FANUC AC SPINDLE SERVO UNIT

P series

MAINTENANCE MANUAL

B-65105E/01

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Should you wish to export or re-export these products, please contact FANUC for advice.

In this manual, we endeavor to include all pertinent matters.
There are, however, a very large number of operations that must not or cannot be performed, and if the manual contained them all, it would be enormous in volume.
It is, therefore, requested to assume that any operations that are not explicitly described as being possible are "not possible".

TABLE OF CONTENTS

AC SPINDLE SERVO UNIT

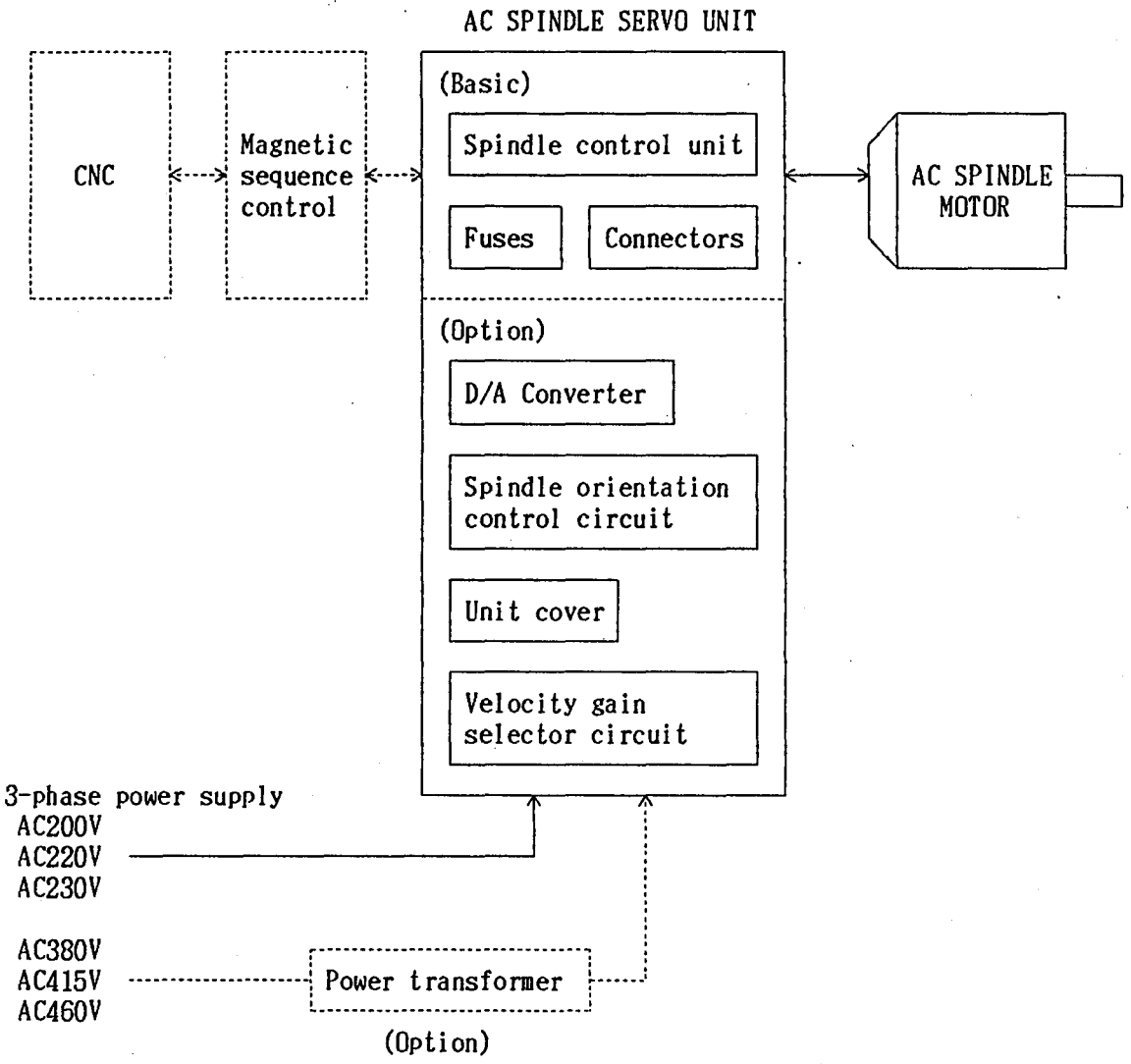
1. OUTLINE

This manual describes maintenance of AC SPINDLE SERVO UNIT and its options.
(For applicable units of this manual, see section 1.2)

1.1 Configuration

The AC SPINDLE SERVO UNIT consists of the following unit and parts.

(1) Spindle control unit	(Basic)	① Unit ② PCB ③ ROM
(2) Fuses(for spare)	(Basic)	
(3) Connectors(for connection)	(Basic)	
(4) D/A converter	(Option)	
(5) Power transformer	(Option)	
(6) Spindle orientation control circuit	(Option)	
(7) Unit cover	(Option for only MODEL 6S,8S)	
(8) Velocity gain selector circuit	(Option)	



1.2 Major components

Model	Order specification	Unit	PCB	ROM	
				Specification	Type
8P 6000rpm	A06B-6055-H306#H536	A06B-6055-H306	A20B-1001-0120	A06B-6055-H536	9636
15P 6000rpm	A06B-6055-H308#H531	A06B-6055-H308		A06B-6055-H531	9631
22P 6000rpm	A06B-6055-H315#H530	A06B-6055-H315		A06B-6055-H530	9630
40P 4500rpm	A06B-6055-H322#H540	A06B-6055-H322		A06B-6055-H540	9640

Table 1.2(a) Major components

Name	Specifications	PCB No.
D/A converter	A06B-6041-J031	
	A06B-6041-J032	
Orientation A (Position coder type, internal setting 2-stage speed change gear spindle)	A06B-6041-J110	A20B-0008-0240
Orientation B (Position coder type, external setting 2-stage speed change gear spindle)	A06B-6041-J111	A20B-0008-0241
Orientation C (Magnetic sensor type, 8000rpm max. 2-stage speed change gear spindle)	A06B-6041-J120	A20B-0008-0030
Orientation D (Magnetic sensor type, 8000rpm max. 3-stage speed change gear spindle)	A06B-6041-J121	A20B-0009-0520
Orientation E (Position coder type, internal setting 4-stage speed change gear spindle)	A06B-6041-J130	A20B-1000-0460
Orientation F (Position coder type, external setting 4-stage speed change gear spindle)	A06B-6041-J131	A20B-1000-0461
Orientation G (Magnetic sensor type, 12000rpm max. 2-stage speed change gear spindle)	A06B-6041-J122	A20B-0008-0031
Orientation H (Magnetic sensor type, 20000rpm max. 2-stage speed change gear spindle)	A06B-6041-J123	A20B-0008-0031 + A06B-6044-J948
Velocity gain selector circuit	A06B-6044-J701	A20B-1700-0020

Table 1.2(b) Configuration elements

2. DAILY MAINTENANCE AND MAINTENANCE TOOLS

Check and clean the following items once every 6 months or so for using the AC spindle motor and AC spindle servo units under a normal condition for a long time.
Take the check frequency into consideration according to the contamination degrees in each item.

2.1 AC Spindle Motor

If the ventilation hole, cooling fan, and fan finger guard (net) of the AC spindle motor become dusty, the radiation efficiency of the motor drops. Clean the AC spindle motor by using the factory air and a vacuum cleaner.

2.2 AC Spindle Servo Unit

If the cooling fan which compulsorily cools the radiator section of the AC spindle servo unit and the fan supplied with the unit adapter are used for a long period, the radiator section or regenerative resistor may become dusty. In these cases the cooling efficiency of the unit is lowered.
In the same manner as for the motor, clean the fan motor section and radiator section.

2.3 Maintenance Tools

Use tools indicated in Table 2.3 (a) for adjustments and tools indicated in Table 2.3 (b) for repairing troubles.

Table 2.3 (a) Tools used for adjustments

Name	Specification	Use
AC voltmeter	1 - 300 V ±1% or less	AC power voltage measurement
⊕ , ⊖ screwdrivers	⊕ large, medium size ⊖ large, medium, small size	

Table 2.3 (b) Tools used for repairing troubles

Name	Specification	Use
AC voltmeter	1 - 300 V ±1% or less	AC power voltage measurement
DC voltmeter	1 mV - 500 V ±1% or less	DC power voltage measurement and offset voltage check
Circuit tester		Resistance value check
⊕ , ⊖ screwdrivers	⊕ large, medium size ⊖ large, medium, small size	

2.4 Major Maintenance Parts

(1) Fuse and surge absorber

Item	Symbol	Model / Name	Model 8P	Model 15P	Model 22P	Model 40P
			A06B-6055-H306#H536	A06B-6055-H308#H531	A06B-6055-H315#H530	A06B-6055-H322#H540
1	F1-3	Fuse	A60L-0001-0127 /25FH75	A60L-0001-0145	A60L-0001-0149	A60L-0001-0163
2	F4a-e	Fuse	A60L-0001-0031/5A			
3	F5,6	Fuse	A60L-0001-0197 /PC1F-20	A60L-0001-0197 /PC1F-30		A60L-0001-0197 /PC2F-50
4	F7	Fuse	A60L-0001-0147	A60L-0001-0145	A60L-0001-0149	A60L-0001-0163
5	Z1-4	Surge absorber	A50L-2001-0155/20D431			
6	AF1	Alarm fuse	A60L-0001-0046/3.2			
7	Faceg	Fuse for PCB	A60L-0001-0175/0.3A			
8	Fd	Fuse for PCB	A60L-0001-0175/1.0A			
Spare parts specification			A06B-6055-K023 (6S)	A06B-6055-K024 (8S)	A06B-6055-K026 (15S)	A06B-6055-K022 (22S)

(2) Main parts

Item	Symbol (*1)	Model / Name	Model 8P	Model 15P	Model 22P	Model 40P
1	P.C.B.	PCB	A20B-1001-0120			
2	ROM	Control ROM	A06B-6055-H536(9636)	A06B-6055-H531(9631)	A06B-6055-H530(9630)	A06B-6055-H540(9640)
3	TM(1-12)	Transistor module	A50L-0001-0096/A	A50L-0001-0109	A50L-0001-0096/A	A50L-0001-0109
4	SM(1-3)	Thyristor module	A50L-5000-0029/30	A50L-5000-0029/50		A50L-5000-0029/80
5	DM(1-3)	Diode module	A50L-2001-0138	A50L-2001-0168	A50L-2001-0146	
6	D(1-3)	Diode	A50L-2001-0103/12JH11			
7	D(4-6)	Diode	A50L-2001-0103/12JG11			
8	D(7,8)	Diode	A50L-2001-0097/U06G			
9	C(1-3)	Capacitor	A42L-0001-0103			
10	C(4-7)	Capacitor	A42L-0001-0126		A42L-0001-0099	A42L-0001-0099/A
11	MCC	Magnetic contactor	A58L-0001-0094 /200V1A1B	A58L-0001-0092/A	A58L-0001-0146/200V	A58L-0001-0166
12	TF	Transformer	A80L-0001-0276			
13	FAN	Fan motor	A90L-0001-0213/A			
14	TH(1,2)	Thermostat	A57L-0001-0051/B90	A57L-0001-0051/B100 A57L-0001-0051/B150	A57L-0001-0028	A57L-0001-0051/B90 A57L-0001-0051/B150
15	ACR	AC reactor	A81L-0001-0077	A81L-0001-0076	A81L-0001-0080	A81L-0001-0063
16	SW(1,2)	Toggle switch	A57L-0001-0048/A			

(*1) Parts number in parenthesis are different depends on unit model.Refer to the parts mounting label in the unit for the details.

