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MITSUBISHI CNC

MELDAS AC SPINDLE
MDS-A-SPJA Series

M64020-ES

SPECIFICATIONS AND MAINTENANCE MANUAL

MELDAS

ADVANCED AND EVER ADVANCING
MITSUBISHI ELECTRIC

Thank you for purchasing the Mitsubishi AC spindle drive unit. This manual describes the handling and precautions for using this unit. Incorrect handling may lead to unforeseen accidents, so always read this manual thoroughly to ensure correct usage.
Make sure that this manual is delivered to the end user. Always store this manual for future reference.
All specifications of the MDS-A-SPJA Series are listed in this manual. However, each CNC does not always apply to the specifications, so confirm the CNC specifications before using the unit.

Precautions for reading this Specifications and Maintenance Manual

(1) This manual gives a general explanation for the spindle system. Refer to the manuals issued by the machine maker for the specifications of each machine tool.
The "restrictions" and "available functions" described in the manuals issued by the machine maker has precedence to those in this manual.

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

Precautions for Safety

Please read this manual and enclosed documents before starting installation, operation, maintenance or inspection to ensure correct usage. Thoroughly understand the device, safety information and precautions before starting operation. After reading, always store this manual where it can be accessed easily.
The safety precautions are ranked as "WARNING" and "CAUTION" in this instruction manual.

⚠ WARNING	When a dangerous situation may occur if handling is mistaken leading to fatal or major injuries.
⚠ 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.

Changes in terminal names

The following terminal names have been changed from production starting April 1995.

- R → R/L1
- S → S/L2
- T → T/L3
- G → G/⏚

For Safe Use

1. Electric shock prevention

⚠ WARNING

- ⚠ 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 turn the power ON while the front cover is removed. The high voltage terminals and charged sections will be exposed, and could lead to electric shocks.
- ⚠ Do not remove the front cover even when the power is turned OFF unless performing wiring or periodic inspections. The inside of the spindle drive is charged, and could lead to electric shocks.
- ⚠ Wait at least 10 minutes after turning the power OFF before starting wiring or inspections. Failure to observe this could lead to electric shocks.
- ⚠ Ground the spindle drive unit and spindle motor with Class 3 grounding or higher.
- ⚠ Wiring must always be carried out by a qualified technician.
- ⚠ Wire the spindle drive unit and spindle motor 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 or engage the cable. Failure to observe this could lead to electric shocks.

2. Fire prevention

⚠ CAUTION

- ⚠ Install the spindle drive unit, spindle motor 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 spindle unit side if a fault occurs in the spindle drive unit. Fires could be caused if a large current continues to flow.
- ⚠ Shut off the power with an error signal when using the regenerative resistor. The regenerative resistor could abnormally overheat and cause a fire due to a fault in the regenerative transistor, etc.

3. Injury prevention

⚠ CAUTION

- ⚠ Do not apply a voltage other than that specified in the Specifications or 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 DC voltage polarity (+, –). Failure to observe this item could lead to ruptures or damage, etc.
- ⚠ Do not touch the spindle drive unit fins, regenerative resistor or spindle motor, etc., while the power is turned ON or immediately after turning the power OFF. Some parts are heated to high temperatures, and touching these could lead to burns.

4. Various precautions

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

(1) Transportation and installation

⚠ CAUTION

⚠ Correctly transport the product according to its weight.
❗ Use the suspension bolts on the spindle motor only to transport the spindle motor. Do not transport the spindle motor when it is installed on the machine.
⚠ Do not stack the spindle motor or spindle amplifiers above the tolerable number.
⚠ Do not hold the cables, axis, detector or PCBs when transporting the spindle motor.
⚠ Do not hold the connected wires or cables when transporting the spindle drive unit.
⚠ Do not hold the front cover when transporting the spindle drive unit. The unit could drop.
⚠ Follow the Instruction Manual and install the unit in a place where the weight can be borne.
⚠ Do not get on top of or place heavy objects on the product. Always observe the installation direction.
⚠ Secure the specified space between the spindle drive unit and inside wall of the control panel, and between other devices.
⚠ Do not install or operate a spindle drive unit or spindle motor that is damaged or missing parts.

⚠ CAUTION

⚠ Do not block the suction and ventilation ports of the spindle motor with cooling fan.
⚠ Do not let conductive objects such as screws or metal chips, etc., or combustible materials such as oil enter the spindle drive unit or spindle motor.
⚠ The spindle drive unit and spindle motor are precision devices, so do not drop them or apply strong impacts to them.
⚠ Store and use the units under the following environment conditions.

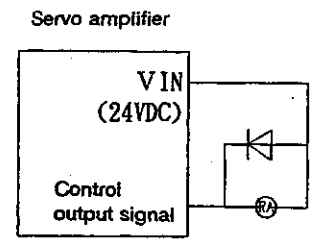
Environment	Conditions	
	Spindle drive unit	Spindle motor
Ambient temperature	0°C to +55°C (with no freezing)	0°C to +40°C (with no freezing)
Ambient humidity	45 to 90%RH (with no freezing)	80%RH or less (with no dew condensation)
Storage temperature	−20°C to +65°C	−15°C to +70°C
Storage humidity	45 to 90%RH (with no dew condensation)	90%RH or less (with no dew condensation)
Atmosphere	Indoors (Where unit is not subject to direct sunlight) With no corrosive gas, combustible gas, oil mist or dust	
Altitude	1000m or less above sea level	
Vibration	0.6GIZ or less	

⚠ Securely fix the spindle motor to the machine. The spindle motor could come off during operation if insecurely fixed.
⚠ Always install a cover, etc., over the shaft so that the rotary sections of the spindle motor cannot be touched during spindle motor rotation.
⚠ When using a coupling connection to the spindle motor shaft, do not apply an impact by hammering, etc. The detector could be damaged.
⚠ Do not apply a load exceeding the tolerable load onto the spindle motor shaft. The shaft could be damaged.
❗ When storing the product for a long time, please contact the Mitsubishi Service Station or Service Center.

(2) Wiring

⚠ CAUTION

⚠ Correctly and securely perform the wiring. Failure to do so could lead to runaway of the spindle motor.
⚠ Do not install a phase advancing capacity, surge absorber or radio noise filter on the output side of the spindle drive unit.
⚠ Correctly connect the output side (terminals U, V, W). Failure to do so could lead to abnormal operation of the spindle motor.
⚠ Do not directly connect a commercial power supply to the spindle motor. Doing so could lead to faults.
⚠ When using an inductive load such as a relay on the control output signals, always connect a diode as a noise measure parallel to that load.



⚠ When using a capacitance load such as a lamp, always connect a protective resistor serial to that load to limit the rush current.
⚠ When connecting a control output signal DC relay, do not mistake the direction of the diode for surge absorption. An incorrect direction could cause the signals not to be output due to a fault, or could impair the protective circuit operation during an emergency stop, etc.
⚠ Do not connect/disconnect the cables connected to the connectors or terminals 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 use of a shielded cable is instructed in the connection diagrams for the signal wire connected to the servo amplifier, always use a shielded wire. Always connect the shield to the connector clamp fitting.
⚠ Always separate the signals wires connected to the spindle motor and spindle amplifier 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.
⚠ Fix the cables connected to each servo amplifier connector on part of the control panel so that they are not pulled forward or up and down.
⚠ Do not use junctions for the speed detector or position detector cables. Doing so could lead to vibration, abnormal noise and position deviation.

(3) Trial operation and adjustment

⚠ WARNING

⚠ When adjusting the unit with a personal computer, note that there are parameters that will be validated immediately when the setting is changed. Take special care when rotating the spindle while adjusting, and make sure not to put body parts near the spindle. Failure to observe this could lead to personal injuries.
⚠ When monitoring the status of the spindle or spindle motor with a personal computer, note that if the max. spindle motor speed setting is 32,000rpm or higher, the spindle motor speed displayed on the personal computer will be half of the actual speed. Failure to observe this could lead to damage of the spindle.

⚠ CAUTION

⚠ Check each 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

⚠ CAUTION

- ❶ Install an external emergency stop circuit so that the operation can be stopped immediately and the power can be shut off.
- ⚠ Turn the power OFF immediately if smoke, abnormal noise or odors are generated from the spindle motor or spindle amplifier.
- Ⓟ Unqualified persons must not disassemble or repair the unit.
- ⚠ Never make modifications.
- ⚠ Connect a noise filter, etc., into the power lead in line of the spindle amplifier to eliminate magnetic damage. The electronic devices used near the spindle amplifier could be affected by magnetic noise.
- ⚠ Use the spindle motor, spindle amplifier and regenerative resistor with the designated combination. Failure to do so could lead to fires or trouble.
- ⚠ After changing the parameters or after maintenance and inspection, always test the operation before starting actual 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 power failure time, etc.).
- ⚠ Install a surge killer on the coils such as the solenoid valves and contactors used near the servo amplifier as noise prevention. Failure to do so could lead to malfunctioning.

(5) Troubleshooting

⚠ CAUTION

- ⚠ If a hazardous situation is predicted during power failure or product trouble, install an external brake mechanism.
- ⚠ Always turn the power OFF when an alarm occurs.
- ⚠ Never go near the machine after restoring the power after a 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

⚠ CAUTION

- ⚠ Always backup the spindle amplifier parameters before starting maintenance or inspections.
- ⚠ The capacity of the electrolytic capacitor will drop due to deterioration. To prevent secondary damage due to faults, replace the capacitor every five years when using under a general environment. Consult the Service Station or Service Center for replacements.
- ⚠ Do not perform a megger test (insulation resistance measurement) on the spindle amplifier during inspections.

(7) Disposal

⚠ CAUTION

- ⚠ Treat this unit as general industrial waste. If the heat radiating fins are protruding from the rear of the spindle amplifier, substitute Fleon is used. Do not dispose of this type of unit as general industrial waste. Always contact the Service Station or Service Center for disposal.
- Ⓟ Do not disassemble the spindle motor or spindle amplifier.

(8) General precautions

⚠ CAUTION
The drawings given in this Specifications and Maintenance 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 turning the spindle motor or spindle amplifier power ON, and always follow the instructions given in this manual.

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1. Outline

1.1 Features for MDS-A-SPJA Series

(1) The unit has been downsized and reduced in weight with the incorporation of a high speed, high integration LSI, high speed DSP and IPM (Intelligent Power Module).

(2) The speed response has been improved with the high speed DSP, improving the cutting capacity and improving the cutting precision during positioning control.

(3) A smooth operation and short time orientation time have been realized by incorporating the high speed orientation method that enables direct orientation from high speeds.

(4) All spindle parameters can be set from the personal computer screen making operation easier.

1.2 Precautions for use

(1) The motor rated output is guaranteed at the drive unit rated input (AC200/220/230V). If the input voltage fluctuates and drops below this, the rated output may not be reached.

(2) A PWM controlled high harmonics chopper voltage is applied on the motor, so a high harmonic leakage current will flow during motor operation.
If a general purpose leakage breaker is used, it may malfunction due to the high harmonics. Always use a leakage breaker for inverter purposes.

(3) The above high harmonics leakage current will also flow in the grounding wire between the motor and controller. If this grounding wire is placed near the NC CRT screen, the CRT screen may malfunction due to the magnetic field of the leakage current. Keep the grounding wire and CRT screen as far away as possible.

(4) Noise could be a problem particularly to AM radio broadcasts due to the magnetic radio wave noise radiated from the motor and controller.
Keep radios as far away from the motor and controller as possible.
A filter for radio noise measures is prepared as an option, so use it as necessary.

1.3 Type configuration

Motor

<Without fan>

SJ-P | 0.2 | A — 10 minute rated output capacity (0.2 to 3.7kW)

AC spindle motor series name

<With fan>

SJ-PF | 2.2 | –01 — 15 minute or 30 minute rated output capacity (2.2 to 7.5kW)

Electrical specifications serial No.

AC spindle motor series name

Drive unit

MDS-A-SPJA | □ | – | □ | □

S-analog AC spindle drive unit name

Specifications 1
None: Standard specifications
S : Special specifications

Output capacity

Option specifications
None: No options
R : Orientation function
D : Digital speed command function
T : S-analog high-speed tapping function
RD : Orientation function + digital speed command function
RT : Orientation function + S-analog high-speed tapping function

① 0.1kW or more and less than 1kW

0 □ □

□ ----0.01kW is 1 (A blank is set for 0)

□ --------0.1kW is 1

(Example) When 0.2kW → 02
When 0.75kW → 075

② 1kW or more
0.1kW is 1

(Example) When 7.5kW → 75

Note) The unit outline shape (including installation) and connection methods, etc., are all the same regardless of the specifications 1 or option specifications.

1.4 Basic functions, auxiliary functions and option functions

	Function			MDS-A-SPJA ** – ** Option symbol					
				None	R	D	T	RD	RT
Basic functions	S-analog command voltage input ±10V			O	O	O	O	O	O
	S-analog command voltage input 0 to +10V			O	O	O	O	O	O
	Machine ready input			O	O	O	O	O	O
	Forward run/reverse run command input			O	O	O	O	O	O
Auxiliary functions	Torque limit 1 to 3 input			□	□	□	□	□	□
	Gear selection 1, 2 input			□	□	□	□	□	□
	Alarm reset input			□	□	□	□	□	□
	Emergency stop input			□	□	□	□	□	□
	Speed selection 1 to 3 input			□	□	□	□	□	□
	Forward run/reverse run indexing input			—	□	—	—	□	□
	Multi-point orientation position command input			—	□	—	—	□	□
	Digital speed command input			—	—	□	—	□	—
	S-analog high-speed tapping input			—	—	—	□	—	□
	Speed meter output			O	O	O	O	O	O
	Load meter output			O	O	O	O	O	O
	Spindle fault output signal (relay contact output)			O	O	O	O	O	O
	Pulse feedback output signal			O	O	O	O	O	O
	Zero speed output signal			O	O	O	O	O	O
	Speed reached output signal			O	O	O	O	O	O
	Speed detection output signal			Δ	Δ	Δ	Δ	Δ	Δ
	Torque reached output signal			Δ	Δ	Δ	Δ	Δ	Δ
	In torque limit output signal			Δ	Δ	Δ	Δ	Δ	Δ
	In motor forward run/reverse run output signal			Δ	Δ	Δ	Δ	Δ	Δ
	In alarm output signal			Δ	Δ	Δ	Δ	Δ	Δ
	In emergency stop output signal			Δ	Δ	Δ	Δ	Δ	Δ
	In ready ON output signal			Δ	Δ	Δ	Δ	Δ	Δ
	Current detection output signal			Δ	Δ	Δ	Δ	Δ	Δ
	In multi-point orientation position command output signal			—	Δ	—	—	Δ	Δ
	Orientation complete output signal			—	Δ	—	—	Δ	Δ
	Positioning complete output signal			—	Δ	—	—	Δ	Δ
Option function	Orientation	Encoder orientation (multi-point, indexing)		—	O	—	—	O	O
		Motor built-in encoder orientation (multi-point, indexing)		—	O	—	—	O	O
	Digital speed command	12-bit binary		—	—	O	—	O	—
		Coded pure binary		—	—	O	—	O	—
		BCD 3 digits		—	—	O	—	O	—
		BCD 2 digits		—	—	O	—	O	—
	S-analog high-speed tapping	1024p/rev encoder specifications	Only for encoder orientation	—	—	—	—	—	O
		Motor built-in encoder specifications	① Motor built-in encoder orientation	—	—	—	—	—	O
			② No orientation	—	—	—	O	—	O

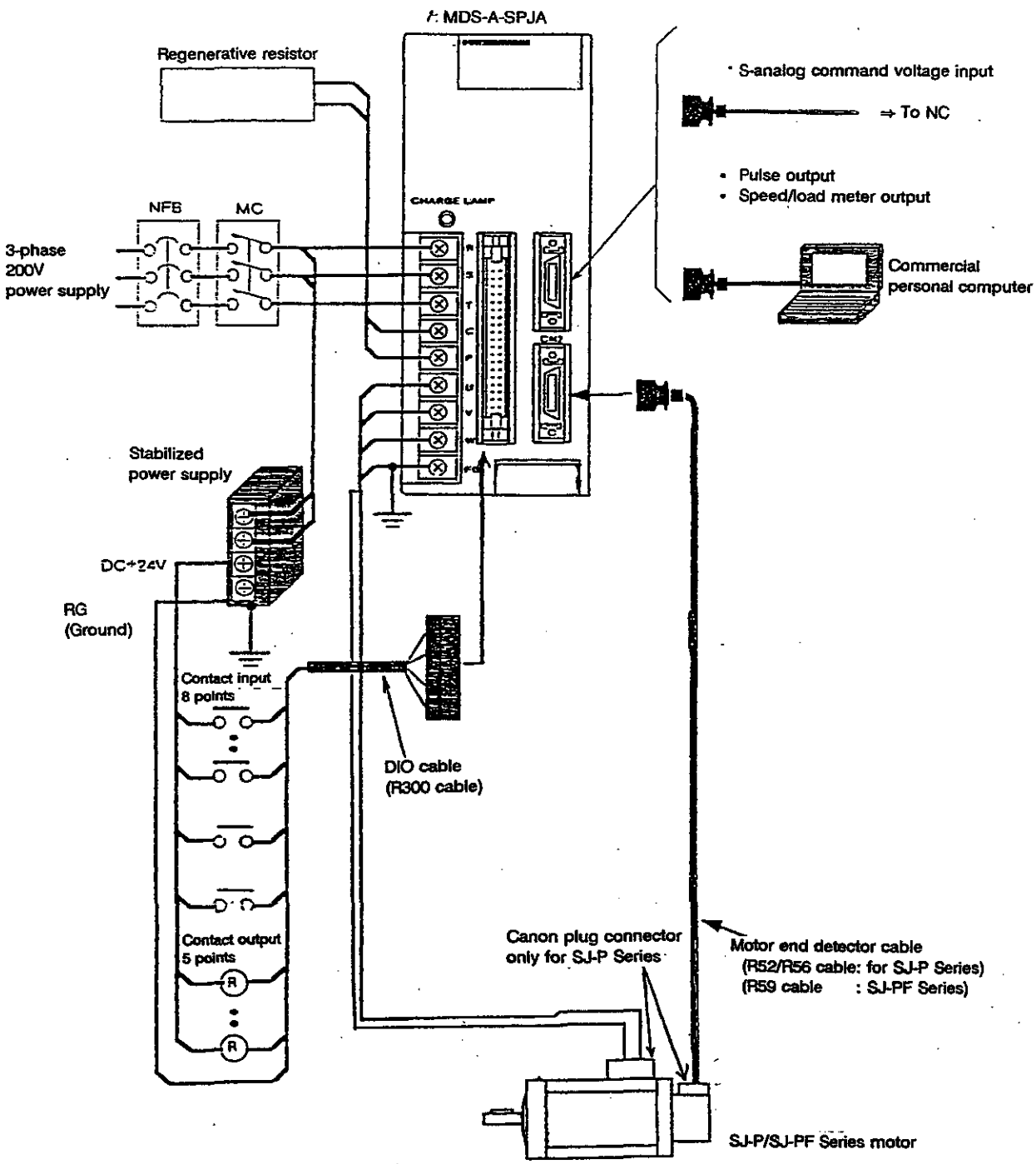
Note 1) O indicates standard functions. □ indicates auxiliary input functions (selective). Δ indicates auxiliary output functions (selective).

Note 2) Up to five input points can be selected from the auxiliary inputs (□ marked functions) in addition to the O marked functions. (Open emitter or open collector)

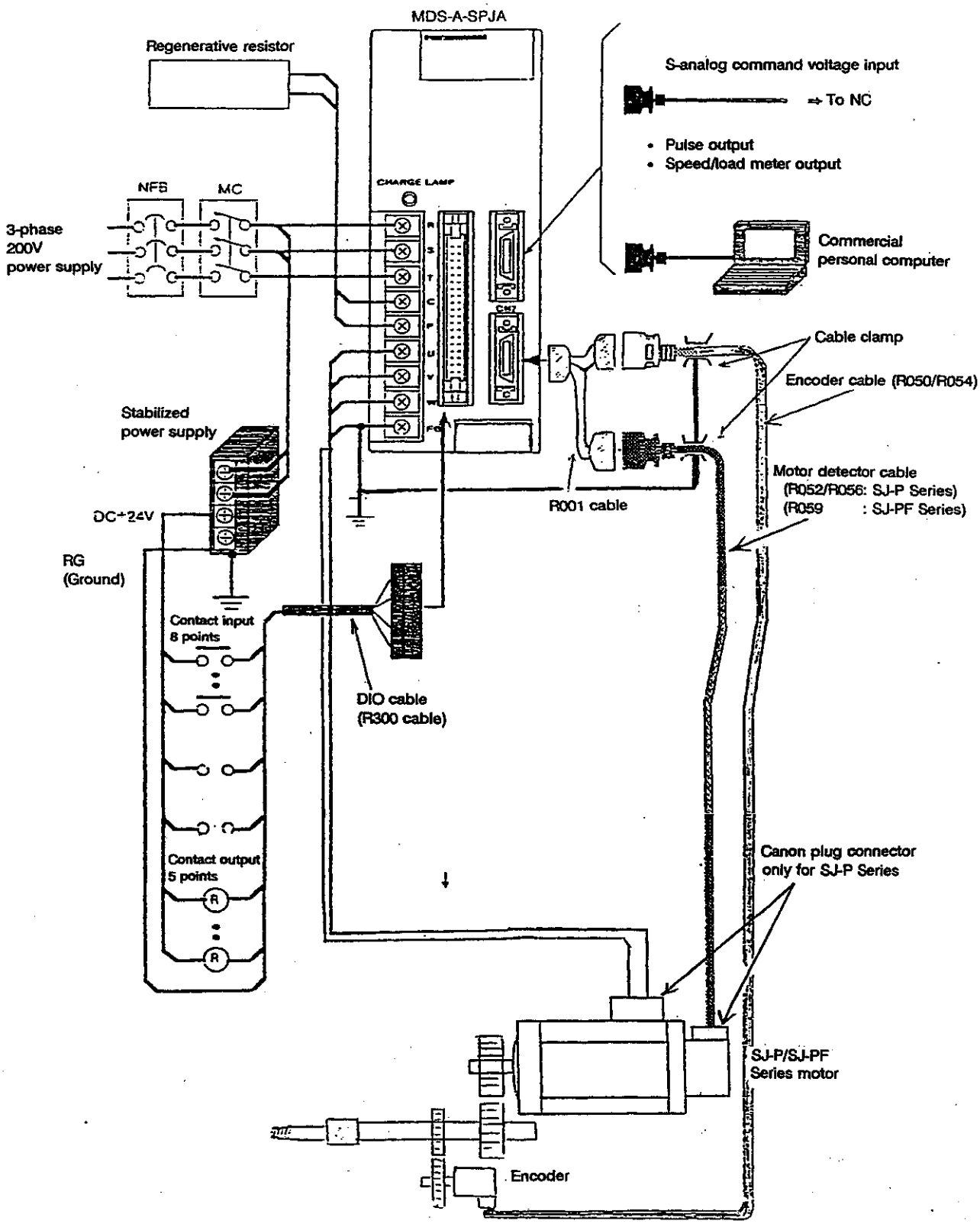
Note 3) Up to three input points can be selected from the auxiliary outputs (Δ marked functions) in addition to the O marked functions. (Open emitter or open collector)

1.5 Configuration

1.5.1 Basic configuration (Semi-closed)



1.5.2 Basic configuration (full closed)



2. Specifications

2.1 AC spindle motor and drive unit specifications

Motor series				SJ-P Series					
Specifications		Spindle motor model		SJ-P0.2	SJ-P0.4	SJ-P0.75	SJ-P1.5	SJ-P2.2	SJ-P3.7
		Spindle drive unit model		MDS-A-SPJA-02	MDS-A-SPJA-04	MDS-A-SPJA-075	MDS-A-SPJA-15	MDS-A-SPJA-22	MDS-A-SPJA-37
Spindle motor	Continuous characteristics (Note 1)	Rated output	(kW)	0.1	0.15	0.3	0.55	1.1	1.5
		Rated torque	(Nm)	0.64	0.96	1.91	3.5	7.0	9.55
			(kgf-cm)	6.5	9.8	19.5	35.7	71.4	97.4
	Short-time characteristics (10min) (Note 1)	Rated output	(kW)	0.2	0.4	0.75	1.5	2.2	3.7
		Rated torque	(Nm)	1.27	2.55	4.77	9.55	14.0	23.5
			(kgf-cm)	13	26	48.7	97.4	143	240
	Rated speed		(r/min)	1500					
	Max. speed		(r/min)	10000				8000	
	Tolerable speed		(r/min)	10000					
	Max. torque		(Nm)	1.54	3.07	5.73	11.4	16.8	28.2
			(kg-cm)	15.6	31.4	58.5	117	171	288
	Max. current		(A)	2.5	5.0	6.5	11	14	23
	Power rate		(kW/sec)	2.8	3.0	4.0	5.8	7.5	9.1
	Moment of inertia	J	($kg\cdot cm^2$)	1.5	3.0	9.0	21	65	100
		GD	($kgf\cdot cm^2$)	6.0	12	36	84	260	400
	Speed position encoder			Incremental encoder resolution 4096p/rev					
	Accessories			Thermal protector and oil seal provided					
	Structure			Fully enclosed self-cooling (IP54) Flange installation					
	Ambient temperature			0°C to 40°C					
	Weight		(kg)	4.5	6.5	10	20	25	35
Spindle drive unit	Power supply (Note 2)	Voltage, frequency		3-phase AC200V to 230V 50/60Hz					
		Tolerable voltage fluctuation		170V to 253V 50/60Hz					
		Tolerable frequency fluctuation		Within ±5%					
		Power facility capacity		0.5	1.0	2.0	3.0	4.0	7.0
	Control method			Sinusoidal PWM control, current control type vector control method					
	Braking method			Regenerative control (resistance electrical-discharge)					
	Speed control range			35 to 10000 (r/min)					
	Tolerable load moment of inertia			10-times or less of motor moment of inertia					
	Controller connection specifications			S-analog command ±10Vmax					
	Protective functions			Overcurrent shut off, overvoltage shut off, overload shut off (thermal relay), undervoltage protection, main circuit element overheat protection, regenerative resistor overheat protection, overspeed protection, excessive error protection, detector error protection					
	Environment	Ambient temperature		0°C to 55°C (with no freezing) Storage -20°C to 65°C					
		Ambient humidity		90%RH (with no dew condensation)					
		Atmosphere		No corrosive gases or dust					
		Altitude		1000m or less					
		Vibration		5.9m/S^2 (0.6G) or less					
	Outline dimensions	HxWxD	(mm)	168 x 90 x 200					
	Weight		(kg)	1.8			2.3		

Note 1) The rated output is guaranteed at the rated input voltage (AC200 to 230V). If the input voltage fluctuates and drops below this value, the rated output may not be achieved.

Note 2) When using a voltage not within the above specifications, prepare a power supply transformer.

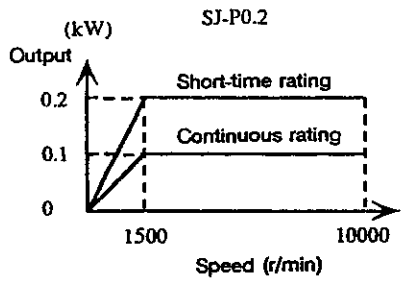
Motor series			SJ-PF Series			
Specifications		Spindle motor model	SJ-PF2.2-01	SJ-PF3.7-01	SJ-PF5.5-02	SJ-PF7.5-01
		Spindle drive unit model	MDS-A-SPJA-22	MDS-A-SPJA-37	MDS-A-SPJA-55	MDS-A-SPJA-75
Spindle motor	Continuous characteristics (Note 1)	Rated output (kW)	1.5	2.2	3.7	5.5
		Rated torque (Nm)	9.55	14.0	23.5	35.0
		(kgf·cm)	97.5	143	240	357
	Short-time characteristics (10min) (Note 1)	Rated output (kW)	2.2	3.7	5.5	7.5
		Rated torque (Nm)	14.0	23.5	35.0	47.8
		(kgf·cm)	143	240	357	487
	Rated speed (r/min)		1500			
	Max. speed (r/min)		10000		8000	
	Tolerable speed (r/min)		10000		8000	
	Max. torque (Nm)		16.8	28.2	42.0	57.4
	(kg·cm)		171	283	428	584
	Max. current (A)		17	28	36	53
	Power rate (kW/sec)		14	23	40	52
	Moment of inertia	J ($kg \cdot cm^2$)	65	85	137	235
		GD ($kgf \cdot cm^2$)	260	340	550	940
	Speed position encoder		Incremental encoder resolution 4096p/rev			
	Accessories		Thermal protector provided			
	Structure		With cooling fan Leg installation/flange installation			
	Ambient temperature		0°C to 40°C			
	Weight (kg)		25	30	49	60
Spindle drive unit	Power supply (Note 2)	Voltage, frequency	3-phase AC200V to 230V 50/60Hz			
		Tolerable voltage fluctuation	170V to 253V 50/60Hz			
		Tolerable frequency fluctuation	Within ±5%			
		Power facility capacity	4.0	7.0	9.0	12.0
	Control method		Sinusoidal PWM control, current control type vector control method			
	Braking method		Regenerative control (resistance electrical-discharge)			
	Speed control range		35 to 10000 (r/min)			
	Tolerable load moment of inertia		10-times or less of motor moment of inertia			
	Controller connection specifications		S-analog command ±10Vmax			
	Protective functions		Overcurrent shut off, overvoltage shut off, overload shut off (thermal relay), undervoltage protection, main circuit element overheat protection, regenerative resistor overheat protection, overspeed protection, excessive error protection, detector error protection			
	Environment	Ambient temperature	0°C to 55°C (with no freezing) Storage -20°C to 65°C			
		Ambient humidity	90%RH (with no dew condensation)			
		Atmosphere	No corrosive gases or dust			
		Altitude	1000m or less			
		Vibration	5.9m/S^2 (0.6G) or less			
	Outline dimensions HxWxD (mm)		168 x 90 x 200		250 x 130 x 200	
	Weight (kg)		2.3		4.5	

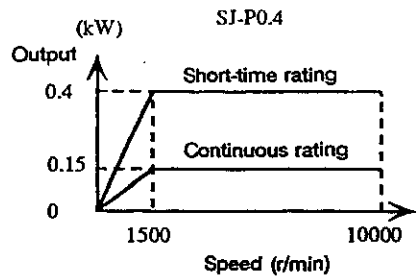
Note 1) The rated output is guaranteed at the rated input voltage (AC200 to 230V). If the input voltage fluctuates and drops below this value, the rated output may not be achieved.

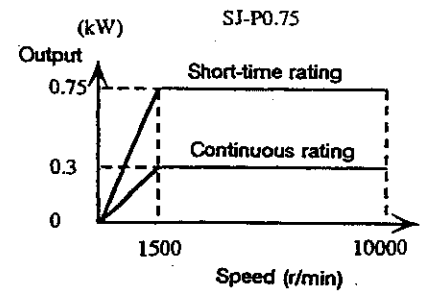
Note 2) When using a voltage not within the above specifications, prepare a power supply transformer.

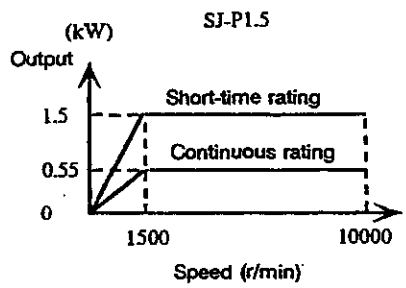
2.2 Output characteristics

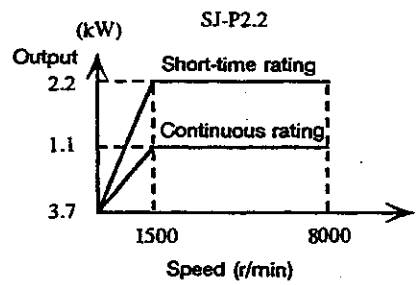
● SJ-P Series

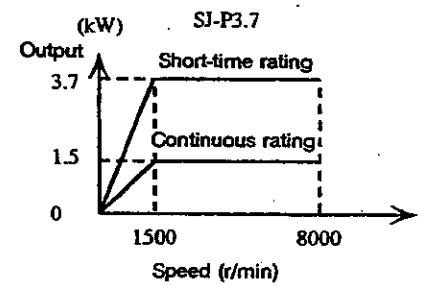




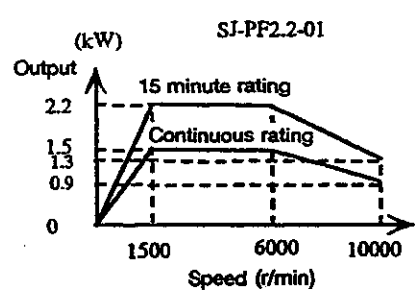


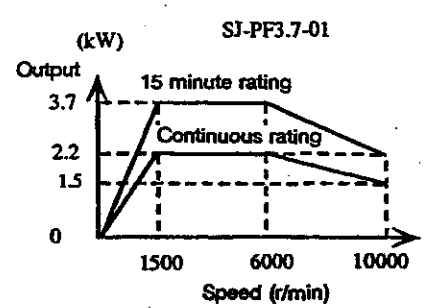


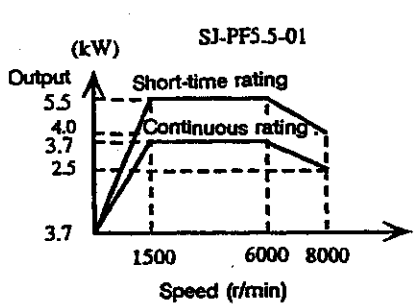


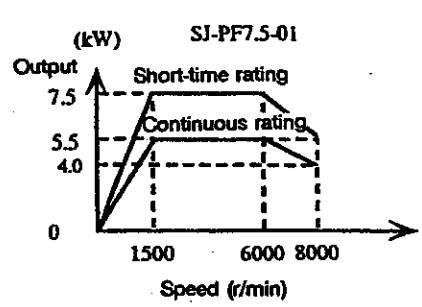


● SJ-PF Series









2.3 Tolerable acceleration/deceleration frequency characteristics

The tolerable acceleration/deceleration frequency characteristics of the controller fluctuate according to the motor speed and motor shaft conversion GD^2, so calculate the tolerable frequency with the following items. The smaller of the frequency determined by the acceleration/deceleration time according to the controller output (refer to appendix) and the frequency determined by the regenerative resistor becomes the operable frequency (tolerable duty cycle).

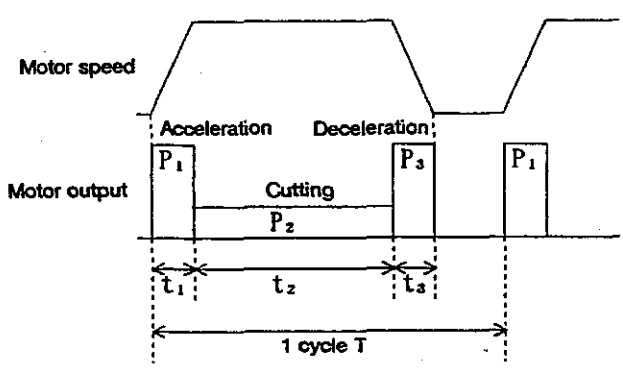
2.3.1 Frequency according to acceleration/deceleration time (tolerable duty cycle)

When machining with a frequent spindle acceleration/deceleration, the average output value per cycle must not exceed the continuous rated output.

Continuous rated output ≥ 1 cycle average output value

(1) How to obtain the average output

$$\text{Average output } P_{AV} = \sqrt{\frac{P_1^2 \cdot t_1 + P_2^2 \cdot t_2 + P_3^2 \cdot t_3}{T}}$$



P_1, P_3 : Output (kW) during acceleration/deceleration
30 minute rated output × 1.2
P2 : Output (kW) during cutting
t_1, t_3 : Acceleration/deceleration time

2.3.2 Frequency according to regenerative resistor (tolerable duty cycle)

The energy during motor deceleration (during regeneration) is consumed by the regenerative resistor. This heating value of this regenerative resistor changes according to the motor type, speed being used, load inertia and continuous repetition cycle (duty cycle).
Use a regenerative resistor with an adequate capacity according to the load and continuous cycle time.

(1) How to obtain the regenerative resistor capacity

Obtain the rotation energy with the following equation, and select so that the value does not exceed the capacity of the regenerative resistor.

Regenerative resistor capacity ≥ Motor rotation energy

Refer to section 2.3.3 for the regenerative resistor capacity.

The spindle motor rotation energy W is:

$$W = \frac{n}{120} \times \frac{(GD_M^2 + GD_L^2)}{4} \times \left[\frac{2\pi \cdot N}{60}\right]^2$$

GD_M^2 : Motor rotor inertia (kg·m^2)
GD_L^2 : Motor shaft conversion load inertia (kg·m^2)
N : Motor speed (rpm)
n : Acceleration/deceleration frequency (times/min.)

$$n = \frac{60}{T}$$ T : Tolerable duty cycle (sec)

2.3.3 Combination of regenerative resistor capacity and unit

The combinations of the regenerative resistor capacity (tolerable heating value) and the unit are shown below.

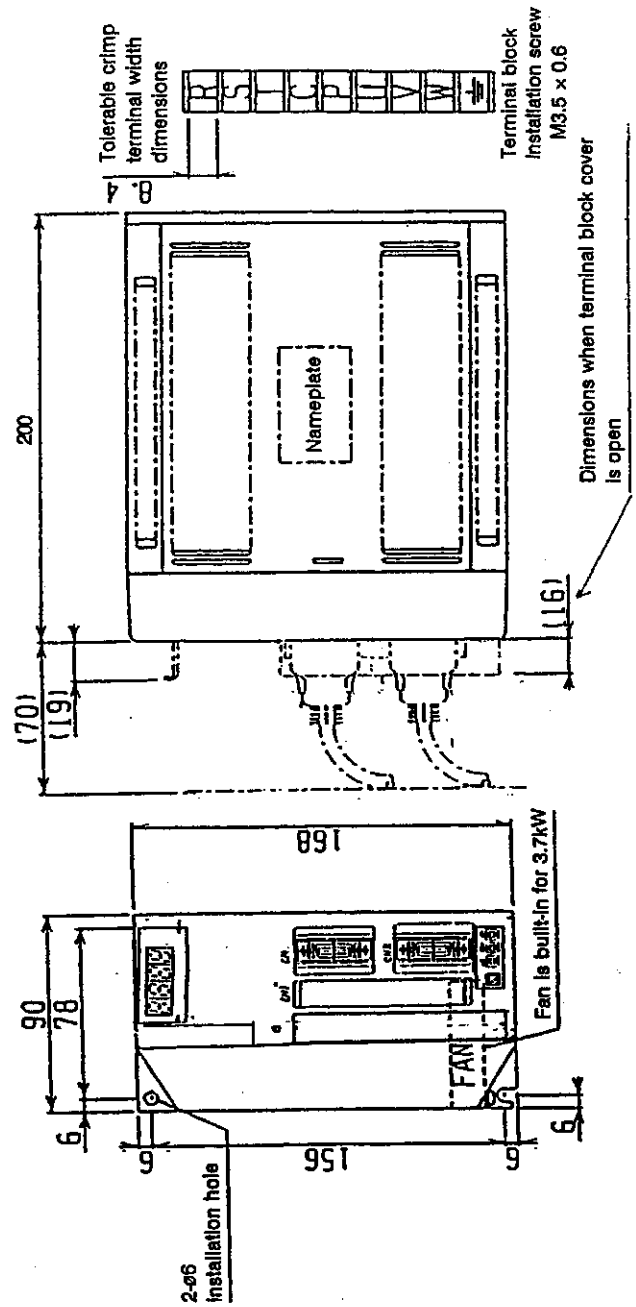
Model	Tolerable heating value	Combination with spindle drive unit (MDS-A-SPJA-□□)							
		-02	-04	-075	-15	-22	-37	-55	-75
No regenerative resistor	———								
FCUA-RB04	60W	O	O						
FCUA-RB075	80W	O	O	O					
FCUA-RB15	120W	O	O	O	O				
FCUA-RB22	155W				O	O			
FCUA-RB37	185W					O	O		
FCUA-RB55	340W						O	O	
FCUA-RB75/2 Two units in series	680W								O
R-UNIT1	700W					O	O		
R-UNIT2	700W							O	O
R-UNIT3	2100W							O	O

If repeated frequency operation exceeding the regenerative resistor capacity is carried out, and over-regeneration alarm will occur and the spindle drive unit will stop.
The over-regeneration alarm detects the cumulative value of the current that flows within a set time to the regenerative resistor. The alarm can be released just by turning the power ON again, but do not resume operation immediately.
If operation is resumed before the regenerative resistor cools, the regenerative resistor could burn out and fires could occur. Always resume operation after the regenerative resistor cools.

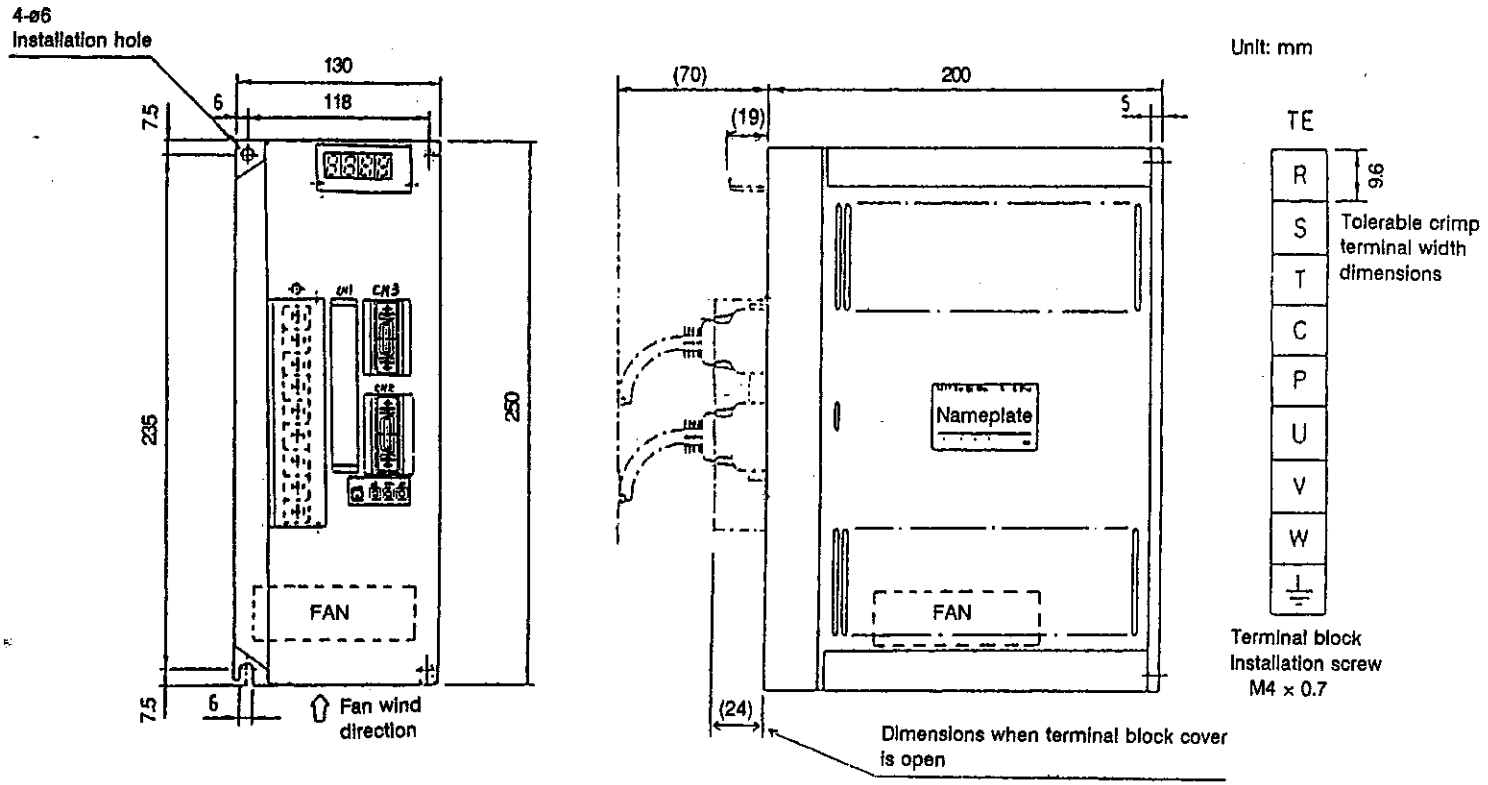
2.4 Outline dimensional drawings

2.4.1 Spindle drive unit

• MDS-A-SPJA-02/075/15/22/37 Outline dimensional drawings

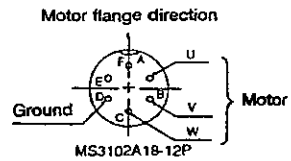


- **MDS-A-SPJA-55/75 Outline dimensional drawings**
  5.5kW, 7.5kW

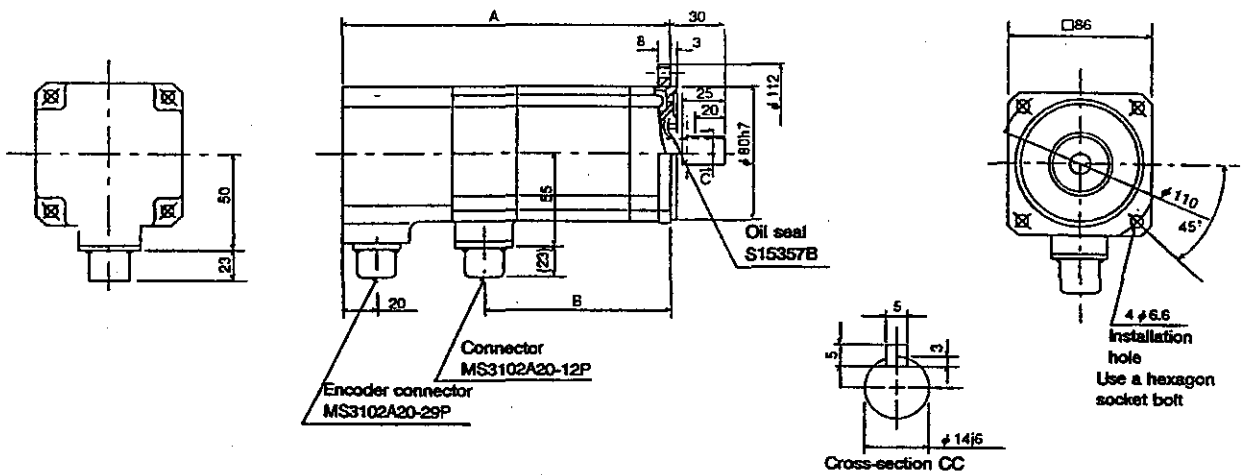


2.4.2 Spindle motor

● SJ-P0.2, SJ-P0.4



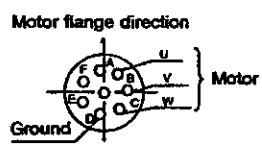
Pin symbol	Lead wires	
A	U	Motor wires
B	V	
C	W	
D	E	Ground
E	} Blank	
F		



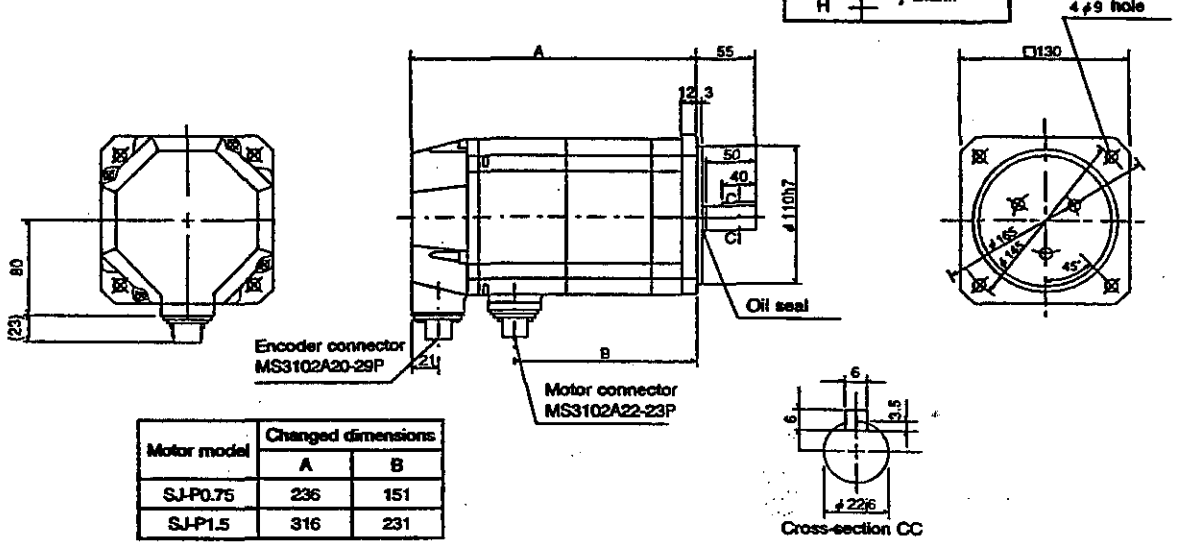
Motor model	Changed dimensions	
	A	B
SJ-P0.2	185	113
SJ-P0.4	225	153

Note 1) Install the canon connector so that it faces downwards.
Note 2) The wiring plug is option. Please order it when required.

