXE256-G80-04	256	Provided	ø 103.2	ø 80	400	1800
MXE256-G80-08					800	
MXE512-G140-04	512	Provided	ø 205.6	ø 140	400	900
MXE512-G140-08					800	
MXE180R-G55-04	180	Provided	ø 72.8	ø 55	400	2560
MXE180R-G55-08					800	
MXE256R-G80-04	256	Provided	ø 103.2	ø 80	400	1800
MXE256R-G80-08					800	

<Reference> The conventional part's type

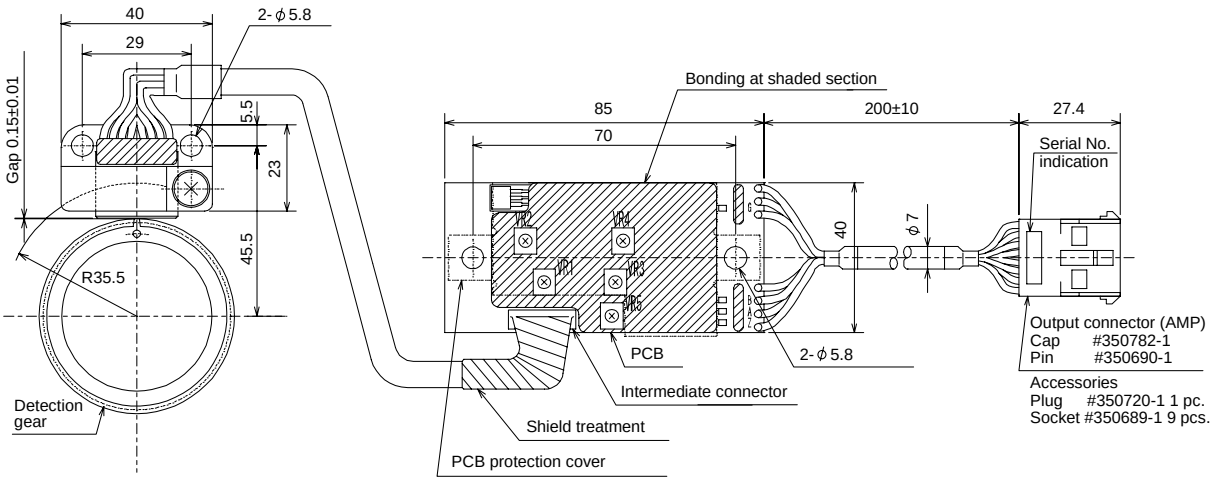
Encoder section : TS1860N2*** has been changed to TS1860N1***.
Gear section : TS1450N2*** has been changed to TS1450N***.

Precautions

1. The length of the standard lead wire connected between the sensor and intermediate connector is 400mm. An 800mm type is available as an option. To prevent the adverse effect of noise, install the PCB section as close to the sensor section, and keep the length of the lead wire between the sensor and PCB as short as possible. Separate this wire from the power wire when possible.
2. Mount the detector gears on the same axis as the final axis.
3. Mount the PCB section where it will not be subject to water or cutting oil, etc. (For example, install a box, etc., design so that oil and water, etc., cannot enter even from the wiring ports, and then install the PCB in that box.)
   In consideration of adjustments and maintenance, use a structure that enables adjustments and replacements.
4. Provide a structure that does not allow foreign matter (iron chips, etc.) enter into the sensor detector surface or detection gear teeth.

(3) Outline dimension drawings

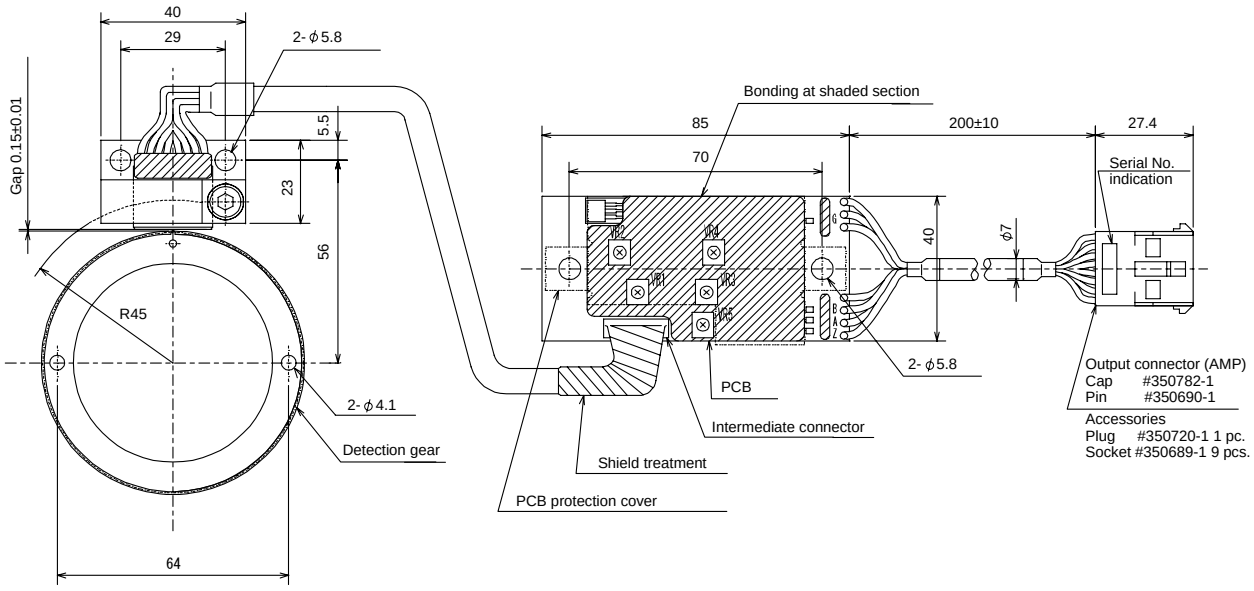
Fig. 1 MXE128-G40-☐



[Unit: mm]

Type	Detector part type	Detector gear part type
MXE128-G40-04	TS1860N2275	MU1450N2137
MXE128-G40-08	TS1860N2276	

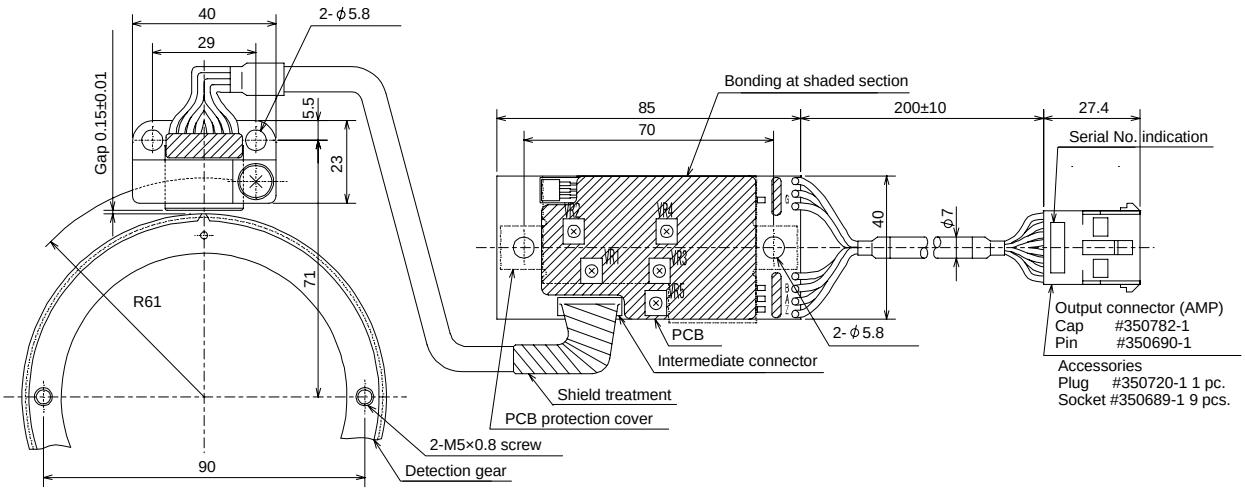
Fig. 2 MXE180-G55-☐



[Unit: mm]

Type	Detector part type	Detector gear part type
MXE180-G55-04	TS1860N2777	MU1450N2730
MXE180-G55-08	TS1860N2775	

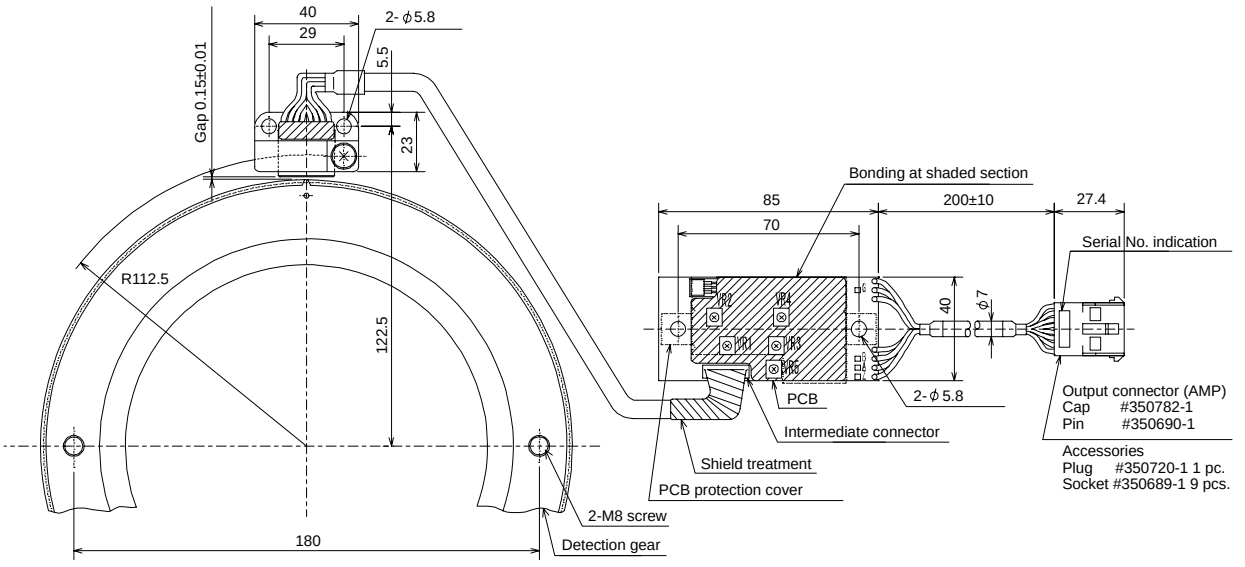
Fig. 3 MXE256-G80-☐



[Unit: mm]

Type	Detector part type	Detector gear part type
MXE256-G80-04	TS1860N2171	MU1450N2236
MXE256-G80-08	TS1860N2174	

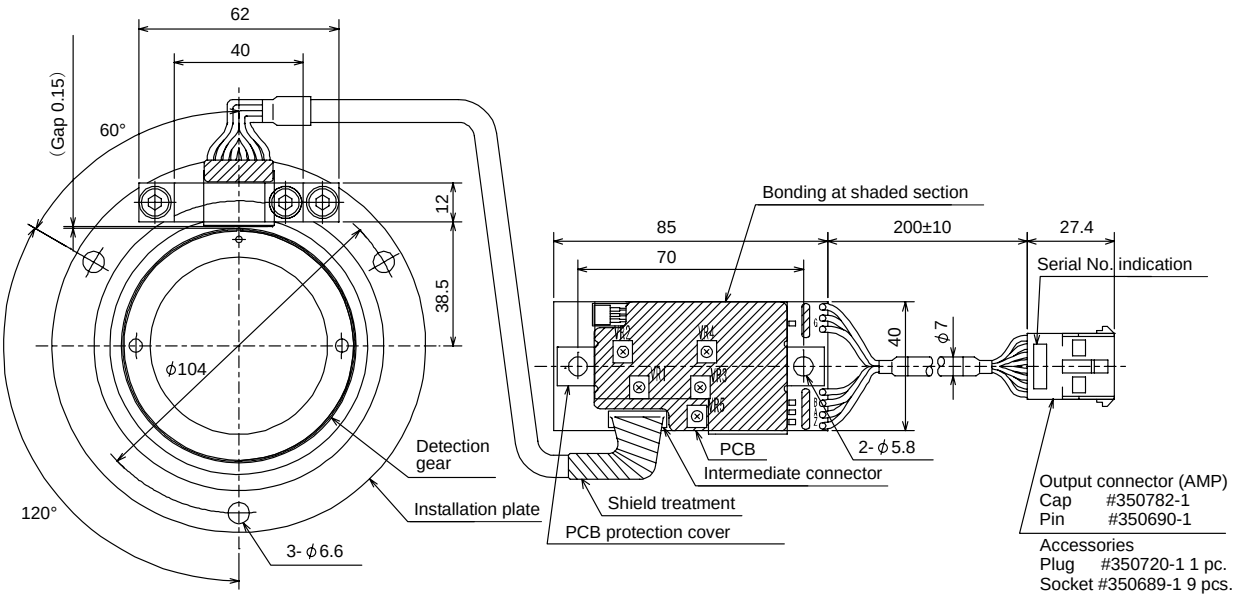
Fig. 4 MXE512-G140-☐



[Unit: mm]

Type	Detector part type	Detector gear part type
MXE512-G140-04	TS1860N2571	MU1450N2534
MXE512-G140-08	TS1860N2572	

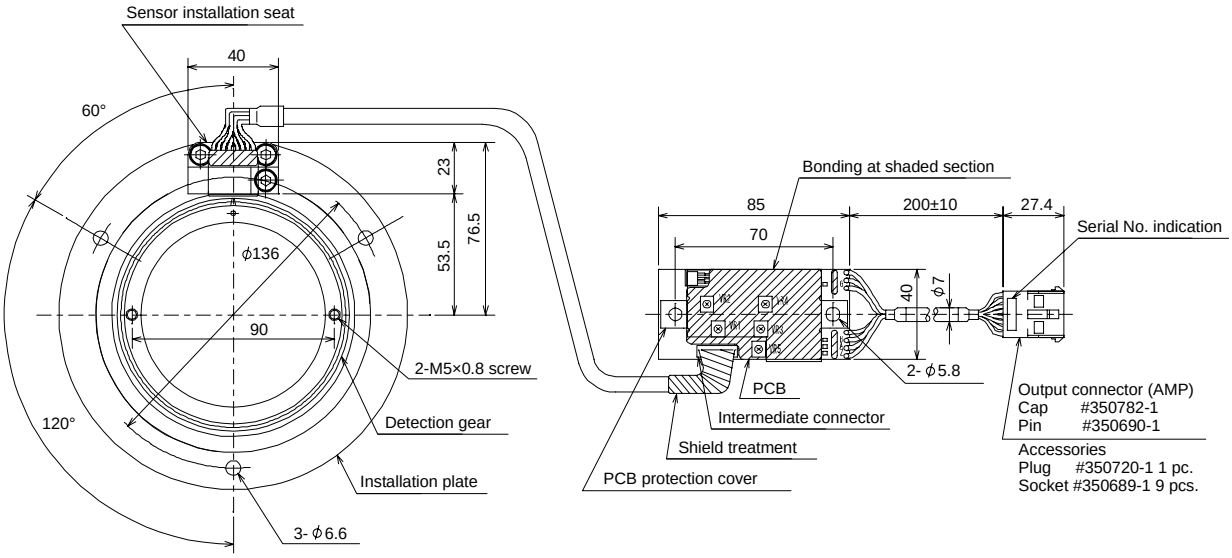
Fig. 5 MXE180R-G55-☐



[Unit: mm]

Type	Detector part type	Detector gear part type
MXE180R-G55-04	TS1860N2770	MU1450N2730
MXE180R-G55-08	TS1860N2776	

Fig. 6 MXE256R-G80-☐



[Unit: mm]

Type	Detector part type	Detector gear part type
MXE256R-G80-04	TS1860N2183	MU1450N2236
MXE256R-G80-08	TS1860N2187	

4-2-7 Detector conversion unit (MDS-B-PJEX)

When a spindle side PLG is used for detecting the position and speed on the spindle, a detector conversion unit (MDS-B-PJEX) is required. At the same time, use MDS-C1-SPX/SPHX series for a spindle drive unit.

(1) Specifications

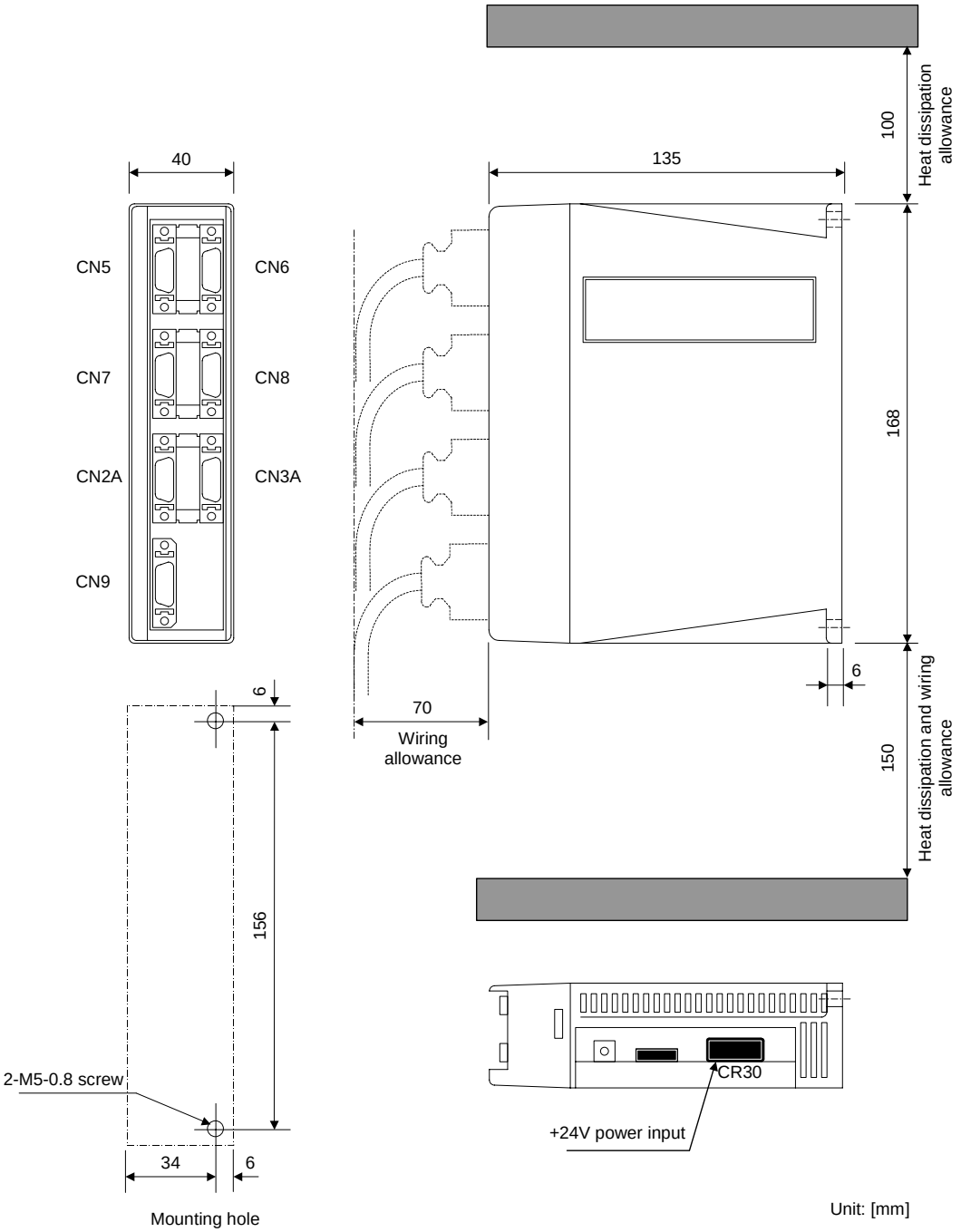
Type	MDS-B-PJEX
Compatible spindle drive unit	MDS-C1-SPX / MDS-C1-SPHX
Compatible detector	MXE128/180/256/512-G□□-□□
Analog signal input specifications (CN5)	A-phase, B-phase, Z-phase Same as motor side PLG detector specifications
Compatible frequency	Analog raw waveform max. 150kHz
Scale resolution	Analog raw waveform/2048 division
Input/output communication style	High-speed serial communication I/F, RS485 or equivalent
Working ambient temperature	0 to 55°C
Working ambient humidity	90%RH or less (with no dew condensation)
Atmosphere	No toxic gases
Tolerable vibration	98.0m/s^2 (10G)
Tolerable impact	294.0m/s^2 (30G)
Tolerable power voltage	24VDC±10%
Maximum heating value	4W
Weight	0.5kg or less
Protective structure	Protective type (protection method: IP20)

(Note 1) The power for the MDS-B-PJEX (24VDC stabilized power 15W) must be prepared by the user.

(Note 2) If a spindle motor whose maximum rotation speed is 10,000r/min or more is driven, use MDS-C1-SPHX series.

(2) Outline dimension drawings

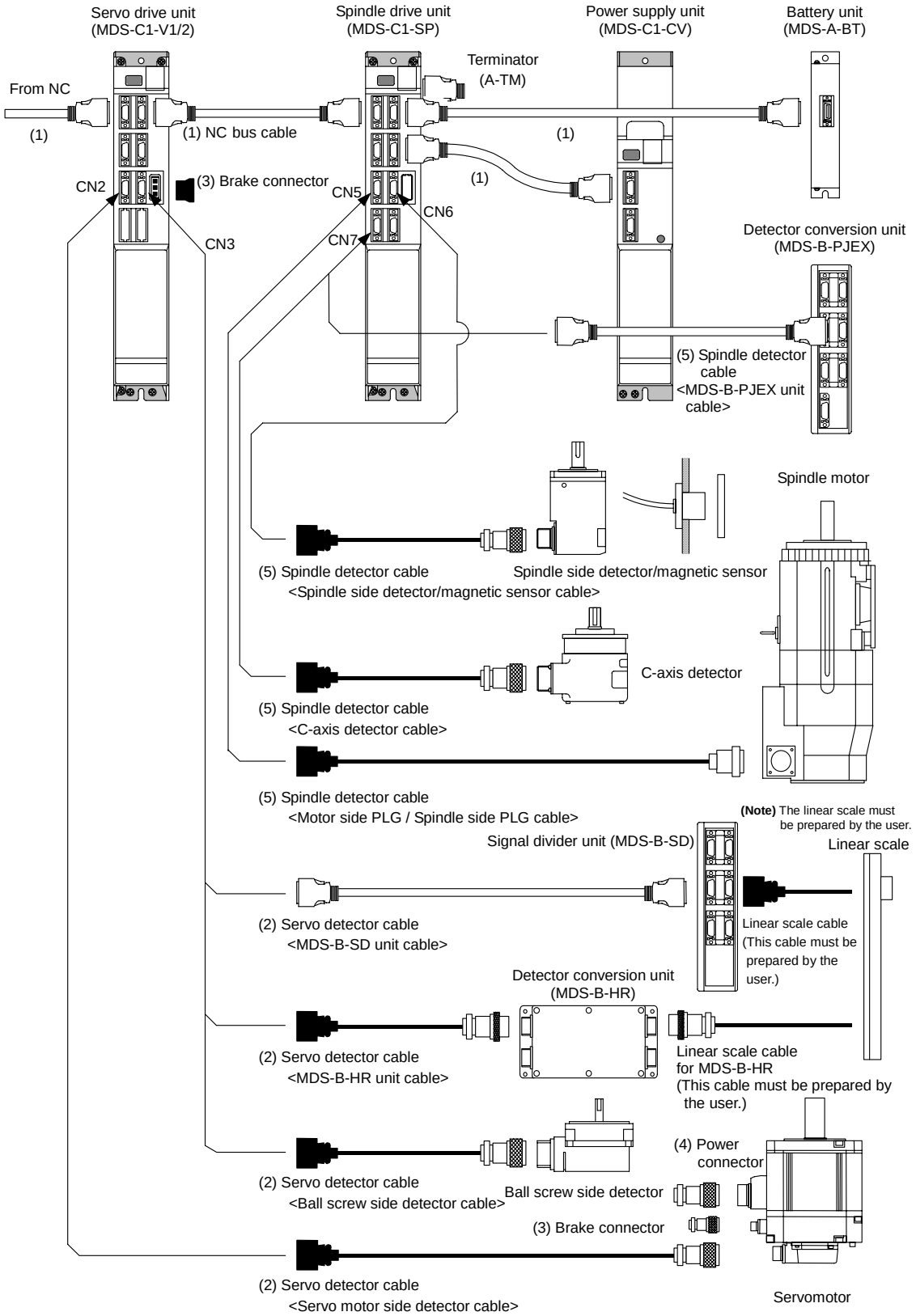
● **MDS-B-PJEX**



4-3 Cables and connectors

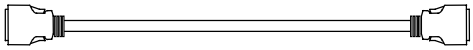
4-3-1 Cable connection diagram

The cables and connectors that can be ordered from Mitsubishi Electric Corp. as option parts are shown below. Cables can only be ordered in the designated lengths shown on the following pages. Purchase a connector set, etc., to create special length cables.



4-3-2 List of cables and connectors

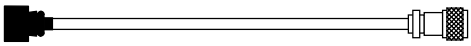
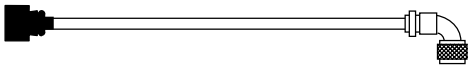
(1) NC bus cable and connector

Item		Model	Contents
For CN1A CN1B	NC bus cable	SH21 Length: 0.35, 0.5, 0.7, 1, 1.5, 2, 2.5, 3, 3.5, 4, 4.5, 5, 6, 7, 8, 9, 10, 15, 20, 30 m	Drive unit side connector (3M) Connector : 10120-6000EL Shell kit : 10320-3210-000 Drive unit side connector (3M) Connector : 10120-6000EL Shell kit : 10320-3210-000 
For CN1A CN1B	NC bus cable connector set	FCUA-CS000	Drive unit side connector (3M) Connector : 10120-3000VE Shell kit : 10320-52F0-008 Drive unit side connector (3M) Connector : 10120-3000VE Shell kit : 10320-52F0-008 

(Note) The connector manufacturer is subject to change without notice.

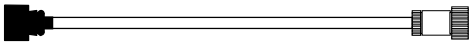
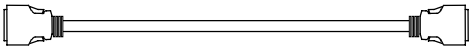
(2) Servo detector cable and connector

<table>
<tr><th colspan="2">Item</th><th>Model</th><th>Contents</th></tr>
<tr><td>For CN2</td><td>Motor side detector cable</td><td>CNV12-□-□□-□
Drive unit side connector
Blank: One-touch lock
S : Screw lock
Environment
Blank:
For general environment
P : IP65 compatible
Detector side connector
2: Straight cannon
3: Angle cannon
Axis No.
0: Not indicated
1: No. 1 axis
to
4: No. 4 axis

Length:
1.5, 2, 2.5, 3,
3.5, 4, 4.5, 5,
6, 7, 8, 9,
10, 11, 12, 13,
14, 15, 17, 20 m</td><td>Servo drive unit side connector (3M)
Servomotor detector side/ Ball screw side detector side connector (DDK)
• Detector connector straight specification
Connector : 10120-3000VE
(One-touch type lock)
Shell kit : 10320-52F0-008
(Screw-type lock)
Shell kit : 10320-52A0-008
For general environment
Straight plug : MS3106B22-14S
Clamp : MS3057-12A
IP65 compatible
Plug : MS3106A22-14S(D190)
Straight back shell: CE02-22BS-S
Clamp : CE3057-12A-3
 
• Detector connector angle specification
Connector : 10120-3000VE
(One-touch type lock)
Shell kit : 10320-52F0-008
For general environment
Angle plug : MS3108B22-14S
Clamp : MS3057-12A
(Screw-type lock)
Shell kit : 10320-52A0-008
IP65 compatible
Plug : MS3106A22-14S(D190)
Angle back shell: CE02-22BA-S
Clamp : CE3057-12A-3
  </td></tr>
<tr><td>For CN3</td><td>Ball screw side detector cable</td><td>CNV13-□-□□-□
Drive unit side connector
Blank: One-touch lock
S : Screw lock
Environment
Blank:
For general environment
P : IP65 compatible
Detector side connector
2: Straight cannon
3: Angle cannon
Axis No.
0: Not indicated
1: No. 1 axis
to
4: No. 4 axis

Length:
1.5, 2, 2.5, 3,
3.5, 4, 4.5, 5,
6, 7, 8, 9,
10, 11, 12, 13,
14, 15, 17, 20 m</td><td></td></tr>
</table>

(Note) The connector manufacturer is subject to change without notice.

Item		Model	Contents
For MDS-B-HR unit	MDS-B-HR unit cable	CNL3 - □ - □ Drive unit side connector Blank: One-touch lock S : Screw lock HR unit connector H1:CON1 H2:CON2 Length: 2, 5, 10, 20, 30 m	Servo drive unit side connector (3M) Connector : 10120-3000VE (One-touch type lock) Shell kit : 10320-52F0-008 (Screw-type lock) Shell kit : 10320-52A0-008 MDS-B-HR unit side connector (Hirose Electric) Plug : RM15WTP-8S Clamp: RM15WTP-CP(10) 
For MDS-B-SD unit	MDS-B-SD unit cable	SH21 Length: 0.35, 0.5, 0.7, 1, 1.5, 2, 2.5, 3, 3.5, 4, 4.5, 5, 6, 7, 8, 9, 10, 15, 20, 30 m	Servo drive unit side connector (3M) Connector : 10120-6000EL Shell kit : 10320-3210-000 MDS-B-SD unit side connector (3M) Connector : 10120-6000EL Shell kit : 10320-3210-000 
	MDS-B-SD unit connector set	FCUA-CS000	Servo drive unit side connector (3M) Connector : 10120-3000VE Shell kit : 10320-52F0-008 MDS-B-SD unit side connector (3M) Connector : 10120-3000VE Shell kit : 10320-52F0-008 

(Note) The connector manufacturer is subject to change without notice.

Item				Model	Contents	
For CN2	Detector connector set for HC -A42/E42, HC -A51/E51, HA -A42/E42, HA -A51/E51	IP67 compati-ble	Straight	ENCP22-14S3 Compliant cable range ø6.8 to ø10	Servo drive unit side connector (3M) Connector : 10120-3000VE Shell kit : 10320-52F0-008 	Servomotor detector side connector (DDK) Plug : MS3106A22-14S(D190) Straight back shell: CE02-22BS-S Clamp: CE3057-12A-3 
			Angle	ENCP22-14L3 Compliant cable range ø6.8 to ø10	Servo drive unit side connector (3M) Connector : 10120-3000VE Shell kit : 10320-52F0-008 	Servomotor detector side connector (DDK) Plug : MS3106A22-14S(D190) Angle back shell: CE-22BA-S Clamp: CE3057-12A-3 
		For general environ-ment	Straight	FCUA-CS080	Servo drive unit side connector (3M) Connector : 10120-3000VE Shell kit : 10320-52F0-008 	Servomotor detector side connector (DDK) Plug : MS3106B22-14S Clamp: MS3057-12A 
			Angle	FCUA-CS084	Servo drive unit side connector (3M) Connector : 10120-3000VE Shell kit : 10320-52F0-008 	Servomotor detector side connector (DDK) Plug : MS3108B22-14S Clamp: MS3057-12A 

(Note) The connector manufacturer is subject to change without notice.

(3) Brake connector

Item				Model	Contents
For motor brake	Brake connector for HC202B,HC352B, HC452B,HC702B HC902B HC203B,HC353B HC453B,HC703B HA053NB,HA13NB HA23NB,HA33NB	IP67 compati-ble	Straight	BRKP10SL-4S Compliant cable range ø5 to ø8.3	Servomotor side brake connector Plug : MS3106A10SL-4S(D190) (DDK) Clamp: YSO10-5-8 (Daiwa Dengyo) 
			Angle	BRKP10SL-4L Compliant cable range ø5 to ø8.3	Servomotor side brake connector Plug : MS3106A10SL-4S(D190) (DDK) Clamp: YLO10-5-8 (Daiwa Dengyo) 
		For general environ-ment	Straight	FCUA-CN804	Servomotor side brake connector (Japan Aviation Electronics) Plug : MS3106B10SL-4S Clamp: MS3057-4A 
			Angle	FCUA-CN808	Servomotor side brake connector (Japan Aviation Electronics) Plug : MS3108B10SL-4S Clamp: MS3057-4A 
For CN20	Connector for motor brake control output			CNU20S(AWG14)	Servo drive unit side connector (DDK) Connector: DK-3200S-03R Contact : DK-3REC2LLP1-100 

(Note) The connector manufacturer is subject to change without notice.

(4) Power connector

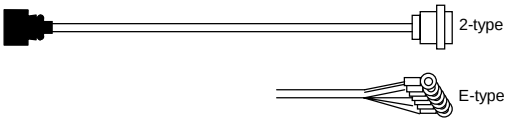
Item				Model	Contents
For motor power	Power connector for HA053N,HA13N, HA23N,HA33N	IP67 and EN compati-ble	Straight	PWCE18-12S Compliant cable range ø8.5 to ø11	Servomotor side power connector (DDK) Plug : CE05-6A18-12SD-B-BSS Clamp: CE3057-10A-2(D265) 
			Angle	PWCE18-12L Compliant cable range ø8.5 to ø11	Servomotor side power connector (DDK) Plug : CE05-8A18-12SD-B-BAS Clamp: CE3057-10A-2(D265) 
		For general environ-ment	Straight	FCUA-CN801	Servomotor side power connector (DDK) Plug : MS3106B18-12S Clamp: MS3057-10A 
			Angle	FCUA-CN805	Servomotor side power connector (DDK) Plug : MS3108B18-12S Clamp: MS3057-10A 
	Power connector for HC52 to 152, HC53 to 153, HC103R to 203R	IP67 and EN compati-ble	Straight	PWCE22-23S Compliant cable range ø9.5 to ø13	Servomotor side power connector (DDK) Plug : CE05-6A22-23SD-B-BSS Clamp: CE3057-12A-2(D265) 
			Angle	PWCE22-23L Compliant cable range ø9.5 to ø13	Servomotor side power connector (DDK) Plug : CE05-8A22-23SD-B-BAS Clamp: CE3057-12A-2(D265) 
		For general environ-ment	Straight	FCUA-CN802	Servomotor side power connector (DDK) Plug : MS3106B22-23S Clamp: MS3057-12A 
			Angle	FCUA-CN806	Servomotor side power connector (DDK) Plug : MS3108B22-23S Clamp: MS3057-12A 

(Note) The connector manufacturer is subject to change without notice.

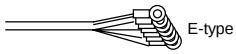
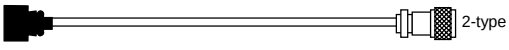
Item				Model	Contents
For motor power	Power connector for HC202,HC352,HC452 HC203,HC353 HC353R,HC503R	IP67 and EN compati-ble	Straight	PWCE24-10S Compliant cable range ø13 to ø15.5	Servomotor side power connector (DDK) Plug : CE05-6A24-10SD-B-BSS Clamp: CE3057-16A-2(D265) 
			Angle	PWCE24-10L Compliant cable range ø13 to ø15.5	Servomotor side power connector (DDK) Plug : CE05-8A24-10SD-B-BAS Clamp: CE3057-16A-2(D265) 
		For general environ-ment	Straight	FCUA-CN803	Servomotor side power connector (DDK) Plug : MS3106B24-10S Clamp: MS3057-16A 
			Angle	FCUA-CN807	Servomotor side power connector (DDK) Plug : MS3108B24-10S Clamp: MS3057-16A 
	Power connector for HC702,HC902 HC453,HC703	IP67 and EN compati-ble	Straight	PWCE32-17S Compliant cable range ø22 to ø23.8	Servomotor side power connector (DDK) Plug : CE05-6A32-17SD-B-BSS Clamp: CE3057-20A-1(D265) 
			Angle	PWCE32-17L Compliant cable range ø22 to ø23.8	Servomotor side power connector (DDK) Plug : CE05-8A32-17SD-B-BAS Clamp: CE3057-20A-1(D265) 
		For general environ-ment	Straight	FCUA-CN811	Servomotor side power connector (DDK) Plug : MS3106B32-17S Clamp: MS3057-20A 
			Angle	FCUA-CN815	Servomotor side power connector (DDK) Plug : MS3108B32-17S Clamp: MS3057-20A 

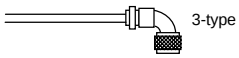
(Note) The connector manufacturer is subject to change without notice.

(5) Spindle detector cable

<table>
<tr><th colspan="2">Item</th><th>Model</th><th>Contents</th></tr>
<tr><td>For CN5</td><td>Motor side PLG cable/Spindle side PLG cable</td><td>CNP5-□□-□
Connector type
2: Connector
E: Crimped terminal
Axis No. (1 to 8 axis)
1: No. 1 axis
to
8: No. 8 axis
System No.
None: 1st system
2 : 2nd system
P : PLC axis
Length:
2, 5, 10, 20, 30 m</td><td>Spindle drive unit side connector (3M)
Connector : 10120-3000VE
Shell kit : 10320-52F0-008
Spindle motor side connector
For 2-type
(Tyco Electronics AMP)
Plug : 350720-1
Pin : 350689-1
For E-type (J.S.T.)
Crimped terminal: V1.25-4
 

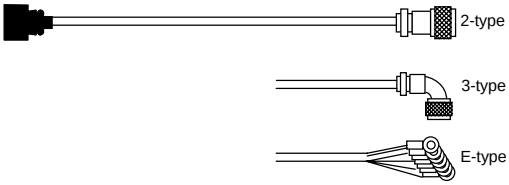
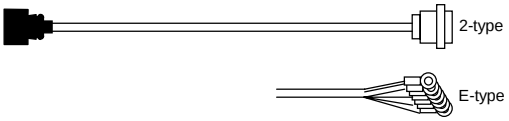
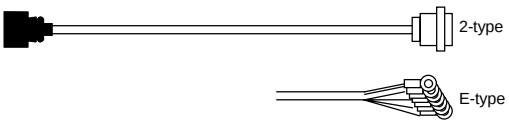
</td></tr>
<tr><td>For CN6</td><td>Magnetic sensor cable</td><td>CNP6M-□□-□
Connector type
2: Connector
E: Crimped terminal
Axis No. (1 to 8 axis)
1: No. 1 axis
to
8: No. 8 axis
System No.
None: 1st system
2 : 2nd system
P : PLC axis
Length:
2, 5, 10, 20, 30 m</td><td>Spindle drive unit side connector (3M)
Connector : 10120-3000VE
Shell kit : 10320-52F0-008
Magnetic sensor side connector
For 2-type (Tajimi Musen)
Plug: TRC116-12A10-7F10.5
For E-type (J.S.T.)
Crimped terminal: V1.25-4
 

 
</td></tr>
<tr><td></td><td>Spindle side detector cable</td><td>CNP6A-□□-□
Connector type
2: Straight cannon
3: Angle cannon
E: Crimped terminal
Axis No. (1 to 8 axis)
1: No. 1 axis
to
8: No. 8 axis
System No.
None: 1st system
2 : 2nd system
P : PLC axis
Length:
2, 5, 10, 20, 30 m</td><td>Spindle drive unit side connector (3M)
Connector : 10120-3000VE
Shell kit : 10320-52F0-008
Spindle side detector side connector
For 2-type (DDK)
Plug : MS3106A20-29S
Clamp: MS3057-12A
For 3-type (DDK)
Plug : MS3108A20-29S
Clamp: MS3057-12A
For E-type (J.S.T.)
Crimped terminal: V1.25-4
 

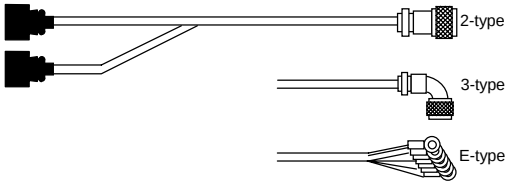
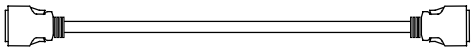
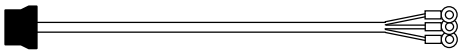
 

 
</td></tr>
</table>

(Note) The connector manufacturer is subject to change without notice.

Item		Model	Contents
For CN7	C-axis detector (OSE90K) cable	CNP7A -□□-□ Connector type 2: Straight cannon 3: Angle cannon E: Crimped terminal Axis No. (1 to 8 axis) 1: No. 1 axis to 8: No. 8 axis System No. None: 1st system 2 : 2nd system P : PLC axis Length: 2, 5, 10, 20, 30 m	Spindle drive unit side connector (3M) Connector : 10120-3000VE Shell kit : 10320-52F0-008 C-axis detector side connector For 2-type (DDK) Plug : MS3106A20-29S Clamp: MS3057-12A For 3-type (DDK) Plug : MS3108A20-29S Clamp: MS3057-12A For E-type (J.S.T.) Crimped terminal: V1.25-4 
	C-axis detector (MBE90K) cable	CNP7B -□□-□ Connector type 2: Connector E: Crimped terminal Axis No. (1 to 8 axis) 1: No. 1 axis to 8: No. 8 axis System No. None: 1st system 2 : 2nd system P : PLC axis Length: 2, 5, 10, 20, 30 m	Spindle drive unit side connector (3M) Connector : 10120-3000VE Shell kit : 10320-52F0-008 C-axis detector side connector For 2-type (Du pont) Housing: 69176-020 Pin : 48235-000 For E-type (J.S.T.) Crimped terminal: V1.25-4 
	C-axis detector (MHE90K) cable	CNP7H -□□-□ Connector type 2: Connector E: Crimped terminal Axis No. (1 to 8 axis) 1: No. 1 axis to 8: No. 8 axis System No. None: 1st system 2 : 2nd system P : PLC axis Length: 2, 5, 10, 20, 30 m	Spindle drive unit side connector (3M) Connector : 10120-3000VE Shell kit : 10320-52F0-008 C-axis detector side connector For 2-type(DDK) Housing: JAC-15P Pin : J-SP1140 For E-type (J.S.T.) Crimped terminal: V1.25-4 

(Note) The connector manufacturer is subject to change without notice.

Item		Model	Contents
For CN6 CN7	C-axis detector (OSE90K with 1024p output) cable	CNP67A - □ □ - □ Connector type 2: Straight cannon 3: Angle cannon E: Crimped terminal Axis No. (1 to 8 axis) 1: No. 1 axis to 8: No. 8 axis System No. None: 1st system 2 : 2nd system P : PLC axis Length: 2, 5, 10, 20, 30 m	Spindle drive unit side connector (3M) Connector : 10120-3000VE Shell kit : 10320-52F0-008 C-axis detector side connector For 2-type (DDK) Plug : MS3106A20-29S Clamp: MS3057-12A For 3-type (DDK) Plug : MS3108A20-29S Clamp: MS3057-12A For E-type (J.S.T.) Crimped terminal: V1.25-4 
For MDS-B-PJEX unit	MDS-B-PJEX unit cable	SH21 Length: 0.35, 0.5, 0.7, 1, 1.5, 2, 2.5, 3, 3.5, 4, 4.5, 5, 6, 7, 8, 9, 10, 15, 20, 30 m	Spindle drive unit side connector (3M) Connector : 10120-6000EL Shell kit : 10320-3210-000 MDS-B-PJEX unit side connector (3M) Connector : 10120-6000EL Shell kit : 10320-3210-000 
	MDS-B-PJEX unit connector set	FCUA-CS000	Spindle drive unit side connector (3M) Connector : 10120-3000VE Shell kit : 10320-52F0-008 MDS-B-PJEX unit side connector (3M) Connector : 10120-3000VE Shell kit : 10320-52F0-008 
	MDS-B-PJEX unit power cable	FCUA-R220 Length: 1, 2, 3, 5, 7, 10, 15, 17 m	MDS-B-PJEX unit side connector (Japan AMP) Connector: 2-178288-3 Contact : 1-175218-5 DC24V(+) power side connector (J.S.T.) Crimped terminal: V1.25-3 
	MDS-B-PJEX unit power connector set	FCUA-CN220	MDS-B-PJEX unit side connector (Japan AMP) Connector: 2-178288-3 Contact : 1-175218-5 

(Note) The connector manufacturer is subject to change without notice.

5. Peripheral Devices

5-1 Selection of wire

5-1-1 Example of wires by unit

Selected wires must be able to tolerate rated current of the unit's terminal to which the wire is connected.
How to calculate tolerable current of an insulated wire or cable is shown in "Tolerable current of electric cable" (1) of Japanese Cable Makers' Association Standard (JCS)-168-E (1995), its electric equipment technical standards or JEAC regulates tolerable current, etc. wire.
When exporting wires, select them according to the related standards of the country or area to export.
In the UL standards, certification conditions are to use wires of 60 °C and 75 °C product. (UL508C)
Wire's tolerable current is different depending on conditions such as its material, structure, ambient temperature, etc. Check the tolerable current described in the specification of the wire to use.

Example of wire selections according to each standard is as follows.

(1) 600V vinyl insulated wire (IV wire) 60°C product (Example according to IEC/EN60204-1, UL508C)

Unit type \ Terminal name		TE1 (L1, L2, L3, ⏚)		TE2 (L+, L-)		TE3 (L11, L21, L12, L22, MC1)	
		mm²	AWG	mm²	AWG	mm²	AWG
Power supply unit	**MDS-C1-CV-37**	3.5	12	Same as TE1		1.25 to 2	16 to 14
	MDS-C1-CV-55	3.5	12				
	MDS-C1-CV-75	5.5	10				
	MDS-C1-CV-110	14	6				
	MDS-C1-CV-150	22	4				
	MDS-C1-CV-185	30	3				
	MDS-C1-CV-220	38	2				
	MDS-C1-CV-260	50	-				
	MDS-C1-CV-300	60	-				
	MDS-C1-CV-370	-	-				
Spindle drive unit	**MDS-C1-SP□-04**	2	14	Match with TE2 of selected power supply unit		1.25 to 2	16 to 14
	MDS-C1-SP□-075	2	14				
	MDS-C1-SP□-15	3.5	12				
	MDS-C1-SP□-22	3.5	12				
	MDS-C1-SP□-37	3.5	12				
	MDS-C1-SP□-55	3.5	12				
	MDS-C1-SP□-75	5.5	10				
	MDS-C1-SP□-110	8	8				
	MDS-C1-SP□-150(S)	14	6				
	MDS-C1-SP□-185	22	4				
	MDS-C1-SP□-220	30	3				
	MDS-C1-SP□-260	38	2				
	MDS-C1-SP□-300	60	-				
Servo drive unit (1-axis)	**MDS-C1-V1-01**	1.25	16	Match with TE2 of selected power supply unit		1.25 to 2	16 to 14
	MDS-C1-V1-03	1.25	16				
	MDS-C1-V1-05	2	14				
	MDS-C1-V1-10	2	14				
	MDS-C1-V1-20	3.5	12				
	MDS-C1-V1-35	5.5	10				
	MDS-C1-V1-45(S)	5.5	10				
	MDS-C1-V1-70(S)	8	8				
	MDS-C1-V1-90	8	8				
	MDS-C1-V1-110	14	6				
	MDS-C1-V1-150	30	3				
Servo drive unit (2-axis)	**MDS-C1-V2-□□□□**	Select wire size for each axes based on wire size of 1-axis drive type.		Match with TE2 of selected power supply unit		1.25 to 2	16 to 14

(2) 600V double (heat proof) vinyl insulated wire (HIV wire) 75°C product (Example according to IEC/EN60204-1, UL508C)

Unit type \ Terminal name		TE1 (L1, L2, L3, ⏚)		TE2 (L+, L-)		TE3 (L11, L21, L12, L22, MC1)	
		mm²	AWG	mm²	AWG	mm²	AWG
Power supply unit	MDS-C1-CV-37	2	14	Same as TE1		1.25 to 2	16 to 14
	MDS-C1-CV-55	3.5	12				
	MDS-C1-CV-75	5.5	10				
	MDS-C1-CV-110	14	6				
	MDS-C1-CV-150	14	6				
	MDS-C1-CV-185	22	4				
	MDS-C1-CV-220	30	3				
	MDS-C1-CV-260	38	2				
	MDS-C1-CV-300	38	2				
	MDS-C1-CV-370	50	-				
Spindle drive unit	MDS-C1-SP□-04	2	14	Match with TE2 of selected power supply unit		1.25 to 2	16 to 14
	MDS-C1-SP□-075	2	14				
	MDS-C1-SP□-15	2	14				
	MDS-C1-SP□-22	2	14				
	MDS-C1-SP□-37	2	14				
	MDS-C1-SP□-55	2	14				
	MDS-C1-SP□-75	3.5	12				
	MDS-C1-SP□-110	5.5	10				
	MDS-C1-SP□-150(S)	14	6				
	MDS-C1-SP□-185	14	6				
	MDS-C1-SP□-220	22	4				
	MDS-C1-SP□-260	30	3				
	MDS-C1-SP□-300	38	2				
Servo drive unit (1-axis)	MDS-C1-V1-01	1.25	16	Match with TE2 of selected power supply unit		1.25 to 2	16 to 14
	MDS-C1-V1-03	1.25	16				
	MDS-C1-V1-05	2	14				
	MDS-C1-V1-10	2	14				
	MDS-C1-V1-20	2	14				
	MDS-C1-V1-35	3.5	12				
	MDS-C1-V1-45(S)	3.5	12				
	MDS-C1-V1-70(S)	5.5	10				
	MDS-C1-V1-90	8	8				
	MDS-C1-V1-110	14	6				
	MDS-C1-V1-150	22	4				
Servo drive unit (2-axis)	MDS-C1-V2-□□□□	Select wire size for each axes based on wire size of 1-axis drive type.		Match with TE2 of selected power supply unit		1.25 to 2	16 to 14

(3) 600V bridge polyethylene insulated wire (IC) 105°C product (Example according to JEAC8001)

Unit type \ Terminal name		TE1 (L1, L2, L3, ⏚)		TE2 (L+, L-)		TE3 (L11, L21, L12, L22, MC1)	
		mm²	AWG	mm²	AWG	mm²	AWG
Power supply unit	MDS-C1-CV-37	2	14	2	14	1.25 to 2	16 to 14
	MDS-C1-CV-55	2	14	3.5	12		
	MDS-C1-CV-75	3.5	12	3.5	12		
	MDS-C1-CV-110	5.5	10	14	6		
	MDS-C1-CV-150	8	8	14	6		
	MDS-C1-CV-185	14	6	22	4		
	MDS-C1-CV-220	14	6	22	4		
	MDS-C1-CV-260	22	4	30	3		
	MDS-C1-CV-300	38	2	38	2		
	MDS-C1-CV-370	38	2	50	-		
Spindle drive unit	MDS-C1-SP□-04	2	14	Match with TE2 of selected power supply unit		1.25 to 2	16 to 14
	MDS-C1-SP□-075	2	14				
	MDS-C1-SP□-15	2	14				
	MDS-C1-SP□-22	2	14				
	MDS-C1-SP□-37	2	14				
	MDS-C1-SP□-55	2	14				
	MDS-C1-SP□-75	3.5	12				
	MDS-C1-SP□-110	5.5	10				
	MDS-C1-SP□-150(S)	14	6				
	MDS-C1-SP□-185	14	6				
	MDS-C1-SP□-220	22	4				
	MDS-C1-SP□-260	30	3				
	MDS-C1-SP□-300	38	2				
Servo drive unit (1-axis)	MDS-C1-V1-01	1.25	16	Match with TE2 of selected power supply unit		1.25 to 2	16 to 14
	MDS-C1-V1-03	1.25	16				
	MDS-C1-V1-05	2	14				
	MDS-C1-V1-10	2	14				
	MDS-C1-V1-20	2	14				
	MDS-C1-V1-35	2	14				
	MDS-C1-V1-45(S)	3.5	12				
	MDS-C1-V1-70(S)	5.5	10				
	MDS-C1-V1-90	8	8				
	MDS-C1-V1-110	14	6				
	MDS-C1-V1-150	22	4				
Servo drive unit (2-axis)	MDS-C1-V2-□□□□	Select wire size for each axes based on wire size of 1-axis drive type.		Match with TE2 of selected power supply unit		1.25 to 2	16 to 14

⚠CAUTION

1. Selection conditions follow IEC/EN60204-1, UL508C, JEAC8001.
   - Ambient temperature is maximum 40°C.
   - Cable installed on walls without ducts or conduits.

   To use the wire under conditions other than above, check the standards you are supposed to follow.
2. The maximum wiring length to the motor is 30m.
   If the wiring distance between the drive unit and motor is 20m or longer, use a thick wire so that the cable voltage drop is 2% or less.
3. Always wire the grounding wire.

5-2 Selection the AC reactor, contactor and no-fuse breaker

5-2-1 Standard selection

Install an AC reactor, contactor and no-fuse breaker (NFB) per one power supply unit. Refer to the table below and select them according to each power supply unit capacity.

Selection of AC reactor, contactor and no-fuse breaker (NFB)

<table>
<tr><th>Power supply unit capacity</th><th>3.7 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</td><td>B-AL-7.5K</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 (Special order part)</td><td>S-N25 200V</td><td>S-N35 200V</td><td>S-N50 200V</td><td>S-N80 200V</td><td>S-N150 200V</td></tr>
<tr><td>Recommended main circuit NFB (Special order part)</td><td>NF50CS3P-40A05</td><td>NF50CS3P-50A05</td><td>NF100CS3P-100A05</td><td>NF225CS3P-150A05</td><td>NF225CS3P-175A05</td></tr>
<tr><td>Recommended motor fan NFB (Special order part)</td><td colspan="5">An NFB or CP (circuit protector) can be used as the motor fan breaker.
Select the NFB or CP using a value approximately double the motor fan rated current value shown below.
Contact the NFB or CP manufacturer for details on the recommended wire size, etc.

<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-LF11K2</td><td>HA-LF15K2</td></tr>
<tr><td>Motor fan rated current</td><td>0.3A</td><td>0.3A</td></tr>
</table>
* A rush current that is approximately double the above rated current flows when the motor starts.</td></tr>
</table>

(Note 1) In the above table, a special order part refers to a part that cannot be ordered from Mitsubishi, and which must be prepared by the user.

(Note 2) To comply with the EC Directives, use contactors and NFB that comply with the EN/IEC Standards.

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

5-2-2 Selection when a contactor is shared

If two or more power supply units share one contactor, select the contactor as explained below. Note, however, that one AC reactor and no-fuse breaker are required per one power supply unit.

(1) Selection

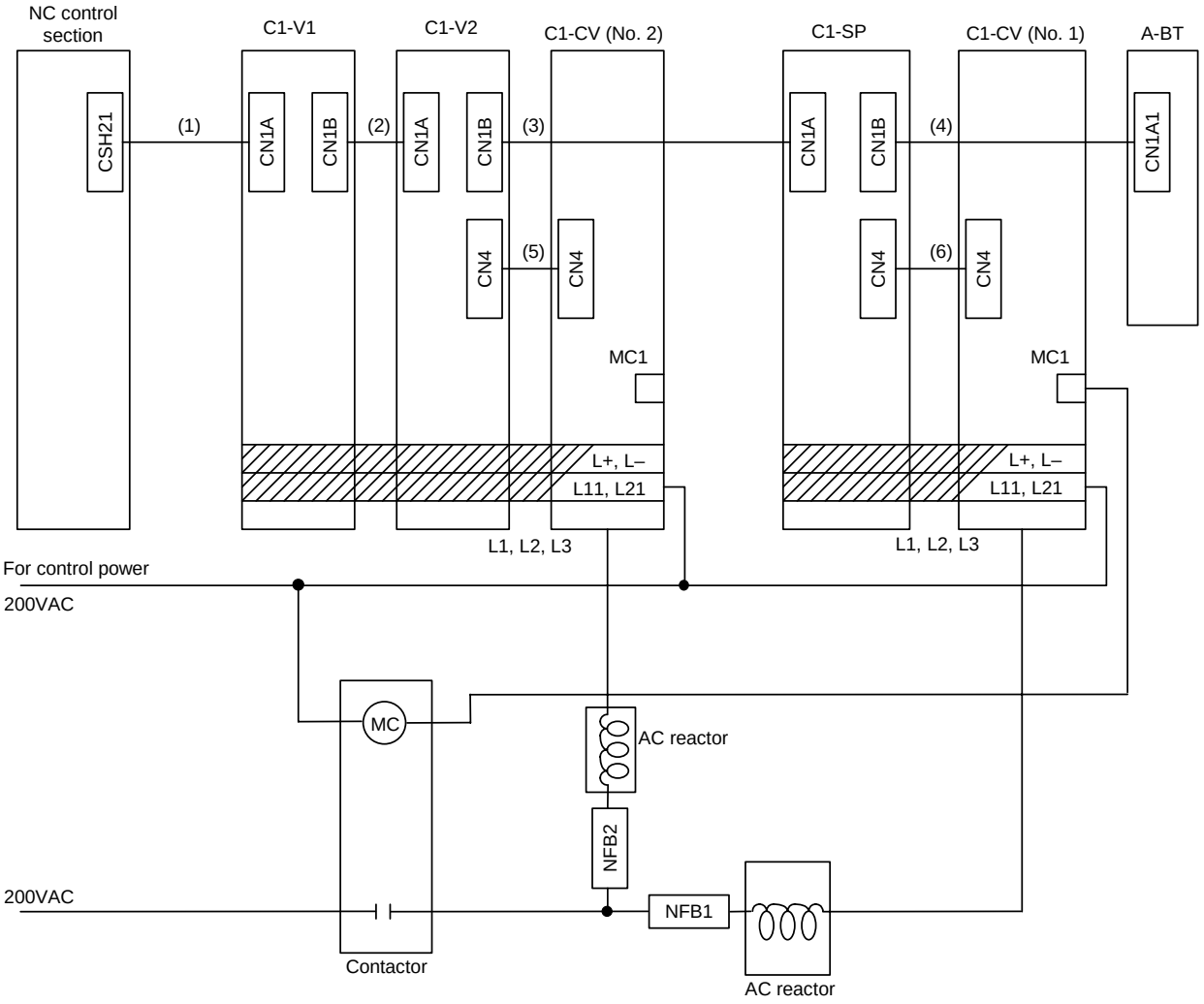
Calculate the total input current of the power supply units that share one contactor by referring to the following table. Select the contactor whose capacity is equal to or less than the rated conductivity current.

Power supply unit input current

Power supply unit	CV-37	CV-55	CV-75	CV-110	CV-150	CV-185	CV-220	CV-260	CV-300	CV-370
Input current	20	30	40	50	70	80	100	120	135	160

(2) Connection diagram when a contactor is shared

Install one AC reactor and no-fuse breaker per each power supply unit.



5-3 Earth leakage breaker

When installing an earth leakage breaker, select the breaker on the following basis to prevent the breaker from malfunctioning by the higher frequency earth leakage current generated in the servo or spindle drive unit.

(1) Selection

Obtaining the earth leakage current for all drive units referring to the following table, select an earth leakage breaker within the “rated non-operation sensitivity current”.
Usually use an earth leakage breaker for inverter products that function at a leakage current within the commercial frequency range (50 to 60Hz).
If a product sensitive to higher frequencies is used, the breaker could malfunction at a level less than the maximum earth leakage current value.

Earth leakage current for each unit

Unit	Earth leakage current	Maximum earth leakage current
MDS-C1-SP-04 to 300	6mA	15mA
MDS-C1-V1-01 to 150	1mA	2mA
MDS-C1-V2-0101 to 9090S	1mA	4mA (for two axes)

(Note1) Maximum earth leakage current: Value that considers wiring length and grounding, etc. (Commercial frequency 50/60Hz)
(Note2) The earth leakage current in the power supply unit side is included in the drive unit side.

(2) Measurement of earth leakage current

When actually measuring the earth leakage current, use a product that is not easily affected by the higher frequency earth leakage current. The measurement range should be 50 to 60Hz.

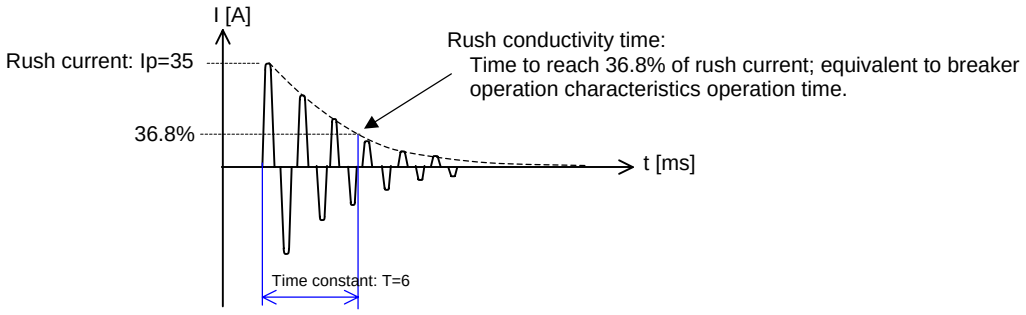
POINT

1. The earth leakage current tends to increase as the motor capacity increases.
2. A higher frequency earth leakage current will always be generated because the inverter circuit in the drive unit switches the transistor at high speed. Always ground to reduce the higher frequency earth leakage current as much as possible.
3. An earth leakage current containing higher frequency may reach approx. several hundreds of mA. According to IEC479-2, this level is not hazardous to the human body.

5-4 Branch-circuit protection

5-4-1 Circuit protector

This breaker is used to switch the control power and to provide overload and short-circuit protection. When connecting a circuit protector or breaker to the power input (TE3 terminals L11 and L21) for the control circuit, use a product that does not trip (incorrectly activate) by a rush current when the power is turned ON. A circuit protector with inertial delay and an operation delayed type breaker are available to prevent unnecessary tripping. Select the product to be used according to the machine specifications. The rush current and rush conductivity time differ according to the power impedance and power ON timing, so select a product that does not trip even under the conditions listed in the following table.



POINT

When collectively protecting the control circuit power for multiple units, select a circuit protector or breaker that satisfies the total sum of the rush current Ip. The largest value is used for the rush conductivity time T.

5-4-2 Fuse protection

The fuse of branch-circuit protection must use UL class CC, J or T. In the selection, please consider rush current and rush conductive time.