3. INSTALLATION

3.1 Installation Procedure

Observe the checking procedure shown in Table 3.1 at installation.

Item	Description	Remarks
1	Check if specification of motor, servo unit, options, etc. are correct.	Check if motor corresponds to units, PCB, and ROM correctly according to Table 1.2(a)(b).
2	Check appearance for damage.	In particular, check that there are no scratches or damage to the parts on the PCB.
3	Check the working power supply for voltage, voltage fluctuation , power capacity(kVA) and frequency.	Refer to Table 3.2.1(b).
4	Connect the earth wire, power cable and drive power cable.	Refer to section 3.2,3.3,3.4 and APPENDIX 1.
5	Turn on power supply, and make sure that green lump 'PIL' lights on PCB.	Refer to APPENDIX 6.
6	Check setting and adjustment results.	Refer to section 5.
7	Give rotation command to check the normal rotation and reverse rotation movement.	
8	Check the operation over the entire velocity renge.	
9	Adjust spindle orientation circuit.	Refer to section 7.

Table 3.1 Installation procedure

3.2 Power Connection

3.2.1 Power voltage and capacity check

Measure the AC power coltage before connecting the power supply, and take the following measure according to power voltage.

AC power voltage	Nominal voltage	Measure
170V - 253VAC	200/220/230VAC	Connect directly.
Higher than 254VAC	380 - 550VAC	Sset input voltage to 200VAC using insulation transformer.

Table 3.2.1(a) Checking power voltage

The input power supply specification of the AC spindle servo unit is as specified in Table 3.2.1(b). Use a power source having the power capacity having a sufficient allowance so that no trouble due to voltage drop occurs with the maximum load.

Nominal rated voltage		200V/220V/230VAC , 3 phases			
Allowable voltage fluctuation		-15% to +10%			
Frequency		50Hz/60Hz±1Hz			
Capacity with 30-minutes reting	Model	8P	15P	22P	40P
	kVA	9	15	22	32

Table 3.2.1(b) Input power specification

3.2.2 Protective earth connection

Connect the protective earth to connection terminal G before connecting the power supply. Use the protective earth having sufficient capacity as compared with the feeder circuit breaker capacity.

3.2.3 Power connection

Connect the power cable after protective earth connection.
The power phase rotation is not specified for AC spindle servo unit.
The cooling fan motor employs three-phase power. When connect the input power to the unit, check the proper phase connection.

3.3 AC Spindle Motor Connection

Connect the AC spindle motor according to the connection diagram in Appendix 1. If the drive power cable connection sequence is in error, vibration are produced the motor does not rotate or alarm (AL-02) occurs to stop the motor. Always connect protective earth "G".

3.4 Signal Cable Connection

Connect the signal cable according to the connection diagram in Appendix 1.

4. TROUBLESHOOTING

Perform troubleshooting, referring to each item in Table 4 according to trouble conditions if a trouble occured.

Item	Trouble conditions	Reference item
1	Power voltage check	4.1
2	Power ON indicator lamp PIL does not light.	4.2
3	Alarm(AL−□□) is displayed on the PCB.	4.3
4	Motor does not rotate. Number of rotation is not as specified.	4.4
5	Vibrations and noises are noticeable during rotation.	4.5
6	An abnormal noise is produced from motor during deceleration.	4.6
7	Motor speed overshoots or hunting occurs.	4.7
8	Cutting power drop.	4.8
9	Spindle orientation is not correct.	4.9
10	Acceleration/Deceleration time is longer than specified.	4.10

Table 4 Types of trouble conditions

Note) When replacing the PCB, follow the cautions described in section 6.2. Refer to Appendix 2.

4.1 Power Voltage Check

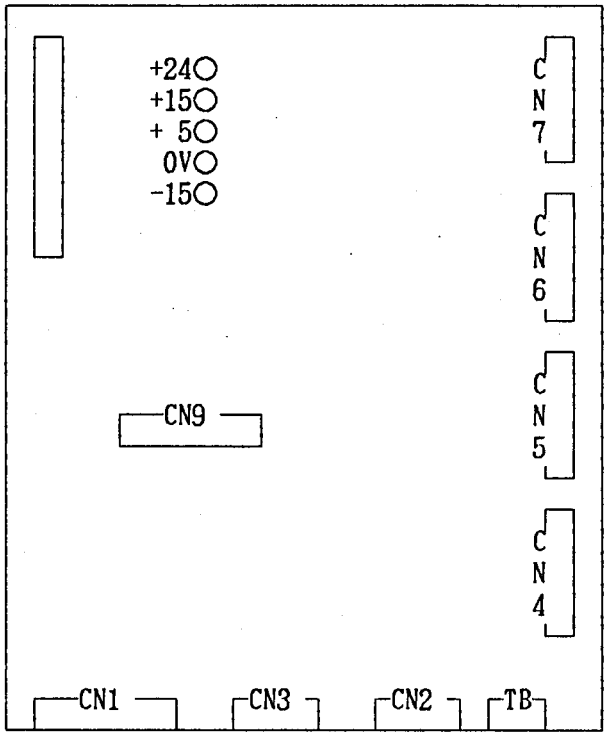
Check power voltage and control power voltage on the spindle control PCB.
Test points and standard values are as specified in Table 4.1

Power voltage check	Check at input terminals R,S,T,G (see 3.2)
Control power voltage check on PCB.	

Voltage	Test points	Standard value
+24V	+24 - 0V	About +23V±4%
+15V	+15 - 0V	+15V±4%
+5V	+5 - 0V	+5V±2%
-15V	-15 - 0V	-15V±4%

Table 4.1 Types of trouble conditions

〔Test points〕 (Refer to Appendix 6.)



Spindle control circuit PCB
A20B-1001-0120

4.2 Power ON Indicator Lamp PIL does not Light

Item	Causes	Check procedure	Remedy
1	AC power is not supplied	Check it at power input terminals R,S,T.	
2	Fuse F4a,b are blown out	See Appendix 5.	Replace fuse F4(5A).
3	Fuse AF1 or fuse resistors FR1,FR2 are blown out.	Check if alarm indications of fuse AF1 appears or not See Appendix 5.	Replace fuse AF1 or fuse resistors FR1,FR2. Replace PCB, if these are blown out again soon after replacing it.
4	PCB connectors CN6 and CN7 are not plugged correctly.	Check if the connector guide groove appears on the PCB connector surface.	Insert connectors correctly.
5	Neither 19A nor 19B is output because of defective transformer TF	Check voltage at check terminals 19A-CT and 19B-CT of PCB. Measuring voltage values should be about 19VAC between these terminals.	Replace transformer TF.
6	PCB power circuit is defective.	Lamp PIL is lit by +24V. Check power voltage according to Table 4.1.	Replace PCB. Refer to section 6.

4.3 Alarm(AL-□□) Indicated

Alarms on AC spindel motor and servo unit are indicated on five digits of seven-segment on the servo unit PCB. Correspondence between seven-segment indications and alarm signals is shown in Table 4.3.

Alarm No.	Meaning	Contents	Remedy
AL-01	Motor overheat	This alarm is issued, when internal temperature of motor is higher than the specified value.	Cool the motor and reset the alarm.
AL-02	Excessive deviation of speed	This alarm is issued, when the motor speed is largely deviated from the command speed.	Reset the alarm.
AL-03	Fuse in DC link is blown out	This alarm is issued, when the fuse in DC power supply is blown out.	Replace fuse after eliminating a cause of its failure.
AL-04	AC input fuse is blown out	This alarm is issued, when AC input fuse is blown out	Replace fuse after eliminating a cause of its failure.
AL-05			
AL-06	Overspeed (Analog detection)	This alarm is issued, when the motor excceds 115% of the reted speed.	Reset the alarm.
AL-07	Overspeed (Digital detection)	Same as described above.	Reset the alarm.
AL-08	Overvoltage	This alarm is issued, when voltage extremely excesses the rated voltage.	Reset the alarm.
AL-09	Overheat of radiator	This alarm is issued, when temperature of radiator such as semiconductor is extremely high.	Cool the unit and reset the alarm.
AL-10	+15V drop detection	This alarm is issued, when the control power +15V is lower than the rated range	Remove the problem and the alarm reset.
AL-11	Overvoltage in power circuit	This alarm is issued, when the DC power voltage of the power supply is abnormally high.	Remove the problem and the alarm reset.
AL-12	Overcurrent	This alarm is issued, when the circuit current is excessive.	Remove the problem and the alarm reset.

Alarm No.	Meaning	Contents	Remedy
AL-13	Abnormal arithmetic circuit detection	This alarm is issued, when CPU or its peripheral parts of arithmetic circuit are abnormal	Remove the problem and the alarm reset.
AL-14	Abnormal ROM	This alarm is issued, when ROM is abnormal	Replace ROM
AL-15	Abnormality in optional circuit	Defects abnormality in optional circuit as spindle selection circuit, and abnormality in connection with the optional circuit.	Remove the problem and the alarm reset.
AL-16	RAM in NVRAM is abnormal condition	This alarm is issued, when RAM in NVRAM is abnormal.	Replace NVRAM
AL-17	ROM in NVRAM is abnormal condition	This alarm is issued, when ROM in NVRAM is abnormal.	Replace NVRAM
AL-18	Sum check alarm of ROM	This alarm is issued, when control ROM is abnormal.	Replace ROM
AL-19	Excessive alarm of U phase current detection circuit offset	This alarm is issued, when current detection resistor or insulation amp is abnormal.	Remove the problem and the alarm reset.
AL-20	Excessive alarm of V phase current detection circuit offset	Same as described above.	Remove the problem and the alarm reset.
AL-21	Excessive alarm of velocity command circuit offset	This alarm is issued, when velocity command circuit is abnormal.	Remove the problem and the alarm reset.
AL-22	Excessive alarm of velocity detection circuit offset	This alarm is issued, when velocity detection circuit is abnormal.	Remove the problem and the alarm reset.
AL-23	Excessive alarm of ER circuit offset	This alarm is issued, when ER detection circuit is abnormal.	Remove the problem and the alarm reset.
A	Defective ROM		

Table 4.3 Contents of alarm

〔Method of alarm reset〕

Normally, alarm reset is performed by the external contact signal, but the method to reset the alarm display on the PCB after removing the cause of the failure is described here.