● SJ-P0.75, SJ-P1.5

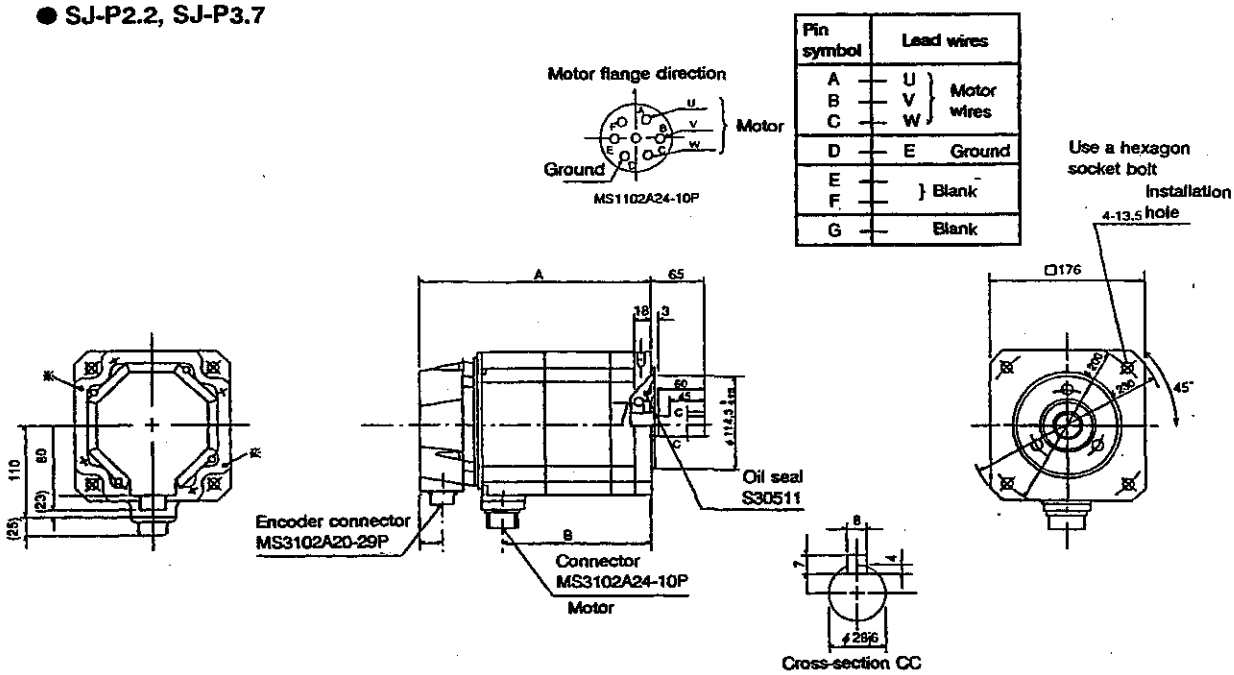


Pin symbol	Lead wires	
A	U	Motor wires
B	V	
C	W	
D	E	Ground
E	} Blank	
F		
G	} Blank	
H		



Motor model	Changed dimensions	
	A	B
SJ-P0.75	236	151
SJ-P1.5	316	231

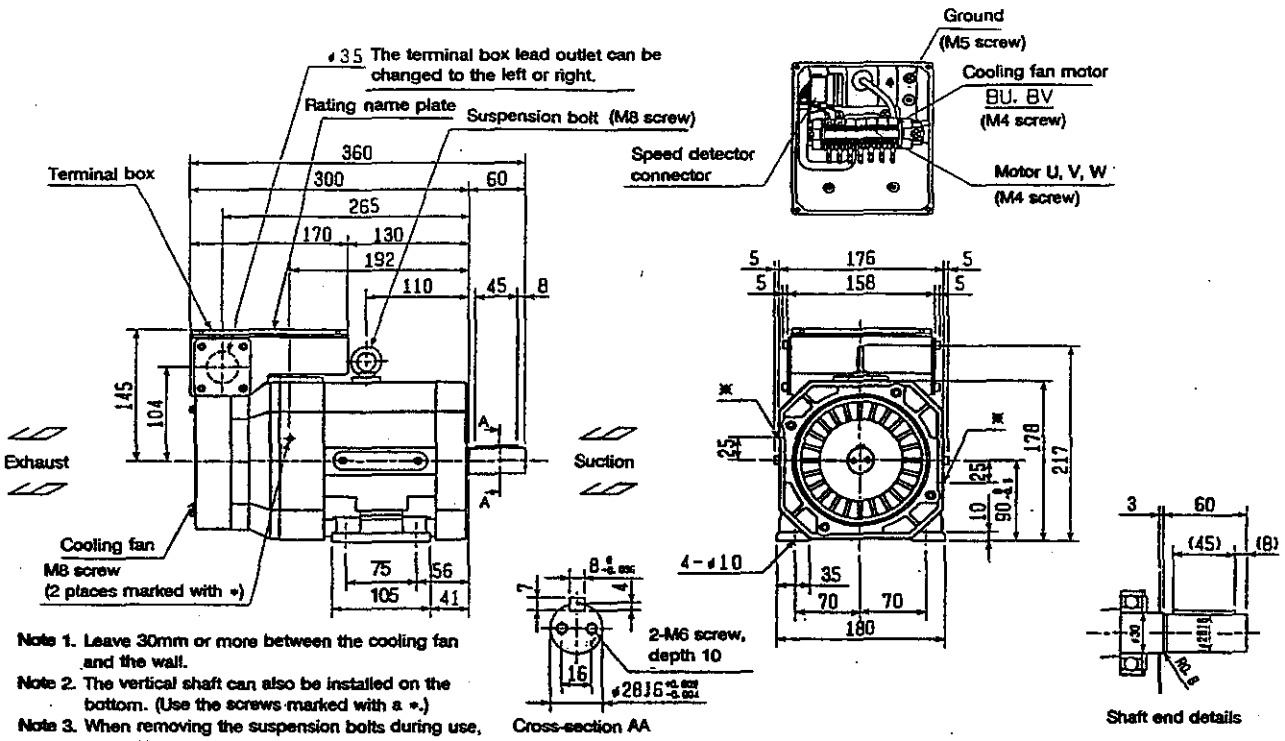
● SJ-P2.2, SJ-P3.7



Motor model	Changed dimensions	
	A	B
SJ-P2.2	293	211
SJ-P3.7	353	271

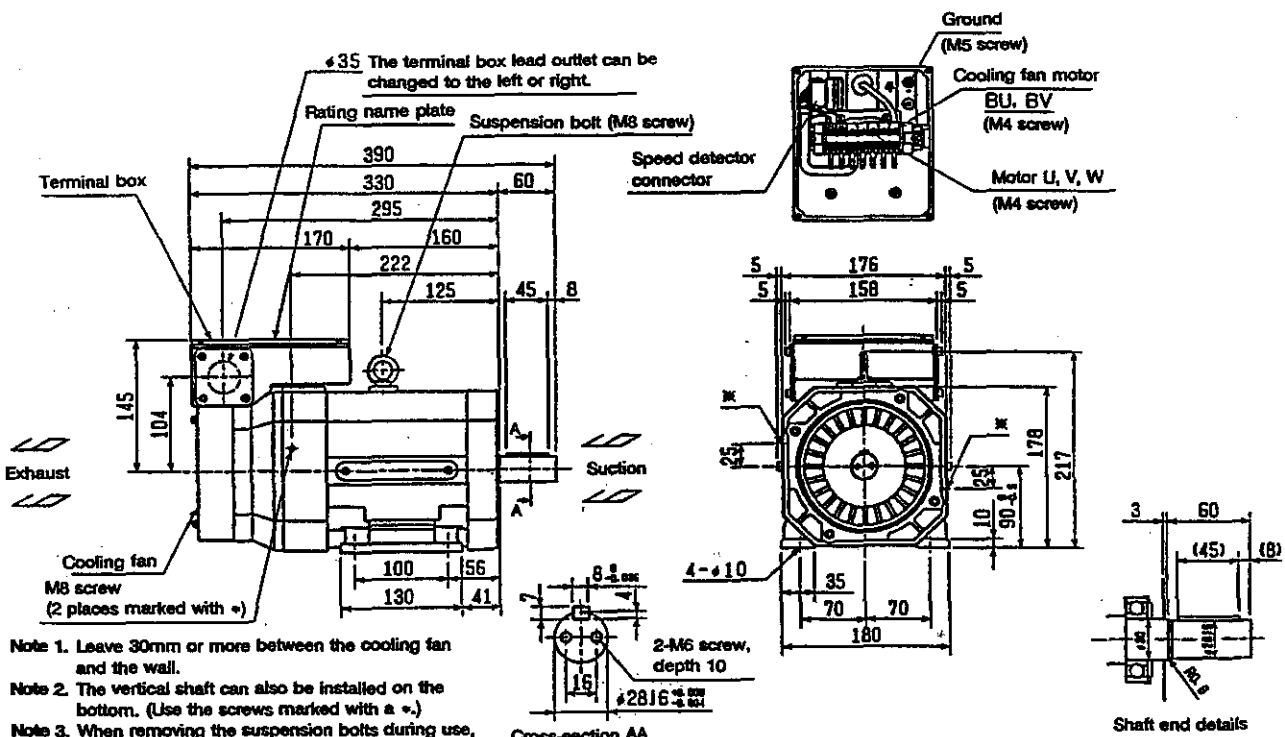
Note 1) Install the canon connector so that it faces downwards.
Note 2) The wiring plug is option. Please order it when required.
Note 3) The hole marked with a ∗ is the M8 installation screw hole for the eye-bolt.

● SJ-PF2.2-01



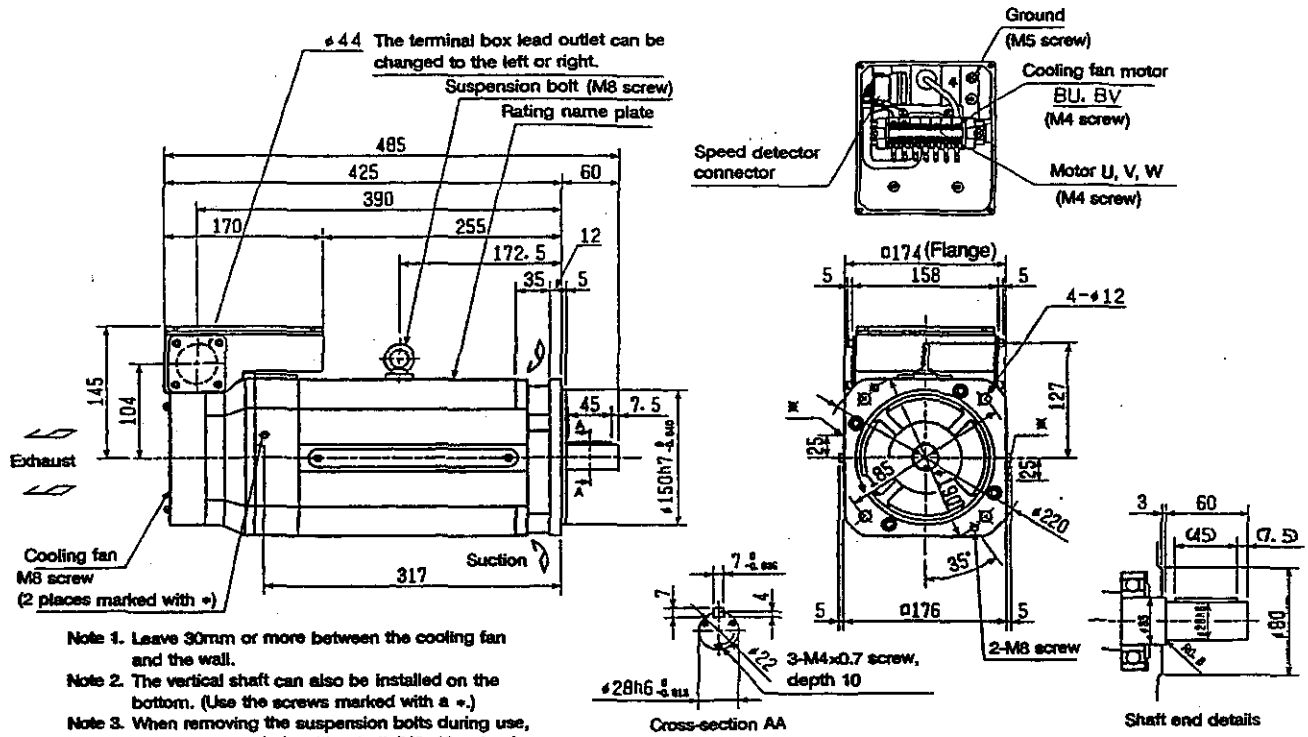
Note 1. Leave 30mm or more between the cooling fan and the wall.
Note 2. The vertical shaft can also be installed on the bottom. (Use the screws marked with a *.)
Note 3. When removing the suspension bolts during use, close the screw hole with a bolt (M8×10 or less).

● SJ-PF3.7-01

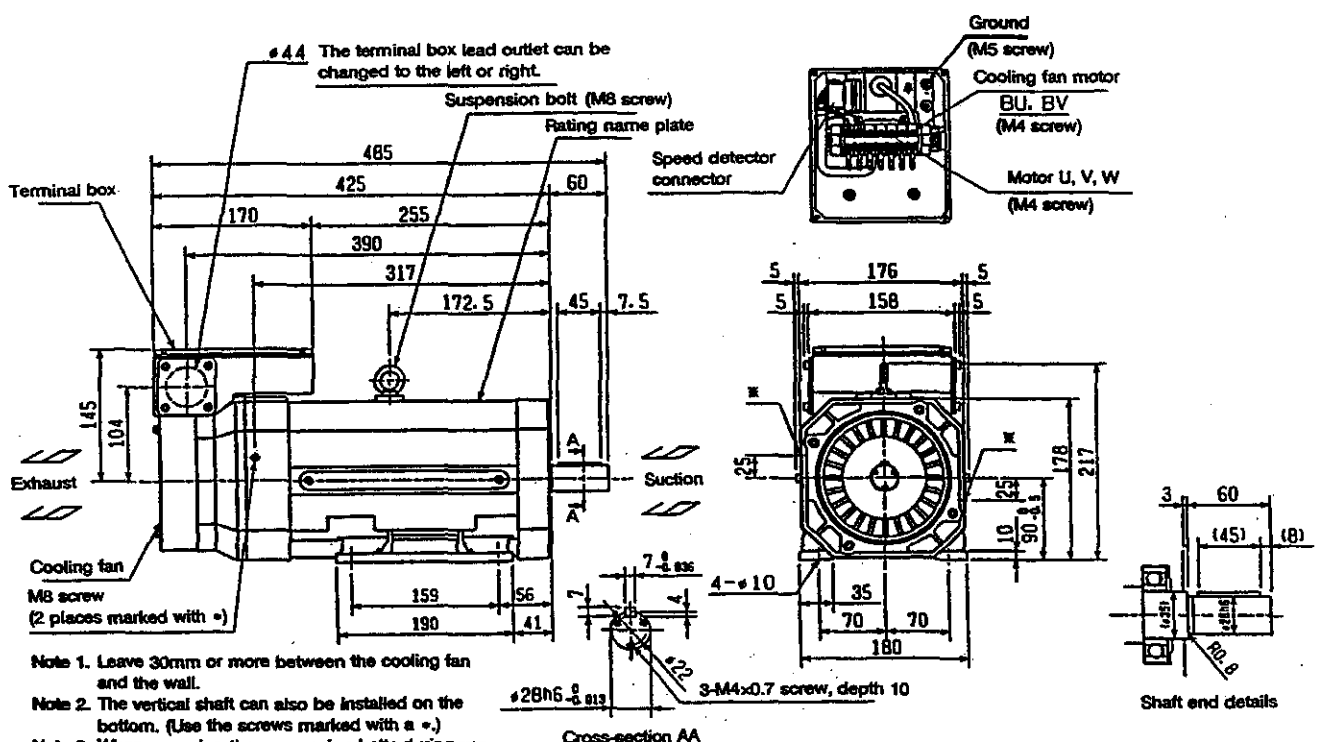


Note 1. Leave 30mm or more between the cooling fan and the wall.
Note 2. The vertical shaft can also be installed on the bottom. (Use the screws marked with a *.)
Note 3. When removing the suspension bolts during use, close the screw hole with a bolt (M8×10 or less).

● SJ-PF5.5-01

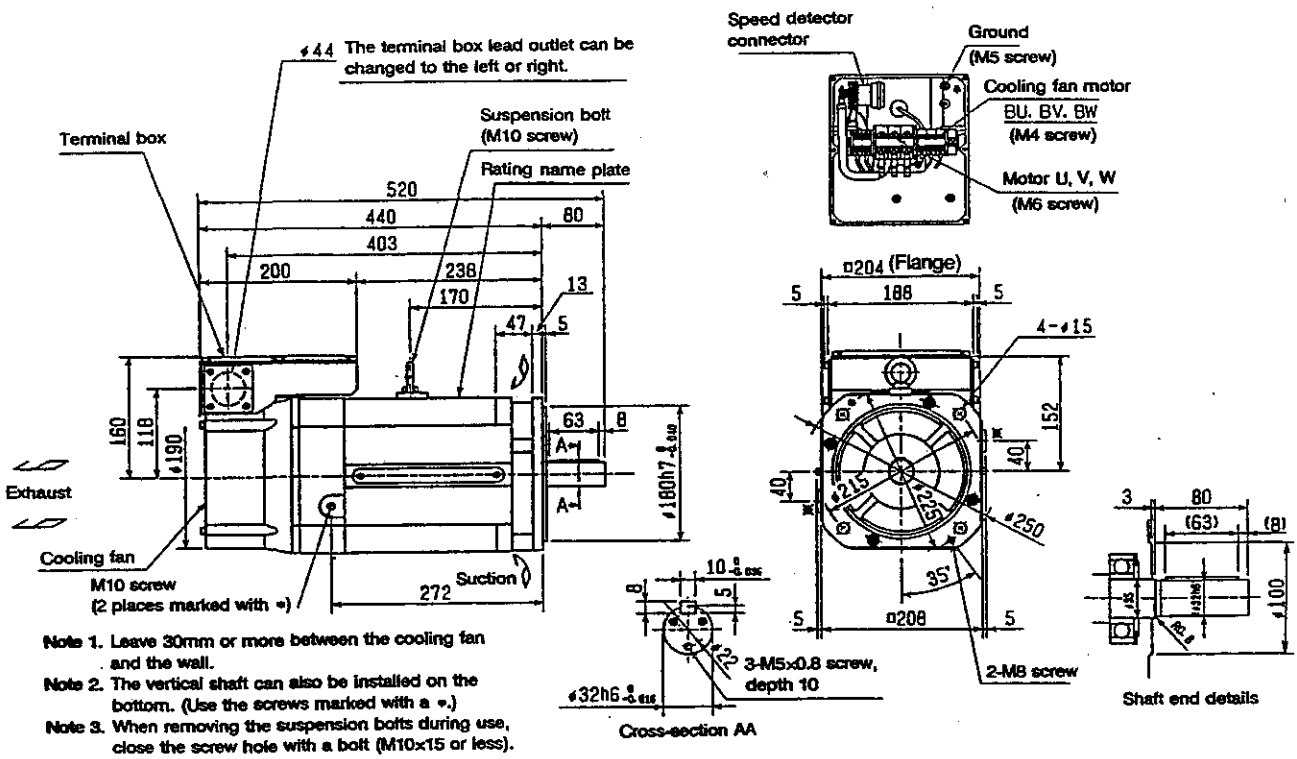


Note 1. Leave 30mm or more between the cooling fan and the wall.
Note 2. The vertical shaft can also be installed on the bottom. (Use the screws marked with a *.)
Note 3. When removing the suspension bolts during use, close the screw hole with a bolt (M8×10 or less).

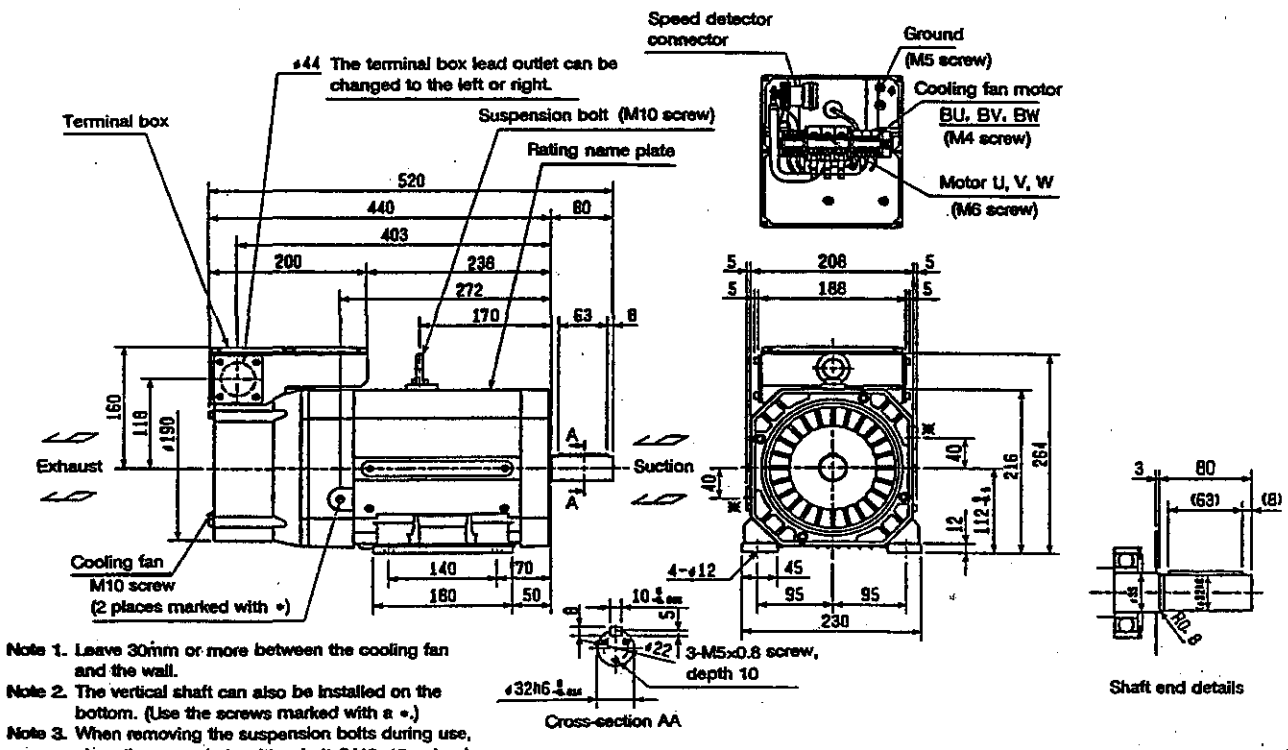


Note 1. Leave 30mm or more between the cooling fan and the wall.
Note 2. The vertical shaft can also be installed on the bottom. (Use the screws marked with a *.)
Note 3. When removing the suspension bolts during use, close the screw hole with a bolt (M8×10 or less).

● SJ-PF7.5-01



Note 1. Leave 30mm or more between the cooling fan and the wall.
Note 2. The vertical shaft can also be installed on the bottom. (Use the screws marked with a *.)
Note 3. When removing the suspension bolts during use, close the screw hole with a bolt (M10x15 or less).

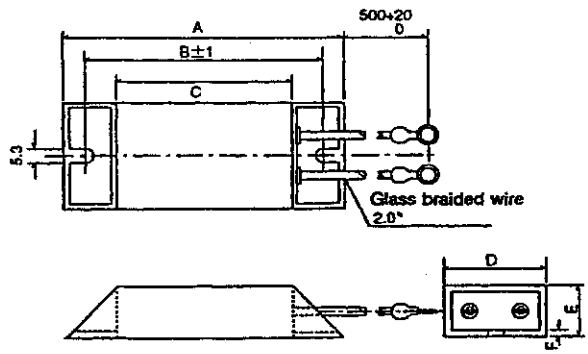


Note 1. Leave 30mm or more between the cooling fan and the wall.
Note 2. The vertical shaft can also be installed on the bottom. (Use the screws marked with a *.)
Note 3. When removing the suspension bolts during use, close the screw hole with a bolt (M10x15 or less).

2.4.3 Regenerative resistor

The regenerative resistor is not built into the spindle unit.
The following regenerative resistor must be installed.

(1) FCUA-RB□□



Regenerative resistor model	Toler-ance (W)	Outline dimensions (mm)					
		A	B	C	D	E	F
FCUA-RB04	60	140	125	100	40	20	2.5
FCUA-RB075	80	215	200	175	40	20	2.5
FCUA-RB15	120	240	225	200	50	25	2.0
FCUA-RB22	155	215	200	175	60	30	2.5
FCUA-RB37	185	335	320	295	60	30	2.5
FCUA-5B55	380	400	385	360	80	40	2.5
FCUA-RB75/2	380	400	385	360	80	40	2.5

Precautions for installation

(1) When using an operation pattern in which the regenerative resistor is used at a high frequency, the surface of the resistor may exceed 300°C, so take care to the installation and the heat radiation. Do not install the resistor where it can be easily touched by hand or body parts as touching could lead to burns. Install a well-ventilated protective cover (punched metal, etc.) if body parts might come in contact.

(2) Installation of the regenerative resistor on a metallic surface outside the panel is recommended to improve the heat radiating effect.

(3) Install the regenerative resistor so that the section where the lead wires are led out is not at the top of the resistor.

(2) Resistor

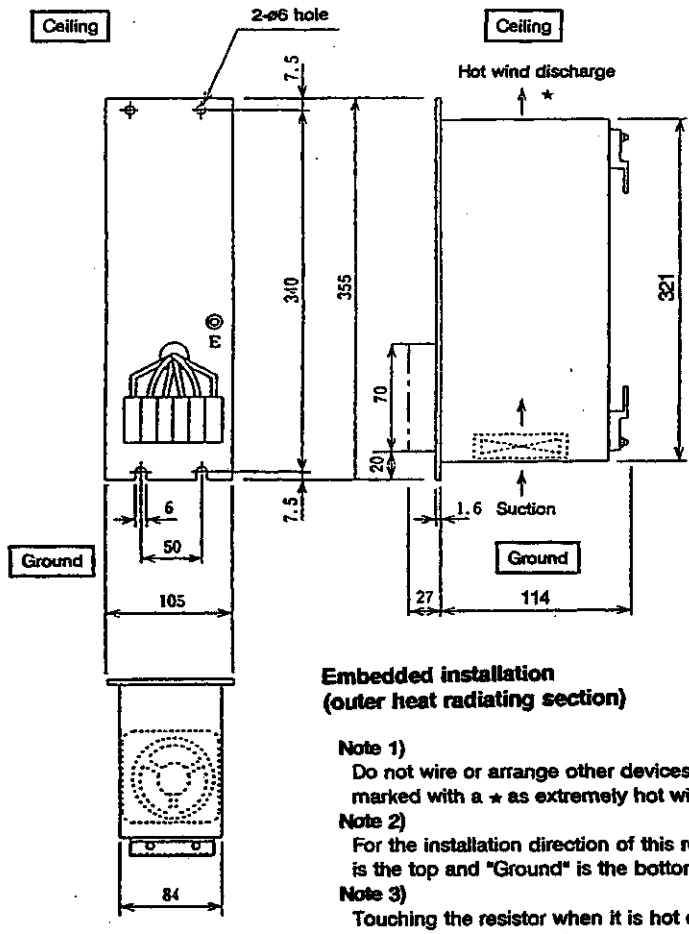
● R-UNIT-1, R-UNIT-2

Capacity	Model
1.5K ~ 3.7K	R-UNIT-1
5.5K, 7.5K	R-UNIT-2

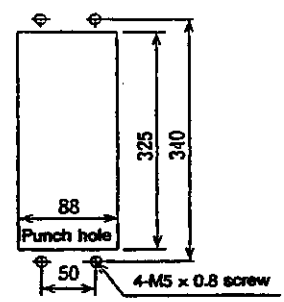
Terminal layout

Terminal screw size:
M4 x 0.7 screw

Applicable crimp terminal:
Bare round terminal up to 5.5-4.



Embedded installation
(outer heat radiating section)



Installation hole dimensions for embedded installation

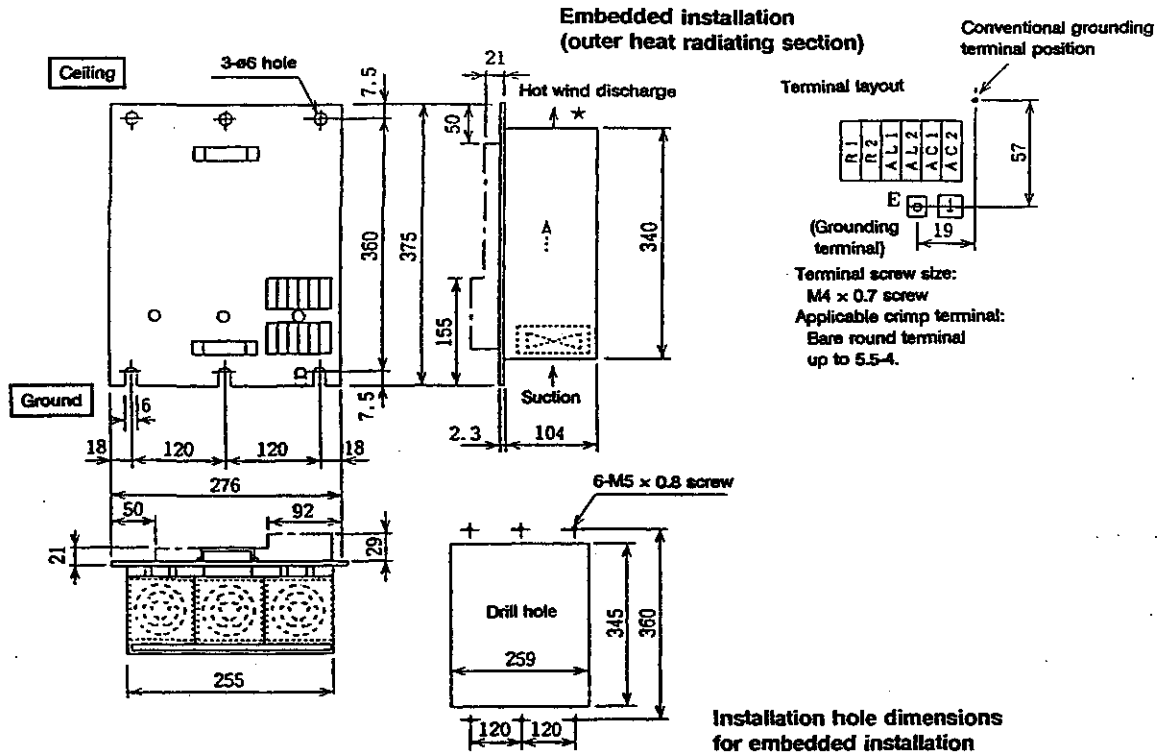
Note 1)
Do not wire or arrange other devices in front of the section marked with a ★ as extremely hot wind will be blown out.

Note 2)
For the installation direction of this resistor, the "Ceiling" is the top and "Ground" is the bottom.

Note 3)
Touching the resistor when it is hot could lead to burns. Always install a protective cover or consider the installation site so that workers will not touch the unit.

Note 4)
The resistor's heating value will differ according to the acceleration/deceleration frequency, speed being used and the load GD^2 conditions, etc. However, install the resistor so that the hot wind is always exhausted to outside the panel.

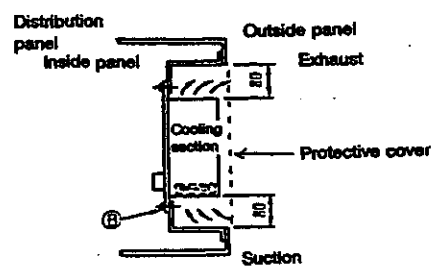
● R-UNIT-3 (For 5.5k, 7.5k high frequency)



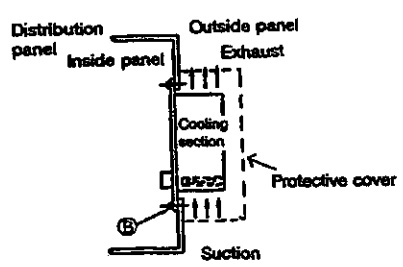
Note 1: The ventilation area is approx. 100 × 120.
Note 2: Attach packing to the flange section.
Note 3: Do not wire or arrange other devices in front of the section marked with a ★ as extremely hot wind will be blown out.
Note 4: For the installation direction of this resistor, the "Ceiling" is the top and "Ground" is the bottom.
Note 5: Touching the resistor when it is hot could lead to burns. Always install a protective cover or consider the installation site so that workers will not touch the unit.
Note 6: The resistor's heating value will differ according to the acceleration/deceleration frequency, speed being used and the load GD^2 conditions, etc. However, install the resistor so that the hot wind is always exhausted to outside the panel.

● Example of resistor installation

Example 1.
To place cooling section on inner side of distribution panel.



Example 2.
To place cooling section on outer side of distribution panel.



3. Functions

3.1 Input/output signals and functions list

(1) Basic functions

1) Input
   - ① S-analog command voltage input
     <±10V/TOP speed>/<0 to +10V/TOP speed> selection
   - ② Machine ready signal
   - ③ Motor forward run command input
   - ④ Motor reverse run command input

2) Output
   - ① Zero speed output
   - ② Speed reached output
   - ③ Speed meter output (0 to +10V)
   - ④ Load meter output (0 to +10V)
   - ⑤ Spindle fault output (relay contact output)
   - ⑥ Pulse feedback output (A, B, Z phase)

(2) Auxiliary input/output

1) Input (Max. 5 points can be selected from following 16 points)
   - ① Orientation command input
   - ② Forward run indexing command input
   - ③ Reverse run indexing command input
   - ④ Torque limit 1 input
   - ⑤ Torque limit 2 input
   - ⑥ Torque limit 3 input
   - ⑦ Gear selection 1 input
   - ⑧ Gear selection 2 input
   - ⑨ External reset input
   - ⑩ Emergency stop input
   - ⑪ Speed selection 1 input
   - ⑫ Speed selection 2 input
   - ⑬ Speed selection 3 input
   - ⑭ Multi-point orientation command validity
   - ⑮ S-analog/digital speed command changeover input
   - ⑯ S-analog high-speed tapping input

2) Output (Max. 3 points can be selected from following 12 points)
   - ① Orientation complete output
   - ② Positioning complete output
   - ③ Torque reached output
   - ④ In torque limit output
   - ⑤ In multi-point orientation positioning
   - ⑥ In motor forward run output
   - ⑦ In motor reverse run output

⑧ In alarm output
⑨ In emergency stop output
⑩ In ready ON output
⑪ In current detection output
⑫ In speed detection output

(3) 12-bit exclusive input (Select 2 points from the following)

① 12-bit multi-point orientation command input
② 12-bit digital speed command input
(Select from 12-bit binary, BCD 3 digits or BCD 2 digits)

(4) Others

RS-232-C interface for "Parameter input, spindle monitor" personal computer

3.2 Input signals

3.2.1 Exclusive inputs

(1) S-analog speed command (SE1, SE2)

This input is used to control the motor speed with an analog voltage input. One point can be selected from the following two points. (Select with the parameter.)

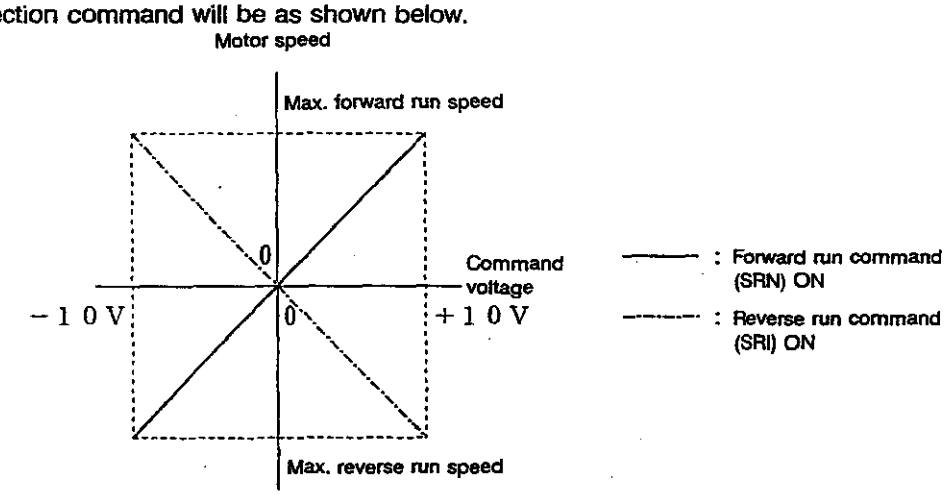
1) Double polarity input (–10V to +10V) Input between SE1 and SE2
2) Single polarity input (0 to +10V) Input between SE3 and SE2

The resolution for each selection is as follows.

For 1) 10V/approx. 485 digits (Example: Approx. 20rpm/digit when max. speed is 10,000rpm.)
For 2) 10V/approx. 895 digits

1) Double polarity input (SE1, SE2)

The motor rotation direction and speed in regard to the commanded voltage and rotation direction command will be as shown below.

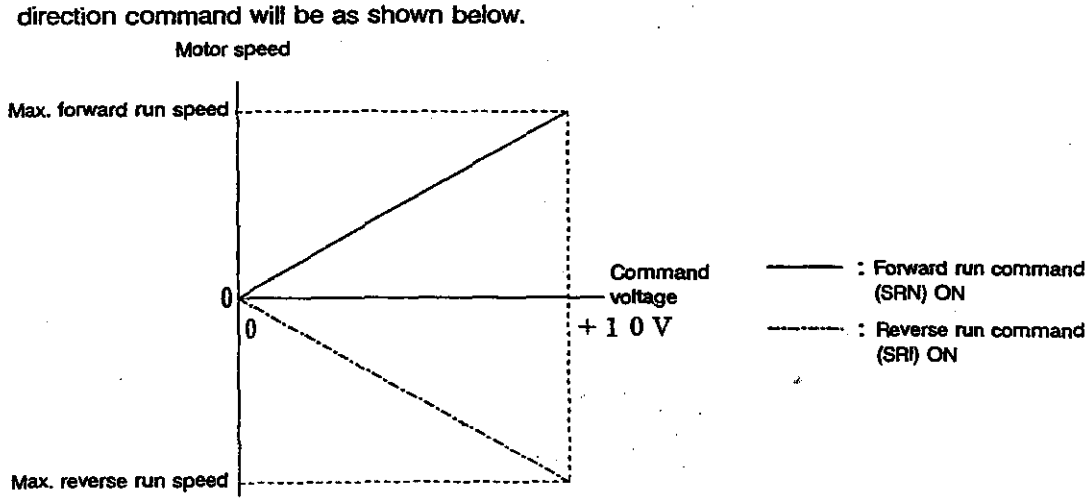


Note 1) The motor may not stop completely even when the speed command voltage is 0V. To stop the motor, turn the forward run or reverse run command OFF.

Note 2) The max. speed referred to here is the speed set in the parameter (SP017:TSP).

2) Single polarity input (SE3, SE2)

The motor rotation direction and speed in regard to the commanded voltage and rotation direction command will be as shown below.



Note 1) The other precautions are the same as for 1) Double polarity.

(2) Machine ready input (REDY, CES1)

1) Other input signals will not be accepted unless this contact is turned ON (closed).
2) The main circuit turns ON when this contact turns ON (closes).
3) If this contact is turned OFF (opened) during operation, the base will be shut off immediately, and the motor will coast to a stop.
4) Even if another input contact is turned ON or OFF before this contact turns ON (closes) or within one second after turns ON (closes), the input will not be read in. Make sure that the other inputs turn ON and OFF after one second has passed after this contact turns ON (opens). (Note that this does not apply to some commands.)
5) Always turn this contact OFF (open) before a worker is to directly touch the spindle to attach/detach a workpiece or tool, etc. Do not use this contact with a remarkable frequency (100 times or more/day).

(3) Motor forward run input (SRN, CES1)

1) When this contact is ON (closed), the motor will run in the counterclockwise direction looking from the shaft side according to the commanded speed.
2) When this contact is OFF (open), the motor will decelerate to a stop and the base will shut OFF.
3) If the orientation start command is input, the orientation start command will have the priority.
4) If this command and the motor reverse run input command are input simultaneously, the motor will stop. Note that the power will be supplied to the motor even when the motor is stopped.

(4) Motor reverse run input (SRI, CES1)

1) When this contact is ON (closed), the motor will run in the clockwise direction looking from the shaft side according to the commanded speed.
2) When this contact is OFF (open), the motor will decelerate to a stop and the base will shut OFF.
3) If the orientation start command is input, the orientation start command will have the priority.
4) If this command and the motor forward run input command are input simultaneously, the motor will stop. Note that the power will be supplied to the motor even when the motor is stopped.

(5) 12-bit command input (RH01 ~ RH12, CES2)

The 12-bit command input is common for both the multi-point orientation and digital speed commands. Thus, make an assignment to the auxiliary inputs, and select which function is to be used.

(1) 12-bit multi-point orientation command input

When using encoder orientation or motor PLG orientation, the following can be determined with these signals.

1) Spindle orientation stop position
2) Stop position during spindle orientation

When all of the signal contacts (RH01 to RH12) for the 12 bits are turned OFF (open), the spindle will stop at the position set in parameter SP007 (OPST).

[How to determine the stopping position]

$$\text{Stopping position} = \frac{360°}{4096} \times [\ (12H) \cdot 2^{11} + (11H) \cdot 2^{11} + \cdots\cdots + (1H) \cdot 2^{0}\ ]$$

Min. movement unit (resolution) = 360°/4096 = 0.088°

Thus, a rounding error may occur depending on the angle when integer degree positioning is executed.

(Example)

1) To stop at a 90° position

$$\frac{90°}{360°} \times 4096 = 1024\ (= 2^{11})$$

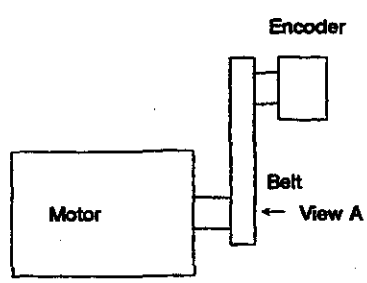
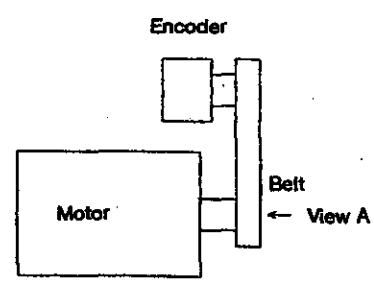
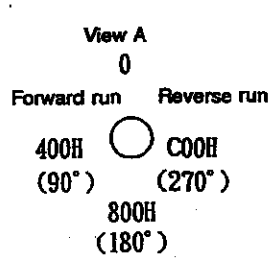
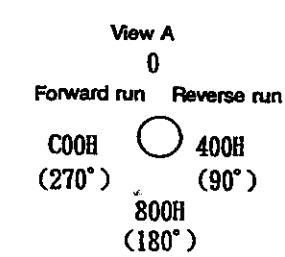
Thus, only 11H is turned ON.