Selection of branch-circuit protection fuse

Connected total of unit	Fuse (Class CC)		Wire Size
	Rated [V]	Current [A]	AWG
1 – 4	600	20	16 to 14
5 – 8		35	

CAUTION

For continued protection against risk of fire, replace only with same type 600 V, 20 or 35 A (UL CLASS CC) fuse.

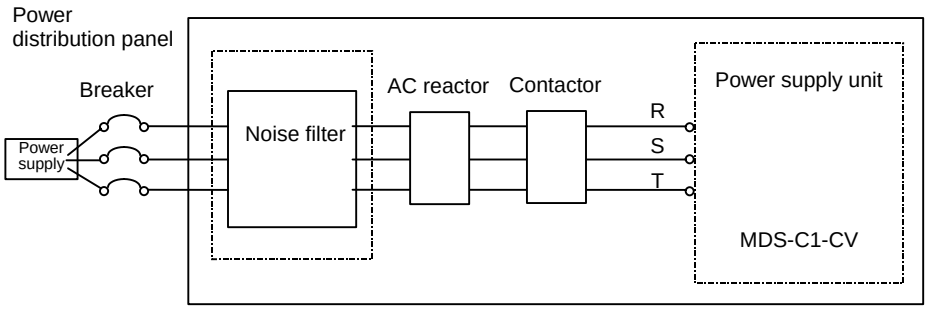
5-5 Noise filter

(1) Selection

Use an EMC noise filter if the noise conducted to the power line must be reduced. Select an EMC noise filter taking the power supply unit's input rated voltage and input rated current into consideration.

(2) Noise filter mounting position

Install the noise filter to the power supply unit's power input as the diagram below indicates.



(Note) The noise filter must be prepared by the user.

Recommended devices:	Okaya Electric Industries	3SUP-HL-ER-6B Series
	Soshin Electric	HF3000C-TMA Series

Contact:	Okaya Electric Industries Co., Ltd.	Telephone: 03-3424-8120 (+81-3-3424-8120) http://www.okayaelec.co.jp
	Soshin Electric Co., Ltd.	Telephone: 03-3775-9112 (+81-3-3775-9112) http://www.soshin.co.jp

(Note) The above devices may be changed at the manufacturer's discretion.
Contact each manufacturer for more information.

5-6 Surge absorber

When controlling a magnetic brake of a servomotor in DC OFF circuit, a surge absorber must be installed to protect the relay contacts and brakes. Commonly a varistor is used.

(1) Selection of varistor

When a varistor is installed in parallel with the coil, the surge voltage can be adsorbed as heat to protect a circuit. Commonly a 120V product is applied. When the brake operation time is delayed, use a 220V product. Always confirm the operation with an actual machine.

(2) Specifications

Select a varistor with the following or equivalent specifications. To prevent short-circuiting, attach a flame resistant insulation tube, etc., onto the leads as shown in the following outline dimension drawing.

Varistor specifications

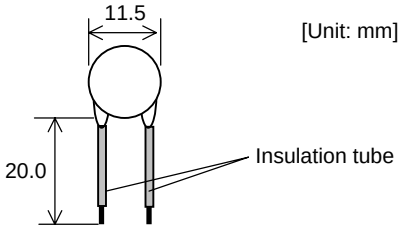
Varistor type	Varistor voltage rating (range)	Rating							Max. limit voltage	Electrostatic capacity (reference value)
		Tolerable circuit voltage		Surge current withstand level (A)		Energy withstand level (J)		Power		
	(V)	AC (V)	DC (V)	1 time	2 times	10/1000us	2ms	(W)	(V)	(pF)
ERZV10D121	120 (108 to 132)	75	100	3500	2500	20	14.5	0.4	200	1400
TNR10V121K										
ERZV10D221	220 (198 to 242)	140	180	3500	2500	39	27.5	0.4	360	410
TNR10V221K										

(Note 1) Selection condition: When ON/OFF frequency is 10 times/min or less, and exciting current is 2A or less

(Note 2) ERZV10D121 and ERZV10D221 are manufactured by Matsushita Electric Industrial Co., Ltd.
TNR10V121K and TNR10V221K are manufactured by MARCON Electronics Co., Ltd.
Contact: Matsushita Electronic Components Co., Ltd : http://www.panasonic.co.jp/ maco/
MARCON Electronics Co., Ltd. Telephone : (Kanto)03-3471-7041 (+81-3-3471-7041)
(Kinki) 06-6364-2381 (+81-3-6364-2381)
(Chubu) 052-581-2595 (+81-52-581-2595)

(3) Outline dimension drawing

• ERZV10D121, ERZV10D221



POINT

Normally use a product with 120V varistor voltage. If there is no allowance for the brake operation time, use the 220V product. A varistor whose voltage exceeds 220V cannot be used, as such varistor will exceed the specifications of the relay in the unit.

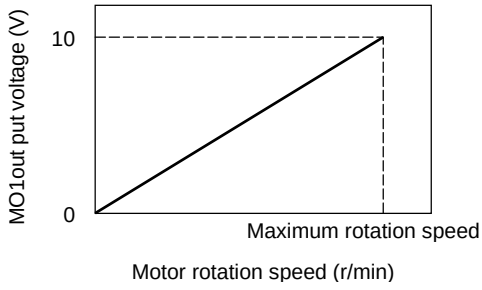
5-7 Speedometer and load meter

Speedometer and load meter can be output from the D/A output which is for measuring control data.

(1) Speedometer output

When speedometer is output, +10V DC is output at the motor's maximum speed regardless of the motor's rotation direction. The following specifications are recommended for the display.

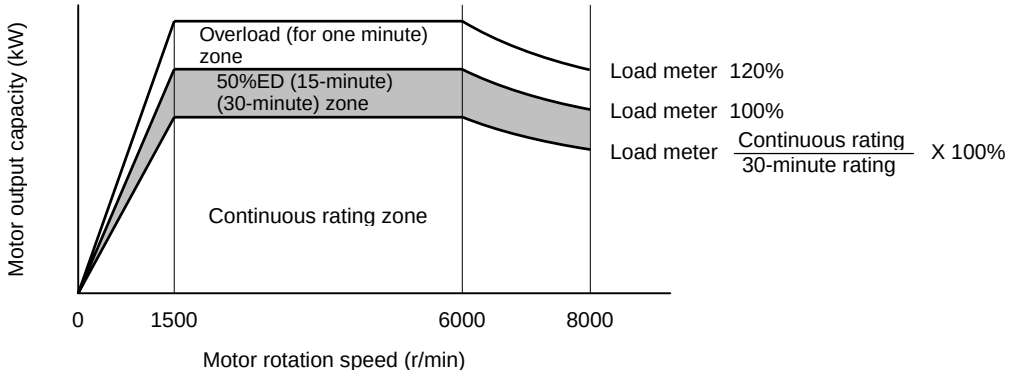
(a) Type YM-8G type DC voltage type (Mitsubishi)
(b) Rating 10VDC full scale
(c) Internal impedance approx. 10kΩ



Speedometer output specification

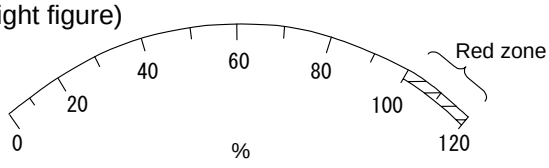
(2) Load meter output

The load meter indicates the percentage of the load in respect to the motor's rated output. The relation of the motor output capacity [kW] and load meter display [%] is as follows.



Load meter output specification

The following specifications are recommended for the display.
(a) Type YM-8G type DC voltage type (Mitsubishi)
(b) Rating 10VDC full scale
(c) Internal impedance approx. 10kΩ
(d) Scale indicating alarm at 100% or above (see right figure)

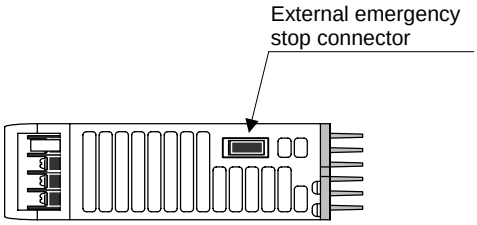


Load meter display

5-8 Cable for peripheral control

5-8-1 Cable for external emergency stop

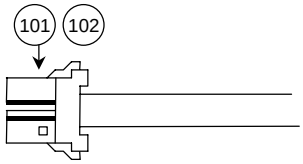
Prepare the cable below for external emergency stop function (dual emergency stop function). The cable for external emergency stop must be prepared by the user.

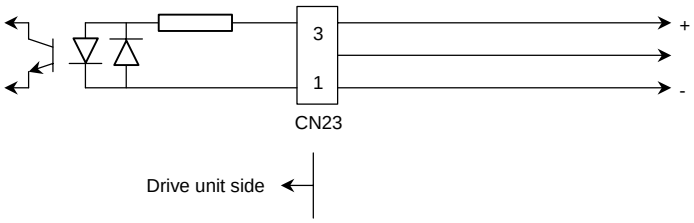


Bottom view of MDS-C1-CV

No.	Item	Type	Manufacturer
101	Connector	2-178288-3	Tyco Electronics AMP
102	Contact	1-175218-2	Tyco Electronics AMP

Wire size:0.5 to 1.25SQ



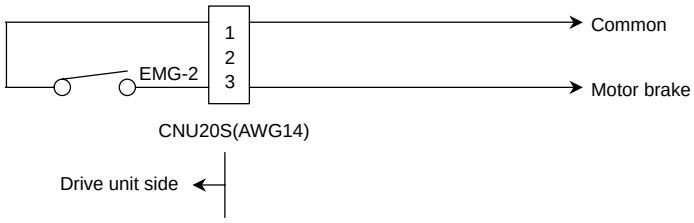


5-8-2 Cable for servomotor magnetic brake

Prepare the cable according to the servo system specifications.

(1) Magnetic brake control for 9kW or less servomotor

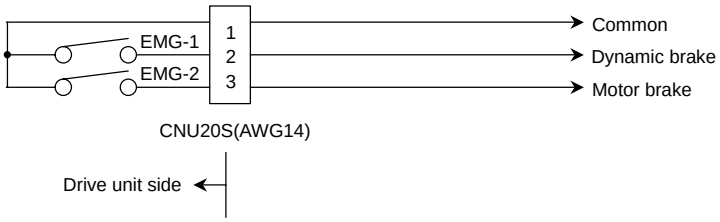
Use CN20 connector output to control a motor magnetic brake. Refer to the section "3-1-5 Magnetic brake" for the connection details.



Connection of CN20 connector

(2) Magnetic brake and dynamic brake control for 11kW or 15kW servomotor

Use a dynamic brake output as well as a motor magnetic brake output for using a dynamic brake unit (MDS-B-DBU-150). Refer to the sections "3-1-5 Magnetic brake" and "4-1-2 Dynamic brake unit" for the connection details.



Connection of CN20 connector when a dynamic brake unit is used

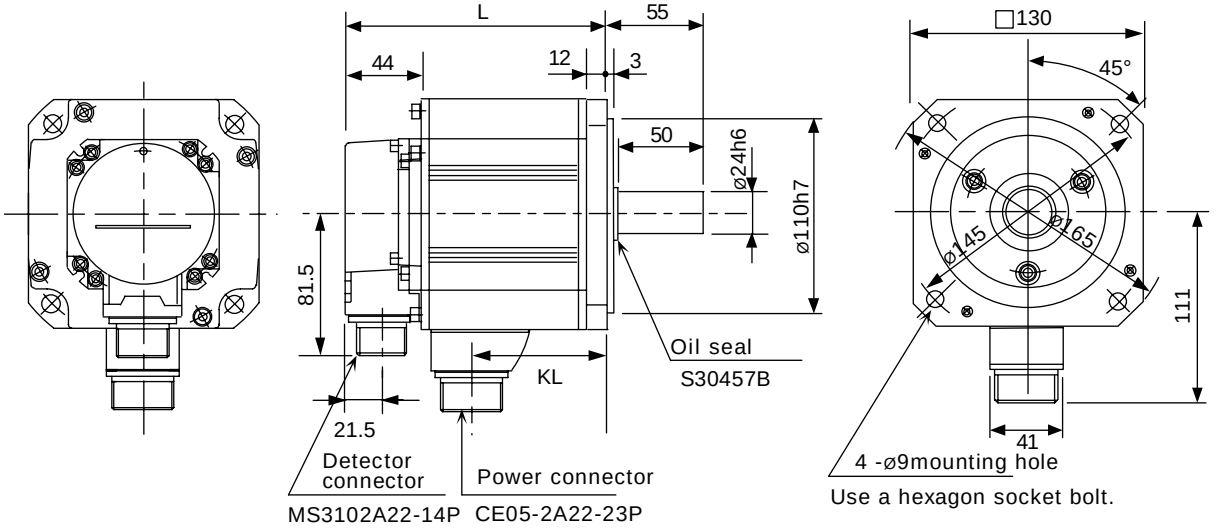
Appendix 1. Outline Dimension Drawings

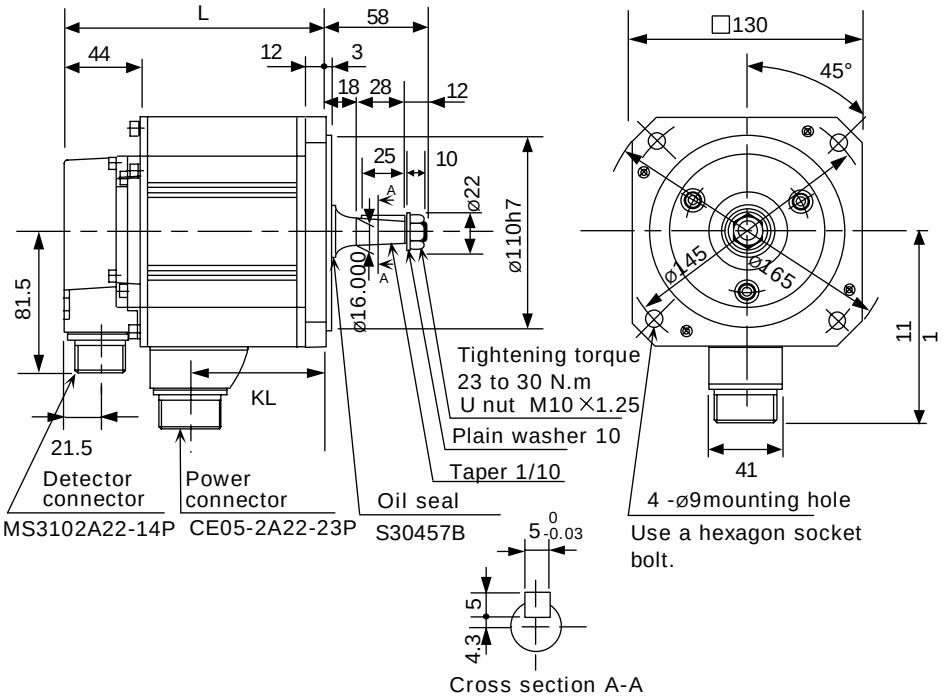
Appendix 1-1 Servomotor outline dimension drawings

Appendix 1-1-1 HC Series

- HC52 (B) S (W)
- HC52 (B) T (W)
- HC53 (B) S (W)
- HC53 (B) T (W)
- HC102 (B) S (W)
- HC102(B) T (W)
- HC103 (B) S (W)
- HC103 (B) T (W)
- HC152 (B) S (W)
- HC152(B) T (W)
- HC153 (B) S (W)
- HC153 (B) T (W)

[Unit: mm]



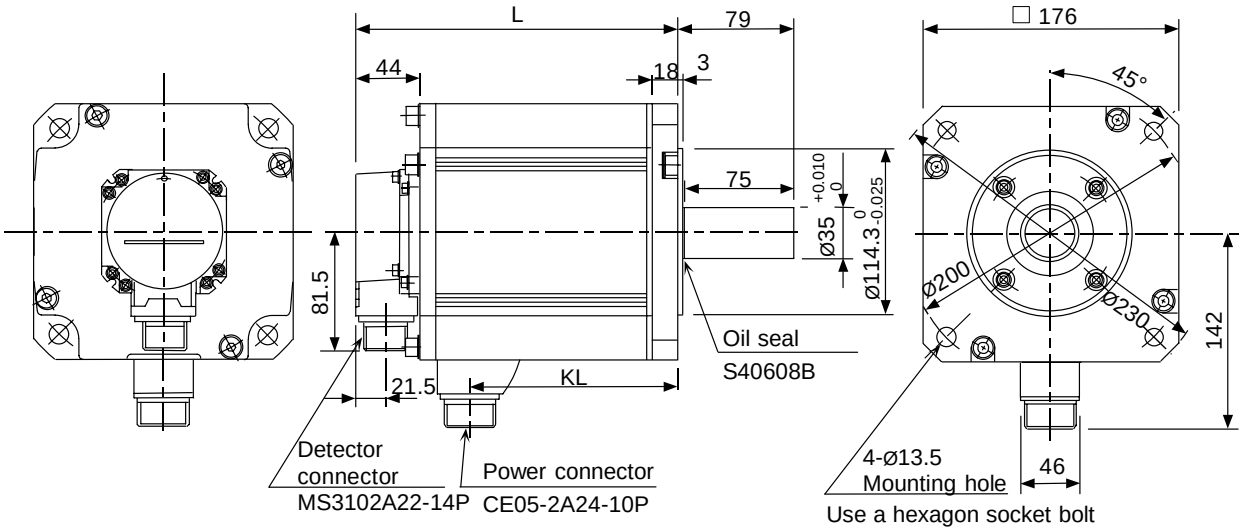


Servomotor type		IP65 specifications		IP67 specifications (With W)	
2000r/min	3000r/min	L (Note 1)	KL	L (Note 1)	KL
HC52 (B)	HC53 (B)	125 (158)	52	135 (168)	52
HC102 (B)	HC103 (B)	150 (183)	77	160 (193)	77
HC152 (B)	HC153 (B)	175 (208)	102	185 (218)	102

(Note 1) The dimensions given in parentheses apply for the servomotor with magnetic brakes.
(Note 2) Use a friction coupling (Spun ring, etc.) to connect with the load.
(Note 3) Attach the cannon connector facing downward to improve the splash-proof performance.

• HC202S (W) • HC352S (W) • HC452S (W)
• HC203S (W) • HC353S (W)

[Unit: mm]

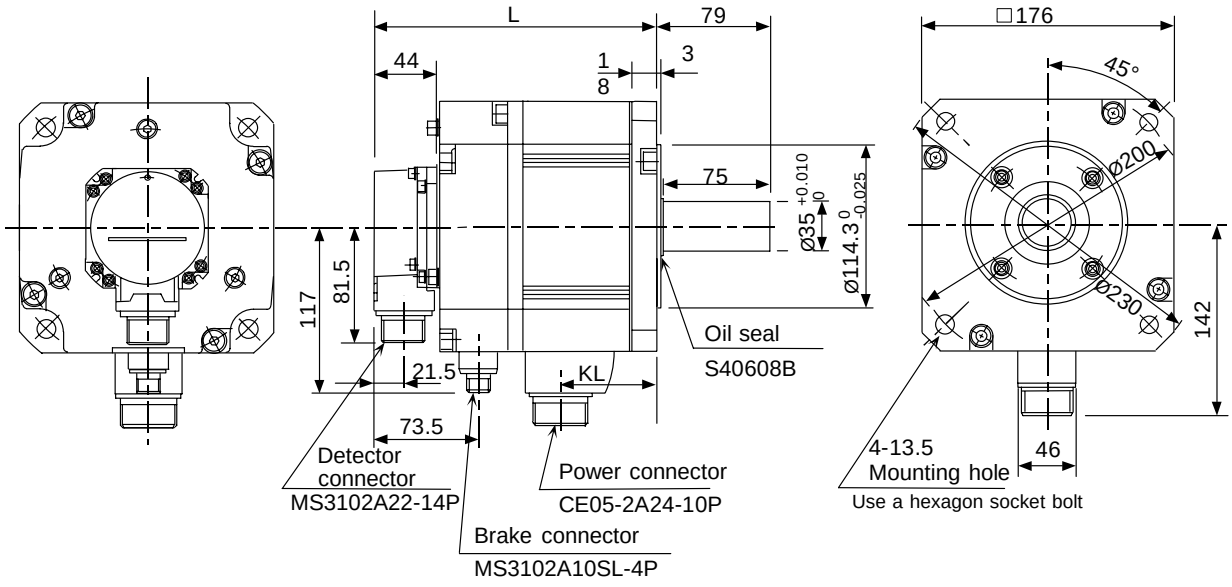


Servomotor type		L	KL
2000r/min	3000r/min		
HC202S	HC203S	150	69
HC352S	HC353S	192	111
HC452S	–	234	153

(Note 1) Use a friction coupling (Spun ring, etc.) to connect with the load.
(Note 2) Attach the cannon connector facing downward to improve the splash-proof performance.
(Note 3) The same dimensions apply for the IP67 specifications (with W).

• HC202BS (W) • HC352BS (W) • HC452BS (W)
• HC203BS (W) • HC353BS (W)

[Unit: mm]

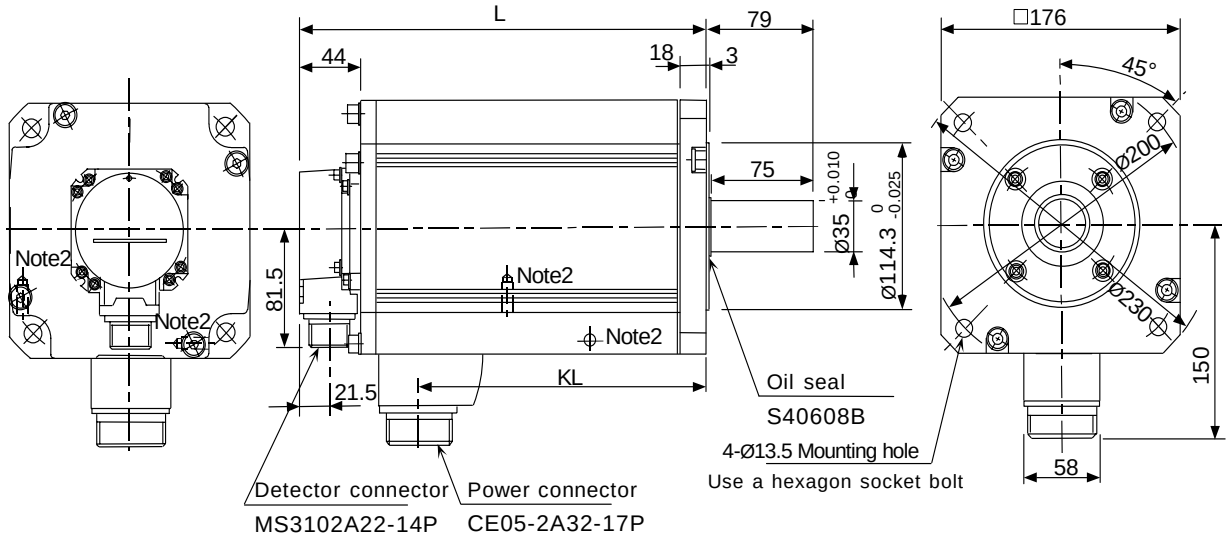


Servomotor type		L	KL
2000r/min	3000r/min		
HC202BS	HC203BS	198	69
HC352BS	HC353BS	240	111
HC452BS	–	282	153

(Note 1) Use a friction coupling (Spun ring, etc.) to connect with the load.
(Note 2) Attach the cannon connector facing downward to improve the splash-proof performance.
(Note 3) The same dimensions apply for the IP67 specifications (with W).

- HC702S (W)
- HC453S (W) • HC703S (W)

[Unit: mm]

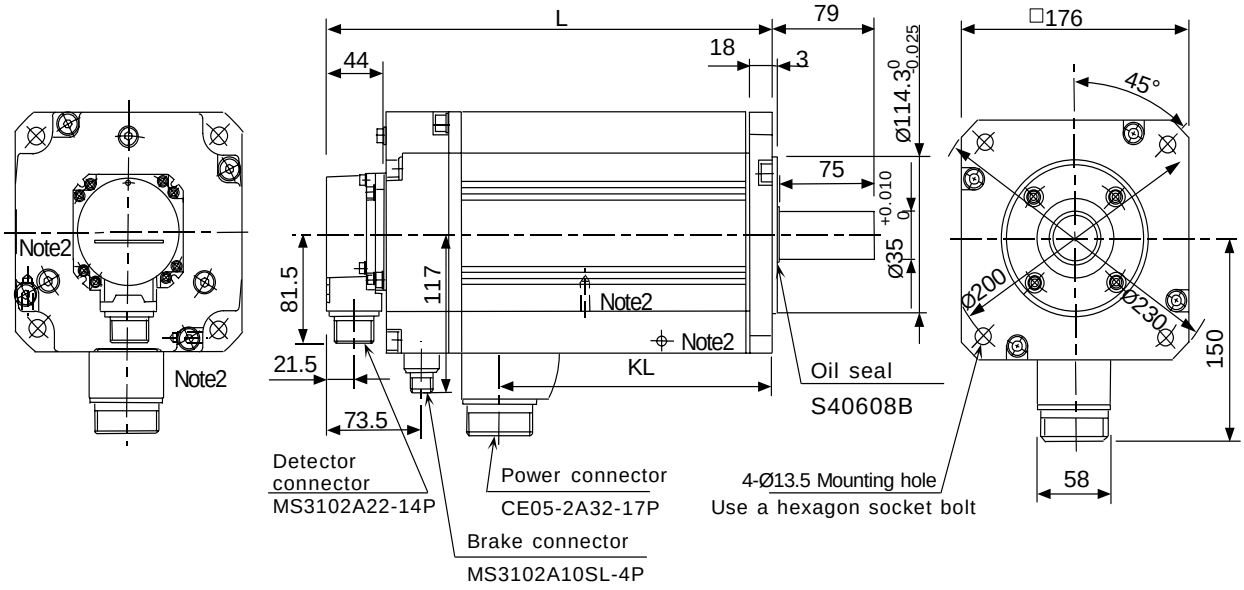


Servomotor type		L	KL
2000r/min	3000r/min		
–	**HC453S**	234	148
HC702S	**HC703S**	297	211

(Note 1) Use a friction coupling (Spun ring, etc.) to connect with the load.
(Note 2) This applies for the HC702S and HC703S. The HC453S does not have the suspension bolt screw hole (M8).
(Note 3) Attach the cannon connector facing downward to improve the splash-proof performance.
(Note 4) The same dimensions apply for the IP67 specifications (with W).

- HC702BS (W)
- HC453BS (W) • HC703BS(W)

[Unit: mm]

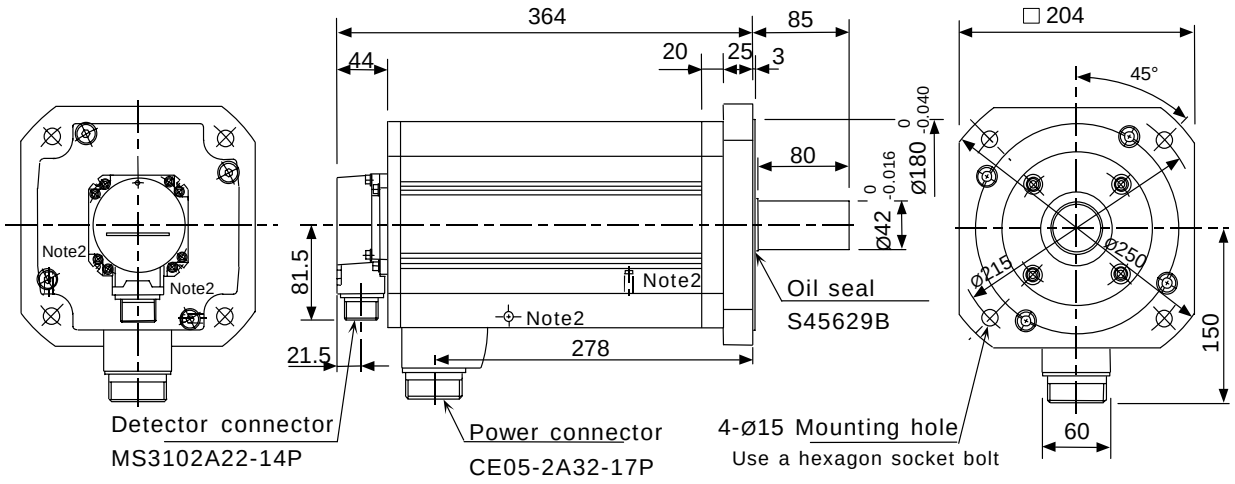


Servomotor type		L	KL
2000r/min	3000r/min		
–	**HC453BS**	282	148
HC702BS	**HC703BS**	345	211

(Note 1) Use a friction coupling (Spun ring, etc.) to connect with the load.
(Note 2) This applies for the HC702BS and HC703BS. The HC453BS does not have the suspension bolt screw hole (M8).
(Note 3) Attach the cannon connector facing downward to improve the splash-proof performance.
(Note 4) The same dimensions apply for the IP67 specifications (with W).

• HC902S (W)

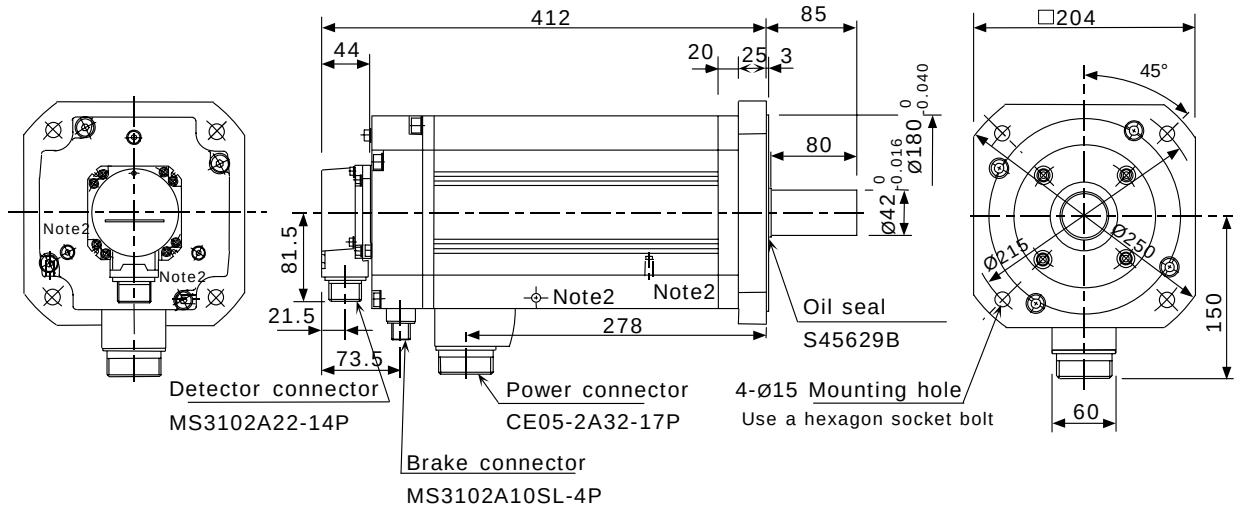
[Unit: mm]



(Note 1) Use a friction coupling (Spun ring, etc.) to connect with the load.
(Note 2) This is the suspension bolt screw hole (M8).
(Note 3) Attach the cannon connector facing downward to improve the splash-proof performance.
(Note 4) The same dimensions apply for the IP67 specifications (with W).

• HC902BS (W)

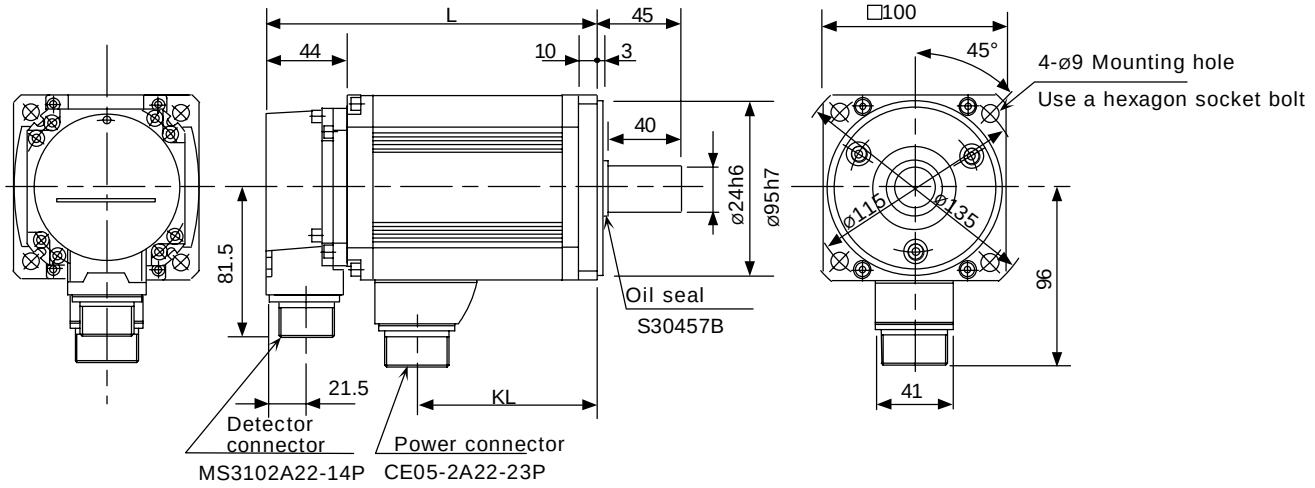
[Unit: mm]

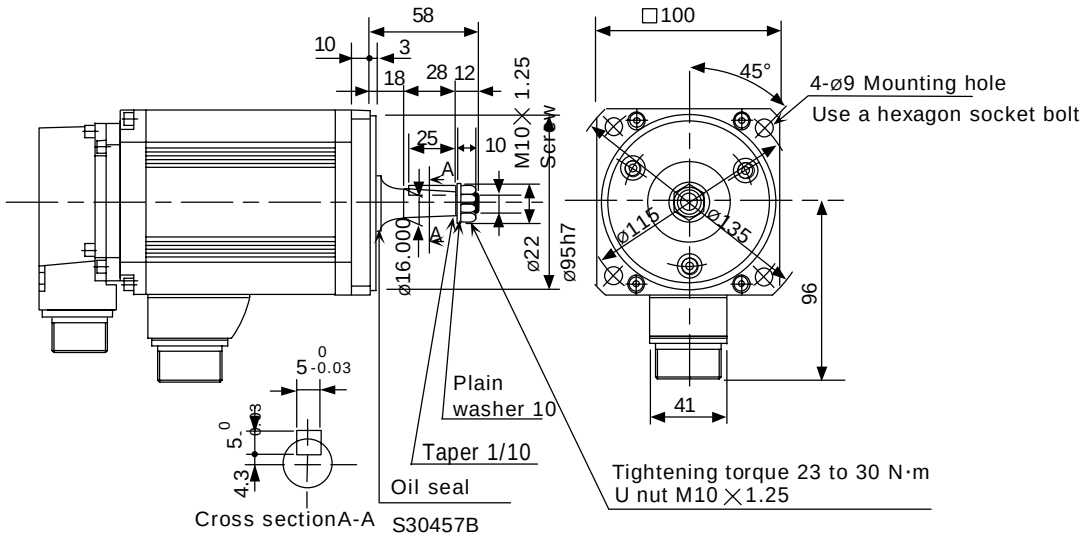


(Note 1) Use a friction coupling (Spun ring, etc.) to connect with the load.
(Note 2) This is the suspension bolt screw hole (M8).
(Note 3) Attach the cannon connector facing downward to improve the splash-proof performance.
(Note 4) The same dimensions apply for the IP67 specifications (with W).

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

[Unit: mm]



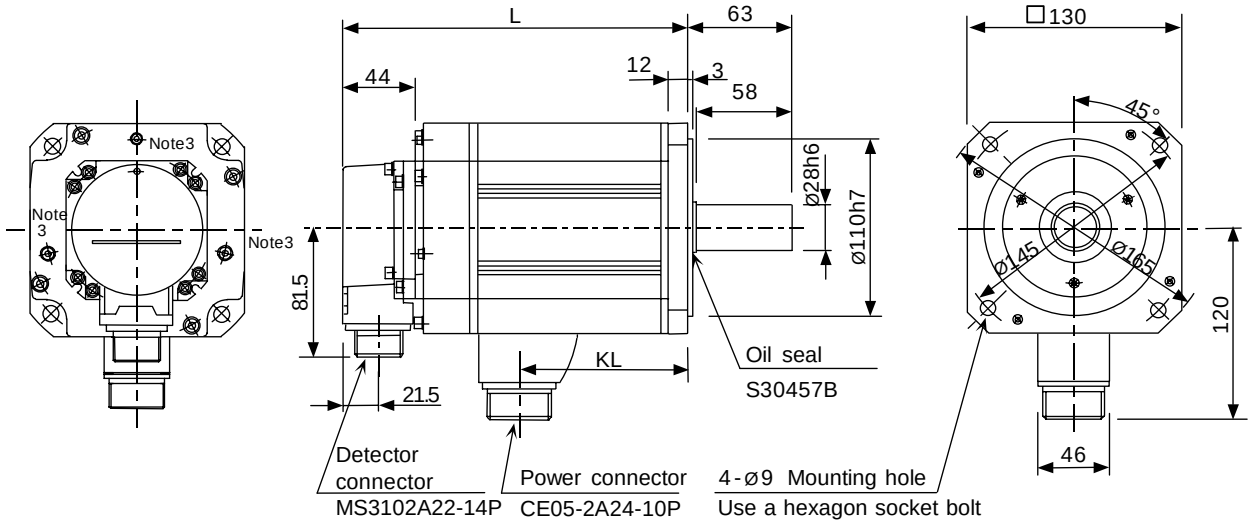


Servomotor type	L (Note 1)	KL
HC103R (B)	152 (189)	71
HC153R (B)	177 (214)	96
HC203R (B)	202 (239)	121

(Note 1) The dimensions given in parentheses apply for the servomotor with magnetic brakes.
(Note 2) Use a friction coupling (Spun ring, etc.) to connect with the load.
(Note 3) Attach the cannon connector facing downward to improve the splash-proof performance.

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

[Unit: mm]



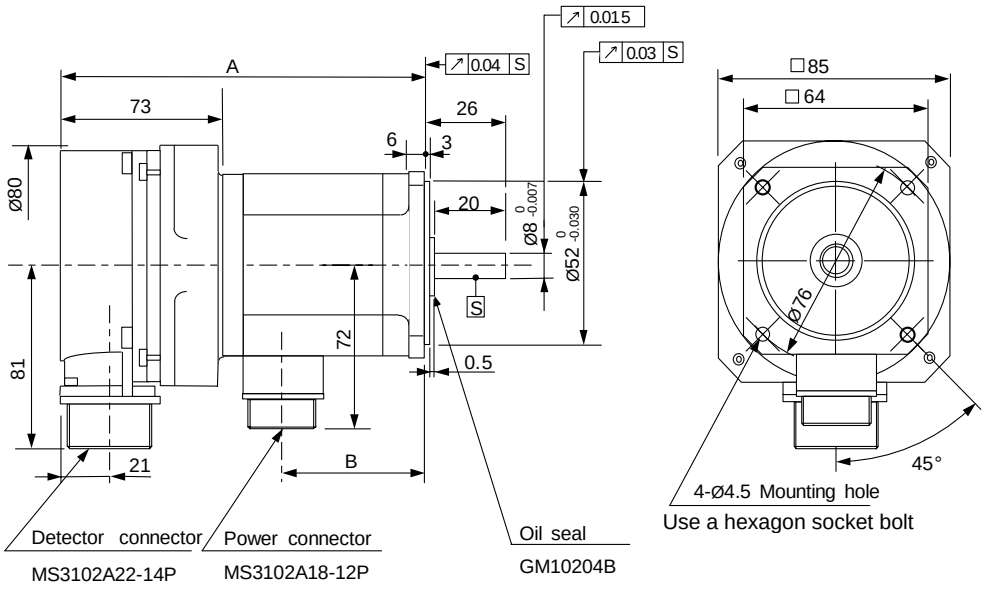
Servomotor type	L (Note 1)	KL
HC353R (B) S	222 (258)	148
HC503R (B) S	279 (315)	205

(Note 1) The dimensions given in parentheses apply for the servomotor with magnetic brakes.
(Note 2) Use a friction coupling (Spun ring, etc.) to connect with the load.
(Note 3) This is for the magnetic brakes.
(Note 4) Attach the cannon connector facing downward to improve the splash-proof performance.

Appendix 1-1-2 HA Series

- HA053NS
- HA13NS

[Unit: mm]

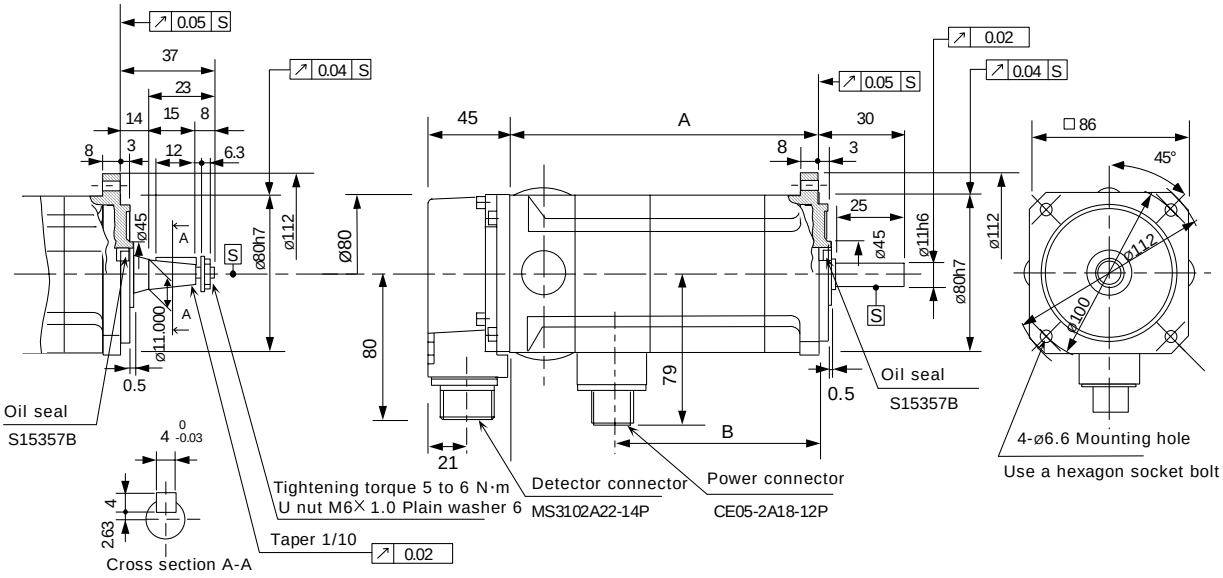


Servomotor type	A	B
HA053NS	139	43
HA13NS	156	60

(Note 1) Use a friction coupling (Spun ring, etc.) to connect with the load.
(Note 2) Attach the cannon connector facing downward to improve the splash-proof performance.
(Note 3) The servomotor with magnetic brakes is a special specification part. Contact the respective sales office or dealer for details.

- HA23NT
- HA33NT
- HA23NS
- HA33NS

[Unit: mm]

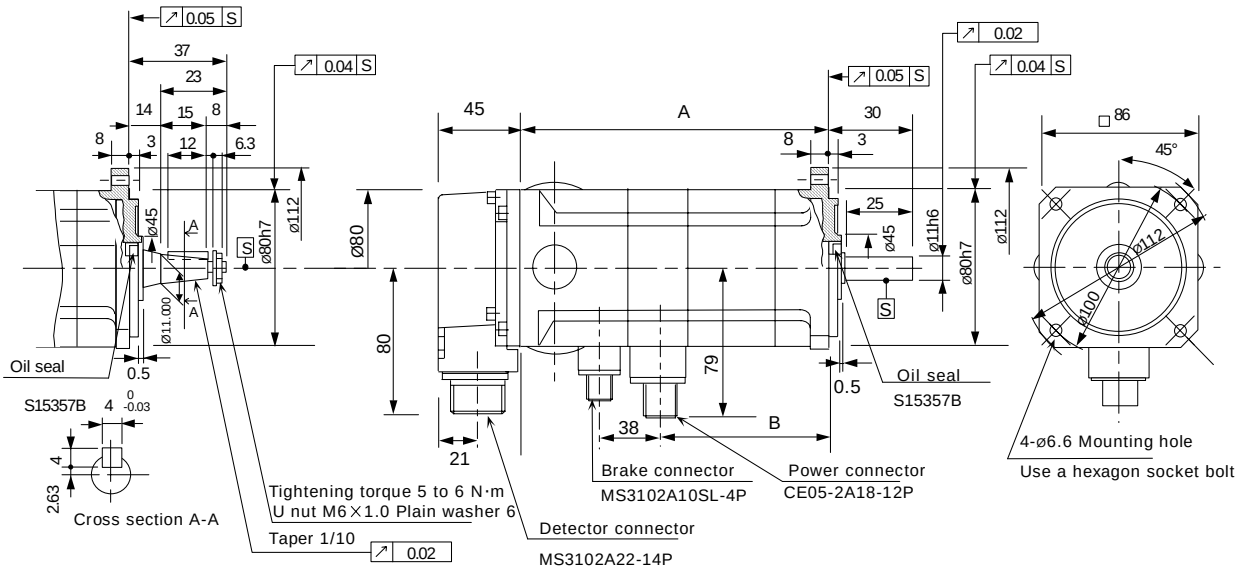


Servomotor type	A	B
HA23N	125	81
HA33N	155	111

(Note 1) Use a friction coupling (Spun ring, etc.) to connect with the load.
(Note 2) Attach the cannon connector facing downward to improve the splash-proof performance.

- HA23NBT
- HA33NBT
- HA23NBS
- HA33NBS

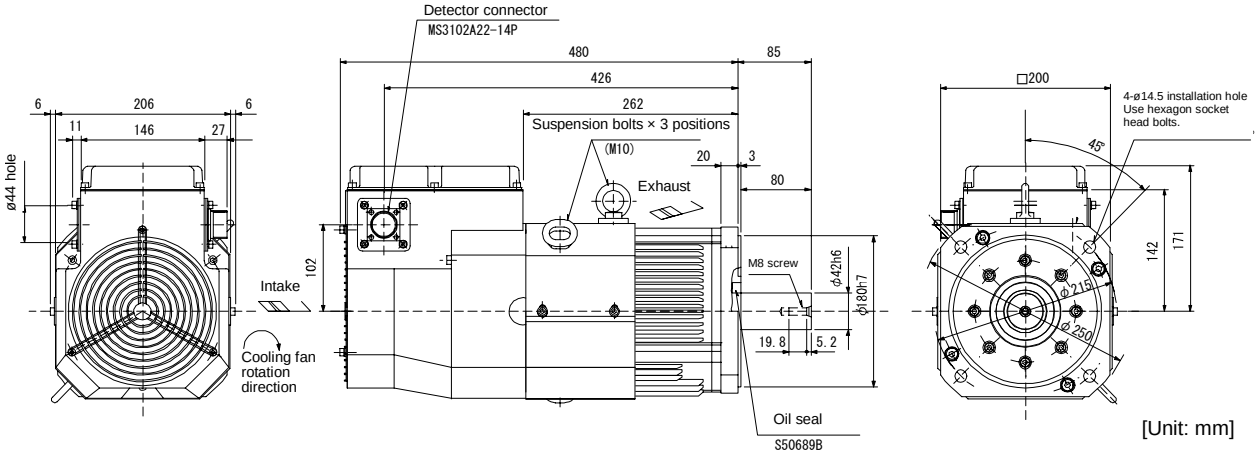
[Unit: mm]



Servomotor type	A	B
HA23NB	162	81
HA33NB	192	111

(Note 1) Use a friction coupling (Spun ring, etc.) to connect with the load.
(Note 2) Attach the cannon connector facing downward to improve the splash-proof performance.

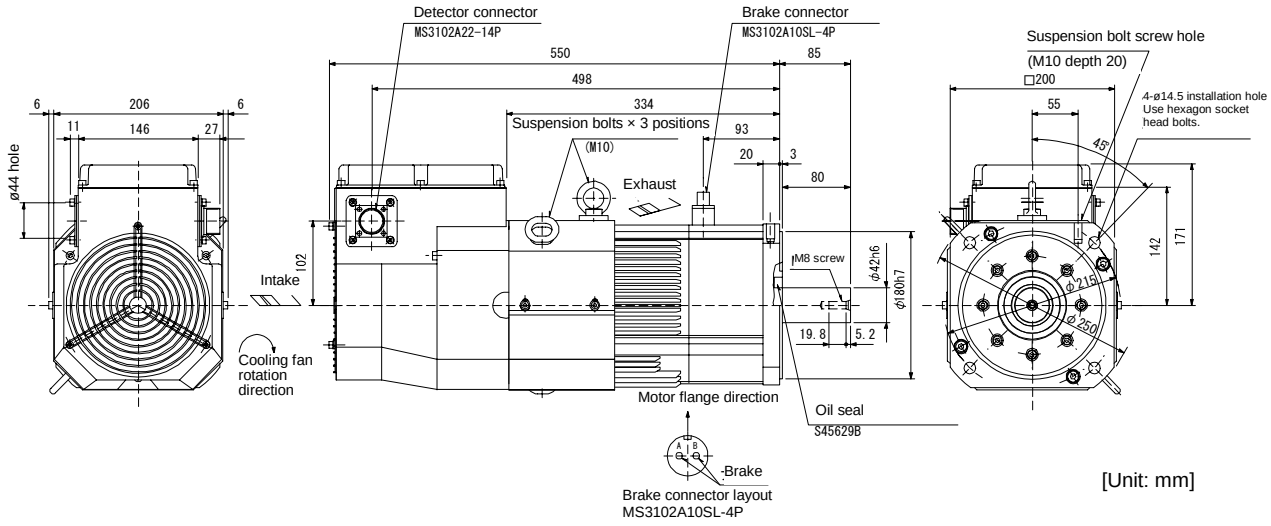
• HA-LF11K2-S8



[Unit: mm]

(Note 1) Use a friction coupling (Spun ring, etc.) to connect with the load.
(Note 2) If the suspension bolts are removed during operation, plug the screw holes with M10×20 or smaller bolts.

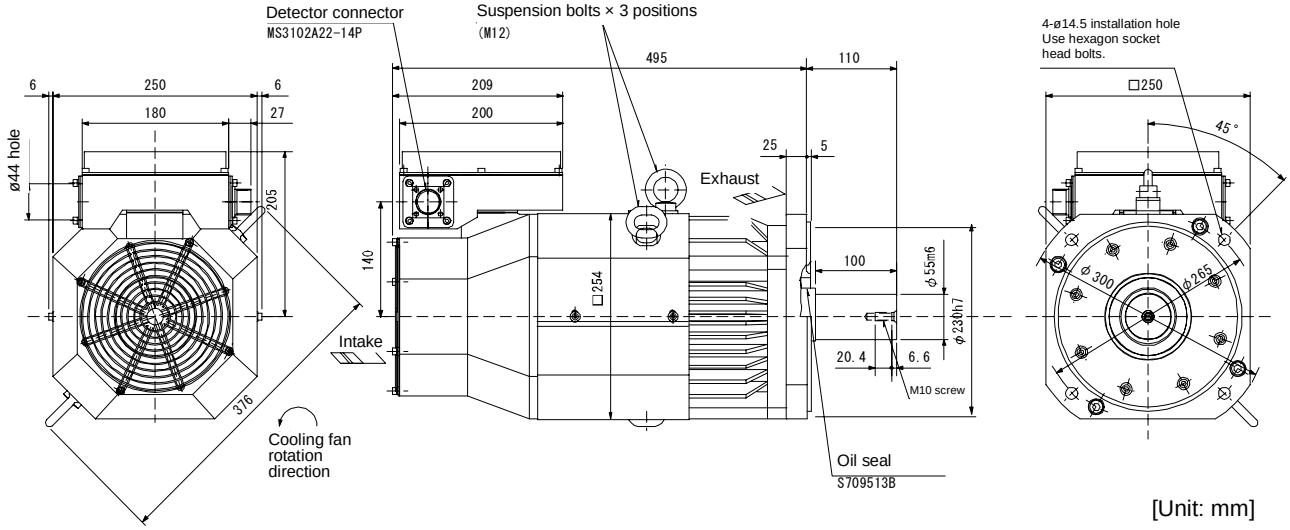
• HA-LF11K2B-S8



[Unit: mm]

(Note 1) Use a friction coupling (Spun ring, etc.) to connect with the load.
(Note 2) If the suspension bolts are removed during operation, plug the screw holes with M10×20 or smaller bolts.

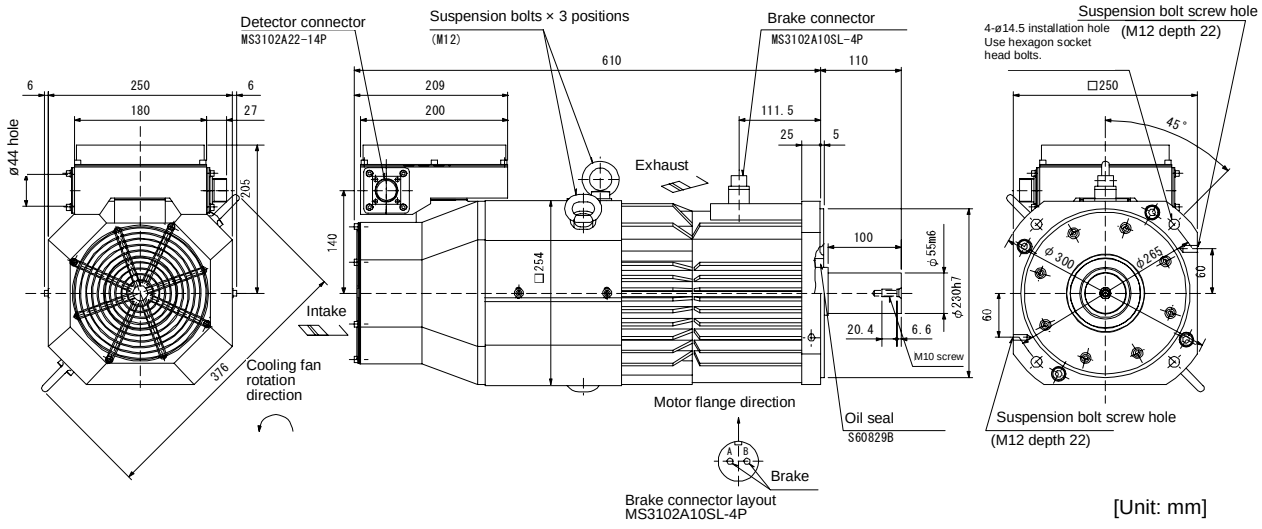
• HA-LF15K2-S8



[Unit: mm]

(Note 1) Use a friction coupling (Spun ring, etc.) to connect with the load.
(Note 2) If the suspension bolts are removed during operation, plug the screw holes with M10×20 or smaller bolts.

• HA-LF15K2B-S8



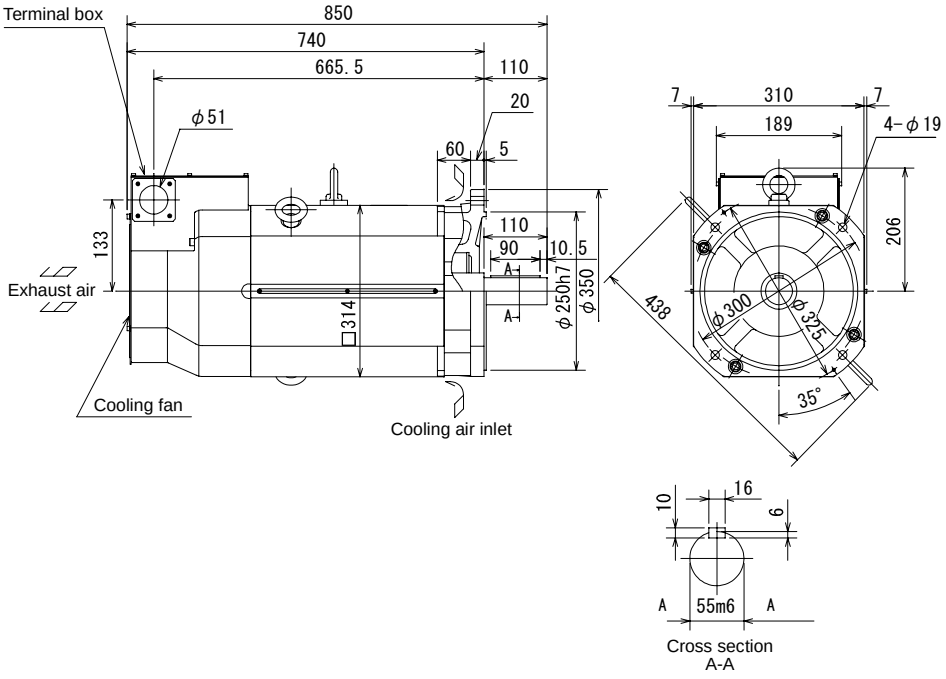
[Unit: mm]

(Note 1) Use a friction coupling (Spun ring, etc.) to connect with the load.
(Note 2) If the suspension bolts are removed during operation, plug the screw holes with M10×20 or smaller bolts.

Appendix 1-2 Outline dimension drawings of spindle motor

Appendix 1-2-1 SJ Series

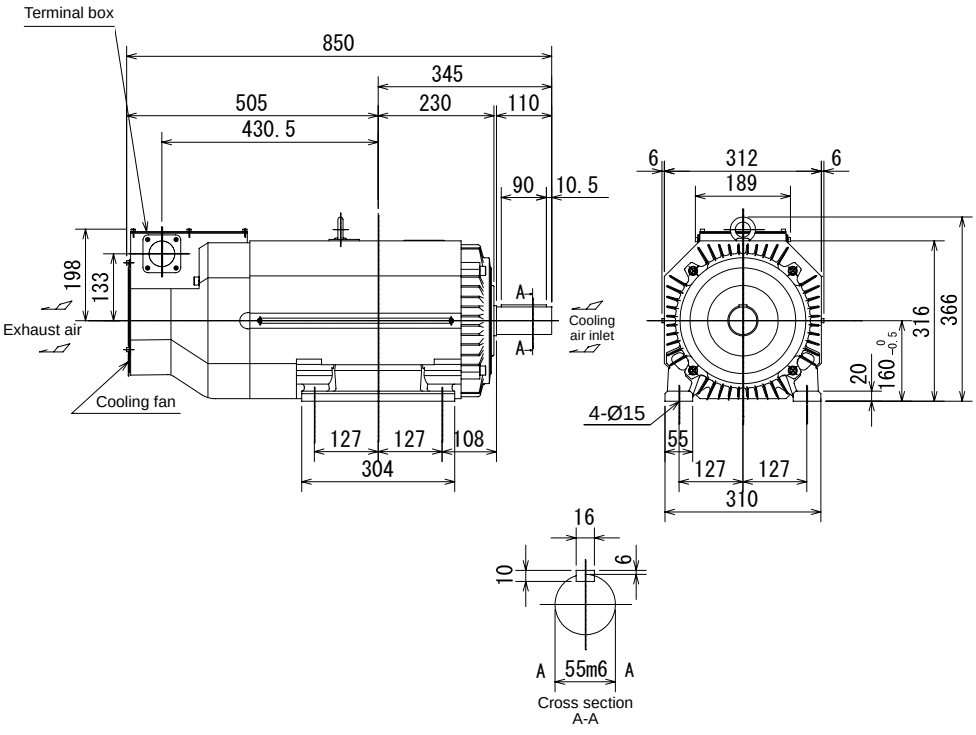
- SJ-30A with standard flange



[Unit: mm]

(Note 1) Provide a clearance of 30mm or more between the cooling fan and wall.
(Note 2) The shaft can also be mounted upward.
(Note 3) If the suspension bolts are removed during operation, plug the screw holes with bolts.

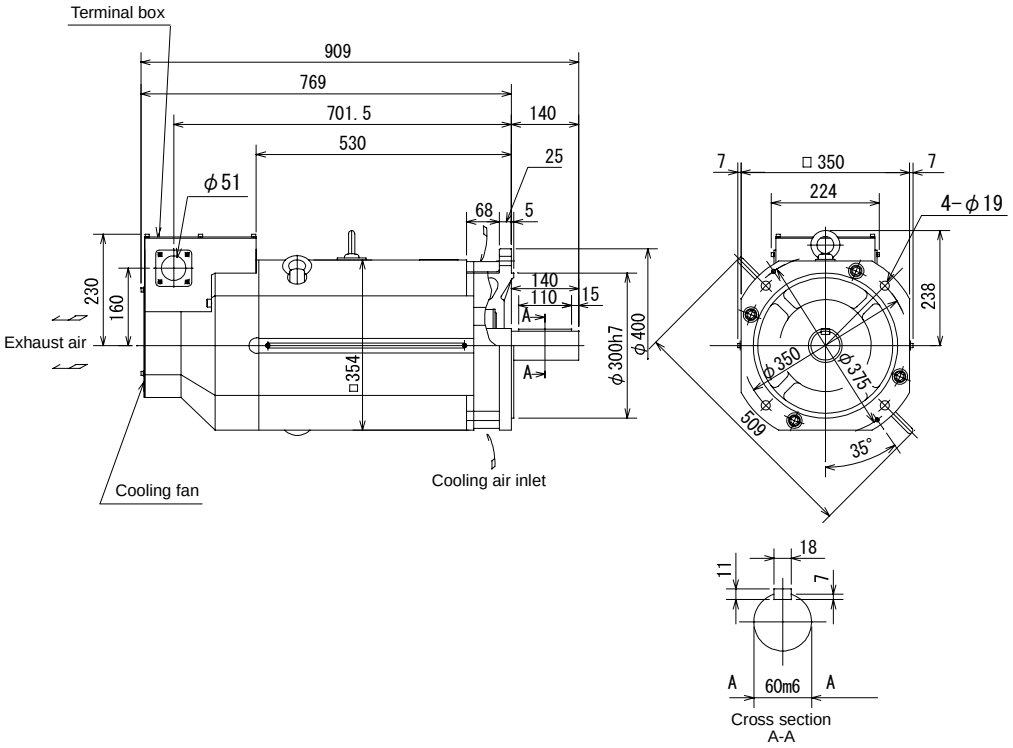
- SJ-30A with standard legs



[Unit: mm]

(Note 1) Provide a clearance of 30mm or more between the cooling fan and wall.
(Note 2) If the suspension bolts are removed during operation, plug the screw holes with bolts.