(1) Set OFF the rotation direction command(SFR,SRV).

(2) Set OFF the orientation command(ORCM).

(3) Set speed command voltage(VCMD) to 0V.

(4) For safety, set to the emergency stop(ESP) state.

(5) While checking (1)-(4), if the setting switches MODE ('MODE') and DATA SET ('DATA SET') are simulataneously set ON, the alarm will be reset. (Regarding the installation position, refer to Appendix 6.)

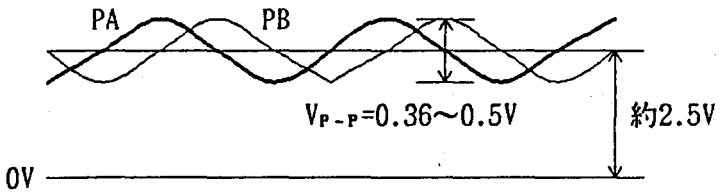
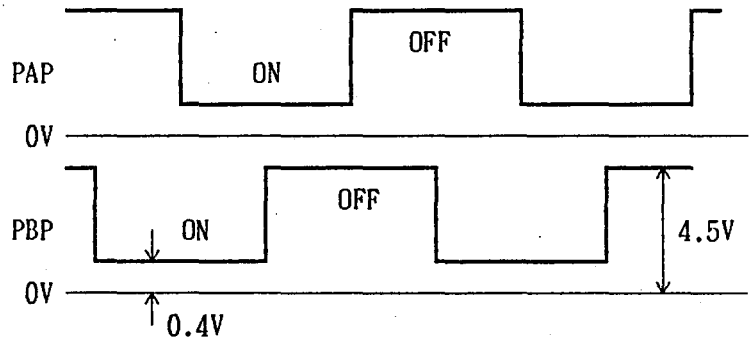
(1) AL－01 Motor is overheated

Item	Causes	Check procedure	Remedy
1	Built-in fan motor of spindle motor is defective.		Replace fan motor.
2	Overload operation	Check it using a load meter.	Re-examine cutting conditions and tools.
3	Motor cooling system is dirty.		Clean it using compressed air or vacuum cleaner.
4	Disconnection or poor contact of wiring	Check connections between motor and servo unit.	Confirm the connection of connector for signal.

(2) AL－02 Speed is deviated from the command value.

Item	Causes	Check procedure	Remedy
1	Overload	Check it using a load meter.	Re-examine cutting conditions and tools.
2	Transistor module is defective.	Transistor collector-emitter is open.	Replace transistor module.
3	Blow out of fuse in regeneration circuit.	Check fuses F5 and F6 for continuity by using a circuit tester.	Check if the acceleration/deceleration on cycle is to frequent. Replace fuses.
4	Blow out or poor connection of the driver protective fuse on PCB.	Check fuses FA, FB, ... FG for blown out or missing.	Connect fuses securely, and replace blown out fuses, if any.
5	Speed feedback signal is defective.	Check the speed feedback signal level.	
6	Wiring failure (disconnection, poor contact, etc.)	Check if connection cables are normally connected.	

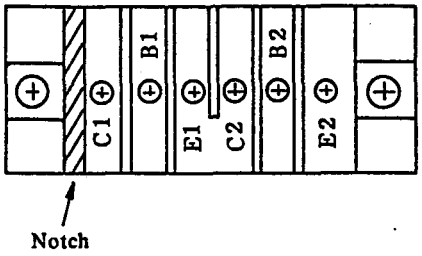
Note 1) Speed feedback signal check
Observe the speed feedback signal using an oscilloscope under the rotation command off (motor stop, drive power off) condition after turning on the power supply. Observe it at the following check terminals, while slowly turning the motor by hand.

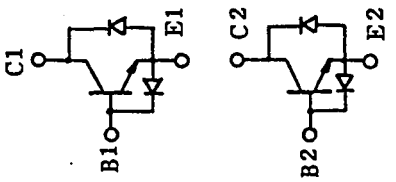
Check terminals	Normal wave forms
PA-0V PB-0V	
RA-0V RB-0V	DC2.5V±0.2V
PAP-0V PBP-0V (In case of CW rotation)	 Check within ON/OFF duty is 50%. (PAP and PBP signals are inverted in CW direction.)

(3) AL－03 DC link fuse(F7) is blown out

In this case, a transistor module may be defective.
Locate and replace the defective element according to the following procedure.
Replace PCB if the transistor module may be faulty due to a trouble of the control PCB.
Please contact FANUC service center, if repair is difficult.

Procedure	Description
1	Turn off AC power supply (turn off the magnetics cabinet breaker) and disconnect the motor power cable.

<table>
<tr><th>Procedure</th><th>Description</th></tr>
<tr><td>2</td><td>
Remove PCB and check the resistance values of the transistor module collector (C1,C2)-emitter (E1,E2), connector (C1,C2)-base (B1,B2) and base (B1,B2)-emitter (E1,E2), respectively.




Criteria (circuit tester range x10Ω)
<table>
<tr><th>Terminal to be observed</th><th>Circuit tester terminal</th><th>Normal</th><th>Faulty</th></tr>
<tr><td rowspan="2">C-E</td><td>Connect C to + terminal</td><td>Several 100Ω</td><td>Short, infinite</td></tr>
<tr><td>Connect C to - terminal</td><td>Infinite</td><td>Short, several 100Ω</td></tr>
<tr><td rowspan="2">C-B</td><td>Connect C to + terminal</td><td>Several 100Ω</td><td>Short, infinite</td></tr>
<tr><td>Connect C to - terminal</td><td>Infinite</td><td>Short, several 100Ω</td></tr>
<tr><td rowspan="2">B-E</td><td>Connect B to + terminal</td><td>Several 100Ω</td><td>Short, infinite</td></tr>
<tr><td>Connect B to - terminal</td><td>Several 100Ω</td><td>Short, infinite</td></tr>
</table>
If a transistor is broken, the collector-emitter and collector-base are shorted, respectively.
</td></tr>
<tr><td>3</td><td>Replace faulty parts. Apply a coat of silicon grease without fail when replacing them.</td></tr>
<tr><td>4</td><td>After replacement, recheck the circuit according to procedure 2.</td></tr>
</table>

Procedure	Description
5	Check the transistor drive circuit on PCB. ① Remove DC link fuse F7 and turn on AC input power supply. Don't apply any rotation commands (SFR,SRV). ② Measure the base-emitter voltage of eight transistors (U,V,W regenerative control circuits)(at connectors CN6,7) by using a circuit tester (2 ∿ 5 V range). Particularly be careful since a high voltage (DC 300 V) is applied to CN6 and CN7. Be careful not to damage any connector when checking the connector using the probe. Criteria A faulty circuit can be checked at glance, since it is different from other normal circuits.

	Base-emitter voltage (based on emitter)
Normal	About -0.8 V ∿ -1.3 V
Faulty	About 0.0 V ∿ -0.8 V

Connector CN6 terminal

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	5C	5B	5E	6C	6B	6E	7C	7B	7E	8C	8B	8E		

Connector CN7 terminals

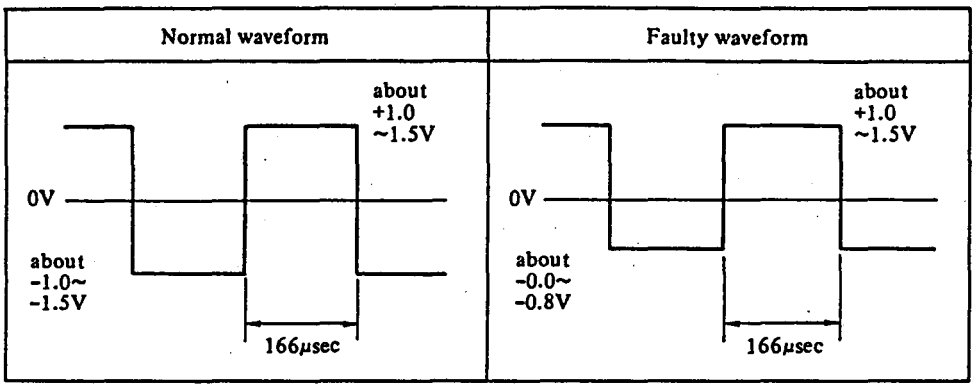
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1C	1B	1E	2C	2B	2E	3C	3B	3E	4C	4B	4E			

(References)
The following figure indicates waveforms under normal and abnormal conditions. Refer to these waveforms, when it is difficult to check a trouble by using a circuit tester.

Be careful since a high voltage (about DC 300 V) is applied to CN6 and CN7.

Select "FC-20" and machine ready signal is turned on.

Observe the base-emitter waveform of each transistor (U,V,W regenerative circuits) at CN6 and CN7 connectors by using an insulated oscilloscope.

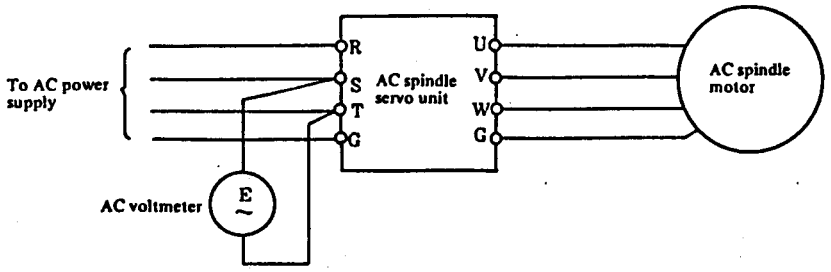
Procedure	Description
5	 Perform the following repair, if a PCB was found to have been faulty. (1) Fuses FA, FB...FG of the driver circuit are mounted in PCB. Check if these fuses are normal by using a circuit tester. If a fuse is blown out, replace it, and check steps (1),(2) again to make sure that the trouble has been recovered. (2) Replace PCB if a PCB does not correspond to (1) or no fuse is blown out in (1).
6	Connect the motor power cable, replace fuse F7, and restart the operation.