2) To stop at 183° position

$$\frac{183°}{360°} \times 4096 \fallingdotseq 2082\ (= 2^{12} + 2^{5} + 2^{1})$$

Thus, in this case turn 11H, 5H and 1H ON.
The stopping position in this case will be 182.99°, so an error of 0.01° will occur. Note that this indicates the pure electrical precision, and this precision may not be obtained at the actual spindle end.

The stopping position according to the encoder installation direction is as shown below.

	Case 1 (When motor rotation direction and encoder rotation direction are opposite)	Case 2 (When motor rotation direction and encoder rotation direction are the same)
Installation direction		
Stopping position		

Case 1 applies for motor PLG orientation.

(2) 12-bit digital speed command input

This contact is used when the speed is to be commanded digitally separately from the analog speed command.
RH01 to RH12 are used for the input.
One of the following types of digital speed commands can be selected. (Select with the parameter.)

1) BCD code 2 digits 8-bit
2) BCD code 3 digits 12-bit
3) Pure binary (12-bit binary) 12-bit
4) Coded pure binary 12-bit

1) BCD code 2 digits

The speed in regard to the commanded value is as follows.

BCD code	Motor speed (When max. speed is 10,000rpm)	Motor speed (When max. speed is 6,000rpm)
00	0 rpm	0 rpm
01	101 rpm	60 rpm
02	202 rpm	121 rpm
•	•	•
•	•	•
•	•	•
•	•	•
•	•	•
98	9898 rpm	5939 rpm
99	10000 rpm	6000 rpm

(Example) The input is made as shown below. ("1" is contact ON (closed), and "0" is contact OFF (open).)

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

2) BCD code 3 digits

The speed in regard to the commanded value is as follows.

BCD code	Motor speed (When max. speed is 10,000rpm)	Motor speed (When max. speed is 6,000rpm)
000	0 rpm	0 rpm
001	10 rpm	6 rpm
002	20 rpm	12 rpm
•	•	•
•	•	•
•	•	•
•	•	•
•	•	•
998	9899 rpm	5939 rpm
999	10000 rpm	6000 rpm

(Example) The input is made as shown below. ("1" is contact ON (closed), and "0" is contact OFF (open).)

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

3) Pure binary (12-bit binary)

The speed in regard to the commanded value is as follows.

BINARY code	Motor speed (When max. speed is 10,000rpm)	Motor speed (When max. speed is 6,000rpm)
000	0 rpm	0 rpm
001	2 rpm	1 rpm
002	4 rpm	2 rpm
•	•	•
•	•	•
•	•	•
•	•	•
•	•	•
FFE	9997 rpm	5998 rpm
FFF	10000 rpm	6000 rpm

(Example) The input is made as shown below. ("1" is contact ON (closed), and "0" is contact OFF (open).)

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

4) Coded pure binary

The speed in regard to the commanded value is as follows.

BINARY code	Motor speed (When max. speed is 10,000rpm)		Motor speed (When max. speed is 6,000rpm)	
000	↑	10000 rpm	↑	6000 rpm
001	|	9995 rpm	|	5997 rpm
002	|	9990 rpm	|	5994 rpm
•	|	•	|	•
7FF	Forward run	4 rpm	Forward run	2 rpm
800		0 rpm		0 rpm
801	Reverse run	4 rpm	Reverse run	2 rpm
•	|	•	|	•
FFE	|	9995 rpm	|	5997 rpm
FFF	↓	10000 rpm	↓	6000 rpm

(Example) The input is made as shown below. ("1" is contact ON (closed), and "0" is contact OFF (open).)

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

3.2.2 Auxiliary inputs

A max. of 5 auxiliary input points can be selected from the 16 points provided.
Input between IN1 to IN5 and CES1.
The meaning of each input will depend on the parameter selection.

Input	Parameter No.	Abbr.	Setting value and meaning
IN01	SP129	H101	0: Invalid (set to input pin not being used) 1: Orientation start 2: Indexing forward run 3: Indexing reverse run 4: Torque limit 1 5: Torque limit 2 6: Torque limit 3 7: Gear selection 1 8: Gear selection 2 9: Alarm reset 10: Emergency stop 11: Speed selection 1 12: Speed selection 2 13: Speed selection 3 14: Multi-point orientation position command validity 15: Digital speed command valid 16: 17: S-analog high-speed tapping 18: 19:
IN02	SP130	H102	
IN03	SP131	H103	
IN04	SP132	H104	
IN05	SP133	H105	

Note 1) Always set "0" for the inputs not being used.
Note 2) Do not set values without an assignment.
Note 3) Do not select the same No. two or more times.

(1) Orientation start command

1) This signal starts the orientation. Orientation will start regardless of the rotation command (SRN, SRI) when this contact is turned ON (closed).
2) If a rotation command (SRN, SRI) is input when this contact is turned OFF (open), the motor will start rotating in that commanded rotation.
3) If the machine ready input is turned OFF and ON while this contact is ON (closed), orientation will start.

(2) Indexing forward run, Indexing reverse run

1) This signal is used to start indexing when using multi-point indexing in the encoder orientation or motor PLG orientation specifications. This signal is valid when the orientation start command is ON.
2) When the indexing forward run signal is turned ON (contact closed), the motor will start indexing in the counterclockwise direction looking from the end of the motor shaft. When the indexing reverse run command is turned ON (contact opened), the indexing will start in the clockwise direction.
   Refer to the Indexing Function Option Specifications for details.

(3) Torque limit 1, 2 and 3

1) When this input is turned ON (contact closed), the motor output will be limited to the value set in the parameters. This is used mainly for mechanical orientation positioning and gear shifting.
2) The following seven torque limit values can be used according to the combination of torque limit 1, 2 and 3.

Torque limit 3	Torque limit 2	Torque limit 1	Torque limit value
0	0	1	Torque limit value set with parameter SP021 (TLM1)
0	1	0	Torque limit value set with parameter SP049 (TLM2)
0	1	1	Torque limit value set with parameter SP050 (TLM3)
1	0	0	Torque limit value set with parameter SP051 (TLM4)
1	0	1	Torque limit value set with parameter SP052 (TLM5)
1	1	0	Torque limit value set with parameter SP053 (TLM6)
1	1	1	Torque limit value set with parameter SP054 (TLM7)

Note) "0" indicates input off (contact open) and "1" indicates input ON (contact closed)

3) When only one torque limit value is to be used, set only torque limit 1 in the auxiliary input. When two to three torque limit values are to be used, set torque limits 1 and 2. When four to seven torque limit values are to be used, set torque limits 1 to 3.

(4) Gear selection 1, 2

1) The spindle gear for orientation and indexing is selected.
2) Four types of gears can be selected according to the combination of gear selection 1 and 2.
3) Do not change the signal during orientation or indexing.

Gear selection 2	Gear selection 1	Parameter used to set the gear ratio
0	0	SP025 (GRA1), SP029 (GRB1)
0	1	SP026 (GRA2), SP030 (GRB2)
1	0	SP027 (GRA3), SP031 (GRB3)
1	1	SP028 (GRA4), SP032 (GRB4)

Note) "0" indicates input off (contact open) and "1" indicates input ON (contact closed)

4) When there are two or less steps in the gears, set gear selection 1 in the auxiliary input, and when there are three or more steps, set gear selection 1 and 2.

(5) Alarm reset

1) This is used to reset the error when an error occurs in the spindle drive unit. (Some alarms cannot be reset unless the power is turned OFF once.)
2) Each unit will enter the default state when this input is turned ON (contact closed) and OFF (contact open).

(6) Emergency stop

1) This signal is a b contact signal. The contact opens when turned ON and closes when turned OFF.
2) If this signal is turned ON (contact open) during motor rotation, the motor will decelerate to a stop, and then the base will be shut off.
3) If this signal is turned OFF (contact closed) again, the operable state will be entered. However if the rotation command (SRN, SRI) signal is turned ON, the motor will not rotate unless the rotation command is turned OFF and ON once.

(7) Speed selection 1, 2 and 3

1) When this input is turned ON (contact closed), the motor speed will be that set in the parameters.
2) Both the digital speed command and S-analog speed command will be ignored, and this input will be valid.
3) Eight types of speeds can be selected by the combination of the three bits.

Speed selection 3	Speed selection 2	Speed selection 1	Motor speed
0	0	0	Speed set in parameter SP162 (SS0).
0	0	1	Speed set in parameter SP163 (SS1).
0	1	0	Speed set in parameter SP164 (SS2).
0	1	1	Speed set in parameter SP165 (SS3).
1	0	0	Speed set in parameter SP166 (SS4).
1	0	1	Speed set in parameter SP167 (SS5).
1	1	0	Speed set in parameter SP168 (SS6).
1	1	1	Speed set in parameter SP169 (SS7).

Note 1) "0" indicates input off (contact open) and "1" indicates input ON (contact closed)
Note 2) If a value other than "0" is set in parameter SP162 (SS0), the motor speed will be that set here even if the speed selection signals 1 to 3 are OFF. The digital speed command and S-analog speed command will be ignored.

4) If two types of speed settings are to be used, set only speed selection 1 in the general purpose input. When using four types, set speed selections 1 and 2. When using more types, set speed selection 1 to 3.

(8) Multi-point orientation position command validity

1) When this input is turned ON (contact closed), the multi-point orientation and multi-point indexing commands are validated.
The command value is determined with RH01 to RH12. Refer to the section on the 12-bit multi-point orientation command input for the exclusive inputs for details.

(9) Digital speed selection valid

1) The digital speed command is validated when this input is turned ON (contact closed), and the S-analog speed command will be ignored. When this input is turned OFF (contact open), the S-analog speed command will be validated. The command value is determined with RH01 to RH12. Refer to the section on 12-bit digital speed command for exclusive inputs for details.

(10) S-analog high-speed tapping

1) This signal is turned ON (contact closed) to synchronize the servo axis and spindle with the S-analog speed command. Note that the position loop must be created on the NC side. Refer to the S-Analog High-Speed Tapping Option Specifications for details.

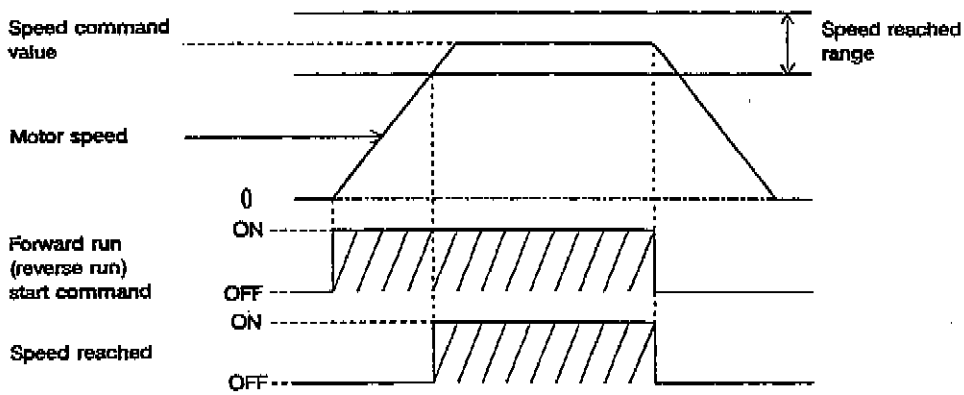
3.3 Output signal

3.3.1 Exclusive signals

The ON state for the output signals described below refers to the output transistor conducted state, and OFF refers to the output transistor shut off state.

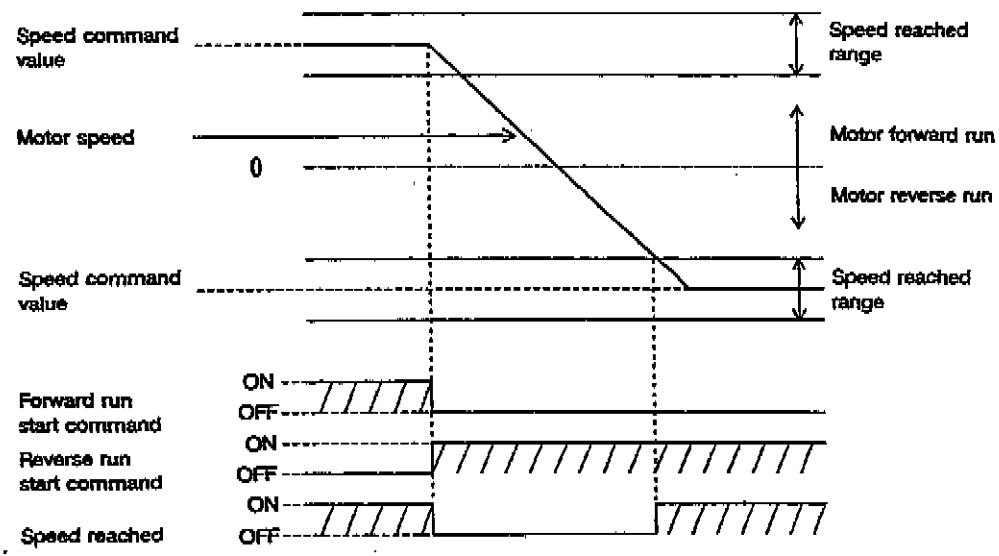
(1) Speed reached

1) This signal turns ON when the start command signal (forward run, reverse run) turns ON and the motor speed reaches within ±15% (standard value) of the speed command value.



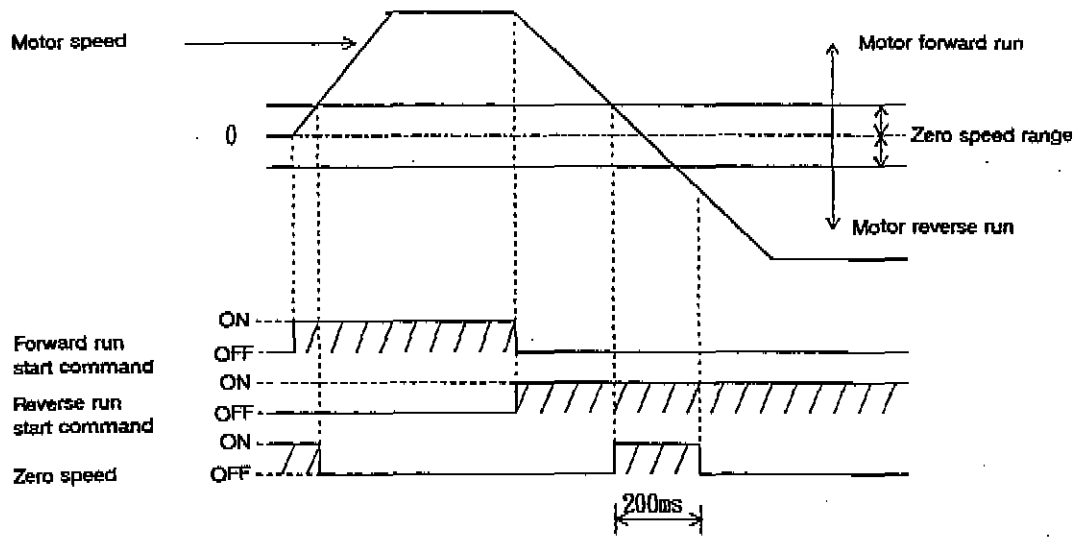
2) This signal turns OFF when the start command signal turns OFF.

3) If the forward run start signal is turned OFF and the reverse start signal turns ON during forward running, this signal will be output as shown in the diagram on the next page.



(2) Zero speed

1) This signal turns ON when the motor speed drops below the speed set in parameter SP018: ZSP regardless of the input signal state.
2) Once this signal turns ON, it will not turn OFF for at least 200msec.
3) If the parameter SP018:ZSP setting value is too low (approx. 10rpm or less), this signal may turn OFF regardless of whether the motor is stopped or not.

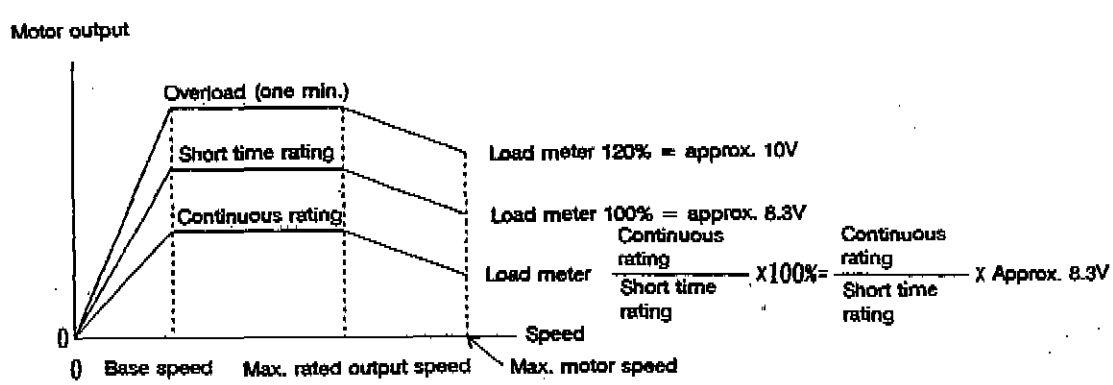


(3) Controller error output (FA, FC)

1) This output is a relay contact output. If an error occurs in a drive unit, the contact will open. When the operation is normal, the contact will close.
2) The error signal will be output for approx. one second after the power is turned ON until the control power starts up.

(4) Load meter output (LM0, 0M)

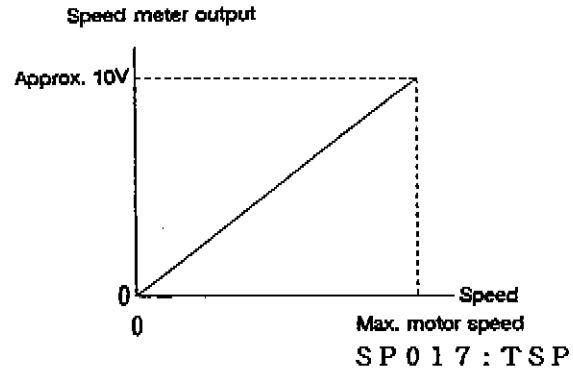
1) This is an analog signal that indicates the motor output state. An approx. 10V voltage is output when the motor output is 120% of the rating. The relation of the motor output and this signal's output is as shown below.



2) The full scale voltage of the meter can be finely adjusted with parameter SP179 (LMG).

(5) Speed meter output (SM0, 0M)

1) This is an analog signal that indicates the motor speed. 10V is output at the max. motor speed (parameter SP017 (TSP)). The relation of the motor speed and this signal output is as shown below.
This signal will output 0 to 10V according to the motor speed regardless of the motor rotation direction.



2) The full scale voltage of the meter can be finely adjusted with parameter SP178 (SMG).

(6) Pulse feedback output (SYA to C, SYA* to C*)

1) The motor speed detector or spindle position detector signals are output as pulse trains. The signal output and the pulse to output are determined as shown below.

Orientation specifications	SYA • SYA*	SYB • SYB*	SYC • SYC*
Motor PLG orientation or no orientation	Motor PLG A phase	Motor PLG B phase	Motor PLG Z phase
Encoder orientation	Encoder A phase	Encoder B phase	Encoder Z phase

3.3.2 Auxiliary outputs

Three auxiliary output points can be selected from the following 12 points.
The auxiliary outputs are output from OUT 1 to 3. The meaning of each output is determined by the parameter setting.

Output	Parameter No.	Abbr.	Setting value and meaning
OUT1	SP141	HO1	0: Invalid (set for output pins not being used) 1: Orientation complete 2: Positioning complete 3: Torque reached 4: In torque limit 5: In multi-point orientation position command. 6: 7: In motor forward run 8: In motor reverse run 9: In alarm 10: In emergency stop 11: In ready ON 12: Current detection 13: Speed detection 14: 15: 16:
OUT2	SP142	HO2	
OUT3	SP143	HO3	

Note 1) Always set "0" for outputs that are not being used.
Note 2) Do not set values without an assignment.

(1) Orientation complete

1) This signal turns ON when the orientation command is input and the spindle position has reached the range (in-position range) for the target stop point.
2) This signal turns OFF when the spindle position leaves the in-position range after orientation is completed, and turns ON when the in-position range is entered again. If the orientation command is turned OFF, this signal will also turn OFF even if the spindle is in the in-position range.
3) The in-position range can be set with parameter SP004: OINP.

(2) Positioning complete

1) This signal turns ON when the spindle position is in the range (in-position range) for the indexing target stop position during indexing.
2) Once this signal turns ON, it stays ON regardless of the spindle position until the orientation signal turns OFF or the next indexing signal is input.
   This signal will always turn OFF when the indexing signal is input even if the current stop position and the next indexing position are in the same in-position range. Min. OFF time = 200msec (standard value)
   Refer to the Indexing Function Option Specifications for details.

(3) Torque reached

1) This signal turns ON when the start signal is input and the torque command reaches the max. value.

(4) In torque limit

1) This signal turns ON while the torque limit signal (1 to 3) is input.

(5) In multi-point orientation position command

1) This signal turns ON while the multi-point orientation position command validity is input.

(6) In motor forward run

1) This signal turns on when the start signal is input and the motor is rotating in the counterclockwise direction looking from the shaft end.
2) This signal may turn ON and OFF when the motor speed is several rpm or less.

(7) In motor reverse run

1) This signal turns on when the start signal is input and the motor is rotating in the clockwise direction looking from the shaft end.
2) This signal may turn ON and OFF when the motor speed is several rpm or less.

(8) In alarm

1) This signal turns ON while an alarm is occurring in each unit.
2) Even if each unit is normal, this signal may turn ON for approx. one sec. after the power is turned ON.

(9) In emergency stop

1) This signal turns ON while the emergency stop signal is input.

(10) In ready ON

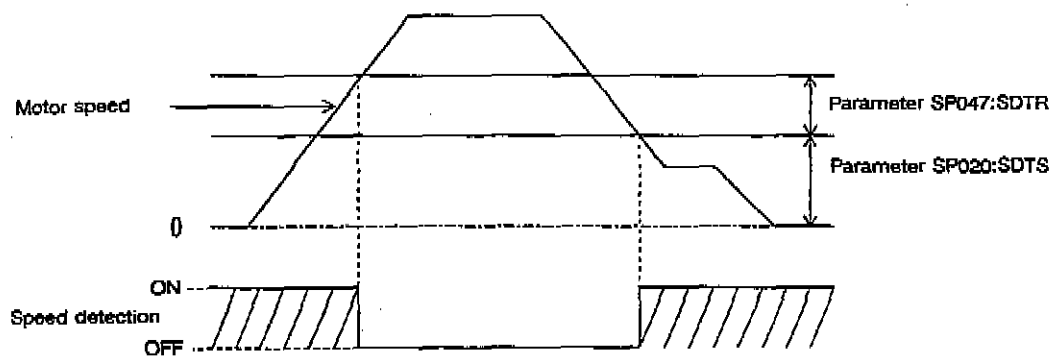
1) This signal turns ON approx. one sec. after the machine ready input signal turns ON.
2) The motor will start rotating when the start signal (forward run, reverse run, orientation) is turned ON while this signal is ON.
3) This signal will turn OFF when the machine ready input signal turns OFF or when an alarm occurs.

(11) Current detection

1) This signal turns ON if the current flowing to the motor exceeds approx. 110% or more of the rating while the start signal (forward run, reverse run, orientation) is ON. (The motor output (current) guarantee value is 120% of the rating.)

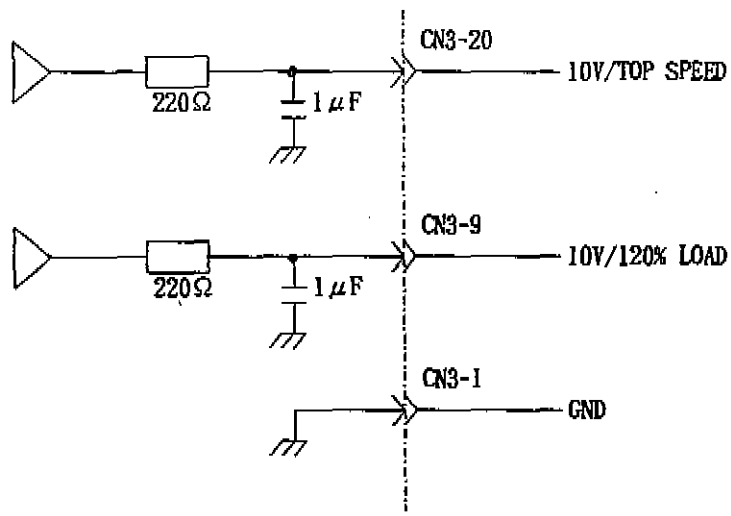
(12) Speed detection

1) This signal turns ON when the motor speed drops below the value set in parameter SP020: SDTS.
2) The hysteresis width of ON → OFF is set in parameter SP047: SDTR.
3) This signal will turn ON when the motor speed drops below the set speed regardless of the input signal status.



3.4 Meter output specifications

The speed meter output and load meter output explained earlier can be used for the meter output. The output section is as follows.



(1) The output voltage for both outputs can be adjusted with parameters.
Speed meter: SP178 (SMG)
Load meter : SP179 (LMG)

3.5 Interface electrical specifications

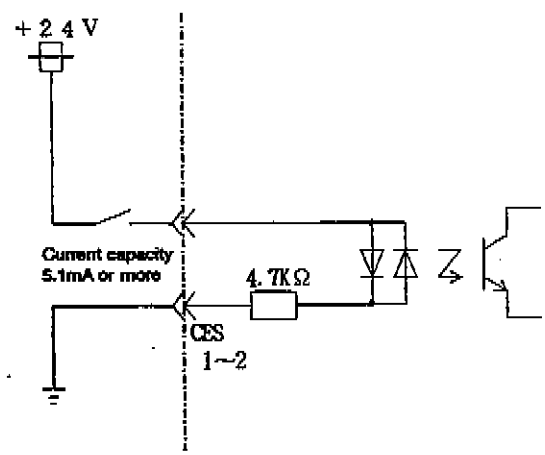
This unit requires a +24V (±10%) power supply. A max. 15W power capacity is required.

3.5.1 Digital input interface: CN1

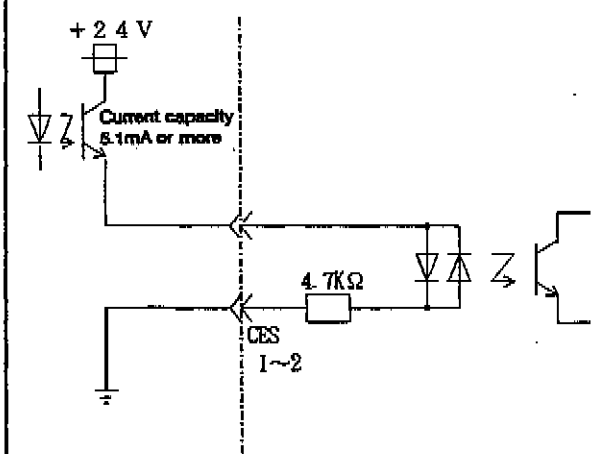
(Exclusive input: 3 points, auxiliary input: 5 points,
multi-point orientation command, digital speed command: 12 points)

Select from the following.

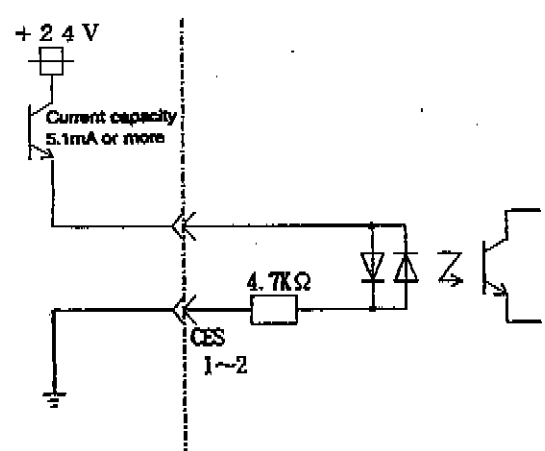
1) Connect with contact



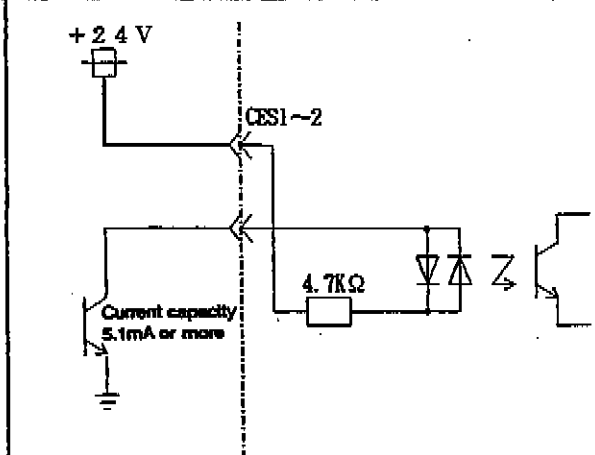
2) Connect with photocoupler



3) Connect with open emitter



4) Connect with open collector



Note 1) The exclusive and auxiliary input common is CES1, the multi-point orientation command common and the digital speed command common are CES2. Each common is electrically separated.
Thus, when using CES1 to 2, connect a signal (power supply, etc.) to each.

Note 2) Carefully select the size of the cable connected to CES1 to 2, as the total input current will flow.
CES1:5.1×8=40.8mA, CES2:5.1×12=61.2mA

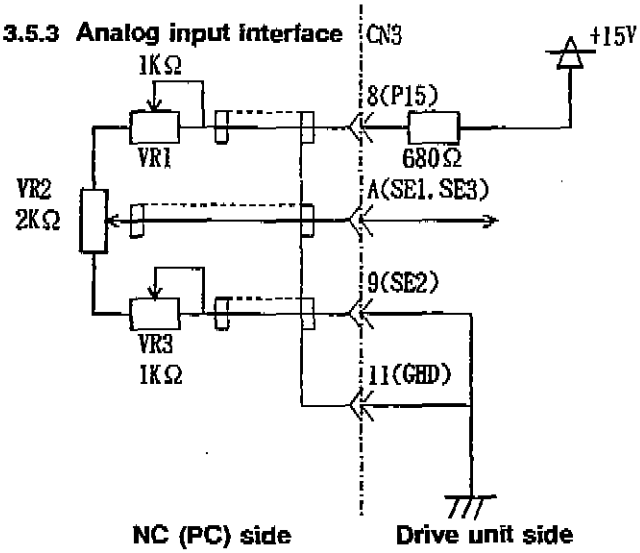
Note 3) The input section filter time constant is 5 to 15ms.

Note 4) An external +24V power supply is not required only when the motor is being test run (when only the machine ready, motor forward run and reverse run inputs are being used and all other 24V series inputs/outputs are not being used). In this case, the internal +24V power supply is used for driving.
At this time use CN1 to 6A pins for +24V, and CN1 to 3A, 3B pins for RG (24G).

3.5.2 Encoder (1024P/REV) input interface

When an encoder is connected, +5V is supplied from the drive unit side.
The power does not need to be supplied from the NC (PC) side.

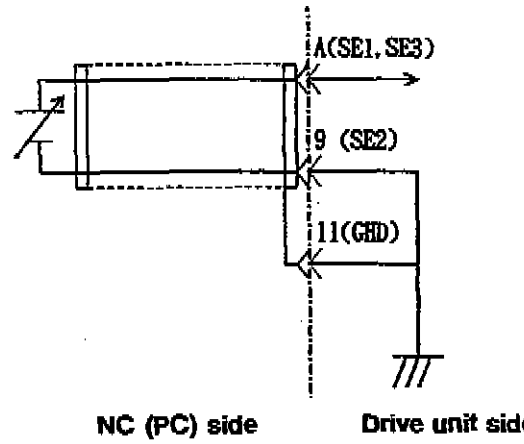
3.5.3 Analog input interface



	Analog speed command input	Analog speed command input
VR1	Upper limit speed setting	Required
VR2	Analog speed setting	
VR3	Lower limit speed setting	Not required
A	SE1 (CN3-18)	SE3 (CN3A-19)

Input impedance of input pin A (SE1, SE3) : Approx. 10KΩ

Note 1) The above diagram shows the case for single polarity input. (The double polarity input cannot be created with only the power supplied from the drive unit side.)
Note 2) A +15V power is output via the resistor from input pin 8 (P15).
Note 3) The tolerable input voltage values of input pin A (SE1, SE3) is as follows.
SE1:±12V SE3:0~+12V
Note 4) Always use a shield cable that has been shield treated for the cable connected each input pin. ([ ] indicates the shield.)
Note 5) If a separate analog speed input command power is available, connect it as shown below.



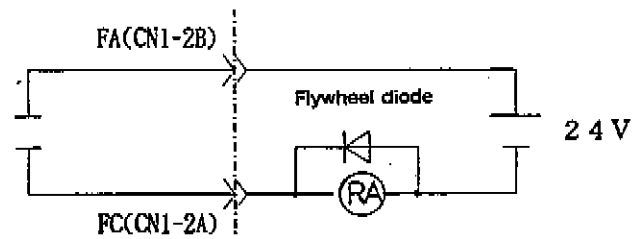
3.5.4 Output interface

(1) External contact output circuit

The drive unit fault output signal (FA (CN1-2B), FC (CN1-2A)) is this output section.
This contact is used with the following ratings.

DC24V 0.3A or less
Chattering 5msec or less

A compact relay is used, so when connecting an inductive load such as a relay, use a DC compact relay when possible. Connect a flywheel diode parallel to the coil as shown below.



(2) Open emitter/collector output circuit

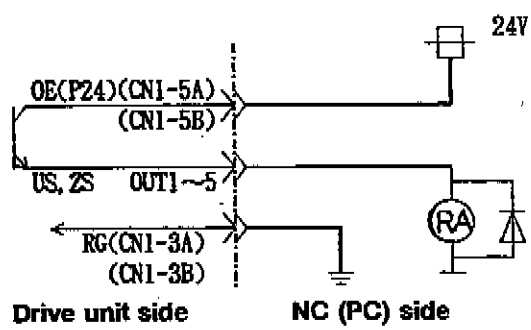
The following outputs are the open emitter/collector output section.

Speed reached output : US (CN1-8B)
Zero speed output : ZS (CN1-8A)
General purpose output 1: OUT 1 (CN1-7B)
General purpose output 2: OUT 2 (CN1-7A)
General purpose output 3: OUT 3 (CN1-6B)

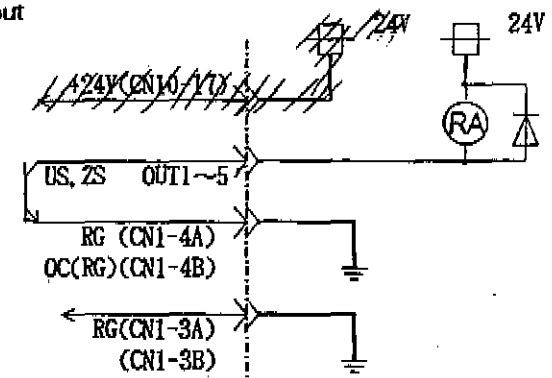
Output transistor rating
Tolerable voltage DC24V or less
Tolerable current 50mA or less (per output)

The open emitter/collector output can be selected with the following type of connection.

1) Open emitter output



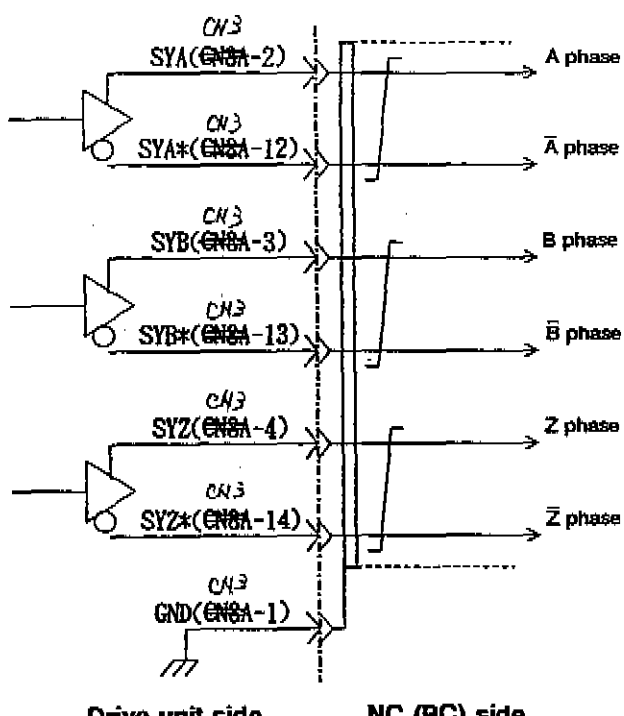
2) Open collector output



Note 1) When using a DC relay externally, connect a flywheel diode in parallel to the coil.
Note 2) 24V and RG are common for the open emitter and collector outputs. Carefully select the cable size.
(24V and RG require 60mA for just the spindle drive unit internal circuit.)
Note 3) When using all eight circuits with the open emitter outputs, make sure that the total current is 350mA or less.
Note 4) Do not wire OE (CN1-5A, 5B) –24V and OC (CN1-4A, 4B) –RG at the same time. Doing so will cause a fault.

(3) Pulse feedback output

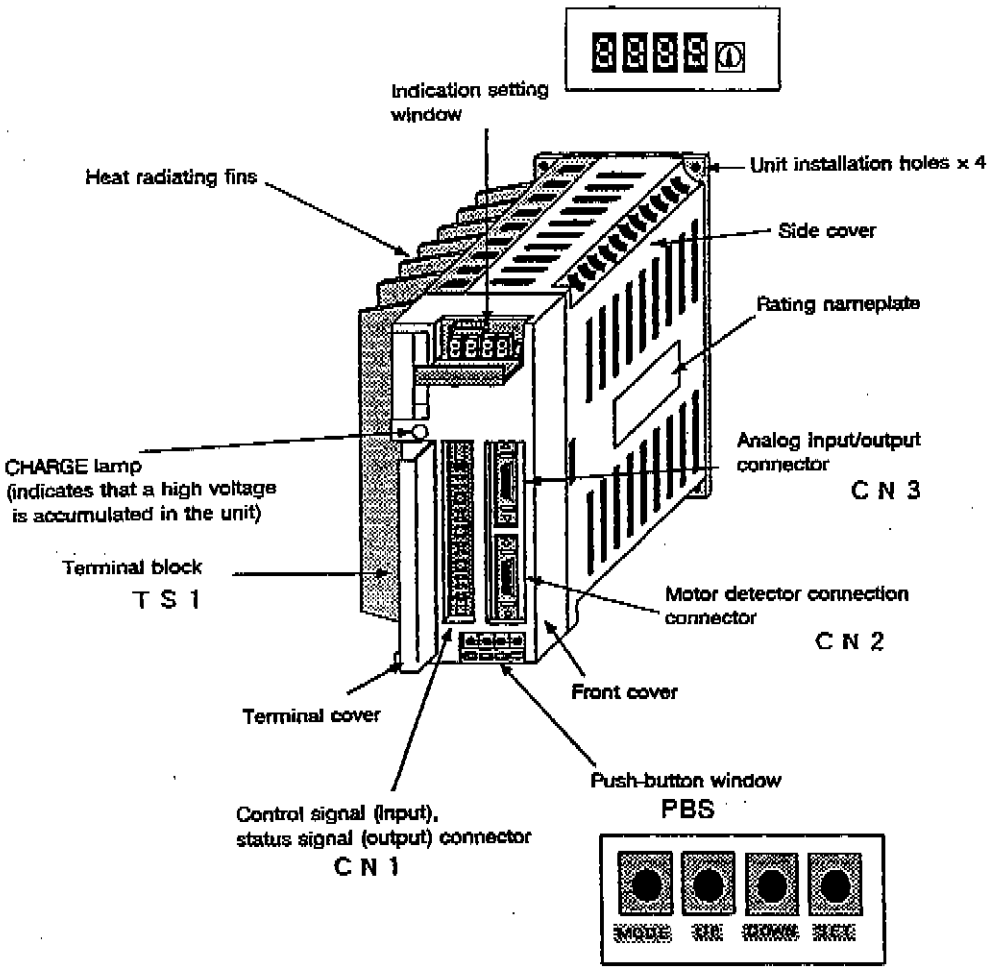
This output is as shown below.



Note 1) The output IC is equivalent to the Motorola MC3487.
Note 2) Refer to the section 3.1.2 Output signals for details on the output signals.

4. Handling

4.1 Explanation of unit parts



⚠ Always turn the power OFF and confirm that the "CHARGE" lamp has gone out before connecting/disconnecting the connectors or wires.

4.2 Unit installation

The spindle drive unit is installed in a sealed structure cabinet as a principle. Observe the following points when installing the unit in the cabinet.

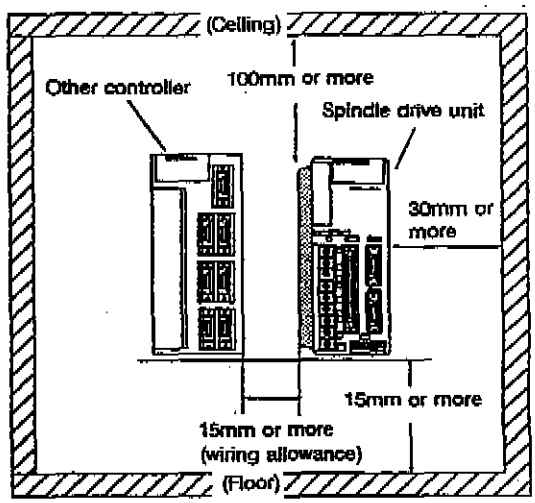
(1) Usage environment conditions

- Ambient temperature: 0 to 55°C (with no freezing)
- Ambient humidity : 90%RH or less (with no dew condensation)
- Vibration : 5.9m/s2 {0.6G} or less

<Note> Keep the average in-panel temperature at 40°C or less to secure the in-panel temperature specifications, spindle drive life and the reliability.

(2) Installation direction and spacing

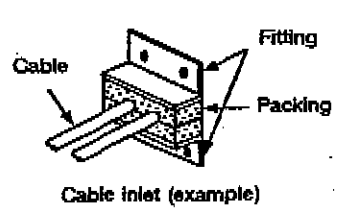
Install each unit so that the front is visible. Secure the spaces shown on the wiring for ventilation considering the heat dissipation and wiring.



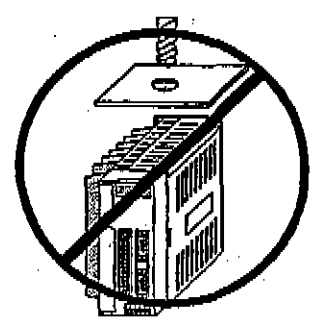
(3) Prevention of foreign matter entry

Carry out the following measures on the cabinet.

- Treat the cable inlets for dust prevention and oil prevention by plugging the inlet with packing, etc.
- Make sure that the external air does not enter inside the cabinet from the heat radiating holes, etc.
- Plug all clearances.
- Securely install the door packing.
- If a rear cover is provided, always install packing.
- Take special measures such as oil proof packing, etc., as oil will easily accumulate on the top plate and enter the cabinet from the screw holes.
- Avoid machining parts in the area after installing each unit. The cutting chips, etc., could adhere on the electronic parts and cause faults.



Cable inlet (example)



4.3 Spindle drive unit heat radiation

The loss generated during continuous rated load operation of the spindle drive unit is shown below. Use the values in table considering the most adverse conditions when designing the thermal aspects of the sealed control panel. In the actual machine, the heating value will be the middle value of the load and no-load according to the cutting load and acceleration/deceleration duty. However, use the loss generated during continuous rated load operation as a guideline.