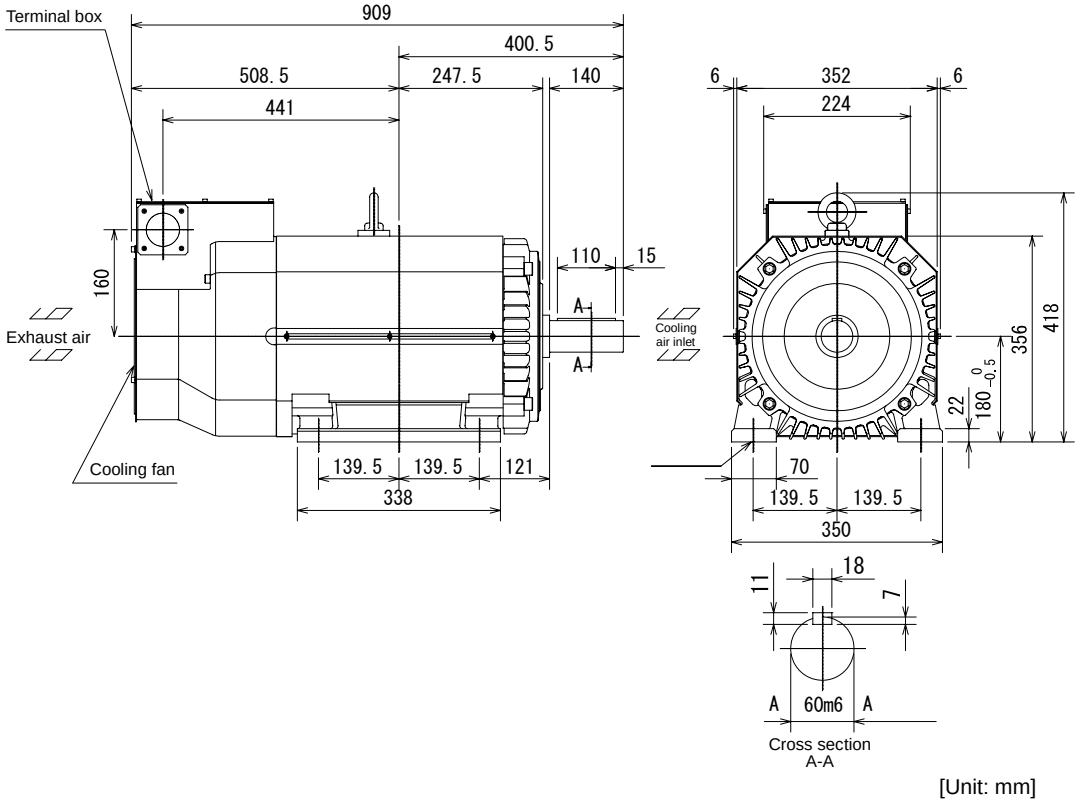
• SJ-37BP, SJ-22XW5 with standard flange



[Unit: mm]

(Note 1) Provide a clearance of 30mm or more between the cooling fan and wall.
(Note 2) The shaft can also be mounted upward.
(Note 3) If the suspension bolts are removed during operation, plug the screw holes with bolts.

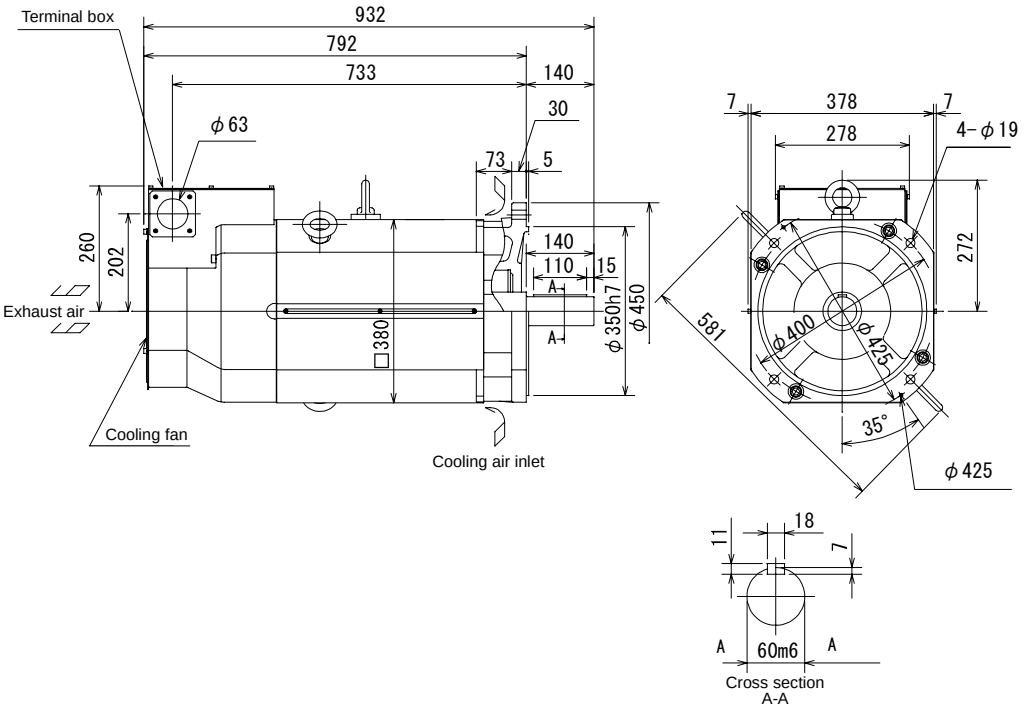
• SJ-37BP, SJ-22XW5 with standard legs



[Unit: mm]

(Note 1) Provide a clearance of 30mm or more between the cooling fan and wall.
(Note 2) If the suspension bolts are removed during operation, plug the screw holes with bolts.

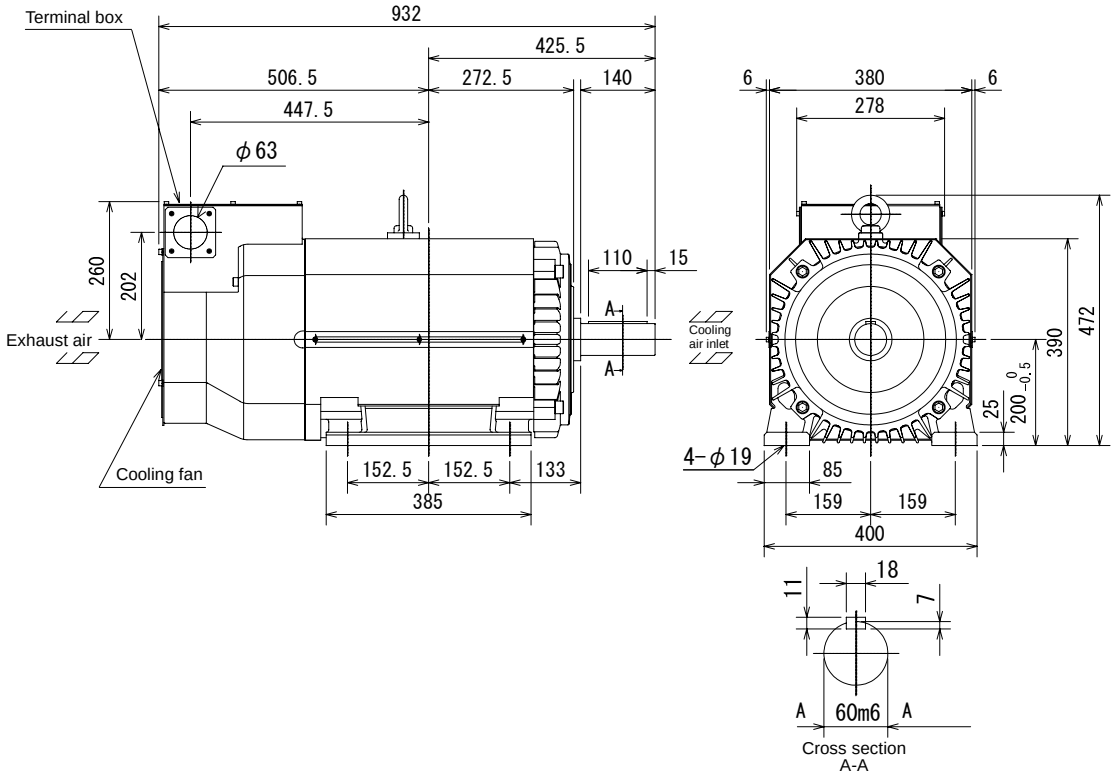
• SJ-45BP, SJ-22XW8 with standard flange



[Unit: mm]

(Note 1) Provide a clearance of 30mm or more between the cooling fan and wall.
(Note 2) The shaft can also be mounted upward.
(Note 3) If the suspension bolts are removed during operation, plug the screw holes with bolts.

• SJ-45BP, SJ-22XW8 with standard legs

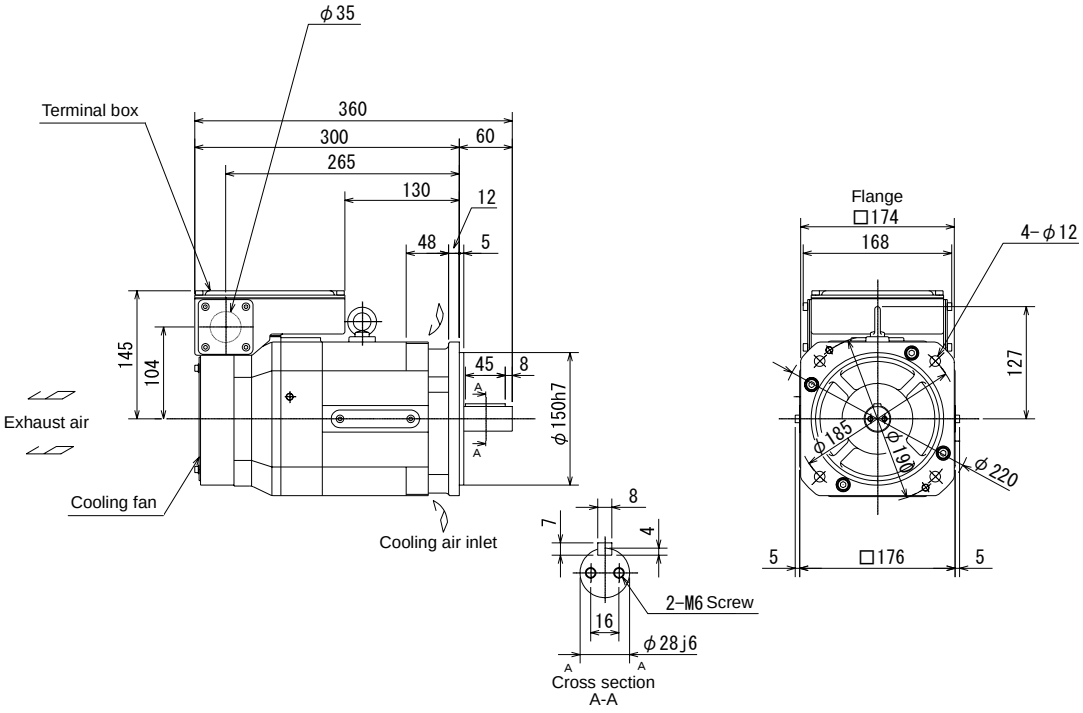


[Unit: mm]

(Note 1) Provide a clearance of 30mm or more between the cooling fan and wall.
(Note 2) If the suspension bolts are removed during operation, plug the screw holes with bolts.

Appendix 1-2-2 SJ-V Series

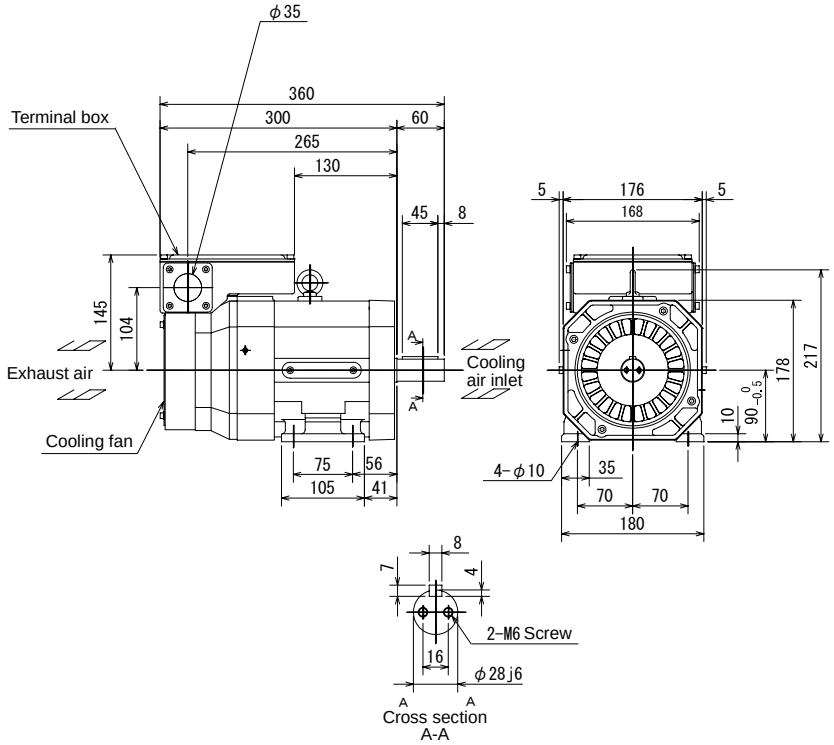
- SJ-V2.2-01, SJ-V3.7-02ZM with standard flange



[Unit: mm]

(Note 1) Provide a clearance of 30mm or more between the cooling fan and wall.
(Note 2) The shaft can also be mounted upward.
(Note 3) If the suspension bolts are removed during operation, plug the screw holes with bolts.

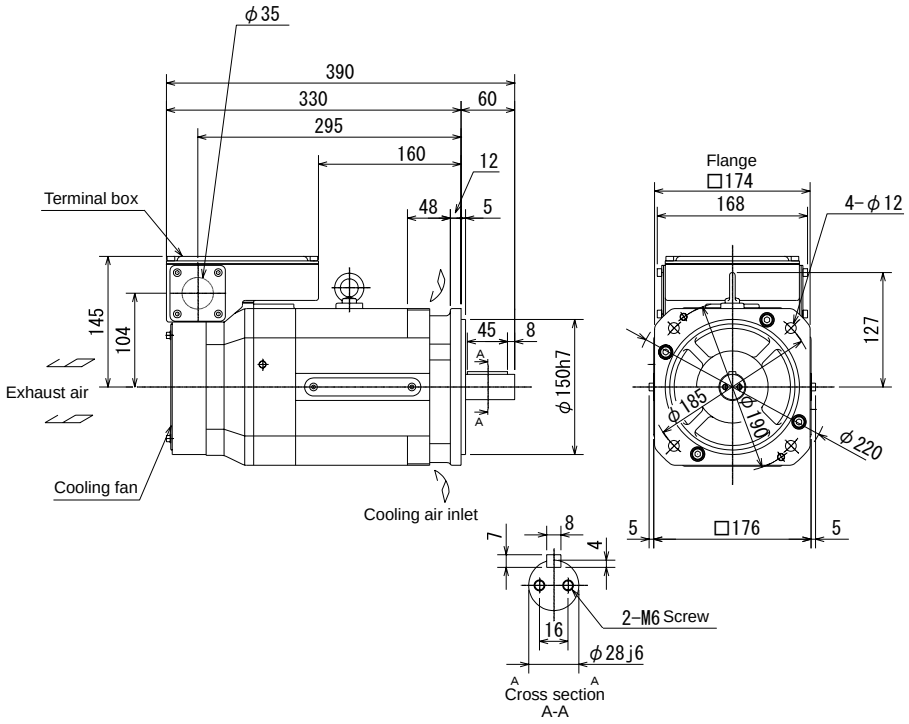
- SJ-V2.2-01, SJ-V3.7-02ZM with standard legs



[Unit: mm]

(Note 1) Provide a clearance of 30mm or more between the cooling fan and wall.
(Note 2) The shaft can also be mounted upward.
(Note 3) If the suspension bolts are removed during operation, plug the screw holes with bolts.

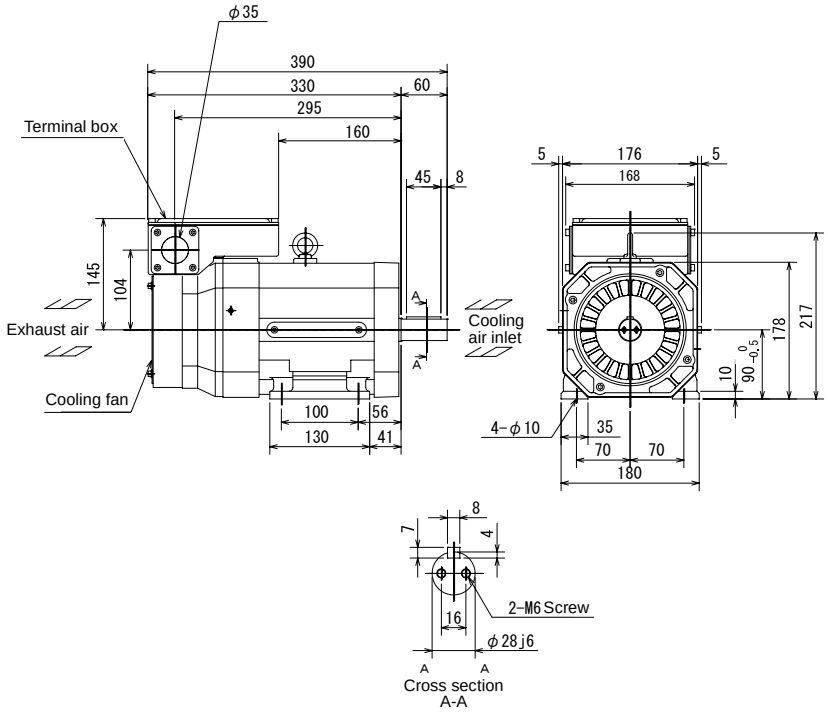
• SJ-V3.7-01 with standard flange



[Unit: mm]

(Note 1) Provide a clearance of 30mm or more between the cooling fan and wall.
(Note 2) The shaft can also be mounted upward.
(Note 3) If the suspension bolts are removed during operation, plug the screw holes with bolts.

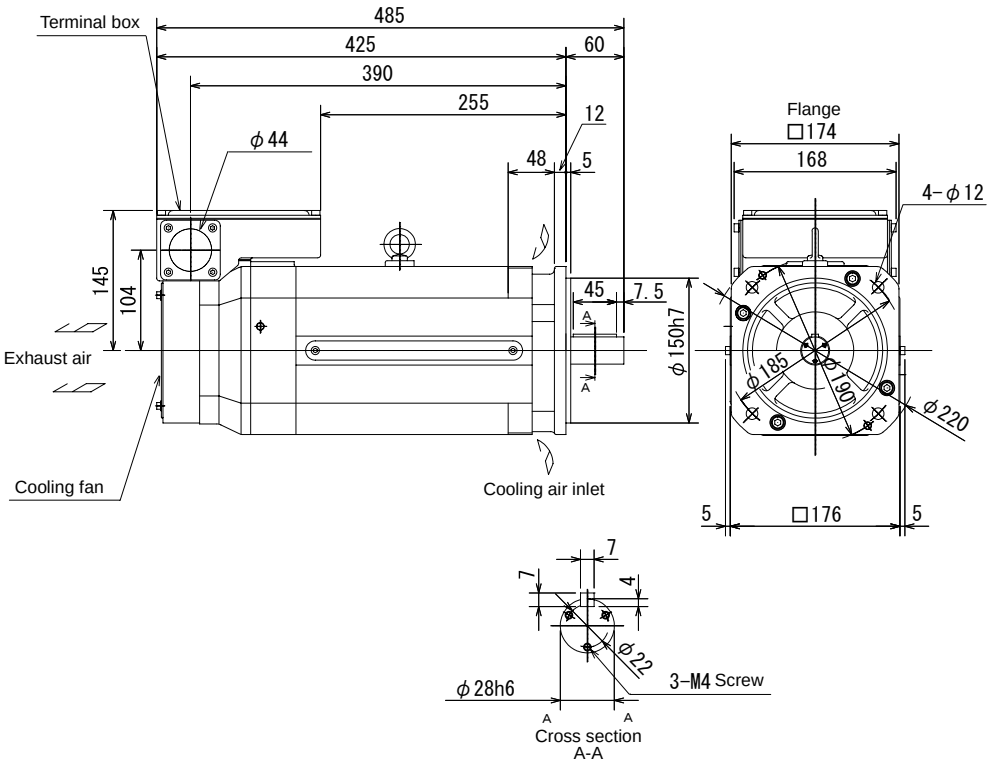
• SJ-V3.7-01 with standard legs



[Unit: mm]

(Note 1) Provide a clearance of 30mm or more between the cooling fan and wall.
(Note 2) The shaft can also be mounted upward.
(Note 3) If the suspension bolts are removed during operation, plug the screw holes with bolts.

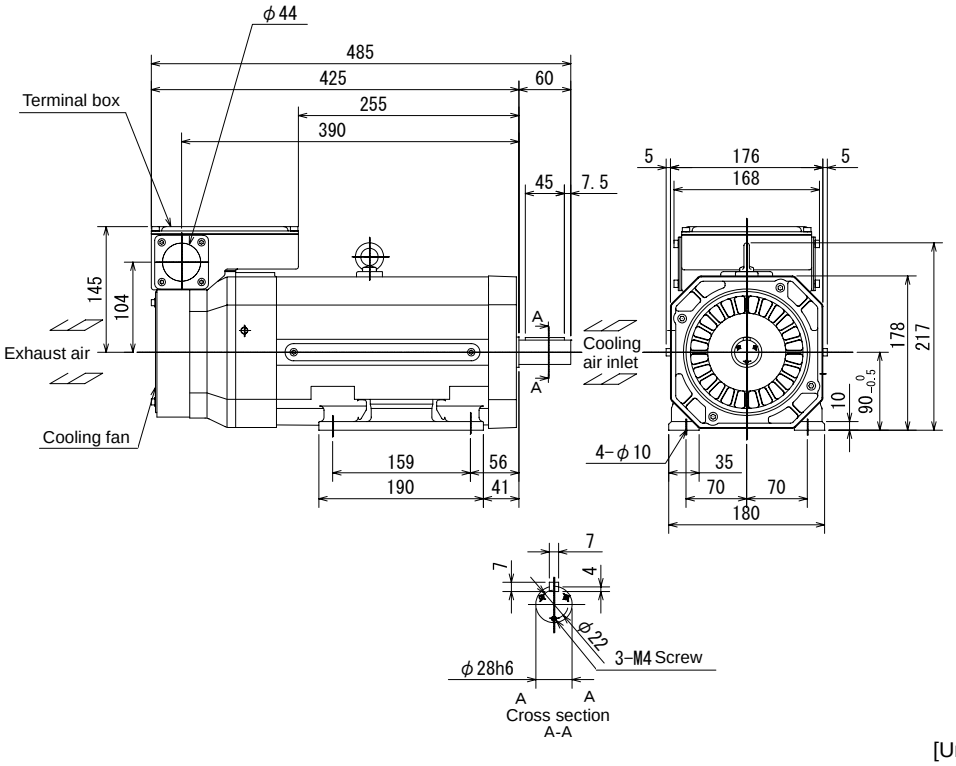
• SJ-V5.5-01 with standard flange



[Unit: mm]

(Note 1) Provide a clearance of 30mm or more between the cooling fan and wall.
(Note 2) The shaft can also be mounted upward.
(Note 3) If the suspension bolts are removed during operation, plug the screw holes with bolts.

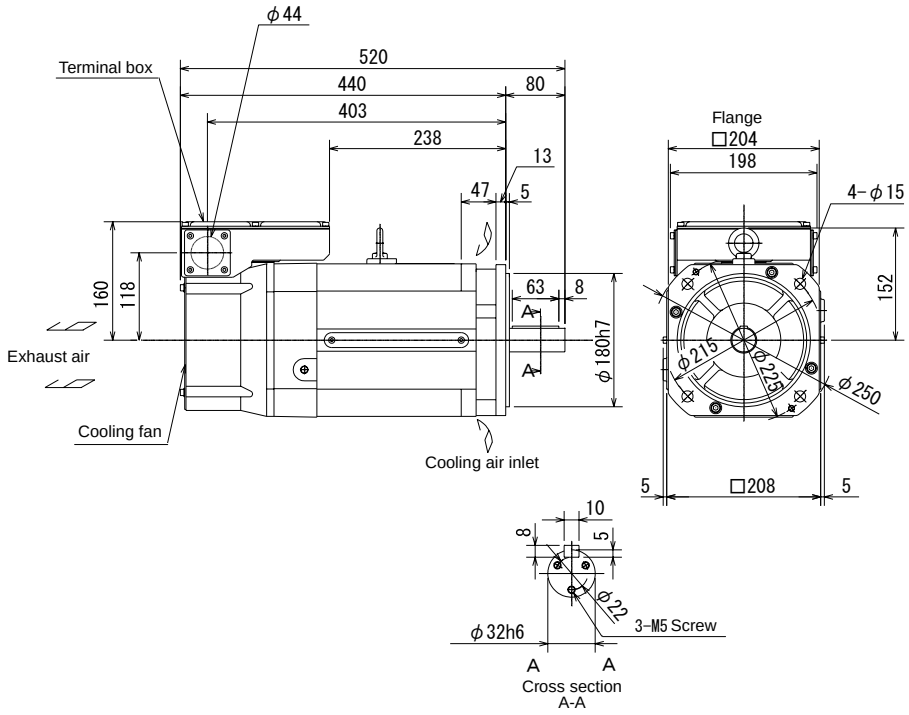
• SJ-V5.5-01 with standard legs



[Unit: mm]

(Note 1) Provide a clearance of 30mm or more between the cooling fan and wall.
(Note 2) The shaft can also be mounted upward.
(Note 3) If the suspension bolts are removed during operation, plug the screw holes with bolts.

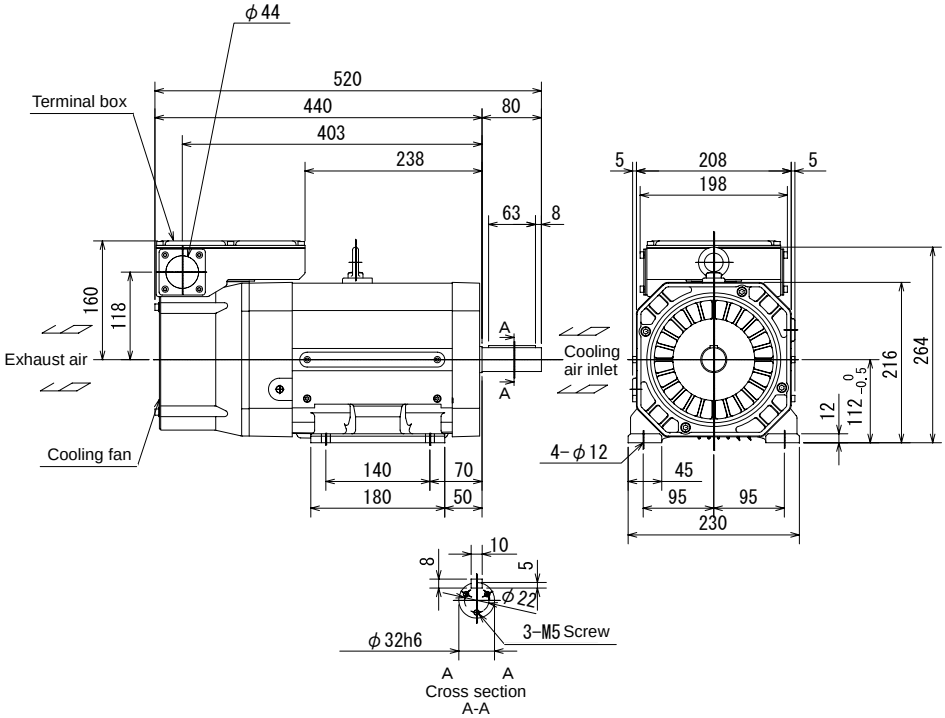
• SJ-V7.5-01, SJ-V7.5-03ZM, SJ-V11-06ZM with standard flange



[Unit: mm]

(Note 1) Provide a clearance of 30mm or more between the cooling fan and wall.
(Note 2) The shaft can also be mounted upward.
(Note 3) If the suspension bolts are removed during operation, plug the screw holes with bolts.

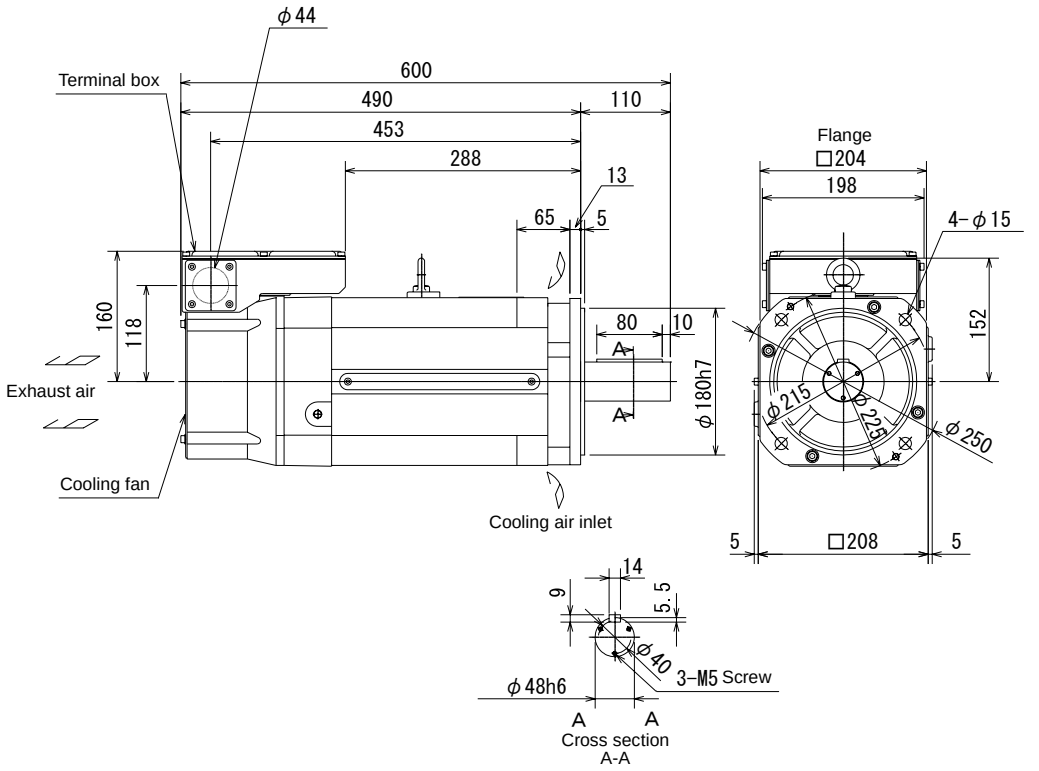
• SJ-V7.5-01, SJ-V7.5-03ZM, SJ-V11-06ZM with standard legs



[Unit: mm]

(Note 1) Provide a clearance of 30mm or more between the cooling fan and wall.
(Note 2) The shaft can also be mounted upward.
(Note 3) If the suspension bolts are removed during operation, plug the screw holes with bolts.

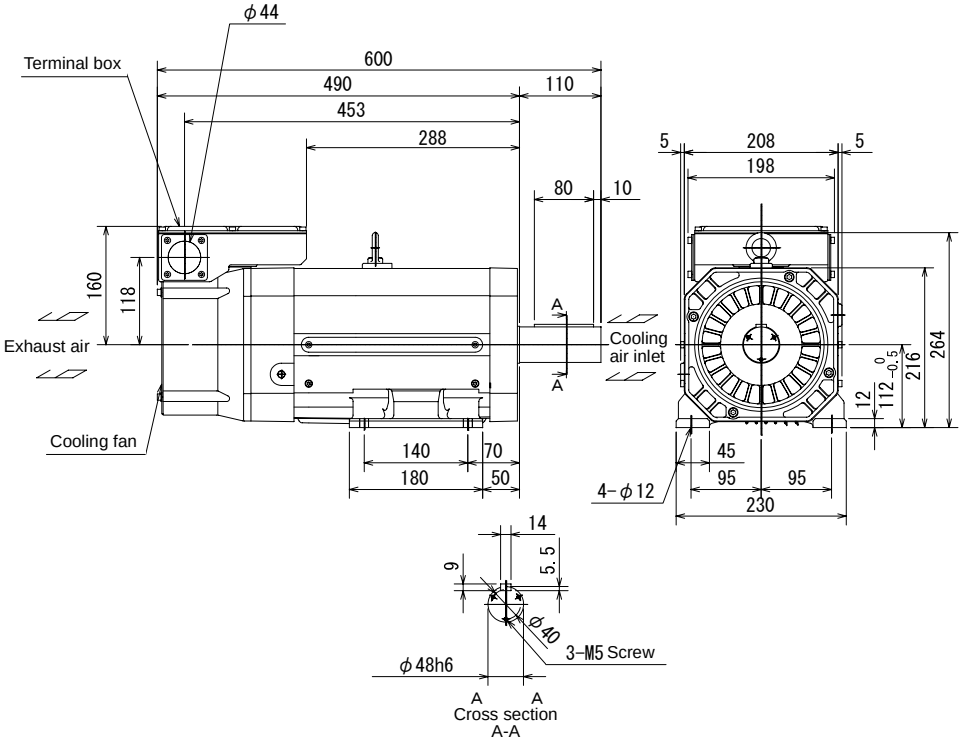
• SJ-V11-01, SJ-V11-08ZM with standard flange



[Unit: mm]

(Note 1) Provide a clearance of 30mm or more between the cooling fan and wall.
(Note 2) The shaft can also be mounted upward.
(Note 3) If the suspension bolts are removed during operation, plug the screw holes with bolts.

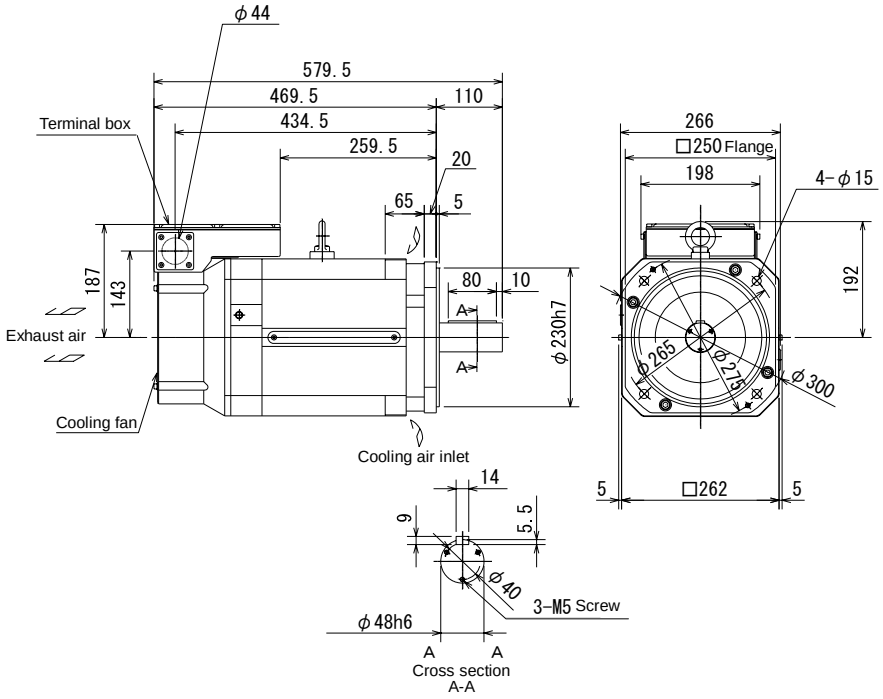
• SJ-V11-01, SJ-V11-08ZM with standard legs



[Unit: mm]

(Note 1) Provide a clearance of 30mm or more between the cooling fan and wall.
(Note 2) The shaft can also be mounted upward.
(Note 3) If the suspension bolts are removed during operation, plug the screw holes with bolts.

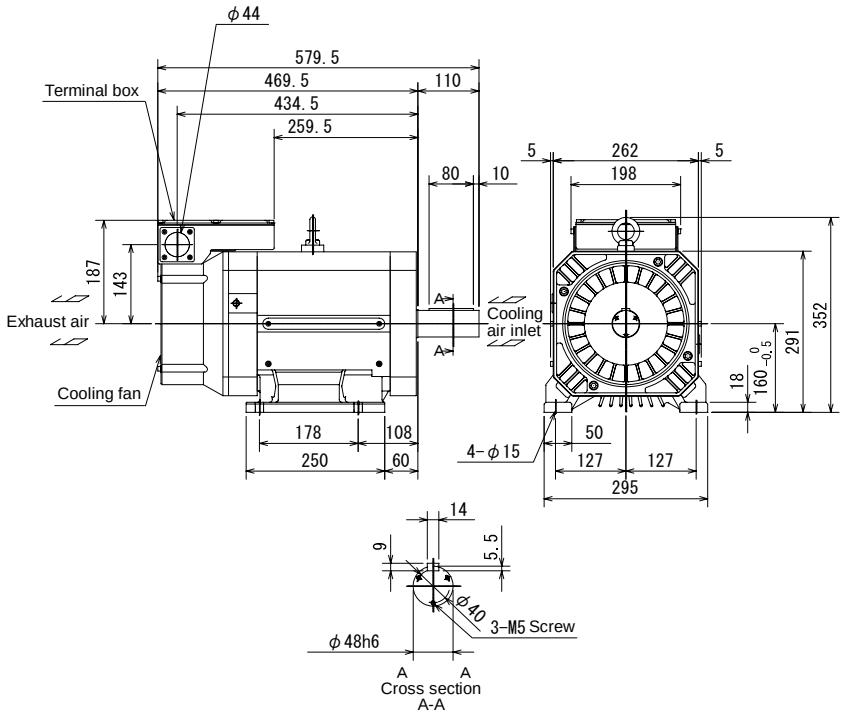
- SJ-V15-01, SJ-V18.5-01, SJ-V11-09, SJ-V15-03, SJ-V22-06ZM with standard flange



[Unit: mm]

(Note 1) Provide a clearance of 30mm or more between the cooling fan and wall.
(Note 2) The shaft can also be mounted upward.
(Note 3) If the suspension bolts are removed during operation, plug the screw holes with bolts.

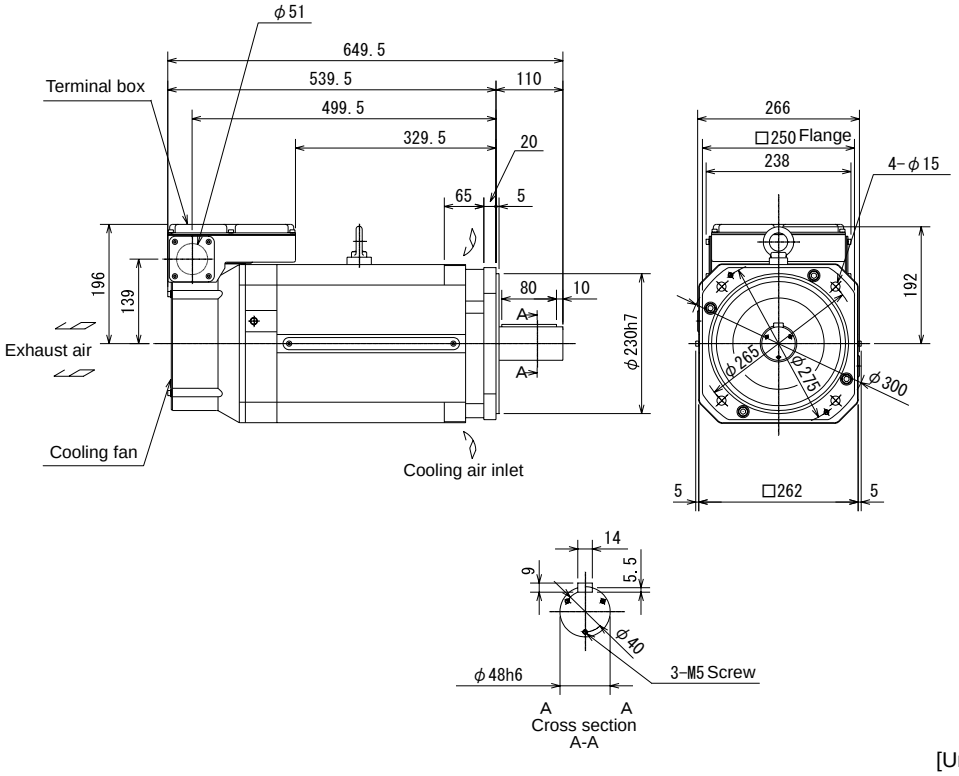
- SJ-V15-01, SJ-V18.5-01, SJ-V11-09, SJ-V15-03, SJ-V22-06ZM with standard legs



[Unit: mm]

(Note 1) Provide a clearance of 30mm or more between the cooling fan and wall.
(Note 2) The shaft can also be mounted upward.
(Note 3) If the suspension bolts are removed during operation, plug the screw holes with bolts.

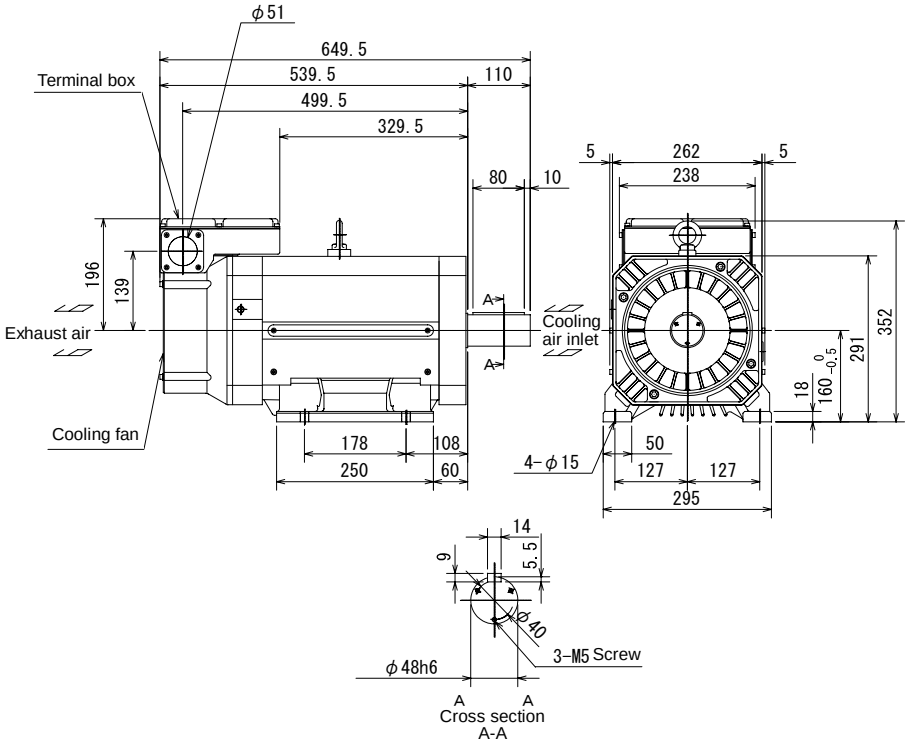
• SJ-V30-02ZM with standard flange



[Unit: mm]

(Note 1) Provide a clearance of 30mm or more between the cooling fan and wall.
(Note 2) The shaft can also be mounted upward.
(Note 3) If the suspension bolts are removed during operation, plug the screw holes with bolts.

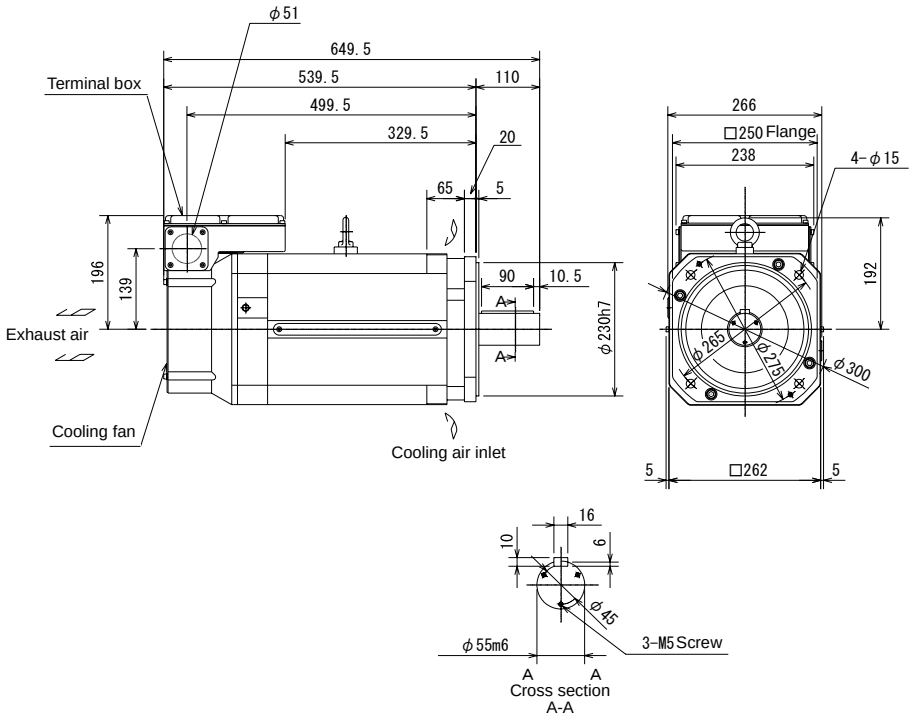
• SJ-V30-02ZM with standard legs



[Unit: mm]

(Note 1) Provide a clearance of 30mm or more between the cooling fan and wall.
(Note 2) The shaft can also be mounted upward.
(Note 3) If the suspension bolts are removed during operation, plug the screw holes with bolts.

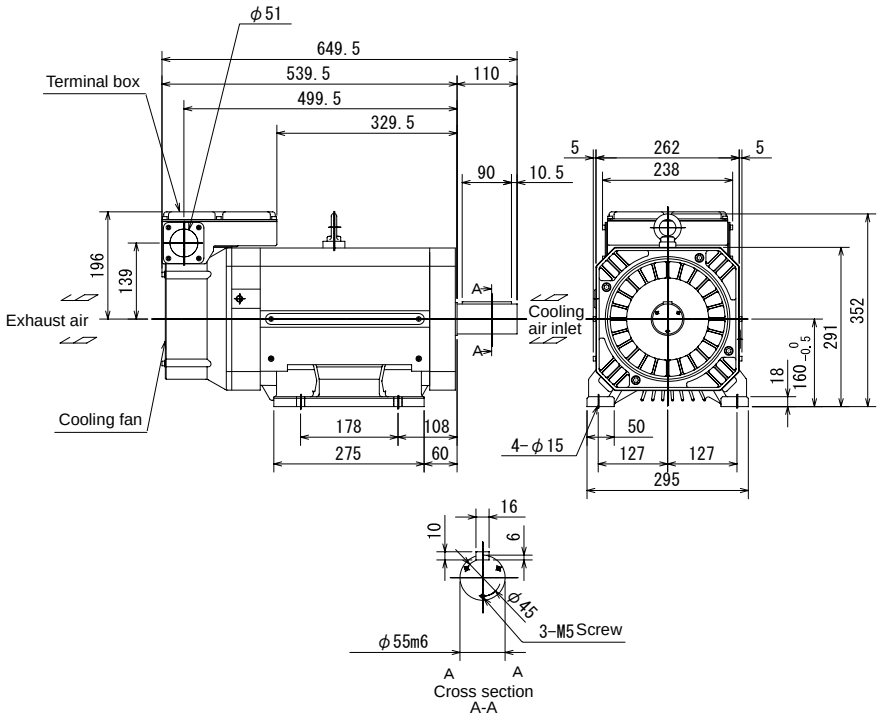
• SJ-V22-01, SJ-V18.5-03, SJ-V22-05 with standard flange



[Unit: mm]

(Note 1) Provide a clearance of 30mm or more between the cooling fan and wall.
(Note 2) The shaft can also be mounted upward.
(Note 3) If the suspension bolts are removed during operation, plug the screw holes with bolts.

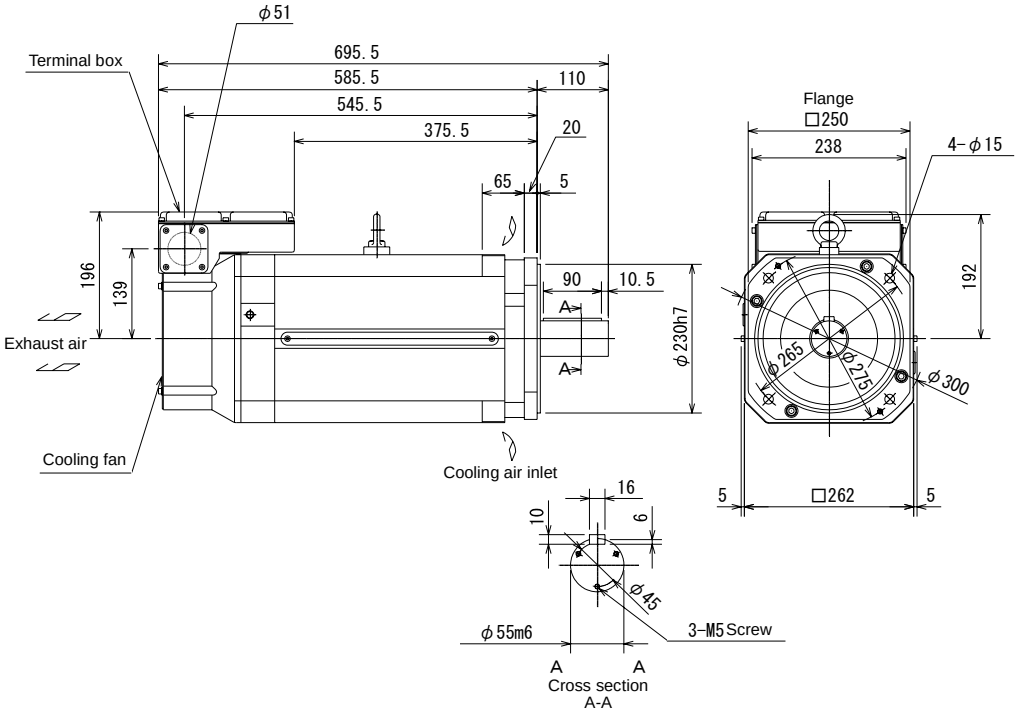
• SJ-V22-01, SJ-V18.5-03, SJ-V22-05 with standard legs



[Unit: mm]

(Note 1) Provide a clearance of 30mm or more between the cooling fan and wall.
(Note 2) The shaft can also be mounted upward.
(Note 3) If the suspension bolts are removed during operation, plug the screw holes with bolts.

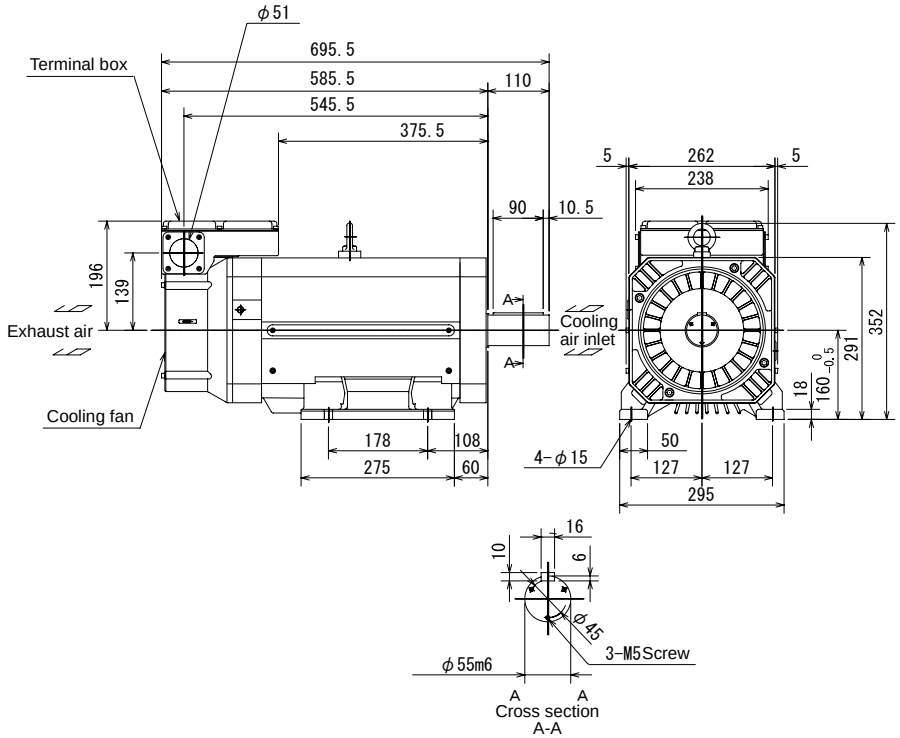
• SJ-V26-01 with standard flange



[Unit: mm]

(Note 1) Provide a clearance of 30mm or more between the cooling fan and wall.
(Note 2) The shaft can also be mounted upward.
(Note 3) If the suspension bolts are removed during operation, plug the screw holes with bolts.

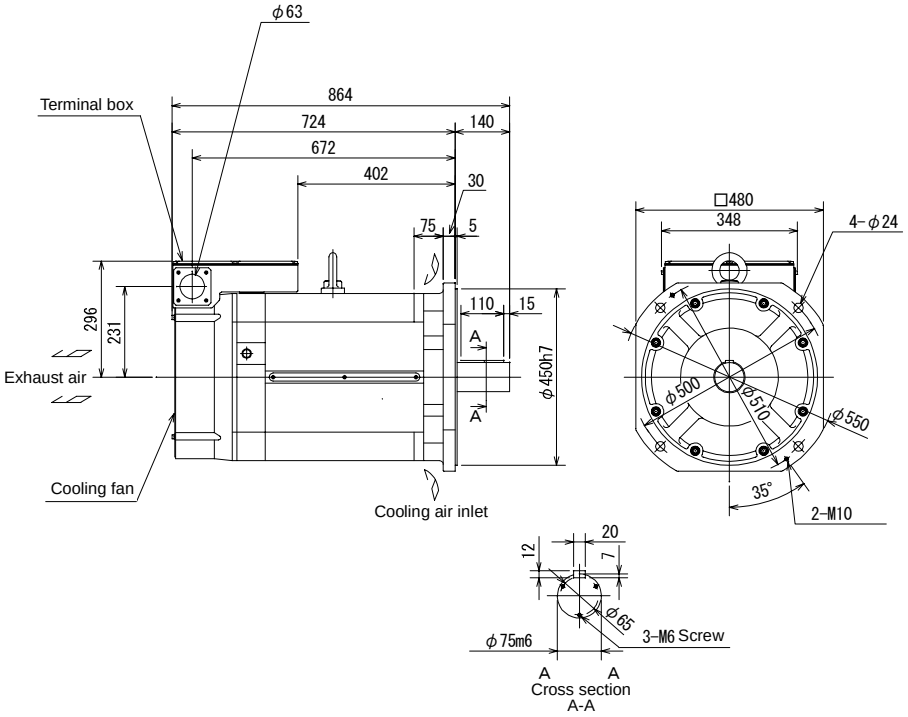
• SJ-V26-01 with standard legs



[Unit: mm]

(Note 1) Provide a clearance of 30mm or more between the cooling fan and wall.
(Note 2) The shaft can also be mounted upward.
(Note 3) If the suspension bolts are removed during operation, plug the screw holes with bolts.

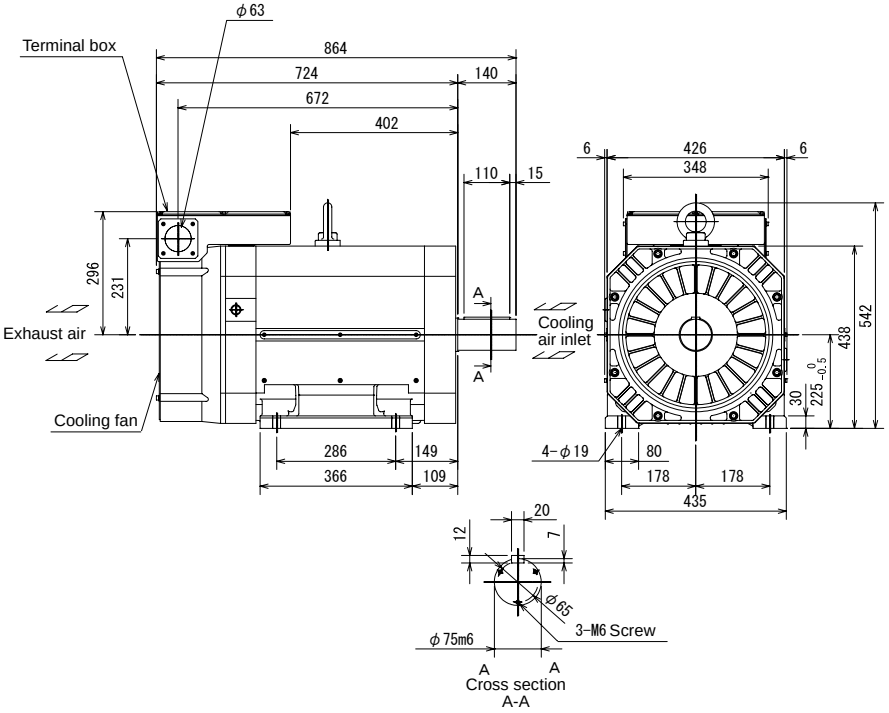
• SJ-V55-01 with standard flange



[Unit: mm]

(Note 1) Provide a clearance of 30mm or more between the cooling fan and wall.
(Note 2) The shaft can also be mounted upward.
(Note 3) If the suspension bolts are removed during operation, plug the screw holes with bolts.

• SJ-V55-01 with standard legs

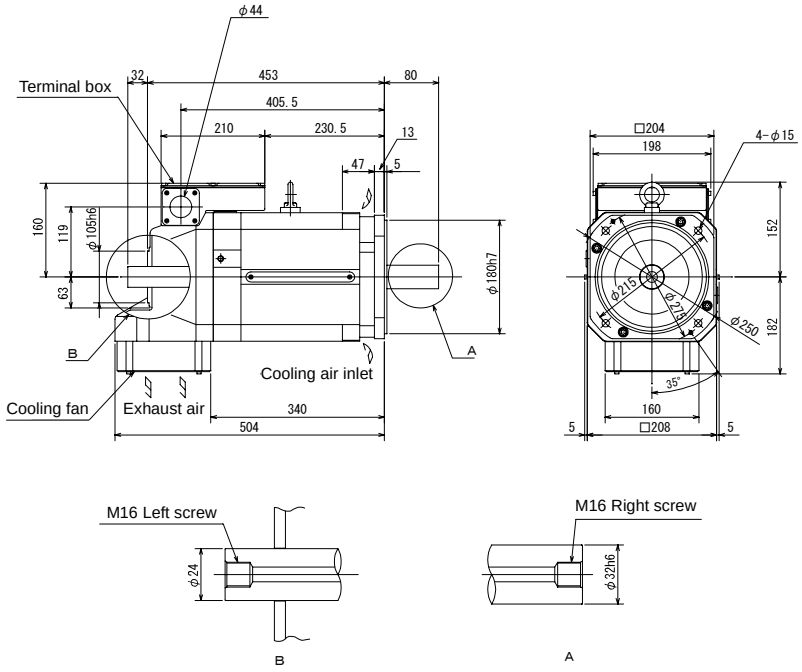


[Unit: mm]

(Note 1) Provide a clearance of 30mm or more between the cooling fan and wall.
(Note 2) The shaft can also be mounted upward.
(Note 3) If the suspension bolts are removed during operation, plug the screw holes with bolts.

Appendix 1-2-3 SJ-VS Series

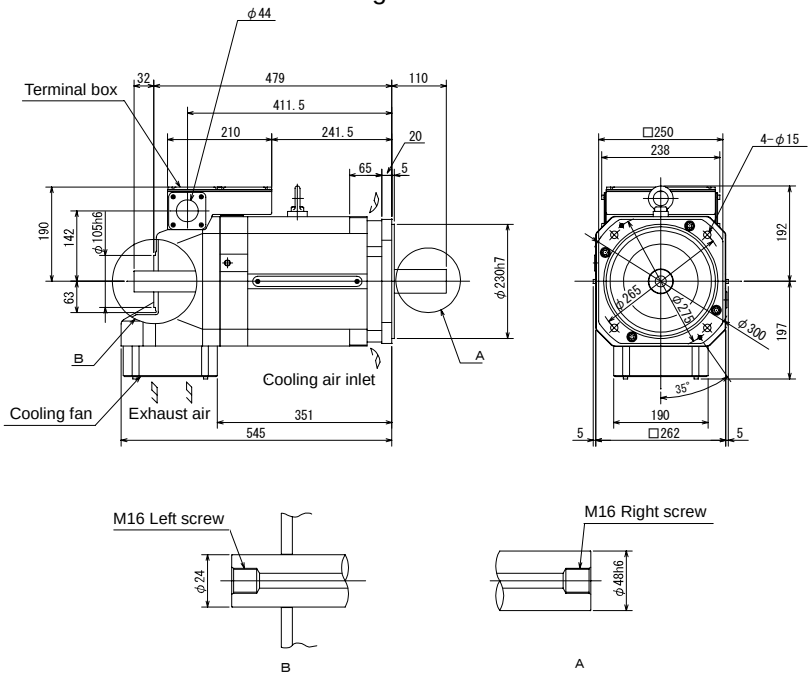
- SJ-VS7.5-03ZM with standard flange



[Unit: mm]

(Note 1) Provide a clearance of 30mm or more between the cooling fan and wall.
(Note 2) The shaft can also be mounted upward.
(Note 3) If the suspension bolts are removed during operation, plug the screw holes with bolts.