(4) AL－04 AC input fuses(F1,F2,F3) are blown out

Item	Causes	Check procedure	Remedy
1	High impedance on AC power supply side. (Note 1) (Example) Two transformers are connected in series or when a variable auto-transformer is connected.	° Alarm No. 4 lights only when the motor speed is reduced from high speed. ° Alarm No. 4 may also light, irrespective of normal condition of F1∿F3.	° Replace the power supply having low power impedance. ° Looseness of input cable connector. Example: Open phase due to loosened screws.
2	Transistor module is defective.	See alarm No. 3.	See alarm No. 3. Replace transistor module and fuse.

Item	Causes	Check procedure	Remedy
3	Diode module or thyristor module is defective.	After disconnecting cables of diode modules DM1∿3 and thyristor modules SM1∿3, check A-K by using a circuit tester. (Defective parts are generally shorted.)	Replace defective parts and fuses.
4	Surge absorbers or capacitors are defective.	Check surge absorbers Z1∿3 and capacitors C4∿6.	Replace defective parts and fuses.
5	Input fuses not blown out.	Check if it is not applicable to item 1.	Replace the PCB if not applicable to item 1.

Note) Power impedance checking method.



1 Calculation formula

$$\frac{E_0 - E_1}{E_0} \times 100\ (\%) < 7\ (\%)$$

where E_0: Voltage when the motor stops operating.
E_1: Voltage during acceleration of motor or voltage just before the motor speed begins lowering with a load applied.

2 Input power specifications

Name	Specifications
Nominal rated voltage	AC200/230V
Allowable voltage fluctuation width	-15% ∿ +10%
Power frequency	50/60Hz
Power impedance	Voltage fluctuation due to load (120% load at 30 minute rating): Less than 7%

(5) AL－06 Overspeed(analog detection)

Item	Causes	Check procedure	Remedy
1	PCB setting failure or adjusting failure	Check PCB for normal setting and adjustment.	Change F-5 setting.
2	Wrong specification of ROM (memory IC)	Check specification referring to Table 1.1.	Replace ROM.
3	PCB is defective.		Replace PCB.

(6) AL－07 Overspeed(digital detection)

Same as in AL-06.

(7) AL－08 +24V overvoltage

Item	Causes	Check procedure	Remedy
1	AC power voltage exceeds +10% of the rated value.	Check power voltage.	
2	Setting failure of voltage selection toggle switch.	Check power voltage.	Setting from 200V to 230V.

(8) AL－09 Radiator is overheated

Item	Causes	Check procedure	Remedy
1	Cooling fan is defective.	Check if fan is stopping.	Replace fan.
2	Overload operation.	Check load by using a load meter.	Re-examine the cutting condition.
3	Dusty and dirty.		Clean using compressed air or vacuum cleaner.

(9) AL－10 +15V voltage drop

This alarm indicates abnormally low AC power voltage (-15% or less).

(10) AL－11 Overvoltage of DC link circuit
(Regenerative circuit is faulty ··· Regeneration failure)

Item	Causes	Check procedure	Remedy
1	Fuses F5 and F6 are blown out.	Check fuses F5, F6 by using a circuit tester. If these fuses are blown out, check transistor module by the same procedure as in alarm No. 3.	Replace fuses.
2	High power impedance.		Examine AC power specification.
3	PCB is defective.		Replace PCB.

(11) AL－12 Overcurrent flows to DC link circuit

Item	Causes	Check procedure	Remedy
1	Output terminals or internal circuit of motor is shorted.	Check connections.	
2	Transistor module is defective.	Check it by the same procedure as in alarm No. 3.	Replace defective parts.
3	PCB is defective.		Replace PCB.

(12) AL－13 CPU alarm
Replace PCB.

(13) AL－14 ROM is defective

Item	Causes	Check procedure	Remedy
1	ROM is not mounted at all or not properly mounted.	Check if ROM is unplugged from the socket or if its leads are broken.	Mount ROM properly.
2	ROM is defective.		Replace ROM having correct specification. (see Table 1.1)

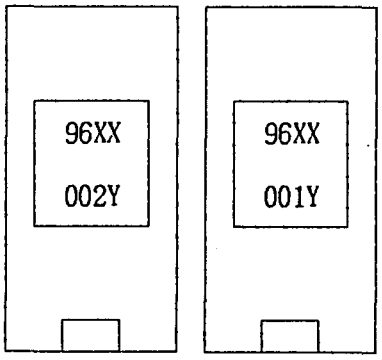
(4) AL−15 Option alarm

Item	Causes	Check procedure	Remedy
1	Spindle selector circuit or other option PCB are faulty.		Replace PCB.
2	Option PCB connection is in error.		Check and correct the connection.

4.4 Motor does not Rotate or its Rotation is Abnormal

Item	Causes	Check procedure	Remedy
1	Defective connection of motor power line	AL-02 occurs when rotation command is given. When AL-02 does not occur, make the speed command voltage large.	Check phase sequence, etc. connection. (Refer to Appendix 2.)
2	Speed feedback signal is defective.	Check signal cable connection. Check signal waveform. Refer to section 4.3(2) AL-02.	Check operation of speed detector inside motor, and check connection and contact of speed feedback cable.
3	Parameter is not proper.	Check whether or not the electromagnetic contactor is ON. Check use/non-use of override.	Set parameters F-01 and F-02 correctly. Refer to section 5.3.
4	ROM is not proper.	Check series No. of ROM. See Table 1.2 (a) - (b)	Set ROM correctly.

(Checking method of ROM series)



Series

96XX : A06B-6055-H5XX

Y : Version number(A to Z)

4.5 Vibration or Noises are too Large during Rotation

Item	Causes	Check procedure	Remedy
1	Motor is defective.		Replace motor.
2	Speed feedback signal is defective.	Check signal cable connection. Check signal waveform. Refer to section 4.3(2) AL-02.	Check operation of speed detector inside motor, and check connection and contact of speed feedback cable.
3	PCB is defective.	(Note 2)	Replace PCB. (Note 1)

Note 1) Refer to chapter 6.
Note 2) Method to run the motor idly and determine the cause of failure.
Regarding rotating the motor, if the speed feedback signal connector CN2 connected to the AC spindle servo unit is pulled out, AL01 occurs, and the motor runs idly.
(When made to run idly, check that the brakes are not applied by the sequence.)
During idle run, if vibrations and noises become extremely small as compared with the normal rotation, the control circuit is considered to be defective. In this case, the remedy is to replace the PCB.
Further, when the noise does not change, consider that there is a regenerative source on the motor and machine tool side.

4.6 Noise is Produced from Motor during Deceleration

During deceleration of the motor, energy is regenerated to the power supply through the regenerative control circuit. If the regenerative energy is excessive, the regenerative current limit circuit operates to change the motor current waveform, causing an abnormal noise to be produced from the motor. In such a case, lessen parameter F-20 until no abnormal noise is produced. Lessening F-20 makes the deceleration period long.

4.7 Speed Overshooting or Hunting Occurs

Item	Causes	Check procedure	Remedy
1	Overshooting		Enlarge F-21 or F-22. (Note)
2	Spindle hunting		Lessen F-21 or F-22. (Note)

Note) Refer to section 5.3.

4.8 Cutting Force is Low

Item	Causes	Check procedure	Remedy
1	ROM is not proper.	Check series No. of ROM.	Replace ROM. (Note)
2	Torque limit command is applied.	Check torque limit signal.	Release of command.

Note) Refer to the Table 1.2 (a) - (b).

4.9 Orientation is not Correct

Item	Causes	Check procedure	Remedy
1	Setting or adjusting failure of spindle orientation control circuit.		Re-adjustment. (Note 1)
2	Spindle orientation control circuit is defective.		Replace PCB. (Note 2)
3	Spindle control circuit is defective.		Replace PCB. (Note 2)
4	Position coder or magnetic sensor is defective.	Check the output signal waveform. (Note 3)	Replace the position coder or magnetic sensor.

Note 1) Refer to chapter 7.
Note 2) Refer to section 6.3.
Note 3) When magnetic sensor, refer to Appendix 8 .

4.10 Acceleration/Deceleration Time is Long

Item	Causes	Check procedure	Remedy
1	Torque limit command is applied.	Check signal.	Release of command.
2	Defective receiver part activates the torque limit.	Check whether or not the acceleration/ deceleration time changes if the value of parameter F-18 is changed.	Replace receiver or PCB. (Note 1)
3	PCB is not adjusted correctly.	Check if the value of parameter F-20 is smaller than necessary, or has not been set. (Note 3)	Readjust F-20. (Note 2)

Note 1) Refer to chapter 6.
Note 2) Refer to section 4.6.
Note 3) Refer to section 5.3.

5. SETTING AND ADJUSTMENT

5.1 Setting Jumper

For the parts on the unit and PCBs, refer to mounting layout of parts (APPENDIX 5 and 6). Confirm the following setting before turning on the power switch.

Jumper	Contents	Setting		Setting at shipment
S1	Control circuit mode selector	Tsest mode	TEST	DRIVE
		Normal operation mode	DRIVE	
S2	For power margin test	Increases +5V power voltage by 10%	H	Without setting
		Decreases +5V power voltage by 10%	L	
SH3	Change of parameter setting for bidden	Operation mode	DRIVE	DRIVE
		When changing setting	SET	

Table 5.1(a) List of setting jumpers

5.2 Parameter Setting Method

The various parameter setting switches and display part are installed in the PCB of the AC spindle servo unit.(Refer to Appendix 6.)
Checking and changing the data contents for the various parameters are performed by operating this switch.

(1) To confirm the current parameter

(a) The speed is usually displayed at the display part(Five digits).

The current parameter number can be displayed when [MODE] (MODE) is on.
The parameter number is displayed as two digits of "F-XX"

(2) To confirm the parameter data

Select the parameter number of data to be checked in the following steps.

(a) Continuously turn 4 swiches [MODE] (MODE) [UP] (UP) [DOWN] (DOWN) [DATA SET] (DATA SET) ON at the same time for more than 1 second.

(b) The display part changes [88888] (the blank) to [FFFFF].

(c) Off all switches.

(d) The current parameter is displayed when [MODE] is ON.

(e) When [UP] is on with [MODE] on, the parameter number is incremented by 1.

(f) When [UP] is continuously on with [MODE] on, the parameter number is increases continuously.