Heating value during rated output

Drive unit model	Spindle drive unit heating value	
	During continuous rating output (W)	During no-load (W)
MDS-A-SPJA-02	30	15
MDS-A-SPJA-04	35	15
MDS-A-SPJA-075	45	15
MDS-A-SPJA-15	55	20
MDS-A-SPJA-22	85	20
MDS-A-SPJA-37	110	20
MDS-A-SPJA-55	150	20
MDS-A-SPJA-75	200	20

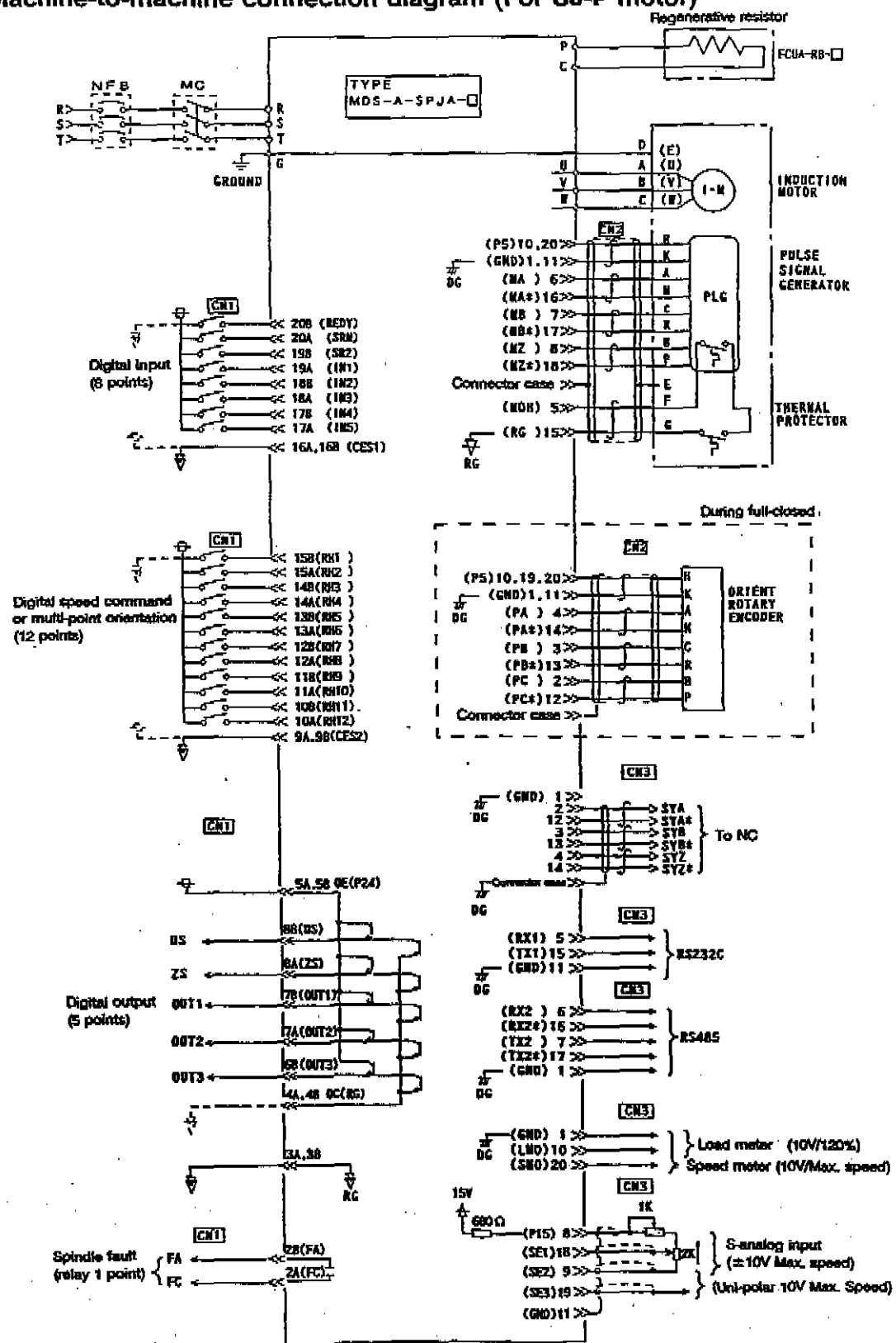
Note) The heat generated during regeneration is not included in the spindle drive unit's heating value. If the acceleration/deceleration frequency is high and the regenerative resistor's heating value is required, calculated it with the following outline equation.

$$W_R = \frac{n}{120} \times \frac{(GD_M^2 + GD_L^2)}{4} \times \left(\frac{2\pi \cdot N}{60}\right)^2 \ [W]$$

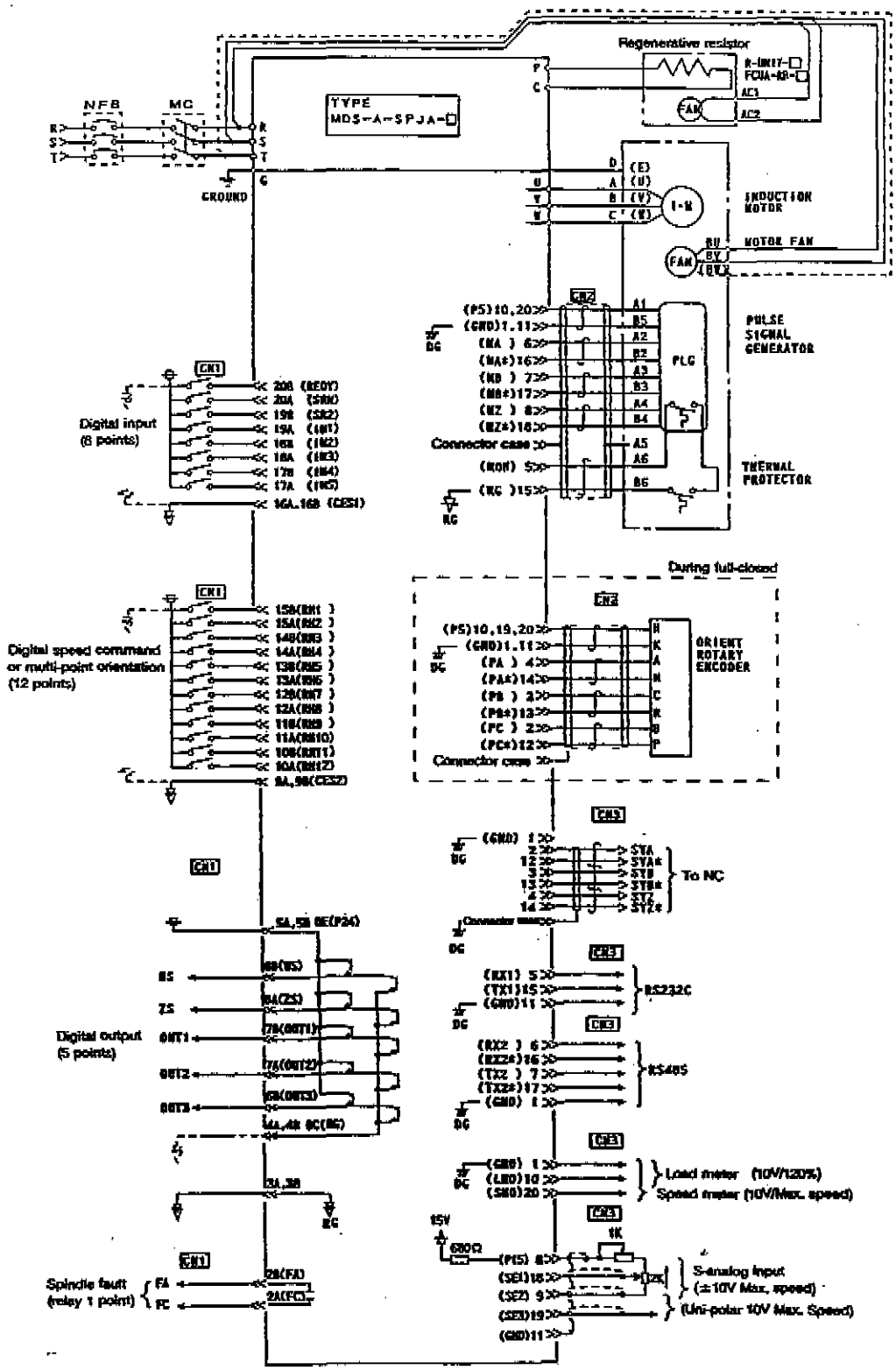
GD_M^2 : Motor rotor inertia [kg-m^2]
GD_L^2 : Motor shaft conversion load inertia [kg-m^2]
N : motor speed [r/min]
n : Acceleration/deceleration frequency [times/min.]

5. Connections

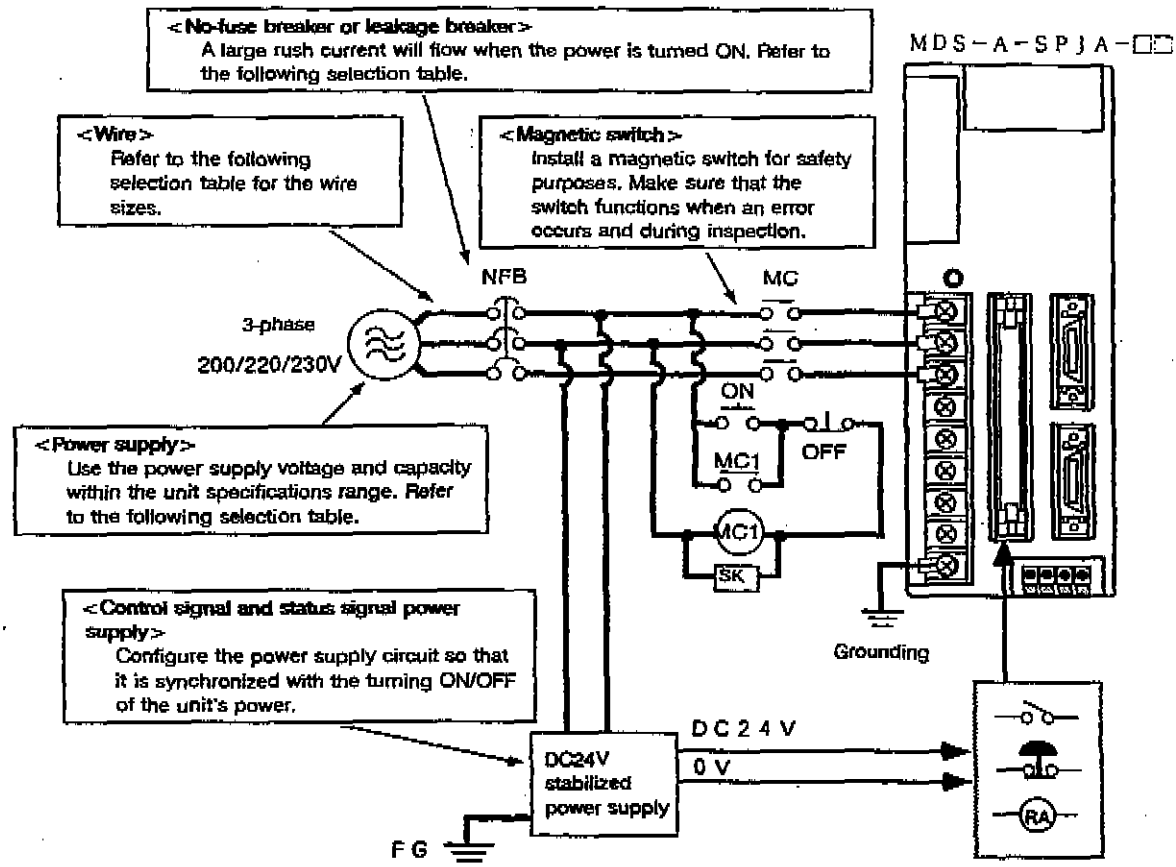
5.1 Machine-to-machine connection diagram (For SJ-P motor)



Machine-to-machine connection diagram (For SJ-PF motor)



5.2 Power supply connections



Power supply, no-fuse breaker, magnetic switch selection table

Model	Power supply facility (kVA)	No-fuse breaker	Magnetic switch
MDS-A-SPJA-02	0.5	NF30-type 5A	S-K10
MDS-A-SPJA-04	1.0	NF30-type 10A	S-K11
MDS-A-SPJA-075	2.0	NF30-type 10A	S-K11
MDS-A-SPJA-15	3.0	NF30-type 15A	S-K18
MDS-A-SPJA-22	4.0	NF30-type 20A	S-K18
MDS-A-SPJA-37	7.0	NF30-type 30A	S-K25
MDS-A-SPJA-55	9.0	NF30-type 40A	S-K25
MDS-A-SPJA-75	12.0	NF30-type 40A	S-K25

Wire size selection table

Model	Wire (mm^2)			Terminal block screw size
	R, S, T, E	U, V, W, E	P, C	
MDS-A-SPJA-02	2	2	2	M3.5 D ≤ 7mm
MDS-A-SPJA-04	2	2	2	
MDS-A-SPJA-075	2	2	2	
MDS-A-SPJA-15	3.5	3.5	3.5	
MDS-A-SPJA-22	3.5	3.5	3.5	
MDS-A-SPJA-37	3.5	3.5	3.5	M4 D ≤ 9.6mm
MDS-A-SPJA-55	3.5	3.5	3.5	
MDS-A-SPJA-75	5.5	5.5	3.5	

5.3 Digital input/output signal connection

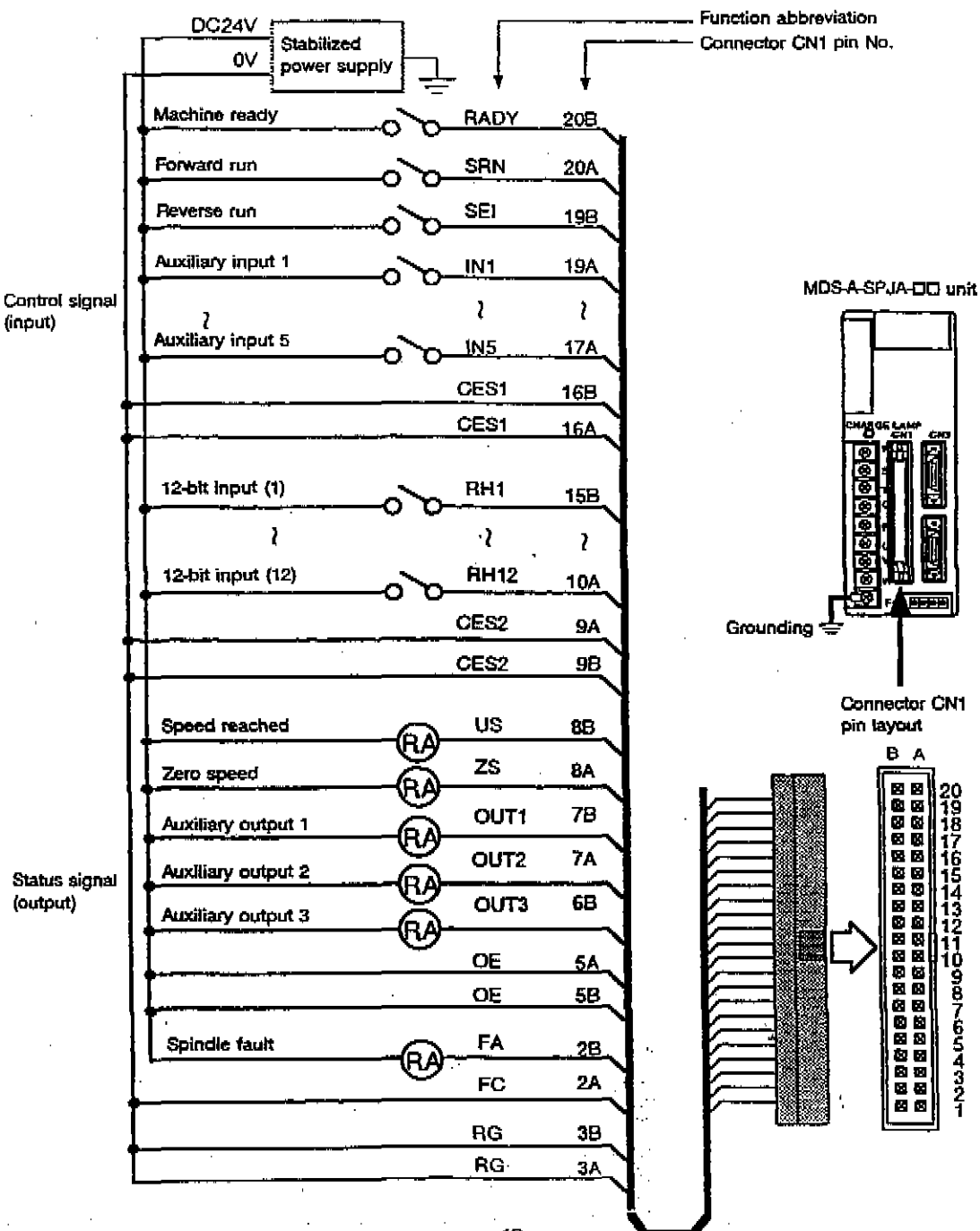
[Standard connection to spindle unit]

The digital input/output signal is connected to connector CN1.

The input signal can be used for either the open emitter input method [connect common CSE1 or 2 pin connector to DC24V] or the open collector input method [connect common CSE1 or 2 pin connector to 0V].

The output signal can also be used for either the open emitter output method [connect common OE pin to DC24V] or the open collector output method [connect common OC pin to 0VG].

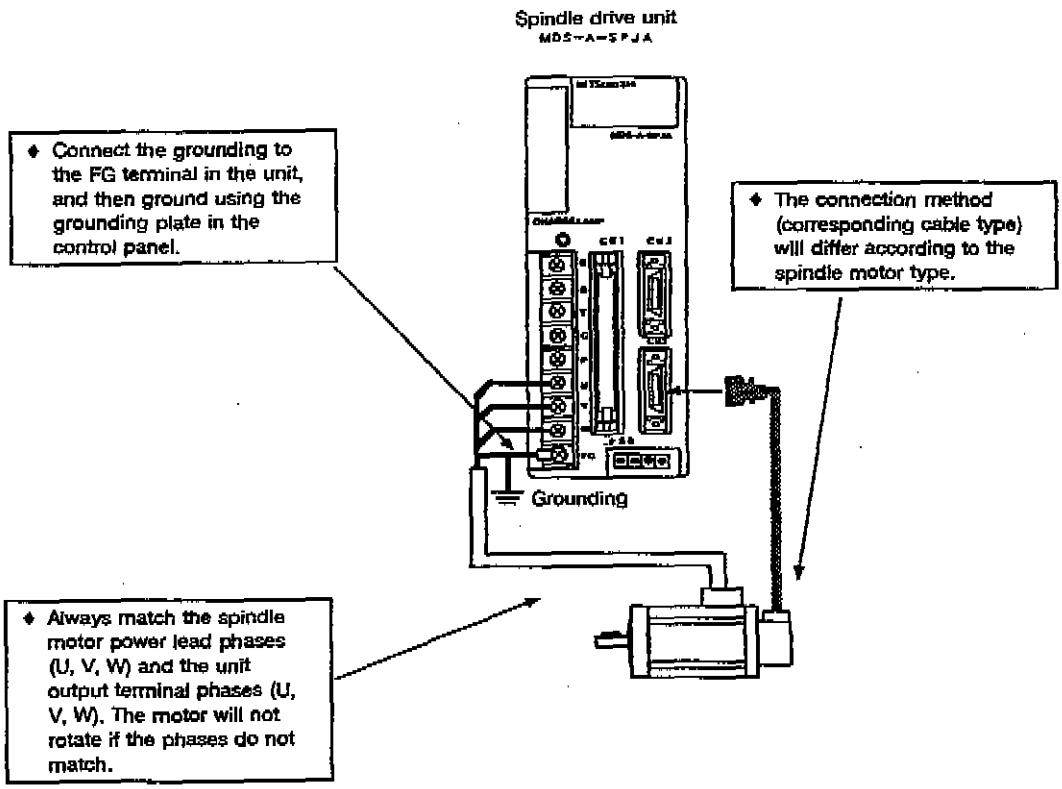
The following diagram shows the connection of the open emitter input method.



5.4 Spindle motor and detector connection

The spindle motor drive line is connected to the U, V and W terminals on the drive unit. Note that the connector shape, etc., will differ according to the type of spindle motor being used.
The spindle motor end detector is connected to connector CN2 on the unit. The cable and connector shape used will differ according to the spindle motor type. Refer to sections 5.4.2 to 5.4.3 for the connection details (detector cable connection according to motor).

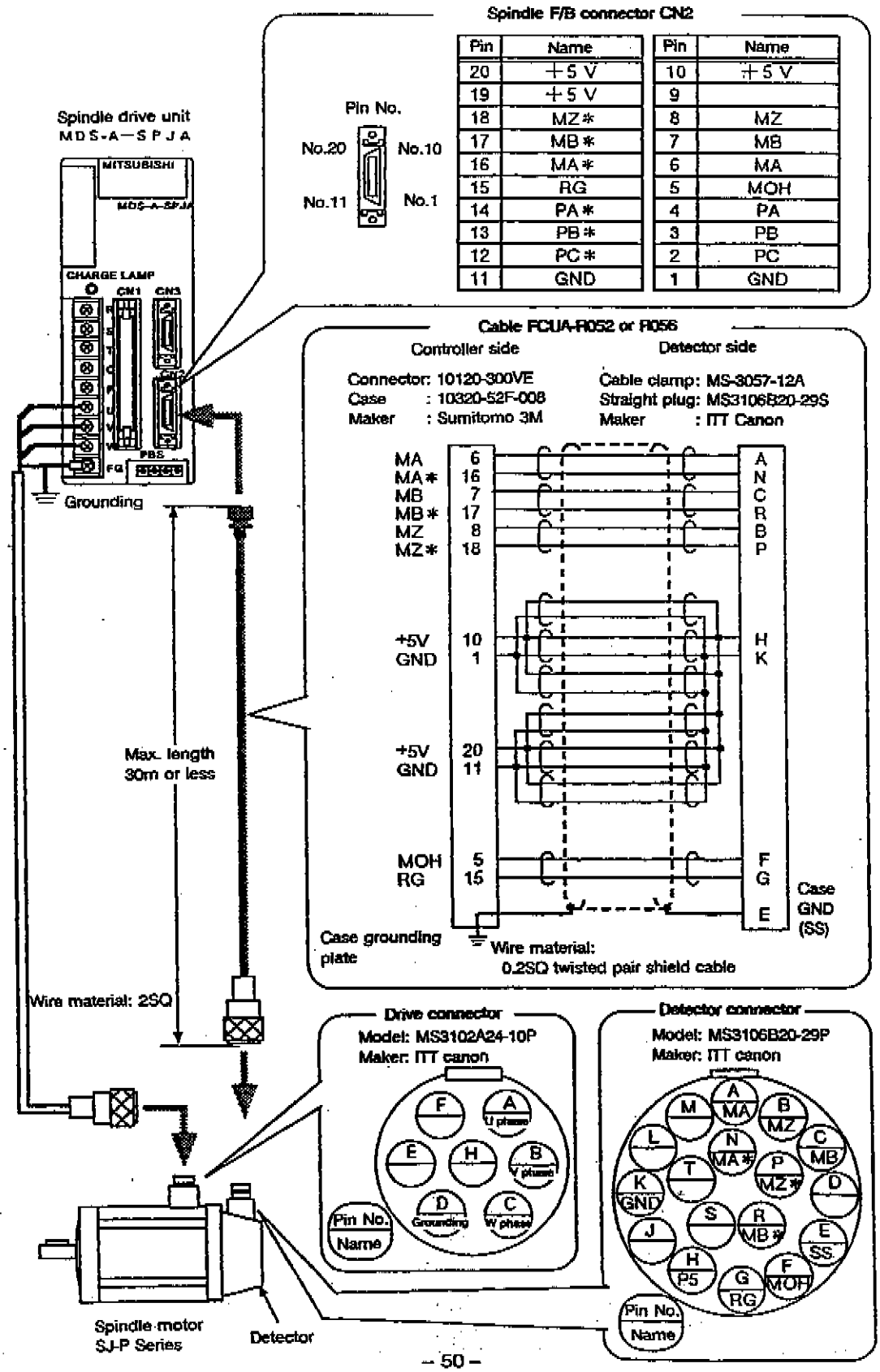
5.4.1 Precautions for connecting spindle motor and detector



Wire size selection table

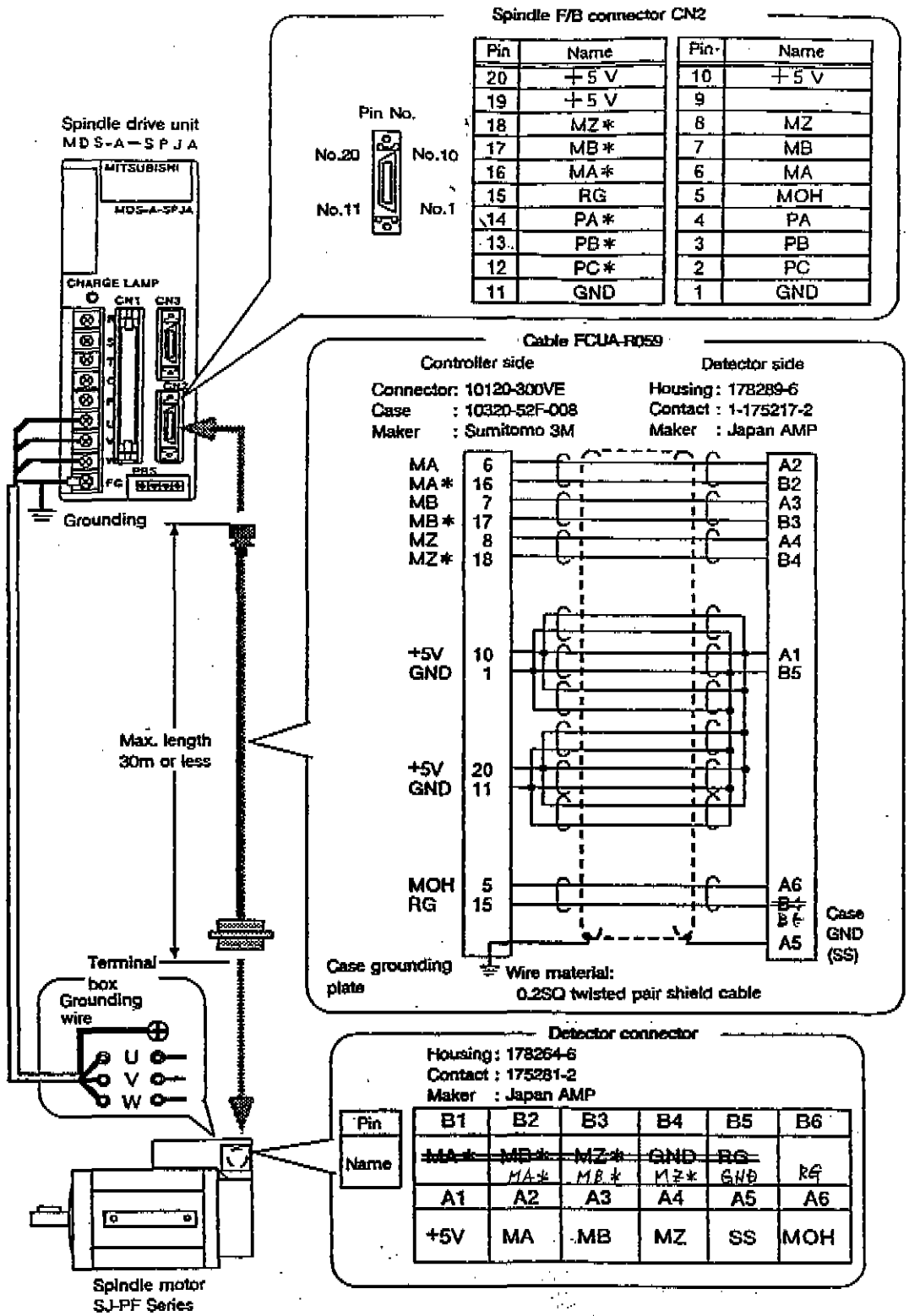
Model	Wire (mm^2)	Terminal block screw size
	U, V, W	
MDS-A-SPJA-02	2	M3.5 D ≤ 7mm
MDS-A-SPJA-04	2	
MDS-A-SPJA-075	2	
MDS-A-SPJA-15	3.5	
MDS-A-SPJA-22	3.5	
MDS-A-SPJA-37	3.5	M4 D ≤ 9.6mm
MDS-A-SPJA-55	3.5	
MDS-A-SPJA-75	5.5	

5.4.2 SJ-P (canon) Series spindle motor and detector connection



Pin	Name	Pin	Name
20	+5 V	10	+5 V
19	+5 V	9	
18	MZ*	8	MZ
17	MB*	7	MB
16	MA*	6	MA
15	RG	5	MOH
14	PA*	4	PA
13	PB*	3	PB
12	PC*	2	PC
11	GND	1	GND

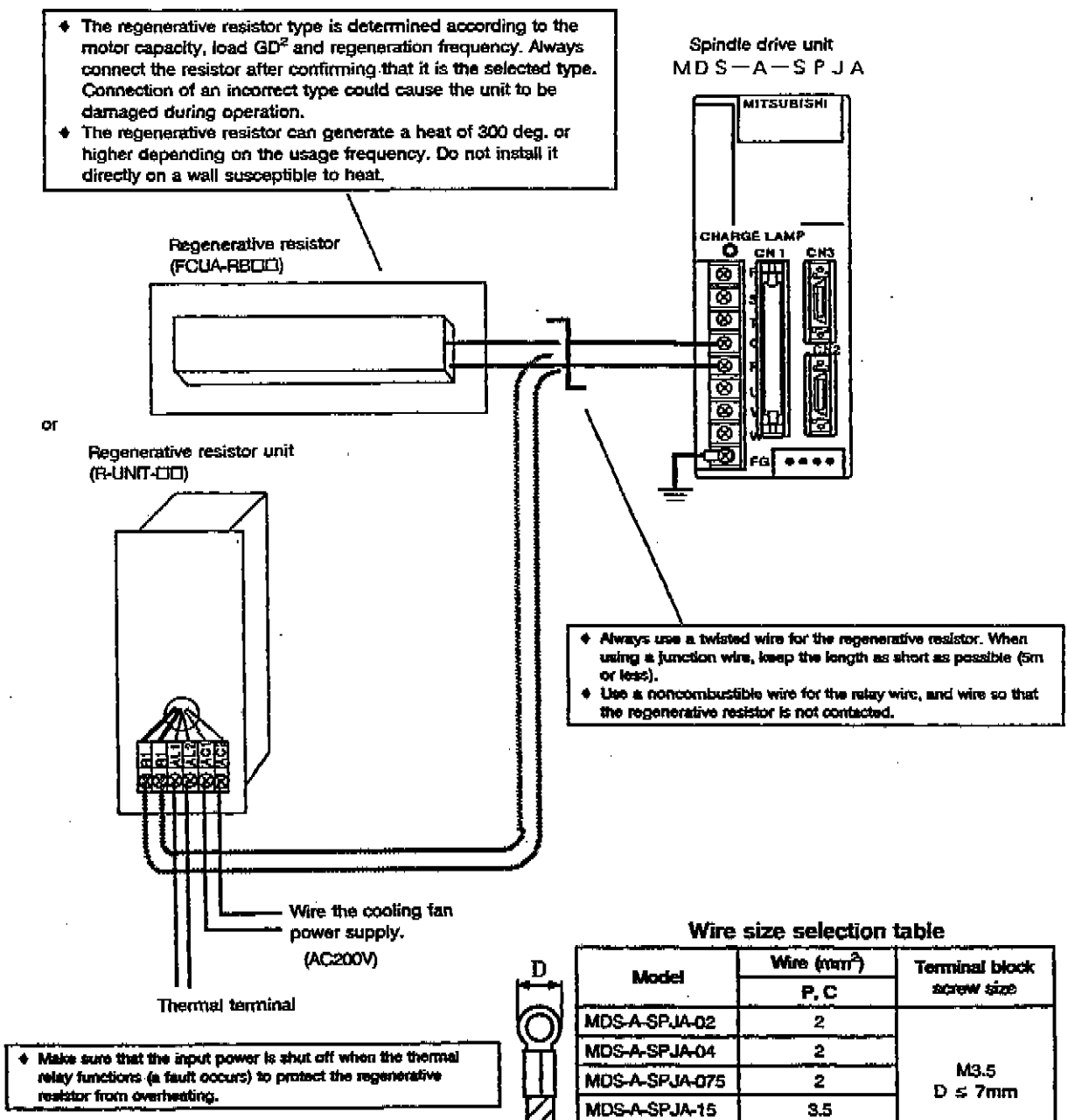
5.4.3 SJ-PF Series spindle motor and detector connection



Pin	Name	Pin	Name
20	+5 V	10	+5 V
19	+5 V	9	
18	MZ*	8	MZ
17	MB*	7	MB
16	MA*	6	MA
15	RG	5	MOH
14	PA*	4	PA
13	PB*	3	PB
12	PC*	2	PC
11	GND	1	GND

5.5 Regenerative resistor connection

A regenerative resistor must be connected to the spindle drive unit.
The regenerative resistor is connected to terminals C and P on the unit.



Wire size selection table

Model	Wire (mm²) P, C	Terminal block screw size
MDS-A-SPJA-02	2	M3.5 D ≤ 7mm
MDS-A-SPJA-04	2	
MDS-A-SPJA-075	2	
MDS-A-SPJA-15	3.5	
MDS-A-SPJA-22	3.5	
MDS-A-SPJA-37	3.5	M4 D ≤ 9.6mm
MDS-A-SPJA-55	3.5	
MDS-A-SPJA-75	3.5	

5.6 Analog input/output connection

5.6.1 Precautions regarding connections

The analog input/output (S-analog command voltage input, speed/load meter voltage output), encoder pulse output and the signals with the personal computer are connected to connector CN3.

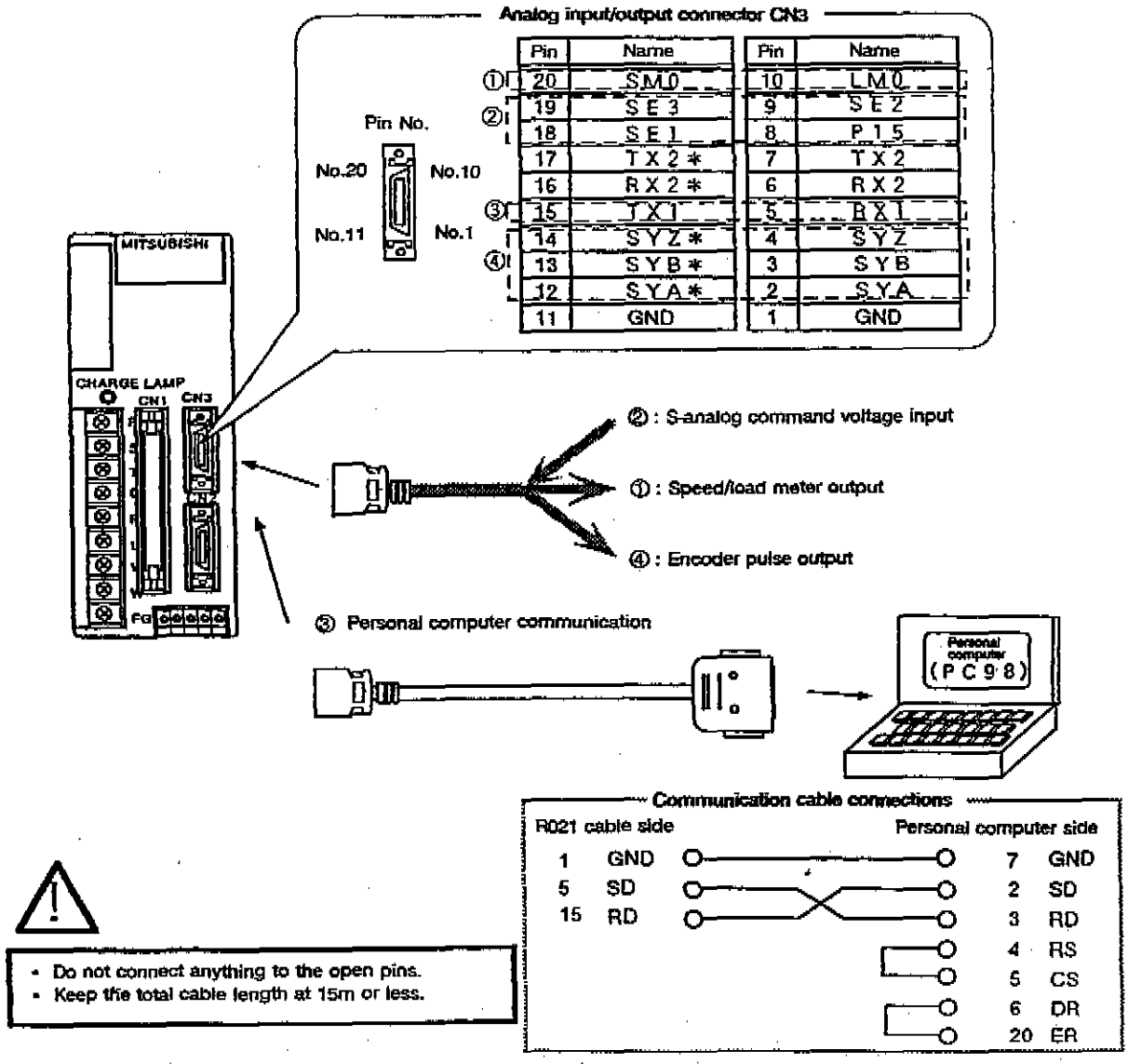
Analog input : The ±10V and 0 to +10V input voltages are available for the S-analog command, so take care when wiring. Always treat the wire with a shield.

Analog output: The speed/load meter output voltage is 0 to 10V. Use a voltmeter having an internal impedance with 10kΩ or more.

Pulse output : The encoder pulses (1024p/rev) are output.

Personal computer communication:

The data is transferred via RS-232-C. Note that this is used for starting up and for maintenance, and must not be connected during normal operation. The total length of the cable should be 3m or less to prevent communication errors. However, the total length may differ according to the specifications of the personal computer being used.



	Pin	Name	Pin	Name
①	20	SM0	10	LM0
②	19	SE3	9	SE2
	18	SE1	8	P15
	17	TX2*	7	TX2
	16	RX2*	6	RX2
③	15	TX1	5	RX1
	14	SYZ*	4	SYZ
④	13	SYB*	3	SYB
	12	SYA*	2	SYA
	11	GND	1	GND

5.7 Cable manufacturing drawing

5.7.1 FCUA-R001 cable manufacturing drawing

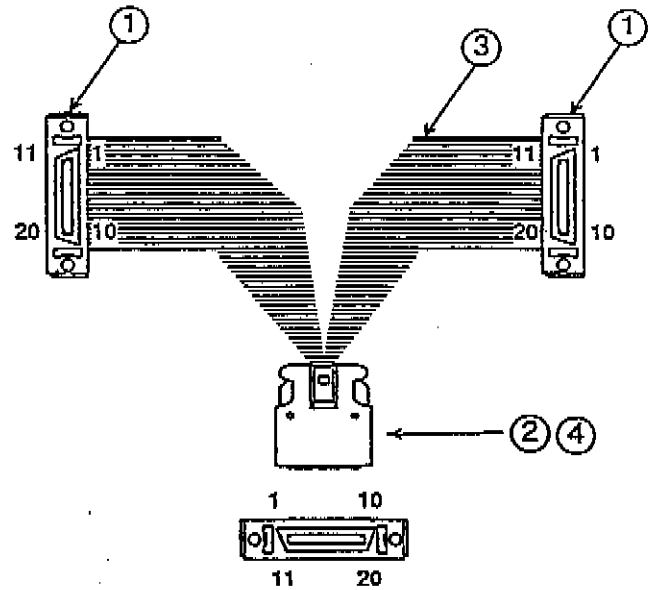
Application:

Distribution of communication terminal signals Max. cable length: 4cm
Distribution of spindle drive unit signals

Assembly drawing:

List of parts

No.	Part name/model	Maker	Qty.
①	Connector 10220-0200EL	Sumitomo 3M	2
②	Connector 10120-3000VE	Sumitomo 3M	1
③	Wire material (flat cable) 1.27mm pitch flat		(1)
④	Connector case 10320-52F0-008	Sumitomo 3M	1



Connection drawing:

The connection is a one-on-one connection. (One pin is connected to one terminal.)

Precautions for manufacturing:

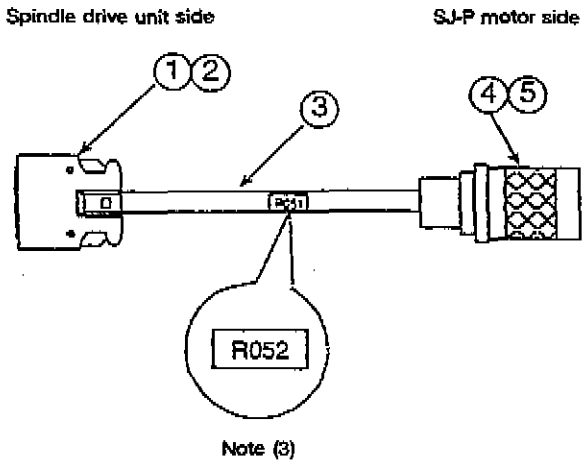
(1) The parts are those recommended by Mitsubishi, and can be replaced with equivalent parts that are compatible specification-wise.

5.7.2 FCUA-R052 cable manufacturing drawing (For SJ-P)

Application:

Connection of spindle drive unit and SJ-P motor (straight type) (Detector cable)

Option (Corresponding connector set) FCUA-CS050

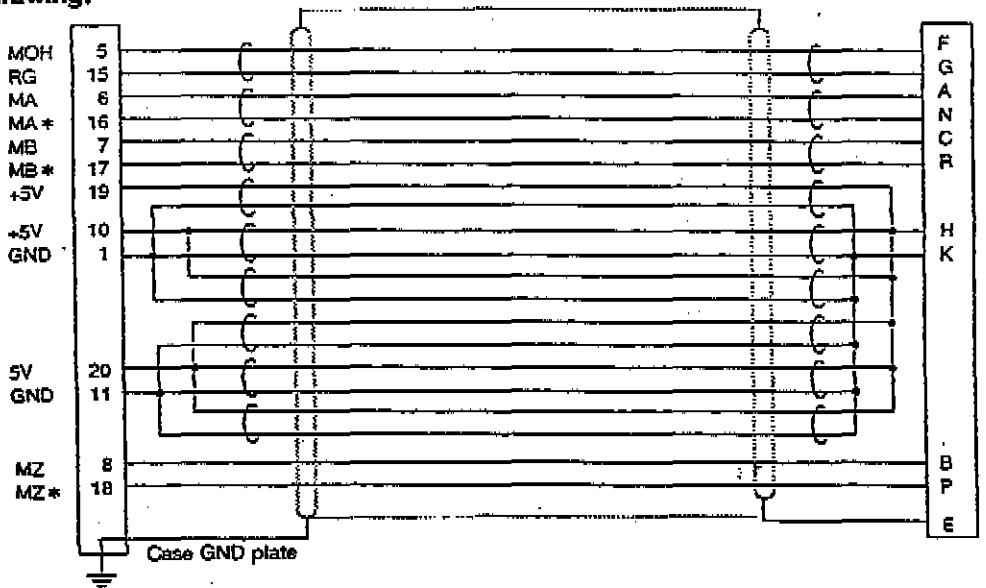


List of parts

No.	Part name/model	Maker	Qty.
①	Connector 10120-3000VE	Sumitomo 3M	1
②	Connector case 10320-52F0-008	Sumitomo 3M	1
③	Wire UL1061-2464 AWG22×12P	Note (1)	(1)
④	Straight plug MS3106B20-29S	ITT Canon	1
⑤	Cable clamp MS3057-12A	ITT Canon	1

Connection drawing:

Max. cable length: 30m



Precautions for manufacturing:

(1) The wire is a cable covering 12 pairs of stranded wheels with a sheath, and is equivalent to the UL1061-2464 standard product AWG22 (0.3mm^2).
(2) The parts are those recommended by Mitsubishi, and can be replaced with equivalent parts that are compatible specification-wise.
(3) Attach the nameplate with protective cover on which the cable name is stamped onto the position designated in the assembly drawing.
(4) Fold the wire shield on the control unit side, and wrap copper foil tape over it. Connect with the connector case GND plate.
(5) For the batch connection treatment or shield treatment wire use a wire that is equivalent to AWG24 (0.2mm^2).
(6) The part 1 connector uses the catalog specifications, and is for wires that are AWG24 (0.2mm^2) or less. However, it also can be used for AWG22 (0.3mm^2).

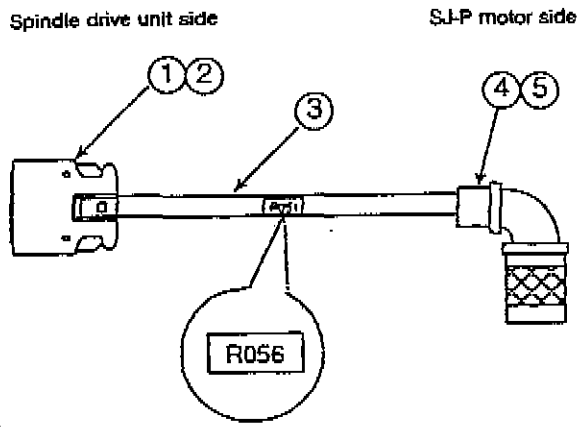
5.7.3 FCUA-R056 cable manufacturing drawing (For SJ-P)

Application:

Connection of spindle drive unit and SJ-P motor (straight type) (Detector cable)

Option (Corresponding connector set) FCUA-CS054

Assembly drawing:

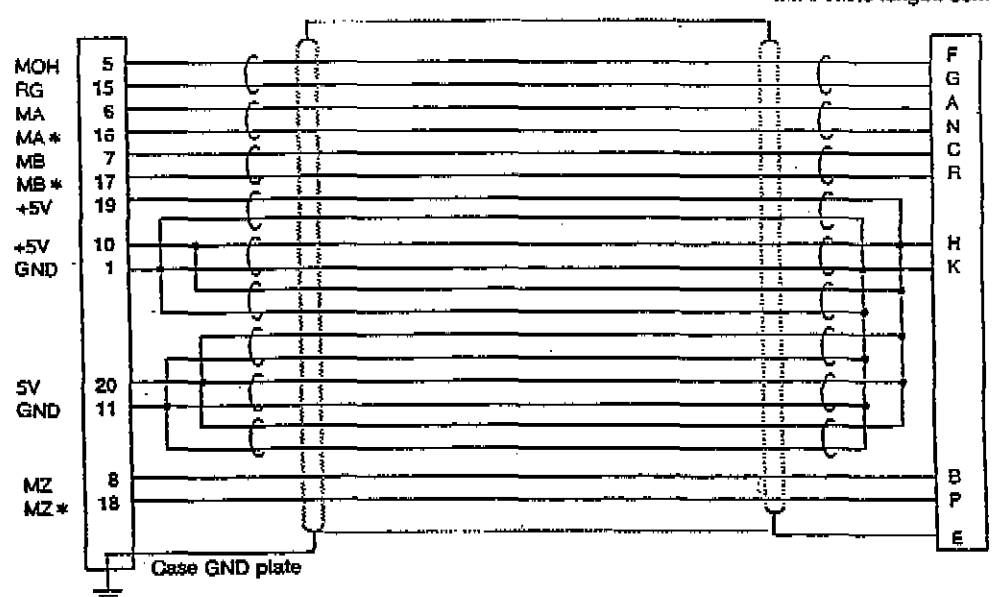


List of parts

No.	Part name/model	Maker	Qty.
①	Connector 10120-3000VE	Sumitomo 3M	1
②	Connector case 10320-52F0-008	Sumitomo 3M	1
③	Wire UL1061-2464 AWG22×12P	Note (1)	(1)
④	Straight plug MS3108B20-29S	ITT Canon	1
⑤	Cable clamp MS3057-12A	ITT Canon	1

Connection drawing: Note (3)

Max. cable length: 30m



Precautions for manufacturing:

(1) The wire is a cable covering 12 pairs of stranded wheels with a sheath, and is equivalent to the UL1061-2464 standard product AWG22 (0.3mm²).
(2) The parts are those recommended by Mitsubishi, and can be replaced with equivalent parts that are compatible specification-wise.
(3) Attach the nameplate with protective cover on which the cable name is stamped onto the position designated in the assembly drawing.
(4) Fold the wire shield on the control unit side, and wrap copper foil tape over it. Connect with the connector case GND plate.
(5) For the batch connection treatment or shield treatment wire use a wire that is equivalent to AWG24 (0.2mm²).
(6) The part 1 connector uses the catalog specifications, and is for wires that are AWG24 (0.2mm²) or less. However, it also can be used for AWG22 (0.3mm²).