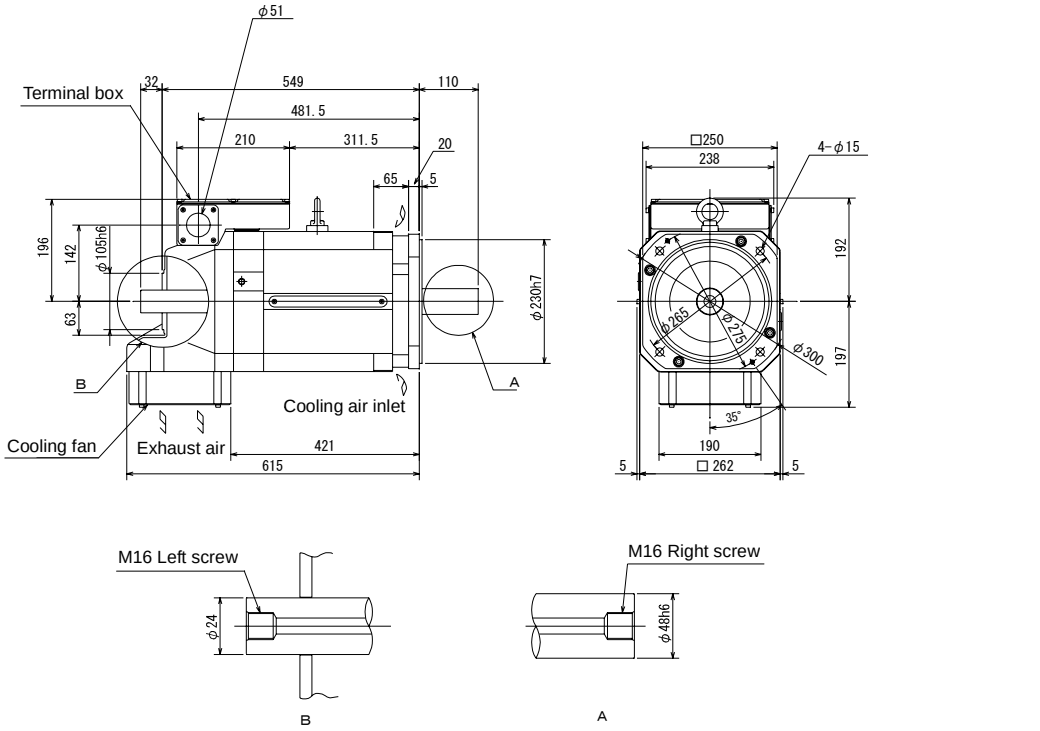
- SJ-VS22-06ZM with standard flange



[Unit: mm]

(Note 1) Provide a clearance of 30mm or more between the cooling fan and wall.
(Note 2) The shaft can also be mounted upward.
(Note 3) If the suspension bolts are removed during operation, plug the screw holes with bolts.

- SJ-VS30-02ZM with standard flange

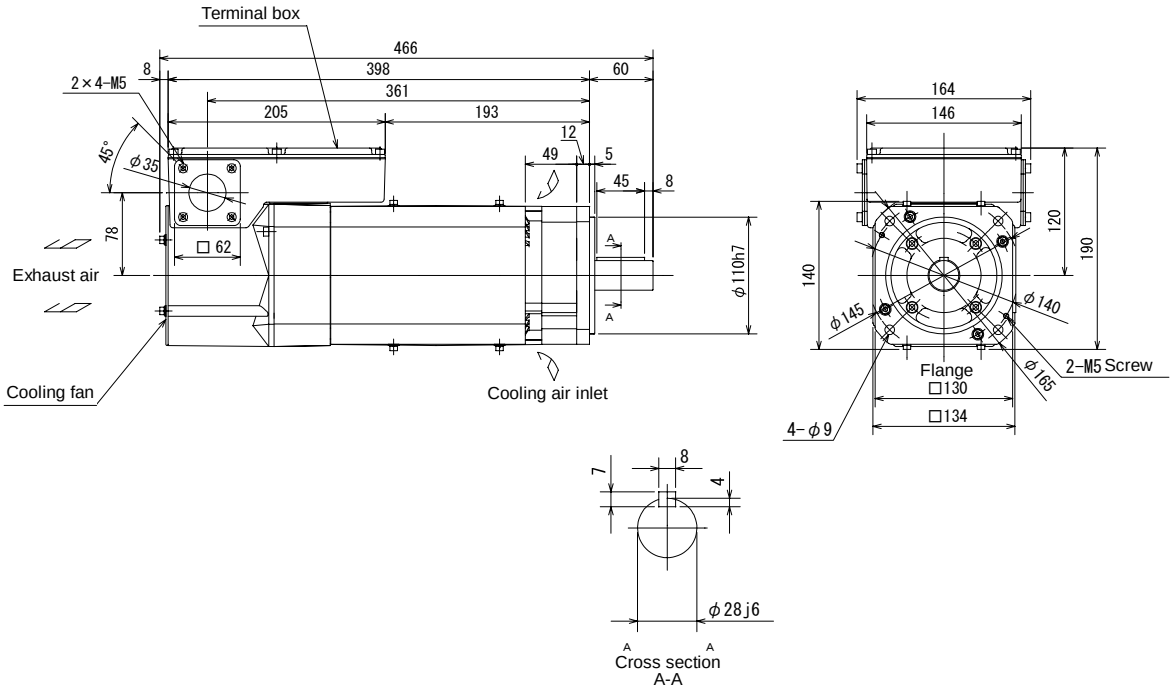


[Unit: mm]

(Note 1) Provide a clearance of 30mm or more between the cooling fan and wall.
(Note 2) The shaft can also be mounted upward.
(Note 3) If the suspension bolts are removed during operation, plug the screw holes with bolts.

Appendix 1-2-4 SJ-PMF Series (IPM motor)

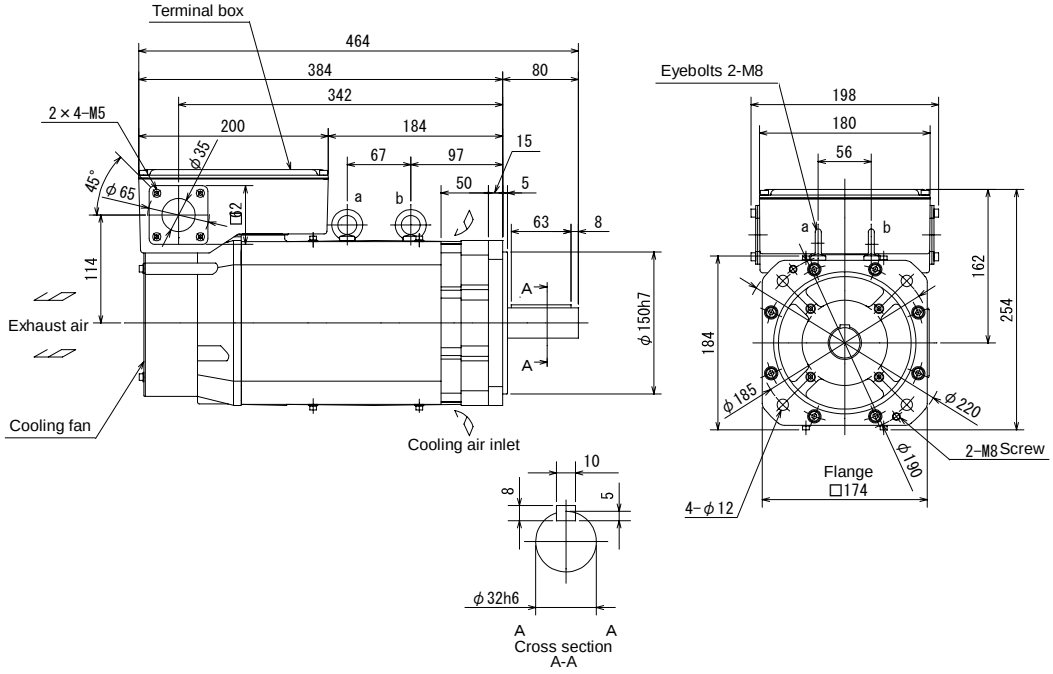
- SJ-PMF01830-00 with standard flange



[Unit: mm]

(Note 1) Provide a clearance of 30mm or more between the cooling fan and wall.
(Note 2) The shaft can also be mounted upward.
(Note 3) If the suspension bolts are removed during operation, plug the screw holes with bolts.

- SJ-PMF03530-00 with standard flange



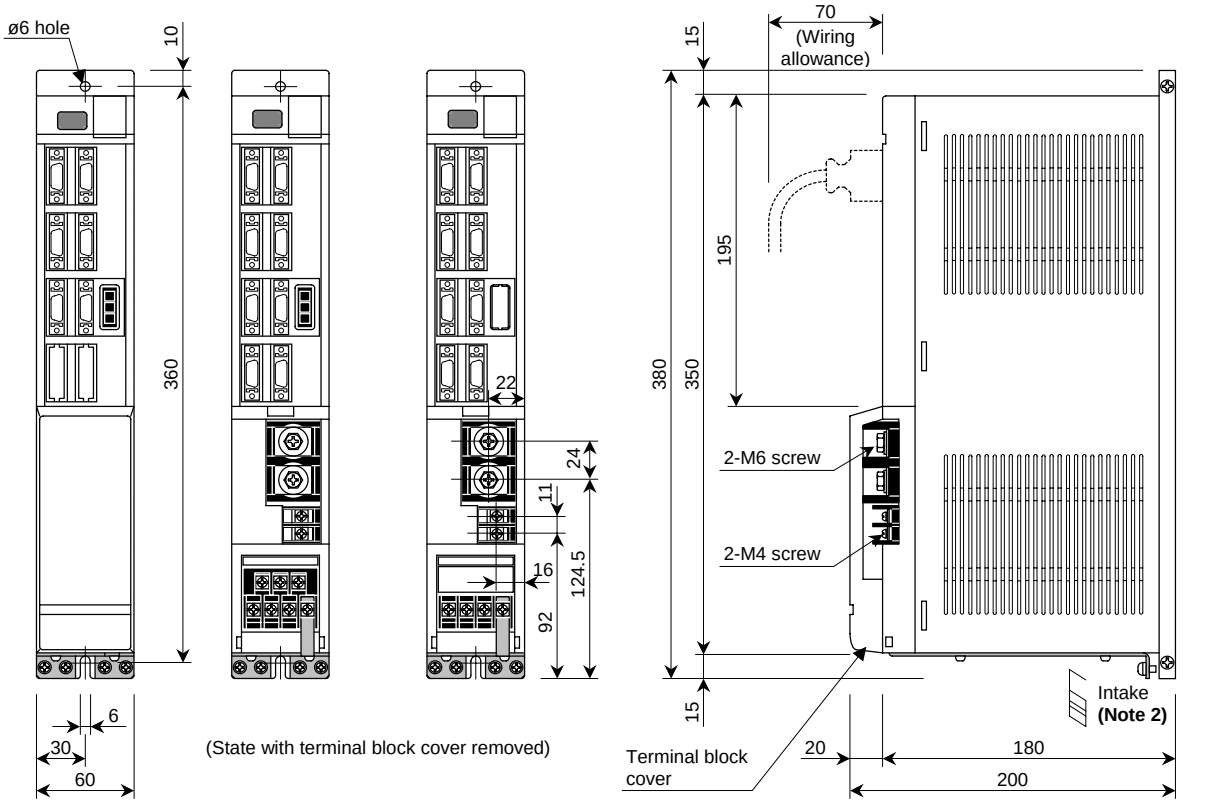
[Unit: mm]

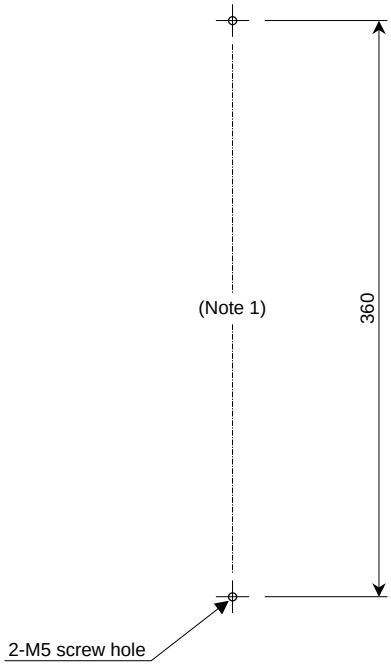
(Note 1) Provide a clearance of 30mm or more between the cooling fan and wall.
(Note 2) The shaft can also be mounted upward.
(Note 3) If the suspension bolts are removed during operation, plug the screw holes with bolts.

Appendix 1-3 Unit outline dimension drawings

Appendix 1-3-1 Servo/spindle drive unit

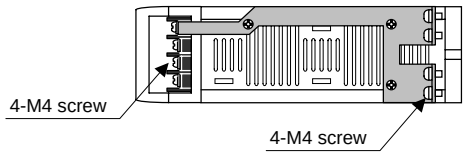
	MDS-C1-V2-0101	
	MDS-C1-V2-0301	
	MDS-C1-V2-0303	
	MDS-C1-V2-0501	
MDS-C1-V1-01	MDS-C1-V2-0503	
MDS-C1-V1-03	MDS-C1-V2-0505	MDS-C1-SP-04
MDS-C1-V1-05	MDS-C1-V2-1005	MDS-C1-SP-075
MDS-C1-V1-10	MDS-C1-V2-1010	MDS-C1-SP-15



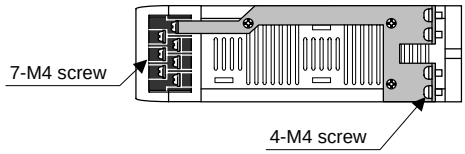


Panel mounting hole machining drawing

● **For MDS-C1-V1 and MDS-C1-SP**



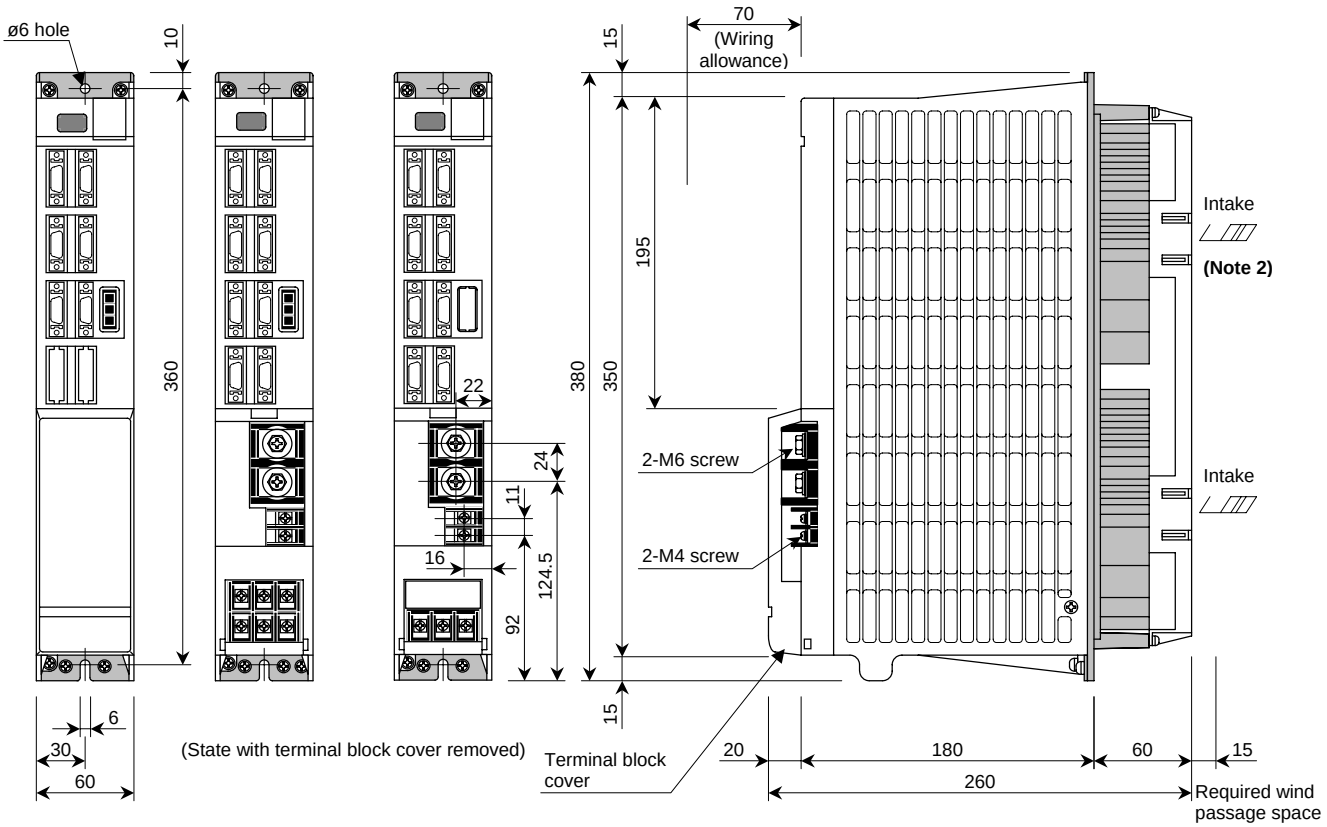
● **For MDS-C1-V2**

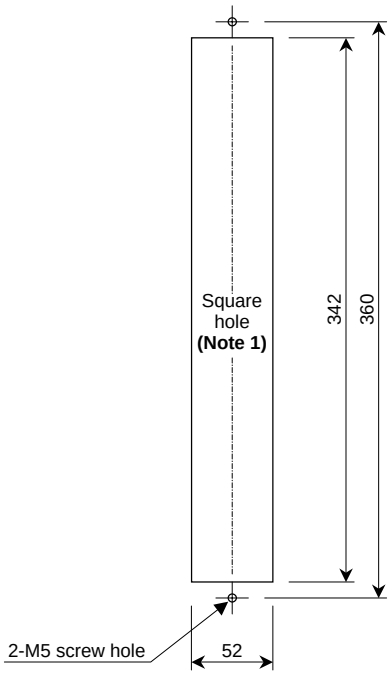


[Unit : mm]

(Note 1) The square hole does not need to be machined.
(Note 2) The MDS-C1-V1-01/03 and MDS-C1-SP-04/075 do not have built-in fans.

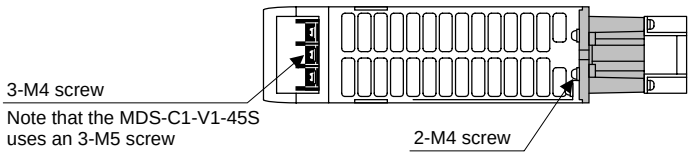
	MDS-C1-V2-2010	
MDS-C1-V1-20	MDS-C1-V2-2020	
MDS-C1-V1-35	MDS-C1-V2-3510S	MDS-C1-SP-22
MDS-C1-V1-45S	MDS-C1-V2-3520S	MDS-C1-SP-37



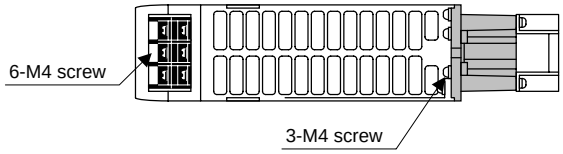


Panel mounting hole machining drawing

● **For MDS-C1-V1 and MDS-C1-SP**



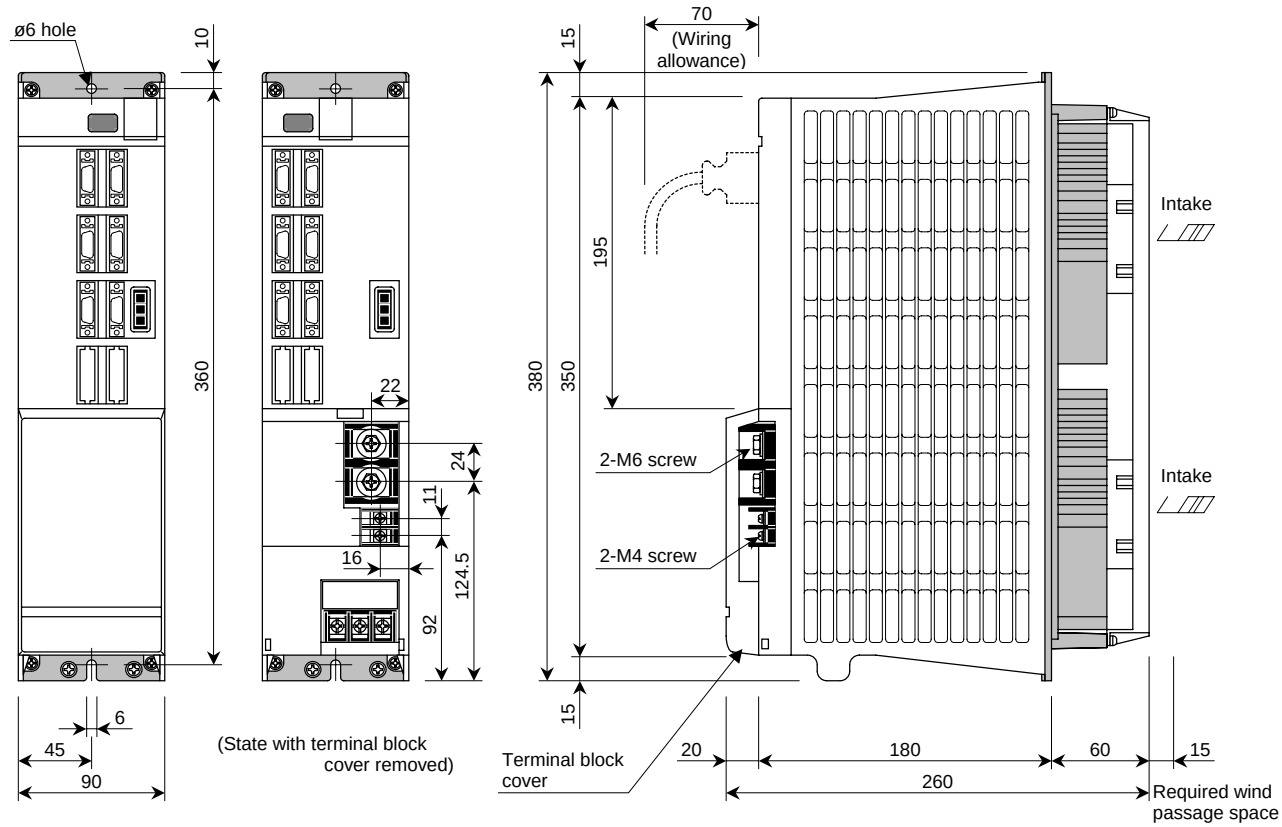
● **For MDS-C1-V2**

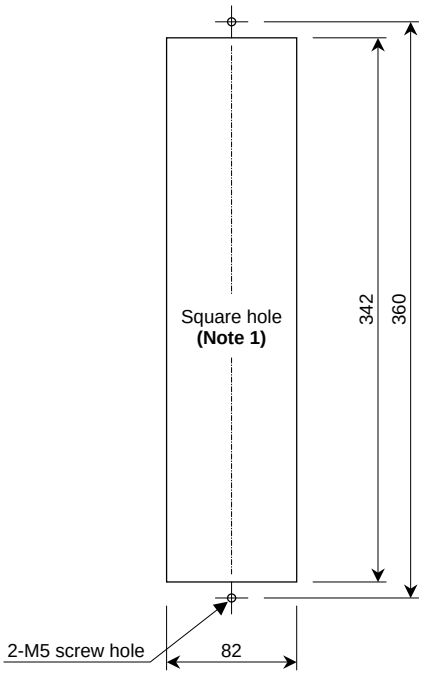


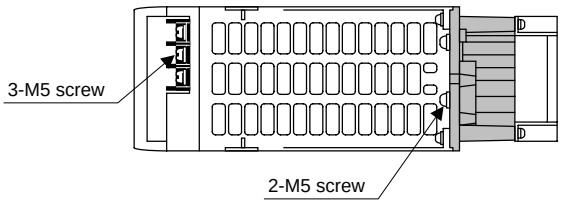
[Unit : mm]

(Note 1) Attach packing around the square hole for sealing.
(Note 2) The MDS-C1-V1-20 does not have a fan at the top.

MDS-C1-V1-45 MDS-C1-V1-70S





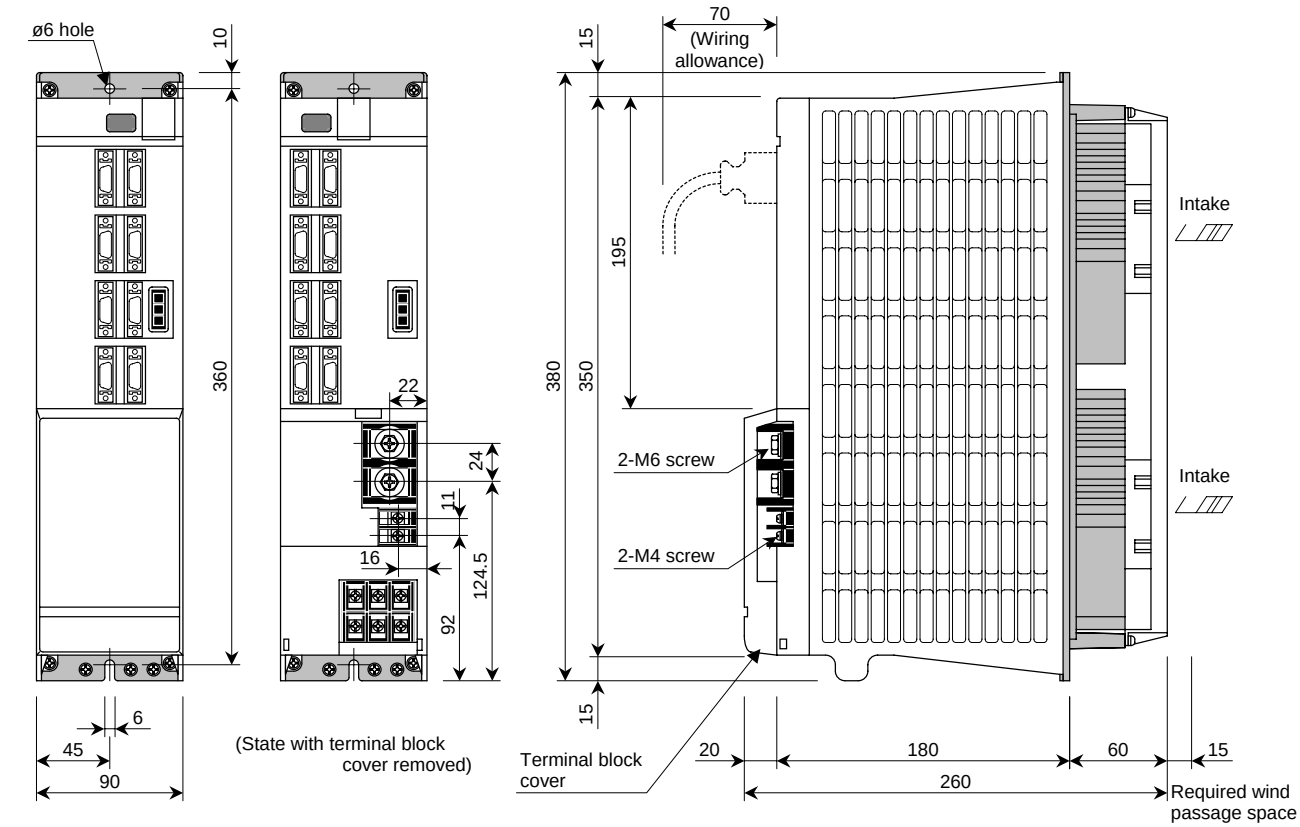


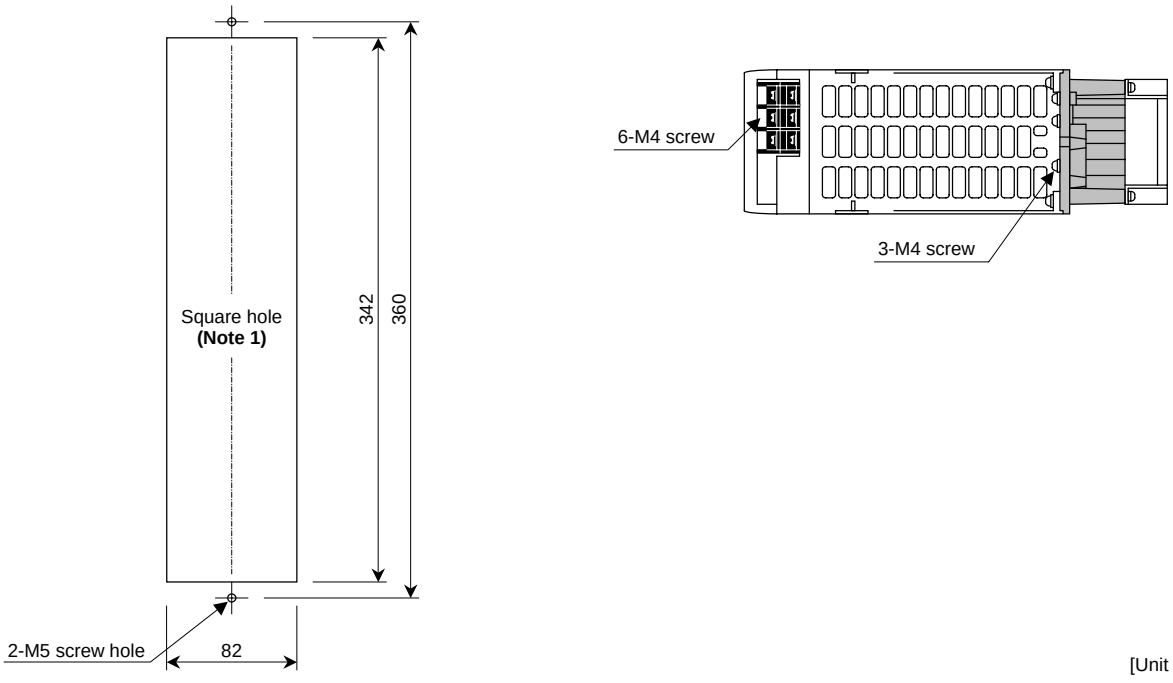
[Unit : mm]

Panel mounting hole machining drawing

(Note 1) Attach packing around the square hole for sealing.

MDS-C1-V2-3510
MDS-C1-V2-3520
MDS-C1-V2-3535
MDS-C1-V2-4520
MDS-C1-V2-4535
MDS-C1-V2-4545S MDS-C1-V2-7070S



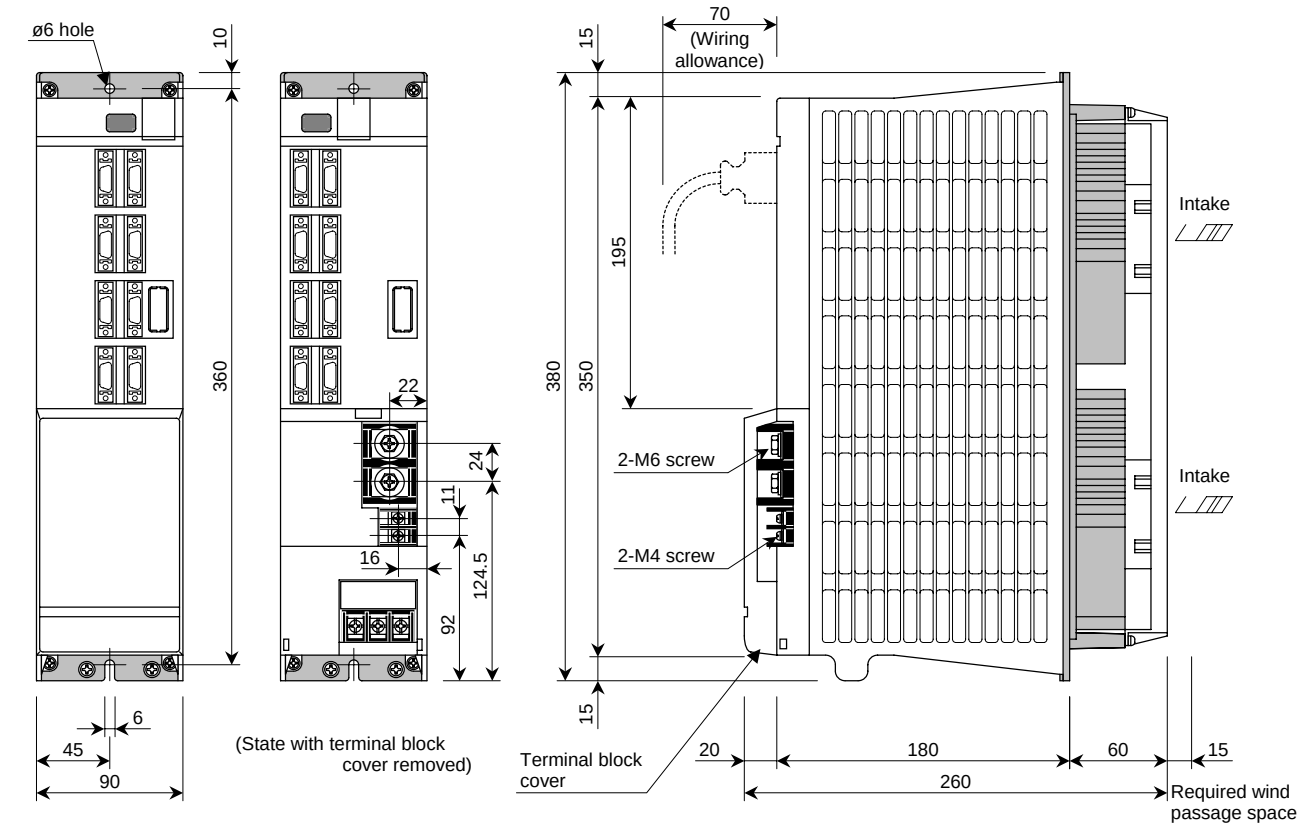


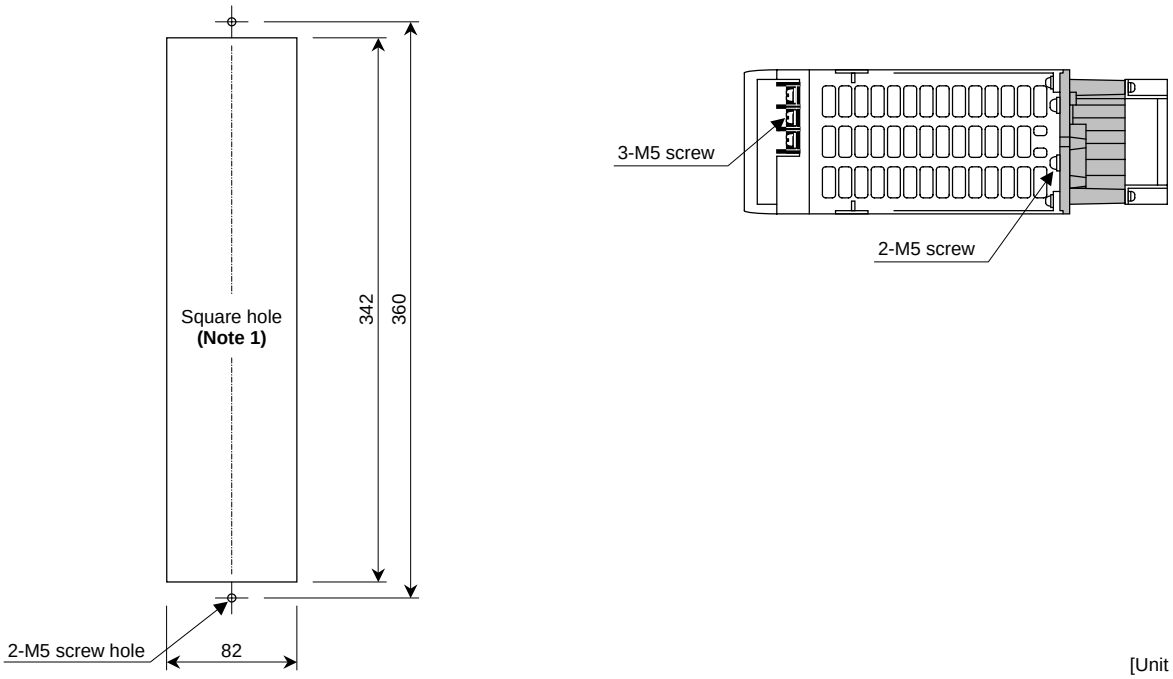
[Unit : mm]

Panel mounting hole machining drawing

(Note 1) Attach packing around the square hole for sealing.

MDS-C1-SP-55
MDS-C1-SP-75
MDS-C1-SP-110 MDS-C1-SP-150S





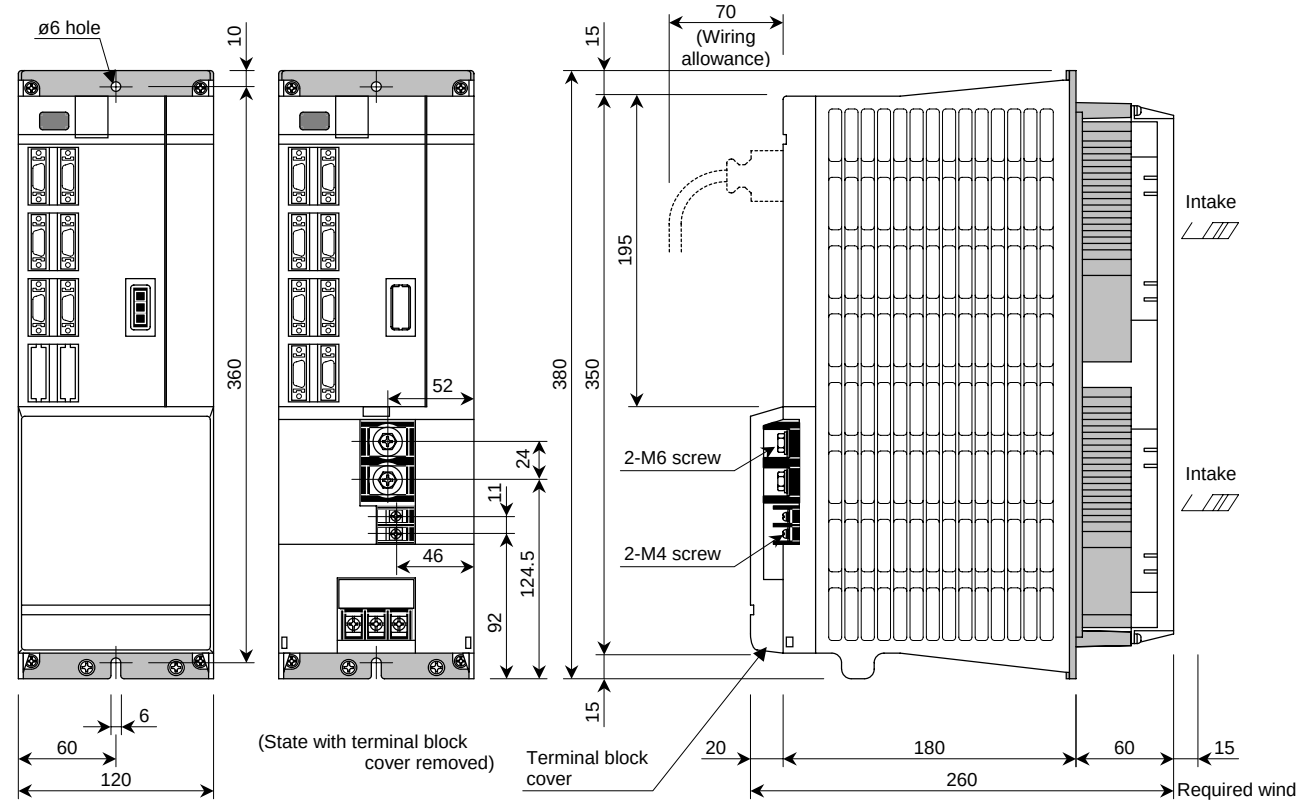
[Unit : mm]

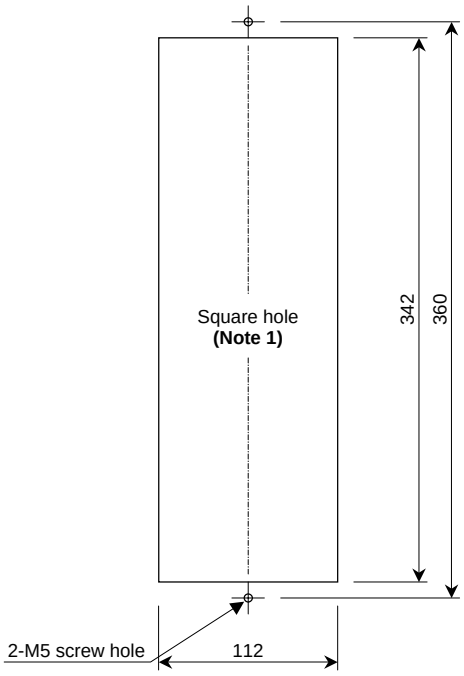
Panel mounting hole machining drawing

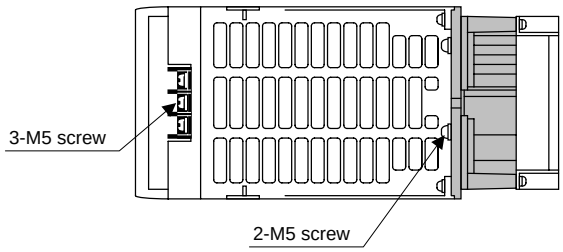
(Note 1) Attach packing around the square hole for sealing.

MDS-C1-V1-70
MDS-C1-V1-90

MDS-C1-SP-150
MDS-C1-SP-185



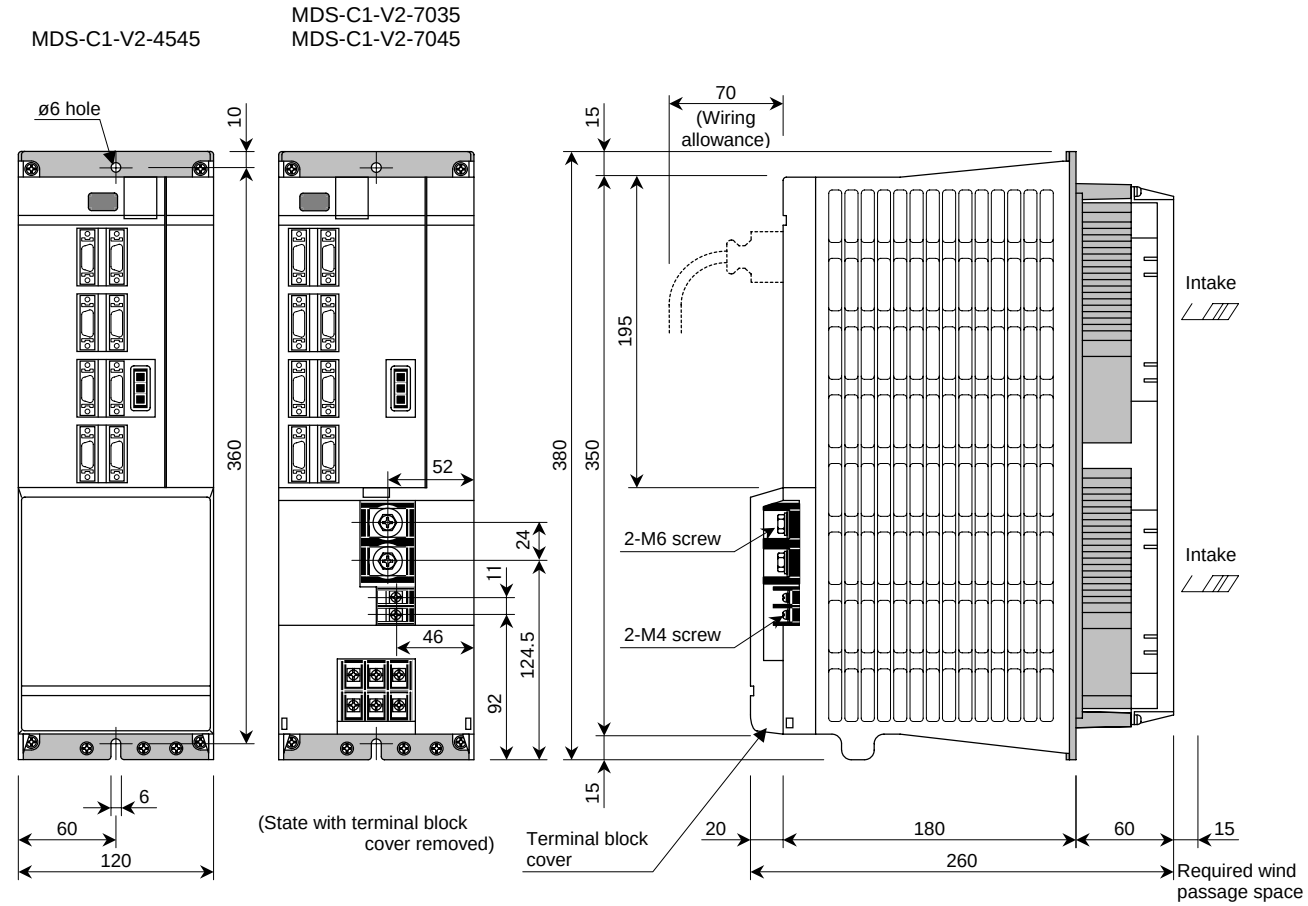


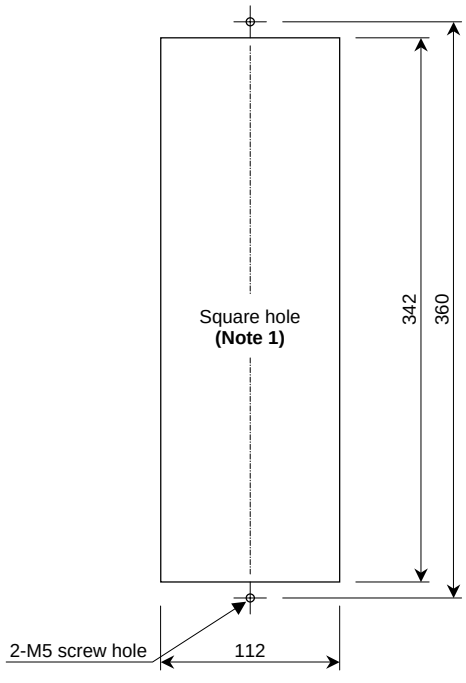


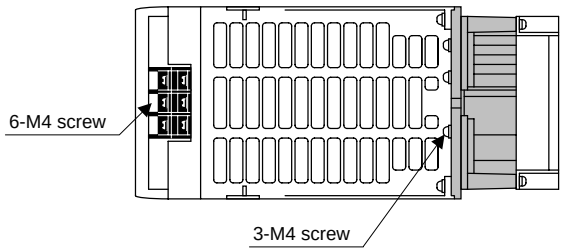
[Unit : mm]

Panel mounting hole machining drawing

(Note 1) Attach packing around the square hole for sealing.







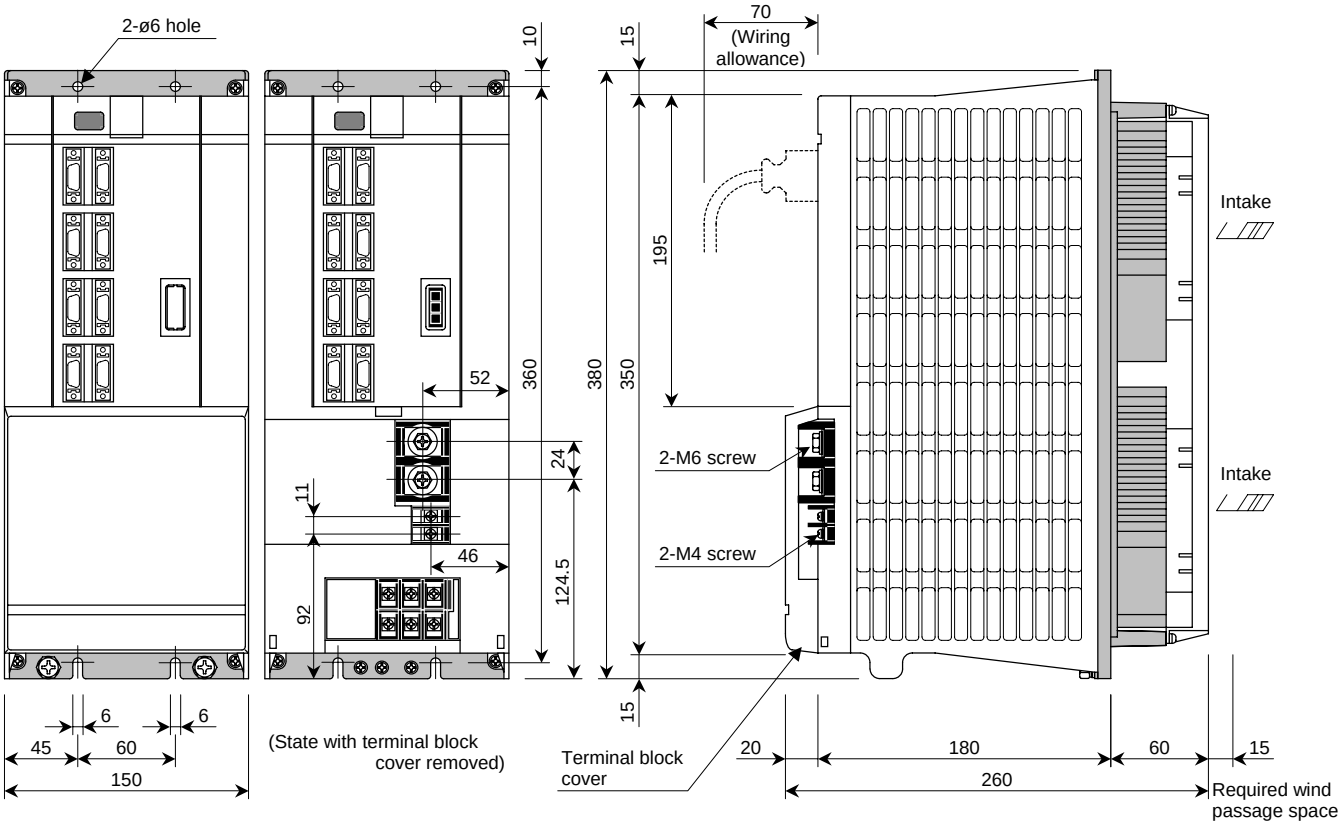
[Unit : mm]

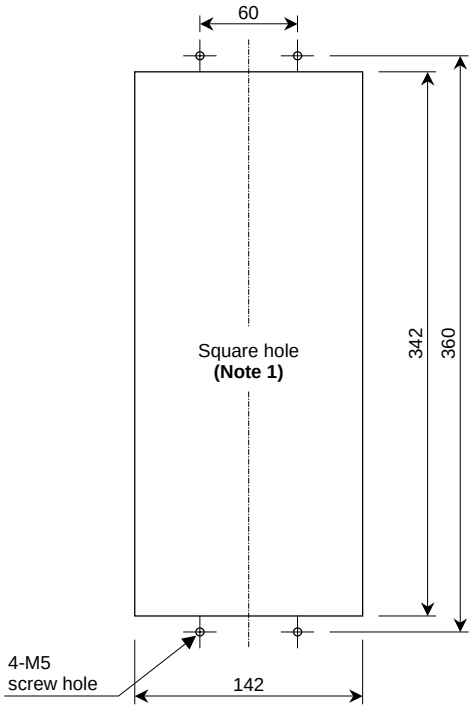
Panel mounting hole machining drawing

(Note 1) Attach packing around the square hole for sealing.

MDS-C1-SP-220

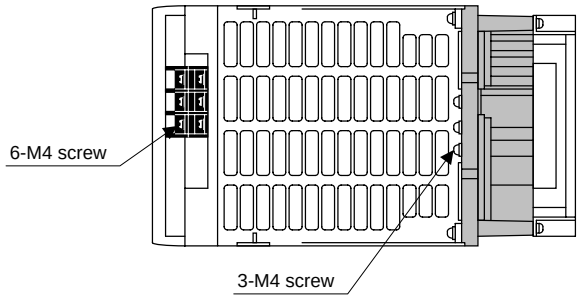
MDS-C1-V2-7070
MDS-C1-V2-9090S



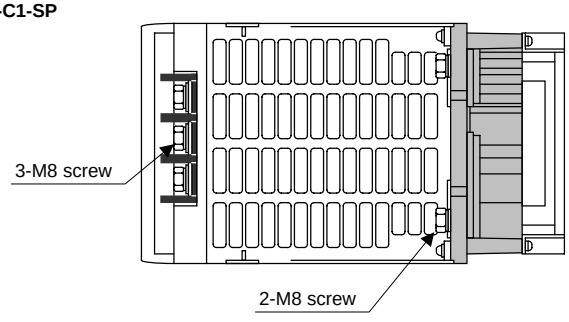


Panel mounting hole machining drawing

● **For MDS-C1-V2**



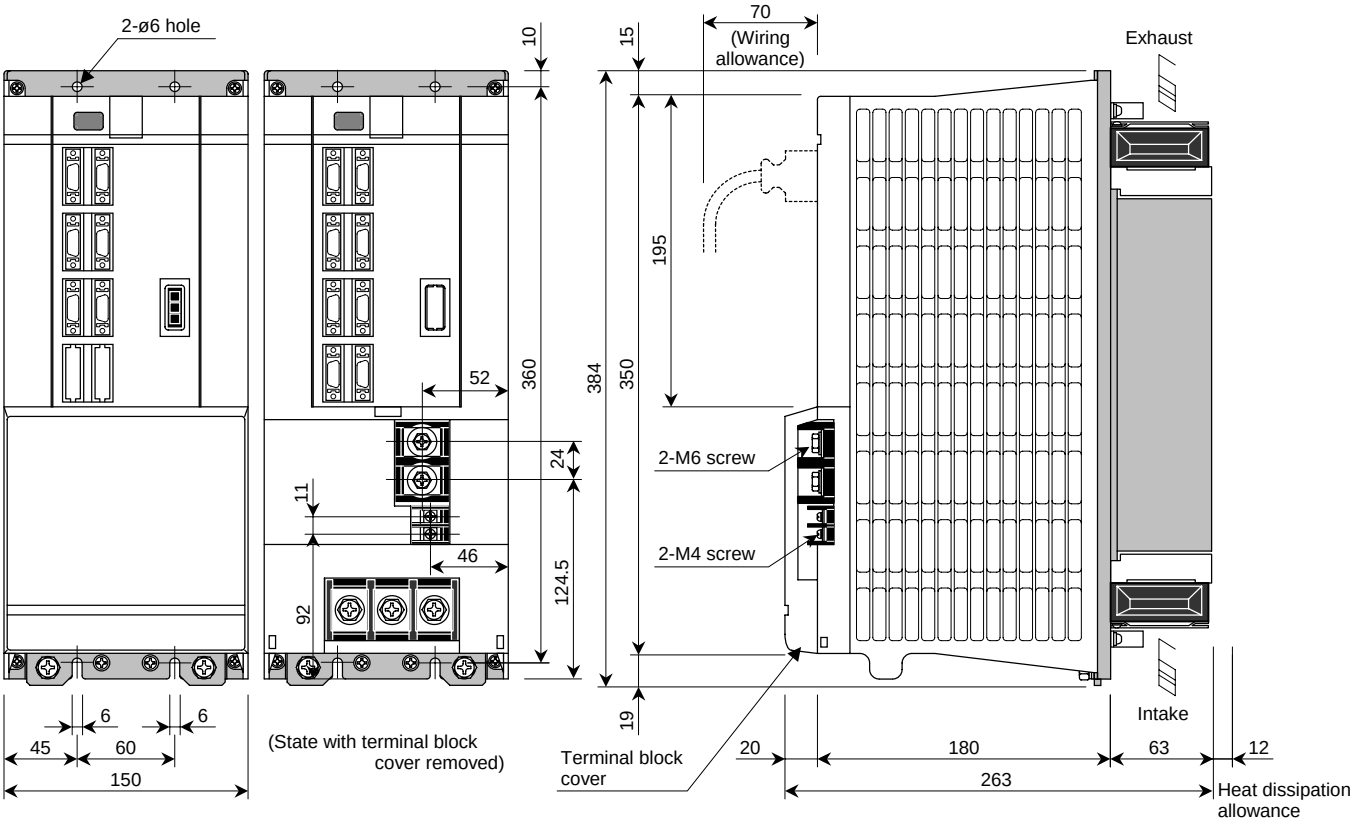
● **For MDS-C1-SP**

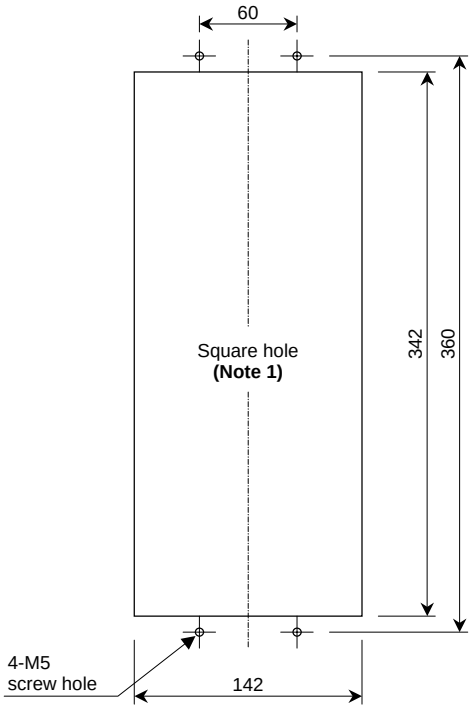


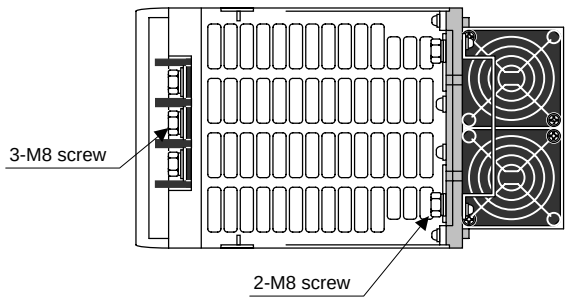
[Unit : mm]

(Note 1) Attach packing around the square hole for sealing.

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







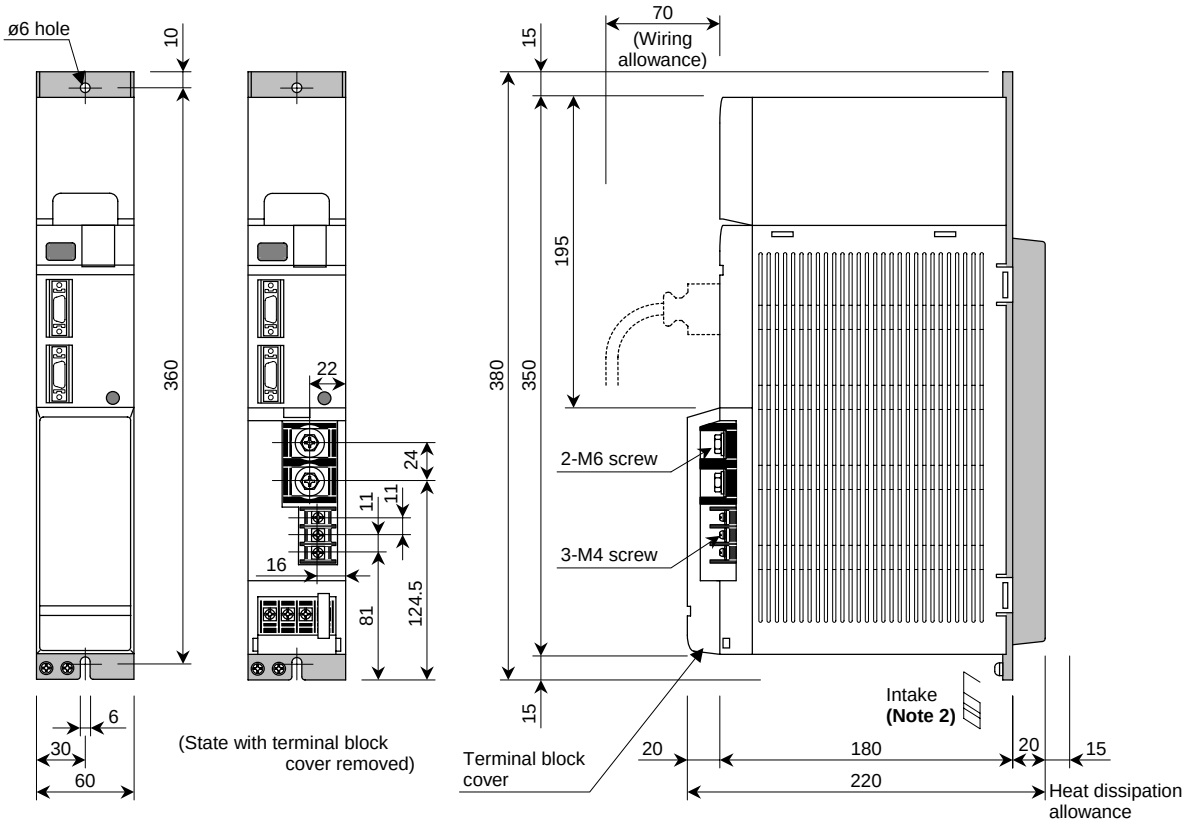
[Unit : mm]

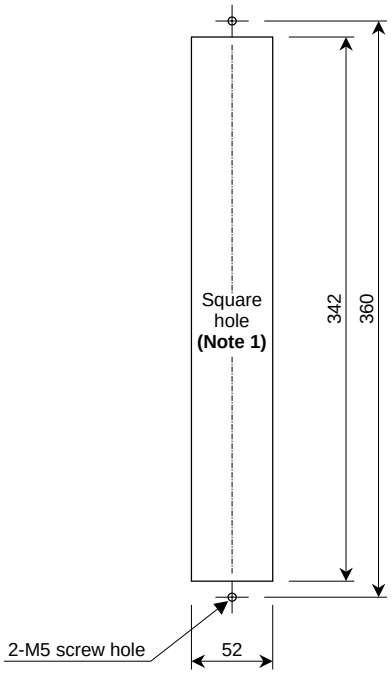
Panel mounting hole machining drawing

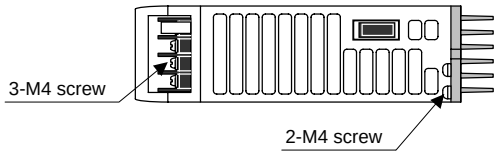
(Note 1) Attach packing around the square hole for sealing.