(g) When [DOWN] is on with [MODE] on, the parameter number is decremented by 1.

(h) When [DOWN] is continuously on with [MODE] on, the parameter number is decreases continuously.

(i) When [MODE] is off, the data is displayed (4 digits) after about 0.5 second.

(j) After about 10 seconds the data display is selected, the speed display is selected.

(3) To alter the data
Before step (a), alter the data according to the following steps after setting the setting jumper SH3 to the "SET" side.

(a) Select the parameter to be changed according to the step (2)-(a) to (h).

(b) Turn [MODE] off, the data of parameter is displayed after about 0.5 second.

(c) Turn [UP] on, the data is incremented by 1.

(d) Turn [UP] on continuously, the data is increases continuously.

(e) Turn [DOWN] off, the data is decremented by 1.

(f) Turn [DOWN] off continuously, the data is decreases continuously.

(g) The motor is controlled using the displayed data.

(h) When replacing the data with the modified data, keep turning [DATA SET] on for 1 second or more.

Note) However in the state in which the rotation direction command(SFR/SRV:ON) has been inputted, this operation will not be accepted. When replacing the data after altering by changing the data, be certain to set OFF the rotation direction command.

(i) The display part changes from [88888] (the blank) to [88888] and modification of the data completes.

(j) When changing the data once again, follow the steps from (3)-(a) above.

(k) The speed is indicated automatically after about 10 seconds. For parameters F-13 and F-14, the speed is displayed after 2 seconds.

5.3 Number and Contents of Parameter

(1) Motor speed indication

Parameter No.	Display data(5 digits)	Contents of data
F-00	88888	The speed of motor is displayed. (rpm)

(2) Use/Non-use of Machine ready signal(MRDY)

Parameter No.	Display data(4 digits)	Contents of data
F-01	0001	0 , 1 (Standard setting : 1)

	Data
Explanation : When machine ready signal(MRDY) is used · · · · ·	1
When machine ready signal(MRDY) is not used · ·	0

(3) Use/Non-use of override function

Parameter No.	Display data(4 digits)	Contents of data
F-02	0001	0 , 1 (Standard setting : 1)

	Data
Explanation : When override function is used · · · · · · · · · ·	1
When override function is not used · · · · · · · ·	0

(4) Override range setting

Parameter No.	Display data(4 digits)	Contents of data
F-03	0001	0 , 1 (Standard setting : 1)

	Data
Explanation : Upper limit of override range = ~120% · · · · ·	1
Upper limit of override range = ~100% · · · · ·	0

Caution : When override function is not used for the parameter F-02 setting data = 0, set "0" into the setting data.

(5) Setting of kind of velocity command(External analog voltage or D/A converter)

Parameter No.	Display data(4 digits)	Contents of data
F-04	0001	0 , 1 (Standard setting : 0)

Explanation : When external analog voltage is used ・・・・・・ Data 0
D/A converter is used ・・・・・・・・・・・・・・ 1

(6) Setting of maximum speed

Parameter No.	Display data(4 digits)	Contents of data
F-05		0 ～ 3 (Setting is performed with the motor specifications.)

Explanation : This sets the levle of the speed feedback voltage.
The difference between the standatd specifications and high-speed specifications is whether the speed detector is 256 pulse /1 revolution (standard specifications) or 128 pulse/1 revolution (high-speed specifications).
Therefore, in high-speed specifications the feedback voltage is the same as for a speed of double the standard specifications.

Standard specifications	High-speed specifications	Setting data
3900rpm～ 5000rpm	7800rpm～10000rpm	0
4900rpm～ 6300rpm	9800rpm～12600rpm	1
6200rpm～ 8200rpm	12400rpm～16400rpm	2
8000rpm～10000rpm	16000rpm～20000rpm	3

If it is below the maximum speed of the motor specifications, the maximum speed can be adjusted to a chosen value. However, less than 3900 rpm cannot be set in standard specifications, or less than 7800 rpm in high-speed specifications.
When adjusted such that the maximum speed differs from specifications of motor, be certain to change the data of parameter F-15 to the adjusted value.

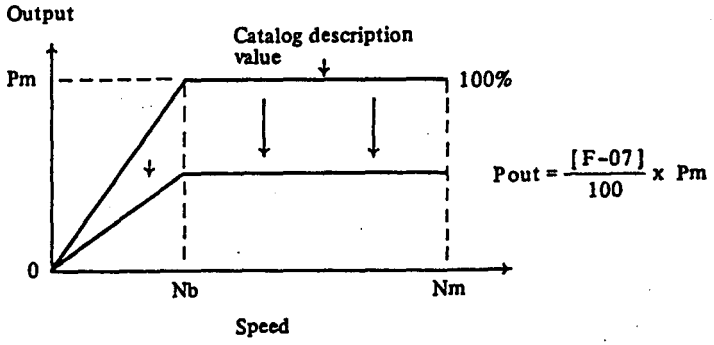
(7) Setting of output limit pattern

Parameter No.	Display data(4 digits)	Contents of data
F-06	0000	0 ～ 6 (Standard setting : 0)

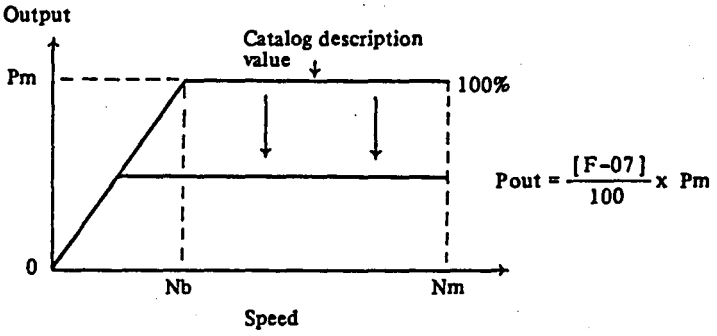
Explanation: This function is not available for a conventional type.
In the following cases, select a pattern which is appropriate respectively.

A. When the output is limited only at acceleration and deceleration, the motor accelerates and decelerates slowly, and operates at the rated output during steady rotation (Setting data: 1 or 4) (function similar to software start and stop)
B. When the motor accelerates and decelerates at the maximum rated output and the output is limited during stable rotation (Setting data: 2 or 5)
C. When the same motor and amplifier are used to operate the machine as a different output specification machine (Setting data: 3 or 6)

(Output limit pattern 1)



(Output limit pattern 2)



Content	Setting data	
	Pattern 1	Pattern 2
The output is not limited.	0	0
Pattern A	1	4
Pattern B	2	5
Pattern C	3	6

(8) Setting of limit value at ourput limit

Parameter No.	Display data(4 digits)	Contents of data
F-07	0100	0 ~ 100 (Standard setting : 100)

Explanation: With the maximum rated output (1.2 multiple of 30-minute rating) as 100%, set the limit value to a value to be limited. This value is available when the output is limited due to parameter F-06.

Output limit value = Maximum rated output x (setting data) %

(Loadmeter display at output limit)
When output limiting by F-06 and 07, the loadmeter output is outputted as regulated to the output limit value of 10 V.

(9) Delay time before cutting motor power supply

Parameter No.	Display data(4 digits)	Contents of data
F-08	0005	0 ~ 255 (Standard setting : 5)

Explanation: The motor power is interrupted by the motor stopping. It is interrupted by strictly detecting zero speed. Zero speed may also be set, but the motor speed is detected at less than 0.75% of the maximum rotation speed.
If the power is interrupted immediately after detecting zero speed, set the time from detecting zero speed up until the motor power interruption by this parameter because the motor runs idly at low speed. When the load inertia of the spindle is large, set a large value.

Delay time = (Setting data) x 40 msec

(10) Use/Non-use of motor power supply shutting off by machine ready signal (MRDY)

Parameter No.	Display data(4 digits)	Contents of data
F-09	0000	0 , 1 (Standard setting : 0)

Explanation: The function is used when it is presumed that the electromagnetic contactor is switched frequently. When the machine ready signal (MRDY) is off, only motor power is interrupted.
The function is used : 1
The function is not used: 0

(Using the function)
When performing spindle orientation and ATC operation, if tool unclamp is performed, the spindle will be locked. At this time, if locked in a state in which the stop position has slightly slipped, the motor attempts to return to the original position and a large current flows. Because of this, there are cases in which the loadmeter vibrates greatly and the transistor module is damaged. Therefore when performing tool unclamp, use this function.

(11) Adjustment of speed error offset at the time of the forward rotation command (SFR)

Parameter No.	Display data(4 digits)	Contents of data
F - 10	0128	0 ~ 255 (Initial setting : 128)

Explanation: The speed error offset is adjusted when stopping motor with the forward rotation command (SFR) and speed command voltage (VCMD) 0 V (zero rotation command) applied. Increase the data when stopping the motor rotating counterclockwise (CCW), as viewed from the shaft.

(12) Adjustment of speed error offset at the time of the reverse rotation command (SRV)

Parameter No.	Display data(4 digits)	Contents of data
F - 11	0128	0 ~ 255 (Initial setting : 128)

Explanation: The speed error offset is adjusted when stopping motor with the reverse rotation command (SRV) and speed command voltage (VCMD) 0 V (zero rotation command) applied. Increase the data when stopping the motor rotating CCW, as viewed from the shaft.

(13) Adjustment of speed error offset at the time of the orientation command(ORCM)

Parameter No.	Display data(4 digits)	Contents of data
F - 12	0128	0 ~ 255 (Initial setting : 128)

Explanation: Normally it is not necessary to adjust this parameter. Offset at orientation stop is performed by a variable resistor (volume) on the orientation circuit, and adjustment is performed by this parameter when it cannot be adjusted.
When performing adjustment by this parameter, the offset adjustment volume of the orientation circuit is adjusted such that IN-POSITION FINE lights in the state set at the 5th division.

(14) Adjustment of speed at forward rotation command(SFR)

Parameter No.	Display data(4 digits)	Contents of data
F - 13		0 ~ 255 (Setting is based on motor specification)

Explanation: Adjust the speed when inputting specific speed command at forward rotation command (SFR). Increase data to increase speed.

(15) Adjustment of speed at forward rotation command(SFR)

Parameter No.	Display data(4 digits)	Contents of data
F - 14		0 ~ 255 (Setting is based on motor specification)

Explanation: Adjust the speed when inputting specific speed command at reverse rotation command (SRV). Increase data to increase speed.

(16) Setting of rotation speed when velocity command voltage(VCMD) is 10V

Parameter No.	Display data(4 digits)	Contents of data
F - 15		40 ~ Rated speed (Setting is based on motor spec.)