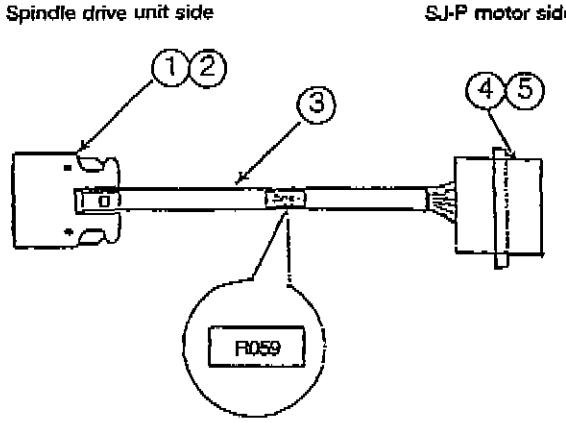
5.7.4 FCUA-R059 cable manufacturing drawing (For SJ-PF)

Application:

Connection of spindle drive unit and SJ-PF motor(straight type) (Detector cable)

Option (Corresponding connector set) FCUA-CS059

Assembly drawing:



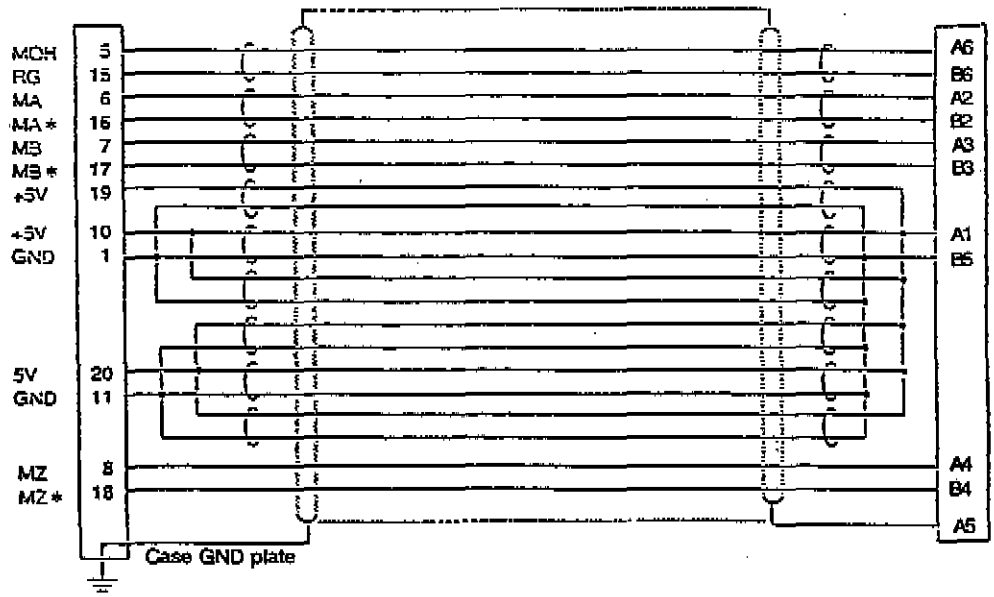
List of parts

No.	Part name/model	Maker	Qty.
①	Connector 10120-3000VE	Sumitomo 3M	1
②	Connector case 10320-52F0-008	Sumitomo 3M	1
③	Wire UL1061-2464 AWG22×12P	Note (1)	(1)
④	Housing 178289-6	Japan AMP	1
⑤	Contact 1-175217-2	Japan AMP	12

B1	B2	B3	B4	B5	B6
	MA*	MB*	MZ*	GND	RG
A1	A2	A3	A4	A5	A6
+5V	MA	MB	MZ	Case GND	MOH

Connection drawing: Note (3)

Max. cable length: 30m



Precautions for manufacturing:

(1) The wire is a cable covering 12 pairs of stranded wheels with a sheath, and is equivalent to the UL1061-2464 standard product AWG22 (0.3mm²).
(2) The parts are those recommended by Mitsubishi, and can be replaced with equivalent parts that are compatible specification-wise.
(3) Attach the nameplate with protective cover on which the cable name is stamped onto the position designated in the assembly drawing.
(4) Fold the wire shield on the control unit side, and wrap copper foil tape over it. Connect with the connector case GND plate.
(5) For the batch connection treatment or shield treatment wire use a wire that is equivalent to AWG24 (0.2mm²).
(6) The part 1 connector uses the catalog specifications, and is for wires that are AWG24 (0.2mm²) or less. However, it also can be used for AWG22 (0.3mm²).

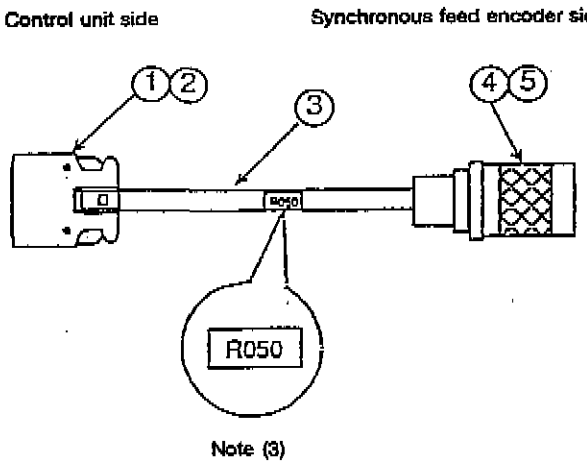
5.7.5 FCUA-R050 cable manufacturing drawing

Application:

Connection between control unit and synchronous feed encoder
(Straight type)

Option (Corresponding connector set)
FCUA-CS050

Assembly drawing:

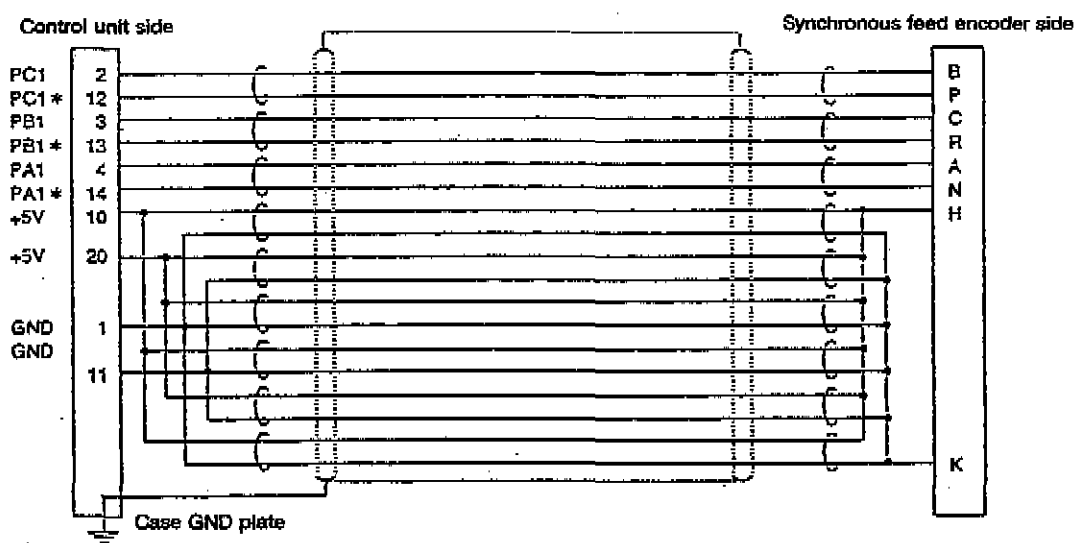


List of parts

No.	Part name/model	Maker	Qty.
①	Connector 10120-3000VE	Sumitomo 3M	1
②	Connector case 10320-52F0-008	Sumitomo 3M	1
③	Wire UL1061-2464 AWG22×12P	Note (1)	(1)
④	Straight plug MS3106B20-29S	ITT Canon	1
⑤	Cable clamp MS3057-12A	ITT Canon	1

Connection drawing:

Max. cable length: 30m



Precautions for manufacturing:

(1) The wire is a cable covering 12 pairs of stranded wheels with a sheath, and is equivalent to the UL1061-2464 standard product AWG22 (0.3mm²).
(2) The parts are those recommended by Mitsubishi, and can be replaced with equivalent parts that are compatible specification-wise.
(3) Attach the nameplate with protective cover on which the cable name is stamped onto the position designated in the assembly drawing.
(4) Fold the wire shield on the control unit side, and wrap copper foil tape over it. Connect with the connector case GND plate.
(5) For the batch connection treatment or shield treatment wire use a wire that is equivalent to AWG24 (0.2mm²).
(6) The part 1 connector uses the catalog specifications, and is for wires that are AWG24 (0.2mm²) or less. However, it also can be used for AWG22 (0.3mm²).

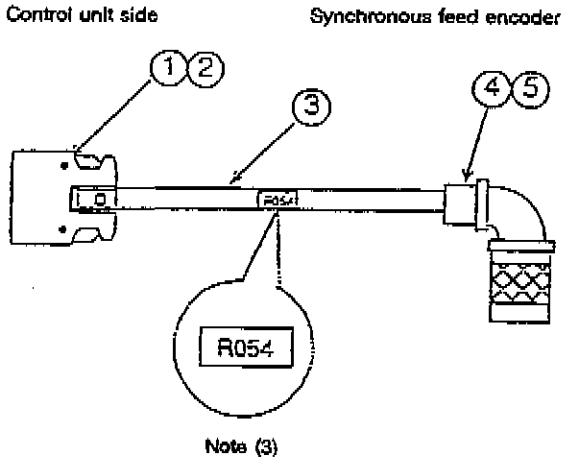
5.7.6 FCUA-R054 cable manufacturing drawing

Application:

Connection between control unit and synchronous feed encoder
(Right angle type)

Option (Corresponding connector set)
FCUA-CS054

Assembly drawing:

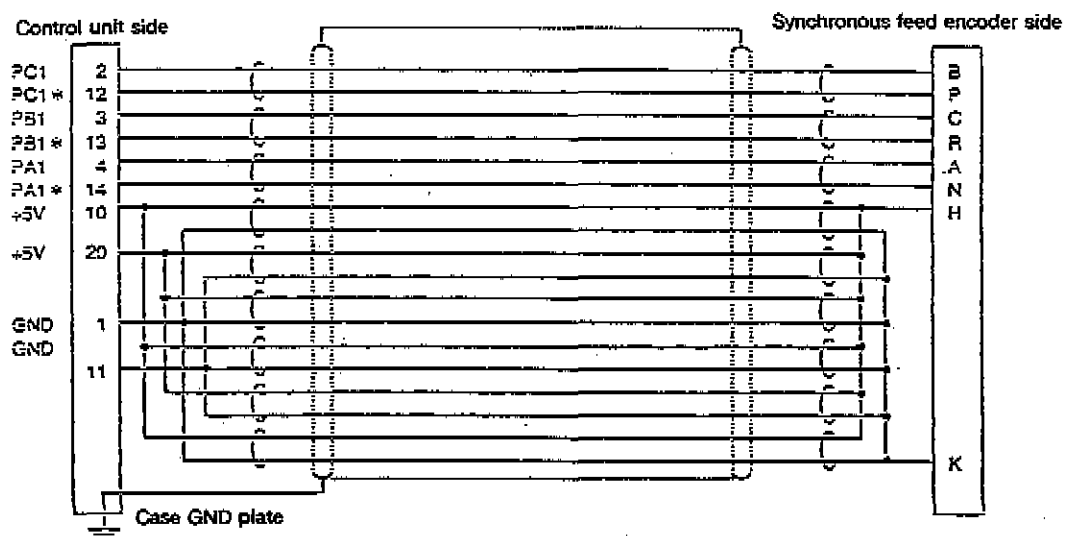


List of parts

No.	Part name/model	Maker	Qty.
①	Connector 10120-3000VE	Sumitomo 3M	1
②	Connector case 10320-52F0-008	Sumitomo 3M	1
③	Wire UL1061-2464 AWG22×12P	Note (1)	(1)
④	Right angle plug MS3108B20-29S	ITT Canon	1
⑤	Cable clamp MS3057-12A	ITT Canon	1

Connection drawing:

Max. cable length: 30m



Precautions for manufacturing:

(1) The wire is a cable covering 12 pairs of stranded wheels with a sheath, and is equivalent to the UL1061-2464 standard product AWG22 (0.3mm^2).
(2) The parts are those recommended by Mitsubishi, and can be replaced with equivalent parts that are compatible specification-wise.
(3) Attach the nameplate with protective cover on which the cable name is stamped onto the position designated in the assembly drawing.
(4) Fold the wire shield on the control unit side, and wrap copper foil tape over it. Connect with the connector case GND plate.
(5) For the batch connection treatment or shield treatment wire use a wire that is equivalent to AWG24 (0.2mm^2).
(6) The part 1 connector uses the catalog specifications, and is for wires that are AWG24 (0.2mm^2) or less. However, it also can be used for AWG22 (0.3mm^2).

5.7.7 FCUA-R300 cable manufacturing reference drawing

Application:

Connection between controller and machine distribution panel

Assembly drawing:

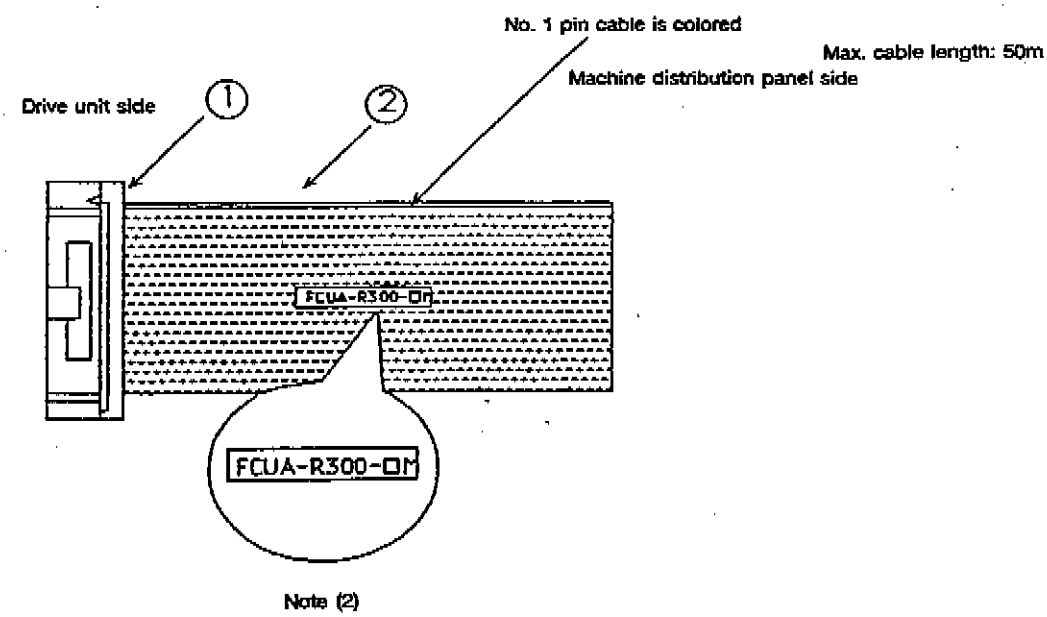
Option (corresponding connector set)

FCUA-CN300 (Note that only the connector on the drive unit side corresponds.)

List of parts

No.	Part name/model	Maker	Qty.
①	Connector 7940-6500SC	Sumitomo 3M	1
②	Wire material B40-S	Note (1)	(1)

Connection drawing:



Precautions for manufacturing:

(1) Attach the nameplate with protective cover on which the cable name is stamped onto the position designated in the assembly drawing.

(2) Fold the wire shield on the control unit side, and wrap copper foil tape over it. Connect with the connector case GND plate.

5.7.8 FCUA-R301 cable manufacturing reference drawing

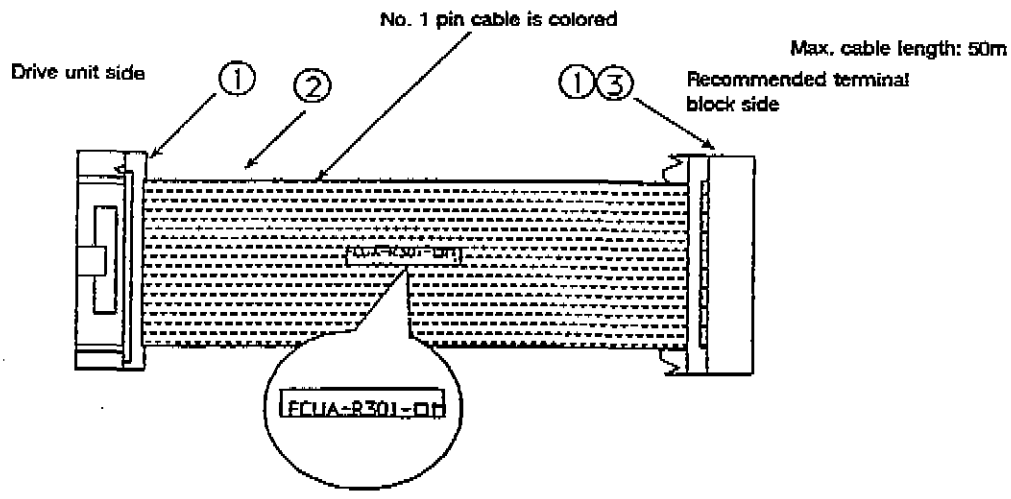
Application:
Connection between controller and recommended terminal block

Assembly drawing:
Option (corresponding connector set)
FCUA-CN301 (Note that only the connector on the drive unit side corresponds.)

List of parts

No.	Part name/model	Maker	Qty.
①	Connector 7940-6500SC	Sumitomo 3M	2
②	Wire material B40-S	Note (1)	(1)
③	Strain relief 3448-7940	Sumitomo 3M	1

Connection drawing:

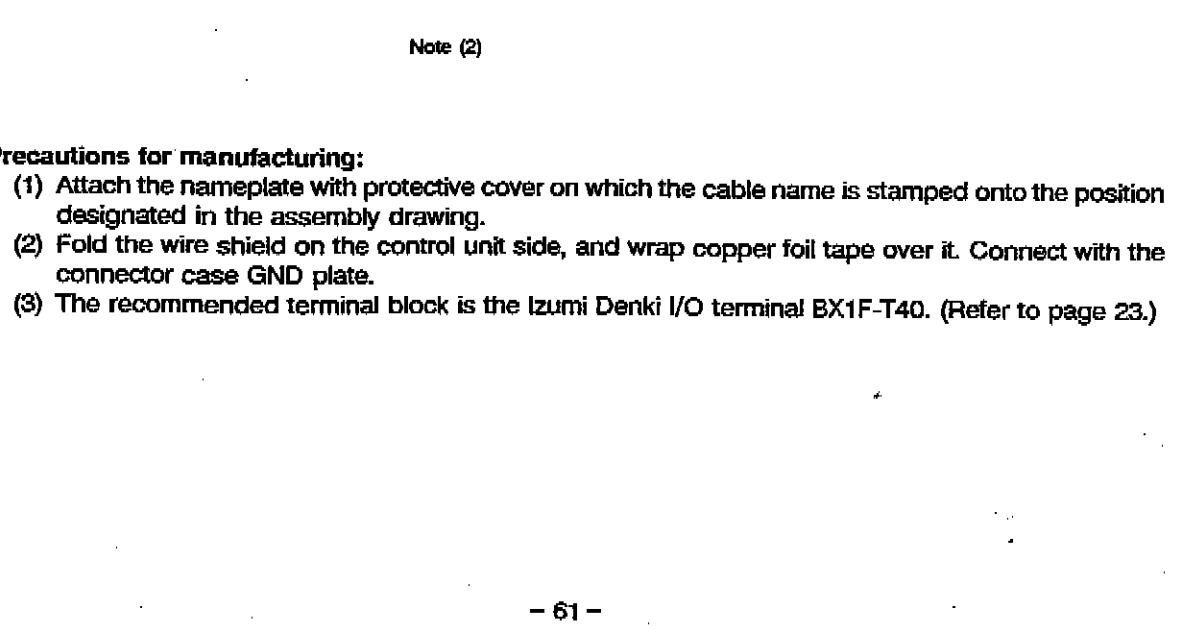


Note (2)

Precautions for manufacturing:
(1) Attach the nameplate with protective cover on which the cable name is stamped onto the position designated in the assembly drawing.
(2) Fold the wire shield on the control unit side, and wrap copper foil tape over it. Connect with the connector case GND plate.
(3) The recommended terminal block is the Izumi Denki I/O terminal BX1F-T40. (Refer to page 23.)

The R300 and R301 cables are available for the digital input/output cable. The R300 cable has one end cut off, and the R301 cable is used to connect with the terminal block.
The R300-3M and R301-3M are prepared by Mitsubishi. If a cable other than the 3m cable is required, use the connector set CN300 or CS301.

* : Recommended terminal block: Please purchase the Izumi Denki BX1F-T40.



Connector pin correspondence table

Terminal block BX1F	CN1
2	A1
4	A2
6	A3
8	A4
10	A5
12	A6
14	A7
16	A8
18	A9
20	A10
22	A11
24	A12
26	A13
28	A14
30	A15
32	A16
34	A17
36	A18
38	A19
40	A20

Terminal block BX1F	CN1
1	B1
3	B2
5	B3
7	B4
9	B5
11	B6
13	B7
15	B8
17	B9
19	B10
21	B11
23	B12
25	B13
27	B14
29	B15
31	B16
33	B17
35	B18
37	B19
39	B20

6. Status Display and Parameter Settings

⚠ WARNING

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

⚠ CAUTION

1. Check the parameters before starting operation. Failure to do so could lead to unforseen movements of the machine.
2. Do not touch the amplifier heat radiater, regenerative resistor or motor, etc., while the power is turned ON or immediately after turning the power OFF. Some parts are heated to high temperatures, and touching these could lead to burns.

The spindle drive unit status can be displayed, and the parameters can be changed with the push-buttons on the LED indicator on the front of the MDS-A-SPJA. The method to change the LED display details and the method to change the parameters using the LED indicator and push-buttons will be explained in this section.

Note that the MDS-A-SPJA parameters can be set with the following two methods.

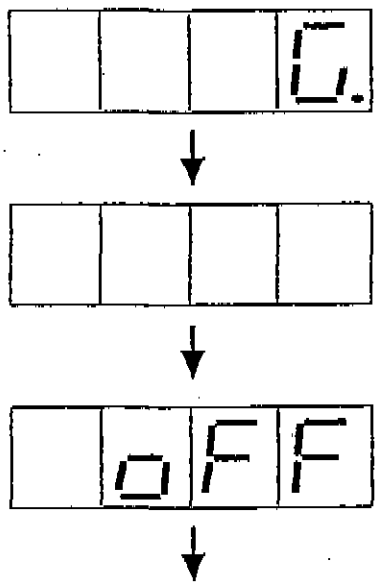
- Setting with personal computer
- Setting with MDS-A-SPJA LED indicator and push-buttons

Refer to the "MDS-A-SPJA Parameter Setting and Spindle Monitor Personal Computer Software Operation Manual (BNP-B2011-19)" for details on how to change the parameters with a personal computer.

6.1 Status display with 7-segment LED

(1) Display when power is turned ON

The following will display and the status display mode will be entered when the power is turned ON.



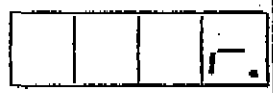
During hardware initialization

During internal memory initialization

Status display mode when initialization is completed.

The status will be displayed immediately when the ready OFF state is not entered.

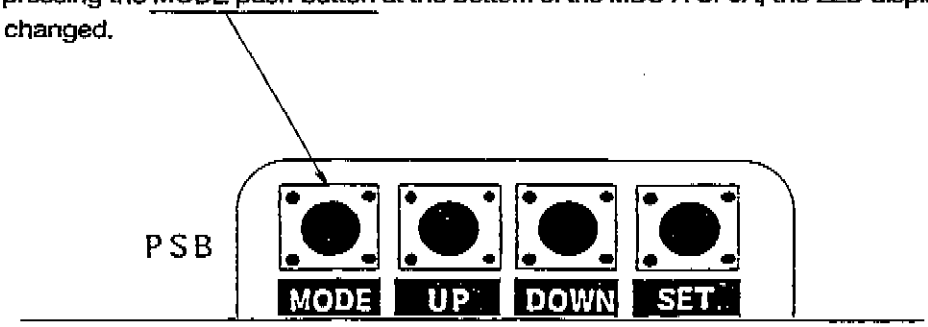
NOTE



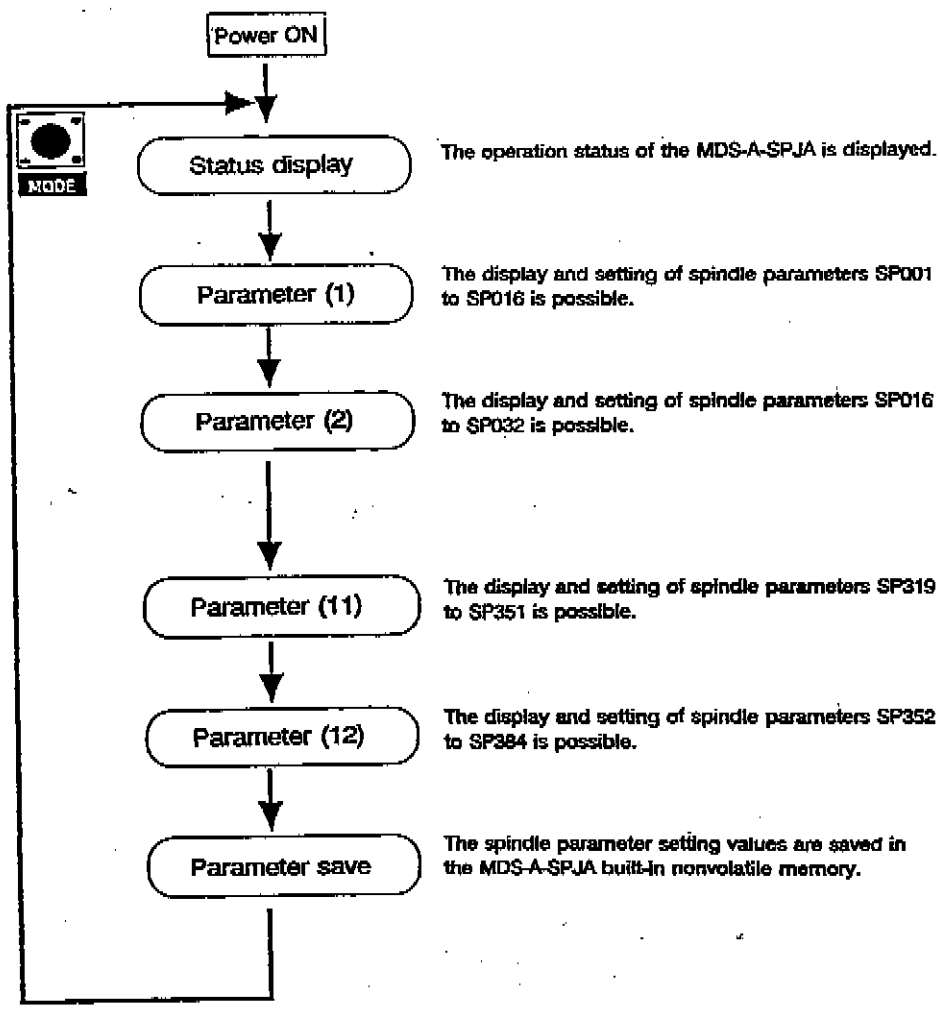
If the following displays, the rotary switch at the side of the LED is set between 8 to F. Set the rotary switch to 0, and then turn the power ON again.

(2) Changeover of LED display mode

By pressing the MODE push-button at the bottom of the MDS-A-SPJA, the LED display mode can be changed.



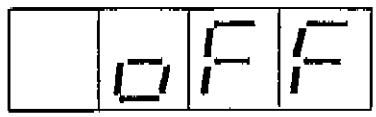
The LED display mode will change as shown below.



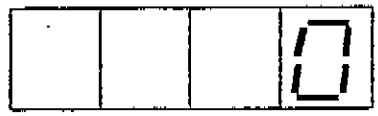
(3) Status display mode

The status display mode displays the ready OFF, ready ON and alarm/warning states separately.

1. During ready OFF
   The following will display in the ready OFF state.



2. During ready ON
   The motor speed is displayed in an [rpm] unit in the ready ON state.



When a current is not flowing to the motor (during gate OFF)

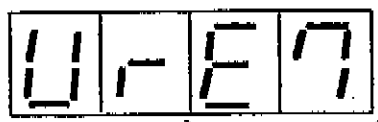
When a current is flowing to the motor (during gate ON), the got of the low-order digit will light.

If the motor speed exceeds 10,000 rpm, "ov" will display.

3. During alarm/warning
   The following will display during an alarm or warning state.

Alarm No.

The display will flicker during an alarm, and the alarm No. will display after "Al".

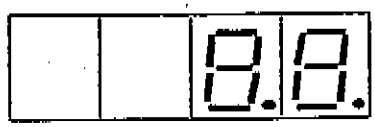


Warning No.

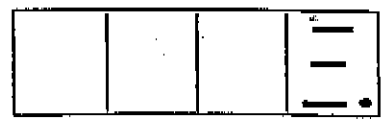
The alarm No. will display after "Wr" during a warning.

Note that the following will display when alarm "88" watch dog or alarm "Z" memory error occurs.

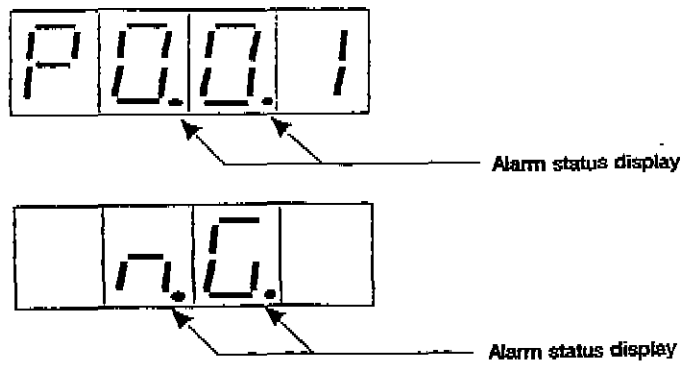
During alarm "88" watch dog



During alarm "Z" memory error

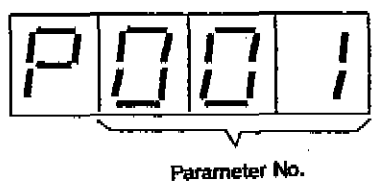


If the LED display is changed to the parameter mode or parameter save mode during an alarm, the alarm status will be displayed.



(4) Parameter mode

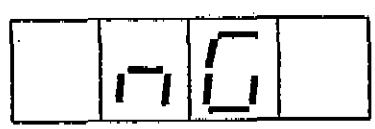
In the parameter mode, a block of 32 parameters can be displayed and set. The parameter No. will display as shown below in the parameter mode.



Refer to section "6.2.1 Parameter display and setting method" for details on displaying and setting parameters.

(5) Parameter save mode

The parameters can be saved in the MDS-A-SPJA built-in nonvolatile memory with the parameter save mode. The following will display when the parameter save mode is entered.



Refer to section "6.2.1 Parameter display and setting method" for details on the parameter save mode.

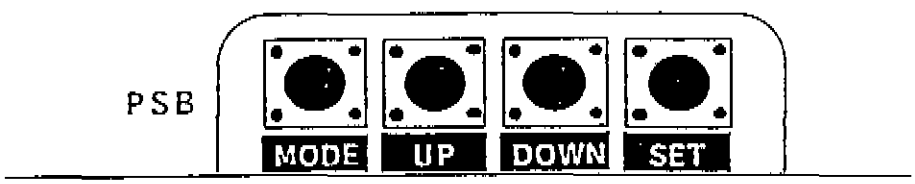
6.2 Parameters

6.2.1 Parameter display and setting method

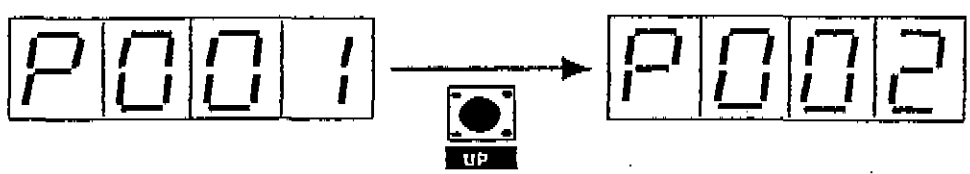
If the LED display mode is parameter (1) to parameter (12), the spindle parameters can be displayed and set.

(1) Changing the parameter No.

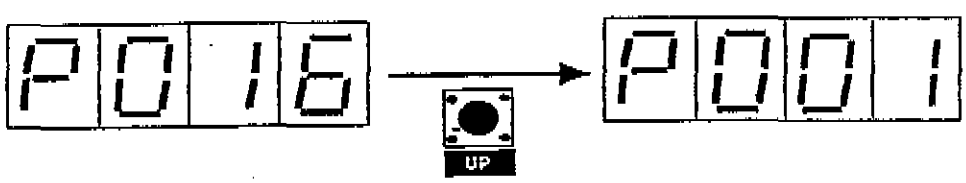
When the LED display is a parameter mode, 32 parameters are handled as a block. To change the parameter No. in the block, press the "UP" or "DOWN" push-buttons at the bottom of the MDS-A-SPJA.



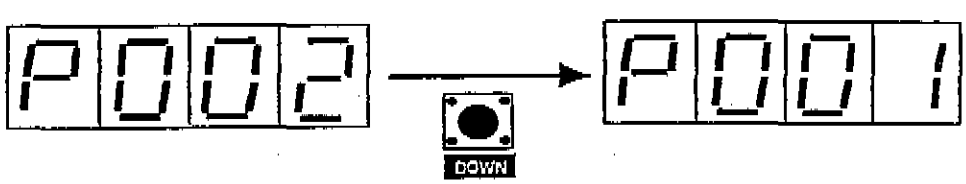
1. The parameter No. will advance by one when the "UP" button is pressed once.



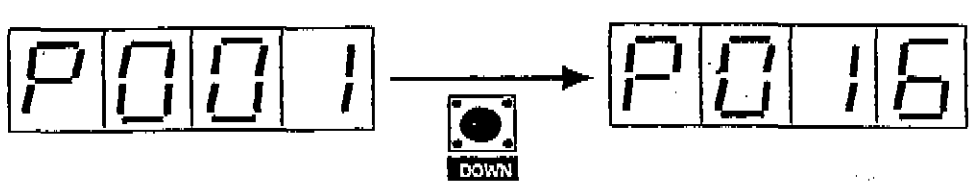
If the "UP" button is pressed once at the last parameter No. in the block, the No. will return to the first parameter of the block.



2. The parameter No. will return by one when the "DOWN" button is pressed once.

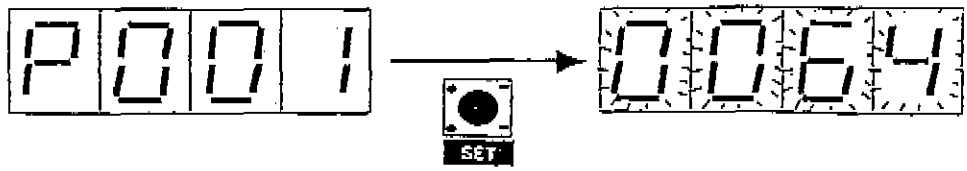


If the "DOWN" button is pressed once at the first parameter No. in the block, the No. will return to the last parameter of the block.

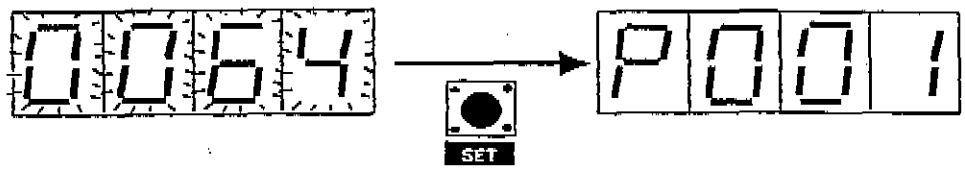


(2) Displaying of parameters

1. If the "SET" button is pressed when a parameter No. is displayed, the display will flicker and the parameter setting value corresponding to the parameter No. will display.
   [Note] All parameter values are displayed as hexadecimal values.

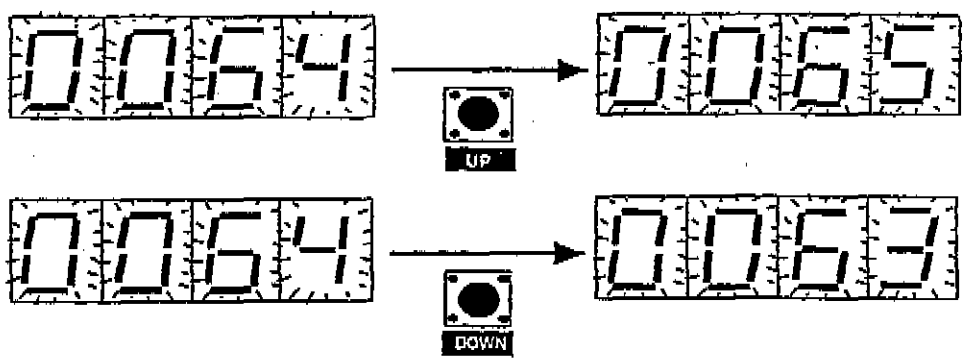


2. If the "SET" button is pressed again, the display will return to the original parameter No.

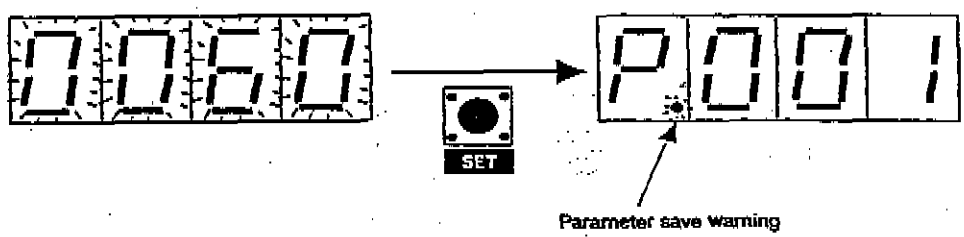


(3) Setting of parameters

1. The parameter setting value can be changed by pressing the "UP" button or "DOWN" button in the state shown in (2) 1. If the button is held down, the value will change quickly.
   [Note] All parameter values are set as hexadecimal values. To set a decimal parameter, convert the decimal value into a hexadecimal value, and then set.

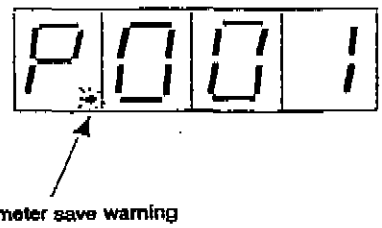


When the value to be set is reached, press the "SET" button. The parameter will change, and the display will return to the parameter No. If the parameter has been changed, the parameter save warning display will flicker.
If the set parameter is not saved in the MDS-A-SPJA nonvolatile memory, the settings will be invalidated the next time the power is turned ON. Refer to section "(4) Saving to nonvolatile memory" for details on saving.

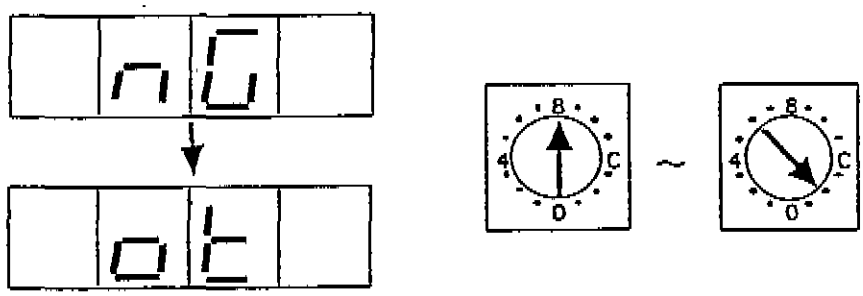


(4) Saving to nonvolatile memory

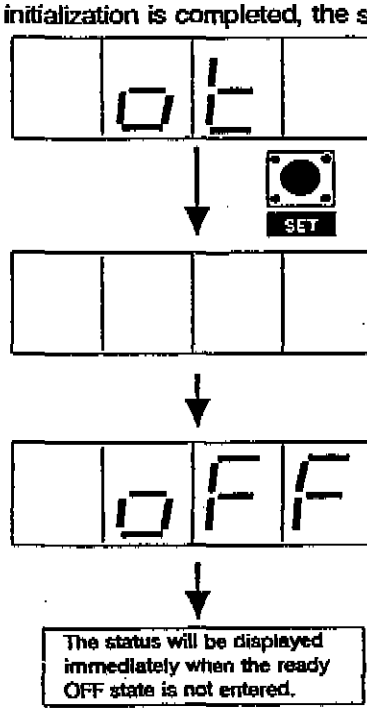
1. If the parameter save warning is flickering and the parameters are not saved in the nonvolatile memory, the set parameters will be invalidated the next time the power is turned ON.



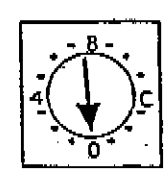
2. Set the LED display to the parameter save mode when saving parameters in the nonvolatile memory.
3. The memory is protected by the rotary switch to prevent unintentional operations.
   Open the cover on the front of the indicator on the MDS-A-SPJA front panel, and set the rotary switch to 8 to E. The display will change from "ng" to "OK".



4. If the "SET" button is pressed, the parameters will be saved in the nonvolatile memory and the MDS-A-SPJA will be reset.
   When initialization is completed, the status display mode will be entered.



5. Always return the rotary switch to "0".
6. Saving of the parameters is completed with steps 1 to 5 above.



6.2.2 Details of parameters

CAUTION

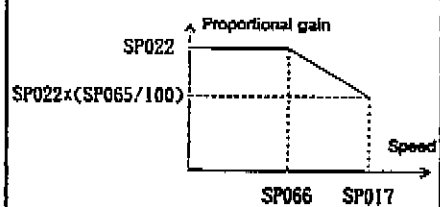
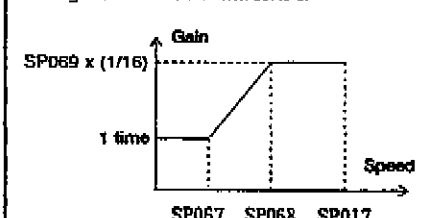
Do not make remarkable adjustments and changes of the parameters as the operation could become unstable.

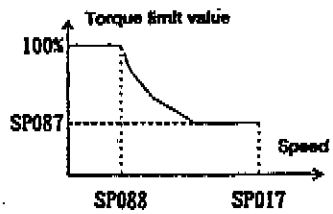
(1) Parameter list

(Note 1) Parameters marked with a * in the CNG column can be set and changed when setting the parameters with a personal computer without turning OFF the spindle drive unit power.
(Note 2) For parameters with a DEC in the TYP column, the value is set as a decimal, and with HEX, the value is set as a hexadecimal.
(Note 3) Described in III-60.