Appendix 1-3-2 Power supply unit

MDS-C1-CV-37
MDS-C1-CV-55
MDS-C1-CV-75





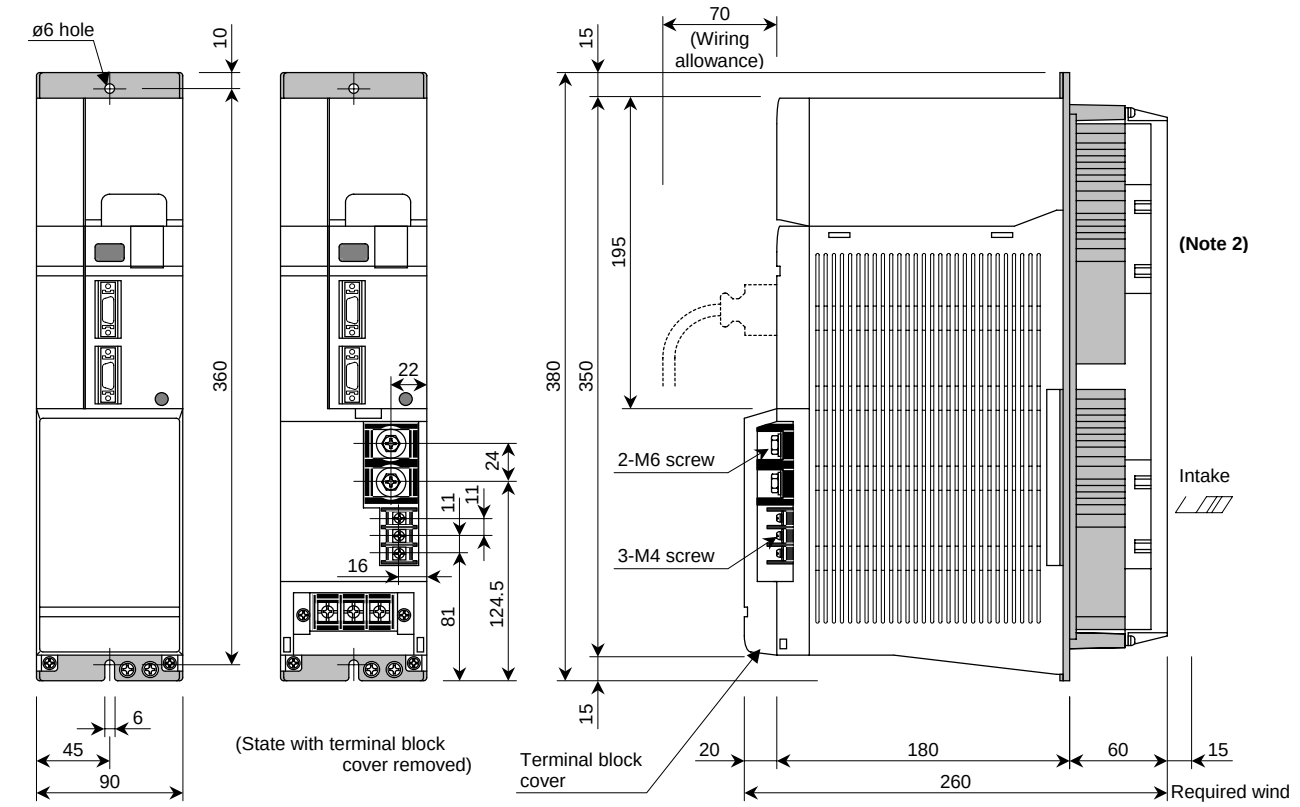


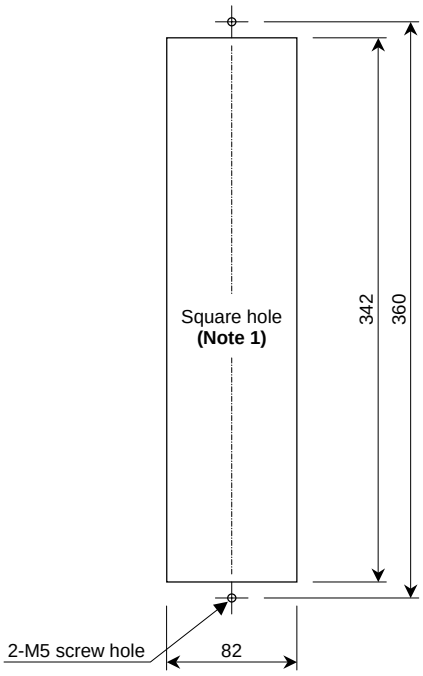
[Unit : mm]

Panel mounting hole machining drawing

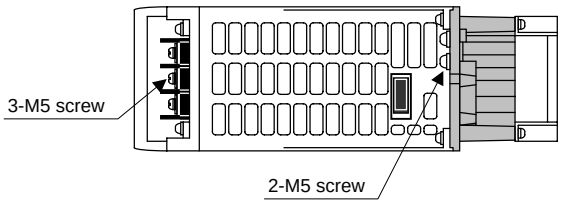
(Note 1) Attach packing around the square hole for sealing
(Note 2) The MDS-C1-CV-37 does not have a built-in fan.

MDS-C1-CV-110





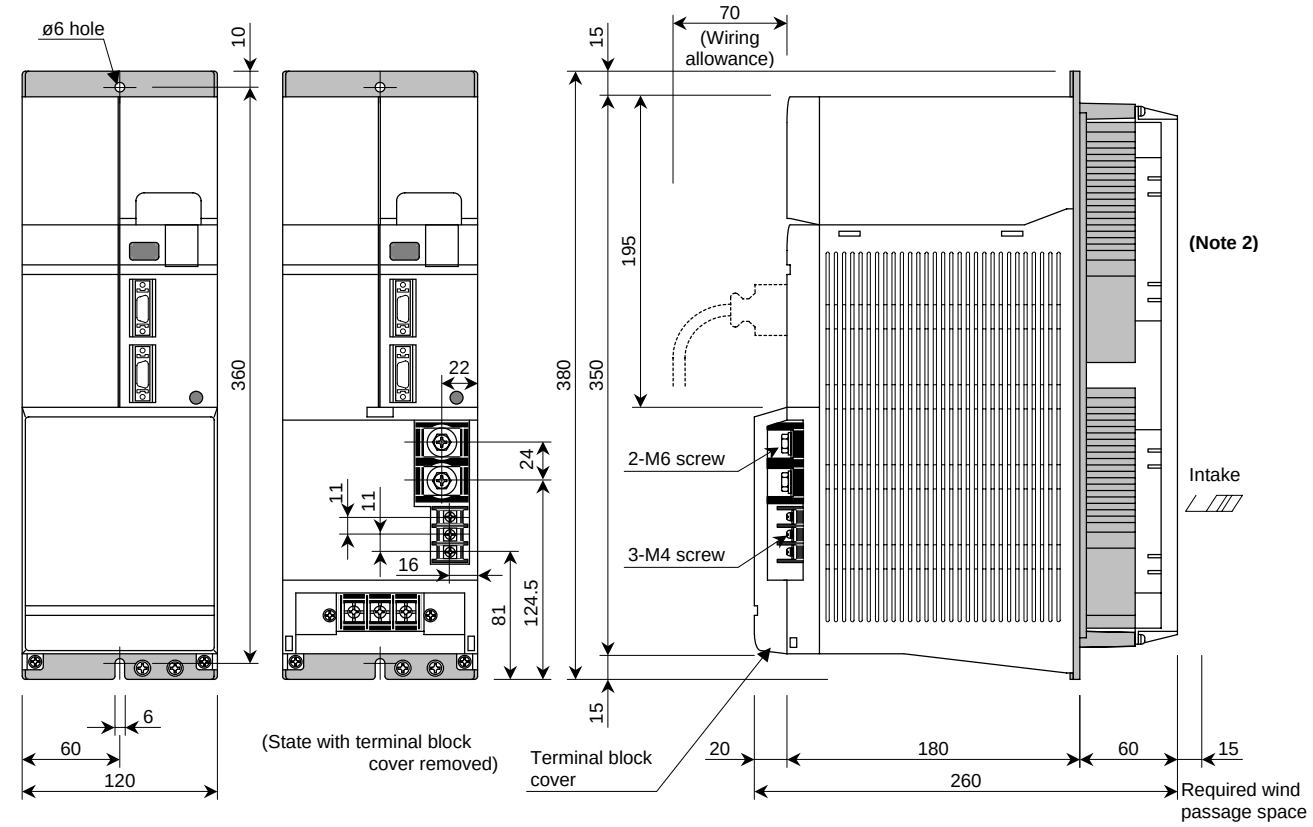
Panel mounting hole machining drawing

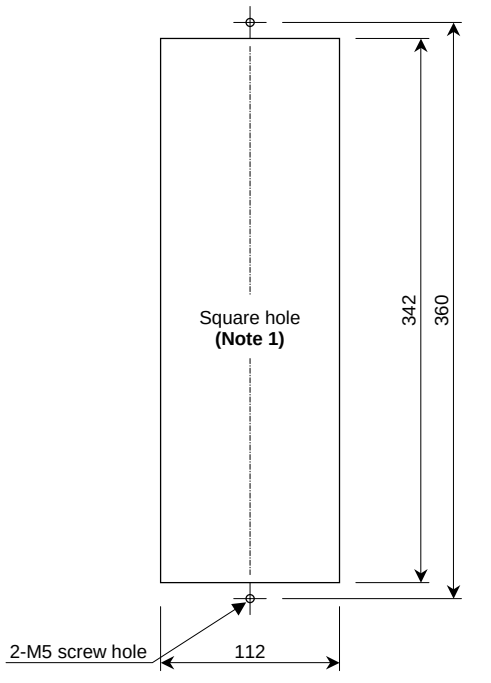


[Unit : mm]

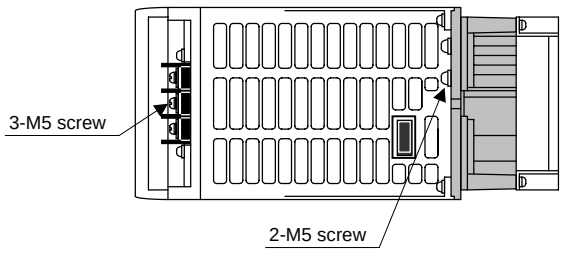
(Note 1) Attach packing around the square hole for sealing
(Note 2) The MDS-C1-CV-110 does not have a fan at the top.

MDS-C1-CV-150
MDS-C1-CV-185





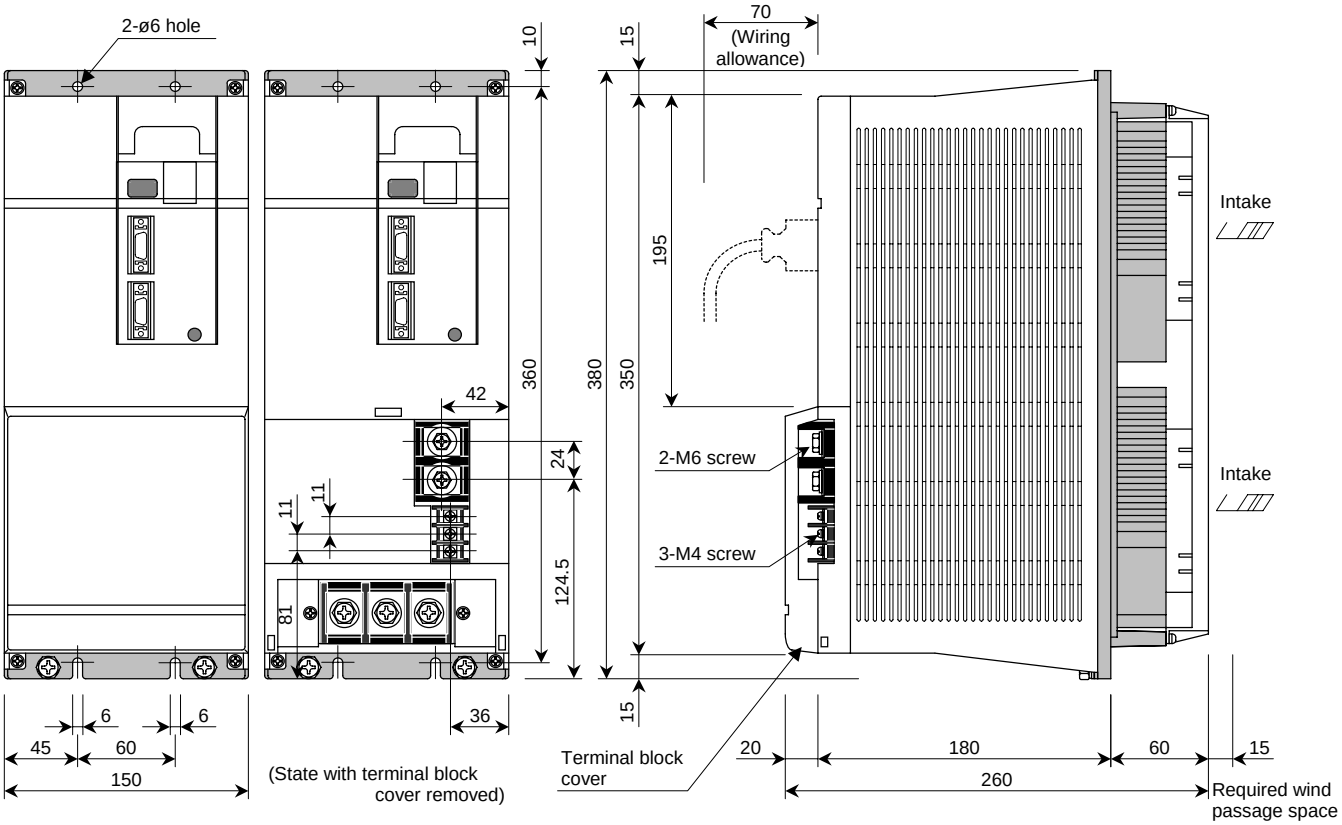
Panel mounting hole machining drawing

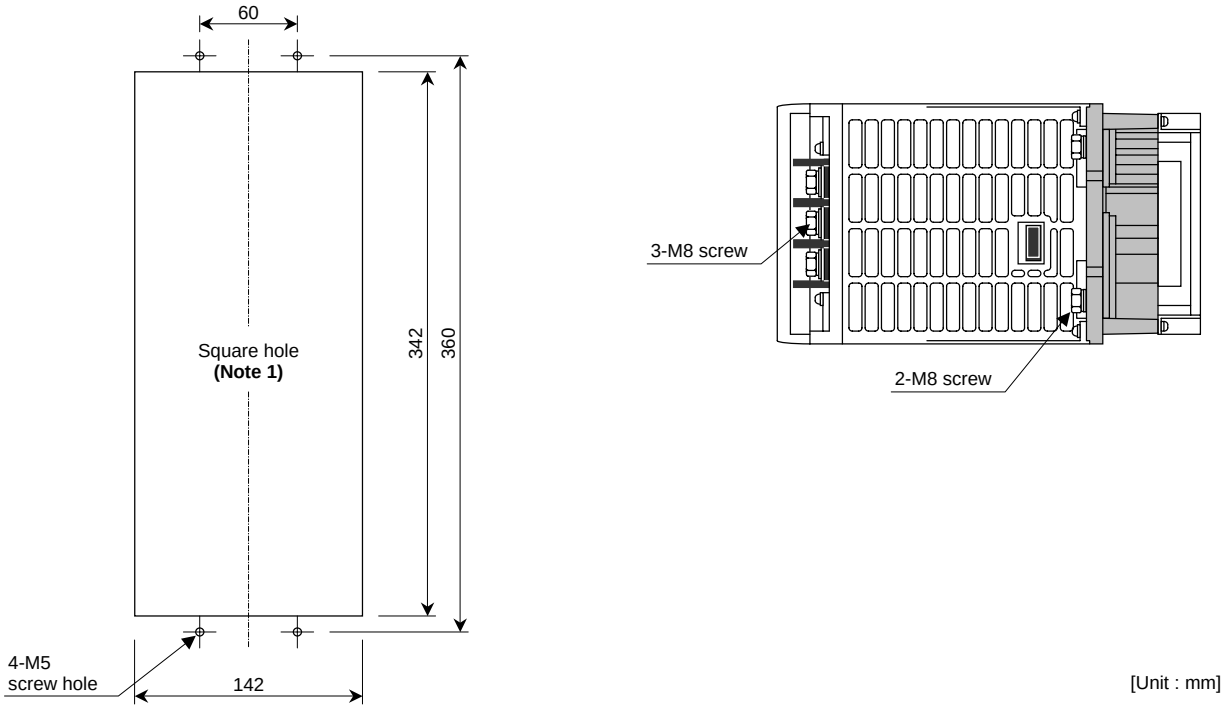


[Unit : mm]

(Note 1) Attach packing around the square hole for sealing.
(Note 2) The MDS-C1-CV-150/185 does not have a fan at the top.

MDS-C1-CV-220
MDS-C1-CV-260
MDS-C1-CV-300
MDS-C1-CV-370





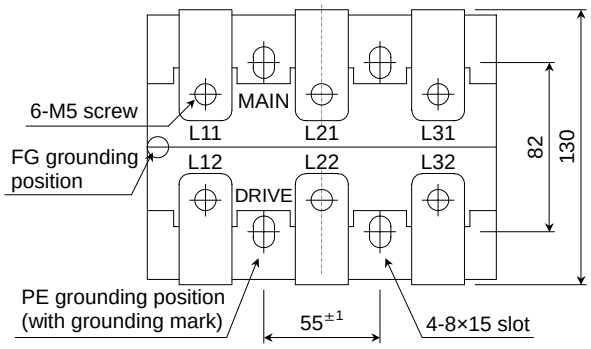
[Unit : mm]

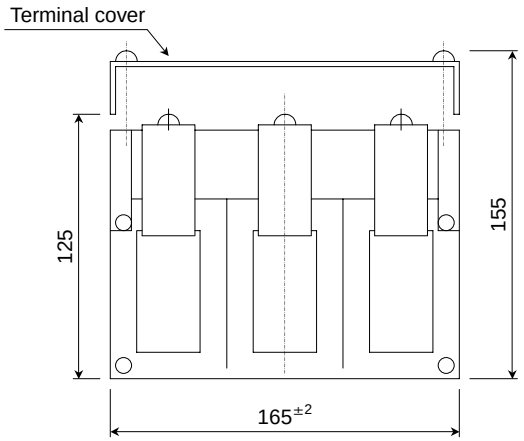
Panel mounting hole machining drawing

(Note 1) Attach packing around the square hole for sealing.

Appendix 1-3-3 AC rector

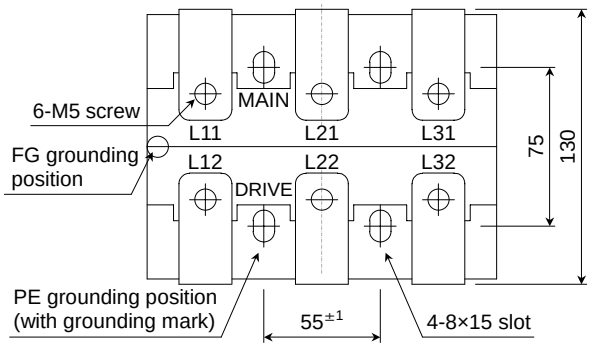
- B-AL-7.5K

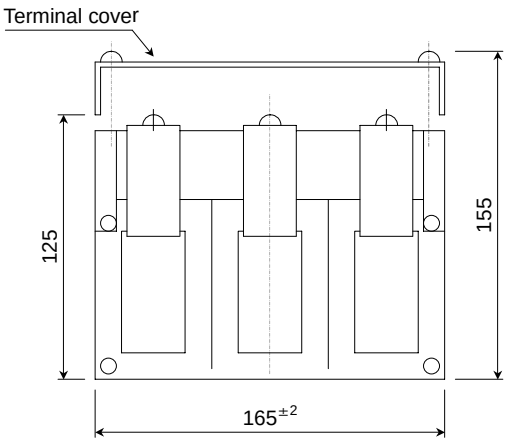




[Unit: mm]

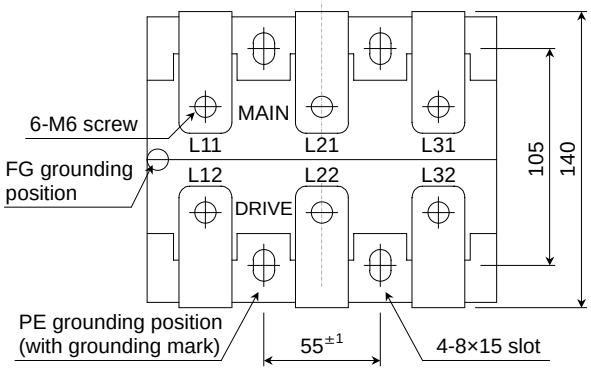
- B-AL-11K

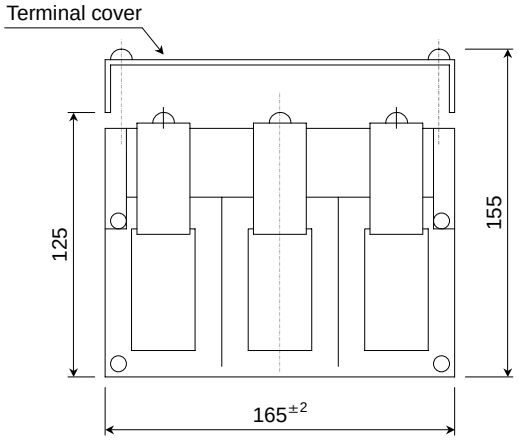




[Unit: mm]

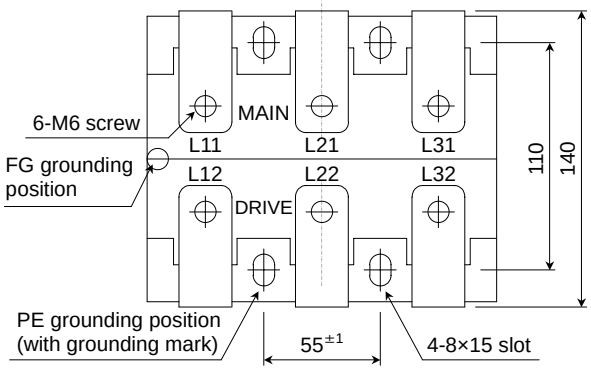
- B-AL-18.5K

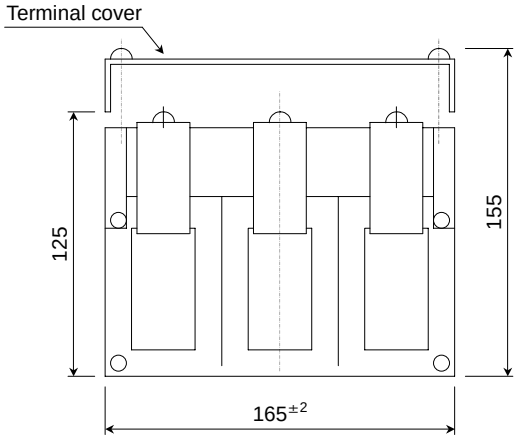




[Unit: mm]

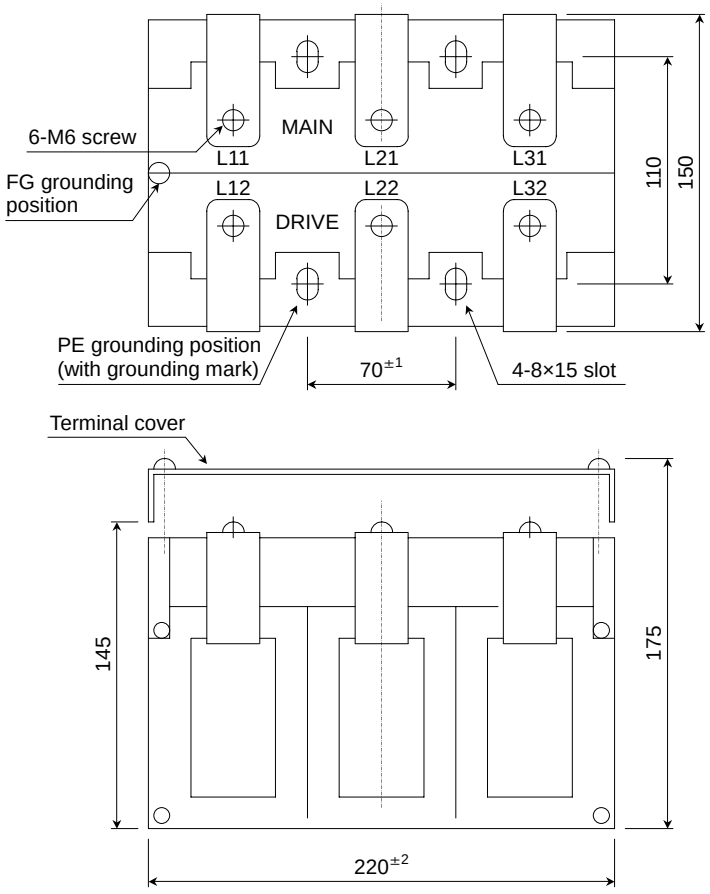
- B-AL-30K





[Unit: mm]

- B-AL-37K



[Unit: mm]

Appendix 2. Cable and Connector Specifications

Appendix 2-1 Selection of cable

Appendix 2-1-1 Cable wire and assembly

(1) Cable wire

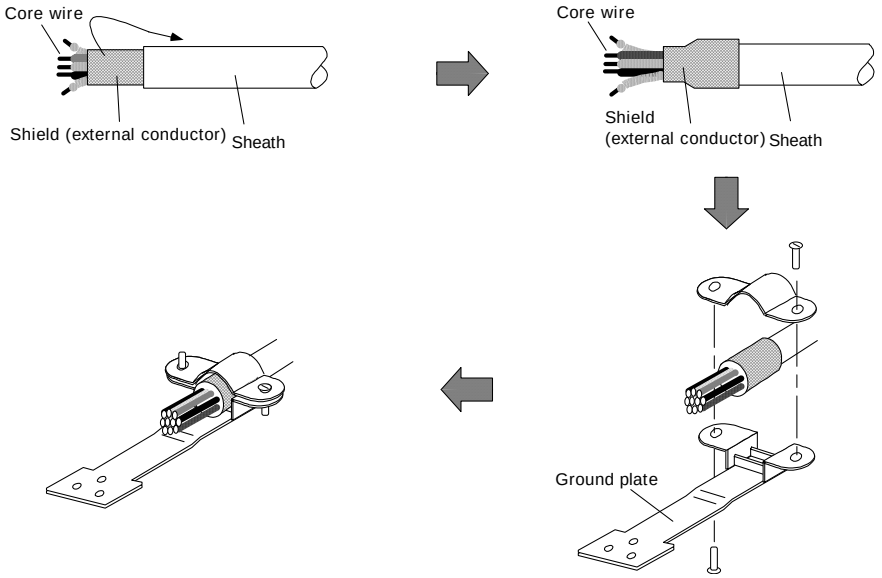
The following shows the specifications and processing of the wire used in each cable. Manufacture the cable using the following recommended wire or equivalent parts.

Recommended wire model (Cannot be directly ordered from Mitsubishi Electric Corp.)	Finished outside diameter	Sheath material	No. of pairs	Wire characteristics					Application
				Configuration	Conductor resistance	Withstand voltage	Insulation resistance	Heat resistant temperature	
UL20276 AWG28 10pair	6.1mm	PVC	10	7 strands/ 0.13mm	222Ω/km or less	AC350/ 1min	1MΩ/km or more	80°C	NC unit communication cable
A14B2343 (Note 1)	7.2mm	PVC	6	40 strands/ 0.08mm	105Ω/km or less	AC500/ 1min	1500MΩ/km or more	105°C	Detector cable
TS-91026 (Note 2)	11.6mm	PVC	2 (0.3 mm^2)	60 strands/ 0.08mm	63Ω/km or less	AC750V/ 1min	60MΩ/km or more	60°C	Detector cable (Cable length: 20m or more)
			10 (0.2 mm^2)	40 strands/ 0.08mm	95Ω/km or less				

(Note 1) Junko Co. (Dealer: Toa Denki)
(Note 2) BANDO ELECTRIC WIRE (http: //www.bew.co.jp)

(2) Cable assembly

Assemble the cable as shown in the following drawing, with the cable shield wire securely connected to the ground plate of the connector.



(3) Cable protection tube (noise countermeasure)

If influence from noise is unavoidable, or further noise resistance is required, selecting a flexible tube and running the signal cable through this tube is effective. This is also an effective countermeasure for preventing the cable sheath from being cut or becoming worn.

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

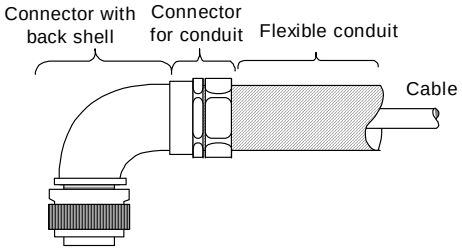
Supplier	Tube	Connector		
		Drive unit side	Installation screws	Motor detector side
Nippon Flex Control Corp.	FBA-4 (FePb wire braid sheath)	RBC-104 (straight) RBC-204 (45°) RBC-304 (90°)	G16 G16 G16	RCC-104-CA2022
DAIWA DENGYO CO., LTD	Hi-flex PT #17 (FePb sheath)	PSG-104 (straight) PLG-17 (90°) PS-17 (straight)	Screw diameter ø26.4 Screw diameter ø26.4 PF1/2	PDC20-17
Sankei Works	Purika Tube PA-2 #17 (FePb sheath)	BC-17 (straight)	Wire tube screws : 15	PDC20-17

(Note) None of the parts in this table can be ordered from Mitsubishi Electric Corp.

Appendix 2-1-2 Flexible conduits

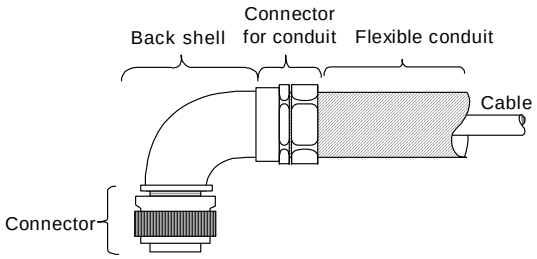
Basically, splash proofing can be ensured if cab-tire cable and connectors with IP65 or higher specifications are used. However, to further improve the oil resistance (chemical resistance to oil), weather resistance (resistance to the environment when used outdoors, etc.), durability, tensile strength, flattening strength, etc., run the cable through a flexible conduit when wiring.
The following shows an example of a flexible conduit. Contact the connector maker for more information.

(1) Method for connecting to a connector with back shell



Appli-cation	Applicable motors	Model			
		DDK		Nippon Flex	
		Connector (straight)	Connector (angle)	Connector for conduit	Flexible conduit
For power	HA053N, HA13N HA23N, HA33N	CE05-6A18-12SD-B-BSS	CE05-8A18-12SD-B-BAS	RCC-103CA18	VF-03 (Min. inside diameter: 10.6)
				RCC-104CA18	VF-04 (Min. inside diameter: 14)
	HC52, HC102, HC152 HC53, HC103, HC153 HC103R, HC153R, HC203R	CE05-6A22-23SD-B-BSS	CE05-8A22-23SD-B-BAS	RCC-104CA2022	VF-04 (Min. inside diameter: 14)
				RCC-106CA2022	VF-06 (Min. inside diameter: 19)
	HC202, HC352, HC452 HC203, HC353 HC353R, HC503R	CE05-6A24-10SD-B-BSS	CE05-8A24-10SD-B-BAS	RCC-106CA2428	VF-06 (Min. inside diameter: 19)
				RCC-108CA2428	VF-08 (Min. inside diameter: 24.4)
	HC702, HC902 HC453, HC703	CE05-6A32-17SD-B-BSS	CE05-8A32-17SD-B-BAS	RCC108CA32	VF-08 (Min. inside diameter: 24.4)
				RCC110CA32	VF-10 (Min. inside diameter: 33.0)

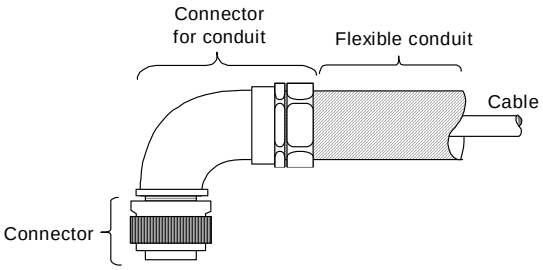
(Note) None of the parts in this table can be ordered from Mitsubishi Electric Corp.



Appli-cation	Applicable motors	Model			
		DDK		Nippon Flex	
		Connector/back shell (straight)	Connector/back shell (angle)	Connector for conduit	Flexible conduit
For brake	HA053NB to HA33NB HC202B to HC902B HC203B to HC703B	Select according to section "(2) Method for connecting to the connector main body".			
For detector	HA053N to HA33N HC52 to HC902, HC53 to HC703 HC103R to HC503R HA-LF11K2-S8, HA-LF15K2-S8	Connector MS3106A22-14S (D190) Back shell CE02-22BS-S	Connector MS3106A22-14S (D190) Back shell CE-22BA-S	RCC-104CA2022	VF-04 (Min. Inside diameter: 14)
				RCC-106CA2022	VF-06 (Min. Inside diameter: 19)

(Note) None of the parts in this table can be ordered from Mitsubishi Electric Corp.

(2) Method for connecting to the connector main body



Appli-cation	Applicable motors	Model		
		DDK	DAIWA DENGYO	
		Connector (straight)	Connector for conduit	Flexible conduit
For power	HA053N, HA13N HA23N, HA33N	CE05-6A18-12SD-B	MSA-12-18 (Straight) MAA-12-18 (Angle)	FCV12 (Min. inside diameter: 12.3)
			MSA-16-18 (Straight) MAA-16-18 (Angle)	FCV16 (Min. inside diameter: 15.8)
	HC52, HC102, HC152 HC53, HC103, HC153 HC103R, HC153R, HC203R	CE05-6A22-23SD-B	MSA-16-22 (Straight) MAA-16-22 (Angle)	FCV16 (Min. inside diameter: 15.8)
			MSA-22-22 (Straight) MAA-22-22 (Angle)	FCV22 (Min. inside diameter: 20.8)
	HC202, HC352, HC452 HC203, HC353 HC353R, HC503R	CE05-6A24-10SD-B	MSA-22-24 (Straight) MAA-22-24 (Angle)	FCV22 (Min. inside diameter: 20.8)
			MSA-28-24 (Straight) MAA-28-24 (Angle)	FCV28 (Min. inside diameter: 26.4)
	HC702, HC902 HC453, HC703	CE05-6A32-17SD-B	Please contact to a maker.	FCV36 (Min. inside diameter: 35.0)
For brake	HA053NB to HA33NB HC202B to HC902B HC203B to HC703B	MS3106A10SL-4S (D190)	MSA-10-10 (Straight) MAA-10-10 (Angle)	FCV10 (Min. inside diameter: 10.0)
For detector	HA053N to HA33N HC52 to HC902, HC53 to HC703 HC103R to HC503R HA-LF11K2-S8, HA-LF15K2-S8	MS3106A22-14S (D190)	MSA-16-22 (Straight) MAA-16-22 (Angle)	FCV16 (Min. inside diameter: 15.8)
			MSA-22-22 (Straight) MAA-22-22 (Angle)	FCV22 (Min. inside diameter: 20.8)

(Note) None of the parts in this table can be ordered from Mitsubishi Electric Corp.

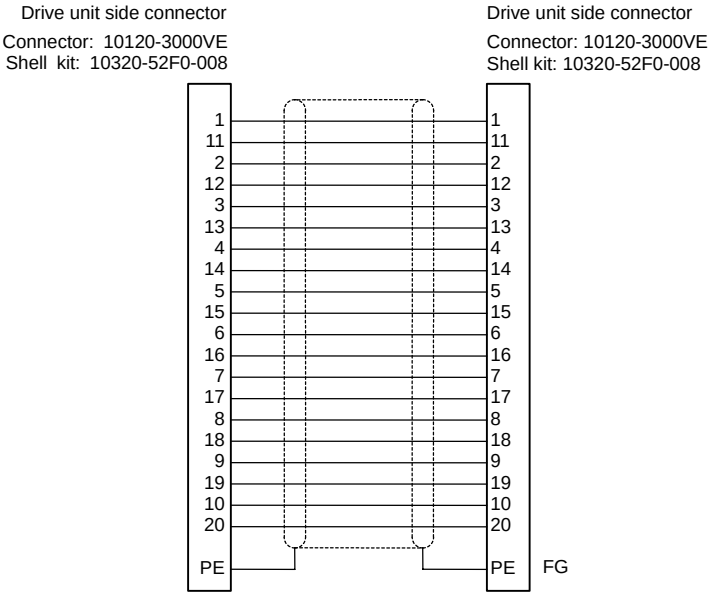
Appendix 2-2 Cable connection diagram

⚠ CAUTION

1. Do not mistake the connection when manufacturing the detector cable. Failure to observe this could lead to faults, runaway or fires.
2. Do not connect anything to pins unless otherwise particularly specified when manufacturing a cable. (Leave OPEN)
3. Contact Mitsubishi when manufacturing a cable longer than 30m.

(1) NC bus cable

<SH21 cable connection diagram>



(2) Servo detector cable

<CNV12/CNV13 cable connection diagram> The connection differs according to the cable length.

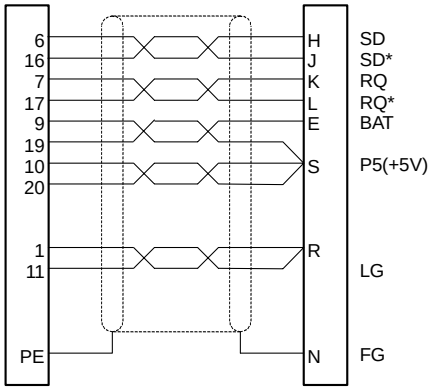
Servo drive unit side connector

Connector: 10120-3000VE
(One-touch type lock)
Shell kit: 10320-52F0-008
(Screw-type lock)
Shell kit: 10320-52A0-008

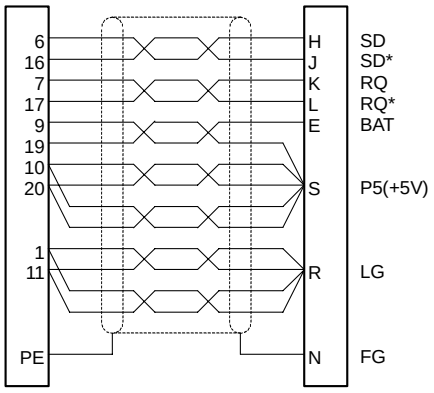
Servomotor detector side/
Ball screw side detector side connector

<For general environment>
Plug: MS3106B22-14S (Straight)
MS3108B22-14S (Angle)
Clamp: MS3057-12A

<IP65 compatible>
Plug:
MS3106A22-14S(D190)
Straight back shell:
CE02-22BS-S (Straight)
CE-22BA-S (Angle)
Clamp: CE3057-12A-3



<For 20m or less>



<For 20m to 30m>

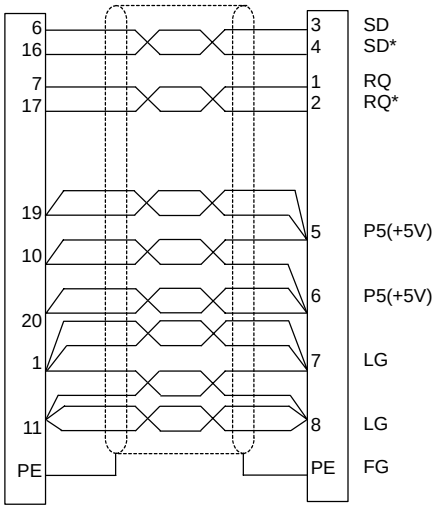
<CNL3H1,CNL3H2,CNL3H1-S,CNL3H2-S cable connection diagram>

Servo drive unit side connector

Connector:10120-3000VE
(One-touch type lock)
Shell kit:10320-52F0-008
(Screw-type lock)
Shell kit: 10320-52A0-008

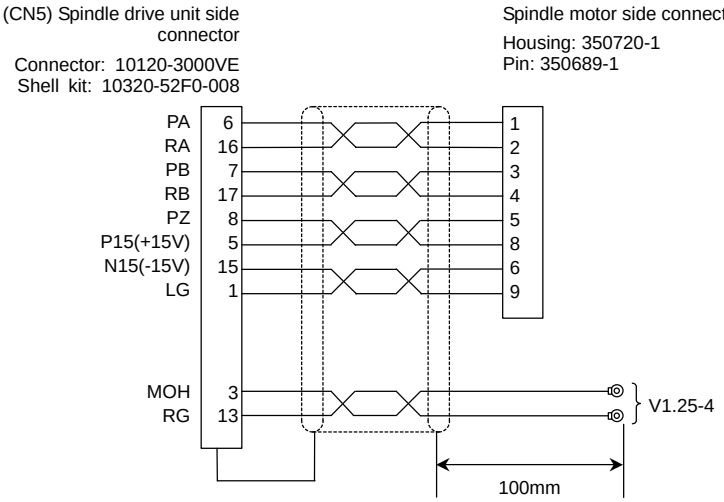
MDS-B-HR unit side connector

Plug: RM15WTP-8S
Clamp: RM15WTP-CP(10)

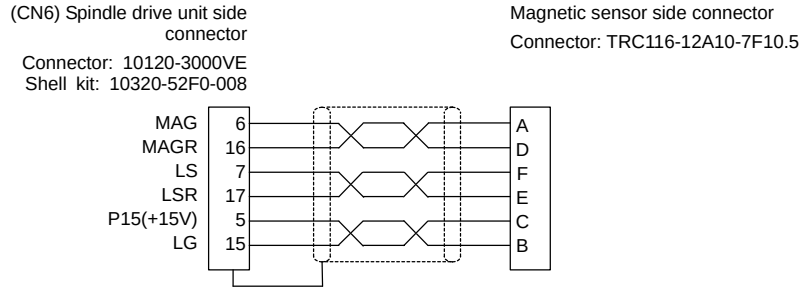


(3) Spindle detector cable

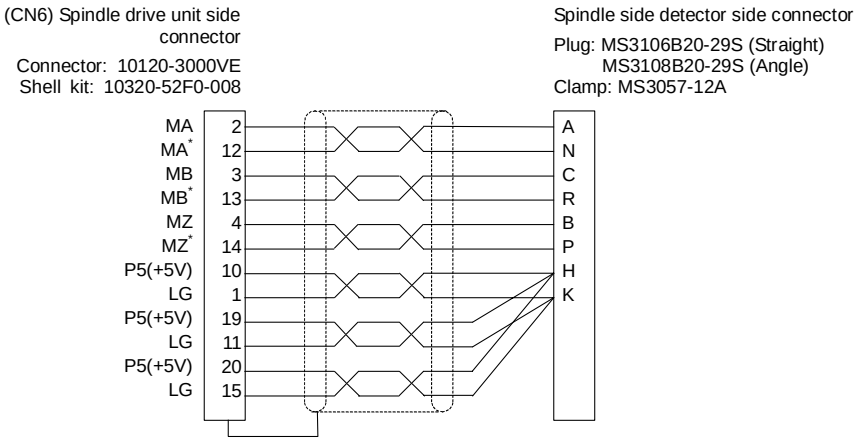
<CNP5 cable connection diagram>



<CNP6M cable connection diagram>

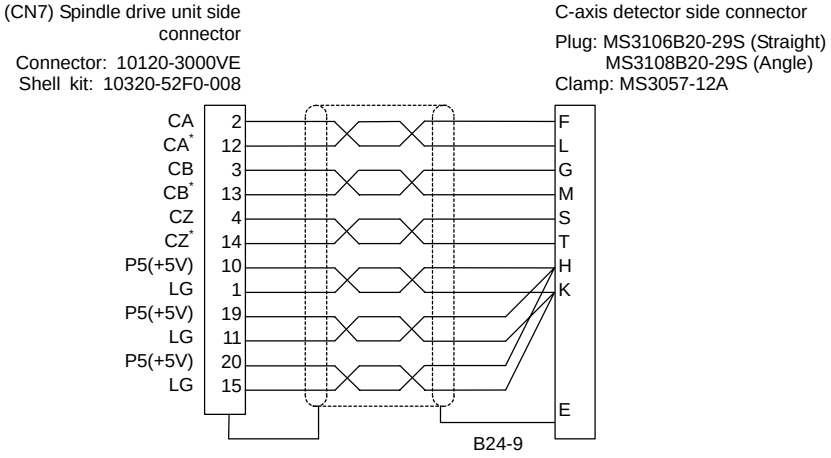


<CNP6A cable connection diagram>

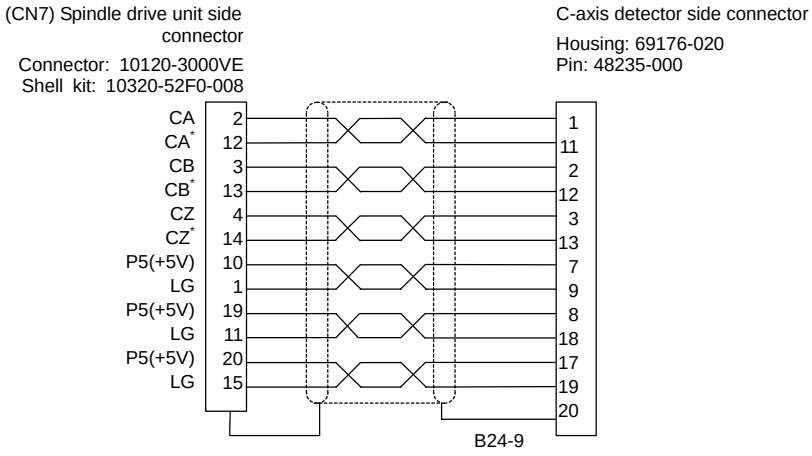


⚠ CAUTION The shield of the spindle detector cable is not connected to the "FG" (earth). Do not connect the cable shield to the earth by clamping the cable, etc.

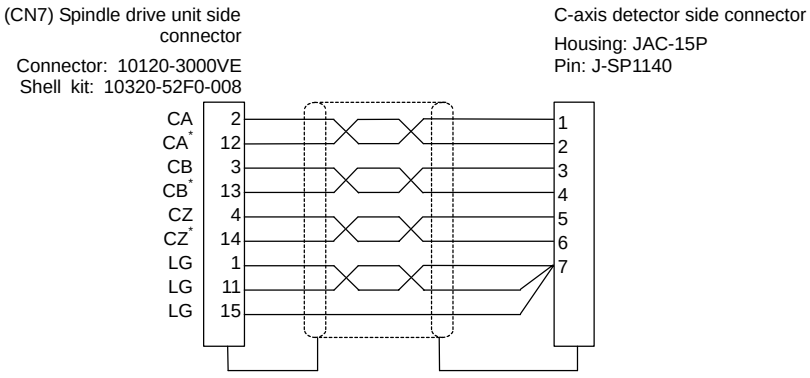
<CNP7A cable connection diagram>



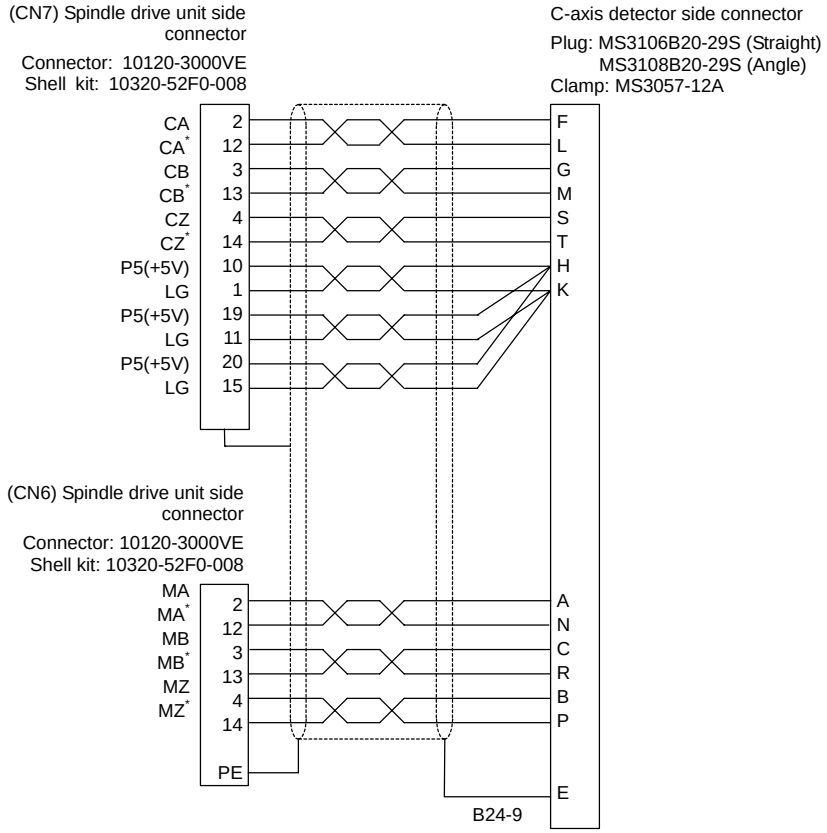
<CNP7B cable connection diagram>



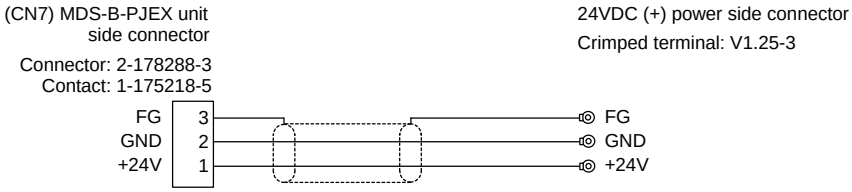
<CNP7H cable connection diagram>



<CNP67A cable connection diagram>



<FCUA-R220 cable connection diagram>

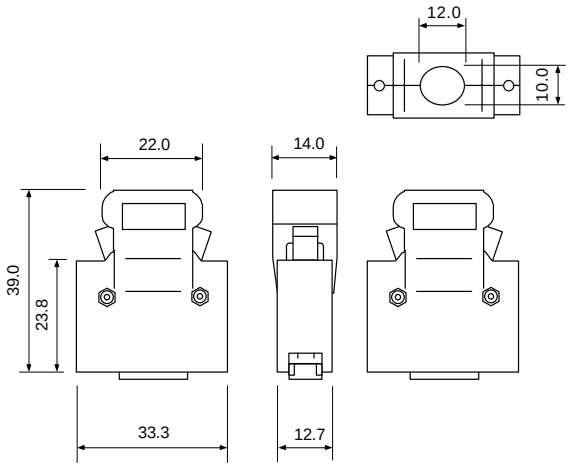


Appendix 2-3 Connector outline dimension drawings

Connector for CN2 Servo drive unit

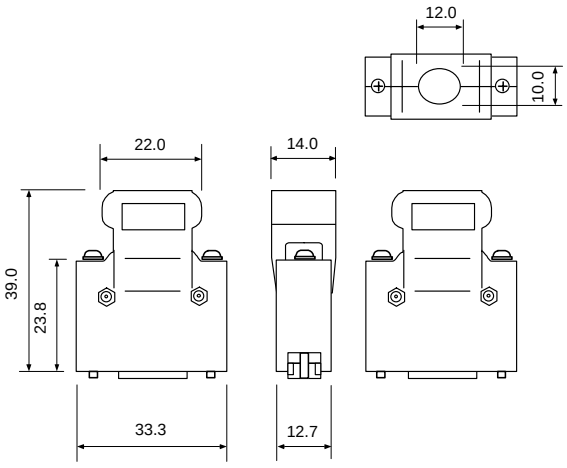
Manufacturer: 3M (Ltd.)
<Type>
Connector: 10120-3000VE
Shell kit: 10320-52F0-008

[Unit: mm]



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

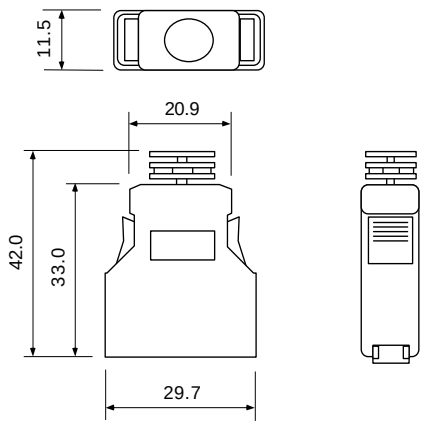
[Unit: mm]



Manufacturer: 3M (Ltd.)
<Type>
Connector: 10120-6000EL
Shell kit: 10320-3210-000

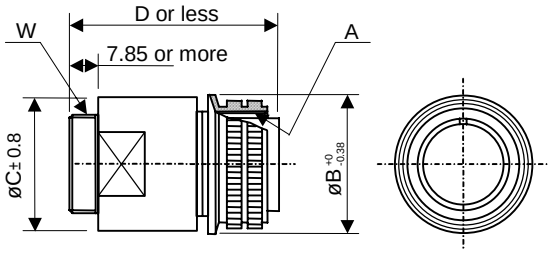
Because this connector is an integrated molding part of the cable, it is not an option setting in the connector set. The terminal connector (A-TM) also has the same outline.

[Unit: mm]



Connectors for detector and motor power (IP67 and EN standard compatible)

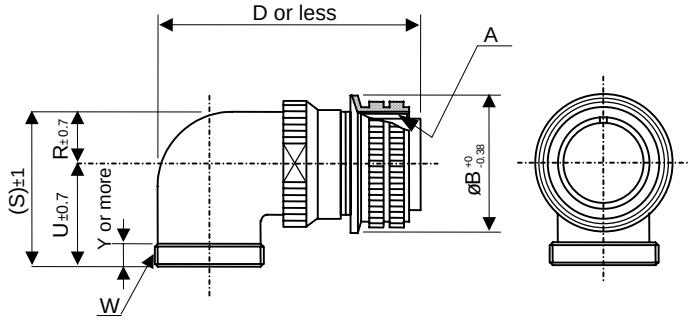
Straight plug
Manufacturer: DDK (Ltd.)



[Unit: mm]

Type	A	B $^{+0}_{-0.38}$	C±0.8	D or less	W
CE05-6A18-12SD-B-BSS	$1^{1}/_{8}$-18UNEF-2B	34.13	32.1	57	1-20UNEF-2A
CE05-6A22-23SD-B-BSS	$1^{3}/_{8}$-18UNEF-2B	40.48	38.3	61	$1^{3}/_{16}$-18UNEF-2A
CE05-6A24-10SD-B-BSS	$1^{1}/_{2}$-18UNEF-2B	43.63	42.0	68	$1^{7}/_{16}$-18UNEF-2A
CE05-6A32-17SD-B-BSS	2-18UNS-2B	56.33	54.2	79	$1^{3}/_{4}$-18UNS-2A

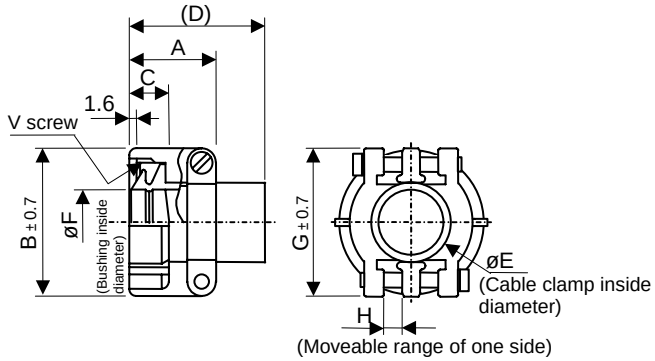
Angle plug
Manufacturer: DDK (Ltd.)



[Unit: mm]

Type	A	B $^{+0}_{-0.38}$	D or less	W	R±0.7	U±0.7	(S) ±1	Y or more
CE05-8A18-12SD-B-BAS	$1^{1}/_{8}$-18UNEF-2B	34.13	69.5	1-20UNEF-2A	13.2	30.2	43.4	7.5
CE05-8A22-23SD-B-BAS	$1^{3}/_{8}$-18UNEF-2B	40.48	75.5	$1^{3}/_{16}$-18UNEF-2A	16.3	33.3	49.6	7.5
CE05-8A24-10SD-B-BAS	$1^{1}/_{2}$-18UNEF-2B	43.63	86.3	$1^{7}/_{16}$-18UNEF-2A	18.2	36.5	54.7	7.5
CE05-8A32-17SD-B-BAS	2-18UNS-2B	56.33	93.5	$1^{3}/_{4}$-18UNS-2A	24.6	44.5	61.9	8.5

Cable clamp
Manufacturer: DDK (Ltd.)

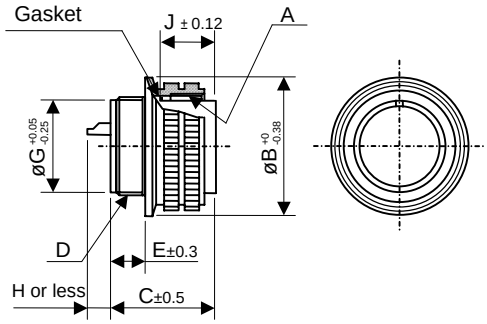


[Unit: mm]

Type	Shell size	Total length A	Outside dia. B	Effective screw length C	D	E	F	G	H	Installation screw V	Bushing	Compliant cable
CE3057-10A-2 (D265)	18	23.8	30.1	10.3	41.3	15.9	11	31.7	3.2	1-20UNEF-2B	CE3420-10-2	ø8.5 to ø11
CE3057-12A-2 (D265)	20	23.8	35	10.3	41.3	19	13	37.3	4	$1^{3}/_{16}$-18UNEF-2B	CE3420-12-2	ø9.5 to ø13
CE3057-12A-3 (D265)	22						10				CE3420-12-3	ø6.8 to ø10
CE3057-16A-2 (D265)	24	26.2	42.1	10.3	41.3	23.8	15.5	42.9	4.8	$1^{7}/_{16}$-18UNEF-2B	CE3420-16-2	ø13 to ø15.5
CE3057-20A-1 (D265)	32	27.8	51.6	11.9	43.0	31.7	23.8	51.6	6.3	$1^{3}/_{4}$-18UNS-2B	CE3420-20-1	ø22 to ø23.8

Connectors for detector, motor power and brake (IP67 and EN standard compatible)

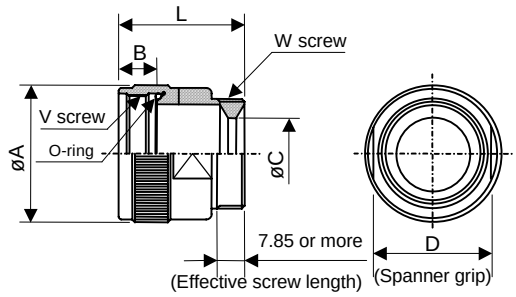
Straight plug
Manufacturer: DDK (Ltd.)



[Unit: mm]

Type	A	$B^{+0}_{-0.38}$	C±0.5	D	E±0.3	$G^{+0.05}_{-0.25}$	J±0.12
MS3106A10SL-4S (D190)	$^{5}/_{8}$-24UNEF-2B	22.22	23.3	$^{9}/_{16}$-24UNEF-2A	7.5	12.5	13.49
MS3106A22-14S (D190)	$1^{3}/_{8}$-18UNEF-2B	40.48	34.11	$1^{1}/_{4}$-18UNEF-2A	12.15	29.9	18.26

Straight back shell
Manufacturer: DDK (Ltd.)

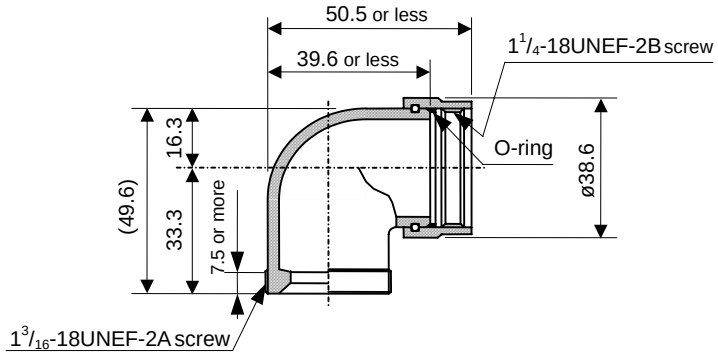


[Unit: mm]

Type	L	A	B	C	D	V	W
CE02-22BS-S	35	36.5	10.9	17.8	32.4	$1^{1}/_{4}$-18UNEF-2B	$1^{3}/_{16}$-18UNEF-2A

Angle back shell
Manufacturer: DDK (Ltd.)
Type: CE-22BA-S

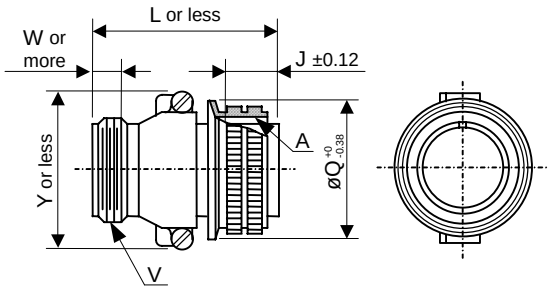
[Unit: mm]



Connectors for detector, motor power and brake (for general environment)

Straight plug

Manufacturer: DDK (Ltd.)