Note) Don't set the value of 40 or less.

Explanation: When making adjustments in F-05, F-13 and F-14, always set this mode. Set the value of speed at 10 V speed command voltage (VCMD) divided by 100.

Setting data = Speed at 10 V speed command voltage (rpm) ÷ 100

(17) Setting of detection range of velocity arrival signal(SAR)

Parameter No.	Display data(4 digits)	Contents of data
F - 16	0015	0 ~ 100 (Standard setting : 15)

Explanation: Sets the detection range of the speed arrival signal (SAR). The speed arrival signal (SAR) is outputted when the motor speed reaches the range within specific percentage of the command speed.

Detection range = (Command speed) x within ($\pm$ (Setting data)) %

(18) Setting of detection range of velocity detection signal(SDT)

Parameter No.	Display data(4 digits)	Contents of data
F - 17	0003	0 ~ 100 (Standard setting : 3)

Explanation: The detection range of the speed detecting signal (SDT) is set.
The speed detecting signal (SDT) is outputted when the motor speed becomes the specific percentage of a maximum speed or less.

Detection range = (Maximum speed) x (Setting data) % or less

⑲ Setting of torque limit value

Parameter No.	Display data(4 digits)	Contents of data
F - 18	0050	0 ~ 100 (Standard setting : 50)

Explanation: When the torque limit signal (TLMH) is turned on, torque limit value is set.
(When TLML is ON, this limit value becomes half.)

Torque limit value = Maximum rated torque (1.2 times 30 min. rated torque) x (Setting data) %

⑳ Setting of acceleration/deceleration time

Parameter No.	Display data(4 digits)	Contents of data
F - 19	0010	0 ~ 255 (Standard setting : 10)

Explanation: Set this parameter when the load inertia is large and the acceleration time from stop to the maximum speed is longer than 5 seconds.

Setting value = (Acceleration time, sec) x 2

㉑ Limiting of regenerating power(adjustment of deceleration time)

Parameter No.	Display data(4 digits)	Contents of data
F-20	0040	0 ~ 100 (Setting is based on motor specification) Note)

Note) Standardly, 40 is set.

Explanation: Adjust the deceleration time to the same as the acceleration time.
The deceleration time shortens when the setting value increases.
The deceleration time lengthens when the setting value decreases.
However, when the regenerative power is excessive, the regenerative limit circuit is actuated and the motor current waveform changes; therefore, abnormal noise may be produced from the motor. In this case, this abnormal noise is suppressed by decreasing the setting value. (The deceleration time becomes longer.)

㉒ Setting of velocity loop proportion gain on normal operation
: High gear (CTH = 1)

Parameter No.	Display data(4 digits)	Contents of data
F-21	0050	0 ~ 255 (Standard setting : 50)

㉓ Setting of velocity loop proportion gain on normal operation
: Low gear (CTH = 0)

Parameter No.	Display data(4 digits)	Contents of data
F-22	0050	0 ~ 255 (Standard setting : 50)

㉔ Setting of velocity loop proportion gain on orientation
: High gear (CTH = 1)

Parameter No.	Display data(4 digits)	Contents of data
F-23	0100	0 ~ 255 (Standard setting : 100)

㉕ Setting of velocity loop proportion gain on orientation
: Low gear (CTH = 0)

Parameter No.	Display data(4 digits)	Contents of data
F-24	0100	0 ~ 255 (Standard setting : 100)

㉖ Setting of velocity loop integral gain on normal operation
: High gear (CTH = 1)

Parameter No.	Display data(4 digits)	Contents of data
F-25	0030	0 ~ 255 (Standard setting : 30)

㉗ Setting of velocity loop integral gain on normal operation
: Low gear (CTH = 0)

Parameter No.	Display data(4 digits)	Contents of data
F-26	0030	0 ~ 255 (Standard setting : 30)

㉘ Setting of velocity loop integral gain on orientation
: High gear (CTH = 1)

Parameter No.	Display data(4 digits)	Contents of data
F-27	0030	0 ~ 255 (Standard setting : 30)

㉙ Setting of velocity loop integral gain on orientation
: Low gear (CTH = 0)

Parameter No.	Display data(4 digits)	Contents of data
F-28	0030	0 ~ 255 (Standard setting : 30)

㉚ Adjustment of velocity detection offset

Parameter No.	Display data(4 digits)	Contents of data
F-29	0128	0 ~ 255 (Initial setting : 128)

Explanation: Adjust this parameter so that the test pin TS3 will be 0 mV at motor stopping.

㉛ Settign of rigid tapping mode

Parameter No.	Display data(4 digits)	Contents of data
F-31	0000	0 , 1 (Standard setting : 0)

Explanation: The torque limit signal (TLML) is used to a conventional torque limit: 0
The torque limit signal (TLML) is used for motor voltage switching when improved transient response characteristics are required for rigid tapping operation: 1

㉜ Setting of motor voltage at normal operation

Parameter No.	Display data(4 digits)	Contents of data
F-32	0010	0 ~ 100 (Standard setting : 10)

㉝ Setting of motor voltage at orientation

Parameter No.	Display data(4 digits)	Contents of data
F-33	0010	0 ~ 100 (Standard setting : 10)

㉞ Setting of motor voltage at rigid tapping mode

Parameter No.	Display data(4 digits)	Contents of data
F-34	0100	0 ~ 100 (Standard setting : 100)

Explanation: This parameter is effective when data of F-31 is 1.

㉟ Setting of detection range of zero-speed signal(SST)

Parameter No.	Display data(4 digits)	Contents of data
F-35	0075	0 ~ 100 (Standard setting : 75)

Explanation: The zero-speed signal SST is used as the completion signal for stop command.
This signal is detected when the speed of the motor becomes (The setting data/100)% of a maximum speed or less.

The detection range = (maximum speed)
x (The setting data/100)% or less

㊱ Setting of detection range of load detection signal(LDT)

Parameter No.	Display data(4 digits)	Contents of data
F-36	0090	0 ~ 100 (Standard setting : 90)

Explanation: The load is detected when the load becomes greater than the specific percentage of maximum detection level of the load meter.

Detection level = (maximum detection level of load meter, 10)
x (setting data)% or more

(Load detection signal (LDT) during acceleration/deceleration)
During acceleration/deceleration, the loadmeter instruction reaches the maximum detection level, but in this case the time preset by F-19 is not outputted. However, there are cases when it is outputted when changing minute speed commands (less than 50 mV).

㊲ Time constant of torque deviation at deceleration start

Parameter No.	Display data(4 digits)	Contents of data
F-37	0000	0 ~ 3 (Standard setting : 0)

Explanation: Use this parameter when the gear noises at deceleration in low speed rotation (base speed) due to the backlash of the spindle.

Data		Time constant (msec)
0	:	0
1	:	50
2	:	100
3	:	150

Set the data to 2 when the gear noises.

㊳ Setting of characteristics of control in deceleration

Parameter No.	Display data(4 digits)	Contents of data
F-38	0000	0 , 1 (Standard setting : 0)

Explanation: Use this parameter when the gear noises at deceleration in high speed rotation. Set the data to 1 to slow down the deceleration rate.

㊴ Setting of characteristics of control in stable rotation with no load

Parameter No.	Display data(4 digits)	Contents of data
F-39	0000	0 , 1 (Standard setting : 0)

Explanation: The motor speed may undulate in the stable rotation when setting the motor voltage (F-32) greater than the standard value (10). Set F-39 to 1 to reduce the motor undulation.

㊵ Setting of characteristics of control in torque limitation

Parameter No.	Display data(4 digits)	Contents of data
F-40	0000	0 , 1 (Standard setting : 0)

Explanation: The motor speed may overshoot due to the timing of the torque limit signal when making the torque limit in mechanical orientation. Set F-40 to 1 to reduce the overshoot of the speed.

〔Setting method of standard data〕
In accordance with the following procedure, reset the standard data.
By means of this operation, the data is written to NVRAM(non-volatile RAM).
Further, before the operation, check whether or not the setting differs from the standard data, and it would be advisable to record it.

(1) Set OFF the power.(Note)
(2) Change the setting of the setting jumper S1 to the "TEST" side.
And change the setting of the jumper SH3 to the "SET" side.
(3) Set ON the power.
(4) Select [FC-22] (FC-22). (Refer to 5.2 (2).)
(5) Set ON [DATA SET] for more than 1 second.
(6) If [Good] (Good) is displayed, this indicates that the setting of the standard data is completed.
(7) Set OFF the power.(Note)
(8) Change the setting of the setting jumper S1 to the "DRIVE" side.
(9) Set ON the power.
(10) Adjust parameter F-29(Velocity detection offset) by motor stop.
(11) Then, set parameter that differ from setting at shipment.
(12) After parameter setting and adjustment, set on [DATA SET] for more than 1 second.
(13) Set OFF the power.(Note)
And Change the setting of setting jumper SH3 to the "DRIVE" side.
(14) Set ON the power.
(15) Check the operation.

Note) When changin the setting of setting jumpers S1 and SH3, be certain to set OFF the power.

5.4 Setting Rank

Parameter is already set at shipping for the application similar to the conventional kind. And therefore, the setting of A in the rank below usually needs to be confirmed or altered by machine manufacturers.
Please have your own ranking at change of application conditions (change of rotation number and special setting).
Please be sure not to change setting values.

Setting of rank A (necessary to be confirmed without fail)

Rank	Mode number	Contents
A	F-01	Setting of use/non-use of machine ready signal
	F-02	Setting of use/non-use of override function
	F-03	Setting of override range
	F-04	Setting of kind of velocity commands (analog voltage, DA converter)

Setting of rank B (when rotation number is changed)

Rank	Mode number	Contents
B	F-13	Rotation number adjustment of forward rotation
	F-14	Rotation number adjustment of reverse rotation
	F-15	Rotation number at maximum velocity command voltage (10 V)

Setting of rank C (when special setting is made)

Rank	Mode number	Contents
C	F-16	Detection range of velocity arrival signal
	F-17	Detection level of velocity detection signal
	F-18	Setting of Torque limit value
	F-19	Setting of acceleration/deceleration time
	F-20	Limiting of regenerated power (adjustment of deceleration time)
	F-09	Use/non-use of motor power supply shutting off by machine ready signal
	F-35	Speed zero signal detection level

5.5 Setting and Adjusting Spindle Orientation Control Circuit

Refer to section "Spindle orientation control circuit."

6. EXCHANGE METHODS OF FUSES AND PCB

6.1 Exchange of Fuses

Replace fuses F1 - F7 in AC SPINDLE SERVO UNIT series after opening the unit cover as shown in 6.1.