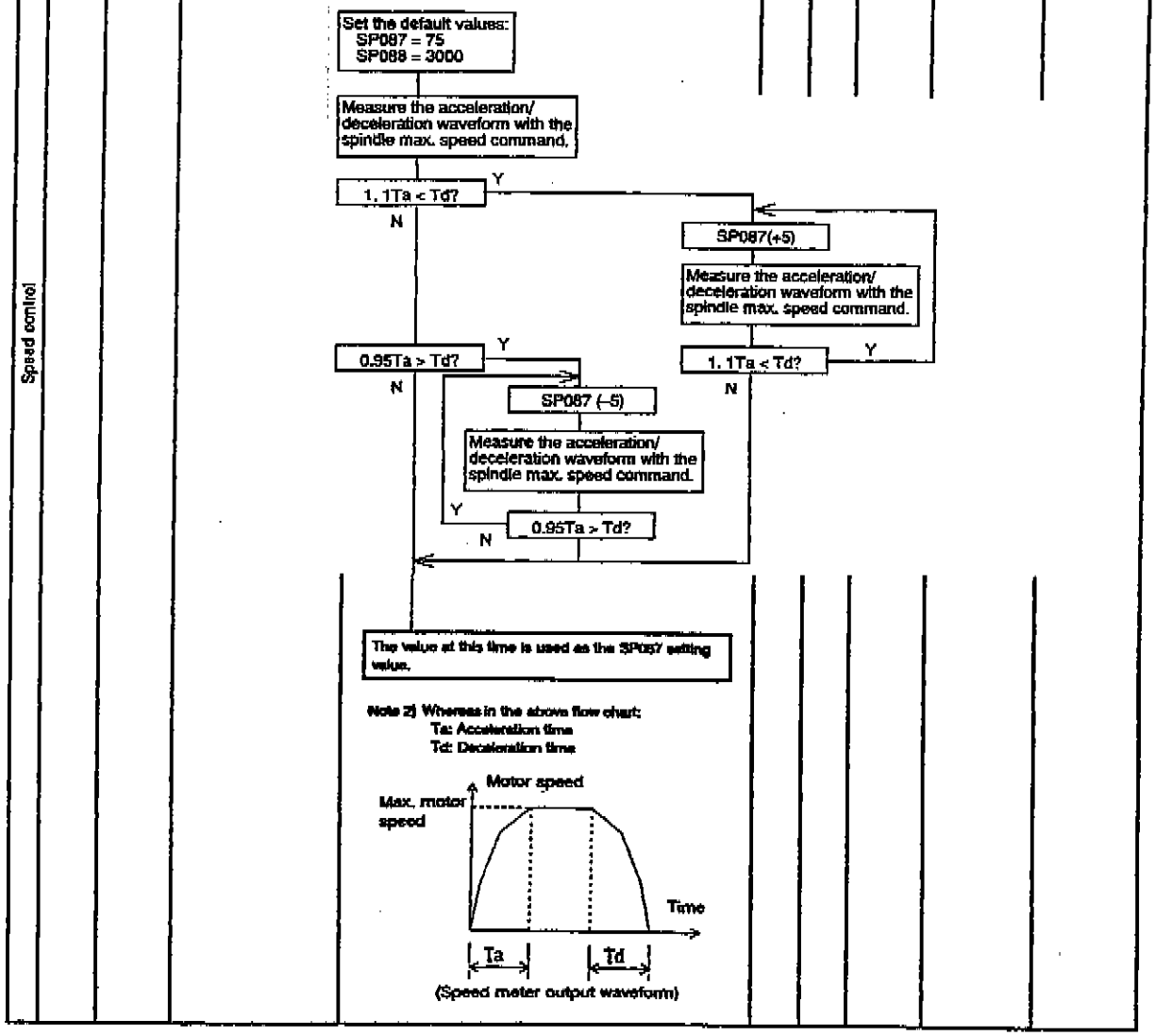
Class	No.	Abbr.	Name	Description	TYP	CNG	Standard setting	Unit	Tolerable setting range
Spindle specifications	SP001	PGM	Magnesensor motor built-in encoder orient position loop gain	The orientation time will be reduced when the value is increased and the servo rigidity will increase. On the other hand, the vibration will increase and machine sway will occur easily.	DEC	*	100	$1/10\ s^{-1}$	0 ~ 360
	SP002	PGE	Encoder orient position loop gain	Same as above	DEC	*	100	$1/10\ s^{-1}$	0 ~ 360
	SP003			Not used. Set to 0.			0		
	SP004	OINP	Orient in-position width	The position error range where the orient complete signal is output is set.	DEC	*	16	1/16 deg.	1 ~ 2880
	SP005	OSP	Orient changeover speed limit value	The motor speed limit value for when changing from the speed loop to position loop during orientation is set. When the setting value is 0, the limit speed will be SP017 (TSP).	DEC		0	rpm	0 ~ 32767
	SP006	OSP	Deceleration rate during orientation	The orientation time will be reduced when the value is increased, but the vibration will increase.	DEC	*	20		1 ~ 1000
	SP007	OPST	Orientation position shift amount	The orientation stop position is set. Motor built-in encoder, encoder (1024P/REV): Set a value that is 360° divided by 4096.	DEC	*	0		0 ~ 4095
	SP008 ~ SP016			Not used. Set to 0.			0		
	SP017	TSP	Motor max. speed	The motor's maximum speed is set.	DEC		6000	rpm	1 ~ 32767
	SP018	ZSP	Motor zero speed	The motor speed where zero speed is output is set. If the motor drops below the speed set here when the forward run, reverse run or orientation signal turns OFF, the motor will coast to a stop. Decrease this setting value if the spindle shaking is great when stopping from rotation. (Practical min. setting value ~ approx. 10)	DEC		50	rpm	1 ~ 1000
	SP019	CSN1	Speed command Acceleration/deceleration time constant	The time constant for the speed command from 0 to the maximum speed is set. This setting will be invalid after changing to the position loop during orientation and during the S-analog synchronized tapping mode. This setting is only a time constant (linear) for the command, and the actual motor acceleration/deceleration time will be determined by the motor output and the relation of the load GD^2 and frictional torque. This setting is only a time constant (linear) for the command, and the actual motor acceleration/deceleration time will be determined by the motor output and the relation of the load GD^2 and frictional torque. Normally this is set to 30. Set a larger value if the acceleration/deceleration time is to be intentionally increased.	DEC		30	10 ms	1 ~ 32767
	SP020	SDTS	Speed detection set value	The motor speed where the speed detection output is performed is set. Normally, 10% of the SP017 (TSP) value is set.	DEC		600	rpm	0 ~ 32767
	SP021	TLM1	Torque limit 1	The torque limit ratio for when torque limit signal 001 is set is set. The 30 min. rated output torque is equivalent to 100%.	DEC		10	%	1 ~ 120
	SP022	VGNP1	Speed loop gain proportion item during speed control	The speed loop proportional gain during speed control is set. The response will improve when increased, but vibration and sound will increase. (Practical setting range: approx. 30 ~ 150.)	DEC		63	rad/s	0 ~ 1000

Class	No.	Abbr.	Name	Description	TYP	CNG	Standard setting	Unit	Tolerable setting range
Spindle specifications	SP023	VGN1	Speed loop gain proportion item during speed control	The speed loop proportional gain during speed control is set. Normally, this is set so that the percentage to SP022 (VGNP1) is approximately constant. (Approx. 1:1 with setting value)	DEC		60	1/10 rad/s	0 ~ 1000
	SP024			Not used. Set to 0.			0		
	SP025	GRA1	Spindle side No. of gear teeth 1	The No. of teeth on the spindle side is set for gear 00. If the spindle speed is slower than the motor speed (deceleration specifications), GRA= > GRB= will be established. If GRA= or GRB= is larger than 32767, both setting values will be multiplied by 1/N (N is a random natural No.) and set to be close to 32767.	DEC		1		1 ~ 32767
	SP026	GRA2	Spindle side No. of gear teeth 2	The No. of teeth on the spindle side is set for gear 01.	DEC		1		1 ~ 32767
	SP027	GRA3	Spindle side No. of gear teeth 3	The No. of teeth on the spindle side is set for gear 10.	DEC		1		1 ~ 32767
	SP028	GRA4	Spindle side No. of gear teeth 4	The No. of teeth on the spindle side is set for gear 11.	DEC		1		1 ~ 32767
	SP029	GRA1	Motor shaft side No. of gear teeth 1	The No. of teeth on the motor shaft side is set for gear 00.	DEC		1		1 ~ 32767
	SP030	GRA2	Motor shaft side No. of gear teeth 2	The No. of teeth on the motor shaft side is set for gear 01.	DEC		1		1 ~ 32767
	SP031	GRA3	Motor shaft side No. of gear teeth 3	The No. of teeth on the motor shaft side is set for gear 10.	DEC		1		1 ~ 32767
	SP032	GRA4	Motor shaft side No. of gear teeth 4	The No. of teeth on the motor shaft side is set for gear 11.	DEC		1		1 ~ 32767
Spindle/machine specifications	SP033	SFNC1	Spindle function 1	This corresponds to bits, and sets the spindle function 1 selection. Refer to section 6.2.2 (2) for details.	HEX		0000		0000 ~ FFFF
	SP034	SFNC2	Spindle function 2	This corresponds to bits, and sets the spindle function 2 selection. Refer to section 6.2.2 (2) for details.	HEX		0000		0000 ~ FFFF
	SP035	SFNC3	Spindle function 3	This corresponds to bits, and sets the spindle function 3 selection. Refer to section 6.2.2 (2) for details.	HEX		0000		0000 ~ FFFF
	SP036	SFNC4	Spindle function 4	This corresponds to bits, and sets the spindle function 4 selection. Refer to section 6.2.2 (2) for details.	HEX		0000		0000 ~ FFFF
	SP037	SFNC5	Spindle function 5	This corresponds to bits, and sets the spindle function 5 selection. Refer to section 6.2.2 (2) for details.	HEX		0000		0000 ~ FFFF
	SP038	SFNC6	Spindle function 6	This corresponds to bits, and sets the spindle function 6 selection. Refer to section 6.2.2 (2) for details.	HEX		0000		0000 ~ FFFF
	SP039	ATYP	Drive unit capacity	Set the capacity of the drive unit being used. Refer to section 6.2.2 (3) for details.	HEX		0		0000 ~ 000F
	SP040	MTYP	Motor selection	This is valid when SP034 (SFNC2) bit -0 is set to 0. Set the applicable motor No. from the motors shown in section 6.2.2(3). This parameter will be ignored when 1 is set in SP034 (SFNC2) bit-0.	HEX		0		0000 ~ FFFF
	SP041	PTYP	Regenerative resistor selection	If the drive unit being used is connected to a regenerative resistor, set the type. Set to 0 when a resistor is not connected. Refer to section 6.2.2 (3) for details.	HEX		0		0000 ~ FFFF
	SP042 ~ SP045			Not used. Set to 0.			0		
	SP046	CSN2	Speed command dual cushion	The speed command is smoothed only during the acceleration/deceleration start according to the acceleration/deceleration time constant set in SP019 (CSN1). If a gear noise is heard when starting acceleration/deceleration, the noise can be reduced by setting a value other than 0. In this case, gradually increase the setting value from 1 and stop where the noise is not bothersome. The smoothness of the operation will increase when this setting value is mall, but the acceleration/deceleration time will increase. This is invalidated when 0 is set.	DEC		0		0 ~ 1000
	SP047	SDTR	Speed detection reset value	The hysteresis width for the reset of the speed detection set value set in SP020 (SDTS) is set.	DEC		30	rpm	0 ~ 1000
	SP048	SUT	Speed reached range	The percentage of the speed deflection for where the speed reached signal is output is set.	DEC		15	%	0 ~ 100
	SP049	TLM2	Torque limit 2	The torque limit ratio for torque limit signal 010 is set.	DEC		20	%	1 ~ 120
	SP050	TLM3	Torque limit 3	The torque limit ratio for torque limit signal 011 is set.	DEC		30	%	1 ~ 120
	SP051	TLM4	Torque limit 4	The torque limit ratio for torque limit signal 100 is set.	DEC		40	%	1 ~ 120
	SP052	TLM5	Torque limit 5	The torque limit ratio for torque limit signal 101 is set.	DEC		50	%	1 ~ 120
	SP053	TLM6	Torque limit 6	The torque limit ratio for torque limit signal 110 is set.	DEC		60	%	1 ~ 120
	SP054	TLM7	Torque limit 7	The torque limit ratio for torque limit signal 111 is set.	DEC		70	%	1 ~ 120

Class	No.	Abbr.	Name	Description	TYP	CNG	Standard setting	Unit	Tolerable setting range
Spindle/machine specifications	SP055	SETM	Speed deflection excessive timer	The time until the speed deflection excessive error is output is set. If the total of the acceleration and deceleration time is longer than the standard setting, set a value that is 1.5 times the total.	DEC		12	sec	0 ~ 60
	SP056	PYVR	Variable excitation rate	The minimum value of the variable excitation ratio is set. The value is decreased if the gear noise or vibration, etc., is large, but the impact load response will drop. Thus, set this value to 50 unless absolutely necessary. If a value higher than 50 is set to improve the impact load response, make sure that gear noise, motor excitation noise and vibration during orientation stopping, etc., are not a problem. If a value lower than 50 is set to improve the gear noise, motor excitation noise and vibration during orientation, make sure that the impact load response and holding force during orientation stopping are not a problem. (Practical setting range: 25 ~ 75)	DEC	*	50	%	0 ~ 100
	SP057 ~ SP062			Not used. Set to 0.			0		
	SP063	OLT	Overload alarm detection time	The detection time for outputting the motor overload alarm detection is set.	DEC		60	sec	0 ~ 1000
	SP064	OLL	Overload alarm detection level	The detection level for outputting the motor overload alarm detection is set.	DEC		110	%	0 ~ 200
Speed control	SP065	VCGN1	Variable speed loop proportional gain target value	The speed loop proportional gain magnification for SP022 (VGNP1) in the motor max. speed set in SP017 (TSP) is set.	DEC		100	%	0 ~ 100
	SP066	VCSN1	Variable speed loop proportional gain change start speed	The speed to start the speed loop proportional gain change is set. This parameter and SP065 (VCGN1) are changed from the standard value if vibration, etc., occurs at the motor high speed area when the SP022 (VGNP1) setting is increased above the standard value to improve the response to the impact load response at low speeds. 	DEC		0	rpm	0 ~ 32767
	SP067	VIGWA	Variable current loop gain change start speed	The speed to start current loop gain change is set.	DEC		0	rpm	0 ~ 32767
	SP068	VIGWB	Variable current loop gain change complete speed	The speed to complete current loop gain change is set.	DEC		0	rpm	0 ~ 32767
	SP069	VIGN	Variable current loop gain target value	The current loop gain (torque amount and excitation amount) magnification in the speed set in SP068 (VIGWB) is set. The magnification will be 1 when set to 0. 	DEC		0	1/16 times	0 ~ 32767

Class	No.	Abbr.	Name	Description	TYP	CNG	Standard setting	Unit	Tolerable setting range
Speed control	SP069 (cont.)	VIGN	Variable current loop gain target value	Use the following values as a guideline for setting SP067 (VIGWA) to SP068 (VIGN). Max. motor speed SP017(TSP) / SP067 (VIGWA) / SP068 (VIGWB) / SP069 (VIGN) 6000 or less / 0 / 0 / 0 6001 ~ 8000 / 5000 / 8000 / 48 8001 or more / 5000 / 10000 / 64 In the above setting: 1) If the motor starts to hunt (high frequency vibration) during max. speed rotation, lower the SP069 (VIGN) value in "-8" decrements, and set at a value where hunting does not occur. 2) If the motor starts to groan (low frequency vibration) during max. speed rotation, increase the SP069 (VIGN) value in "+8" increments, and set at a value where groaning does not occur. 3) If "AL32" (overcurrent) or "AL75" (overvoltage) occurs when decelerating from the max. speed, increase the SP069 (VIGN) value in "+8" increments, and set at a value where the alarm does not occur. 4) If there is no problem during max. speed rotation, but the 1) or 2) phenomenon occurs at the middle speed area, change the SP067 (VIGWA) and SP068 (VIGWB) settings.					
	SP070 ~ SP076			Not used. Set to 0.			0		
	SP077	TDS2	Fixed control constant 1	This parameter is determined by Mitsubishi. Set this to 14 unless specially indicated.	DEC		14		0 ~ 63
	SP078	FPWM	Fixed control constant 2	This parameter is determined by Mitsubishi. Set this to 0 unless specially indicated.	DEC		0		0 ~ 9
	SP079	ILMT	Fixed control constant 3	This parameter is determined by Mitsubishi. Set this to 0 unless specially indicated.	DEC		0		0 ~ 32767
	SP080	ILMA	Fixed control constant 4	This parameter is determined by Mitsubishi. Set this to 0 unless specially indicated.	DEC		0		0 ~ 32767
	SP081 ~ SP086			Not used. Set to 0.			0		
	SP087	DIOM	Variable torque limit magnification target value during deceleration	The minimum value of the torque limit value fluctuated during deceleration is set.	DEC		75	%	0 ~ 150
	SP088	DION	Torque limit magnification change start speed during deceleration	The speed to start changing the torque limit value during deceleration is set.  1) If "AL32" (overcurrent) or "AL75" (overvoltage) occurs during deceleration of a high-speed rotation (10,000rpm or more) specifications motor, and the symptoms cannot be improved even when SP067 (VIGWA) to SP069 (VIGN) are changed, lower the SP087 (DIOM) value in "-15" decrements, and set at a value where the alarm does not occur. 2) If the above type of problem does not occur, and the deceleration time is longer than the acceleration time, change the value for SP087 (DIOM) with the flow shown below, and adjust the deceleration time so that it is equal to the acceleration time. Note 1) This adjustment is made with the H gears when using the geared machine, and with the H coil when using the coil changeover motor. Measure the time with the speed meter output (CN9A-No. 9 pin)	DEC		0	rpm	0 ~ 32767

Class	No.	Abbr.	Name	Description	TYP	CNG	Standard setting	Unit	Tolerable setting range
Speed control	SP088 (cont.)	DION	Torque limit magnification change start speed during deceleration						



Class	No.	Abbr.	Name	Description	TYP	CNG	Standard setting	Unit	Tolerable setting range
Speed control	SP088 ~ SP093			Not used. Set to 0.			0		
	SP094	LMAV	Load meter output filter	The filter time constant for load meter output is set. If the value is increased, the ripple during constant load meter output will decrease, but the response during transition will decrease. The constant will be 100ms when 0 is set.	DEC		0	×2 ms	0 ~ 32767
	SP095	VFAV	Fixed control constant 5	This parameter is determined by Mitsubishi. Set this to 0 unless specially indicated.	DEC		0		0 ~ 4
	SP096	EGAR	Encoder gear ratio	The gear ratio of the spindle end and encoder is set. This setting can be made only when the spindle speed is slower (deceleration specifications) than the encoder. Parameter setting: "0" Deceleration ratio 1:1; "1" 1:2; "2" 1:4; "3" 1:8; "4" 1:16	DEC		0		0 ~ 4
Orientation control	SP097	SPECO	Orientation specification	This corresponds to the bit and selects the orientation specifications. Refer to section 6.2.2 (2) for details.	HEX		0000		0000 ~ FFFF
	SP098	VGOP	Speed loop gain proportional item during orientation	The speed loop proportional gain during orientation is set. The response will improve when increased but the vibration and sound will increase. (Practical setting range: 30 to 200)	DEC		63	rad/s	0 ~ 1000
	SP099	VGOI	Speed loop gain integral item during orientation	The speed loop integral gain during orientation is set. Normally this is set so that the ratio in regard to SP098 (VGOP) is approximately constant. (Approx. 1:1 with setting value.)	DEC		60	1/10 rad/s	0 ~ 1000
	SP100	VGOD	Speed loop gain delay advance item during orientation	The speed loop delay advance gain during orientation is set. The impact response will increase when this value is raised, but the deflection in the orientation stop position from forward run and the orientation stop position from reverse run will increase. PI control will be applied when 0 is set. Set this when using a machine with a large frictional torque or to decrease the inconsistency in the orientation stop position. If 0 is set, the spindle will be mechanically fixed during orientation stop, so input a torque limit signal. Set this parameter to 15 unless there is a particular problem.	DEC		15	1/10 rad/s	0 ~ 1000
	SP101	DINP	Orientation dummy in-position width	This is valid when SP097 (SPEC0) bit 2 is set to 1. By setting a value larger than the normal in-position width (SP004:OINP) to reduce the ATC time, it will seem as though the orientation is completed early. If this value is raised too high, ATC operation may start before the spindle reaches the ATC position. Thus, when using this parameter, the operation must be checked carefully.	DEC		16	1/16 deg.	1 ~ 2880
	SP102	OODR	Excessive error value during orientation	The excessive error width for detecting the excessive error alarm during orientation is set. Normally set this to 32767. The excessive error alarm will not be output when this is set to 0.	DEC		32767	1/4 pulse (1 pulse = 0.088 deg.)	1 ~ 32767
	SP103	FTIM	Positioning complete off time timer	The time to forcibly turn off an index positioning complete signal other than the orientation complete signal due to the starting of the index start signal is set.	DEC		200	ms	1 ~ 10000
	SP104	TLOR	Torque limit value during orientation servo lock	The torque limit value during orientation stop is set. The 30 min. rating is equal to 100%. Note that if an external torque limit signal is input during orientation stop, the external torque limit value will have the priority. This is used to mechanically fix the spindle during orientation stop in machines where the frictional torque is small and there is little inconsistency in the orientation stop position.	DEC		100	%	1 ~ 120

Class	No.	Abbr.	Name	Description	TYP	CNG	Standard setting	Unit	Tolerable setting range
Orientation control	SP105	IOGO	Current loop gain magnification 1 during orientation	The current loop gain (torque amount) magnification during orientation is set. This will be 100% (1-time) when 100 is set. If vibration cannot be eliminated during orientation stop even when SP001 (PGM), SP002 (PGE), SP088 (VGOP) and SP089 (VGOI) are changed, change the value set for this parameter. 1) When high frequency fine vibration occurs: Decrease the setting value 2) When low frequency fine vibration occurs: Increase the setting value Always set the SP106 (IOGO) value to the same value when this parameter has been changed. (Practical setting range: 50 ~ 300)	DEC		100	%	1 ~ 1000
	SP106	IOGO	Current loop gain magnification 2 during orientation	The current loop gain (excitation amount) magnification during orientation is set. Refer to the section for SP105 (IOGO) for the setting method.	DEC		100	%	1 ~ 1000
	SP107	CSP2	Deceleration ratio 2 during orientation	The deceleration ratio during orientation for gear 01 is set. This parameter is set to use the shortest orientation time for each gear. When 0 is set, the value set in SP006 (CSP) will be applied.	DEC	*	0		1 ~ 1000
	SP108	CSP3	Deceleration ratio 3 during orientation	The deceleration ratio during orientation for gear 10 is set. Setting will be the same as SP107 (CSP2).	DEC	*	0		1 ~ 1000
	SP109	CSP4	Deceleration ratio 4 during orientation	The deceleration ratio during orientation for gear 11 is set. Setting will be the same as SP107 (CSP2).	DEC	*	0		1 ~ 1000
	SP110	WOML	Special specifications 1	Special specifications are set. Set to 0 unless specially indicated.	DEC	*	0		0 ~ 32767
	SP111	WOEL	Special specifications 2	Special specifications are set. Set to 0 unless specially indicated.	DEC	*	0		0 ~ 32767
	SP112	WCLP	Special specifications 3	Special specifications are set. Set to 0 unless specially indicated.	DEC	*	0		0 ~ 32767
	SP113	WINP	Special specifications 4	Special specifications are set. Set to 0 unless specially indicated.	DEC	*	0		0 ~ 32767
	SP114 ~ SP128			Not used. Set to 0.					
IO function	SP129	HI01	Auxiliary input selection 1	The auxiliary input 1 (IN1: CN1-19 pin) signals are assigned. Which signal is assigned depends on the following settings.	DEC		0		0 ~ 19
	SP130	HI02	Auxiliary input selection 2	The auxiliary input 2 (IN2: CN1-18B pin) signals are assigned. The setting method is the same as SP129 (HI01).	DEC		0		0 ~ 19

Setting value	Meaning
0	Invalid
1	Orientation start
2	Forward run indexing
3	Reverse run indexing
4	Torque limit 1
5	Torque limit 2
6	Torque limit 3
7	Gear selection 1
8	Gear selection 2
9	Alarm reset
10	Emergency stop
11	Speed selection 1
12	Speed selection 2
13	Speed selection 3
14	Multi-point orientation position command validity
15	Digital speed command value
16	
17	S-analog high-speed tapping
18	
19	

Note 1) Do not set a value other than the values given above for SP129 (HI01) to SP133 (HI05).
Note 2) Always set 0 for inputs not being used in SP129 (HI01) to SP133 (HI05).
Note 3) Do not set the same value for SP129 (HI01) to SP133 (HI05). (Excluding 0.)

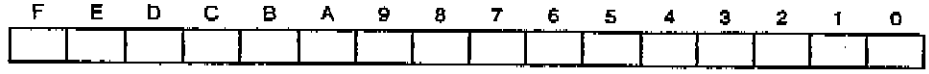
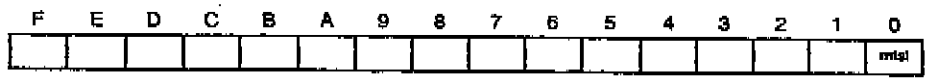
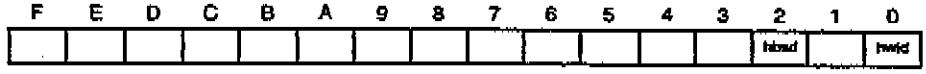
Class	No.	Abbr.	Name	Description	TYP	CNG	Standard setting	Unit	Tolerable setting range
IO function	SP131	HI03	Auxiliary input selection 3	The auxiliary input 3 (IN3: CN1-18A pin) signals are assigned. The setting method is the same as SP129 (HI01).	DEC		0		0 ~ 19
	SP132	HI04	Auxiliary input selection 4	The auxiliary input 4 (IN4: CN1-17B pin) signals are assigned. The setting method is the same as SP129 (HI01).	DEC		0		0 ~ 19
	SP133	HI05	Auxiliary input selection 5	The auxiliary input 5 (IN5: CN1-17A pin) signals are assigned. The setting method is the same as SP129 (HI01).	DEC		0		0 ~ 19
	SP134 ~ SP140			Not used. Set to 0.					
	SP141	HO1	Auxiliary output selection Open emitter 1	The auxiliary output (open emitter) 1 (OUT1: CN1-7B pin) signals are assigned. Which signals are assigned depends on the following settings. Note 1) Set 0 for outputs not being used in SP141 (HO1) to SP143 (HO3). Note 2) Do not set the same value in SP141(HO1) to SP143(HO3). Note 3) Do not set a value other than the values given above.	DEC		0		0 ~ 23
	SP142	HO2	Auxiliary output selection 2	The auxiliary output 2 (OUT2: CN1-7A pin) signals are assigned. The setting method is the same as SP141 (HO1).	DEC		0		0 ~ 23
	SP143	HO3	Auxiliary output selection 3	The auxiliary output 3 (OUT3: CN11-6 pin) signals are assigned. The setting method is the same as SP141 (HO1).	DEC		0		0 ~ 23
	SP144 ~ SP154			Not used. Set to 0.	DEC		0		0 ~ 23
	SP155	SAtyp	S-analog speed command input type	Where to input the S-analog input is selected. 0: Input between SE1 (CN3-18 pin) and SE2 (CN3-9 pin) (Standard) 1: Input between OR2 (CN3-19 pin) and OR1 (CN3-9 pin).	DEC		0		0 ~ 1
	SP156	DCtyp	Digital speed command input type	The digital speed command type is selected. 0: Coded binary 1: Non-coded 12-bit binary 2: BCD 2 digits 3: BCD 3 digits	DEC		0		0 ~ 3

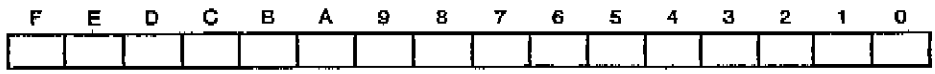
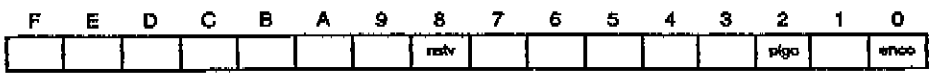
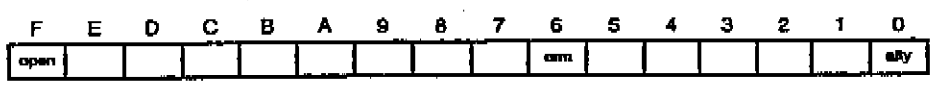
Setting value	Meaning
0	Invalid
1	Orientation complete
2	Positioning complete
3	Torque reached
4	In torque limit
5	In multi-point orientation position command validity
7	In motor forward run
8	In motor reverse run
9	In alarm
10	In emergency stop
11	In ready ON
12	Current detection
13	Speed detection
14	
15	
16	
17	
18	
19	
20	
21	
22	
23	

Class	No.	Abbr.	Name	Description	TYP	CNG	Standard setting	Unit	Tolerable setting range
IO function	SP157	SAavr	S-analog speed command input filter	The filter time constant for the S-analog speed command is set. The filter time constant is 0.8ms x setting value, and when 0 is set, it will be 25.6ms. Use the standard setting value unless there is a particular problem. This setting will be ignored during S-analog high-speed tapping. (No filter)	DEC		0	0.8ms	0 ~ 32767
	SP158	ADofs	S-analog speed command input offset	The offset value for the S-analog speed command input voltage is adjusted. The following values are set as a standard, and are gradually changed and adjusted. 1) When 0 is set for SP155 (SAtyp): Standard value 0 2) When 1 is set for SP155 (SAtyp): Standard value 45	DEC	*	When SP155:0 → 0 When SP155:1 → 45		-999 ~ 999
	SP159	ADcp1	S-analog speed command input clamp 1	The + side non-sensitive band for the S-analog speed command is set. This is set if the motor is not to be rotated when the S-analog command input voltage is small on the + side.	DEC	*	0		0 ~ 999
	SP160	ADcp2	S-analog speed command input clamp 2	The − side non-sensitive band for the S-analog speed command is set. This is set if the motor is not to be rotated when the S-analog command input voltage is small on the − side.	DEC	*	0		-999 ~ 999
	SP161	Sgain	S-analog speed command input gain	The gain for the S-analog speed command input is set. The following values are set as a standard, and are gradually changed and adjusted. 1) When 0 is set for SP155 (SAtyp): Standard value 1064 2) When 1 is set for SP155 (SAtyp): Standard value 1098	DEC	*	When SP157:0 → 1064 When SP157:1 → 1098	1/1000 times	0 ~ 2500
	SP162	SS00	Speed setting 0	The speed for the speed selection command input 000 is set. If a value other than 0 is set here when not using the speed selection command input, the S-analog speed command and digital speed command will be ignored when the start command is input, and the motor will run at the speed set here.	DEC		0	rpm	0 ~ 32767
	SP163	SS01	Speed setting 1	The speed for the speed selection command input 001 is set.	DEC		0	rpm	0 ~ 32767
	SP164	SS02	Speed setting 2	The speed for the speed selection command input 010 is set.	DEC		0	rpm	0 ~ 32767
	SP165	SS03	Speed setting 3	The speed for the speed selection command input 011 is set.	DEC		0	rpm	0 ~ 32767
	SP166	SS04	Speed setting 4	The speed for the speed selection command input 100 is set.	DEC		0	rpm	0 ~ 32767
	SP167	SS05	Speed setting 5	The speed for the speed selection command input 101 is set.	DEC		0	rpm	0 ~ 32767
	SP168	SS06	Speed setting 6	The speed for the speed selection command input 110 is set.	DEC		0	rpm	0 ~ 32767
	SP169	SS07	Speed setting 7	The speed for the speed selection command input 111 is set.	DEC		0	rpm	0 ~ 32767
	SP170	SSchg	Speed selection changeover filter	The filter time constant for when changing the speed selection command input is set. The filter time constant is 0.8ms x setting value, and when 0 is set, the filter will be disabled. Use the standard setting unless there is a particular problem.	DEC		0	0.8ms	0 ~ 32767
	SP171	HSPT	Max. S-analog high-speed tapping speed	The max. speed for S-analog synchronous tapping is set. When 0 is set, the same value as SP017 (TSP) will be used. Set this parameter to a value smaller than SP017 (TSP) if the gear noise is annoying during S-analog synchronous tapping compared to normal speed loop operation.	DEC		0	rpm	0 ~ 32767
	SP172	VGHP	S-analog high-speed tapping Speed loop gain proportional item	The speed loop gain proportional item for S-analog high-speed tapping is set. The response will improve when the value is increased, but the vibration and sound will also increase. Set this value to a smaller value if gear noise or vibration is large during S-analog high-speed tapping, and increase this value to improve the tapping precision. When 0 is set, the same value as SP022 (VGNP1) will be used. (Practical setting range: Approx. 30 to 150)	DEC		0	rad/s	0 ~ 1000
	SP173	VGHI	S-analog high-speed tapping Speed loop gain integral item	The speed loop gain integral item for S-analog high-speed tapping is set. If the SP172 (VGHP) setting is changed, change this setting value so that the ratio is constant. (Approx. 1:1 with setting values) When 0 is set, the same value as SP023 (VGN11) will be used.	DEC	*	0	1/10 rad/s	0 ~ 1000

Class	No.	Abbr.	Name	Description	TYP	CNG	Standard setting	Unit	Tolerable setting range
I/O function	SP174	HPYV	Variable excitation rate during S-analog high-speed tapping	The min. value of the variable excitation rate during S-analog high-speed tapping is set. If the gear noise or vibration is annoying during S-analog high-speed tapping, decrease the value. To improve the tapping precision, increase the value. If 0 is set, the same value as SP056 (PYVR) will be applied.	DEC		0	%	0 ~ 100
	SP175	HSgn	Speed command gain during S-analog high-speed tapping	The gain of the speed command voltage for S-analog high-speed tapping is adjusted. Basically this is set to the same value as SP161 (Sgain).	DEC	*	0		0 ~ 2500
	SP176	HADef	Speed command offset during S-analog high-speed tapping	The offset value of the speed command voltage for S-analog high-speed tapping is adjusted. Basically this is set to the same value as SP158 (ADofs).	DEC	*	0		-999 ~ 999
	SP177	MADJ	Meter full scale forced output	Set this parameter to 1 when full scale adjustment of the speed meter or load meter is to be enforced. A full scale voltage will be output from each meter output. At this time, adjust the meter with SP178 (SMG) and SP179 (LMG). Always return this parameter to 0 when adjustments are completed.	DEC	*	0		0 ~ 1
	SP178	SMG	Speed meter output full scale adjustment	The full scale voltage of the speed meter output is adjusted. When SP177 (MADJ) is set to 1, adjust this parameter so that the speed meter sway comes to the required position. 1000 is equal to 1-fold.	DEC	*	841	1/1000-fold	0 ~ 1000
	SP179	LMG	Load meter output full scale adjustment 1	The full scale voltage of the load meter output is adjusted. When SP177 (MADJ) is set to 1, adjust this parameter so that the load meter sway comes to the required position. 1000 is equal to 1-fold.	DEC	*	841	1/1000-fold	0 ~ 1000
	SP180	Sgnb	Special gain 1	Always set to 0.	DEC	*	0	1/1000-fold	0 ~ 2500
	SP181	HSgnb	Special gain 2	Always set to 0.	DEC	*	0	1/1000-fold	0 ~ 2500
	SP182 ~ SP247			Not used. Set to 0.			0		
	SP248	PNC	Fixed control constant 5	This parameter is determined by Mitsubishi. This parameter cannot be changed by the user.	DEC		0		0 ~ 7
	SP249	SMO	Speed meter full scale voltage output speed	The motor speed for outputting the speed meter full scale voltage is set. When 0 is set, the speed will be that set in SP017 (TSP).	DEC	*	0	rpm	0 ~ 32767
	SP250	LMO	Load meter output full scale adjustment 2	This generally adjusts the load meter output full scale voltage. Normally make adjustments with SP179 (LMG), and leave this setting to 0.	DEC	*	0		0 ~ 10
Others	SP251			Not used. Set to 0.			0		
	SP252								
	SP253	DA1NO	DA output channel 1 data No.	The output data No. for channel 1 (CN3-20 pin) of the D/A output function is set. Always set this to 0.	DEC	*	0		-32768 ~ 32767
	SP254	DA2NO	DA output channel 2 data No.	The output data No. for channel 2 (CN3-10 pin) of the D/A output function is set. Always set this to 0.	DEC	*	0		-32768 ~ 32767
	SP255	DA1MP	DA output channel 1 scale	The output scale of channel 1 (CN3-20 pin) of the D/A output function is set. Always set this to 0.	DEC	*	0	1/256 times	-32768 ~ 32767
	SP256	DA2MP	DA output channel 2 scale	The output scale of channel 2 (CN3-10 pin) of the D/A output function is set. Always set this to 0.	DEC	*	0	1/256 times	-32768 ~ 32767
Motor constants	SP257 ~ SP320	RPM ~ BSD	Motor constant (H)	This is set when using a motor other than the standard motor. Set with the following conditions. 1) When SP034 (SFNC2) - bit 0 is 1 and bit 2 is 0 The constants for a special motor are set. This parameter is set by Mitsubishi, and must not be changed by the user.	HEX		0000		0000~FFFF
	SP321 ~ SP384	RPML ~ BSDL		Not used. Set to 0.	HEX		0000		0000~FFFF

(2) Details of parameters corresponding to bits

Name	Abbr.	Description	TYP
SP033	SFNC1	 Not used.	HEX setting
SP034	SFNC2	 [mtsl] Motor constant (0: standard/1: special)	HEX setting
SP035		 [hwid] Wide constant output (0: invalid/1: valid) [hbsd] Base slide (0: invalid/1: valid)	HEX setting

Name	Abbr.	Description	TYP
SP036	SFNC4	 Not used.	HEX setting
SP037	SFNC5	 The orientation position detector, etc., are set. [enco] Encoder (1024p/rev) orientation [plgo] Motor built-in encoder (PLG) orientation [nstv] No signal detection type (0: constant monitor/ 1: only during position loop or orientation) **Note)** Do not set two or more of bit 0 to 2 to "1" at the same time.	HEX setting
SP038	SFNC6	 [alty] Deceleration stop during alarm (0: invalid/1: valid) .. Note, only during specific alarms [orm] Orientation start memo (0: Invalid/1: Valid) ... Refer to Note 1. [open] Open loop operation (0: Invalid/1: valid)	HEX setting

Note 1) When this is validated, the motor will stop within one rotation during the second and following orientations after the power is turned OFF. Note that this is possible only under the following conditions.
- In encoder (1024p/rev) or PLG orientation specifications, gear ratio 1:1 with no gear transmission, PRE orientation rotation direction mode, and 0 setting for orientation changeover speed limit value SP005 (OSP).

Name	Abbr.	Description	TYP
SP097	SPEC0	F E D C B A 9 8 7 6 5 4 3 2 1 0 fdir pyfx dmin odi2 odi1 [odi1] [odi2] The orientation rotation direction is set with a 2-bit combination. 0: Pre (orientation from direction rotated in during speed control) 1: Orientation from motor forward run direction 2: Orientation from motor reverse run direction 3: Setting prohibited [dmin] Dummy in-position (0: Invalid/1: Valid) [pyfx] Fixed excitation during orientation servo lock (0: Invalid/1: Valid) [fdir] Encoder detector polarity (0: (+)/1: (-))	HEX setting

(3) Drive unit capacity, motor type and power supply type selection details

Name	Abbr.	Description	TYP
SP039	ATYP	Select the capacity of the drive unit to be used.	HEX setting

Setting value	Drive unit model
0000	———
0001	MDS-A-SPA-02
0002	MDS-A-SPA-04
0003	MDS-A-SPA-075
0004	MDS-A-SPA-15
0005	MDS-A-SPA-22
0006	MDS-A-SPA-37
0007	MDS-A-SPA-55
0008	MDS-A-SPA-75

Name	Abbr.	Description	TYP
SP040	MTYP	Set the motor to be used. This parameter is valid only when SP034 (SFNC2) - bit 0 is set to 0.	HEX setting

Setting value	Motor model	Max. speed (rpm)	Corresponding drive unit model name
/000			
/001	SJ-P0.2	10000	MDS-A-SPA-02
/002	SJ-P0.4	10000	MDS-A-SPA-04
/003	SJ-P0.75	10000	MDS-A-SPA-075
/004	SJ-P1.5	10000	MDS-A-SPA-15
/005	SJ-P2.2	8000	MDS-A-SPA-22
/006	SJ-P3.7	8000	MDS-A-SPA-37
/007	SJ-PF5.5	8000	MDS-A-SPA-55
/008	SJ-PF7.5	8500	MDS-A-SPA-75

<table>
<tr><th>Name</th><th>Abbr.</th><th>Description</th><th>TYP</th></tr>
<tr><td>SP041</td><td>PTYP</td><td>Select a value from the following table according to the regenerative resistor being used.

<table>
<tr><th>Setting value</th><th>Regenerative resistor model</th><th>Capacity [W]</th><th>Resistance value [Ω]</th></tr>
<tr><td>0000</td><td>———</td><td>—</td><td>—</td></tr>
<tr><td>2000</td><td>No connection</td><td>—</td><td>—</td></tr>
<tr><td>2100</td><td>FCUA-RB04</td><td>60</td><td>200</td></tr>
<tr><td>2200</td><td>FCUA-RB075</td><td>80</td><td>100</td></tr>
<tr><td>2300</td><td>FCUA-RB15</td><td>120</td><td>60</td></tr>
<tr><td>2400</td><td>FCUA-RB22</td><td>155</td><td>40</td></tr>
<tr><td>2500</td><td>FCUA-RB37</td><td>185</td><td>25</td></tr>
<tr><td>2600</td><td>FCUA-RB55</td><td>340</td><td>20</td></tr>
<tr><td>2700</td><td>FCUA-RB75/2</td><td>680</td><td>15</td></tr>
<tr><td>2800</td><td>R-UNIT1</td><td>700</td><td>30</td></tr>
<tr><td>2900</td><td>R-UNIT2</td><td>700</td><td>15</td></tr>
<tr><td>2A00</td><td>R-UNIT3</td><td>2100</td><td>15</td></tr>
</table>
(Note 1)

Note 1) FCUA-RB75/2 is used by connecting two units with a serial connection.</td><td>HEX setting</td></tr>
</table>

6.3 Alarm and warning table

Alarm No.	Abbr.	Name	Details	Operation	Resetting method
Z	ME1	Memory error 1	A check sum or RAM check error occurred in the spindle drive control card ROM.	a	AR
13	SWE	Software process error	The software data process did not end within the set time.	a	AR
17	ADE	AD error	The current detection AD converter did not function correctly during initialization.	a	PR
20	NS1	No signal detection 1 (Motor detector)	A signal was not input from the motor detector, or the input signal is not the correct level.	a	PR
21	NS	No signal detection 2 (spindle encoder)	A signal (for orientation) was not input from the spindle encoder, or the input signal is not the correct level.	a	PR
23	OSE	Excessive speed deflection	The speed command and actual motor speed deflection exceeded the specified value and the state continued for a specified time.	a	PR
30	ORG	Over-regeneration	Overheating of the regenerative resistor was detected due to frequent regeneration.	a	PR
31	OS	Overspeed	The actual motor speed exceeded 115% of the set max. speed.	a	PR
32	PME	Power module error	A current exceeding the specified value flowed to the IPM used in the spindle drive main circuit section.	a	PR
33	OV	Overvoltage	The main circuit capacity abnormally rose above the specified value due to the regeneration energy during data deceleration.	a	PR
37	PE	Parameter error	A parameter value exceeding the tolerable value was set.	a	PR
38	PMOH	Power module overheat	The IPM used in the spindle drive main circuit section overheated.	a	PR
46	OHM	Motor overheat	Overload, or the motor cooling blower stop and the motor overheated causing the built-in thermal protector to function.	a	PR
50	OL	Overload	The motor current flowed for a time exceeding the overload time constant of the overload detection level.	a	PR
52	OD	Excessive error	The position tracking error was over the specified value in the position loop operation.	a	PR
57	OPE	Option error	A function signal was input to a drive unit not provided with option functions (orientation, digital speed command, S-analog synchronous tapping).	a	PR
88	WD	Watch dog	The software process did not end within the specified time.	a	AR
E0	WOR	Over-regeneration alarm	The regenerative resistor load reached 80% of the alarm level.	b	—
E1	WOL	Overload warning	The motor current flowed at 80% or more of the detection time constant for a time exceeding the overload detection level.	b	—
E4	WPE	Parameter error warning	A value exceeding the tolerable value was set during ready ON.	b	—
E7	NCE	NC emergency stop	The emergency stop command was input from an external source.	c	—

Note 1) If the above protective functions activate, the alarm No. will be displayed on the 7-segment LED built into the spindle drive, and the following will occur. Reset with the methods given below.

[Operation]
- a : The base of the spindle drive unit is shut off and the spindle motor coasts to a stop.
- b : This is only a warning display. The operation will continue.
- c : The spindle motor decelerates to a stop with regenerative braking, the base is shut off.

[Resetting method]
- AR : Turn the spindle drive unit OFF once.
- PR : Turn the spindle drive unit reset input signal ON and OFF.
- — : Operation will be automatically reset after the warning is canceled. Note that the start command must be turned OFF once when an emergency stop warning occurs. (Excluding during orientation.)

6.4 Monitor display with personal computer

The parameters can be set and changed, and the motor and drive unit operation can be monitored when a personal computer is connected to the spindle drive unit MDS-A-SPJA and the Mitsubishi-supplied software is used.
Refer to "MDS-A-SPJA Parameter Setting and Spindle Monitor Personal Computer Software Operation Manual (BNP-B2011-19)" for details on handling.

⚠ WARNING

Always turn the spindle drive unit power OFF before connecting the cables. Making a connection while the power is ON could cause the spindle drive unit to malfunction, the machine to be damaged or personal injury to occur.

⚠ CAUTION

A communication error may occur if the order that the power is turned ON is incorrect.

⚠ CAUTION

To prevent communication errors, the cable length must be 3m or less.

6.4.1 Required devices

The following devices are required for setting the parameters and monitoring the spindle drive unit with a personal computer.

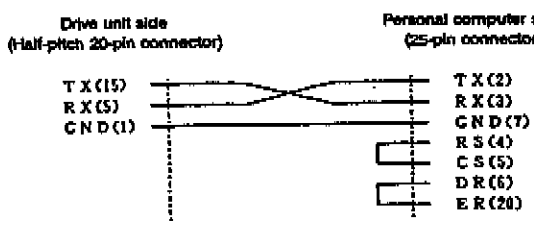
(1) Personal computer

NEC PC9801 or 100% compatible model, or
IBM PC/AT or 100% compatible model

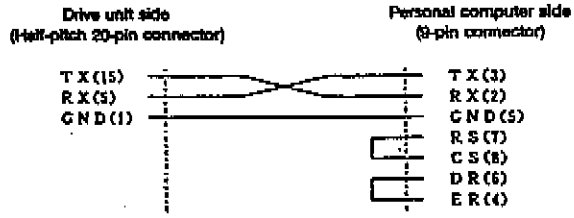
(2) Communication cable

Use a communication cable compatible with the personal computer being used.

For NEC PC-9801 Series



For IBM PC/AT personal computer



6.4.2 Software start up

(1) The following software is required to set the parameters and monitor with the personal computer.

When using the NEC PC9801 Series:
- MS-DOS (version 5.0 or higher)
- "SPJ98.EXE" command supplied from Mitsubishi (System No. BND-526W002)

When using an IBM PC/AT:
- MS-DOS (version 5.0 or higher) or PC-DOS (version 5.0 or higher)
- "SPJAT.EXE" command supplied from Mitsubishi (System No. BND-526W003)

(2) Confirm that MS-DOS or PC-DOS starts up correct with the personal computer being used, and that the software supplied from Mitsubishi is in one of the drives or directories.

(3) Input the command corresponding to the personal computer being used after the DOS prompt.

```
A:¥>spjat
```

This is spj98 when using the PC-9801 Series

(4) The following menu screen will display, and the preparation will be completed.