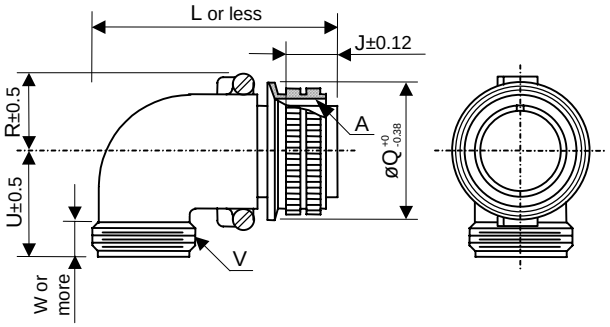


[Unit: mm]

Type	Coupling screw A	Length of coupling section J±0.12	Total length L or less	Connection nut outside diameter øQ +0 −0.38	Cable clamp installation screw V	Effective screw length W or more	Max. width Y or less
MS3106B18-12S	$1^{1}/_{8}$-18UNEF	18.26	52.37	34.13	1-20UNEF	9.53	42
MS3106B22-14S	$1^{3}/_{8}$-18UNEF	18.26	55.57	40.48	$1^{3}/_{16}$-18UNEF	9.53	50
MS3106B22-23S							
MS3106B24-10S	$1^{1}/_{2}$-18UNEF	18.26	58.72	43.63	$1^{7}/_{16}$-18UNEF	9.53	53
MS3106B32-17S	2-18UNS	18.26	61.92	56.33	$1^{3}/_{4}$-18UNS	11.13	66

Angle plug

Manufacturer: DDK (Ltd.)



[Unit: mm]

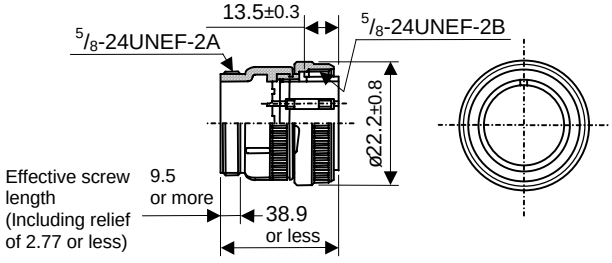
Type	Coupling screw A	Length of coupling section J±0.12	Total length L or less	Connection nut outside diameter øQ +0 −0.38	R±0.5	U±0.5	Cable clamp installation screw V	Effective screw length W or more
MS3108B18-12S	$1^{1}/_{8}$-18UNEF	18.26	68.27	34.13	20.5	30.2	1-20UNEF	9.53
MS3108B22-14S	$1^{3}/_{8}$-18UNEF	18.26	76.98	40.48	24.1	33.3	$1^{3}/_{16}$-18UNEF	9.53
MS3108B22-23S								
MS3108B24-10S	$1^{1}/_{2}$-18UNEF	18.26	86.51	43.63	25.6	36.5	$1^{7}/_{16}$-18UNEF	9.53
MS3108B32-17S	2-18UNS	18.26	95.25	56.33	32.8	44.4	$1^{3}/_{4}$-18UNS	11.13

Straight plug

Manufacturer: Japan Aviation Electronics (Ltd.)

Type: MS3106B10SL-4S

[Unit: mm]



Connectors for detector, motor power and brake (for general environment)

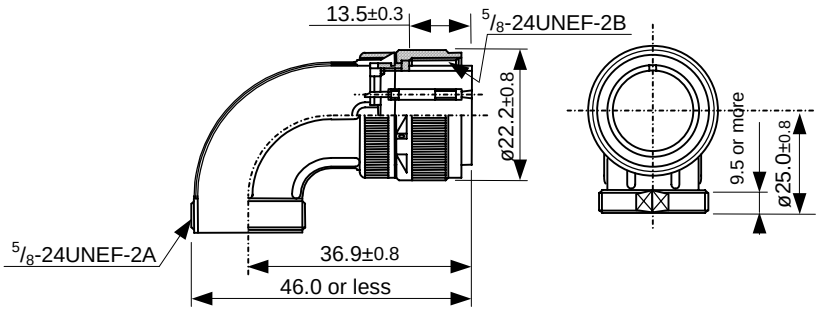
Angle plug

Manufacturer:

Japan Aviation Electronics (Ltd.)

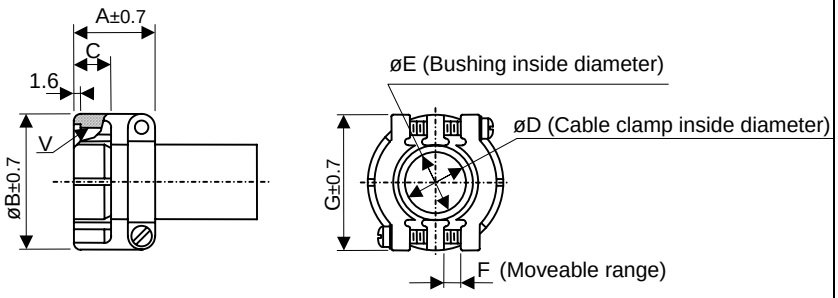
Type: MS3108B10SL-4S

[Unit: mm]



Cable clamp

Manufacturer: DDK (Ltd.)



[Unit: mm]

Type	Shell size	Total length A±0.7	Outside diameter øB±0.7	Effective screw length C	øD	øE	F	G±0.7	Installation screw V	Bushing
MS3057-4A	10SL, 12S	20.6	20.6	10.3	7.9	5.6	1.6	22.2	5/8-24UNEF	AN3420-4
MS3057-10A	18	23.8	30.1	10.3	15.9	14.3	3.2	31.7	1-20UNEF	AN3420-10
MS3057-12A	20, 22	23.8	35.0	10.3	19.0	15.9	4.0	37.3	1 3/16-18UNEF	AN3420-12
MS3057-16A	24, 28	26.2	42.1	10.3	23.8	19.1	4.8	42.9	1 7/16-18UNEF	AN3420-16
MS3057-20A	32	27.8	51.6	11.9	43	31.7	6.3	51.6	1 3/4-18UNEF	AN3420-20

Appendix 3. Selection

Appendix 3-1 Selecting the servomotor series

Appendix 3-1-1 Motor series characteristics

The servomotor series is categorized according to purpose, motor inertia size, and detector resolution. Select the motor series that matches the purpose of the machine to be installed.

Motor series characteristics

Motor series	Capacity (rated speed)	Detector resolution	Features
HC□	0.5 to 9.0kW (2000r/min) 0.5 to 7.0kW (3000r/min)	1,000,000 p/rev /100,000 p/rev	This is a motor for NC machine tool feed axes. It has smooth torque characteristics and is compatible with high resolution detectors. It has the same shaft shape and flange size as conventional HA motors (HA□N), but with shorter L dimensions, designing machine becomes easier. It is drip-proofed against cutting oil entering the unit, and it clears IP65 specifications for environmental resistance performance as a standard.
HC□R	1.0 to 5.0kW (3000r/min)	1,000,000 p/rev /100,000 p/rev	This is the standard HC motor made into a low inertia motor. It has a high output, compact design, and is suitable for high speed driving of light loads such as loaders. The detector has been made compatible with the feed axis. It is drip-proofed against cutting oil entering the unit, and it clears IP65 specifications for environmental resistance performance as a standard.
HA□N	0.05 to 0.45kW (3000r/min)	1,000,000 p/rev /100,000 p/rev	This is a motor for conventional NC machine tool feed axes. This motor is used for the small capacity feed axes of which no HC motor capacity being set.
HA-LF	11 to 15kW (2000r/min)	1,000,000 p/rev /100,000 p/rev	This is a motor for NC machine tool large capacity feed axes. Select the HA-LF Series when the HC motor capacity range is exceeded.

Appendix 3-1-2 Servomotor precision

The control precision of the servomotor is determined by the detector resolution, motor characteristics and parameter adjustment. This section examines the following four types of servomotor control precision when the servo parameters are adjusted. When selecting a servo, confirm that these types of precision satisfy the machine specifications before determining the servomotor series.

(1) Theoretic precision: Δε

This value is determined by the motor detector precision, and is the value obtained by dividing the movement amount (ΔS) per motor rotation by the detector resolution (RNG).

(2) Positioning precision : Δεp

This is the precision outline that affects the machine targeted for positioning, and expresses the machine's positioning precision.
When the motor is a single unit, this is determined by the detector resolution and matches with the theoretic precision Δεp. When the motor is actually installed on a machine, the positioning precision Δεp becomes 1 to 2 times the theoretic precision Δε. This is due to the effect on the motor control by the machine rigidity, etc. Furthermore, the value to which the error from the motor shaft to the machine is added becomes the actual machine positioning precision. If accurate positioning precision is required at the machine, use the MDS-C1-V1/V2 series servo drive unit that allows the scale feedback to be input.

(3) Surface precision during machining : Δεv

This is the precision outline that affects the machine tools, etc., which are important factors in the machine operation path and interpolation functions. It also affects the surface roughness of the machining surface. The machining surface roughness is affected by elements caused by the detector resolution, the motor's electrical characteristics (torque ripple, etc.) and mechanical characteristics (cogging torque, etc.). In the NC unit feed axis motor (HCﾌﾞ, HAﾌﾞN) those torque characteristics are excellent, and higher precision machining is possible than that of other motors. Because the effects of torque ripple and cogging torque are relatively small in motors with large amounts of inertia, the motor with the larger inertia, among the two identical capacity motors, will be more advantageous for surface precision. Due to the effects of differences in characteristics of the motor itself, the surface precision during machining will differ greatly according to the motor series.

(4) Absolute position repeatability precision: Δεa

This is the precision outline that affects the absolute position system machine, and expresses the precision in repeatability of the position before the power was shut off and the position when the power is turned on again. With the single motor unit, the precision is 1 to 2 times the theoretic precision Δε. Note that the absolute position repeatability Δεa is the difference between when the power was turned off last and returned on. This error is not cumulated.

Appendix 3-2 Selection of servomotor capacity

The following three elements are used to determine the servomotor capacity.

1. Load inertia ratio
2. Short time characteristics (acceleration/deceleration torque)
3. Continuous characteristics (continuous effective load torque)

Carry out appropriate measures, such as changing the motor series or increasing the motor capacity, if any of the above conditions is not fulfilled.

Appendix 3-2-1 Load inertia ratio

Each servomotor has an appropriate load inertia ratio (load inertia/motor inertia). The control becomes unstable when the load inertia ratio is too large, and the servo parameter adjustment becomes difficult. It becomes difficult to improve the surface precision in the feed axis, and the positioning time cannot be shortened in the positioning axis because the settling time is longer.
If the load inertia ratio exceeds the recommended value in the servomotor specifications list, increase the motor capacity or change to a motor series with a larger inertia. Note that the recommended value for the load inertia ratio is strictly one guideline. This does not mean that controlling of the load with inertia exceeding the recommended value is impossible.

POINT

1. When selecting feed axis servomotors for NC unit machine tools, place importance on the surface precision during machining. To do this, always select a servomotor with a load inertia ratio within the recommended value. Select the lowest value possible within that range.
2. Judge the load inertia ratio for the motor with brakes using the motor inertia of motors without brakes as a reference.

Appendix 3-2-2 Short time characteristics

In addition to the continuous operation range, the servomotor has the short time operation range that can only be used for short times such as acceleration/deceleration. This range is expressed at the maximum torque. The maximum torque differs for each motor even at the same capacity, so confirm the specifications in section "2-1 Servomotor".
The maximum torque affects the acceleration/deceleration time constant that can be driven. The linear acceleration/deceleration time constant ta can be approximated from the machine specifications using expression (a). Determine the maximum motor torque required from this expression, and select the motor capacity.

$$ta = \frac{(J_L + J_M) \times N}{95.5 \times (0.8 \times T_{MAX} - T_L)} \quad (ms) \qquad \text{..... (a)}$$

N	: Motor reach speed	(r/min)
J_L	: Motor shaft conversion load inertia	($kg \cdot cm^2$)
J_M	: Motor inertia	($kg \cdot cm^2$)
T_{MAX}	: Maximum motor torque	(N·m)
T_L	: Motor shaft conversion load (friction, unbalance) torque	(N·m)

Appendix 3-2-3 Continuous characteristics

A typical operation pattern is assumed, and the motor's continuous effective load torque (Trms) is calculated from the motor shaft conversion and load torque. If numbers <1> to <8> in the following drawing were considered a one cycle operation pattern, the continuous effective load torque is obtained from the root mean square of the torque during each operation, as shown in the expression (b).

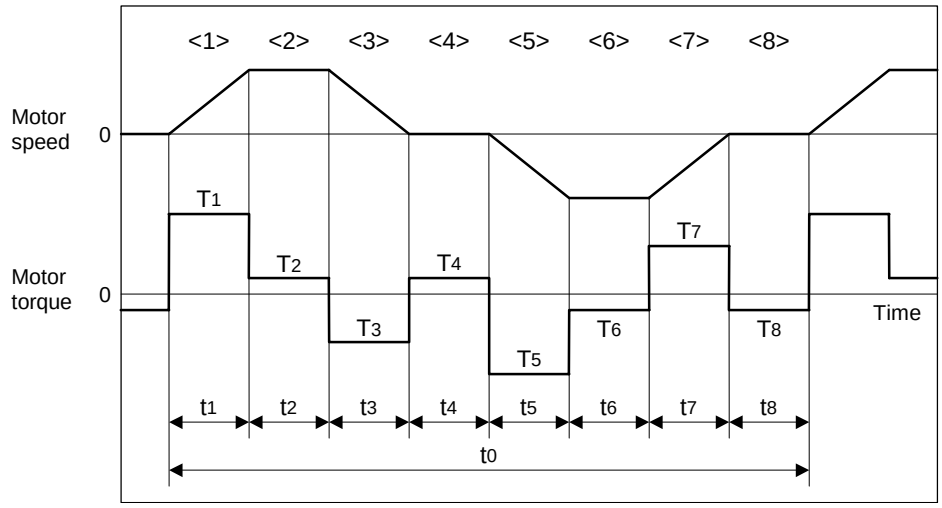


Fig. 1 Continuous operation pattern

$$Trms = \sqrt{\frac{T1^2 \cdot t1 + T2^2 \cdot t2 + T3^2 \cdot t3 + T4^2 \cdot t4 + T5^2 \cdot t5 + T6^2 \cdot t6 + T7^2 \cdot t7 + T8^2 \cdot t8}{t0}} \quad \text{..... (b)}$$

Select a motor so that the continuous effective load torque Trms is 80% or less of the motor stall torque Tst.

$$Trms \leq 0.8 \cdot Tst \quad \text{..... (c)}$$

The amount of acceleration torque (Ta) shown in tables 11-6 and 11-7 is the torque to accelerate the load inertia in a frictionless state. It can be calculated by the expression (d). (For linear acceleration/ deceleration)

$$Ta = \frac{(J_L + J_M) \times N}{95.5 \times ta} \ (N \cdot m) \quad \text{..... (d)}$$

N	:	Motor reach speed	(r/min)
J_L	:	Motor shaft conversion load inertia	($kg \cdot cm^2$)
J_M	:	Motor inertia	($kg \cdot cm^2$)
ta	:	Linear acceleration/deceleration time constant	(ms)

For an unbalance axis, select a motor so that the motor shaft conversion load torque (friction torque + unbalance torque) is 60% or less of the stall.

$$T_L \leq 0.6 \cdot Tst \quad \text{..... (e)}$$

(1) Horizontal axis load torque

When operations <1> to <8> are for a horizontal axis, calculate so that the following torques are required in each period.

Load torques of horizontal axes

Period	Load torque calculation method	Explanation
<1>	(Amount of acceleration torque) + (Kinetic friction torque)	Normally the acceleration/deceleration time constant is calculated so that this torque is 80% of the maximum torque of the motor.
<2>	(Kinetic friction torque)	–
<3>	(Amount of deceleration torque) + (Kinetic friction torque)	The absolute value of the acceleration torque amount is same as the one of the deceleration torque amount. The signs for the amount of acceleration torque and amount of deceleration torque are reversed.
<4>	(Static friction torque)	Calculate so that the static friction torque is always required during a stop.
<5>	– (Amount of acceleration torque) – (Kinetic friction torque)	The signs are reversed with period <1> when the kinetic friction does not change according to movement direction.
<6>	– (Kinetic friction torque)	The signs are reversed with period <2> when the kinetic friction does not change according to movement direction.
<7>	– (Amount of deceleration torque) – (Kinetic friction torque)	The signs are reversed with period <3> when the kinetic friction does not change according to movement direction.
<8>	– (Static friction torque)	Calculate so that the static friction torque is always required during a stop.

(2) Unbalance axis load torque

When operations <1> to <8> are for an unbalance axis, calculate so that the following torques are required in each period. Note that the forward speed shall be an upward movement.

Load torques of unbalance axes

Period	Load torque calculation method	Explanation
<1>	(Amount of acceleration torque) + (Kinetic friction torque) + (Unbalance torque)	Normally the acceleration/deceleration time constant is calculated so that this torque is 80% of the maximum torque of the motor.
<2>	(Kinetic friction torque) + (Unbalance torque)	–
<3>	(Amount of deceleration torque) + (Kinetic friction torque) + (Unbalance torque)	The absolute value of the acceleration torque amount is same as the one of the deceleration torque amount. The signs for the amount of acceleration torque and amount of deceleration torque are reversed.
<4>	(Static friction torque) + (Unbalance torque)	The holding torque during a stop becomes fairly large. (Upward stop)
<5>	– (Amount of acceleration torque) – (Kinetic friction torque) + (Unbalance torque)	–
<6>	– (Kinetic friction torque) + (Unbalance torque)	The generated torque may be in the reverse of the movement direction, depending on the size of the unbalance torque.
<7>	– (Amount of deceleration torque) – (Kinetic friction torque) + (Unbalance torque)	–
<8>	– (Static friction torque) + (Unbalance torque)	The holding torque becomes smaller than the upward stop. (Downward stop)

POINT

During a stop, the static friction torque may constantly be applied. The static friction torque and unbalance torque may be applied during an unbalance axis upward stop, and the torque during a stop may become extremely large. Therefore, caution is advised.

Appendix 3-3 Example of servo selection

A servomotor is selected using a machining center with the following specifications as an example.

Specification item	Unit	X axis	Y axis	Z axis
Axis type		Linear	Linear	Linear
Movement direction		Horizontal	Horizontal	Vertical
Table support method		Rolling	Rolling	Rolling
Table movement friction coefficient	**%**	5	5	2
Ball screw diameter	**mm**	40	40	40
Ball screw length	**mm**	900	800	1000
Ball screw lead	**mm**	10	10	10
Deceleration ratio		1	1	2/3
Primary side gear inertia	**kg·cm^2**	–	–	1.6
Secondary side gear inertia	**kg·cm^2**	–	–	8.1
Motor/ball screw connection section inertia	**kg·cm^2**	2.0	2.0	–
Weight of moving object installed on the machine (table, etc.)	**kg**	500	400	400
Weight of standard-added-moving object (workpiece, etc.)	**kg**	100	100	10
Rapid traverse rate	**mm/min**	30000	30000	20000
Target acceleration/deceleration time constant	**ms**	120	120	120
Rapid traverse positioning frequency	**times/min**	20	20	20
Motor brake		Without	Without	With

Appendix 3-3-1 Motor selection calculation

The selection calculation is carried out in order using the Z axis as an example.

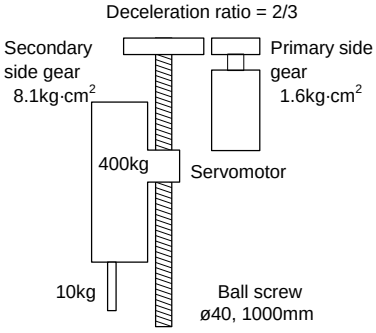


Fig. 11-3 Z axis configuration

(1) Obtaining the load inertia

Calculate the motor shaft conversion load inertia separately for the rotation load and linear movement load. Furthermore, calculate the rotation load inertia separately for the primary and secondary side.

- **Primary side rotation load inertia: J_{R1}**
  This is the primary side gear inertia.

  $J_{R1} = 1.6$ (kg·cm^2)

- **Secondary side rotation load inertia: J_{R2}**
  This is the sum of the ball screw inertia J_B and secondary side gear inertia. The ball screw is generally calculated as a cylinder made of steel. Refer to section "Appendix 3-3-4 Expressions for load inertia calculation".

  $$J_{R2} = J_B + 8.1 = \frac{\pi \cdot \rho \cdot L}{32} D^4 + 8.1 = \frac{\pi \times 7.80 \times 10^{-3} \times 100}{32} \times 4^4 + 8.1$$
  $$= 19.6 + 8.1 = 27.7 \text{ (kg·cm}^2\text{)}$$

- **Total rotation load inertia: J_R**
  This is the sum of the primary side load inertia and secondary side load inertia. To convert the secondary side load inertia to the motor shaft (primary side), multiply by the square of the deceleration ratio.

  $$J_R = J_{R1} + \left(\frac{2}{3}\right)^2 \times J_{R2} = 1.6 + \frac{4}{9} \times 27.7 = 1.6 + 12.3 = 13.9 \text{ (kg·cm}^2\text{)}$$

- **Linear movement load inertia: J_T**
  The inertia is calculated when a standard workpiece, tool, etc., is attached. The conversion to the motor shaft by the deceleration ratio is included in the movement increment per motor rotation. Refer to section "Appendix 3-3-4 Expressions for load inertia calculation".

$$J_T = W \cdot \left(\frac{\Delta S}{20\pi} \right)^2 = (400 + 10) \cdot \left(\frac{10 \times 2}{20\pi \times 3} \right)^2 = 4.6 \ (kg \cdot cm^2)$$

- **Load inertia: J_L**
  This is the sum of the total rotation load inertia and the linear movement inertia.

$$J_L = 13.9 + 4.6 = 18.5 \ (kg \cdot cm^2)$$

  When looking at the load inertia components, the linear movement weight tends to increase. However, the rotation load generally accounts for most of the inertia. The load inertia does not change much even if the workpiece weight changes greatly in the table axis.

(2) Obtaining unbalance torque

The unbalance torque is obtained from the moving object weight. Here, the drive system efficiency is calculated as 1.
Refer to section "Appendix 3-3-3 Motor shaft conversion load torque".

$$T_U = \frac{(W_1 - W_2) \cdot g \cdot \Delta S}{2 \times 10^3 \pi \cdot \eta} = \frac{(410 - 0) \times 9.8 \times 10 \times 2}{2 \times 10^3 \pi \times 1 \times 3} = 4.3 \ (N \cdot m)$$

(3) Obtaining friction torque

The friction torque is obtained from the moving object weight and friction coefficient. Here, the drive system efficiency is calculated as 1. Refer to section "Appendix 3-3-3 Motor shaft conversion load torque".

$$T_F = \frac{F \cdot \Delta S}{2 \times 10^3 \pi \cdot \eta} = \frac{\mu \cdot W \cdot g \cdot \Delta S}{2 \times 10^3 \pi \cdot \eta} = \frac{0.02 \times 410 \times 9.8 \times 10 \times 2}{2 \times 10^3 \pi \times 1 \times 3} = 0.09 \ (N \cdot m)$$

(4) Selecting the appropriate motor from the load inertia ratio

Because it is a machine tool, the HC Motor Series is required for the control precision, and a motor maximum speed of 3000r/min. or more is required because of the rapid traverse speed and gear ratio. Furthermore, the motor to be selected is limited to HC 3B Series because a motor with a brake is required. Note that even when the motor has brakes, use the motor inertia for a motor without brakes to judge the load inertia ratio.
The state is determined to be appropriate if the load inertia is within 3-fold of the recommended load inertia for HC53B or larger capacity as shown below.

Motor type	Motor inertia ($kg \cdot cm^2$)	Load inertia ($kg \cdot cm^2$)	Load inertia magnification	Judgment
HC53B	6.6	18.5	2.80	○
HC103B	13.7	18.5	1.35	○
HC153B	20.0	18.5	0.93	○

(5) Selecting the appropriate motor from the short time characteristics (acceleration/deceleration time constant)

The acceleration/deceleration time constant is calculated using expression (a), and is judged whether it satisfies the target acceleration/deceleration time constant of 120ms.

$$\text{HC53B} \quad : ta = \frac{(J_L + J_M) \times N}{95.5 \times (0.8 \times T_{MAX} - T_U - T_F)} = \frac{(18.5 + 8.6) \times 3000}{95.5 \times (0.8 \times 8.82 - 4.3 - 0.09)} = 320.5 \text{ (ms)}$$

$$\text{HC103B} : ta = \frac{(J_L + J_M) \times N}{95.5 \times (0.8 \times T_{MAX} - T_U - T_F)} = \frac{(18.5 + 15.7) \times 3000}{95.5 \times (0.8 \times 16.7 - 4.3 - 0.09)} = 119.9 \text{ (ms)}$$

$$\text{HC153B} : ta = \frac{(J_L + J_M) \times N}{95.5 \times (0.8 \times T_{MAX} - T_U - T_F)} = \frac{(18.5 + 22.0) \times 3000}{95.5 \times (0.8 \times 28.4 - 4.3 - 0.09)} = 69.4 \text{ (ms)}$$

The motors that satisfy the conditions from the calculation results above are the HC103B and HC153B as shown below.

Motor type	Maximum torque (N·m)	Total inertia ($kg \cdot cm^2$)	Acceleration/ deceleration time constant [ms]	Judgment
HC53B	8.82	27.1	320.5	×
HC103B	16.7	34.2	119.9	○
HC153B	28.4	40.5	69.4	○

(6) Selecting the appropriate motor from the continuous characteristics

Generally, the state is calculated following the typical operation pattern. Because the Z axis is the vertical axis here, the motor will be judged by the stopped torque during an upward stop.
The unbalance axis torque during a stop should be 60% or less of the stall torque (rated torque for general-purpose motor). As shown in the following table, the only motor that satisfies this reference is HC153B. From the judgment in steps (4) to (6) it is the appropriate motor with Z axis.

Motor type	Stall torque (N·m)	Torque during stop T_U+T_F ($kg \cdot cm^2$)	Load rate (%)	Judgment	Explanation
HC53B	2.94	4.39	149.1	×	An overload alarm occurs just by holding.
HC103B	5.88	4.39	74.6	×	There is no allowance for an acceleration/ deceleration operation.
HC153B	8.82	4.39	49.8	○	The torque during stop should be 60% or less.

Appendix 3-3-2 Servo selection results

As a result of calculating the servo selection, the servo specifications for the Z axis of this machining center have been determined.

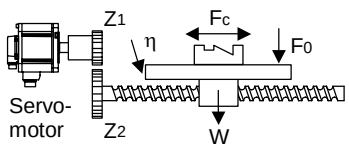
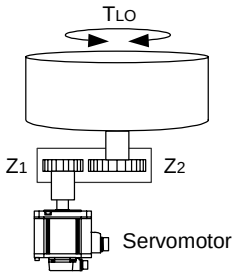
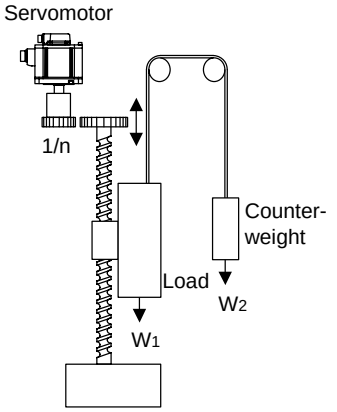
Item	Type
Servo drive unit	MDS-C1-V1-20
Servomotor	HC153B□

The □ in the motor type will be decided based on separate machine specifications such as motor shaft shape and absolute position system.
The following table shows the servo selections for all axes.

Item	Unit	X axis	Y axis	Z axis
Axis type		Linear	Linear	Linear
Movement direction		Horizontal	Horizontal	Vertical
Table support method		Rolling	Rolling	Rolling
Table movement friction coefficient	**%**	5	5	2
Ball screw diameter	**mm**	40	40	40
Ball screw length	**mm**	900	800	1000
Ball screw lead	**mm**	10	10	10
Deceleration ratio		1	1	2/3
Primary side gear inertia	**kg·cm^2**	–	–	1.6
Secondary side gear inertia	**kg·cm^2**	–	–	8.1
Motor/ball screw connection section inertia	**kg·cm^2**	2.0	2.0	–
Weight of moving object installed on the machine (table, etc.)	**kg**	500	400	400
Weight of standard-added-moving object (workpiece, etc.)	**kg**	100	100	10
Rapid traverse rate	**mm/min**	30000	30000	20000
Target acceleration/deceleration time constant	**ms**	120	120	120
Rapid traverse positioning frequency	**times/min**	20	20	20
Motor brake		Without	Without	With
Motor shaft conversion rotation load inertia	**kg·cm^2**	19.6	17.7	13.9
Motor shaft conversion linear movement load inertia	**kg·cm^2**	15.2	12.7	4.6
Motor shaft conversion total load inertia	**kg·cm^2**	34.8	30.4	18.5
Motor inertia	**kg·cm^2**	13.7	13.7	22.0
Motor shaft conversion load inertia magnification	**-fold**	2.54	2.22	0.84
Motor shaft conversion unbalance torque	**N·m**	0.0	0.0	4.3
Motor shaft conversion friction torque	**N·m**	0.47	0.39	0.09
Motor shaft conversion total load torque	**N·m**	0.47	0.39	4.39
Motor speed during rapid traverse	**r/min**	3000	3000	3000
Rapid traverse acceleration/deceleration time constant	**ms**	118.3	106.7	69.4
Maximum torque during motor stop	**N·m**	0.47	0.39	4.39
Maximum load rate during motor stop	**%**	8.0	6.6	49.8
Servo drive unit type		MDS-C1-V1-10	MDS-C1-V1-10	MDS-C1-V1-20
Servomotor type		HC103□	HC103□	HC153B□

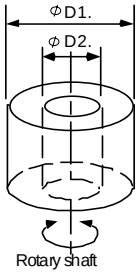
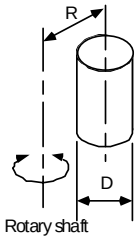
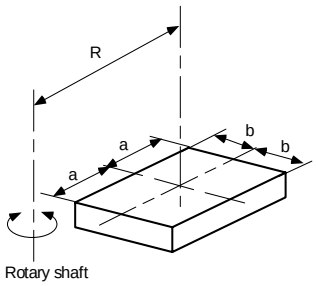
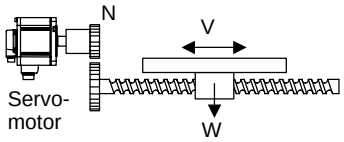
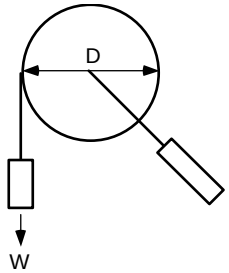
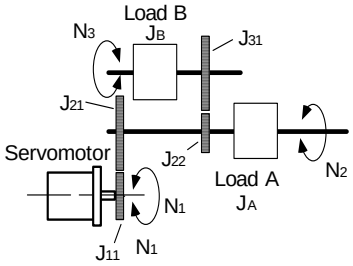
Appendix 3-3-3 Motor shaft conversion load torque

The calculation method for a representative load torque is shown.

Type	Mechanism	Calculation expression
Linear movement		$T_L = \frac{F}{2\times10^3\pi\eta} \cdot \left(\frac{V}{N}\right) = \frac{F\cdot\Delta S}{2\times10^3\pi\eta}$ T_L : Load torque (N·m) F : Force in axial direction of the machine that moves linearly (N) η : Drive system efficiency V : Speed of object that moves linearly (mm/min) N : Motor speed (r/min) ΔS : Object movement amount per motor rotation (mm) Z1, Z2 : Deceleration ratio F in the above expression is obtained from the expression below when the table is moved as shown on the left. $F = Fc + \mu (W \cdot g + F_0)$ Fc : Force applied on axial direction of moving section (N) F_0 : Tightening force on inner surface of table guide (N) W : Total weight of moving section (kg) g : Gravitational acceleration = 9.8 (m/s^2) μ : Friction coefficient
Rotary movement		$T_L = \frac{Z_1}{Z_2} \cdot \frac{1}{\eta} \cdot T_{LO} + T_F = \frac{1}{n} \cdot \frac{1}{\eta} \cdot T_{LO} + T_F$ T_L : Load torque (N·m) T_{LO} : Load torque on load shaft (N·m) T_F : Motor shaft conversion load friction torque (N·m) η : Drive system efficiency Z_1, Z_2 : Deceleration ratio n : Deceleration rate
Vertical movement		When rising $T_L = T_U + T_F$ When lowering $T_L = -T_U \cdot \eta^2 + T_F$ T_L : Load torque (N·m) T_U : Unbalanced torque (N·m) T_F : Friction torque on moving section (N·m) $T_U = \frac{(W_1 - W_2)\cdot g}{2\times10^3\pi\eta} \cdot \left(\frac{V}{N}\right) = \frac{(W_1 - W_2)\cdot g\cdot\Delta S}{2\times10^3\pi\eta}$ $T_F = \frac{\mu\cdot(W_1 + W_2)\cdot g\cdot\Delta S}{2\times10^3\pi\eta}$ W_1 : Load weight (kg) W_2 : Counterweight weight (kg) η : Drive system efficiency g : Gravitational acceleration = 9.8 (m/s^2) V : Speed of object that moves linearly (mm/min) N : Motor speed (r/min) ΔS : Object movement amount per motor rotation (mm) μ : Friction coefficient

Appendix 3-3-4 Expressions for load inertia calculation

The calculation method for a representative load inertia is shown.

Type	Mechanism	Calculation expression
Cylinder	Rotary shaft is cylinder center 	$J_L = \frac{\pi \cdot \rho \cdot L}{32} \cdot (D_1^4 - D_2^4) = \frac{W}{8} \cdot (D_1^2 - D_2^2)$ J_L : Load inertia [kg·cm^2] ρ : Density of cylinder material [kg·cm^3] L : Length of cylinder [cm] D_1 : Outer diameter of cylinder [cm] D_2 : Inner diameter of cylinder [cm] W : Weight of cylinder [kg] **Reference data** Material densities Iron ..... 7.80×10^{-3} [kg/cm^3] Aluminum ..... 2.70×10^{-3} [kg/cm^3] Copper ..... 8.96×10^{-3} [kg/cm^3]
	When rotary shaft and cylinder shaft are deviated 	$J_L = \frac{W}{8} \cdot (D^2 + 8R^2)$ J_L : Load inertia [kg·cm^2] W : Weight of cylinder [kg] D : Outer diameter of cylinder [cm] R : Distance between rotary axis and cylinder axis [cm]
Column		$J_L = W \left(\frac{a^2 + b^2}{3} + R^2\right)$ J_L : Load inertia [kg·cm^2] W : Weight of cylinder [kg] a.b.R : Left diagram [cm]
Object that moves linearly		$J_L = W \left(\frac{1}{2\pi N} \cdot \frac{V}{10}\right)^2 = W \left(\frac{\Delta S}{20\pi}\right)^2$ J_L : Load inertia [kg·cm^2] W : Weight of object that moves linearly [kg] N : Motor speed [r/min] V : Speed of object that moves linearly [mm/min] ΔS : Object movement amount per motor rotation [mm]
Suspended object		$J_L = W \left(\frac{D}{2}\right)^2 + J_P$ J_L : Load inertia [kg·cm^2] W : Object weight [kg] D : Diameter of pulley [cm] J_P : Inertia of pulley [kg·cm^2]
Converted load		$J_L = J_{11} + (J_{21} + J_{22} + J_A) \cdot \left(\frac{N_2}{N_1}\right)^2 + (J_{31} + J_B) \cdot \left(\frac{N_3}{N_1}\right)^2$ J_L : Load inertia [kg·cm^2] J_A,J_B : Inertia of load A, B [kg·cm^2] J_{11}~J_{31} : Inertia [kg·cm^2] N_1~N_3 : Each shaft's speed [r/min]

Appendix 3-4 Selecting the power supply

When selecting the power supply capacity, select the capacity that satisfies both the "Appendix 3-4-1 Rated capacity selection" and "Appendix 3-4-2 Momentary maximum rated capacity selection".

Appendix 3-4-1 Selecting according to the continuous rated capacity

Select the power supply capacity that satisfies the following conditions for the servomotor and spindle motor to which the power is supplied.

(a) When there is only one servomotor axis

Power supply unit rated capacity ≥ ∑ (spindle motor output) + (servomotor output) ….. (1)

(b) When there are two or more servomotor axes

Power supply unit rated capacity ≥ ∑ (spindle motor output) + 0.7 × (servomotor output) ….. (2)

Rated capacity of power supply unit

MDS-C1-CV-	37	55	75	110	150	185	220	260	300	370
Rated capacity: (kW)	4.2	6.0	8.0	11.5	15.5	19.0	23.0	27.0	31.0	38.0

POINT

1. When no spindle motor is used, calculate as ∑ (spindle motor output) = 0kW.
2. "Spindle motor output" refers to the short time rated output (kW) of the spindle motor.
3. If the spindle motor output in acceleration/deceleration is different from that in steady state, substitute the larger value for "spindle motor output".
4. If the spindle motor output is limited, multiply the output value by the limit rate and then substitute the multiplied value for "spindle motor output".
5. "Servomotor output" refers to the rated output (kW) of the servomotor. Note that the servomotor rated output and the drive unit capacity are not always the same.
   (Example) MDS-C1-V1-35 + HC203…servomotor output = 2.0kW

⚠ CAUTION

1. When there are two or more servomotor axes, select the power supply unit whose capacity is the same or larger than the largest rated capacity of the loaded servomotors.
   (Example) HC902(9.0kW) + HC102(1.0kW) … Select MDS-C1-CV-110.
2. If the selection capacity exceeds 38.0kW, use two or more power supply units. Select so that the capacity of each power supply unit satisfies the expressions (1) and (2).
3. Only when MDS-B-SP-370 or larger capacity spindle drive unit is connected, a large-capacity power supply unit (MDS-B-CVE-450, 550) can be used. Refer to "Appendix 4. Explanation of Large Capacity Spindle Unit Specifications" for details.
4. For the spindle drive unit, the drive unit capacity may become large depending on the spindle motor such as high-troupe motor. Make sure that the capacity limit of drive unit which can be connected is provided depending on the power supply.

Power supply unit		Spindle drive unit
MDS-C1-CV-	37	MDS-C1-SP□-04 to 75
	55	MDS-C1-SP□-04 to 110
	75	MDS-C1-SP□-04 to 150
	110	MDS-C1-SP□-04 to 185
	150	MDS-C1-SP□-04 to 220
	185	MDS-C1-SP□-04 to 260
	220	MDS-C1-SP□-04 to 300
	260	MDS-C1-SP□-04 to 300 MDS-B-SP-370
	300	MDS-C1-SP□-04 to 300 MDS-B-SP-370 to 450
	370	MDS-C1-SP□-04 to 300 MDS-B-SP-370 to 550

Appendix 3-4-2 Selection with maximum momentary capacity

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

Maximum momentary capacity of power supply unit ≥
Σ (Maximum momentary output of spindle motor)
+
Σ (Maximum momentary output of servomotor accelerating/decelerating simultaneously)

(1) Spindle motor maximum momentary output

The maximum momentary output of the spindle motor is calculated by multiplying the acceleration/deceleration output of the spindle motor by 1.2.

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. If there are no specifications in the acceleration/deceleration output characteristics, maximum output (kW) of the short time rated output specified at a time of 10 minutes or more and 30 minutes or less.

(2) Servomotor maximum momentary output

Selection capacity of power supply unit

Motor type	HC52	HC102	HC152	HC202	HC352	HC452	HC702	HC902
Maximum momentary output (kW)	1.5	2.7	4.5	5.3	7.4	10.6	15	19.5

Motor type	HC53	HC103	HC153	HC203	HC353	HC453	HC703
Maximum momentary output (kW)	1.6	3.2	5.4	7.6	10.6	13.7	20.1

Motor type	HC103R	HC153R	HC203R	HC353R	HC503R
Maximum momentary output (kW)	1.5	2.3	3.0	5.3	7.6

Motor type	HA053N	HA13N	HA23N	HA33N	HA-LF11K2-S8	HA-LF15K2-S8
Maximum momentary output (kW)	0.15	0.3	0.6	1.1	21.7	30.6

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

(3) Power supply unit maximum momentary capacity

Maximum momentary capacity of power supply unit

MDS-C1-CV-	37	55	75	110	150	185	220	260	300	370
Maximum momentary output (kW)	14	19	21	28	41	42	53	54	55	75

POINT

1. If a spindle motor has a coil switch function, calculate with the specification of the coil that has larger acceleration/deceleration output.
2. If a servomotor doesn't accelerate/decelerate simultaneously with others, even if its load is applied to the power supply, the motor can be excluded from the selection.

Appendix 3-4-3 Selection example

(Example 1) Spindle motor: 30-minute rated output 22kW × 1 axis
Servomotor : HC452 × 1 axis
HC352 × 2 axes
(The three servo axes are simultaneously accelerated/decelerated)

(1) Selection with rated capacity

Σ (Spindle motor output) + 0.7 x (servomotor output) = 22kW + 0.7 x (4.5kW + 3.5kW x 2) = 30.05kW
→"MDS-C1-CV-300" that has the selection capacity of 31.0kW, or larger unit is required.

(2) Selection with maximum momentary rated capacity

Σ (Maximum momentary output of spindle motor)
+
Σ (Maximum momentary output of servomotor accelerating/decelerating simultaneously)
= 22kW x 1.2 + (10.6kW + 7.4kW x 2) = 51.8kW
→"MDS-C1-CV-220" that has the maximum momentary capacity of 53kW, or larger unit is required.

(3) Overall selection

Select the power supply unit "MDS-C1-CV-300" that meets the conditions (1) and (2).

(Example 2) Spindle motor: 30-minute rated output 22kW × 1 axis
Servomotor : HC453 × 2 axes
HC353 × 1 axis
(The three servo axes are simultaneously accelerated/decelerated)

(1) Selection with rated capacity

Σ (Spindle motor output) + 0.7 x (servomotor output) = 22kW + 0.7 x (4.5kW x 2 + 3.5kW) = 30.75kW
→"MDS-C1-CV-300" that has the selection capacity of 31.0kW, or larger unit is required.

(2) Selection with maximum momentary rated capacity

Σ (Maximum momentary output of spindle motor)
+
Σ (Maximum momentary output of servomotor accelerating/decelerating simultaneously)
= 22kW × 1.2 + (13.7kW × 2 + 10.6kW) = 64.4kW
→"MDS-C1-CV-370" that has the maximum momentary capacity of 75kW, or larger unit is required.

(3) Overall selection

Select the power supply unit "MDS-C1-CV-370" that meets the conditions (1) and (2).

Appendix 4. Explanation of Large Capacity Spindle Unit Specifications

Appendix 4-1 Explanation of large capacity spindle unit specifications

Appendix 4-1-1 Outline

The MDS-B-SP Series large capacity spindle unit (37KW, 45KW, 55KW) is an expanded capacity version of the MDS-C1-SP Series standard spindle unit (30KW or less).
Additional items related to the increased capacity are explained in this section.

Appendix 4-1-2 List of units

<Power supply unit>

Type	Capacity (kW)	Weight (kg)
B-CVE-450	45	20
B-CVE-550	55	21

<Spindle drive unit>

Type	Capacity (kW)	Weight (kg)
B-SP-370	37	20
B-SP-450	45	21
B-SP-550	55	21

(Note) Use the MDS-C1-CV-370 for the power supply unit 37kW.

Appendix 4-1-3 Selection of AC reactor (B-AL), contactor and NFB

Always mount the AC reactor and contactor shown below on the input side of each power supply unit (B-CVE-450, 550).

(Note 1) Always mount one contactor for each power supply unit when using the MDS-B-CVE-450 or 550. The power supply unit could be damaged if the contactor is omitted or shared with another unit.)

(Note 2) Always mount one AC reactor for each power supply unit. The power supply unit could be damaged if the AC reactor is omitted or shared.

The selection of the NFB when using only one power supply unit is shown below for reference.

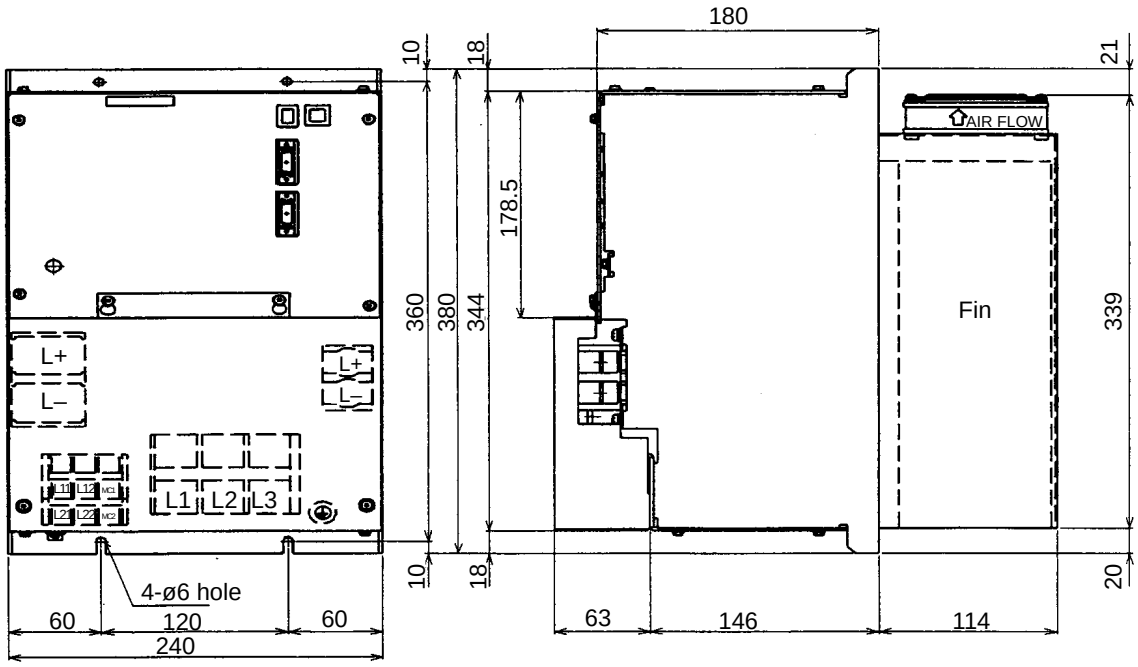
Power supply unit type	MDS-B-CVE-450	MDS-B-CVE-550
AC reactor (ordered part)	B-AL-45K	B-AL-55K
Recommended contactor (special order part)	S-N150	S-N180
Recommended NFB (special order part)	NF225CS3P-200A	NF400CS3P-300A

(Note) Even when OFF, an earth leakage current of maximum 15mA 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 the contactor that can be turned ON at 15mA or less or cannot be turned OFF at 15mA. When using a contactor with an internal electronic circuit, consult with the contactor manufacturer and make sure that the contactor will operate correctly even if an earth leakage current of 15mA or less flows.

Appendix 4-1-4 Outline dimension drawings

The I bolt mounting hole is provided only at the top of the MDS-B-CVE-550 and MDS-B-SP-450, 550. The I bolt (size: M10) is not enclosed and must be prepared by the user. Use an I bolt with a 13 to 25mm long thread.

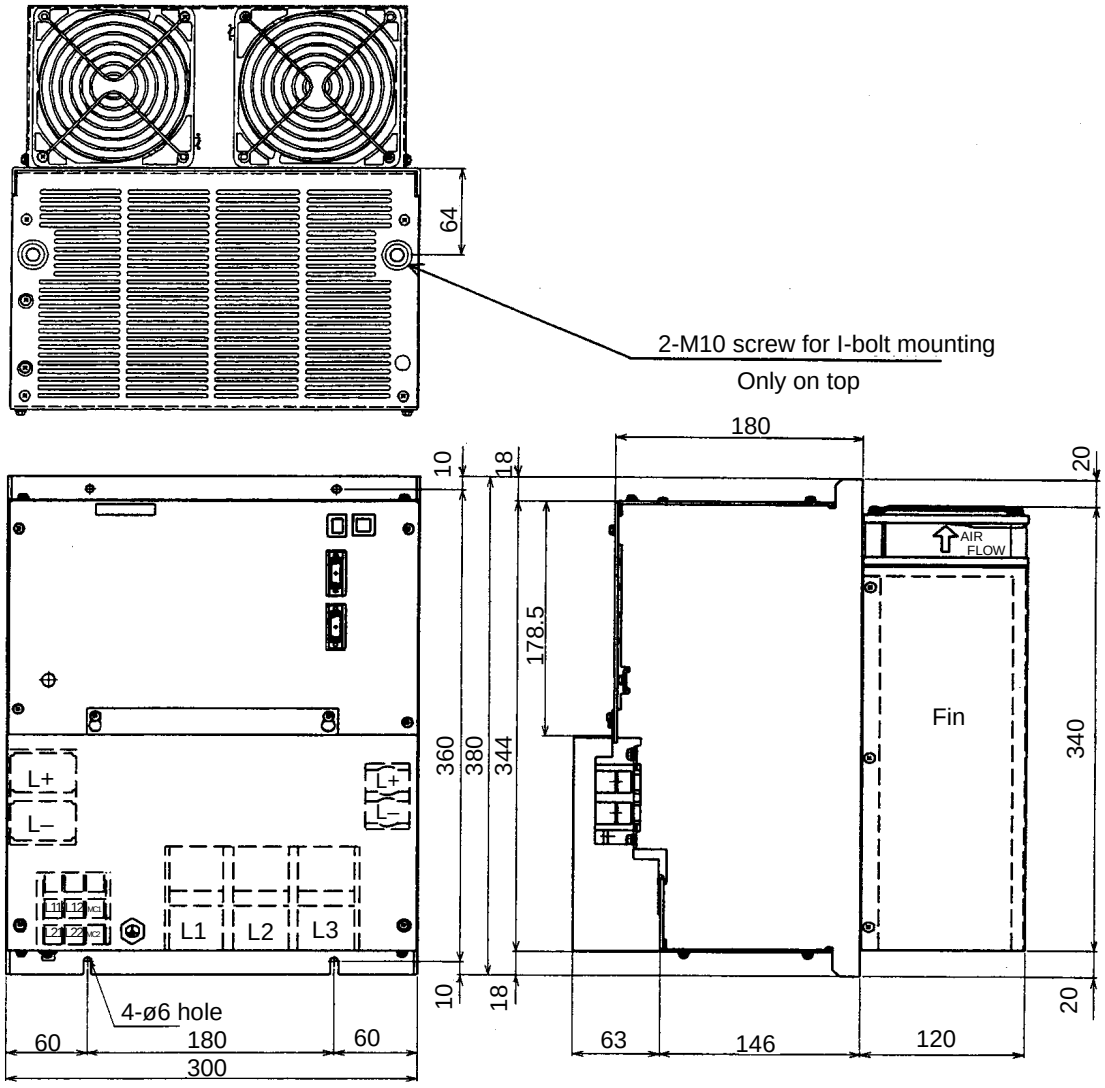
(1) MDS-B-CVE-450



[Unit : mm]

(Note) Always install a large capacity drive unit in the left side of power supply unit, and connect TE2(L+,L-) with DC connection bar.

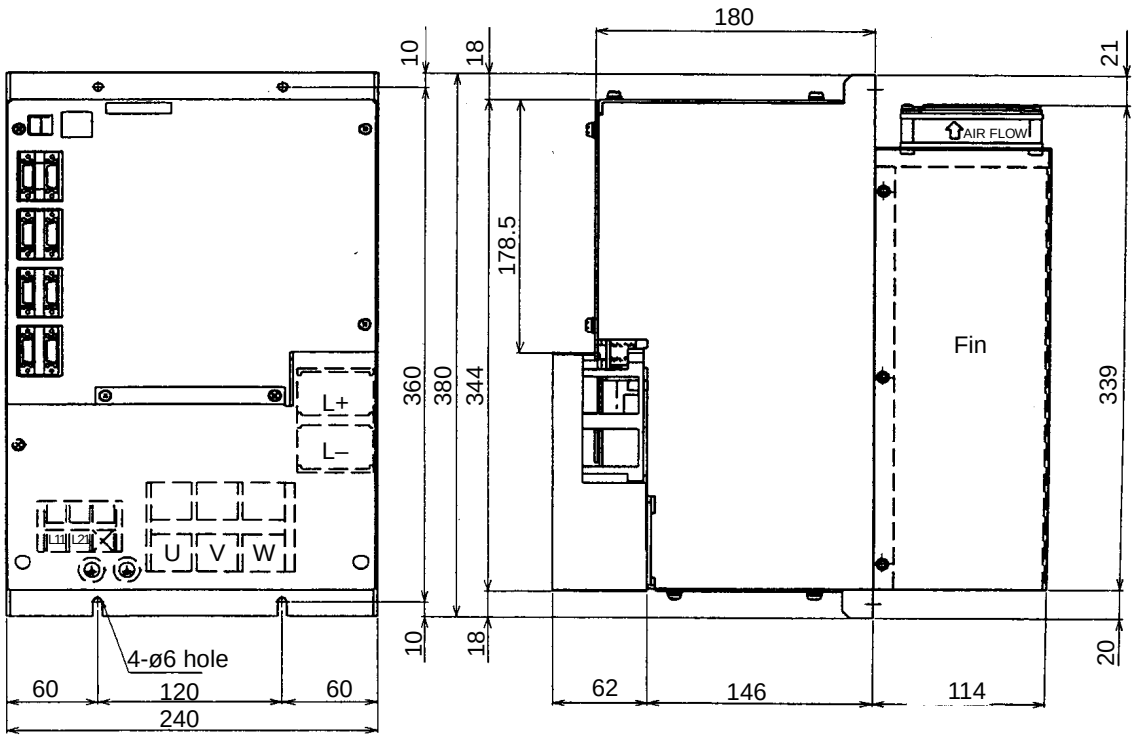
(2) MDS-B-CVE-550



[Unit : mm]

(Note) Always install a large capacity drive unit in the left side of power supply unit, and connect TE2(L+,L-) with DC connection bar.

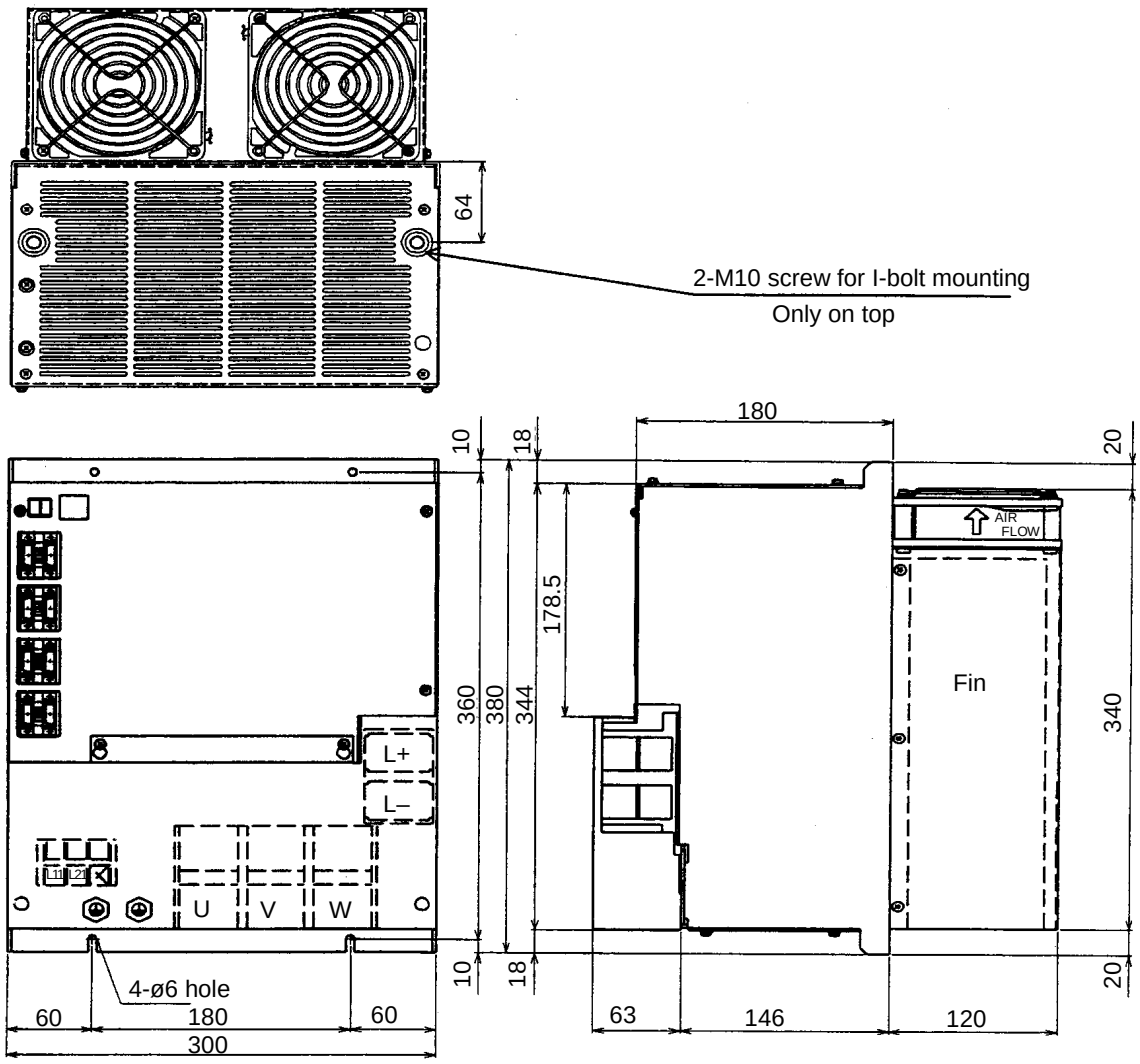
(3) MDS-B-SP-370



[Unit : mm]

(Note) Always install a large capacity drive unit in the left side of power supply unit, and connect TE2(L+,L-) with DC connection bar.

(4) MDS-B-SP-450/550

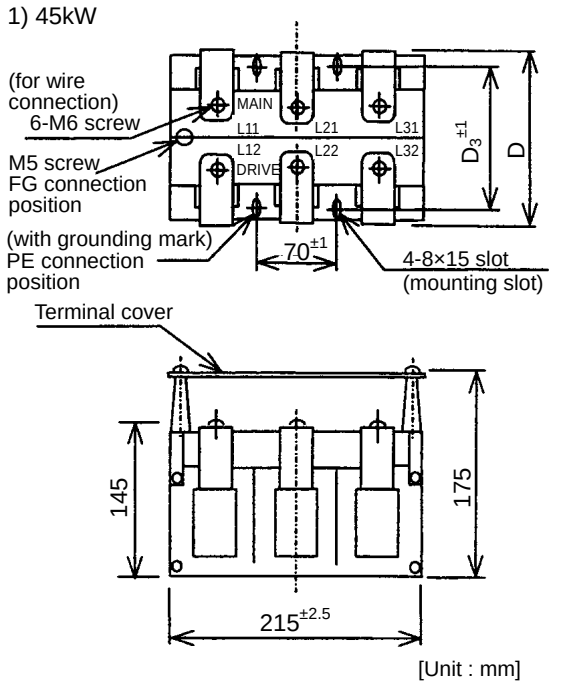


[Unit : mm]

(Note) Always install a large capacity drive unit in the left side of power supply unit, and connect TE2(L+,L-) with DC connection bar.

(5) AC reactor

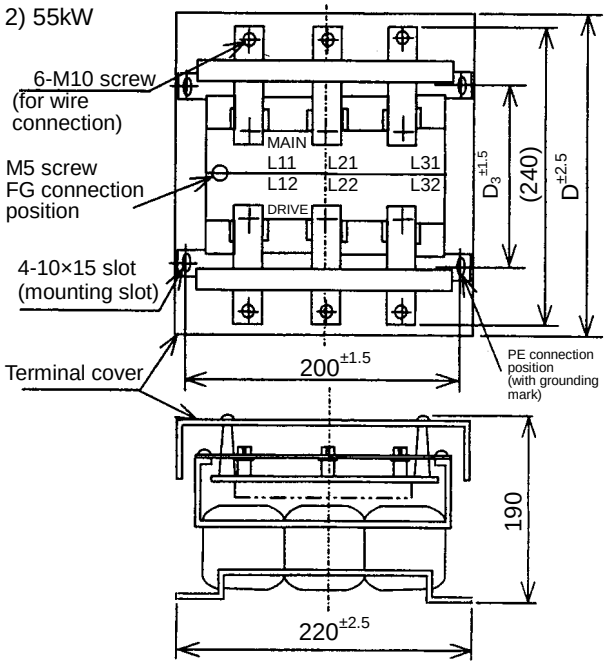
1) 45kW



[Unit : mm]

ACL type	Compatible power supply unit	D_3	D	Weight
B-AL-45K	MDS-B-CVE-450	120	160	12.8kg

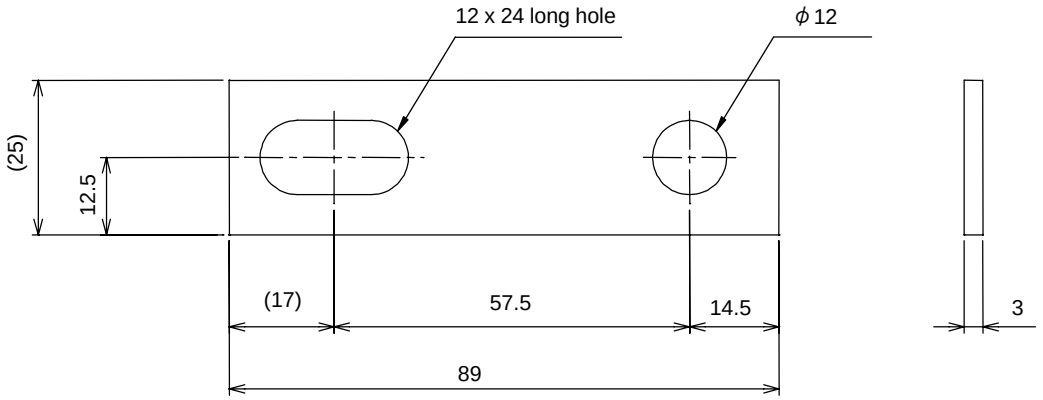
2) 55kW



[Unit : mm]

ACL type	Compatible power supply unit	D_3	D	Weight
B-AL-55K	MDS-B-CVE-550	200	320	10.0kg

(6) DC connection bar

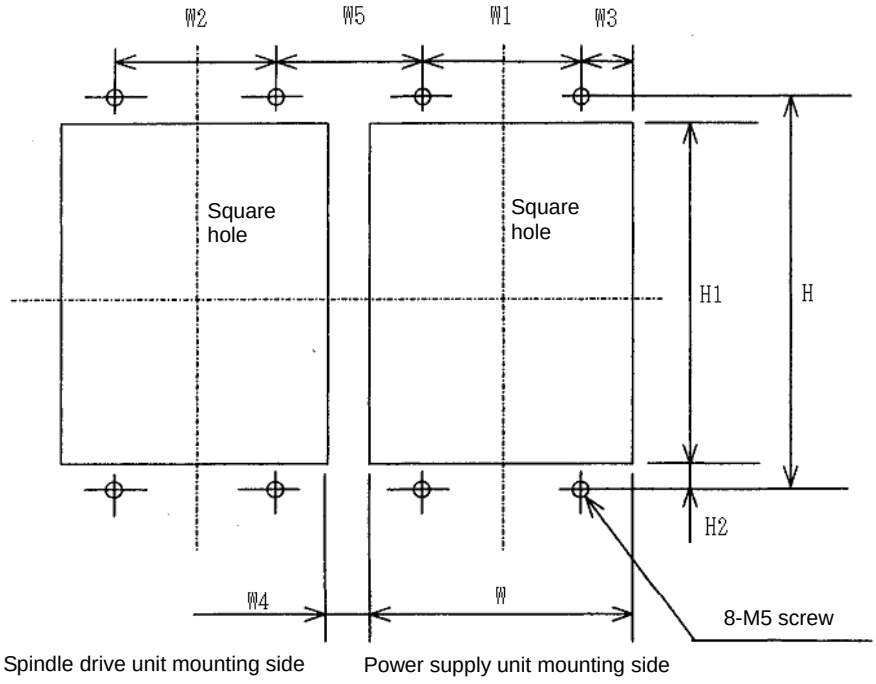


(Note) This DC connection bar is a set of two DC connection bars.