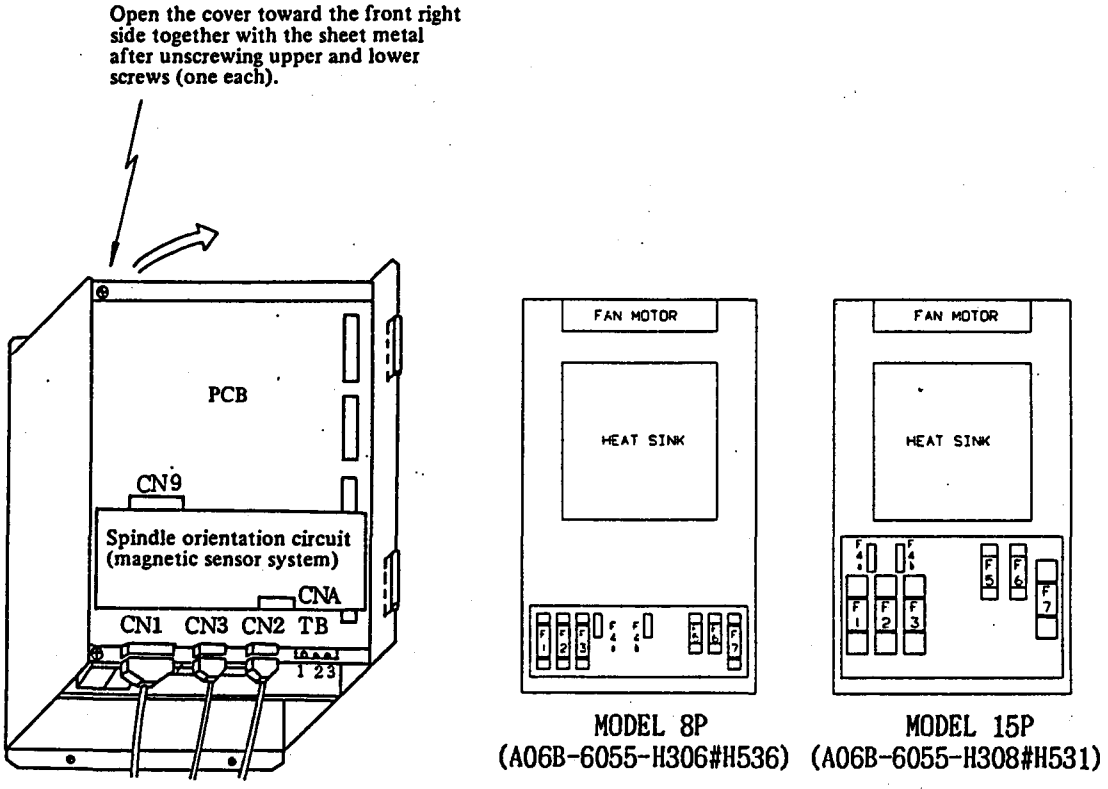


Fig. 6.1 How to open the AC SPINDLE SERVO UNIT series cover (1/2)

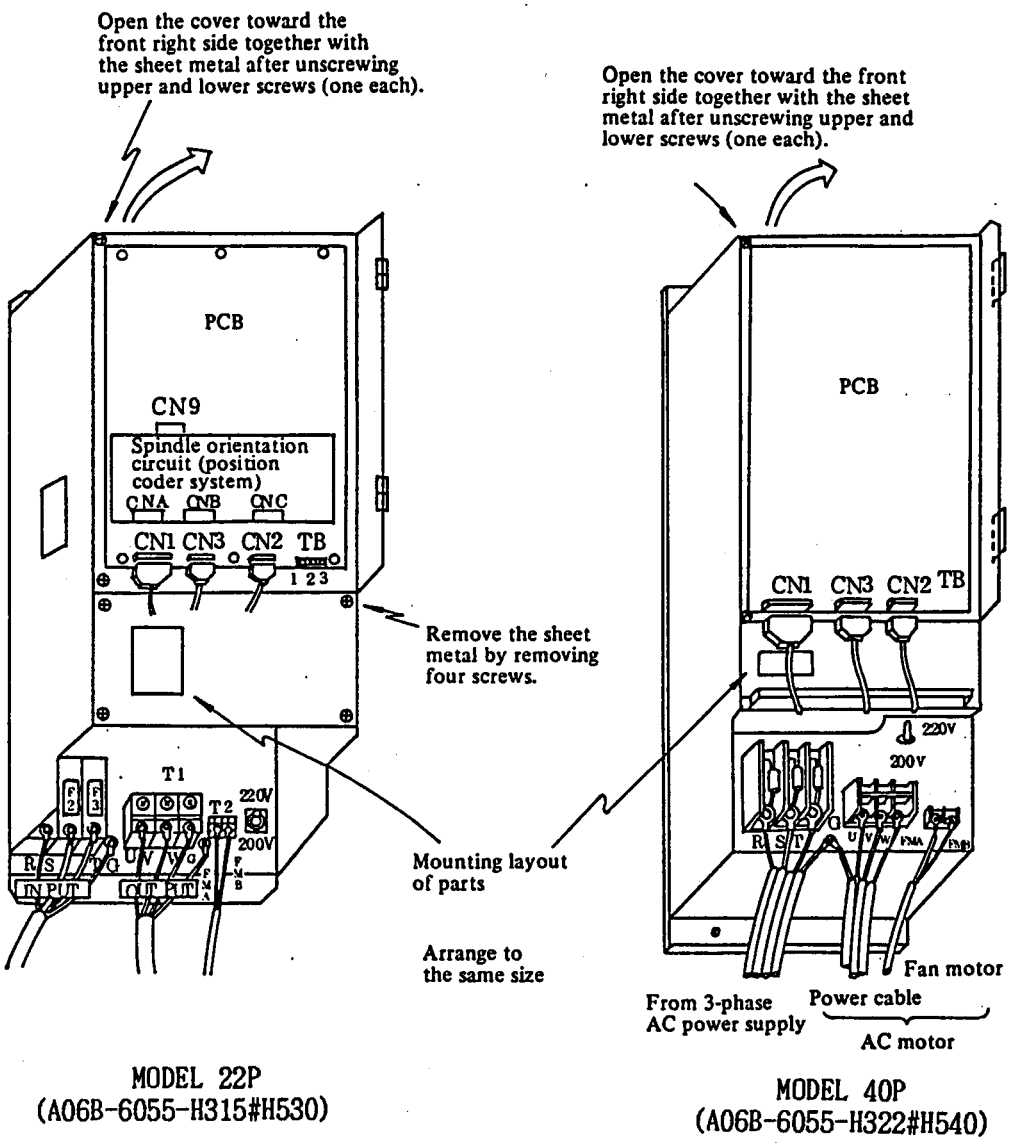


Fig. 6.1 How to open the AC SPINDLE SERVO UNIT series cover (2/2)

6.2 Exchange of PCB

6.2.1 MODEL 8P, 15P, 22P, 40P

Table 6.2.1 (a) How to remove PCB

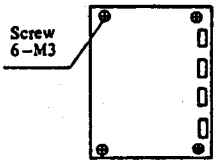
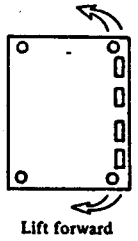
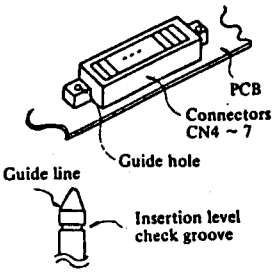
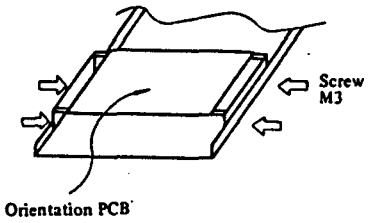
Step	Procedure
1	Disconnect cables from PCB after turning off power supply. Record the correspondence between cables and connector No.
2	Remove six screws fixing PCB. 
3	Gradually lift the upper right and lower right part of PCB forward at a time, and remove PCB by disconnecting connectors CN4 – 7 (pins are inserted from the rear side). 

Table 6.2.1 (b) How to mount PCB

Step	Procedure
1	After setting the guide holes of PCB connectors CN4 – 7 to the guide pins on the unit side and insert CN4 – 7 until check groove (see right figure) appears on the PCB connector surface. 
2	Fix PCB on the unit by using four screws. See step 2 in Table 6.2.1 (a).
3	Connect cables to the connectors.
4	Start operating the unit after confirming the ROM specification and PCB setting.

6.3 Exchange of Spindle Orientation Control Circuit PCB

Table 6.3.1 How to remove PCB

Step	Procedure
1	Remove the entire PCB from the spindle control unit according to Table 6.2.1 (a) disconnect cables connection PCB.
2	Remove 4 screws which fix the stays of spindle orientation control circuit PCB. 

Mount PCB by reversing the procedure specified in Table 6.3.1.

7. SPINDLE ORIENTATION CONTROL CIRCUIT

This chapter describes instructions for maintenance, installation, and adjustment when a pure electric orientation (constant position stop) function is attached to the spindle of an NC machine tool.