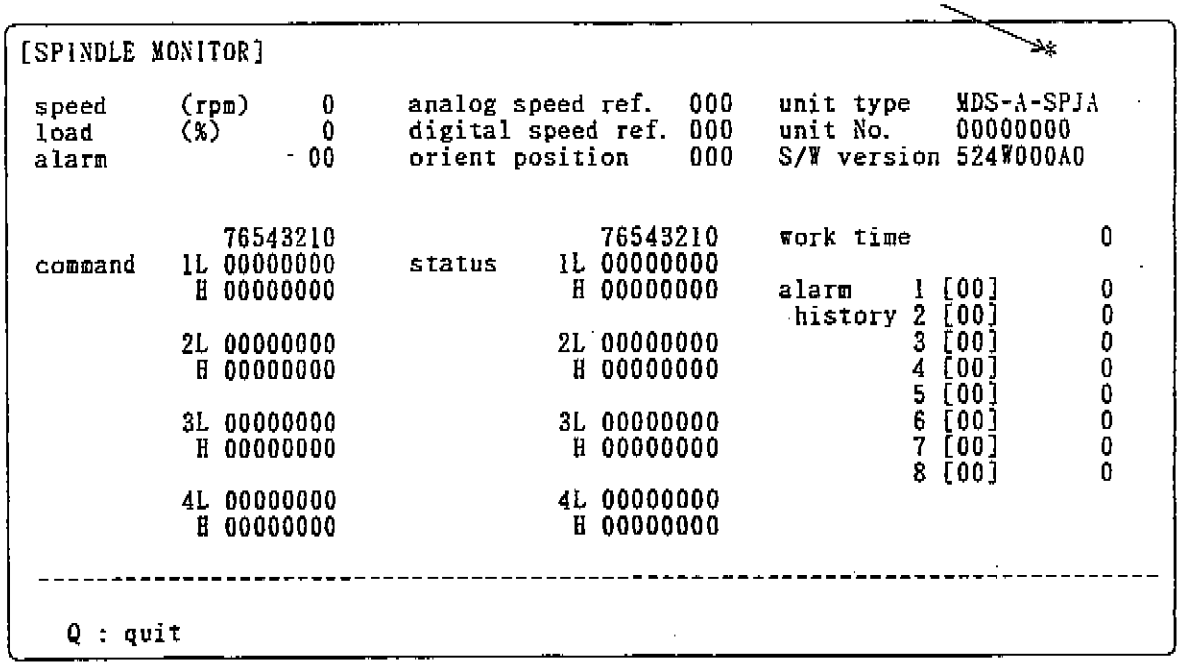
```
MITSUBISHI SPINDLE DRIVE CONTROLLER MDS-A-SPJA  Series
PARAMETER setting & SPINDLE MONITOR system  BND-526W00*-***
COPYRIGHT (C) 1995 MITSUBISHI ELECTRIC CORPORATION
                                          ALL RIGHTS RESERVED




   1 : PARAMETER setting
   2 : PARAMETER initialize
   3 : SPINDLE MONITOR
   4 : PARAMETER compare
   5 : quit
                          Please choice No. -> 
```

Menu screen

6.4.3 Spindle monitor

The motor rotation state and the spindle drive unit state can be monitored.
The spindle monitor display will have a slight delay due to the communication processing time between the spindle drive unit and personal computer. Because of this, the accurate speed display or control input/output timing cannot be confirmed.
The spindle monitor is executed by pressing the "3" key on the menu screen. The details of the monitor display are as follow

Flickers when the communication with the spindle controller is correct.



Display item	Details
speed	The motor speed is displayed. A value with - indicates that the motor is running in reverse.
load	The motor load value is displayed with a %. The motor's 30 min. rated output is 100%.
alarm	The No. of the alarm occurring in the spindle drive unit is displayed. (00 indicates that there is no alarm.)
analog speed ref.	The A/D converter conversion value of the speed command voltage input is displayed as a hexadecimal.
digital speed ref.	The digital speed command input command value is displayed as a hexadecimal.
orient position	The multi-point orientation command input command value is displayed as a hexadecimal.
command	The input signal status is displayed with bit correspondence. (Refer to section 6.4.4.1 for details on the signals.)
status	The output signal status is displayed with bit correspondence. (Refer to section 6.4.4.2 for details on the signals.)
unit type	The spindle drive unit type is displayed.
unit No.	The spindle drive unit manufacturing No. is displayed.
S/W version	The spindle drive unit software version is displayed.
work time	The cumulative operating time of the spindle drive unit is displayed.
alarm history	The alarm occurrence history, and the cumulative operating time of the occurrence time is displayed. 1 is the latest alarm.

Press the "Q" key to leave the monitor display and return to the menu screen.

6.4.4 Control input/output details

6.4.4.1 Control inputs

(1) Control input 1L, H

	7	6	5	4	3	2	1	0
1L	aimr	prm						rdy
1H						t13	t12	t11

1L			1H		
bit	Name	Details	bit	Name	Details
0	rdy	Ready ON command	0	t11	Torque limit 1
1			1	t12	Torque limit 2
2			2	t13	Torque limit 3
3			3		
4			4		
5			5		
6	prm	Parameter conversion command	6		
7	aimr	Alarm reset command	7		

(2) Control input 2L, H

Not used.

(3) Control input 3L, H

	7	6	5	4	3	2	1	0
3L		gr2	gr1	sc5	sc4	sc3	sc2	sc1
3H		msl	lcs	orc	wri	wm	sri	sm

3L			3H		
bit	Name	Details	bit	Name	Details
0	sc1	Spindle control mode selection command 1 (internally created)	0	sm	Forward run start signal
1	sc2	Spindle control mode selection command 2 (internally created)	1	sri	Reverse run start signal
2	sc3	Spindle control mode selection command 3 (internally created)	2	wm	Forward run indexing command
3	sc4	Spindle control mode selection command 4 (internally created)	3	wri	Reverse run indexing command
4	sc5	Spindle control mode selection command 5 (internally created)	4	orc	Orientation start command
5	gr1	Gear selection command 1	5		
6	gr2	Gear selection command 2	6		
7			7		

(4) Control input 4L, H

	7	6	5	4	3	2	1	0
4L	hsp	ovr	deg		ss3	ss2	ss1	emg
4H								

4L			4H		
bit	Name	Details	bit	Name	Details
0	emg	Emergency stop	0		
1	ss1	Speed selection 1	1		
2	ss2	Speed selection 2	2		
3	ss3	Speed selection 3	3		
4			4		
5	deg	Digital speed command valid	5		
6			6		
7	hsp	S-analog high-speed tapping	7		

6.4.4.2 Control outputs

(1) Control output 1L, H

	7	6	5	4	3	2	1	0
1L	alm	pmrf		wng				ron
1H	tlmt					tl3a	tl2a	tl1a

1L			1H		
bit	Name	Details	bit	Name	Details
0	ron	Ready ON	0	tl1a	In torque limit 1
1			1	tl2a	In torque limit 2
2			2	tl3a	In torque limit 3
3			3		
4	wng	In drive unit warning	4		
5			5		
6	pmrf	In parameter conversion	6		
7	alm	In alarm	7		

(2) Control output 2L, H

Not used.

(3) Control output 3L, H

	7	6	5	4	3	2	1	0
3L		gr2a	gr1a	sc5a	sc4a	sc3a	sc2a	sc1a
3H		msla	lcsa	orca	wria	wrna	sria	srna

3L			3H		
bit	Name	Details	bit	Name	Details
0	sc1a	In spindle control mode selection 1	0	srna	In motor forward run
1	sc2a	In spindle control mode selection 2	1	sria	In motor reverse run
2	sc3a	In spindle control mode selection 3	2	wrna	In forward run indexing
3	sc4a	In spindle control mode selection 4	3	wria	In reverse run indexing
4	sc5a	In spindle control mode selection 5	4	orca	In orientation start
5	gr1a	In gear selection 1	5		
6	gr2a	In gear selection 2	6		
7			7		

(4) Control input 4L, H

	7	6	5	4	3	2	1	0
4L	wrf	mkc		orcf	zs	us	sd	cd
4H	al4	al3	al2	al1	emga	tlu		la2m

4L			4H		
bit	Name	Details	bit	Name	Details
0	cd	Current detection	0		
1	sd	Spewed detection	1		
2	us	Speed reached	2	tlu	Torque reached
3	zs	Zero speed	3	emga	In emergency stop
4	orcf	Orientation complete	4		
5			5		
6			6		
7			7		

7. Optional Specifications and Parts

⚠ WARNING

Always wait at least 10 minutes after turning the power OFF before connecting options or peripheral devices. Failure to do so could lead to electric shocks.

⚠ CAUTION

Use the designated peripheral devices and options. Failure to do so could lead to trouble or fires.

7.1 Orient specifications (optional)

The following two types of orient specifications are available:

① 4096 point orientation using encoder
② 4096 point orientation using motor built-in encoder

7.1.1 4096 point orientation using encoder

(1) Connection

Refer to page "Configuration" for the connection of the encoder and spindle drive unit.

(2) Installation conditions

Mechanical characteristics for rotation

a. Inertia	: 100g-cm^2 or less
b. Shaft friction torque	: 1kg-cm or less
c. Shaft angle acceleration	: 10^4rad/sec^2 or less
d. Tolerable speed	: 7,030rpm

Mechanical configuration

a. Bearings	: Non-lubricated for 100,000 or more rotations (at 2,000rpm) Non-lubricated for 20,000 hours or more at 6,000rpm
b. Shaft amplitude	: 0.02mm or less at 15mm from end
c. Tolerable load	: Thrust direction 10kg (5kg during operation) Radial direction 20kg (10kg during operation)
d. Weight	: 1.5kg max
e. Squareness of flange to shaft	: 0.05mm or less
f. Flange matching eccentricity	: 0.05mm or less

Working conditions

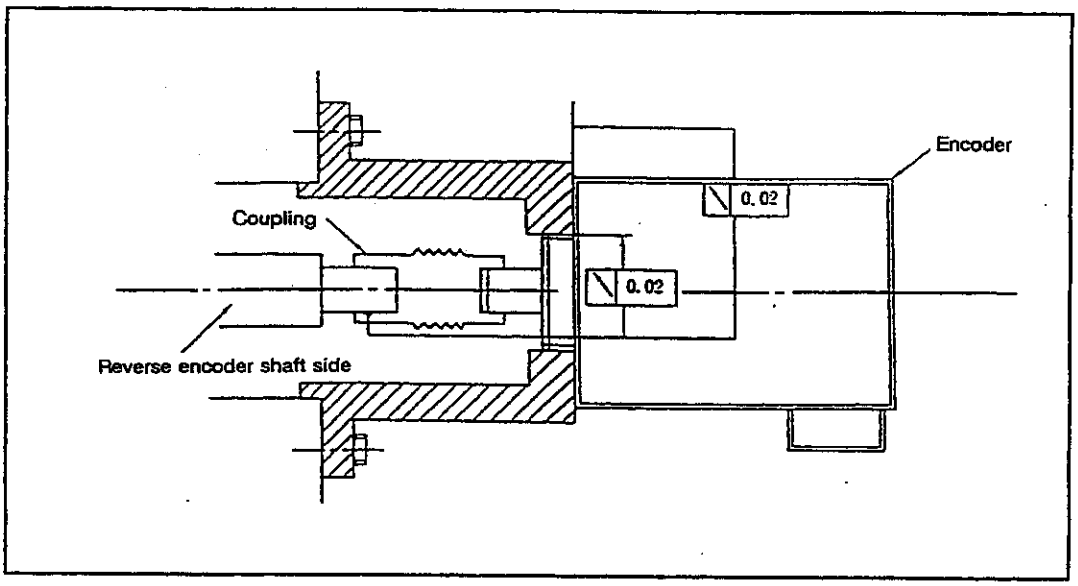
a. Working temperature range	: –5°C ~ +55°C
b. Storage temperature range	: –20°C ~ +85°C
c. Humidity range	: 95% PH (at 40°C) for 8 hours
d. Vibration resistance	: 5 to 50Hz, total vibration width 1.5mm, each axis for 30 min.
e. Impact resistance	: 30G 11msec, each axis 6 times

(3) Handling

a. Use of a flexible coupling is recommended for the connection of the encoder and spindle shaft in terms of improving the encoder life and performance.

b. Installation precision

The precision shown below should be secured for the encoder installation section engaging section and installation surface sway in order to maximize the coupling life.



c. Recommended coupling

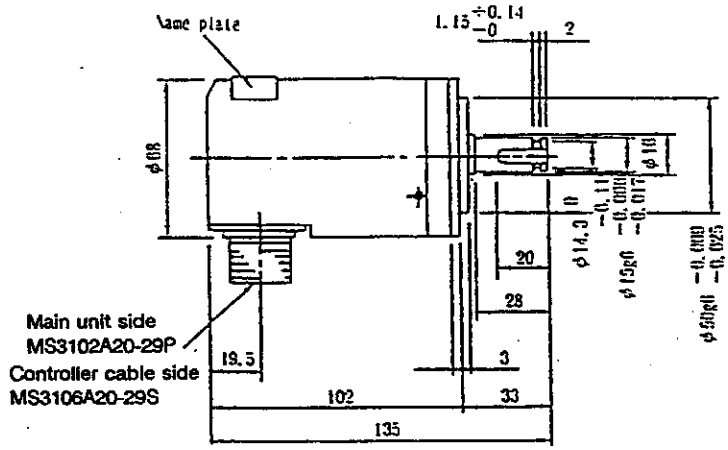
		Recommendation 1	Recommendation 2
Maker		Tokushu Seiko	Eagle
Model		Model M1	FCS38A
Resonance frequency		1,374 Hz	3,515 Hz
Position detection error		0.8×10^{-3} deg	1.2×10^{-3} deg
Tolerable speed		20,000 rpm	10,000 rpm
Mis-alignment	Core deviation	0.7 mm	0.16 mm
	Angle displacement	1.5 deg	1.5 deg
Dimensions	Max. length	74.5 mm	33 mm
	Max. diameter	ø57 mm	ø38 mm

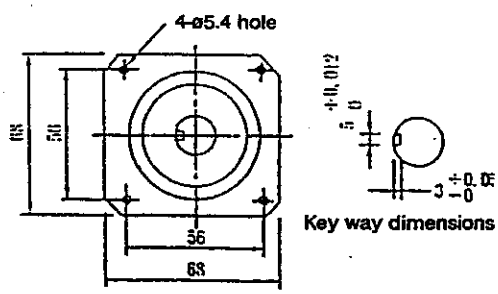
Refer to the coupling catalogue for details on the coupling.

(4) Encoder orientation parts (Optionally supplied parts)

Encoder (1024P/rev)

Encoder model	Tolerable speed
RFH-1024-22-1M-68	6000rpm
RFH-1024-22-1M-68-8	8000rpm





A	1chA	K	OV
B	2chZ	L	
C	1chB	M	
D		N	1ch$\bar{A}$
E	Case earth	P	2ch$\bar{Z}$
F		R	1ch$\bar{B}$
G		S	
H	+5V	T	
J			

7.1.2 4096 point orientation using motor built-in encoder

This can be used only when the motor and spindle connection is the direction connection or when the timing belt with a reduction ratio of 1 is used.

(1) Connection

Refer to page "Configuration" for the connection of the signal wires.

(2) Installation conditions

The encoder is built into the motor so no special detector needs to be installed.

7.1.3 Other option specifications

Refer to the following Option Specifications prepared per function for details on the specifications not listed in this manual.

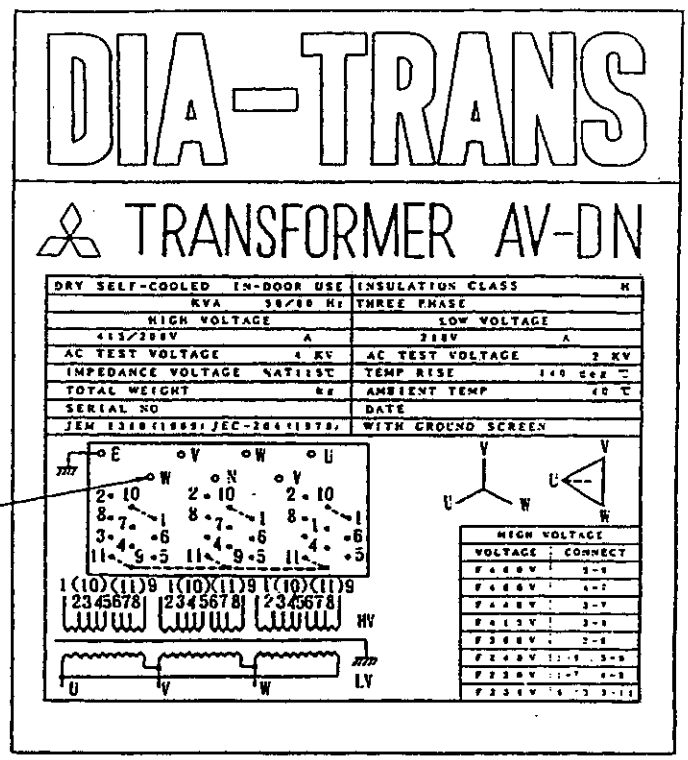
	Option Specifications title	Specifications No.
①	MDS-A Series Spindle Indexing Function Option Specifications	BNP-A2993-21
②	MDS-A Series S-Analog High-speed Tapping Function Option Specifications	BNP-A2993-25

7.2 Single parts (optionally supplied parts)

7.2.1 Power step-down transformer

When available power supply is at 400V, use this optional step-down transformer.

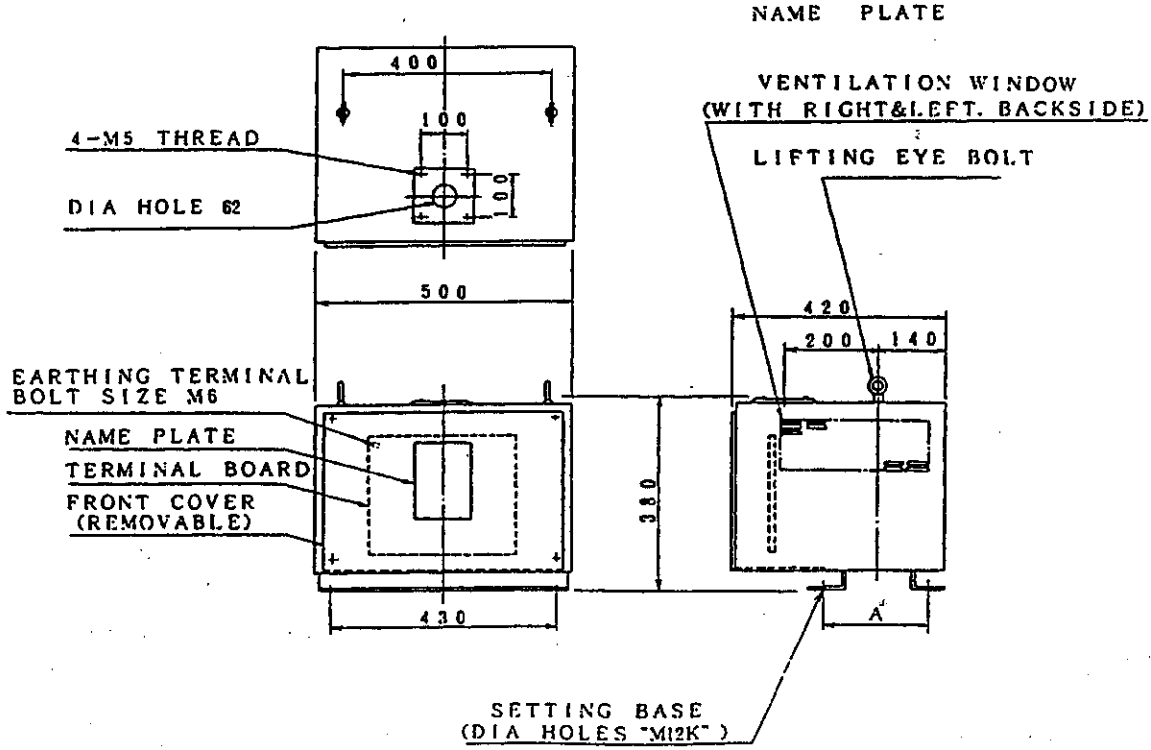
(1) 12-23KVA (ITEM1 ~ 3)



HV&LV TERMINAL BOLT SIZE M8

NAME PLATE

Item	Capacity (kVA)	Dimensions A		Weight (kg)	Remarks
1	12	230		90	7.5K



7.2.2 Noise filter

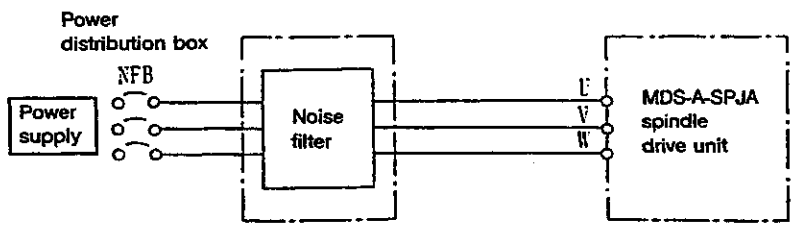
(1) Selection

If radio noise must be reduced, select a noise filter from the following table according to the power supply unit model:

MDS-A-CV-SPJA	Noise filter name (Tohoku Kinzoku)
0.75K or less	LF-310
1.5K	LF-315
2.2K	LF-320
3.7K	LF-330
5.5K	LF-340
7.5K	LF-350

(2) Noise filter installation position

Insert the noise filter in the unit input.



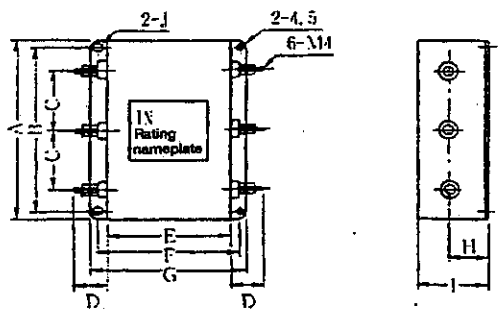
* Connect to the transformer input in power supply units that use the transformer.

(3) Specifications

Name	Rated voltage AC DC (V)	Rated current AC DC (A)	Tested voltage AC 1 min. (V) Between case terminals	Insulation resistance (MΩ) 500VDC	Leakage current (mA) 250V 60Hz	Working temperature range (°C)
LF-310	250	10	1500	> 300	< 1	-20 ~ +55
LF-315	250	15	1500	> 300	< 1	-20 ~ +55
LF-320	250	20	1500	> 300	< 1	-20 ~ +55
LF-330	250	30	1500	> 300	< 1	-20 ~ +55
LF-340	250	40	1500	> 300	< 1	-20 ~ +45
LF-350	250	50	1500	> 300	< 1	-20 ~ +55

(4) Shape and dimensions

OLF-300 series



Unit: mm

Part name	A	B	C	D	E	F	G	H	I	
LF-310	180	170	60	25	120	135	150	35	65	4.5 x 7
LF-315	180	170	60	25	120	135	150	35	65	4.5 x 7
LF-320	180	170	60	29	120	135	150	35	65	6.5 x 9
LF-330	180	170	60	29	120	135	150	35	65	6.5 x 9
LF-340	180	160	50	30	200	220	240	40	80	6.5 x 9
LF-350	180	160	50	30	200	220	240	40	80	6.5 x 9

8. Replacing the Unit

8.1 Preparation for replacing the unit

Observe the following points when replacing the unit.

(1) Turn OFF the entire system power, including the power for the peripheral devices.

(2) A high voltage is still charged in the spindle drive unit after the power is turned OFF. Wait at least three to four minutes after turning the power off before touching the unit's terminal block or regenerative resistor.

(3) Disconnect all cables connected to the unit.

If the work is done without turning the power OFF, the unit or peripheral devices could be damaged, and the work itself will be hazardous.

8.2 Unit replacement method

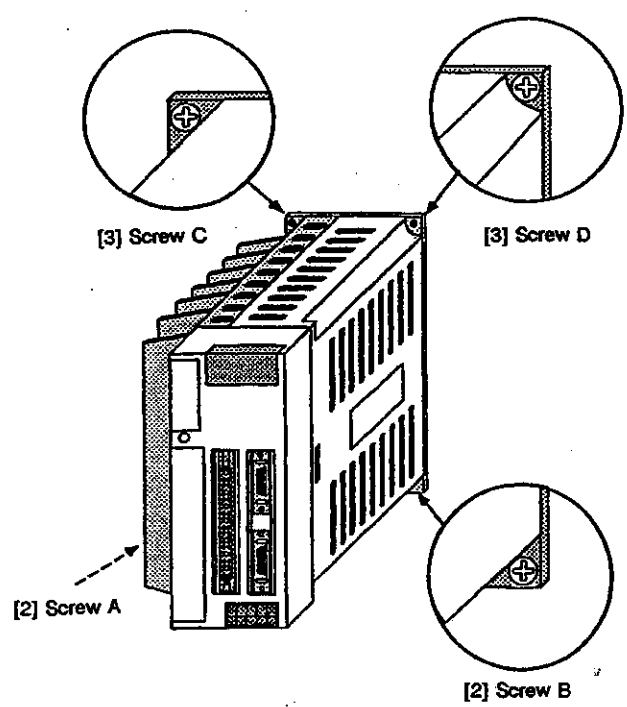
The method for replacing the spindle drive unit is explained below.

(1) Disconnect all cables on the front side.

(2) Loosen screws A and B. (These do not need to be removed.)

(3) While holding the unit with a hand, remove screws C and D.

(4) Lift the unit upward.



9. Daily Maintenance

⚠ WARNING
1. Wait at least ten minutes after turning the power OFF before starting maintenance or inspection. Failure to do so could lead to electric shocks. 2. Maintenance and inspection must be done by a qualified technician. Failure to observe this could lead to electric shocks. Contact your nearest Service Center or Service Station for repairs and part replacement.

9.1 Tools for maintenance

NOTICE
Never perform a megger test (insulation resistance measurement) on the amplifier control circuit.

(1) Measurement instruments

The following measurement instruments are required to confirm that the correct power is being supplied to the amplifier and that the amplifier wiring is correct.

Equipment	Conditions	
Tester		Confirm that the wiring to the amplifier is correct before turning on the power.
Oscilloscope		For general measurement and troubleshooting.
AC voltmeter	Measure the AC power voltage. The tolerable difference is ±2% or less.	Measure the AC power voltage being supplied to the amplifier.
DC voltmeter	Maximum reading 10V, 30V. The tolerable difference is ±2% or less.	Measure the DC power voltage.
AC ammeter		Measures the current supplied to the motor.

Note) A digital voltmeter can be used instead of the AC voltmeter, DC voltmeter and tester.

(2) Tools

Screwdrivers (Large and medium Phillips type, small flat head)

9.2 Periodic inspection

A still type drive unit is being used, but the fan built in the unit and the additional cooling fans must be inspected periodically.

The motor is a brushless type and basically does not require maintenance. However, periodically inspect for abnormal noise and vibration.

Recommended periodic inspection items

Item		Inspection frequency	Inspection details	Remedies
Cooling fan (fan built-in unit) and additional cooling fan (outside unit)		Monthly	1. Can the fan be rotated easily by hand? 2. Does the fan rotate properly when the power is ON? 3. Is the fan dirty with oil or dirt? 4. Do the bearings make abnormal sounds?	Clean or replace the fan
Terminal block screws		As necessary	1. Are the screws loose?	Tighten the screws
			2. Are the screws dirty with oil or dirt?	Clean
Cables and connectors		As necessary	1. Is there any damage or scratches, etc.?	Replace the cable
			2. Are the connectors loose?	Tighten the connectors
Battery unit		Every seven years	1. The guideline for the battery life is seven years under normal use. Note that this will differ according to the usage environment (temperature, usage frequency, etc.).	Replace the unit
Motor	Sound, vibration	Monthly	Is there any abnormal sound or vibration?	
	Tempera-ture	Monthly	Are the motor bearings or frame hot when touched by hand?	
	Insulation	Twice/year	Is the resistance 1MΩ or higher when insulated with a 500V megger tester (Disconnect the motor's canon plug before measuring.)	

10. Adjustment Procedures

10.1 Trial operation

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

Couple the motor and machine, and confirm the control status while running in the machine.

(1) Do the command speed and actual speed match?
→ If they do not match, check the following.

1) Are the spindle parameters (SP000 to SP384) correctly set?
Check the following parameters in particular for incorrect settings.
① SP017 (TSP)
② SP034 (SFNC2)
③ SP040 (MTYP)
④ SP257 ~ SP384 (TSP)

(2) Is the rotation smooth?

(3) Is there any abnormal noise?

(4) Is there any abnormal odor?

(5) Is the bearing temperature abnormal?

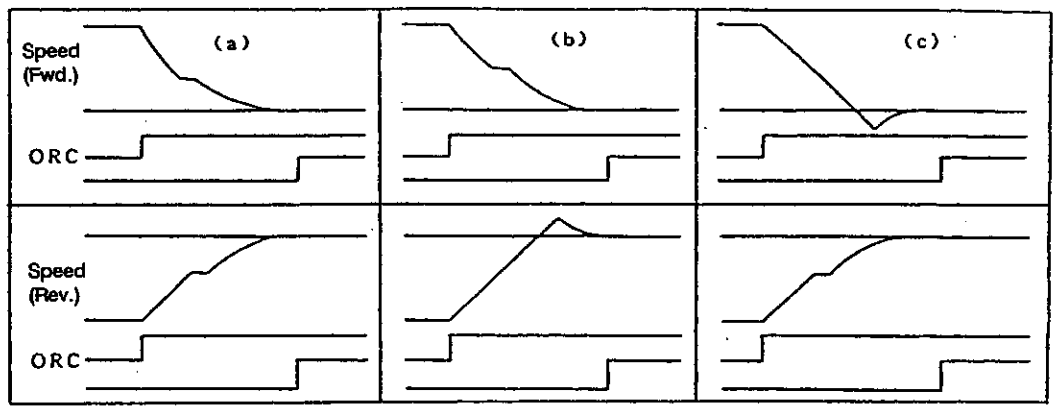
Next, check that there are no abnormalities during actual load operation of the motor.

10.2 Adjustment of orientation function

10.2.1 Orientation

There are three types of orientation stop that can be set with parameter SPECO .

1. PRE ..... (a) Orientation starts from current rotation direction.
2. Forward run orientation .... (b) Orientation is always in forward run direction.
3. Reverse run orientation .... (c) Orientation is always in reverse run direction.



10.2.2 Operation sequence

(1) When orientation command (ORC) turns on, motor speed changes from steady run speed to position loop control speed and at the same time "stop position command" (multi-point spindle orientation) is read.

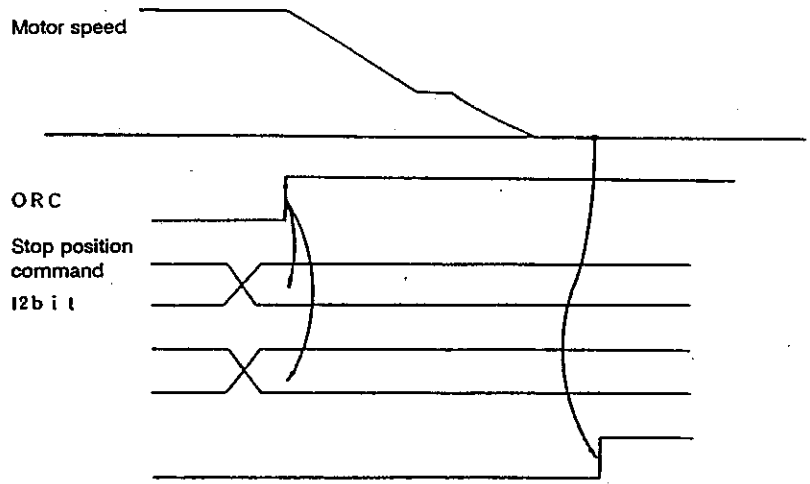
(2) When motor speed reaches the position loop control speed, control mode changes from "speed control" mode to "position control" mode (position loop gain parameter (Note 1)).
(Position loop control speed is automatically determined in accordance with position loop gain setting.)

(3) When control mode changes to position control mode, the distance to the orientation stop position is calculated and spindle speed is decelerated in accordance with the deceleration pattern set by parameter CSP to stop and the orientation state to be entered.

(4) When the spindle enters the "in-position" range set by parameter OINP , orientation complete signal ORCF turns on.

(5) Spindle stop position can be shifted by setting parameter OPST .

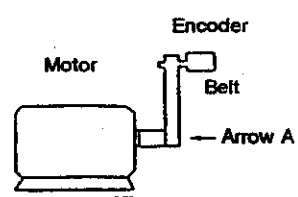
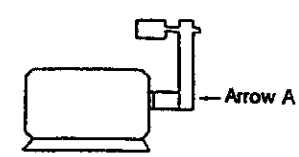
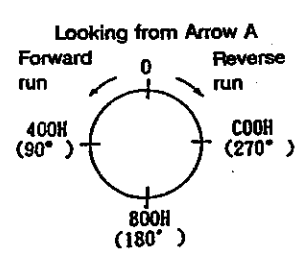
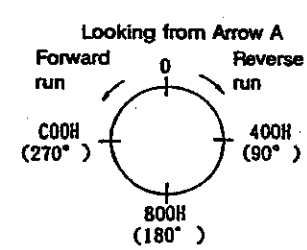
(6) When orientation command (ORC) is turned off, motor speed returns to the previously set speed command.



Note 1) The motor built-in encoder orientation uses PGM, and the encoder orientation uses PGE.

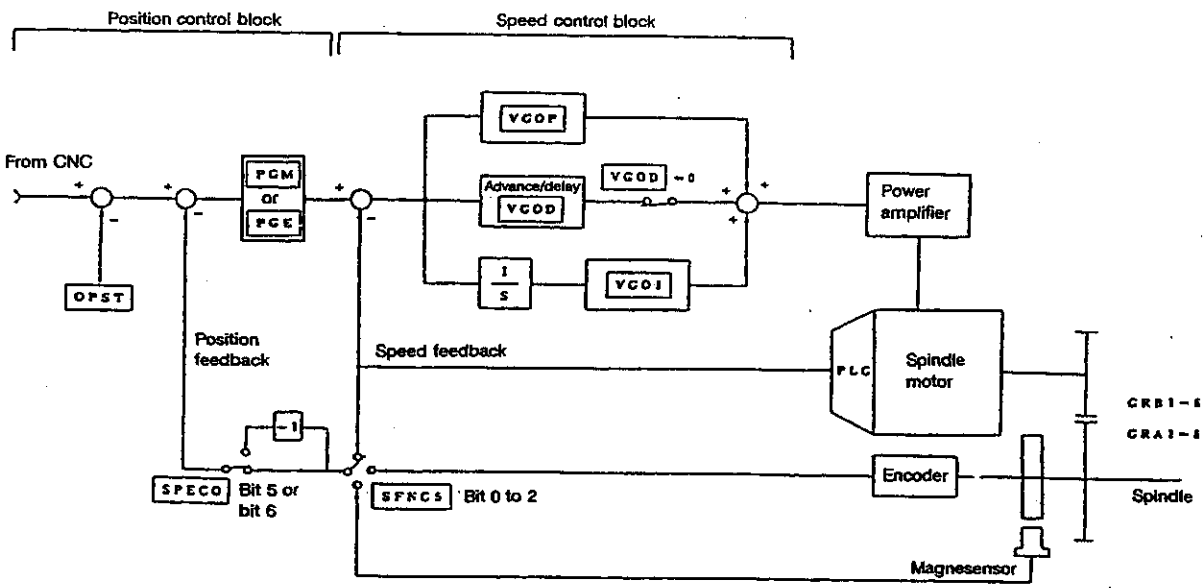
10.2.3 Encoder orientation stop positions

The stop positions will be as shown below depending on the direction that the encoder is installed.

	Case 1	Case 2
Installation direction		
Normal orientation		

10.2.4 Parameter block diagram for orientation

Parameter names are enclosed in boxes.



10.2.5 Preparation for adjustment of motor built-in encoder orientation

[Parameters]

Parameter name	No.	Initial value
PGM	SP001	100
OINP	SP004	16
OSP	SP005	0
CSP	SP006	20
OPST	SP007	0
GRA1	SP025	1
GRA2	SP026	1
GRA3	SP027	1
GRA4	SP028	1
GRB1	SP029	1
GRB2	SP030	1
GRB3	SP031	1
GRB4	SP032	1
VGOP	SP098	63
VGOI	SP099	60
VGOD	SP100	15
CSP2	SP107	0
CSP3	SP108	0
CSP4	SP109	0

[Preparation]

a) Confirm that the parameters are set to the values given above.

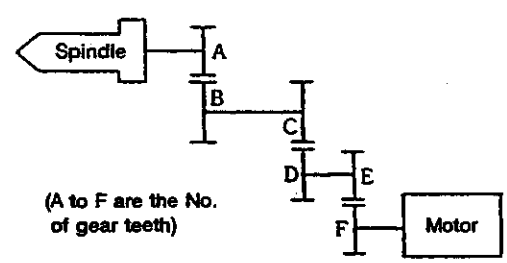
10.2.6 Preparation for adjustment of encoder orientation

[Parameters]

Parameter name	No.	Initial value
PGE	SP002	100
OINP	SP004	16
OSP	SP005	0
CSP	SP006	20
OPST	SP007	0
GRA1	SP025	1 ~ 32767
GRA2	SP026	1 ~ 32767
GRA3	SP027	1 ~ 32767
GRA4	SP028	1 ~ 32767
GRB1	SP029	1 ~ 32767
GRB2	SP030	1 ~ 32767
GRB3	SP031	1 ~ 32767
GRB4	SP032	1 ~ 32767
VGOP	SP098	63
VGOI	SP099	60
VGOD	SP100	15
CSP2	SP107	0
CSP3	SP108	0
CSP4	SP109	0

[Preparation]

a) An accurate gear ratio (or pulley ratio) from the motor axis to the magnesensor rotation axis is required.
Confirm that the correct No. of gear tooth is set in parameters GRA1 to GRB4 .



GRA = AxCxE

GRB = BxDxF

Note) The No. of gear teeth parameters GRA1 to GRB4 may require user settings. In that case, set the correct value that corresponds to the machine.

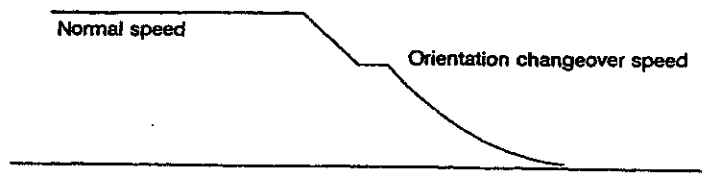
b) Confirm that the parameters are set to the values given above.

10.2.7 Adjustment of orientation

<Adjustment> (Parameters shown in square brackets [ ] are for encoder orientation.)

(1) Orientation position adjustment
There is no volume or rotary switch for the position shift.
Set the position shift with parameter [OPST].
Change the [OPST], execute orientation and adjust so that the target stop point is achieved.

(2) Orientation time and vibration adjustment



Refer to the following table and set the corresponding parameters properly.

Phenomena	Adjustment	
	[PGM] [PGE]	[CSP]
Overrun at stop	↘	↘
Long orientation time	↗	↗
Hunting at stop	↘	→

Note 1)

↗ : Increase the parameter value.
→ : Do not change the parameter.
↘ : Decrease the parameter.

Adjust [PGM] [[PGE]] first and then adjust [CSP].

To execute the shortest orientation time per gear setting, adjust [CSP2], [CSP3], [CSP4] in the same manner.

If the gear ratio is large (ex. 1:10) and the excessive error alarm occurs, adjust [OSP]. If large hunting occurs during orientation stop, the orientation detector installation direction, etc., may require adjustment. In that case, follow the orientation position adjustment on this page, and readjust.

10.2.8 Adjustment of servo rigidity

"Servo rigidity" at orientation stop can be increased as follows:

1) Increase the [PGM] (motor built-in encoder orientation, magnesensor orientation) and [PGE] (encoder orientation) values to the degree that swaying does not occur during orientation stop.

2) Raise parameters [VGOP] and [VGOI] with the same ratio.

   For example, if [VGOP] is set to 80, set [VGOI] to 80.
   However, if vibration occurs during orientation stop, the scale cannot be raised higher.

3) Parameter [VGOD] is the advance/delay compensation gain.
   If the value is increased, the momentary servo rigidity will increase, however, the torque in regard to the position deflection will drop.

   When [VGOD] is set to 0, PI control will be applied during orientation stop.

10.2.9 Advance/delay control and PI control

The normal advance/delay control is selected. Use PI control in the following cases.

- Static frictional torque of spindle is large and particularly accurate stop is required.

When "PI control" is used, the servo rigidity will be somewhat inferior than the "advance/delay" control so make a selection that meets the machine specifications.

10.2.10 Troubleshooting during orientation error

(1) Does not orient

(a) Keeps rotating

Cause	Check items	Remedy	Remarks
Parameter setting value is inappropriate	The parameters and the orient detector do not match. Parameter [SFNC5] Motor built-in encoder orient .... 4 Encoder orient ..... 1 Magnesensor orient 2	Set parameter [SFNC5] correctly.	
Specifications are not correct.	Orientation is being carried out with a standard motor instead of motor built-in encoder with Z phase.	Change to the motor with the motor built-in encoder with Z-phase.	For motor built-in encoder orientation.
Wiring error	The connector pin No. is incorrect, or the connector No. where the wire is connected is incorrect.	Change the wiring	

(2) Stops after exceeding stopping point. (Overruns and stops)

Cause	Check items	Remedy	Remarks
Parameter setting value is inappropriate	Gear ratio parameters GRA1 to 4, GRB1 to 4 are incorrect.	Correctly set the gear ratio parameters.	
	Improves when parameter [CSP] is halved.	Readjust parameter [CSP], and select the optimum value.	Same for CSP2, CSP3 and CSP4.
	Improves when parameters [PGM], [PGE] are halved.	Readjust parameters [PGM] and [PGE], and select the optimum value.	
	The orientation stop direction is in one direction (CCW or CW). The parameter [SPECO] bits 0, 1 are not set to 0.	Set the orientation stop mode to the pre mode. (Change [SPECO] to pre.)	

(3) The stop position is off.

Cause	Check items	Remedy	Remarks
Machine factor	The stop position is not off on the encoder axis. • The reduction ratio between the spindle and encoder is not 1:1 or 1:2.	There is backlash or slippage between the spindle and encoder.	
		Set the reduction ratio to 1:1 or 1:2.	
	The reduction ratio between the spindle and encoder is 1:2 and the position shift 2048 was changed. (Disconnected at the encoder shaft)	In this case one rotation is made with 2048 pulses, so the position does not change. (Note that it will change at the encoder shaft.)	
Noise	The encoder cable is junctioned.	Use a single encoder cable.	

(4) Vibrates when stopping.

Cause	Check items	Remedy	Remarks
Parameter setting value is inappropriate	The gear ratio parameters GRA1 to 4, GRB 1 to 4 are not correct.	Correctly set the gear ratio parameters.	
Orientation adjustment	The vibration frequency is several Hz.	Lower the position loop gain PGM and PGE.	
	The frequency is 10Hz or higher.	Lower the orientation speed loop gain VGOP and VGOI.	

(5) The oriented complete signal is not output.

Cause	Check items	Remedy	Remarks
Refer to (1) Does not orient.			
The machine load is heavy.	The in-position parameter OINP is too small.	Review the in-position range. (Parameter OINP)	
	Orientation complete occurs when PI control is used during orientation.	Review the orientation speed loop gain (parameter VGOP and VGOI).	Hunting may occur at the stop position.

11. Troubleshooting

⚠ WARNING

1. Wait at least ten minutes after turning the power OFF before starting maintenance or inspection. Failure to do so could lead to electric shocks.
2. Maintenance and inspection must be done by a qualified technician. Failure to observe this could lead to electric shocks. Contact your nearest Service Center or Service Station of repairs and part replacement.

11.1 Introduction

If any trouble occurs with the control unit, perform the preliminary checks described below and then proceed to the troubleshooting described later.

The following preliminary checks are very important when you consult with service engineer.

Preliminary check

NOTICE

Never perform a megger test (insulation resistance measurement) on the amplifier control circuit.

1. Which alarm is displayed on the unit alarm display? Confirm the past alarms on the unit's 7-segment display or on the NC diagnosis screen. (Refer to the alarm and warning table in 6.3.)
2. Is the trouble or failure repeatable?
3. Are ambient and inner-panel temperatures normal?
4. When did the trouble occur (during acceleration, or deceleration, or steady-speed operation)? What was the speed?
5. Is rotation direction correct?
6. Did instantaneous power failure occur?
7. Does the same trouble occur in a specific operation, or when a specific command is given?
8. How frequently does the trouble occur?
9. Does the trouble occur when load is applied, or when load is removed?
10. Were emergency procedures performed?
11. How many years has the control system been used?
12. Is supply voltage normal?
    Does it change from time to time?

11.2 First step of troubleshooting

Perform the following check:

(1) Power supply voltage: 200V ($^{+10\%}_{-15\%}$) 50Hz, 200 ~ 230V ($^{+10\%}_{-15\%}$) 60Hz
In any case, it should not drop below −15% of 200V.
(Ex.) • Check if the supply voltage drops at a specific time everyday.
• Check if the supply voltage drops at start of a specific machine in the factory.

(2) Is the peripheral control unit or functions in good condition?
(Ex.) • Are the NC, sequence circuit, etc., proper?
• Visually check the condition of cables and other components.

(3) Is temperature inside and outside the control unit below 55°C?

(4) Visually check the control unit appearance.
(Ex.) Looseness in the connector, damage or entering of foreign matter, etc.

If the above conditions are confirmed, the section where the error occurred should be apparent. The most likely troubles or failures of MDS-A-SPJA can be largely divided into the following two groups:

Trouble A
- Control unit does not work satisfactorily when it is turned on for the first time (I).
- Control unit comes into a standstill abruptly (II).
- Control unit fails from time to time, or error occurs in orientation stop position, or "alarm" lamp lights (III).

Trouble B
- Unit trouble
  - Trouble in power supply unit
  - Trouble in spindle drive unit
- Trouble with detector
  - Failure in speed detect encoder
  - Trouble in 1024P/rev encoder
  - Trouble in 90000P/rev encoder
  - Trouble in magnesensor
- Trouble in parameter, transfer data from NC
- Trouble with power supply
- Trouble with motor
- Other troubles (mismatching input signal conditions, cable disconnection, etc.)

11.3 Second step of troubleshooting

Trouble I	Checkup	Remedy
Unit does not work satisfactorily when it is turned on for the first time.	As long as the control unit is handled carefully, this type of trouble is quite unlikely to occur. The most possible cause is, (1) Mechanical shock or impact was given to the unit during shipment, installation or handling.	(1) Visually check if any part of the equipment is damaged.
	(2) External wiring or sequence is incorrect, or disconnected. Check grounding wire. (It is not required to consider power phase sequence.)	(2) Confirm that the 7-segment LED in the unit is lit. Check the wiring and sequence. (Note 1) The input/output signals to the unit can be checked on the NC monitor screen.
	(3) Check for mistakes in the parameter settings.	(3) Check the spindle parameters.
	(4) Motor speed cannot be increased.	(4) Check that the motor wires are correctly connected to UVW. When using the built-in motor, make sure that the waveform output from the speed detector is correct.
	(5) No-load operation is in good condition.	(5) Check load condition.
	(6) Only orientation stop function is not in good condition (overrun, etc.)	(6) Adjust the orientation.
	(7) The C axis, synchronous tap and spindle synchronization do not operate correctly.	(7) Adjust and check the waveform of each detector.
	(8) An alarm is displayed on the unit's 7-segment display.	(8) Refer to 2.5.

Note 1) Turn the start signal CW and CCW input ON after the REDY signal and speed command are input.