POINT

1. These DC connection bars are accessories.
2. Always install a large capacity drive unit in the left side of power supply unit, and connect TE2(L+,L-) with DC connection bar.

Appendix 4-1-5 Panel cut dimension drawing



(Front view)

Unit [mm]

Power supply unit

Sym-bol	MDS-B-CVE-450	MDS-B-CVE-550
H	360±0.3	360±0.3
W	222±1	282±1
H1	341±1	341±1
H2	10±0.5	10±0.5
W1	120±0.3	180±0.3
W2	–	–
W3	51±0.5	51±0.5
W4	18±0.5	18±0.5
W5	120±0.5	120±0.5

Spindle drive unit

Sym-bol	MDS-B-SP-370	MDS-B-SP-450	MDS-B-SP-550
H	360±0.3	360±0.3	360±0.3
W	222±1	282±1	282±1
H1	341±1	341±1	341±1
H2	10±0.5	10±0.5	10±0.5
W1	–	–	–
W2	120±0.3	180±0.3	180±0.3
W3	51±0.5	51±0.5	51±0.5
W4	–	–	–
W5	–	–	–

(Note 1) The spindle drive unit must be mounted to the left of the power supply unit looking from the front of the unit. The panel must be cut taking this into consideration.

(Note 2) L+ and L– connection conductors are enclosed with the MDS-B-CVE-450 and 550 capacities, so provide space between the units according to the dimensions shown above.

Appendix 4-1-6 Heating value

Power supply unit

Type	Heating value (W)
MDS-B-CVE-450	500
MDS-B-CVE-550	600

Spindle drive unit

Type	Heating value (W)
MDS-B-SP-370	850
MDS-B-SP-450	1000
MDS-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 panel when mounting in an enclosed structure.

Unit	Heating value outside panel
MDS-B-CVE-450, 550	Heating value outside panel = (B-CVE heating value -30) × 0.75
MDS-B-SP-370, 450, 550	Heating value outside panel = (B-SP heating value -40) × 0.75

Appendix 4-1-7 Selecting the power capacity

The power capacity required for the power supply unit is shown below.

Power supply unit type	Power capacity (kVA)
MDS-B-CVE-450	63
MDS-B-CVE-550	77

Appendix 4-1-8 Selecting the wire size

(1) Recommended wire size for power lead-in wire

Regardless of the motor type, select the wire size as shown below using the power supply unit capacity as a reference.

Power supply unit type	Recommended wire size for power-lead-in wire
MDS-B-CVE-450	HIV60mm^2
MDS-B-CVE-550	HIV80mm^2

(2) Recommended wire size for spindle motor output wire

Regardless of the motor type, select the wire size as shown below using the spindle drive unit capacity as a reference.

Spindle drive unit type	Recommended wire size for spindle motor output wire
MDS-B-SP-370	HIV50mm^2
MDS-B-SP-450	HIV60mm^2
MDS-B-SP-550	HIV80mm^2

(3) L+, L– link bar wire size

Power supply unit type	L+, L– link bar wire size
MDS-B-CVE-450	Dedicated link bars are enclosed as accessories (always use accessories)
MDS-B-CVE-550	Dedicated link bars are enclosed as accessories (always use accessories)

(Note) The wire sizes above for the MDS-B-CVE-450/550 are the values when connecting to the terminal section on the left front.

(4) L11, L21, MC1

Regardless of the spindle drive unit and power supply unit capacities, use an IV2mm^2 or more wire size.

Appendix 4-1-9 Drive unit connection screw size

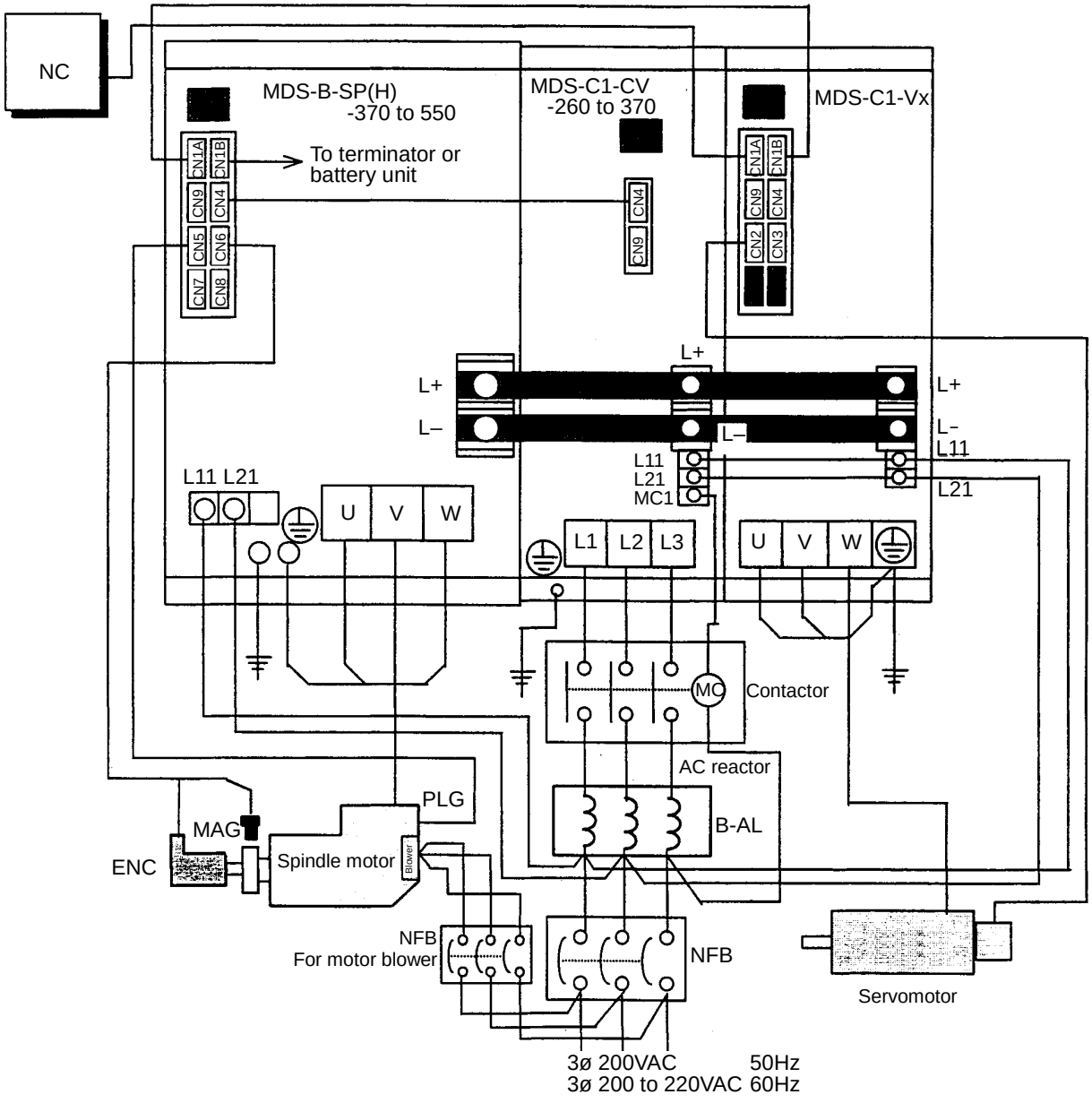
Type	Power supply unit				Spindle drive unit	
	MDS-B-CVE-450		MDS-B-CVE-550		MDS-B-SP-370	MDS-B-SP-450 MDS-B-SP-550
	Left	Right	Left	Right		
L1, L2, L3	M8		M10		–	–
U, V, W	–		–		M8	M10
L+, L–	M10	M6	M10	M6	M10	M10
L11, L21	M4		M4		M4	M4
MC1	M4		M4		–	–

Appendix 4-1-10 Connecting each unit

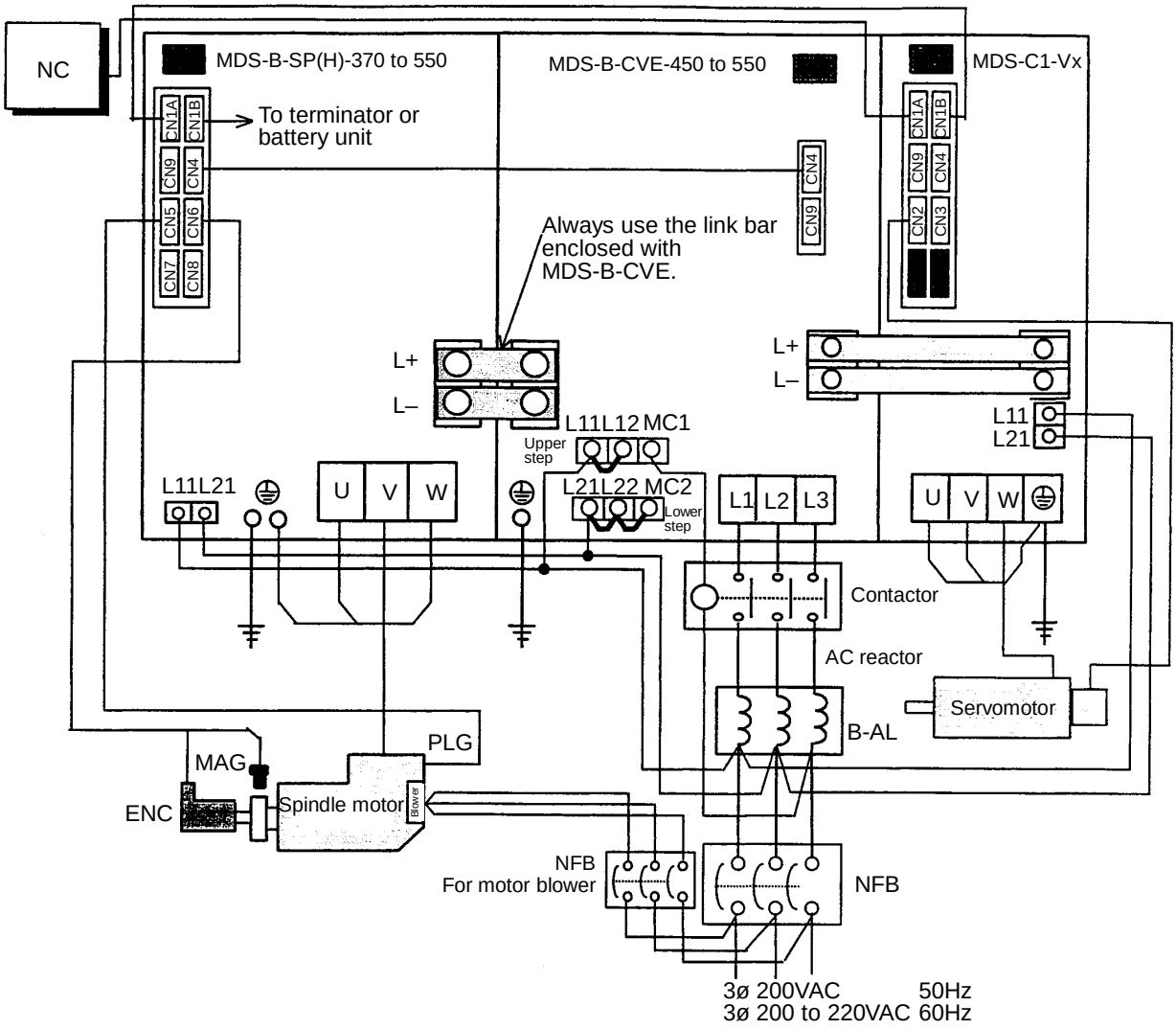
(1) Wiring system

The wiring system is the same as the MDS-C1 Series. (Refer to the wiring system example below.) Note that there are restrictions to the mounting and selection, so refer to the Restrictions given in Section Appendix 5-1-11.

(a) When using MDS-C1-CV-370 or smaller



(b) When using MDS-B-CVE-450, 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 MDS-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.

(Note 3) One end of the contactor coil is connected to the MC1 terminal and the other end is connected to the power supply. The phase on the side connected to the power supply must be different from the phase connected to the power supply unit's L21.

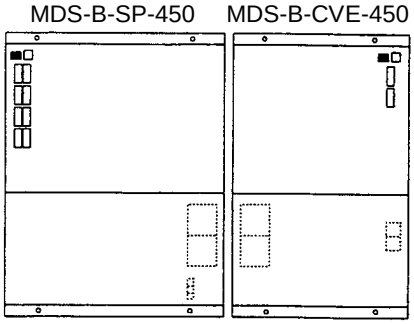
Appendix 4-1-11 Restrictions

(1) Mounting

Always mount the MDS-B-SP-370,450, 550 on the left of the power supply unit.
When using MDS-B-CVE-450, 550, always use the enclosed link bar to connect L+ and L- on the MDS-B-SP-370, 450, 550.

(a) Layout when connecting only one spindle drive unit to power supply unit.
Mount the power supply on the right and the spindle drive unit on the left.
Always cut the panel according to the panel cut dimension drawings shown in Appendix 5-1-5.

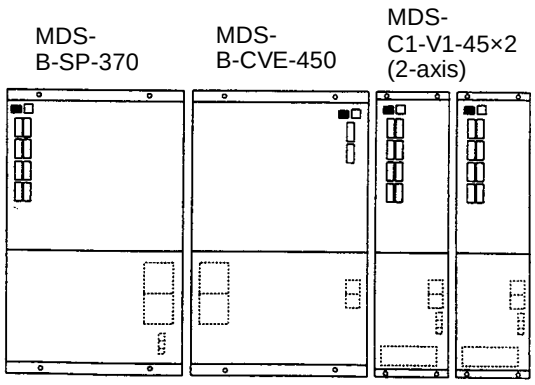
<Example 1>



(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 MDS-B-CVE-450 and MDS-B-SP-370 are combined, 9kW (=45kW–37kW+1kW) worth of units.
- When MDS-B-CVE-550 and MDS-B-SP-450 are combined, 11kW (=55kW–45kW+1kW) worth of units.
- When MDS-B-CVE-450 and MDS-B-SP-370 are combined, 19kW (=55kW–37kW+1kW) worth of units.

In this case, arrange the MDS-B-SP-370, 450 to the left of MDS-B-CVE-450, 550 as shown in the panel cut dimension drawings in Appendix 5-1-5. Mount the additional drive units to the right of the MDS-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's output is determined by the motor output.)

<Example 2>



(2) Selection

(a) When using the MDS-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 MDS-B-SP-370, 450, 550 can be connected to one MDS-B-CVE-450, 550.

(b) When using MDS-B-SP-370, 450 or 550, the following power supply unit must be selected.
- When using MDS-B-SP-370: Select MDS-C1-CV-260 or more or MDS-B-CVE-450 or 550
- When using MDS-B-SP-450: Select MDS-C1-CV-300 or more or MDS-B-CVE-450 or 550
- When using MDS-B-SP-550: Select MDS-C1-CV-370 or more or MDS-B-CVE-450 or 550

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 1> When using MDS-B-SP-370
When total of servo/spindle motor output is 23kW or less: Select MDS-C1-CV-260
When total of servo/spindle motor output is 23.1kW or more: Select power supply unit with normal selection method.

<Example 2> When using MDS-B-SP-450
When total of servo/spindle motor output is 27kW or less: Select MDS-C1-CV-300
When total of servo/spindle motor output is 27.1kW or more: Select power supply unit with normal selection method.

<Example 3> When using MDS-B-SP-550
When total of servo/spindle motor output is 31kW or less: Select MDS-C1-CV-370
When total of servo/spindle motor output is 31.1kW or more: Select power supply unit with normal selection method.

Appendix 4-1-12 Parameters

The parameters added and changed in respect to the 30kW or smaller drive unit are shown below. The parameters other than those shown below are the same as the 30kW or smaller capacity. For details on the parameters, refer to "MDS-C1 SERIES INSTRUCTION MANUAL" (BNP-B2365)

<table>
<tr><th>No.</th><th>Abbr.</th><th>Parameter name</th><th>Details</th><th>Setting range</th><th>Standard setting</th></tr>
<tr><td>SP039</td><td>ATYP*</td><td>Drive unit type</td><td>Set the spindle drive unit's capacity type.
(HEX setting)
<table>
<tr><th>Setting</th><th>Unit capacity</th><th>Setting</th><th>Unit capacity</th></tr>
<tr><td>0000</td><td>---</td><td>0010</td><td>MDS-B-SP-550</td></tr>
<tr><td>0001</td><td>MDS-C1-SP-075</td><td>0011</td><td>---</td></tr>
<tr><td>0002</td><td>MDS-C1-SP-15</td><td>0012</td><td>---</td></tr>
<tr><td>0003</td><td>MDS-C1-SP-22</td><td>0013</td><td>---</td></tr>
<tr><td>0004</td><td>MDS-C1-SP-37</td><td>0014</td><td>---</td></tr>
<tr><td>0005</td><td>MDS-C1-SP-55</td><td>0015</td><td>---</td></tr>
<tr><td>0006</td><td>MDS-C1-SP-75</td><td>0016</td><td>---</td></tr>
<tr><td>0007</td><td>MDS-C1-SP-110</td><td>0017</td><td>---</td></tr>
<tr><td>0008</td><td>MDS-C1-SP-150</td><td>0018</td><td>---</td></tr>
<tr><td>0009</td><td>MDS-C1-SP-185</td><td>0019</td><td>---</td></tr>
<tr><td>000A</td><td>MDS-C1-SP-220</td><td>001A</td><td>---</td></tr>
<tr><td>000B</td><td>MDS-C1-SP-260</td><td>001B</td><td>---</td></tr>
<tr><td>000C</td><td>MDS-C1-SP-300</td><td>001C</td><td>---</td></tr>
<tr><td>000D</td><td>MDS-B-SP-370</td><td>001D</td><td>---</td></tr>
<tr><td>000E</td><td>MDS-B-SP-450</td><td>001E</td><td>---</td></tr>
<tr><td>000F</td><td>MDS-C1-SP-04</td><td>001F</td><td>---</td></tr>
</table></td><td>0000 to FFFF</td><td>0000</td></tr>
<tr><td>SP041</td><td>PTYP*</td><td>Power supply type</td><td>When the CN4 connector of the drive unit and the power supply are connected, setting below is necessary.
To validate the external emergency stop function, add 40h.
(HEX setting)
<table>
<tr><th>Unit capacity</th><th>External emergency stop invalid</th><th>External emergency stop valid</th></tr>
<tr><td>MDS-C1-CV-260</td><td>0126</td><td>0166</td></tr>
<tr><td>MDS-C1-CV-300</td><td>0130</td><td>0170</td></tr>
<tr><td>MDS-C1-CV-370</td><td>0137</td><td>0177</td></tr>
<tr><td>MDS-B-CVE-450</td><td>0145</td><td>0185</td></tr>
<tr><td>MDS-B-CVE-550</td><td>0155</td><td>0195</td></tr>
</table></td><td>0000 to FFFF</td><td>0000</td></tr>
</table>

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

Appendix 4-1-13 Precautions

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.

Appendix 5. Transportation Restrictions for Lithium Batteries

Appendix 5-1 Transportation restrictions for lithium batteries

Appendix 5-1-1 Restriction for packing

The United Nations Dangerous Goods Regulations "Article 12" became effective from 2003. When transporting lithium batteries with means subject to the UN Regulations, such as by air transport, measures corresponding to the Regulations must be taken. The UN Regulations classify the batteries as dangerous goods (Class 9) or not dangerous goods according to the lithium content.
To ensure safety during transportation, lithium batteries (battery unit) directly exported from Mitsubishi are packaged in a dedicated container (UN package) for which safety has been confirmed. When the customer is transporting these products with means subject to the UN Regulations, such as air transport, the shipper must follow the details explained in section (2).

(1) Target products

The following Mitsubishi NC products use lithium batteries. The UN Regulations classify the batteries as dangerous goods (Class 9) or not dangerous goods according to the lithium content. (Refer to the battery unit's rating nameplate or section "4-1-2 Battery option" for details on the lithium content.) If the batteries subjected to hazardous materials are incorporated in a device and shipped, a dedicated packaging (UN packaging) is not required. However, the item must be packed and shipped following the Packing Instruction 912 specified in the IATA DGR (Dangerous Goods Regulation) book.
Also, all lithium battery products incorporated in a machinery or device must be fixed securely in accordance with the Packing Instruction 900 and shipped with protection in a way as to prevent damage or short-circuits.

(a) Products requiring dedicated packaging (Materials falling under Class 9)

Mitsubishi type	Battery type	Lithium metal content	Battery manufacturer	Battery class
MDS-A-BT-4	ER6-B4-11	2.6g	Toshiba Battery	Battery
MDS-A-BT-6	ER6-B6-11	3.9g		
MDS-A-BT-8	ER6-B8-11	5.2g		
FCU6-BT4-D1	Combination of ER6-B4D-11 and ER6	2.6g+0.65g		
(built-in battery)	CR23500SE-CJ5	1.52g	Sanyo Battery	Battery cell

(b) Products not requiring dedicated packaging (Materials not falling under Class 9)

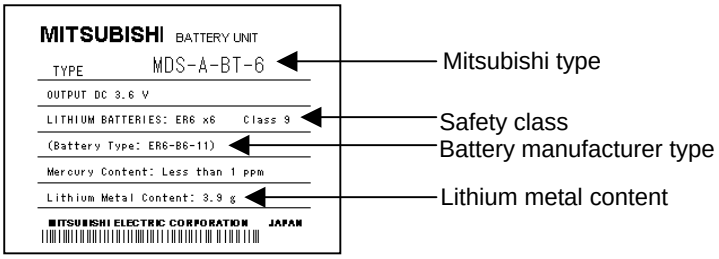
Mitsubishi type	Battery type	Lithium metal content	Battery manufacturer	Battery class
MDS-A-BT-2	ER6-B2-12	1.3g	Toshiba Battery	Battery
FCU6-BTBOX	2CR5	1.96g		
(built-in battery)	CR2032	0.067g		Battery cell
(built-in battery)	CR2450	0.173g		
(built-in battery)	ER6, ER6V	0.7g		
MR-BAT	MR-BAT	0.48g		
Q6BAT	Q6BAT	0.49g	Mitsubishi Electric Battery	

Note 1) Dedicated packaging is required if the shipment exceeds 12 batteries/24 battery cells. Package the batteries so that this limit is not exceeded.

Note 2) The battery units labeled as "FCUA-" instead of "MDS-A-" also use the same battery.

Note 3) Always use the cell battery (MR-BAT) in combination with the dedicated case (MDS-BTCASE). Maximum 8 (either 2, 4, 6 or 8) cell batteries can be installed to the dedicated case (MDS-BTCASE).

Example) Rating nameplate for battery units



(2) Handling by user

The following technical opinion is solely Mitsubishi's opinion. The shipper must confirm the latest IATA Dangerous Goods Regulations, IMDG Codes and laws and orders of the corresponding export country. These should be checked by the company commissioned for the actual transportation.

IATA : International Air Transport Association
IMDG Code : A uniform international code for the transport of dangerous goods by seas determined by IMO (International Maritime Organization).

(a) When shipping isolated lithium battery products (Packing Instruction 903)

1) Reshipping in Mitsubishi UN packaging

The isolated battery's safety test and packaging specifications comply with the UN Regulations (Packing Instruction 903). Thus, the user only needs to add the following details before shipping. (Consult with the shipping company for details.)

i) Indication of container usage mark on exterior box (Label with following details recorded.)
- Proper shipping name (Lithium batteries)
- UN NO. (UN3090 for isolated battery, UN3091 for battery incorporated in a device or included)
- Shipper and consignee's address and name

Example of completing form

SHIPPER: CONSIGNEE:

Shipper information Consignee information

PROPER SHIPPING NAME LITHIUM BATTERIES

UN NO.: UN3090 CLASS: 9 SUBSIDIARY RISK
PACKING GROUP: II PACKING INST.: 903

ii) Preparation of shipping documents (Declaration of dangerous goods)

2) When packaged by user

The user must follow UN Regulations when packing, preparing for shipping and preparing the indications, etc.

i) **Packing a lithium battery falling under Class 9**
- Consult with The Ship Equipment Inspection Society of Japan for details on packaging.
- Prepare for shipping as explained in "1) Reshipping in Mitsubishi UN packaging".

The Ship Equipment Inspection Society of Japan
Headquarters Telephone: 03-3261-6611 Fax: 03-3261-6979

ii) **Packing a lithium battery not falling under Class 9**
- Cells and batteries are separated so as to prevent short circuits and are stored in a strong outer packaging. (12 or less batteries, 24 or less cells.)
- Certificates or test results showing compliance to battery safety test.
  The safety test results have been obtained from the battery manufacturer. (Consult with Mitsubishi when the safety test results are required.)
- Prepare for shipping as explained in "1) Reshipping in Mitsubishi UN packaging".

(b) When shipping lithium batteries upon incorporating in a machinery or device (Packing Instruction 900)

Pack and prepare for shipping the item in accordance with the Packing Instruction 900 specified in the IATA DGR (Dangerous Goods Regulation) book. (Securely fix the batteries that comply with the UN Manual of Tests and Criteria to a machinery or device, and protect in a way as to prevent damage or short-circuit.)
Note that all the lithium batteries provided by Mitsubishi have cleared the UN recommended safety test; fixing the battery units or cable wirings securely to the machinery or device will be the user's responsibility.
Check with your shipping company for details on packing and transportation.

(c) When shipping a device with lithium batteries incorporated (Packing Instruction 912)

A device incorporating lithium batteries does not require a dedicated packaging (UN packaging). However, the item must be packed, prepared for shipping and labeled following the Packing Instruction 912 specified in the IATA DGR (Dangerous Goods Regulation) book.
Check with your shipping company for details on packing and transportation.

The outline of the Packing Instruction 912 is as follows:

- All the items in the packing instructions for shipping the isolated lithium battery products (Packing Instruction 903) must be satisfied, except for the items related to container, short-circuit, and fixation.
- A device incorporating lithium batteries has to be stored in a strong water-proofed outer packaging.
- To prevent an accidental movement during shipment, securely store the item in an outer packaging.
- Lithium content per device should be not more than 12g for cell and 500g for battery.
- Lithium battery mass per device should be not more than 5kg.

(3) Reference

Refer to the following materials for details on the regulations and responses.

Guidelines regarding transportation of lithium batteries and lithium ion batteries (Edition 2)
..... Battery Association of Japan

Appendix 5-1-2 Issuing domestic law of the United State for primary lithium battery transportation

Federal Aviation Administration (FAA) and Research and Special Programs Administration (RSPA) announced an additional regulation (interim final rule) for the primary lithium batteries transportation restrictions item in "Federal Register" on Dec.15 2004. This regulation became effective from Dec.29, 2004.
This law is a domestic law of the United States, however if also applies to the domestic flight and international flight departing from or arriving in the United States. Therefore, when transporting lithium batteries to the United State, or within the United State, the shipper must take measures required to transport lithium batteries.
Refer to the Federal Register and the code of Federal Regulation ("(a), (b) and (c) in the item (4)" described below) for details.

(1) Outline of regulation

(a) Transporting primary lithium battery by passenger aircraft is forbidden.

- Excluding primary lithium battery for personal use in a carry-on or checked luggage (Lithium metal content should be not more than 5g for cell and 25g for battery. For details on the lithium metal content, refer to "(a) and (b) in the section 5-1-1 item (1)".)

(b) When transporting primary lithium battery by cargo aircraft, indicate that transportation by passenger aircraft is forbidden on the exterior box.

(2) Target products

All NC products for which the lithium batteries are used are subject to the regulation.
(Refer to the table "(a) and (b) in the section 5-1-1 item (1)".)

(3) Handling by user

The "(1) Outline of regulation" described above is solely Mitsubishi's opinion. The shipper must confirm orders of "(a), (b) and (c) in the item (4)" described below for transportation method corresponding the regulation. Actually, these should be checked by the company commissioned for the actual lithium buttery transportation.

(a) Indication of exterior box

When transporting primary lithium battery by cargo aircraft, indicate that transportation by passenger aircraft is forbidden on the exterior box.

Display example

PRIMARY LITHIUM BATTERIES

FORBIDDEN FOR TRANSPORT ABOARD PASSENGER AIRCRAFT.

- The character color must be displayed with contrast. (black characters against white background, black characters against yellow background, etc.)
- The height (size) of characters to be displayed is prescribed depending on the packaging weight.
  When the total weight is over 30kg: at least 12mm
  When the total weight is less than 30kg: at least 6mm

(4) Reference

(a) Federal Register (Docket No. RSPA-2004-19884 (HM-224E)) PDF format
http://www.regulations.gov/fredpdfs/05-11765.pdf

(b) 49CFR (Code of Federal Regulation, Title49) (173.185 Lithium batteries and cells.)
http://www.access.gpo.gov/nara/cfr/waisidx_00/49cfr173_00.html

(c) DOT regulation body (Department of Transportation)
http://hazmat.dot.gov/regs/rules/final/69fr/docs/69fr-75207.pdf

Appendix 6. Compliance to EU EC Directives

Appendix 6-1 Compliance to EC Directives

Appendix 6-1-1 European EC Directives

In the EU Community, the attachment of a CE mark (CE marking) is mandatory to indicate that the basic safety conditions of the Machine Directives (issued Jan. 1995), EMC Directives (issued Jan. 1996) and the Low-voltage Directives (issued Jan. 1997) are satisfied. The machines and devices in which the servo and spindle drive are assembled are the targets for CE marking.

(1) Compliance to EMC Directives

The servo and spindle drive are components designed to be used in combination with a machine or device. These are not directly targeted by the Directives, but a CE mark must be attached to machines and devices in which these components are assembled. The next section "EMC Installation Guidelines", which explains the unit installation and control panel manufacturing method, etc., has been prepared to make compliance to the EMC Directives easier.

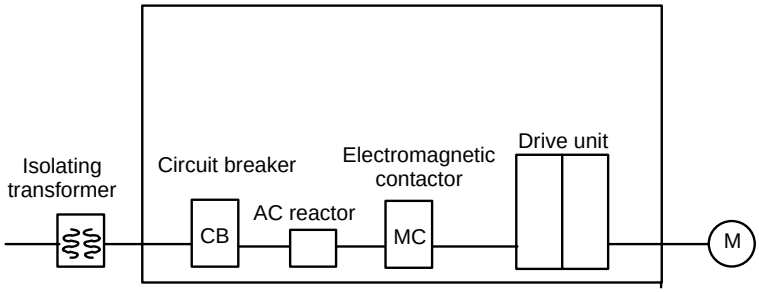
(2) Compliance to Low-voltage Directives

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

Appendix 6-1-2 Cautions for EC Directive compliance

Use the Low-voltage Directive compatible parts for the servo/spindle drive and servo/spindle motor. In addition to the items described in this instruction manual, observe the items described below.

(1) Configuration



Use a type B (AC/DC detectable type) breaker

(2) Environment

Use the units under an Overvoltage Category II and Pollution Class of 2 or less environment as stipulated in IEC60664.
These units do not provide protection against electric shock and fire sufficient for the requirements of the Low-voltage Directive and relevant European standards by themselves, so provide additional protection (refer to 5.2.4 and 7.1.6.1 of EN50178)

Drive unit

	During operation	Storage	During transportation
Ambient temperature	0°C to 55°C	-15°C to 70°C	-15°C to 70°C
Humidity	90%RH or less	90%RH or less	90%RH or less
Altitude	1000m or less	1000m or less	13000m or less

Motor

	During operation	Storage	During transportation
Ambient temperature	0°C to 40°C	-15°C to 70°C	-15°C to 70°C
Humidity	80%RH or less	90%RH or less	90%RH or less
Altitude	1000m or less	1000m or less	13000m or less

(3) Power supply

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

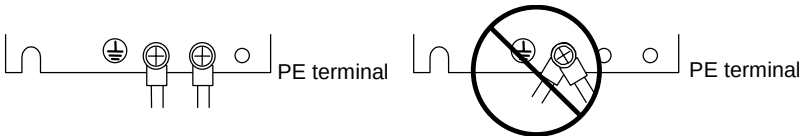
[2] In case of Overvoltage Category III, connect the PE terminal of the units to the earthed-neutral of the star-connection power supply system.

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

(4) Earthing

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

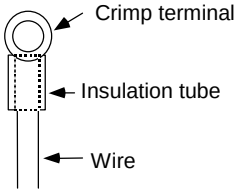
[2] When connecting the earthing wire to the protective earth (PE) terminal, do not tighten the wire terminals together. Always connect one wire to one terminal.



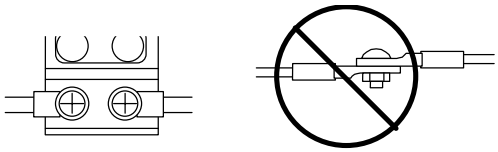
[3] Select the earthing wire size in accordance with Table 1 of EN60204-1.

(5) Wiring

[1] Always use crimp terminals with insulation tubes so that the connected wire does not contact the neighboring terminals.



[2] Do not connect the wires directly.



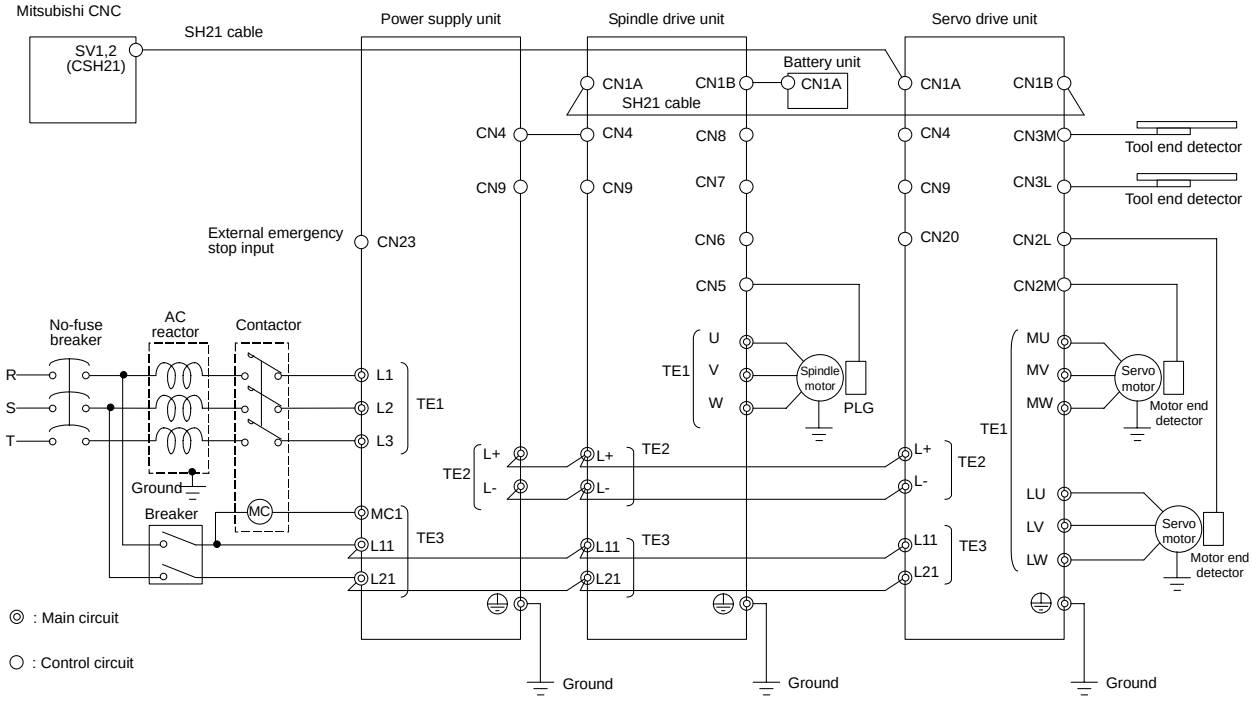
[3] Select the size of the wires for input power supply to Power Supply unit in accordance with Table 4 and 5 of EN60204-1.

(6) Peripheral devices

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

(7) Miscellaneous

[1] Refer to the next section "EMC Installation Guidelines" for methods on complying with the EMC Directives.
[2] Ground the facility according to each country's requirements.
[3] The control circuit connector (○) is safely separated from the main circuit (◎).
[4] Inspect the appearance before installing the unit. Carry out a performance inspection of the final unit, and save the inspection records.



Appendix 7. EMC Installation Guidelines

Appendix 7-1 Introduction

EMC Instructions became mandatory as of January 1, 1996. The subject products must have a CE mark attached indicating that the product complies with the Instructions.
As the NC unit is a component designed to control machine tools, it is believed to be out of the direct EMC Instruction subject. However, we would like to introduce the following measure plans to backup EMC Instruction compliance of the machine tool as the NC unit is a major component of the machine tools.

(1) Methods for installation in control/operation panel
(2) Methods of wiring cable outside of panel
(3) Introduction of countermeasure parts

Mitsubishi is carrying out tests to confirm the compliance to the EMC Standards under the environment described in this manual. However, the level of the noise will differ according to the equipment type and layout, control panel structure and wiring lead-in, etc. Thus, we ask that the final noise level be confirmed by the machine manufacturer.
These contents are the same as the EMC INSTALLATION GUIDELINES (BNP-B8582-45).
For measures for CNC, refer to "EMC INSTALLATION GUIDELINES" (BNP-B2230).

Appendix 7-2 EMC instructions

The EMC Instructions regulate mainly the following two withstand levels.

Emission ..... Capacity to prevent output of obstructive noise that adversely affects external sources.
Immunity ..... Capacity not to malfunction due to obstructive noise from external sources.

The details of each level are classified as Table 1. It is assumed that the Standards and test details required for a machine are about the same as these.

Table 1

Class	Name	Details	Generic Standard	Standards for determining test and measurement
Emission	Radiated noise	Electromagnetic noise radiated through the air	EN50081-2 EN61800-3 (Industrial environment)	EN55011
	Conductive noise	Electromagnetic noise discharged from power line		
Immunity	Static electricity electrical discharge	**Example)** Withstand level of discharge of electricity charged in a human body.	EN61000-6-2 EN61800-3 (Industrial environment)	IEC61000-4-2
	Radiated magnetic field	**Example)** Simulation of immunity from digital wireless transmitters		IEC61000-4-3
	Burst immunity	**Example)** Withstand level of noise from relays or connecting/disconnecting live wires		IEC61000-4-4
	Conductive immunity	**Example)** Withstand level of noise entering through power line, etc.		IEC61000-4-6
	Power supply frequency field	**Example)** 50/60Hz power frequency noise		IEC61000-4-8
	Power dip (fluctuation)	**Example)** Power voltage drop withstand level		IEC61000-4-11
	Surge	**Example)** Withstand level of noise caused by lightning		IEC61000-4-5

Appendix 7-3 EMC measures

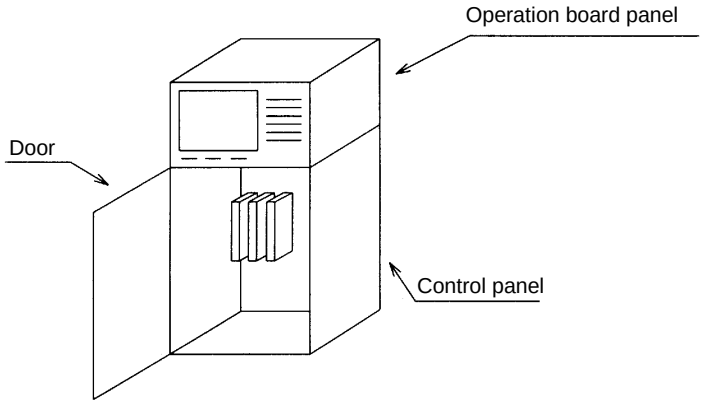
The main items relating to EMC measures include the following.
(1) Store the device in an electrically sealed metal panel.
(2) Earth all conductors that are floating electrically. (Lower the impedance.)
(3) Wire the power line away from the signal wire.
(4) Use shielded wires for the cables wired outside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

Ensure the following items to suppress noise radiated outside of the panel.
(1) Securely install the devices.
(2) Use shielded wires.
(3) Increase the panel's electrical seal. Reduce the gap and hole size.

Note that the electromagnetic noise radiated in the air is greatly affected by the clearance of the panel and the quality of the cable shield.

Appendix 7-4 Measures for panel structure

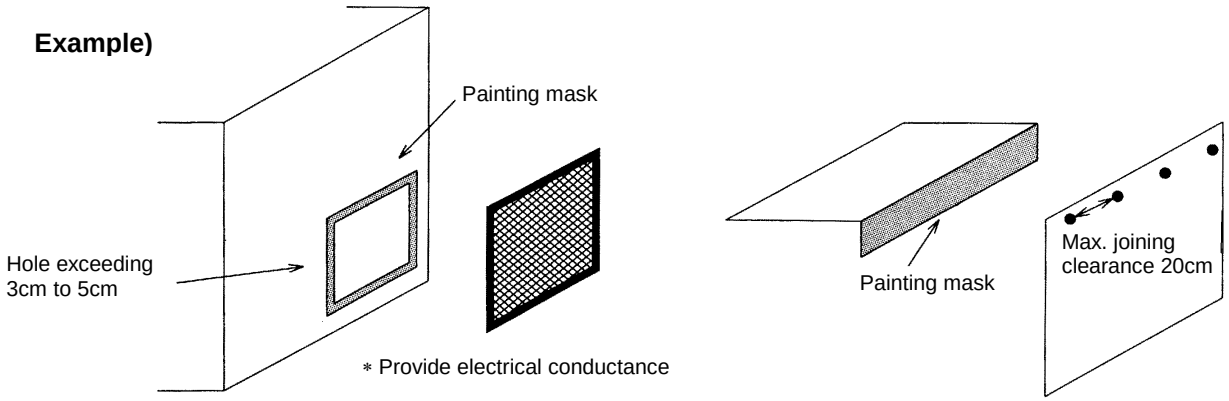
The design of the panel is a very important factor for the EMC measures, so take the following measures into consideration.



Appendix 7-4-1 Measures for control panel unit

(1) Use metal for all materials configuring the panel.
(2) For the joining of the top plate and side plates, etc., mask the contact surface with paint, and fix with welding or screws.
In either case, keep the joining clearance to a max. of 20cm for a better effect.
(3) Note that if the plate warps due to the screw fixing, etc., creating a clearance, noise could leak from that place.
(4) Plate the metal plate surface (with nickel, tin) at the earthing section, such as the earthing plate.
(5) The max. tolerable hole diameter of the openings on the panel surface, such as the ventilation holes, must be 3cm to 5cm. If the opening exceeds this size, use a measure to cover it. Note that even when the clearance is less than 3cm to 5cm, noise may still leak if the clearance is long.

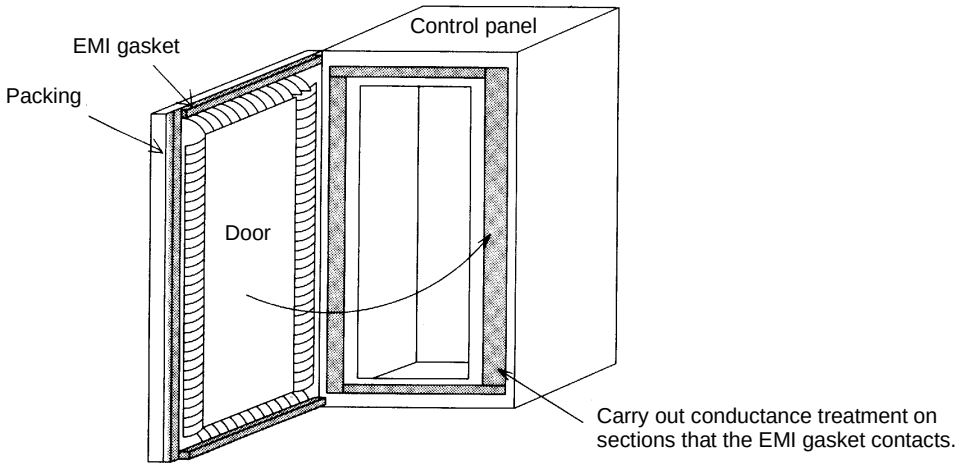
Example)



Appendix 7-4-2 Measures for door

(1) Use metal for all materials configuring the door.
(2) Use an EMI gasket or conductive packing for the contact between the door and control panel unit.
(3) The EMI gasket or conductive packing must contact at a uniform and correct position of the metal surface of the control panel unit.
(4) The surface of the control panel unit contacted with the EMI gasket or conductive packing must have conductance treatment.

Example) Weld (or screw) a plate that is plated (with nickel, tin).



(5) As a method other than the above, the control panel unit and door can be connected with a plain braided wire. In this case, the panel and door should be contacted at as many points as possible.

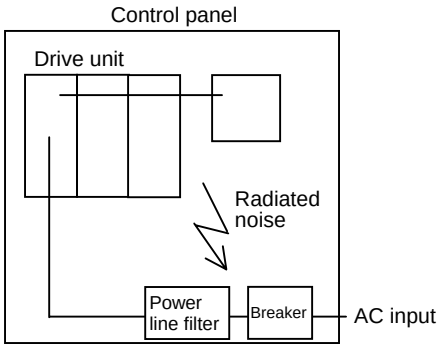
Appendix 7-4-3 Measures for operation board panel

(1) Always connect the operation board and indicator with an earthing wire.
(2) If the operation board panel has a door, use an EMI gasket or conductive packing between the door and panel to provide electrical conductance in the same manner as the control panel.
(3) Connect the operation board panel and control panel with a sufficiently thick and short earthing wire.

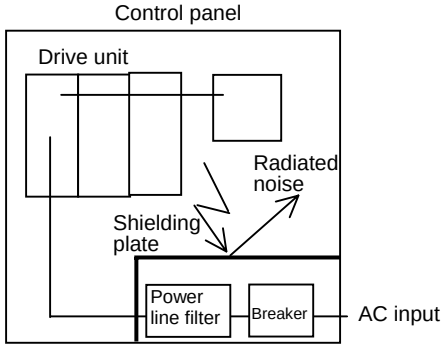
Refer to the "EMC INSTALLATION GUIDELINES" BNP-B2230 for the NC for more details.

Appendix 7-4-4 Shielding of the power supply input section

(1) Separate the input power supply section from other parts in the control panel so that the input power supply cable will not be contaminated by radiated noise.
(2) Do not lead the power line through the panel without passing it through a filter.



The power supply line noise is eliminated by the filter, but cable contains noise again because of the noise radiated in the control panel.



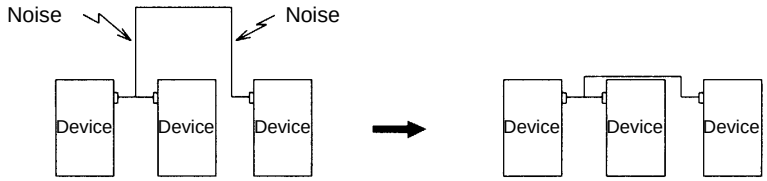
Use a metal plate, etc., for the shielding partition. Make sure not to create a clearance.

Appendix 7-5 Measures for various cables

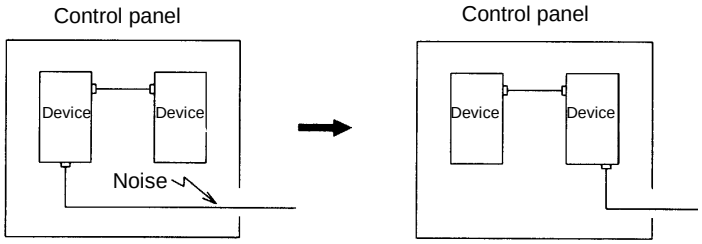
The various cables act as antennas for the noise and discharge the noise externally. Thus appropriate treatment is required to avoid the noise.
The wiring between the drive unit and motor act as an extremely powerful noise source, so apply the following measures.

Appendix 7-5-1 Measures for wiring in panel

(1) If the cables are led unnecessarily in the panel, they will easily pick up the radiated noise. Thus, keep the wiring length as short as possible.



(2) The noise from other devices will enter the cable and be discharged externally, so avoid internal wiring near the openings.



(3) Connect the control device earthing terminal and earthing plate with a thick wire. Take care to the leading of the wire.

Appendix 7-5-2 Measures for shield treatment

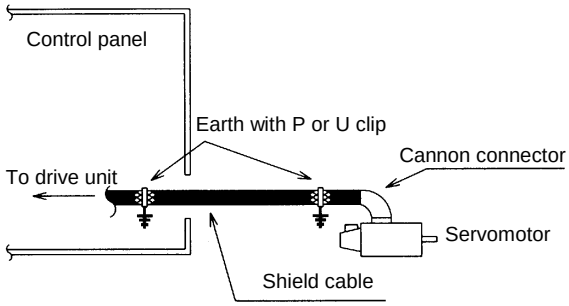
Common items

Use of shield clamp fittings is recommended for treating the shields. The fittings are available as options, so order as required. (Refer to section "6.1 Shield clamp fitting".)
Clamp the shield at a position within 10cm from the panel lead out port.

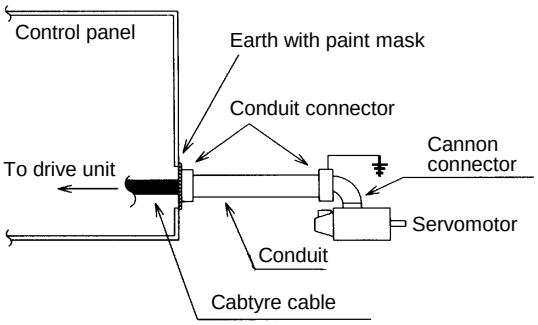
POINT

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

Appendix 7-5-3 Servomotor power cable

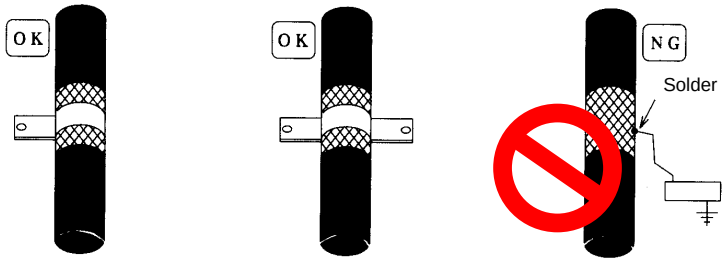


Using shield cable

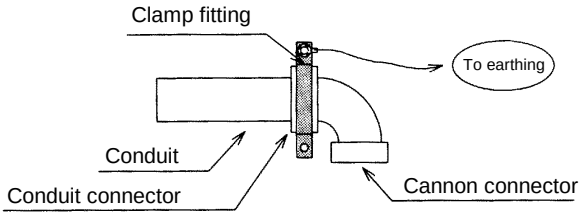


Using conduit

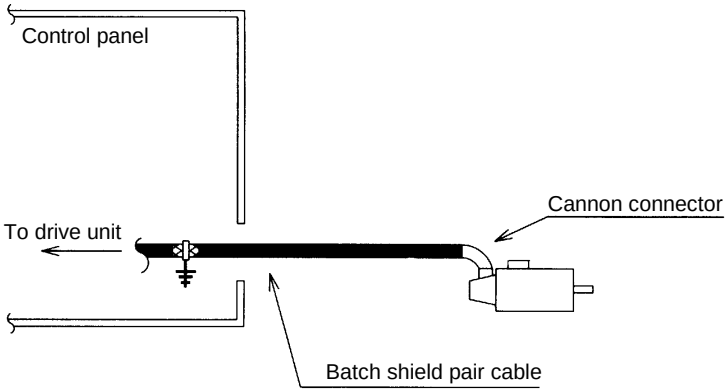
(1) Use four wires (3-phase + earthing) for the power cable that are completely shielded and free from breaks.
(2) Earth the shield on both the control panel side and motor chassis side.
(3) Earth the shield with a metal P clip or U clip.
(A cable clamp fitting can be used depending on the wire size.)
(4) Directly earth the shield. Do not solder the braided shield onto a wire and earth the end of the wire.



(5) When not using a shield cable for the power cable, use a conventional cabtyre cable. Use a metal conduit outside the cable.
(6) Earth the power cable on the control panel side at the contact surface of the conduit connector and control panel. (Mask the side wall of the control panel with paint.)
(7) Follow the treatment shown in the example for the conduit connector to earth the power cable on the motor side. (Example: Use a clamp fitting, etc.)

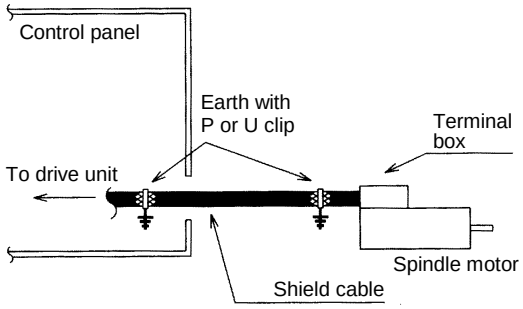


Appendix 7-5-4 Servomotor feedback cable

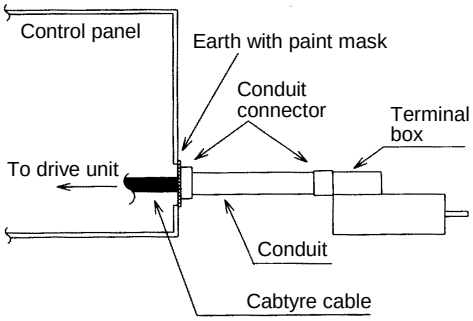


Use a conventional batch shield pair cable for the servomotor feedback cable, and ground it in the NC side (control panel).

Appendix 7-5-5 Spindle motor power cable



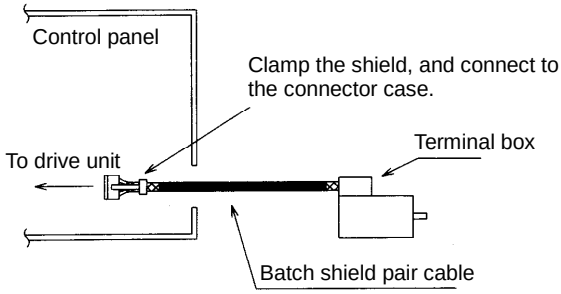
Using shield cable

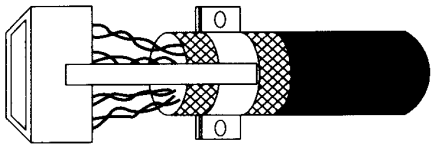


Using conduit

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

Appendix 7-5-6 Spindle motor feedback cable





Spindle side connector
(State with the cover removed)

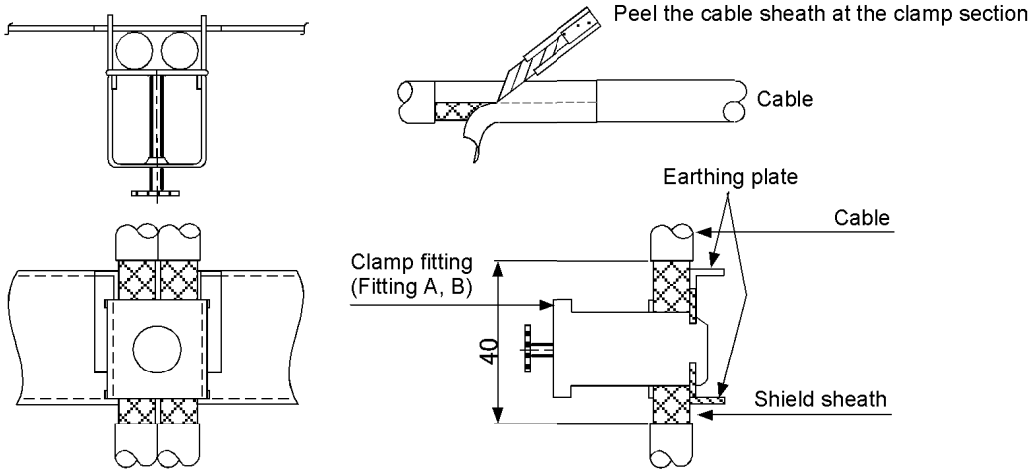
(1) Use a conventional batch shield pair cable for the spindle motor feedback cable.

Note) A shield for the spindle motor feedback cable is not "FG", and therefore do not ground it.

Appendix 7-6 EMC countermeasure parts

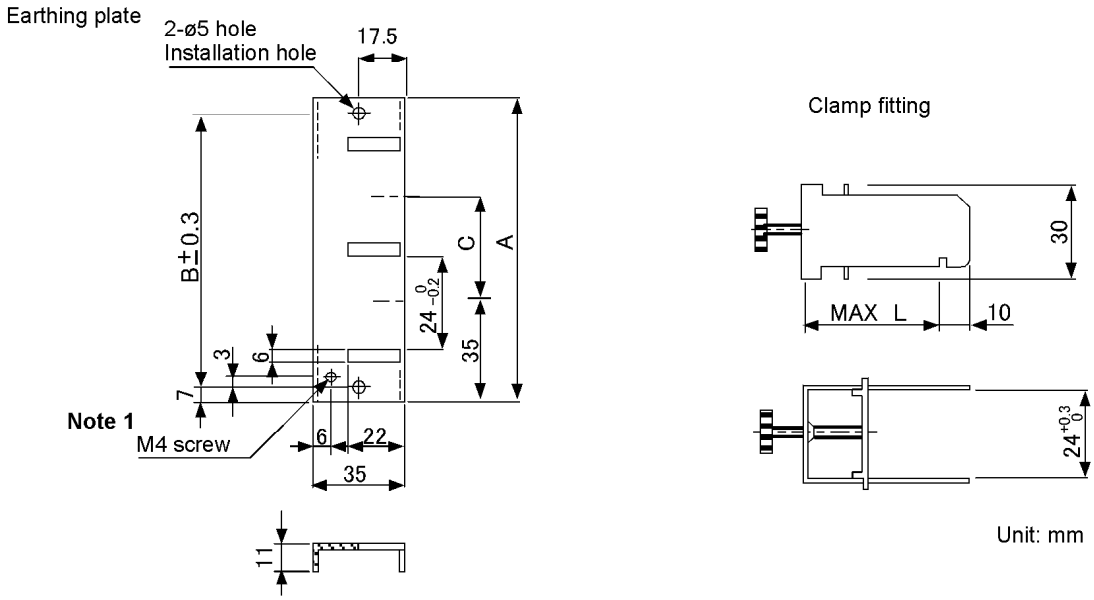
Appendix 7-6-1 Shield clamp fitting

The effect can be enhanced by connecting the cable directly to the earthing plate. Install an earthing plate near each panel's outlet (within 10cm), and press the cable against the earthing plate with the clamp fitting. If the cables are thin, several can be bundled and clamped together. Securely earth the earthing plate with the frame ground. Install directly on the cabinet or connect with an earthing wire. Contact Mitsubishi if the earthing plate and clamp fitting set (AERSBAN-□ SET) is required.



View of clamp section

- **Outline drawing**



Note 1) Screw hole for wiring to earthing plate in cabinet.
Note 2) The earthing plate thickness is 1.6mm.

	A	B	C	Enclosed fittings
AERSBAN-DSET	100	86	30	Clamp fitting A × 2
AERSBAN-ESET	70	56	–	Clamp fitting B × 1

	L
Clamp fitting A	70
Clamp fitting B	45

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

Appendix 7-6-2 Ferrite core

A ferrite core is integrated and mounted on the plastic case.
Quick installation is possible without cutting the interface cable or power cable.
This ferrite core is effective against common mode noise, allowing measures against noise to be taken without affecting the signal quality.