Trouble II	Checkup	Remedy
Control unit comes into a standstill abruptly.	(1) Check the input power voltage. AC200V +10% −15% 50Hz AC200~230V +10% −15% 60Hz	(1) Restore to normal if abnormal. Secure a power capacity that can maintain the voltages on the left during operations (during acceleration/deceleration, cutting).
	(2) An alarm is displayed on the unit's 7-segment display.	(2) Refer to 11.4.1.
	(3) Is the signal input from NC correct?	(3) Confirm with the NC spindle monitor screen.
	(4) Is the waveform output from each detector normal? • Built-in speed detector • 1024P/rev encoder	(4) Check the waveform with a synchroscope, and readjust or replace.

Trouble III	Checkup	Remedy
Operation is not correct sometimes. The orientation stop position deviates. An alarm displays, but after turning the power of and on or resetting, the operation is restored.	In this case, the comprehensive analysis must be accomplished to determine the cause (load condition, operation mode, etc.). Refer to the causes below.	
	(1) The input power stopped instantaneously or dropped, and the instantaneous stop alarm displayed.	(1) Check for fluctuations in the power supply, etc.
	(2) Check if malfunction occurred in control circuit, due to large noise. The unit is capable of withstanding noise (in power supply) of 1600V/1μs.	(2) Find the noise source, and install a surge killer, etc. Review the unit's grounding, detector shields and grounding, etc.
	(3) The orientation is incorrect. The orientation stop position is deviated. The orientation time is long.	(3) Readjust the parameters for orientation. (Change the SP001, 002, and 006 setting values.) When using the 1024P/rev encoder, inspect the backlash between the spindle and encoder.

11.4 Approach per phenomenon

11.4.1 When alarm or warning is displayed on the 7-segment display

(1) Alarm No. [Z] : Memory error 1

[Meaning] A check sum or RAM check error occurred in the spindle drive control card ROM.

	Investigation item	Investigation results	Remedy
1	Investigate the repeatability.	Occurs each time the power is turned on.	Replace the spindle drive unit.
		Occurs periodically.	Perform investigation item 2, and remedy.
2	Investigate the wiring and installation environment. 1) Is the unit correctly grounded? 2) Is there any equipment generating noise near the unit?	1) The grounding is incomplete.	Correctly ground.
		2) The alarm occurs easily when certain equipment operates.	Take noise prevention measures for the left equipment.
		No special problem.	Replace the spindle drive unit.

(2) Alarm No. [13] : Software process error

[Meaning] The software data process did not end within the set time.

	Investigation item	Investigation results	Remedy
1	Investigate the repeatability.	Occurs each time the power is turned on.	Replace the spindle drive unit.
		Occurs periodically.	Perform investigation item 2, and remedy.
2	Investigate the wiring and installation environment. 1) Is the unit correctly grounded? 2) Is there any equipment generating noise near the unit?	1) The grounding is incomplete.	Correctly ground.
		2) The alarm occurs easily when certain equipment operates.	Take noise prevention measures for the left equipment.
		No special problem.	Replace the spindle drive unit.

(3) Alarm No. 17 : AD converter error

[Meaning] The current detection AD converter circuit did not function correctly during initialization.

	Investigation item	Investigation results	Remedy
1	Investigate the repeatability.	Occurs each time the power is turned on.	Replace the spindle drive unit.
		Occurs periodically.	Perform investigation item 2, and remedy.
2	Investigate the wiring and installation environment. 1) Is the unit correctly grounded? 2) Is there any equipment generating noise near the unit?	1) The grounding is incomplete.	Correctly ground.
		2) The alarm occurs easily when certain equipment operates.	Take noise prevention measures for the left equipment.
		No special problem.	Replace the spindle drive unit.

(4) Alarm No. 20 : No signal detection 1

[Meaning] There is an error in the motor built-in encoder's A, B and Z phases signals.

	Investigation item	Investigation results	Remedy
1	Tug the detector connector (spindle drive unit side and detector side) to investigate whether it has disconnected.	Is disconnected (loose).	Reconnect.
		Is not disconnected (loose).	Perform investigation item 2, and remedy.
2	Turn the power OFF, and check the detector cable connection with a tester.	The connection was defective or there was a broken wire.	Replace the detector cable. Correct the connection.
		The connection is correct.	Replace the spindle drive unit or detector.

(5) Alarm No. 21 : No signal detection 2

[Meaning] Error in the 1024p/rev encoder for orientation A, B, Z phase signals.

	Investigation item	Investigation results	Remedy
1	Check the spindle parameter (SP037: SFNC5) setting value.	"1" is set to Bit 0 even though encoder orientation is not used.	Correctly set.
		No special problem.	Perform investigation item 2, and remedy.
2	Tug the connector to check if the detector connector (spindle drive unit side and detector side) is disconnected.	Is disconnected (loose).	Correctly connect.
		Is not disconnected (loose).	Perform investigation item 3, and remedy.
3	Turn the power off and check the detector cable connection with a tester.	A connection defect or broken wire is found.	Replace the detector cable. Correctly connect.
		Connection is normal.	Replace the spindle drive unit or detector.

(6) **Alarm No. 23 : Excessive speed deflection**

[Meaning] The speed command and current motor speed difference exceeded 50rpm for 12 seconds or more.

	Investigation item	Investigation results	Remedy
1	Check the U, V, W wiring between the spindle drive unit and motor.	The wiring is not correct.	Correctly wire.
		The wiring is correct.	Perform investigation item 2, and remedy.
2	Check the spindle parameters (SP034, SP040, SP055, SP257 and following) setting values.	The values are not correct.	Correctly set.
		The correct values are set.	Perform investigation item 3, and remedy.
3	Measure the acceleration/ deceleration time to the max. spindle speed. If the alarm occurs when changing from forward run (reverse run) to reverse run (forward run), measure the time from the forward run (reverse run) max. speed to the reverse run (forward run) max. speed.	Takes more 12 sec. or more.	Increase the spindle parameter (SP055) setting value.
		Takes 12 sec. or less.	Perform investigation item 4, and remedy.
4	If the alarm occurs during cutting, check the load amount.	The load amount is 120% or higher.	Decrease the load.
		The load amount is 119% or lower.	Perform investigation item 5, and remedy.
5	Tug the connector to check if the detector connector (spindle drive unit side and detector side) is disconnected.	Is disconnected (loose).	Correctly connect.
		Is not disconnected (loose).	Perform investigation item 6, and remedy.
6	Turn the power off and check the speed detector cable connection with a tester.	A connection defect or broken wire is found.	Replace the detector cable. Correctly connect.
		Connection is normal.	Replace the spindle drive unit.

(7) **Alarm No. 30 : Over-regeneration**

[Meaning] Regeneration at the regeneration capacity limit is occurring.

	Investigation item	Investigation results	Remedy
1	Check the regenerative resistor capacity.	The regenerative resistor capacity is small.	Change to a regenerative resistor with the correct capacity.
		The correct regenerative resistor is connected.	Perform investigation item 2, and remedy.
2	Check the spindle parameter (SP041) setting value.	The values are not correct.	Correctly set.
		The correct values are set.	Perform investigation item 3, and remedy.
3	Check the spindle load value.	The start/stop frequency is high.	Lower the start/stop frequency. Increase the regenerative resistor capacity.
		No problem found.	Replace the spindle drive unit.

(8) **Alarm No. 31 : Overspeed**

[Meaning] The motor speed exceeded 115% of the value set in spindle parameter (SP017:TSP).

	Investigation item	Investigation results	Remedy
1	Investigate the repeatability	Occurs only during speed loop operation.	Perform investigation item 2, and remedy.
		Occurs only during a position loop.	Perform investigation item 3, and remedy.
		Occurs constantly.	Perform investigation item 4, and remedy.
2	Check the spindle parameter (SP017: TSP) setting value.	The setting value is '2000' or less.	Increase the setting value.
		The setting value is '2001' or more.	Perform investigation item 4, and remedy.
3	1) If it occurs during synchronous tapping, check the spindle parameter (SP193:SPECT) setting value and the tapping time constant.	1) The SP193 bit 5 (position detector polarity) setting value is incorrect, or the tapping time constant setting value is small.	Correctly set.
		The correct values are set.	Perform investigation item 4, and remedy.

	Investigation item	Investigation results	Remedy
4	Investigate the wiring and installation environment. 1) Is the unit correctly grounded?	1) The grounding is incomplete.	Correctly ground.
	2) Is there any equipment generating noise near the unit?	2) The alarm occurs easily when certain equipment operates.	Take noise prevention measures for the left equipment.
	3) Are the speed and position detector cables correctly shielded?	3) The shields are not correct.	Correctly shield the cables.
		No special problem.	Replace the spindle drive unit.

(9) Alarm No. 32 : Power module error

[Meaning] One of the following errors occurred in the IPM used by the spindle drive unit.
1) The overcurrent protection functioned.
2) The base power voltage dropped.

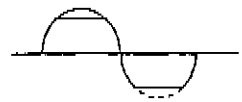
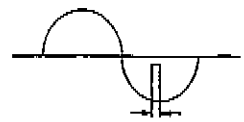
	Investigation item	Investigation results	Remedy
1	Check when the phenomenon occurred.	Occurs before ready ON.	Replace the spindle drive unit.
		Occurs after servo ON.	Perform investigation item 2, and remedy.
2	Check the spindle parameters (SP034, SP040, SP055, SP257 and following) setting values.	The values are not correct.	Correctly set.
		The correct values are set.	Perform investigation item 3, and remedy.
3	If the alarm occurs during cutting, check the load amount.	The load amount is 120% or higher.	Decrease the load.
		The load amount is 119% or lower.	Perform investigation item 4, and remedy.
4	Check the U, V, W wiring between the spindle drive unit and motor. 1) Are the terminal screws loose?	1) The screws are loose.	Correctly tighten.
	2) Do the wires short-circuit between phases?	2) There is a short-circuit.	Replace the cable.
	3) Is there a ground fault in one of the phases?	3) There is a ground fault.	Replace the cable.
	Open both ends of the cable when checking 2) and 3).	There is no special problem.	Perform investigation item 5, and remedy.

	Investigation item	Investigation results	Remedy
5	Check the motor insulation. Check between each motor wire and ground with a megger tester.	The resistance value is 1MΩ or less.	Replace the motor.
		The resistance value is 1MΩ or more.	Perform investigation item 6, and remedy.
6	Check the power voltage.	The power voltage drops below 170V during acceleration/deceleration and cutting.	Review the power capacity.
		The power voltage is constantly 171V or more.	Perform investigation item 7, and remedy.
7	Investigate the wiring and installation environment. 1) Is the unit correctly grounded?	1) The grounding is incomplete.	Correctly ground.
	2) Is there any equipment generating noise near the unit?	2) The alarm occurs easily when certain equipment operates.	Take noise prevention measures for the left equipment.
		No special problem.	Replace the spindle drive unit.

(10) Alarm No. 33 : Overvoltage

[Meaning] The PN bus-line voltage exceeded 400V.

	Investigation item	Investigation results	Remedy
1	Check the P and C wiring between the spindle drive unit and the regenerative resistor.	It is disconnected.	Reconnect.
		It is not disconnected.	Perform investigation item 2, and remedy.
2	Is the specified power capacity secured?	The power capacity is insufficient.	Increase the power capacity.
		No problem found.	Perform investigation item 3, and remedy.
3	Using a tester, confirm that there is 170V or more during motor acceleration/deceleration.	Voltage drops to 170V or less.	Increase the power capacity.
		The voltage is 170V or more.	Perform investigation item 4, and remedy.

	Investigation item	Investigation results	Remedy
4	Measure the power voltage waveform with a synchroscope (also during acceleration/deceleration).	1. Power waveform distortion  2. Partial dropping  3. Other waveform or frequency error	Eliminate the waveform distortion. 1. Increase the power capacity or the power cable size. 2. Improve the other semiconductor devices generating the waveform distortion. (Add an AC reactor)
		No problem found.	Perform investigation item 5, and remedy.
5	Measure the voltage between the R-S, S-T and T-R wires with a tester.	The voltage difference between each wire is 10V or more.	Improve the power phase balance.
		No problem found.	Perform investigation item 6, and remedy.
6	Measure the power waveform with a synchroscope.	Instantaneous power failures or voltage drops occur frequently.	Review the power supply facility.
		No problem found.	Perform investigation item 7, and remedy.
7	Check the wiring and installation environment. 1) Is the grounding correct? 2) Is there any noise generating equipment in the surrounding area?	1) Grounding is incomplete.	Correctly ground.
		2) Alarm occurs easily when a certain device operates.	Perform the noise measures for the device on the left.
		No problem found.	Replace the spindle drive unit.

(11) Alarm No. 37 : Parameter error

[Meaning] The spindle parameter sent during initialization was illegal.

	Investigation item	Investigation results	Remedy
1	Check the spindle parameter setting value.	The setting is incorrect.	Correctly set.
		No special problem.	Replace the spindle drive unit.

(12) Alarm No. 3B : Power module overheat

[Meaning] Overheating of the IPM used in the spindle drive unit main circuit was detected.

	Investigation item	Investigation results	Remedy	
1	Investigate the heat radiating environment			
	1) Rotation of unit's lower fans.	The fan is not rotating properly.	Replace the fan	Remedy so that cutting oil and cutting chips do not get on the fins.
	2) Contamination of unit's side heat radiating fins.	Cutting oil and chips, etc., are adhered on the heat radiating fins.	Clean the fin	
	3) Measure the unit's ambient temperature.	55°C is exceeded.	Consider the panel ventilation and cooling.	
		No problem found.	Perform investigation time 2, and remedy.	
2	Investigate the wiring and installation environment. 1) Is the grounding correct? 2) Is there any noise generating equipment in the surrounding area?	1) Grounding is incomplete.	Correctly ground.	
		2) Alarm occurs easily when a certain device operates.	Perform the noise measures for the device on the left.	
		No problem found.	Replace the spindle drive unit	

(13) Alarm No. 46 : Motor overheat

[Meaning] The motor overheated and the thermal protector built-in the motor activated.

	Investigation item	Investigation results	Remedy
1	Investigate the repeatability.	Occurs immediately after turning power on. Occurs several minutes after operation starts.	Perform investigation item 2, and remedy.
		Occurs after operating for a while.	Perform investigation item 5, and remedy.
2	Tug the speed detector cable connector on the spindle drive unit to see if it is disconnected.	Is disconnected (loose).	Correctly connect.
		No special problem.	Perform investigation item 3, and remedy.
3	Check the speed detector cable connection.	A connection defect is found.	Correctly connect.
		Connection is normal.	Perform investigation item 4, and remedy.
4	Check between MOH and RG on the motor thermal protector with tester.	The resistance value is several 100Ω or higher.	Replace the motor.
		The resistance value is several 10Ω or lower.	Replace the spindle drive unit.
5	Check the spindle load amount.	The unit is started and stopped frequently, or the cutting load is large.	Decrease the starting/ stopping frequency or lower the load.
		No special problem.	Perform investigation item 6, and remedy.
6	Check the motor cooling fan wiring and rotation.	The motor cooling fan wiring is incorrect.	Correctly wire.
		The wiring is correct but the fan does not rotate.	Replace the motor.
		No special problem.	Perform investigation item 7, and remedy.
7	Check the finger guard on the motor cooling fan section.	The guard is clogged.	Clean.
		No special problem.	Replace the spindle drive unit.

(14) Alarm No. 50 : Overload

[Meaning] The current flowed to the spindle motor exceeded the overload detection level (spindle parameter SP064: OLL) and continued longer than the overload detection time (spindle parameter SP063: OLT).

	Investigation item	Investigation results	Remedy
1	Check the spindle parameters (SP034, SP040, SP055, SP257 and following) setting values.	The values are not correct.	Correctly set.
		The correct values are set.	Perform investigation item 2, and remedy.
2	Check the spindle parameters (SP063, SP064) setting values.	The standard value is not set.	Set the standard value.
		The standard value is set.	Perform investigation item 3, and remedy.
3	Check the U, V, W wiring between the spindle drive unit and motor. 1) Are the terminal screws loose? 2) Do the wires short-circuit between phases? 3) Is there a ground fault in one of the phases? Open both ends of the cable when checking 2) and 3).	1) The screws are loose.	Correctly tighten.
		2) There is a short circuit.	Replace the cable.
		3) There is a ground fault.	Replace the cable.
		There is no special problem.	Perform investigation item 4, and remedy.
4	Tug the connector to check if the detector connector (spindle drive unit side and speed detector side) is disconnected.	Is disconnected (loose).	Correctly connect.
		Is not disconnected (loose).	Perform investigation item 5, and remedy.
5	Turn the power off and check the speed detector cable connection with a tester.	A connection defect or broken wire is found.	Replace the detector cable. Correctly connect.
		Connection is normal.	Perform investigation item 6, and remedy.
6	Check the motor load amount.	The load amount exceeds the motor rating.	Decrease the load to within the motor rating.
		No special problem.	Perform investigation item 7, and remedy.
7	Check the motor rotation.	The motor is locked.	Review the machine side.
		No special problem.	Replace the spindle drive unit.

(15) Alarm No. 52 : Excessive error

[Meaning] The position tracking error was over the specified value (excessive error width setting value) during the orientation.

- Excessive error width setting value
  During the orientation (SP102:OODR) : Standard value 32767 (32767 pulses)

	Investigation item	Investigation results	Remedy
1	If the alarm occurs during encoder orientation, check the spindle parameter (SP097: SPEC0) bit 5 setting value.	OK if the bit 5 setting value is changed.	Change the bit 5 setting value.
		NG even if the bit 5 setting value is changed.	Return the bit 5 setting value to the original value, perform investigation item 2, and remedy.
2	Check the spindle parameter (SP001:PGM, SP002:PGE, P006: CSP) setting values.	OK if PGM and PGE are doubled or if CSP is decreased to half.	Change the setting values.
		NG even with the above settings.	Perform investigation item 3, and remedy.
3	Tug the connector to check if the detector connector (spindle drive unit side and position/speed detector sides) is disconnected.	Is disconnected (loose).	Correctly connect.
		Is not disconnected (loose).	Perform investigation item 6, and remedy.
4	Turn the power off and check the position/speed detector cable connections with a tester.	A connection defect or broken wire is found.	Replace the detector cable. Correctly connect.
		Connection is normal.	Replace the spindle drive unit or the position detector.

The tracking error amount (droop amount) can be calculated with the following equation. If this value exceeds the excessive error width setting value, this alarm will occur.

$$\text{Droop amount (No. of pulses)} = \frac{\{\text{Spindle speed (rpm)}/60\} \times \text{No. of pulses per rotation (*1)}}{\text{Position loop gain (sec}^{-1}\text{)}}$$

(*1) The No. of pulses per rotation is as follows.

4096

(16) Alarm No. 57 : Option error

[Meaning] A signal for an option function (orientation, digital speed command, S-analog synchronous tap) that is not set was input.

	Investigation item	Investigation results	Remedy
1	Check the spindle parameter (SP129:HI01 to SP133: HI05 and SP248:FNC) setting values.	A function not set in SP248 is selected for the SP129 to SP133 auxiliary input.	Correctly set.
		No problem found.	Replace the spindle drive unit.

(17) Alarm No. 88 : Watch dog

[Meaning] The software process did not end within the specified time.

	Investigation item	Investigation results	Remedy
1	Check the repeatability.	Alarm occurs every ready ON.	Replace the spindle drive unit.
		Occurs periodically.	Perform investigation item 2, and remedy.
2	Check the wiring and installation environment. 1) Is the grounding correct? 2) Is there any noise generating equipment in the surrounding area?	1) Grounding is incomplete.	Correctly ground.
		2) Alarm occurs easily when a certain device operates.	Perform the noise measures for the device on the left.
		No problem found.	Replace the spindle drive unit.

(18) Alarm No. E0 : Over-regeneration warning

[Meaning] The regenerative resistor load reached 80% of the alarm.

	Investigation item	Investigation results	Remedy
1	Perform the same investigation and remedies as for alarm No. 30 .		

(19) Warning No. E1 : Overload warning

[Meaning] The current flowed to the spindle motor exceeded the overload detection level (spindle parameter SP064: OLL) and the time exceeded 80% of the overload detection time (spindle parameter SP063: OLT).

	Investigation item	Investigation results	Remedy
1	Perform the same investigation and remedies as for alarm No. 50 .		

(20) Warning No. E4 : Parameter error warning

[Meaning] A value exceeding the tolerable range was set during ready ON.

	Investigation item	Investigation results	Remedy
1	Perform the same investigation and remedies as for alarm No. 37.		

(21) Warning No. E7 : NC Emergency stop

[Meaning] An emergency stop signal has been input from the NC or an alarm has occurred in another servo axis or spindle.

	Investigation item	Investigation results	Remedy
1	Check whether the emergency stop switch is on.	Switch is on.	Turn off the emergency stop switch.
		Switch is off.	Perform investigation item 2, and remedy.
2	Tug the connector between the NC and spindle drive unit side to investigate whether it has disconnected. Check whether an excessive force is being applied on the connector.	Is disconnected (loose). Excessive force was applied.	Reconnect.
		It is not disconnected.	Perform investigation item 3, and remedy.
3	Disconnect the cable between the NC and spindle drive unit, and check the connection with a tester.	The connection was defective.	Replace the cable.
		The connection is correct.	Perform investigation item 4, and remedy.
4	Check the wiring and installation environment. 1) Is the grounding correct? 2) Is there any noise generating equipment in the surrounding area?	1) Grounding is incomplete.	Correctly ground.
		2) Alarm occurs easily when a certain device operates.	Perform the noise measures for the device on the left.
		No problem found.	Replace the spindle drive unit.

11.4.2 When alarm or warning is not displayed on indicator

(1) Motor does not rotate even when an alarm is not displayed.

	Investigation item	Investigation results	Remedy
1	Check the wiring around the spindle drive unit. Also check for looseness in the terminal screws and for broken wires, etc.	The wiring is incorrect. Loose screws or broken wires are found.	Correctly wire. Tighten the screws. Replace the wires.
		No special problem.	Perform investigation item 2, and remedy.
2	Check the input voltage.	The voltage exceeds the specified value.	Restore the power to the specified value.
		The voltage is within the specified value.	Perform investigation item 3, and remedy.
3	Confirm all spindle parameters.	The correct value is not set.	Correctly set.
		The correct value is set.	Perform investigation item 4, and remedy.
4	Confirm the input signals. Are the ready, forward run, reverse run signals input? The forward and reverse run signals must be input at least one second after ready ON. The forward run and reverse run signals may be turned ON simultaneously.	The signal is not input or the sequence is incorrect. The orientation command is input.	Correct the input signals.
		No special problem.	Perform investigation item 5, and remedy.
5	Confirm the speed command. (Confirm on the spindle diagnosis screen.)	The speed command is not correctly input.	Correctly input the speed command.
		The speed command is correctly input.	Replace the spindle drive unit.

(2) An alarm is not displayed but the motor only rotates slowly. The sound from the motor is loud.

	Investigation item	Investigation results	Remedy
1	Check the U, V, W wiring between the spindle drive unit and motor.	The wiring is not correct.	Correctly wire.
		The wiring is correct.	Perform investigation item 2, and remedy.
2	Confirm the input voltage.	One of the three phases is not the specified value.	Restore the power to the specified value.
		No special problem.	Perform investigation item 3, and remedy.
3	Confirm the speed command.	The speed command is not correctly input.	Correctly input the speed command.
		The speed command is correctly input.	Perform investigation item 4, and remedy.

	Investigation item	Investigation results	Remedy
4	Tug the connector to check if the speed detector connector (spindle drive unit side and speed detector side) is disconnected.	Is disconnected (loose).	Correctly connect.
		Is not disconnected (loose).	Perform investigation item 5, and remedy.
5	Turn the power off and check the speed detector cable connection with a tester.	A connection defect or broken wire is found.	Replace the detector cable. Correctly connect.
		Connection is normal.	Replace the spindle drive unit.

(3) The commanded speed and actual speed do not match.

	Investigation item	Investigation results	Remedy
1	Confirm the speed command.	The speed command is not correctly input.	Correctly input the speed command.
		The speed command is correctly input.	Perform investigation item 2, and remedy.
2	Check for slips between the motor and spindle. (If the belt or clutch are connected.)	Slipping is found.	Repair the machine side.
		No special problem.	Perform investigation item 3, and remedy.
3	Check the spindle parameters (SP034, SP040, SP017, SP257 and following).	The correct value is not set.	Correctly set.
		The correct value is set.	Replace the spindle drive unit.

(4) The start up time is long or has become longer.

	Investigation item	Investigation results	Remedy
1	Check if the friction torque has increased.	The torque has increased.	Repair the machine side.
		No special problem.	Perform investigation item 2, and remedy.
2	Rotate the motor bearings by hand to see that they are normal.	The bearings do not rotate smoothly.	Replace the spindle motor.
		The bearings rotate smoothly.	Perform investigation item 3, and remedy.
3	Check if the torque limit signal is being input.	The signal is input.	Do not input the signal.
		The signal is not input.	Replace the spindle drive unit.

(5) The motor stops during cutting.

	Investigation item	Investigation results	Remedy
1	Check the load amount during cutting.	The load meter indicates a value higher than 120% during cutting.	Decrease the load.
		No special problem.	Perform investigation item 2, and remedy.
2	Perform the same investigation and remedies as for item (4).		

(6) The vibration and noise (gear noise) is large.

	Investigation item	Investigation results	Remedy
1	Check the machines movement balance. (Free run from the max. speed.)	The same sound is heard during free run.	Repair the machine side.
		No special problem.	Perform investigation item 2, and remedy.
2	Check for a resonance point on the machine. (Free run from the max. speed.)	The vibration and sound increases at a certain speed during free run.	Repair the machine side.
		No special problem.	Perform investigation item 3, and remedy.
3	Check the machine backlash.	Backlash is large.	Repair the machine side.
		No special problem.	Perform investigation item 4, and remedy.
4	Confirm the spindle parameter (SP022: VGNP1, SP023: VGNI1, SP056: PYVR) settings.	The phenomenon decreases when the setting value is lowered to half.	Change the setting. Note that the impact response will decrease.
		No change even with the above settings.	Return the setting value to the original value, perform investigation item 5, and remedy.
5	Tug the connector to check if the speed detector connector (spindle drive unit side and speed detector side) is disconnected.	Is disconnected (loose).	Correctly connect.
		Is not disconnected (loose).	Perform investigation item 6, and remedy.
6	Turn the power off and check the speed detector cable connection with a tester.	A connection defect or broken wire is found.	Replace the detector cable. Correctly connect.
		Connection is normal.	Replace the spindle drive unit.

(7) The spindle coasts during deceleration.

	Investigation item	Investigation results	Remedy
1	Check for slips between the motor and spindle. (If the belt or clutch are connected.)	Slipping is found.	Repair the machine side.
		No special problem.	Replace the spindle drive unit.

(8) The rotation is not stable.

	Investigation item	Investigation results	Remedy
1	Confirm the spindle parameter (SP022: VGNP1, SP023: VGNI1) settings.	The stabilizes when the setting values are doubled.	Change the setting. Note that the gear noise may increase.
		No change even with the above settings.	Return the setting value to the original value, perform investigation item 2, and remedy.
2	Tug the connector to check if the speed detector connector (spindle drive unit side and speed detector side) is disconnected.	Is disconnected (loose).	Correctly connect.
		Is not disconnected (loose).	Perform investigation item 3, and remedy.
3	Turn the power off and check the speed detector cable connection with a tester.	A connection defect or broken wire is found.	Replace the detector cable. Correctly connect.
		Connection is normal.	Perform investigation item 4, and remedy.
4	Investigate the wiring and installation environment. 1) Is grounding properly performed? 2) Is there any noise generating equipment in the surrounding area?	1) Grounding is incomplete.	Correctly ground.
		2) Alarm occurs easily when a certain device operates.	Perform the noise measures for the device on the left.
		No special problem.	Replace the spindle drive unit.

(9) The motor speed does not rise above a certain speed.

	Investigation item	Investigation results	Remedy
1	Check the speed command. Confirm whether the override input on the machine operation panel is being input.	The speed command is not correctly input.	Correctly input the speed command.
		The speed command is correctly input.	Perform investigation item 2, and remedy.
2	Check whether the load has increased suddenly.	The load has increased.	Repair the machine side.
		No special problem.	Perform investigation item 3, and remedy.
3	Check that the motor bearings can be rotated normally by hand.	The bearings do not rotate smoothly.	Replace the spindle motor.
		The bearings rotate smoothly.	Perform investigation item 4, and remedy.
4	Tug the connector to check if the speed detector connector (spindle drive unit side and speed detector side) is disconnected.	Is disconnected (loose).	Correctly connect.
		Is not disconnected (loose).	Perform investigation item 5, and remedy.
5	Turn the power off and check the speed detector cable connection with a tester. (Especially check the shield wiring.)	A connection defect or broken wire is found.	Replace the detector cable. Correctly connect.
		Connection is normal.	Replace the spindle drive unit.

11.5 Periodic inspection

Maintenance and inspection are impertinent for using the device performance to the fullest, to prevent accidents and continue highly reliable operation for a long time.

⚠ CAUTION

Electric shock accidents could lead to major accidents. Confirm that all power supplies are shut off before starting inspections for which the power does not need to be ON. Make sure that the CHARGE lamp has gone out before starting any work.

11.5.1 Inspection of control unit

Check item	Frequency	Check	Remedy
1. Cooling fan	Monthly	(1) Rotate the fan shaft manually to check. (2) Turn on the fan to check that the fan runs powerfully. (3) Check if abnormal sound occurs in bearing.	Replace the fan.
2. Dirt and terminal screw looseness	Appropriate interval	Periodically clean the areas around the amplifier, especially the cooling fin, and tighten the input/output terminals and connections.	
3. Wiring	Appropriate interval	Check that the wires are not contacting the conductive parts and that they are not caught.	

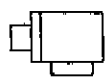
11.5.2 Inspection of motor

Check item	Frequency	Check	Remedy
1. Noise and vibration	Monthly	• Check if abnormal sound or intense vibration occurs. If abnormal sound or intense vibration occurs, perform the following check: (1) Check foundation and installation. (2) Check shaft alignment. (3) Check if vibration is transmitted through shaft coupling. (4) Check if bearing is damaged or abnormal noise occurs. (5) Check if noise or vibration is caused by reduction gear or belt. (6) Check control unit for condition. (7) Check cooling fan for condition. (8) Check belt tension.	Clean
2. Temperature rise	Monthly	• Check bearing temperature. (Normal amb. temp. + 10 to 40°C) • Check motor frame temperature. If temperature is high excessively, perform the following check: (1) Check cooling fan operation. (2) Check cooling air passage (between frame and cover). (3) Check load condition.	
		(4) Check control unit.	Refer to trouble-shooting.
3. Insulation resistance	Every 6 months	• Check if insulation resistance is excessively low. Disconnect the wiring with the spindle drive unit, and measure the resistance between the entire circuit and ground. (There is no problem if the value is 1MΩ or more with a 500V megger tester.) If the insulation resistance is less than 1MΩ, clean the inside of the motor and dry it out. To dry, disassemble the motor and heat it in a dryer at a temperature less than 90°C.	
4. Cooling fan	Weekly, monthly	• Check cooling fan for operation, abnormal noise and vibration.	

Appendix 1

Mitsubishi AC Spindle Drive MDS-A-SPA/SPJA Delivery Specifications

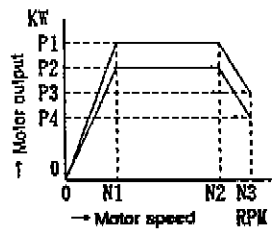
1. Motor specifications

Motor model (Rating table No.)			SJ- (RSJ)		
No. of motor speed detector pulses			pulse/rev		
Installation method			Installation direction		
	Flange installation	Circle one item		Output shaft horizontal	Circle one item
	Leg installation			Output shaft perpendicular downward	
	Built-in			Output shaft perpendicular upward	
Cooling wind direction		P → O	 Load side: P O: Reverse load side		Circle one item
		O → P			

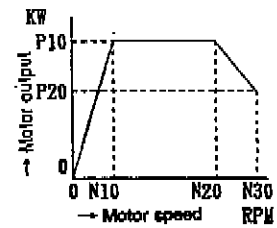
Output characteristics of usage state (Write in the right column for the coil changeover motor)

Output	30 min. (15 min.) or 50% ED rating	Constant output P1 (P10)	( ) kW	Fill in numerical value (Note in the ( ) when necessary)
		Abated output P3 (P20)	( ) kW	
	Continuous rating	Constant output P2		
		Abated output P4		
Speed	Base speed	N1 (N10)	( ) RPM	
	Max. speed	Constant output N2 (N20)	( ) RPM	
		Abated output N3 (N30)	( ) RPM	

Output characteristics during constant run



Output characteristics during acceleration/deceleration

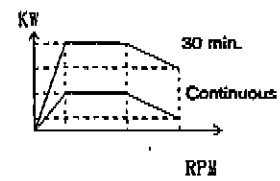


Output characteristics of each coil for coil changeover motor

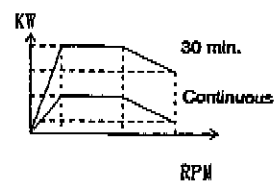
Changeover speed RPM

Output during constant run

Low-speed coil

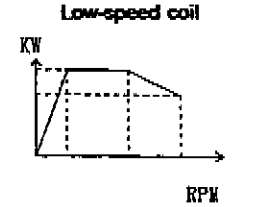


High-speed coil

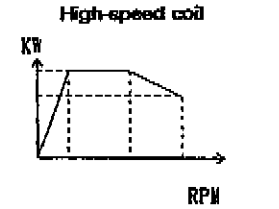


Output during acceleration/deceleration

Low-speed coil



High-speed coil



Fill in the numerical value. (Write output characteristics in the table.)

2. Mechanical specifications

Drive method	Gear		Belt: V-belt, Timing belt	Direct	Circle one item
Max. speed of final axis at each gear	H : High-speed		RPM		
	MH : Middle-high		RPM		
	ML : Middle-low		RPM		
	L : Low-speed		RPM		
Motor shaft conversion load GD^2	H : High-speed		$kg\text{-}m^2$		Fill in numerical value
	MH : Middle-high		$kg\text{-}m^2$		
	ML : Middle-low		$kg\text{-}m^2$		
	L : Low-speed		$kg\text{-}m^2$		
No. of gear teeth or pulley diameter up to final shaft from motor shaft (diameter)	H : High-speed		—— × —— × ——		
	MH : Middle-high		—— × —— × ——		
	ML : Middle-low		—— × —— × ——		
	L : Low-speed		—— × —— × ——		

3. System specifications/model		
Spindle drive unit model	MDS-A-SPJA -	Circle an item or fill in numerical value
Power supply unit model	MDS-A-C -	
Drive unit model connected to same power supply unit	MDS-A-SP -	
	MDS-A-SP -	
	MDS-A-SP -	
Magnesensor model	BKO-C	
Encoder model		
Resistor model		
ACL model for power supply unit	A-AL BKO-NC6851H	
ACL model for motor	BKO-	

4. Electrical specifications							
Max. motor speed RPM [Speed during max. command (10V)]		3450		4500		4600	Circle an item or fill in numerical value
		6000		8000		10000	
	Special					RPM (per 10RPM)	
Zero speed detection		50RPM				25RPM	
	Special	RPM				1 to 1000 (per 1RPM)	
Load meter output		10V (at 120%)				3V (at 120%)	Circle one item
Acceleration/deceleration time constant		0.3S		3S		5S	Circle an item or fill in numerical value
	Special	S		20 to 32760ms (per 10ms)			
Torque limit		10%		30%		50%	
	Special	%		0 to 120% (per 1%)			
Speed detection range (% to max. speed)		10%		30%		50%	
	Special	%		0 to 100% (per 1%)			

5. Additional specifications				
	No additional specifications			Circle or fill in all relevant items
	Magnesensor orientation (1-point orientation)			
	Encoder (1024 pulses) orientation		1-point orientation	
			Multi-point orientation	
	Motor built-in encoder orientation		Multi-point indexing orientation	
	Motor built-in encoder pulse output	Drive unit pulse output in regard to No. of motor built-in encoder pulses	1-fold	
			2-fold	
	1-amplifier 2-motor changeover		Spindle motor + spindle motor (fill sub-side specifications on following pages)	
			Spindle motor + general purpose motor (fill sub-side specifications in Section 8.)	
	S-analog high-speed synchronous tapping		According to encoder (1024 pulses)	
			According to motor built-in encoder	
	Digital speed command	12-bit binary	BCD 2 digits	
		Coded 12-bit binary	BCD 3 digits	

	General purpose input		IN01		IN02		IN03		IN04		IN05		IN06			
			IN07		IN08		IN09		IN10		IN11		IN12			
	General purpose output		OUT1		OUT2		OUT3		OUT4		OUT5		OUT6		OUT7	OUT8
			OUT1C		OUT2C		OUT3C		OUT4C		OUT5C		OUT6C			

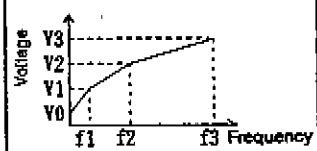
6. Additional specifications (When orientation function is provided)

Motor shaft rotation direction during orientation		PRE		Circle one item
		Forward run		
		Reverse run		
In-position range	For magnesensor orientation			Circle an item or fill in numerical value
		±1°	±5°	
	Special	± °	0–±20° (per 1/16)	
	For encoder orientation			
		±0.88°	±5.02°	
	Special	± °	per ±0.088°	

7. Usage conditions of encoder for orientation and contour control (C axis control)

Encoder rotation direction	Motor rotates in direction shown below looking from shaft 	↓	Circle one item
		↑	
Transmission ratio of final axis and encoder	1 : 1		
	1 : 2 (When encoder shaft is decelerating)		
	1 : 4 (When encoder shaft is decelerating)		

8. Sub-motor ratings (When 1-amplifier 2-motor changeover function with general purpose motor is provided)



		Rated output			kW		Fill in all items
		Rated current			A		
		No. of motor poles			Poles		
		Maker/model			/		
		Cushion time to max. frequency (f3)			s		
V/F pattern	Frequency	f1 = Hz	f3 = Hz	Voltage	V0 = V	V2 = V	
		f2 = Hz			V1 = V	V3 = V	

9. Special notes

10. Sales Information

Customer	Messrs.
Machine maker	Messrs.
Final delivery destination	Messrs.
Machine name	
Machine model	
No.of units	units
Work No.	

Revision column	

MITSUBISHI ELECTRIC CORPORATION			
Created by	Checked by	Approved by	
Delivery specifications No. BN 435 U S		Pages	/
		Sub No.	

MDS-A-SPJA Parameter setting list (1/3)

Customer:
Machine name:
[Setting 1] Amplifier : MDS-A-SPJA-
Motor : SJ-P
Regenerative resistor :

Remarks:

No.	Abbr.	Standard setting	Setting
SP001	PGM	100	
SP002	PGE	100	
SP003		0	
SP004	OINP	16	
SP005	OSP	0	
SP006	CSP	20	
SP007	OPST	0	
SP008		0	
SP009		0	
SP010		0	
SP011		0	
SP012		0	
SP013		0	
SP014		0	
SP015		0	
SP016		0	
SP017	TSP	6000	
SP018	ZSP	50	
SP019	CSN1	30	
SP020	SDTS	600	
SP021	TLM1	10	
SP022	VGNP1	63	
SP023	VGNI1	60	
SP024		0	
SP025	GRA1	1	
SP026	GRA2	1	
SP027	GRA3	1	
SP028	GRA4	1	
SP029	GRB1	1	
SP030	GRB2	1	
SP031	GRB3	1	
SP032	GRB4	1	

No.	Abbr.	Standard setting	Setting
SP033	SFNC1	0000	
SP034	SFNC2	0000	
SP035	SFNC3	0000	
SP036	SFNC4	0000	
SP037	SFNC5	0000	
SP038	SFNC6	0000	
SP039	ATYP	0000	
SP040	MTYP	0000	
SP041	PTYP	0000	
SP042		0	
SP043		0	
SP044		0	
SP045		0	
SP046	CSN2	0	
SP047	SDTR	30	
SP048	SUT	15	
SP049	TLM2	20	
SP050	TLM3	30	
SP051	TLM4	40	
SP052	TLM5	50	
SP053	TLM6	60	
SP054	TLM7	70	
SP055	SETM	12	
SP056	PYVR	50	
SP057		0	
SP058		0	
SP059	MKT	0	
SP060	MKT2	0	
SP061	MKIL	0	
SP062		0	
SP063	OLT	60	
SP064	OLL	110	

No.	Abbr.	Standard setting	Setting
SP065	VCGN1	100	
SP066	VCSN1	0	
SP067	VIGWA	0	
SP068	VIGWB	0	
SP069	VIGN	0	
SP070		0	
SP071		0	
SP072		0	
SP073		0	
SP074		0	
SP075		0	
SP076		0	
SP077	TDSL	0	
SP078	FPWM	0	
SP079	ILMT	0	
SP080	ILMA	0	
SP081		0	
SP082		0	
SP083		0	
SP084		0	
SP085		0	
SP086		0	
SP087	DIQM	75	
SP088	DIQN	3000	
SP089		0	
SP090		0	
SP091		0	
SP092		0	
SP093		0	
SP094	LMAV	0	
SP095	VFAV	0	
SP096	EGAR	0	

No.	Abbr.	Standard setting	Setting
SP097	SPECO	0000	
SP098	VGOP	63	
SP099	VGOI	60	
SP100	VGOD	15	
SP101	DINP	16	
SP102	OODR	32767	
SP103	FTM	200	
SP104	TLOR	100	
SP105	IQGO	100	
SP106	IDGO	100	
SP107	CSP2	20	
SP108	CSP3	20	
SP109	CSP4	20	
SP110	WCML	0	
SP111	WDEL	0	
SP112	WCLP	0	
SP113	WINP	0	
SP114		0	
SP115		0	
SP116		0	
SP117		0	
SP118		0	
SP119		0	
SP120		0	
SP121		0	
SP122		0	
SP123		0	
SP124		0	
SP125		0	
SP126		0	
SP127		0	
SP128		0	

MDS-A-SPA (H) Parameter setting list (2/3)

No.	Abbr.	Standard setting	Setting
SP129	HI01	0	
SP130	HI02	0	
SP131	HI03	0	
SP132	HI04	0	
SP133	HI05	0	
SP134		0	
SP135		0	
SP136		0	
SP137		0	
SP138		0	
SP139		0	
SP140		0	
SP141	H001	0	
SP142	H002	0	
SP143	H003	0	
SP144		0	
SP145		0	
SP146		0	
SP147		0	
SP148		0	
SP149		0	
SP150		0	
SP151		0	
SP152		0	
SP153		0	
SP154		0	
SP155	SAtyp	0	
SP156	DGtyp	0	
SP157	SAavr	0	
SP158	ADofs	0	
SP159	ADcp1	0	
SP160	ADcp2	0	
SP161	Sgain	0	
SP162	SS00	0	
SP163	SS01	0	
SP164	SS02	0	
SP165	SS03	0	

No.	Abbr.	Standard setting	Setting
SP166	SS04	0	
SP167	SS05	0	
SP168	SS06	0	
SP169	SS07	0	
SP170	SSchg	0	
SP171	HSPT	0	
SP172	VGHP	0	
SP173	VGHI	0	
SP174	HPYV	0	
SP175	HSgn	0	
SP176	HADof	0	
SP177	MADJ	0	
SP178	SMG	938	
SP179	LMG	938	
SP180	Sgnb	0	
SP181	HSgnb	0	
SP182		0	
SP183		0	
SP184		0	
SP185		0	
SP186		0	
SP187		0	
SP188		0	
SP189		0	
SP190		0	
SP191		0	
SP192		0	
SP193		0	
SP194		0	
SP195		0	
SP196		0	
SP197		0	
SP198		0	
SP199		0	
SP200		0	
SP201		0	
SP202		0	

No.	Abbr.	Standard setting	Setting
SP203		0	
SP204		0	
SP205		0	
SP206		0	
SP207		0	
SP208		0	
SP209		0	
SP210		0	
SP211		0	
SP212		0	
SP213		0	
SP214		0	
SP215		0	
SP216		0	
SP217		0	
SP218		0	
SP219		0	
SP220		0	
SP221		0	
SP222		0	
SP223		0	
SP224		0	
SP225		0	
SP226		0	
SP227		0	
SP228		0	
SP229		0	
SP230		0	
SP231		0	
SP232		0	
SP233		0	
SP234		0	
SP235		0	
SP236		0	
SP237		0	
SP238		0	
SP239		0	

No.	Abbr.	Standard setting	Setting
SP240		0	
SP241		0	
SP242		0	
SP243		0	
SP244		0	
SP245		0	
SP246		0	
SP247		0	
SP248	FNC	0	
SP249	SMO	0	
SP250	LMO	0	
SP251		0	
SP252		0	
SP253	DA1NO	0	
SP254	DA2NO	0	
SP255	DA1MPY	0	
SP256	DA2MPY	0	
SP257	RPM	0000	
SP258	NR	0000	
SP259	NP	0000	
SP260	NB	0000	
SP261	NF	0000	
SP262	PM	0000	
SP263	PLG	0000	
SP264	KVP	0000	
SP265	KVI	0000	
SP266	KVF	0000	
SP267	KFP	0000	
SP268	KFI	0000	
SP269	PYLT	0000	
SP270	KDP	0000	
SP271	KDI	0000	
SP272	KQP	0000	
SP273	KQI	0000	
SP274	IDSM	0000	
SP275	IQSM	0000	
SP276	KVDS	0000	

Appendix 4 Unit Conversion Table

The correspondence of the conventional unit symbols used in this manual and the international unit system (SI) is as follows.

Name of weight	Conventional unit symbol	SI unit and symbols of units used commonly	Conversion value
Weight/load (To express mass)	kgf	———	The values are the same
Mass	———	kg	
Weight/load (The concept for force)	kgf	N	1 kgf = 9.80665N
Force	kgf	N	1 kgf = 9.80665N
Torque	kgf · cm	N · m	1 kgf · cm = 9.80665×10^{-2} N-m
Inertia (J)	kgf · cm · S^2	kg · m^2	1 kgf-cm-S^2 = 9.80665×10^{-2} kg·m^2
GD^2	kgf · cm^2	———	$J = \frac{GD^2}{4g}$ (g: Gravitational acceleration, 980cm/S^2)

Revision History

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