Recommended ferrite core

TDK ZCAT Series

Shape and dimensions

ZCAT type

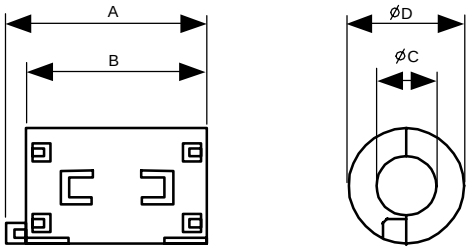


Fig. 1

ZCAT-A type

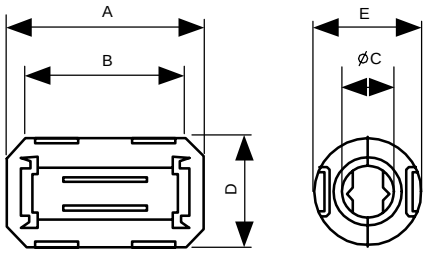


Fig. 2

ZCAT-B type

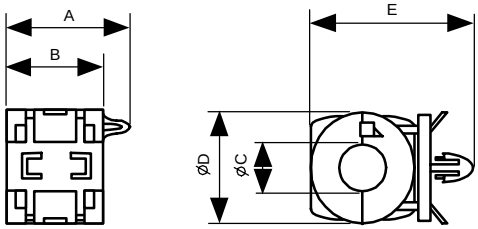


Fig. 3

ZCAT-C type

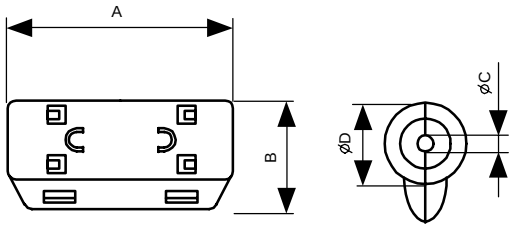


Fig. 4

Unit [mm]

Part name	Fig.	A	B	C	D	E	Applicable cable outline	Weight	Recommended ferrite core
ZCAT3035-1330 (-BK)*1	1	39	34	13	30	---	13 max.	63	⊙
ZCAT2035-0930-M (-BK)	2	35	29	13	23.5	22	10 to 13	29	
ZCAT2017-0930-M (-BK)	3	21	17	9	20	28.5	9 max.	12	
ZCAT2749-0430-M (-BK)	4	49	27	4.5	19.5	---	4.5 max.	26	

*1 A fixing band is enclosed when shipped.

ZCAT-B type: Cabinet fixed type, installation hole ø4.8 to 4.9mm, plate thickness 0.5 to 2mm
ZCAT-C type: Structured so that it cannot be opened easily by hand once closed.

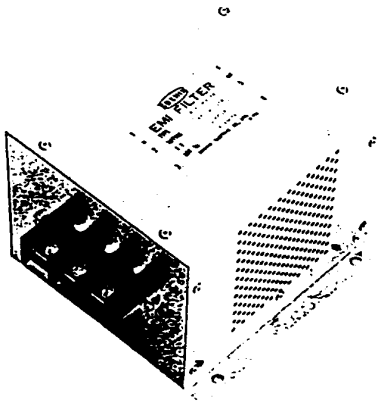
Appendix 7-6-3 Power line filter

(1) Power line filter for 200V

HF3000A-TM Series for 200V

■ **Features**

- 3-phase 3-wire type (250V series, 500V series)
- Compliant with noise standards German Official Notice Vfg243, EU Standards EN55011 (Class B)
- Effective for use with IGBT inverter and MOS-FET inverter.
- Easy mounting with terminal block structure, and outstanding reliability.



■ **Application**

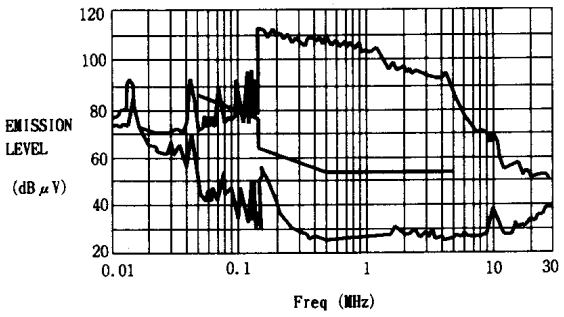
- Products which must clear noise standards German Official Notice Vfg243 and EU Standards EN55011 (Class B).
- For input of power converter using advanced high-speed power device such as IGBT MOS-FET.

■ **Specifications (250V series)**

Part name	HF3005A-TM	HF3010A-TM	HF3015A-TM	HF3020A-TM	HF3030A-TM	HF3040A-TM	HF3050A-TM	HF3060A-TM	HF3080A-TM	HF3100A-TM	HF3150A-TM
Rated voltage	250VAC										
Rated current	5A	10A	15A	20A	30A	40A	50A	60A	80A	100A	150A
Leakage current	1.5mA MAX 250VAC 60Hz										

Contact: Soshin Electric Co., LTD. Telephone: 03-3775-9112 (+81-3-3775-9112) http://www.soshin.co.jp

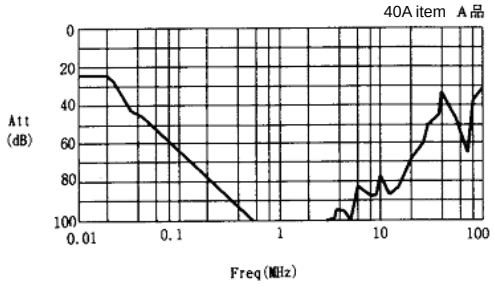
<Example of measuring voltage at noise terminal> ... Measured with IGBT inverter



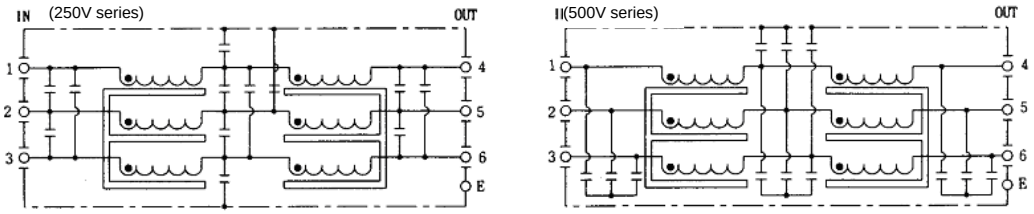
German Official Notice Vfg243 measurement data

EU Standards EN55011 (Class B) measurement data

<Typical characteristics>

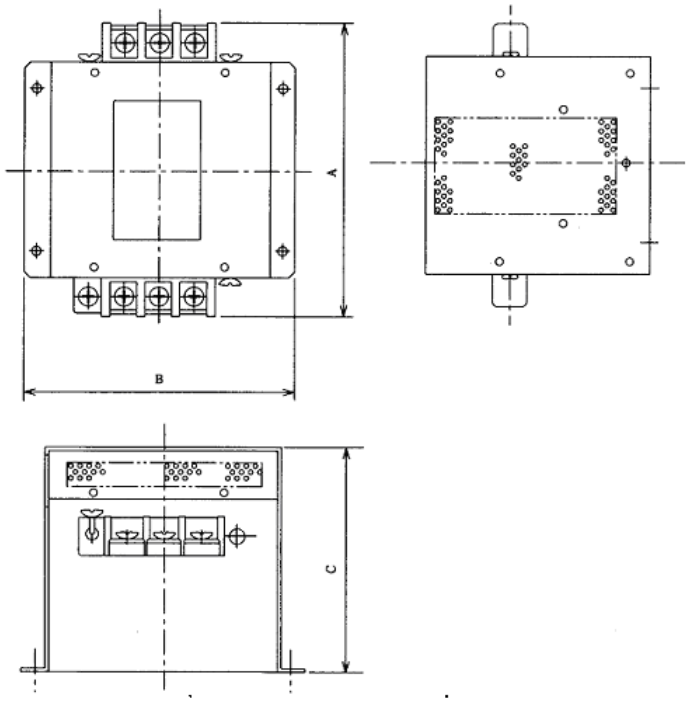


<Circuit diagram>



■ Outline dimensions

[Unit : mm]



Part name	Dimensions		
	A	B	C
HF3005A-TM	180	170	130
HF3010A-TM			
HF3015A-TM			
HF3020A-TM			
HF3030A-TM	260	155	140
HF3040A-TM			
HF3050A-TM	290	190	170
HF3060A-TM			230
HF3080A-TM	405	220	210
HF3100A-TM			
HF3150A-TM	570	230	

200V MX13 Series 3-phase high attenuation noise filter

■ Features

- Perfect for mounting inside control panel: New shape with uniform height and depth dimensions
- Easy mounting and maintenance work: Terminals are centrally located on the front
- Complaint with NC servo and AC servo noise: High attenuation of 40dB at 150KHz
- Safety Standards: UL1283, CSA22.2 No.8, EN133200
- Patent and design registration pending

■ Specifications

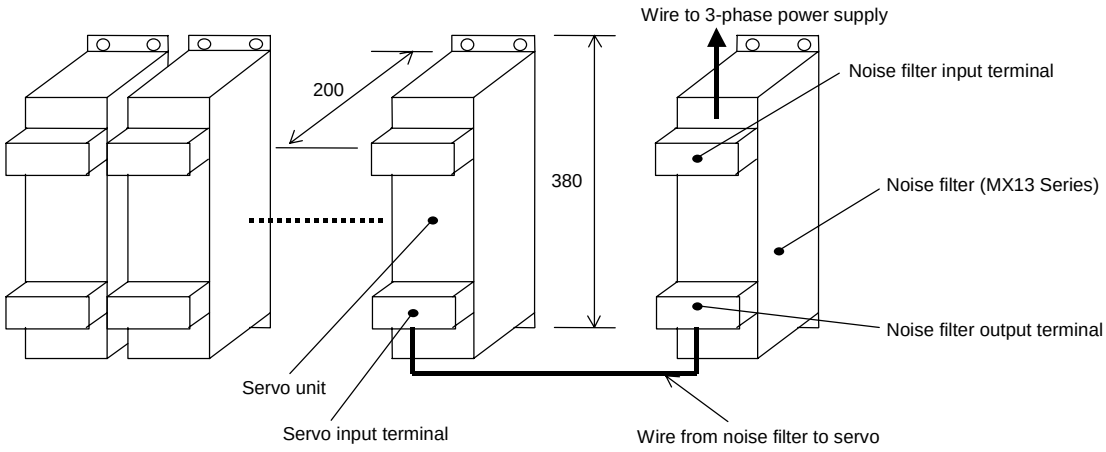
Item \ Type		MX13030	MX13050	MX13100	MX13150
1	**Rated voltage (AC)**	3-phase 250VAC (50/60Hz)			
2	**Rated current (AC)**	30A	50A	100A	150A
3	**Test voltage (AC for one minute across terminal and case)**	2500VAC (100mA) at 25°C, 70% RH			
4	**Insulation resistance (500VDC across terminal and case)**	100MΩ min. at 25°C, 70% RH			
5	**Leakage current (250V, 60Hz)**	3.5 mA max.		8 mA max.	
6	**DC resistance**	30 mΩ max.	11 mΩ max.	5.5 mΩ max.	3.5 mΩ max.
7	**Temperature rise**	30°C max			
8	**Working ambient temperature**	–25°C to +85°C			
9	**Working ambient humidity**	30% to 95% RH (non condensing)			
10	**Storage ambient temperature**	–40°C to +85°C			
11	**Storage ambient humidity**	10% to 95% RH (non condensing)			
12	**Weight (typ)**	2.8kg	3.9kg	11.5kg	16kg

(Note) This is the value at Ta≤50°C.
Refer to the following output derating for Ta>50°C.

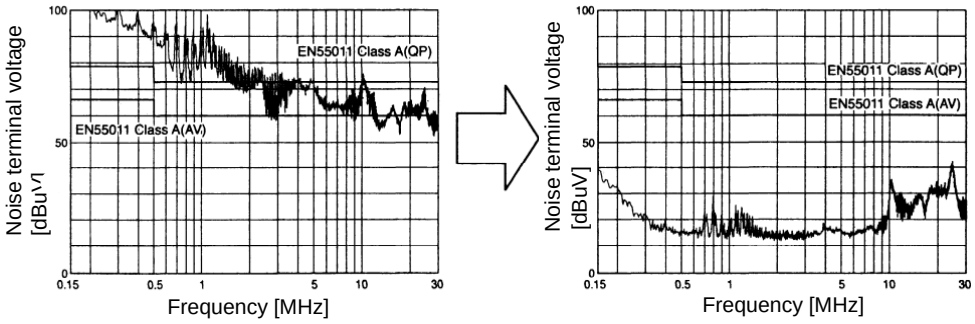
Contact : Densei-lambda Co., Ltd. Telephone : 03-3447-4411 (+81-3-3447-4411)
Fax : 03-3447-7784 (+81-3-3447-7784)
http://www.densei-lambda.com

■ Example of using MX13 Series

This is a noise filter with the same dimensions as MDS-D/DH drive unit depth (200mm) and height (380mm). This unit can be laid out easily in the device by arranging it in a row with the servo unit. As with the servo unit, the terminals are arranged on the front enabling ideal wire lead-out. Refer to the following usage examples for details.



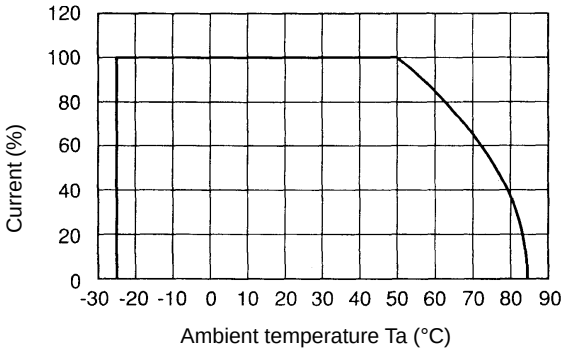
■ Example of noise terminal voltage attenuation



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

EMI data for control panel + noise filter (MX13030)

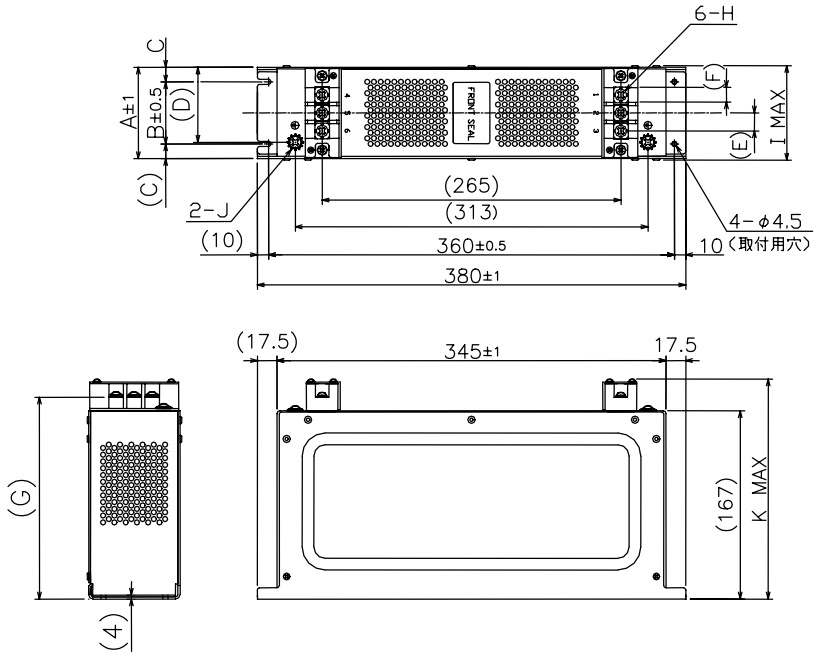
■ Output derating



■ Outline drawing

● MX13030, MX13050

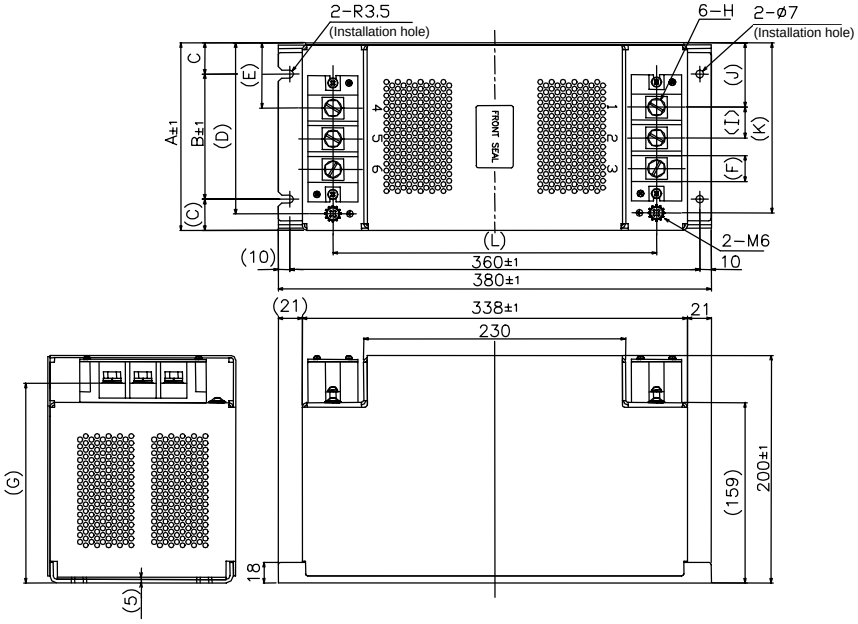
[Unit : mm]



	MX13030	MX13050
A	66	81
B	45	55
C	10.5	13
D	50	67
E	13	16
F	10	13
G	177	179
H	M4 screw	M6 screw
I	70	85
J	M4 screw	M6 screw
K	195	200

● MX13100, MX13150

[Unit : mm]



	MX13100	MX13150
A	130	165
B	90	110
C	20	27.5
D	115	150.5
E	37.5	57.5
F	18	23
G	174	176
H	M6 screw	M8 screw
I	21	27
J	37.5	56.5
K	115	149.5
L	276	284

Appendix 7-6-4 Surge protector

Insert a surge protector in the power input section to prevent damage to the control panel or power supply unit, etc. caused by the surge (lightning or sparks, etc.) applied on the AC power line.
Use a surge protector that satisfies the following electrical specifications.

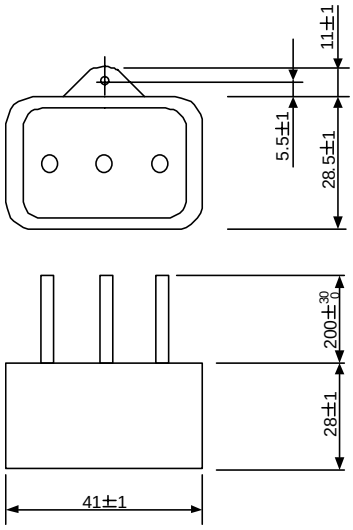
(1) Surge protector for 200V

R•A•V BYZ series for 200V

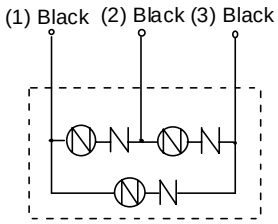
Part name	Circuit voltage 50/60Hz Vrms	Maximum tolerable circuit voltage	Clamp voltage (V) ±10%	Surge withstand level 8/20μs (A)	Surge withstand voltage 1.2/50μs (V)	Electrostatic capacity	Service temperature
RAV-781BYZ-2	3AC 250V	300V	783V	2500A	20kV	75pF	-20 to 70°C

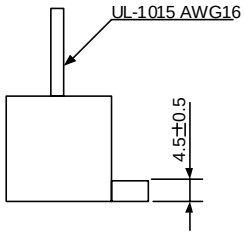
(Note) Refer to the manufacturer's catalog for details on the surge protector's characteristics and specifications, etc.

Outline dimension drawings



Circuit diagram





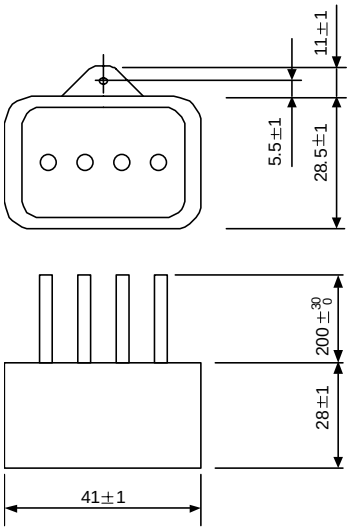
unit: mm

R•A•V BXZ series for 200V

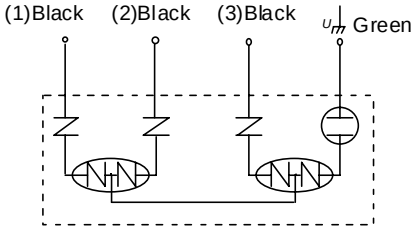
Part name	Circuit voltage 50/60Hz Vrms	Maximum tolerable circuit voltage	Clamp voltage (V) ±10%	Surge withstand level 8/20μs (A)	Surge withstand voltage 1.2/50μs (V)	Electrostatic capacity	Service temperature
RAV-781BXZ-4	3AC 250V	300V	1700V	2500A	2kV	75pF	-20 to 70°C

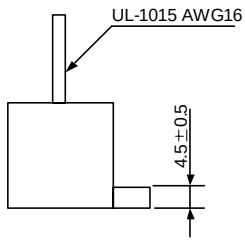
(Note) Refer to the manufacturer's catalog for details on the surge protector's characteristics and specifications, etc.

Outline dimension drawings



Circuit diagram

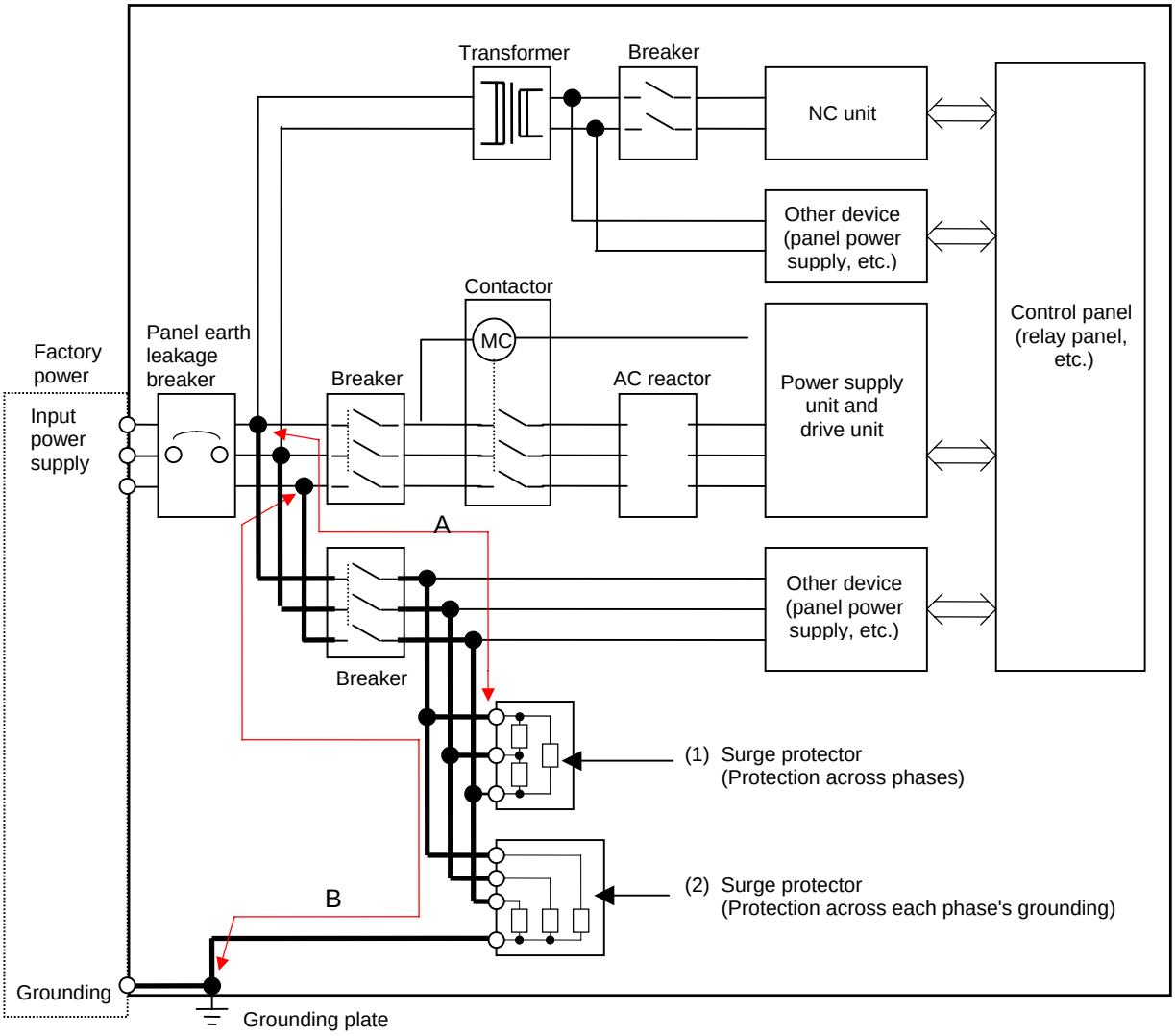




unit: mm

(2) Example of surge protector installation

An example of installing the surge protector in the machine control panel is shown below.
A short-circuit fault will occur in the surge protector if a surge exceeding the tolerance is applied. Thus, install a circuit protection breaker in the stage before the surge protector. Note that almost no current flows to the surge protector during normal use, so a breaker installed as the circuit protection for another device can be used for the surge protector.



Installing the surge absorber

⚠ CAUTION

1. The wires from the surge protector should be connected without extensions.
2. If the surge protector cannot be installed just with the enclosed wires, keep the wiring length of A and B to 2m or less. If the wires are long, the surge protector's performance may drop and inhibit protection of the devices in the panel.
3. The selected surge protector differs according to the input power voltage.

Appendix 8. EC Declaration of conformity

Appendix 8-1 Compliance to EC Directives

MDS-D/DH Series can respond to LVD and EMC directive.
Approval from a third party certification organization has been also acquired for the Low Voltage Directive. The declaration of conformity of each unit is shown below.

Appendix 8-1-1 Low voltage equipment

MDS-C1-CV series

MITSUBISHI ELECTRIC

MITSUBISHI

MITSUBISHI ELECTRIC CORPORATION
NAGOYA WORKS
1-14 YADA-MINAMI 5-CHOME,
HIGASHI-KU, NAGOYA, 461-8670 JAPAN
Phone: (052) 721-2111

DECLARATION OF CONFORMITY
(According to Low Voltage Directive 72/23/EEC)
(as last amended by EEC Directive 93/68/EEC)

We hereby state that the following products are in conformity with Low Voltage Directive 72/23/EEC and 93/68/EEC.
This is supported by product tests of the following standards.

Description : Power Supply Unit
Type : MDS-C1-CV Series

Manufactured by : MITSUBISHI ELECTRIC CORPORATION NAGOYA WORKS

Address : 1-14 Yada-Minami 5-Chome, Higashi-Ku, Nagoya, 461-8670, Japan

Standard(s) : EN50178

Year of CE marking : 2000

MITSUBISHI ELECTRIC CORPORATION
NAGOYA WORKS

Issued by :
NAGOYA, 27 / October, 2000

Toshio Yoshida
Manager
Numerical Control System Department

Zertifikat *Certificate*

TÜV

Zertifikat Nr. *Certificate No.*
R 2-50005414

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Ihr Zeichen *Client Reference*	**Unser Zeichen** *Our Reference*	**Ausstellungsdatum** *Date of Issue (day/mb/yr)*
M.K.	ZO-MWE- 02062303 001	28.09.2001

Genehmigungsinhaber *License Holder*
Mitsubishi Electric Corp.
Nagoya Works
5-1-14 Yada-Minami, Higashi-ku
NAGOYA-SHI, AICHI 461-8670
JAPAN

Fertigungsstätte *Manufacturing Plant*
Mitsubishi Electric Corp.
Nagoya Works
5-1-14 Yada-Minami, Higashi-ku
NAGOYA-SHI, AICHI 461-8670
JAPAN

Prüfzeichen *Test Mark*
TÜV Rheinland Product Safety | BAUART GEPRÜFT | TYPE APPROVED

Geprüft nach *Tested acc. to*
EN 50178:1997

Zertifiziertes Produkt (Geräteidentifikation) *Certified Product* *(Product Identification)*

Lizenzentgelte - Einheit *License Fee - Unit*

Einbau-Schaltnetzteil Power Supply Unit

Type Designation	: MDS-C1-CV-x	6
	x = 37,55,75,110,150,185,220,260,300 or 370	3
Rated Voltages	: 3AC 200V, 50Hz/3AC 200-230V, 60Hz and AC 200V, 50Hz/AC 200-230V, 60Hz	
Rated Currents	: (see Appendix 1)	
Protection Class	: I	
Output Voltage	: DC 270-311V	
Output Current	: (see Appendix 1)	
Ambient Temperature	: 0 - 55°C	
Overvoltage Category	: II	
Pollution Degree	: 2	

Remarks: Input- and output power circuits, which are connected directly, provide protective separation to signal circuits. Protection against electrical shock has to be maintained by building-in. The unit must be installed in accordance with the manufacturer's specifications.

9

ANLAGE (Appendix): 1

TÜV Rheinland Product Safety GmbH · TÜV Rheinland · Zertifizierungsstelle

Dem Zertifikat liegt unsere Prüf- und Zertifizierungsordnung zugrunde. Das Produkt entspricht den o.g. Anforderungen, die Herstellung wird überwacht. This certificate is based on our Testing and Certification Regulation. The product fulfills above-mentioned-requirements, the production is subject to surveillance.

Zertifizierungsstelle

TÜV Rheinland Product Safety GmbH, Am Grauen Stein, D-51105 Köln

W. Nölke

Dipl.-Ing. W. Nölke

MDS-C1-V1/V2 series

MITSUBISHI ELECTRIC

MITSUBISHI

MITSUBISHI ELECTRIC CORPORATION
NAGOYA WORKS
1-14 YADA-MINAMI 5-CHOME,
HIGASHI-KU, NAGOYA, 461-8670 JAPAN
Phone: [052]721-2111

DECLARATION OF CONFORMITY
(According to Low Voltage Directive 72/23/EEC)
(as last amended by EEC Directive 93/68/EEC)

We hereby state that the following products are in conformity with Low Voltage Directive 72/23/EEC and 93/68/EEC.
This is supported by product tests of the following standards.

Description : Servo Drive Unit
Type : MDS-C1-V1 Series
MDS-C1-V2 Series

Manufactured by : MITSUBISHI ELECTRIC CORPORATION NAGOYA WORKS

Address : 1-14 Yada-Minami 5-Chome, Higashi-Ku, Nagoya, 461-8670, Japan

Standard(s) : EN50178

Year of CE marking : 2000

MITSUBISHI ELECTRIC CORPORATION
NAGOYA WORKS

Issued by :
NAGOYA, 27 / October, 2000

Toshio Yoshida
Manager
Numerical Control System Department

BNP-B3940-008-*

Zertifikat *Certificate*

TÜV

Zertifikat Nr. *Certificate No.*
R 2-50005415

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0001

Ihr Zeichen *Client Reference*	**Unser Zeichen** *Our Reference*	**Ausstellungsdatum** *Date of Issue (day/mo/yr)*
M.K.	ZO-MWE- 02062303 001	28.09.2001

Genehmigungsinhaber *License Holder*
Mitsubishi Electric Corp.
Nagoya Works
5-1-14 Yada-Minami, Higashi-ku
NAGOYA-SHI, AICHI 461-8670
JAPAN

Fertigungsstätte *Manufacturing Plant*
Mitsubishi Electric Corp.
Nagoya Works
5-1-14 Yada-Minami, Higashi-ku
NAGOYA-SHI, AICHI 461-8670
JAPAN

Prüfzeichen *Test Mark*
BAUART GEPRÜFT
TYPE APPROVED
TÜV Rheinland Product Safety

Geprüft nach *Tested acc. to*
EN 50178:1997

Zertifiziertes Produkt (Geräteidentifikation) *Certified Product* (*Product Identification*)

Lizenzentgelte - Einheit *License Fee - Unit*

Steuergerät für Stellmotoren AC Servo Drive Unit

Type Designations :	MDS-C1-V1-x	5
	MDS-C1-V2-x	1
	x = (see table 1 of Appendix 1 and 1.1)	4
Rated Voltages	: DC 270-311V and AC 200V, 50Hz / AC 200-230V, 60Hz	
Rated Currents	: (see Appendix 1 or 1.1)	
Protection Class	: I	
Output Voltage	: 3AC 155V, 0 - 240Hz	
Output Current	: (see Appendix 1 or 1.1)	
Ambient Temperature	: 0 - 55°C	
Overvoltage Category	: II	
Pollution Degree	: 2	

Remarks: Input- and output power circuits, which are connected directly, provide protective separation to signal circuits. Protection against electrical shock has to be maintained by building-in.
The unit must be installed in accordance with the manufacturer's specifications.

10

ANLAGE (Appendix): 1, 1.1

TÜV Rheinland Product Safety GmbH — TÜV Rheinland — Zertifizierungsstelle

Dem Zertifikat liegt unsere Prüf- und Zertifizierungsordnung zugrunde. Das Produkt entspricht den o.g. Anforderungen, die Herstellung wird überwacht. This certificate is based on our Testing and Certification Regulation. The product fulfills above-mentioned-requirements, the production is subject to surveillance.

TÜV Rheinland Product Safety GmbH, Am Grauen Stein, D-51105 Köln

Zertifizierungsstelle

Dipl.-Ing. W. Nölke

MDS-C1- SP/SPH/SPM/SPX series

MITSUBISHI ELECTRIC

MITSUBISHI

MITSUBISHI ELECTRIC CORPORATION
NAGOYA WORKS
1-14 YADA-MINAMI 5-CHOME,
HIGASHI-KU, NAGOYA, 461-8670 JAPAN
Phone:(052)721-2111

DECLARATION OF CONFORMITY
(According to Low Voltage Directive 72/23/EEC)
(as last amended by EEC Directive 93/68/EEC)

We hereby state that the following products are in conformity with Low Voltage Directive 72/23/EEC and 93/68/EEC.
This is supported by product tests of the following standards.

Description : Spindle Drive Unit
Type : MDS-C1-SP / SPH / SPM / SPX Series

Manufactured by : MITSUBISHI ELECTRIC CORPORATION NAGOYA WORKS

Address : 1-14 Yada-Minami 5-Chome, Higashi-Ku, Nagoya, 461-8670, Japan

Standard(s) : EN50178

Year of CE marking : 2000

MITSUBISHI ELECTRIC CORPORATION
NAGOYA WORKS

Issued by :
NAGOYA, 27 / October, 2000

Toshio Yoshida
Manager
Numerical Control System Department

BNP-B3940-007-*

Zertifikat *Certificate*

TÜV

Zertifikat Nr. *Certificate No.*
R 2-50005422

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0001

Ihr Zeichen *Client Reference*	**Unser Zeichen** *Our Reference*	**Ausstellungsdatum**	*Date of Issue (day/mb/yr)*
M.K.	ZO-MWE- 02062303 001	28.09.2001	

Genehmigungsinhaber *License Holder*
Mitsubishi Electric Corp.
Nagoya Works
5-1-14 Yada-Minami, Higashi-ku
NAGOYA-SHI, AICHI 461-8670
JAPAN

Fertigungsstätte *Manufacturing Plant*
Mitsubishi Electric Corp.
Nagoya Works
5-1-14 Yada-Minami, Higashi-ku
NAGOYA-SHI, AICHI 461-8670
JAPAN

Prüfzeichen *Test Mark*
TÜV Rheinland Product Safety — BAUART GEPRÜFT — TYPE APPROVED

Geprüft nach *Tested acc. to*
EN 50178:1997

Zertifiziertes Produkt (Geräteidentifikation)
Certified Product *(Product Identification)*

Lizenzentgelte - Einheit
License Fee - Unit

Steuergerät für Stellmotoren AC Spindle Drive Unit

Type Designation	: MDS-C1-SPy-x	5
	y = blank or combination of H, X and M	2
	x = (see Appendix 1)	3
Rated Voltages	: DC 270-311V and AC 200V, 50Hz / AC 200-230V, 60Hz	
Rated Currents	: (see Appendix 1)	
Protection Class	: I	
Output Voltage	: 3AC 200V, 0 - 833Hz	
Output Current	: (see Appendix 1)	
Ambient Temperature	: 0 - 55°C	
Overvoltage Category	: II	
Pollution Degree	: 2	

Remarks: Input- and output power circuits, which are connected directly, provide protective separation to signal circuits. Protection against electrical shock has to be maintained by building-in. The unit must be installed in accordance with the manufacturer's specifications.

10

ANLAGE (Appendix): 1

TÜV Rheinland Product Safety GmbH — TÜV Rheinland — Zertifizierungsstelle

Dem Zertifikat liegt unsere Prüf- und Zertifizierungsordnung zugrunde.
Das Produkt entspricht den o.g. Anforderungen, die Herstellung wird überwacht.
This certificate is based on our Testing and Certification Regulation. The product fulfills above-mentioned-requirements, the production is subject to surveillance.

TÜV Rheinland Product Safety GmbH, Am Grauen Stein, D-51105 Köln

Zertifizierungsstelle

Dipl.-Ing. W. Nölke

B-AL series

MITSUBISHI ELECTRIC

MITSUBISHI

MITSUBISHI ELECTRIC CORPORATION
NAGOYA WORKS
1-14 YADA-MINAMI 5-CHOME,
HIGASHI-KU, NAGOYA, 461-8670 JAPAN
Phone:(052) 721-2111

DECLARATION OF CONFORMITY
(According to Low Voltage Directive 73/23/EEC)
(as last amended by EEC Directive 93/68/EEC)

We hereby state that the following products are in conformity with Low Voltage Directive 73/23/EEC and 93/68/EEC.
This is supported by product tests of the following standards.

Description : AC Reactor
Type : B-AL-[x]K Series, CH-AL-[x]K Series
D-AL-[x]K Series, DH-AL [x]K Series
[x] can be 7.5, 11, 18.5, 30, 37, 45, 55 and 75.

Manufactured by : MITSUBISHI ELECTRIC CORPORATION NAGOYA WORKS

Address : 1-14 Yada-Minami 5-Chome, Higashi-Ku, Nagoya, 461-8670, Japan

Standard(s) : EN50178: 1997

Year of CE marking : 2004

MITSUBISHI ELECTRIC CORPORATION
NAGOYA WORKS

Issued by :
NAGOYA, 4 / November, 2004

Tsutomu Kazama

Tsutomu Kazama
Manager
Numerical Control System Department

BNP-B3940-016-A

Appendix 8-1-2 Electromagneic compatibility

MDS-C1-CV series

MITSUBISHI ELECTRIC

MITSUBISHI

MITSUBISHI ELECTRIC CORPORATION
NAGOYA WORKS
1-14 YADA-MINAMI 5-CHOME,
HIGASHI-KU, NAGOYA, 461-8670 JAPAN
Phone: (052) 721-2111

MANUFACTURERS DECLARATION
(According to EMC Directive 89/336/EEC)

We hereby state that the following component has been designed and manufactured in accordance with the following transposed Harmonized European Standards, and conform to these standards on condition that EMC Installation Guidelines are met.

Component Description : Power Supply Unit
Type : MDS-C1-CV Series

Manufactured by : MITSUBISHI ELECTRIC CORPORATION NAGOYA WORKS

Address : 1-14 Yada-Minami 5-Chome, Higashi-Ku, Nagoya, 461-8670, Japan

Standard(s) : EN61800-3 : 1996
[EN50011: 1998/A1: 1999]
[EN61000-6-2: 1999]

Additional Information :

Please utilize the EMC Installation Guidelines (Document Number: BNP-B8582-45). Compliance of the installation is the responsibility of the installer. Since a component of NC system is considered by the European commission to be a complex component, it cannot bear the CE mark. Component of NC system has no inherent function for end users, and EMC performance is only to be considered when placed into service as part of an apparatus.

Incorporation :

The products listed above must not be put into service until the machinery into which they have been incorporated has been declared in conformity with the EMC Directive 89/336/EEC.

MITSUBISHI ELECTRIC CORPORATION
NAGOYA WORKS

Issued by :
NAGOYA, 29 / May, 2001

T. Yoshida

Toshio Yoshida
Manager
Numerical Control System Department

BNP-B3896-029-A

MDS-C1-V1/V2 series

MITSUBISHI ELECTRIC

MITSUBISHI

MITSUBISHI ELECTRIC CORPORATION
NAGOYA WORKS
1-14 YADA-MINAMI 5-CHOME,
HIGASHI-KU, NAGOYA, 461-8670 JAPAN
Phone: (052) 721-2111

MANUFACTURERS DECLARATION
(According to EMC Directive 89/336/EEC)

We hereby state that the following component has been designed and manufactured in accordance with the following transposed Harmonized European Standards, and conform to these standards on condition that EMC Installation Guidelines are met.

Component Description : Servo Drive Unit
Type : MDS-C1-V1 Series
MDS-C1-V2 Series

Manufactured by : MITSUBISHI ELECTRIC CORPORATION NAGOYA WORKS

Address : 1-14 Yada-Minami 5-Chome, Higashi-Ku, Nagoya, 461-8670, Japan

Standard(s) : EN61800-3 : 1996
[EN50011: 1998/A1: 1999]
[EN61000-6-2: 1999]

Additional Information :

Please utilize the EMC Installation Guidelines (Document Number: BNP-B8582-45). Compliance of the installation is the responsibility of the installer. Since a component of NC system is considered by the European commission to be a complex component, it cannot bear the CE mark. Component of NC system has no inherent function for end users, and EMC performance is only to be considered when placed into service as part of an apparatus.

Incorporation :

The products listed above must not be put into service until the machinery into which they have been incorporated has been declared in conformity with the EMC Directive 89/336/EEC.

MITSUBISHI ELECTRIC CORPORATION
NAGOYA WORKS

Issued by :
NAGOYA, 29 / May, 2001

T. Yoshida

Toshio Yoshida
Manager
Numerical Control System Department

BNP-B3896-031-A

MDS-DH-SP/SPH/SPM/SPX series

MITSUBISHI ELECTRIC

MITSUBISHI

MITSUBISHI ELECTRIC CORPORATION
NAGOYA WORKS
1-14 YADA-MINAMI 5-CHOME,
HIGASHI-KU, NAGOYA, 461-8670 JAPAN
Phone: (052) 721-2111

MANUFACTURERS DECLARATION
(According to EMC Directive 89/336/EEC)

We hereby state that the following component has been designed and manufactured in accordance with the following transposed Harmonized European Standards, and conform to these standards on condition that EMC Installation Guidelines are met.

Component Description : Spindle Drive Unit
Type : MDS-C1-SP / SPH / SPM / SPX Series

Manufactured by : MITSUBISHI ELECTRIC CORPORATION NAGOYA WORKS

Address : 1-14 Yada-Minami 5-Chome, Higashi-Ku, Nagoya, 461-8670, Japan

Standard(s) : EN61800-3 : 1996
[EN50011: 1998/A1: 1999]
[EN61000-6-2: 1999]

Additional Information :

Please utilize the EMC Installation Guidelines (Document Number: BNP-B8582-45). Compliance of the installation is the responsibility of the installer. Since a component of NC system is considered by the European commission to be a complex component, it cannot bear the CE mark. Component of NC system has no inherent function for end users, and EMC performance is only to be considered when placed into service as part of an apparatus.

Incorporation :

The products listed above must not be put into service until the machinery into which they have been incorporated has been declared in conformity with the EMC Directive 89/336/EEC.

MITSUBISHI ELECTRIC CORPORATION
NAGOYA WORKS

Issued by :
NAGOYA, 29 / May, 2001

T. Yoshida

Toshio Yoshida
Manager
Numerical Control System Department

BNP-B3896-030-A

Appendix 9. Instruction Manual for Compliance with UL/c-UL Standard

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 panel	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 [*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 for each product.

[*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 MDS-B Series)
[*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 panel	0 to 55°C
	Base I/O unit	0 to 55°C
	Remote I/O unit	0 to 55°C
	I/O module	0 to 55°C
AC servo/spindle system	Power supply unit	0 to 55°C
	Servo drive unit	0 to 55°C
	Spindle drive unit	0 to 55°C
	Option unit, Battery unit	0 to 55°C
	Servo motor, Spindle Motor	0 to 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

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 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 servo motor

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□
150x150x6	---	---	Under 100W	Under 100W	---
250x250x6	---	---	200W	200,300W	---
250x250x12	0.5 to 1.5kW	1.0 to 2.0kW	400W	400,600W	0.5 to 1.5kW
300x300x12	---	---	750W	---	---
300x300x20	2.0 to 7.0kW	---	---	---	2.0 to 7.0kW

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 to 300s
SV022	OLL	Overload Detection level	Set the overload current detection level with a percentage (%) of the stall rating.	150%	1 to 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 to 1000s
SP064	OLL	Overload Detection level	Set the overload current detection level with a percentage (%) of the rating.	110%	1 to 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 to 7.5	11.0 to 18.5	22.0 to 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°C #12/75°C	#8/60°C #10/75°C	#4/60°C #8/75°C	#4/60°C #4/75°C	#3/60°C #4/75°C
Crimping Terminals Type	R5.5-6	R8-6 R5.5-6	R22-6 R8-6	R22-6	
Crimping Tools Type	YHT-2210	YHT-8S YHT-2210	YPT-60 YHT-8S	YPT-60	

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

L11, L21 (R0, S0), MC1

Capacity [kW]	3.7 to 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°C #12/75°C	#10/60°C #10/75°C	#10/75°C	#4/60°C #4/75°C	#3/60°C #4/75°C	#3/75°C
Crimping Terminals Type	5.5-S4			L300T 459-23		
Crimping Tools Type	YHT-2210			YPT-60		
Earth Wire Size (AWG)	#10/60°C #10/75°C	#10/60°C #10/75°C	#10/75°C	#4/60°C #4/75°C	#3/60°C #4/75°C	#3/75°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 #2/75°C	#1/0/60°C #1/75°C	#1/75°C	1/0/75°C	#2/0 /75°C	#3/0 /75°C
Crimping Terminals Type	38-S8	L330T 459-12 38-S8	38-S8	L330T 459-12	70-8	R80-10
Crimping Tools Type	YPT-60	YET300 YF-1 YPT-60	YPT-60	YET300 YF-1	YTP-150	
Earth Wire Size (AWG)	#3/60°C #3/75°C	#1/60°C #3/75°C	#3/75°C	1/75°C	#1/75°C	#1/0 /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 to 3.5	4.5 to 9.0	11.0, 15.0	0.1+0.1 to 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 to 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 to 1.0	2.0	3.5	4.5
Wire Size (AWG) /Temp Rating Note 1	#14/60°C	#10/60°C	#8/60°C	#8/60°C
	#14/75°C	#14/75°C	#10/75°C	#10/75°C
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°C	#10/60°C	#8/60°C	#8/60°C
	#14/75°C	#12/75°C	#10/75°C	#10/75°C

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°C
	#14/75°C
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°C		#10/60°C	#8/60°C	#8/60°C	#4/60°C
	#14/75°C	#14/75°C		#12/75°C	#10/75°C	#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°C		#10/60°C	#8/60°C	#8/60°C	#4 /60°C
	#14/75°C	#14/75°C		#10/75°C	#10/75°C	#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.

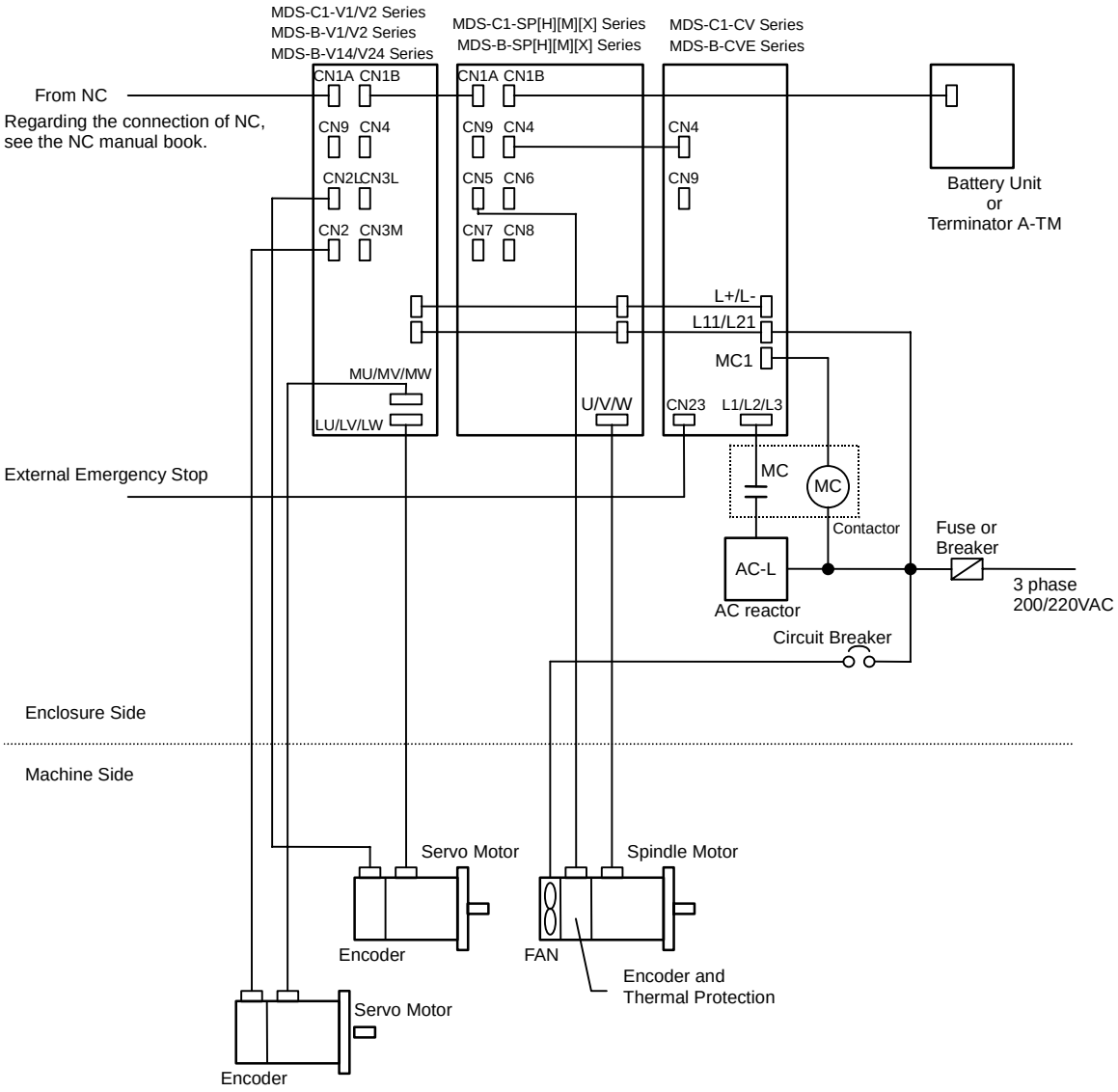
4.8 Spindle Drive / Motor Combinations

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	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	

Note1: [] can be H, M, X, HX, MX or none.
Note2: 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



Appendix 10. Compliance with China Compulsory Product Certification (CCC Certification) System

Appendix 10-1 Outline of China Compulsory Product Certification System

The Safety Certification enforced in China included the "CCIB Certification (certification system based on the "Law of the People's Republic of China on Import and Export Commodity Inspection" and "Regulations on Implementation of the Import Commodities Subject to the Safety and Quality Licensing System" enforced by the State Administration of Import and Export Commodity Inspection (SACI) on import/export commodities, and the "CCEE Certification" (certification system based on "Product Quality Certification Management Ordinance" set forth by the China Commission for Conformity Certification of Electrical Equipment (CCEE) on commodities distributed through China.
CCIB Certification and CCEE Certification were merged when China joined WTO (November 2001), and were replaced by the "China Compulsory Product Certification" (hereinafter, CCC Certification) monitored by the State General Administration of Quality Supervision, Inspection and Quarantine (AQSIQ) of the People's Republic of China.
The CCC Certification system was partially enforced from May 2002, and was fully enforced from May 2003. Target commodities which do not have CCC Certification cannot be imported to China or sold in China. (Indication of the CCIB or CCEE mark has been eliminated from May 1, 2003.)

CCIB : China Commodity Inspection Bureau
CCEE: China Commission for Conformity Certification of Electrical Equipment
CCC : China Compulsory Certification

Appendix 10-2 First Catalogue of Products subject to Compulsory Product Certification

The First Catalogue of Products subject to Compulsory Product Certification, covering 132 items (19 categories) based on the CCIB products (104 items), CCEE products (107 items) and CEMC products (Compulsory EMC Certification products) was designated on December 3, 2001.

Class	Product catalogue	
1	Electric Wires and Cables (5 items)	
2	Switches, Installation protective and connection devices (6 items)	
3	Low-voltage Electrical Apparatus (9 items)	Compulsory Certification Regulations
	Circuit-breakers (including RCCB, RCBO, MCB)	CNCA -01C -011: 2001 (Switch and Control Equipment) CNCA -01C -012: 2001 (Installation Protective Equipment)
	Low-voltage switchers (disconnectors, switch-disconnectors, and fuse-combination devices.	
	Other protective equipment for circuits (Current limiting devices, circuits protective devices, over current protective devices, thermal protectors, over load relays, low-voltage electromechanical contactors and motor starters)	
	Relays (36V < Voltage ≤ 1000V)	
	Other switches (Switches for appliances, vacuum switches, pressure switches, proximity switches, foot switches, thermal sensitive switches, hydraulic switches, push-button switches, position limit switches, micro-gap switches, temperature sensitive switches, travel switches, change-over switches, auto-change-over switches, knife switches)	
	Other devices (contactors, motor starters, indicator lights, auxiliary contact assemblies, master controllers, A.C. Semiconductor motor controllers and starters)	
	Earth leakage protectors	
	Fuses	
	Low-voltage switchgear	CNCA-01C-010:2001 (Low-voltage switchgear)
4 **(Note)**	Small power motors (1 item)	CNCA-01C-013:2001 (Small power motors)

Class	Product catalogue	
5	Electric tools	(16 items)
6	Welding machines	(15 items)
7	Household and similar electrical appliances	(18 items)
8	Audio and video equipment	(16 items)
9	Information technology equipment	(12 items)
10	Lighting apparatus	(2 items)
11	Telecommunication terminal equipment	(9 items)
12	Motor vehicles and Safety Parts	(4 items)
13	Tyres	(4 items)
14	Safety Glasses	(3 items)
15	Agricultural Machinery	(1 item)
16	Latex Products	(1 item)
17	Medical Devices	(7 items)
18	Fire Fighting Equipment	(3 items)
19	Detectors for Intruder Alarm Systems	(1 item)

(Note) When the servomotor or the spindle motor of which output is 1.1kW or less (at 1500 r/min) is used, NC could have been considered as a small power motor. However, CQC (China Quality Certification Center) judged it is not.

Appendix 10-3 Precautions for Shipping Products

As indicated in Appendix 10-2, NC products are not included in the First Catalogue of Products subject to Compulsory Product Certification. However, the Customs Officer in China may judge that the product is subject to CCC Certification just based on the HS Code.[Note 2]
NC cannot be imported if its HS code is used for the product subject to CCC Certification. Thus, the importer must apply for a "Certification of Exemption" with CNCA.[Note 3] Refer to Appendix 10-4. Application for Exemption for details on applying for an exemption.

(Note 1) The First Catalogue of Products subject to Compulsory Product Certification (Target HS Codes) can be confirmed at http://www.cqc.com.cn/Center/html/60gonggao.htm.

(Note 2) HS Code: Internationally unified code (up to 6 digits) assigned to each product and used for customs.

(Note 3) CNCA: Certification and Accreditation Administration of People's Republic of China (Management and monitoring of certification duties)

Appendix 10-4 Application for Exemption

Following "Announcement 8" issued by the Certification and Accreditation Administration of the People's Republic of China (CNCA) in May 2002, a range of products for which application for CCC Certification is not required or which are exempt from CCC marking has been approved for special circumstances in production, export and management activities.
An application must be submitted together with materials which prove that the corresponding product complies with the exemption conditions. Upon approval, a "Certification of Exemption" shall be issued.

<Range of products for which application is exempt>

Range of products not requiring application	(a) Items brought into China for the personal use by the foreign embassies, consulates, business agencies and visitors (Excluding products purchased from Service Company for Exporters) (b) Products presented on a government-to-government basis, presents (c) Exhibition products (products not for sale) (d) Special purpose products (e.g., for military use) Products not requiring application for CCC Certification are not required to be CCC marked or certified.
Range of products for which application is exempted	(e) Products imported or manufactured for research and development and testing purposes (f) Products shipped into China for integration into other equipment destined for 100% re-export to a destination outside of China (g) Products for 100% export according to a foreign trade contract (Excluding when selling partially in China or re-importing into China for sales) (h) Components used for the evaluation of an imported product line (i) The products imported or manufactured for the service (service and repairs) to the end-user. Or the spare parts for the service (service and repairs) of discontinued products. (j) Products imported or manufactured for research and development, testing or measurements (k) Other special situations

The following documents must be prepared to apply for an exemption of the "Import Commodity Safety and Quality License" and "CCC Certification".

(1) Formal Application
   (a) Relevant introduction and description of the company.
   (b) The characteristics of the products to be exempted.
   (c) The reason for exemption and its evidence (ex. customs handbook).
   (d) The name, trademark, quantity, model and specification of the products to be exempted. (Attach a detail listing of these items for a large quantity of products. When importing materials for processing and repair equipments, submit a list of the importing materials for each month and repair equipments.)
   (e) Guarantee for the safety of the products; self-declaration to be responsible for the safety during the manufacturing and use.
   (f) To be responsible for the authenticity and legitimacy of the submitted documents. Commitment to assist CNCA to investigate on the authenticity of the documents (When CNCA finds it necessary to investigate on the authenticity of the documents.)

(2) Business license of the company (Copy)

(3) Product compliance declaration
Indicate which standard's requirements the products comply with or submit a test report (Copy is acceptable. The report can be prepared in a manufacturer's laboratory either at home or overseas.)

(4) Import license (Only if an import license is needed for this product. Copy is acceptable.)

(5) Quota certificate (Only if a quota certificate is needed for this product. Copy is acceptable.)

(6) Commercial contract (Copy is acceptable.)

(7) If one of item (4), (5) or (6) cannot be provided, alternative documents, such as bill of lading, the invoice, and other evidential documents must be submitted.

Appendix 10-5 Mitsubishi NC Product Subject to/Not Subject to CCC Certification

The state whether or not Mitsubishi NC products are subject to the CCC Certification is indicated below, based on the "First Catalogue of Products subject to Compulsory Product Certification" issued by the State General Administration of Quality Supervision, Inspection and Quarantine (AQSIQ) of the People's Republic of China and the Certification and Accreditation Administration of the People's Republic of China (CNCA) on July 1, 2002.

Model	China HS Code (Note 1)	Judgment on whether or not subject to CCC Certification
Power supply unit **Servo/spindle drive unit**	85044090 85371010	Not subject to CCC Certification
Servo/spindle	85015100 85015200	Not subject to CCC Certification
NC	–	Not subject to CCC Certification
Display unit	–	Not subject to CCC Certification

(Note 1) The China HS Code is determined by the customs officer when importing to China. The above HS Codes are set based on the HS Codes used normally when exporting from Japan.

(Note 2) Reference IEC Standards are used as the actual IEC Standards may not match the GB Standards in part depending on the model.

Whether or not the NC products are subject to CCC Certification was judged based on the following five items.

(a) Announcement 33 (Issued by AQSIQ and CNCA in December 2001)
(b) HS Codes for the products subject to CCC Certification (Export Customs Codes)
  * HS Codes are supplementary materials used to determine the applicable range. The applicable range may not be determined only by these HS Codes.
(c) GB Standards (This is based on the IEC Conformity, so check the IEC. Note that some parts are deviated.)
(d) Enforcement regulations, and products specified in applicable range of applicable standards within
(e) "Products Excluded from Compulsory Certification Catalogue" (Issued by CNCA, November 2003)

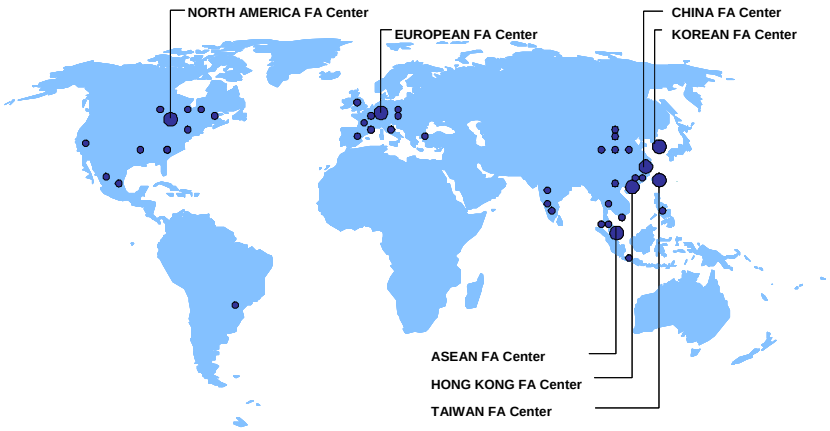
Reference

- Outline of China's New Certification System (CCC Mark for Electric Products), Japan Electrical Manufacturers' Association
- Outline of China's New Certification System (CCC Mark for Electric Products) and Electric Control Equipment, Nippon Electric Control Equipment Industries Association

Revision History

Date of revision	Manual No.	Revision details
May 2004	BNP-C3040B	First edition created.
Dec. 2004	BNP-C3040D	• C axis detector (OSE90K) was added. • C axis detector (MBE90K) was added. • C axis detector (MHE90K) was added. • Connector for motor brake: CNU20S(AWG14) was added. • C axis detector (OSE90K,MBE90K,MHE90K,OSE90K with 1024p output) cable was added. • Power cables and connector sets for MDS-B-PJEX unit were added. • Specifications for surge absorber selection was changed. • Cable for external emergency stop was added. • Selection of cable was added. • Appendix 9 "Compliance with China Compulsory Product Certification (CCC Certification) System" was added. • Miswrite is corrected.
Sep. 2004	BNP-C3040E	• DC connection bar specifications were added. • Drive unit specifications list was revised. • Selection of wire was revised. • Protection fuse specifications were added. • The section "EC Declaration of conformity" was added. • Miswrite is corrected.

Global service network



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Notice

Every effort has been made to keep up with software and hardware revisions in the contents described in this manual. However, please understand that in some unavoidable cases simultaneous revision is not possible.
Please contact your Mitsubishi Electric dealer with any questions or comments regarding the use of this product.

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MODEL	MDS-C1 Series
MODEL CODE	008—305
Manual No.	BNP-C3040E(ENG)

(0509) MEE