7.1 Configuration

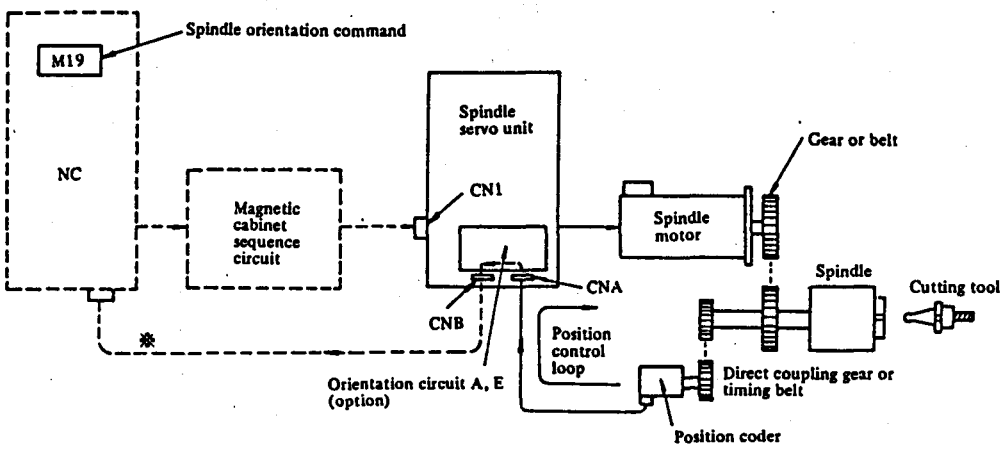


Fig. 7.1 (a) Configuration of spindle orientation using position coder (Internal stop position setting type)

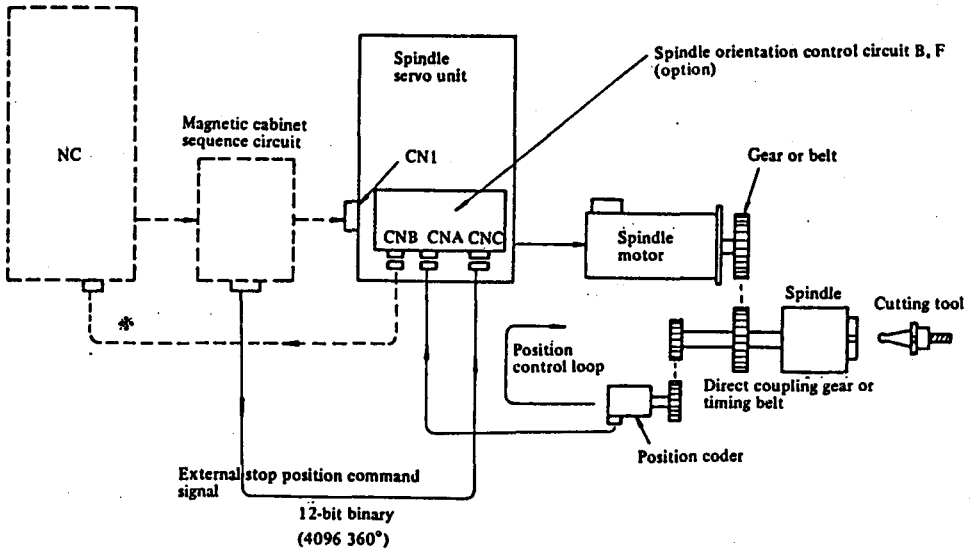


Fig. 7.1 (b) Configuration of spindle orientation using position coder (External stop position setting type)

Note 1) If a position coder is mounted on a lathe, etc., it is applicable to this system.

Note 2) Asterisked cable route is employed when the position coder of the lathe or sync. feed position coder in machining center is combined.

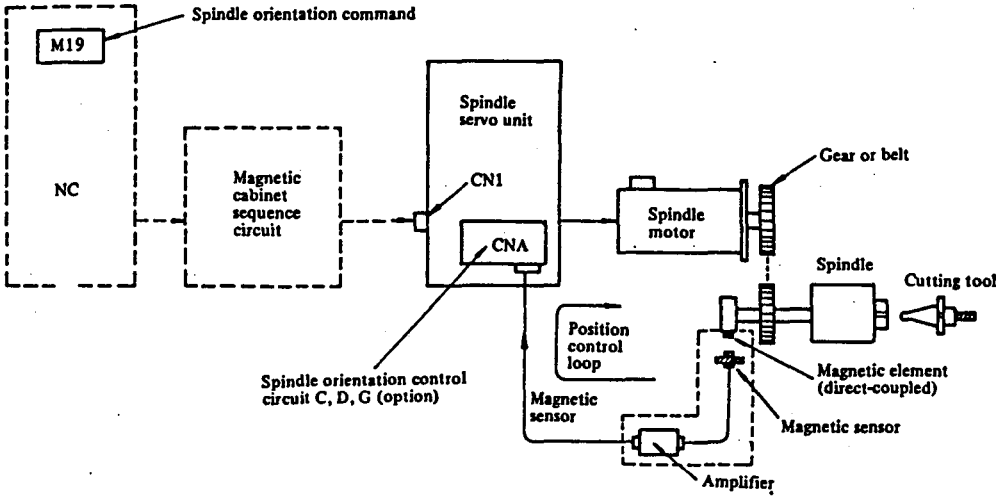


Fig. 7.1 (c) Configuration of spindle orientation using magnetic sensor

Name	Specification No.	Remarks (PCB No.)
Orientation A (Position coder type, 2-stage speed change gear spindle)	A06B-6041-J110	A20B-0008-0240
Orientation B (Position coder type, 2-stage speed change gear spindle)	A06B-6041-J111	A20B-0008-0241
Orientation C (Magnetic sensor type, 2-stage speed change gear spindle spindle speed: less than 8,000rpm)	A06B-6041-J120	A20B-0008-0030
Orientation D (Magnetic sensor type, 3-stage speed change gear spindle spindle speed: less than 8,000rpm)	A06B-6041-J121	A20B-0009-0520
Orientation E (Position coder type, 4-stage speed change gear spindle)	A06B-6041-J130	A20B-1000-0460
Orientation F (Position coder type, 4-stage speed change gear spindle)	A06B-6041-J131	A20B-1000-0461
Orientation G (Magnetic sensor type, 2-stage speed change gear spindle spindle speed: less than 12,000 rpm)	A06B-6041-J122	A20B-0008-0031
Orientation H (Magnetic sensor type, 2-stage speed change gear spindle spindle speed: less than 20,000rpm)	A06B-6041-J123	A20B-0008-0031 +A06B-6044-J948

7.2 Setting and Adjusting Spindle Orientation Control Circuit of Position Coder System

7.2.1 Setting and adjustment of spindle orientation control circuit in 2-stage spindle speed change

Application PCB drawing number A20B-0008-0240 (A06B-6041-J110 : Orientation A)
A20B-0008-0241 (A06B-6041-J111 : Orientation B)

1) Display contents
The following display is done using LED.
Refer to Fig. 7.2.1 for the installation position.

LED No.	Symbol	Description
LED 1	ORIENTATION	Lights when orientation command (ORCM) is input.
LED 2	LOW	Lights when contact of gear HIGH/LOW switching signal (*CTH) is closed, and means that gear LOW has been selected.
LED 3	IN-POSITION OUT	Lights when orientation operation is completed and is within setting pulse of stop position, and indicates that the orientation end signal has been sent. The width setting of the stop position is performed by SH02.
LED 4	IN-POSITION ADJUST	Lights when spindle enters within 1 pulse width of orientation command position. Adjust the variable resistor RV3/RV5 for offset adjustment when the gear is HIGH or LOW, and adjust so that this LED lights.

2) Setting

Name	Contents	Setting		
T1 - T5	Setting of power for position coder (+5 V)	Supply from unit ON side selection (Note)		
		Supply from NC No mark side selection		
T6 - T14	Type of position coder (Balanced type/ unbalanced type)	Balanced type	T6-14	A side selection
		Unbalanced type	T6-14	B side selection
SH01 - 03	Refer to article 3).			

Note) When supplied from the unit, the +5 V power supply will short circuit, so do not connect with the NC.

3) Setting SH01-03
"o" mark in table indicates short circuit; "x" mark indicates open.
3)-1 Setting SH01

No.	Setting contents		SH01								Remarks
			1 | 16	2 | 15	3 | 14	4 | 13	5 | 12	6 | 11	7 | 10	8 | 9	
1	Setting of rotating direction in the first orientation after turning on the power switch.	CCW	o	x							Setting at shipment
		CW	x	o							
2	Setting of rotating direction in the second and subsequent orientation.	CCW direction only			x	(o)					(Note)
		CW direction only			x	x					(Note)
		Same as rotation direction			(o)	x					Setting at shipment (Note)
3	Determined by position gain. Setting to clamp the orientation speed.	1					x	x			
		2/3					o	x			
		1/3					x	o			
4	Setting by rotation direction of spindle and rotation direction of position coder.	Same direction							o	x	Differs for each machine tool. Hunting occurs if this setting is inverted.
		Opposite direction							x	o	

3)-2 Setting SH02

No.	Setting contents		SH01 1-16	SH01 2-15	SH01 3-14	SH01 4-13	SH01 5-12	SH01 6-11	SH01 7-10	SH01 8-9	Remarks
1	Setting of the in-position width when orientation end signals (ORAR1, 2) are output. (Note)	±2 pulses	o	o	o	o	o	o			1 pulse corresponds to 0.088°
		±4 pulses		o	o	o	o	o			
		±8 pulses			o	o	o	o			
		±16 pulses				o	o	o			
		±32 pulses					o	o			
		±64 pulses						o			
2	Setting by hysteresis of position coder	No compensation							x	x	Setting at shipment
		+1 pulse							o	x	
		-1 pulse							x	o	

Note) The sending conditions of the orientation end signal C are when the AND condition of the following 3 signals are effected.
C = (Angle position is located within the in-position width setting pulse) x (Speed zero signal (SST) is turned on) x (Orientation command (ORCM) is turned on)

3)-3 Setting SH03

No.	Contents		SH03 1-2	SH03 2-3	Remarks
1	Setting according to the type of AC spindle servo unit.	DC	o	x	
		AC	x	o	Setting at shipment

Note) Setting by the user is not necessary.

4) Setting position switches (SW1, 2, 3)
Setting of stop position is performed by the digital switches SW1 - 3 which are the respective 16th divisions. Refer to Fig. 7.2.1 for the installation position of the digital switches.

Setting switch	Pulse number per 1 division	Angle per 1 division
SW1	4096/16 = 256 pulses	22.5°/division
SW2	256/16 = 16 pulses	1.4°/division
SW3	16/16 = 1 pulse	0.088°/division

The spindle motor can be stopped at any position in one rotation in the unit of 1/4096 x 360° = 0.088° by setting these switches in the order of SW1, SW2, SW3.

5) Adjustments
Refer to Fig. 7.2.1 for the installation position of each of the variable resistors RV1 - 6.

No.	Item	Name of variable resistor	Standard adjustment (Division)	Measuring point	Description
1	Speed feedback voltage offset	RV1	5	TSA2 CH14 (TSA2)	Adjust RV1 until TSA2 voltage becomes 0 ±1 mV.
2	Gear HIGH position gain	RV2	3 - 4	Spindle motion or CH14	Set the gain to the maximum within a range where the spindle does not overshoot.
3	Gear HIGH offset	RV3	About 5	LED4 (ADJUST)	Adjust RV3 until LED4 lights or flickers.
4	Gear LOW position gain	RV4	3 - 6	Spindle motion or CH14	Set the gain to the maximum within a range where the spindle does not overshoot.
5	Gear LOW offset	RV5	About 5	LED4 (ADJUST)	Adjust RV5 until LED4 lights or flickers.
6	Speed loop gain	RV6AC	7	CH14 (TSA2)	Make sure that motor is not hunting. The rigidity increases during stop by turning these RV clockwise.

Note) It is not necessary to adjust RV6DC.

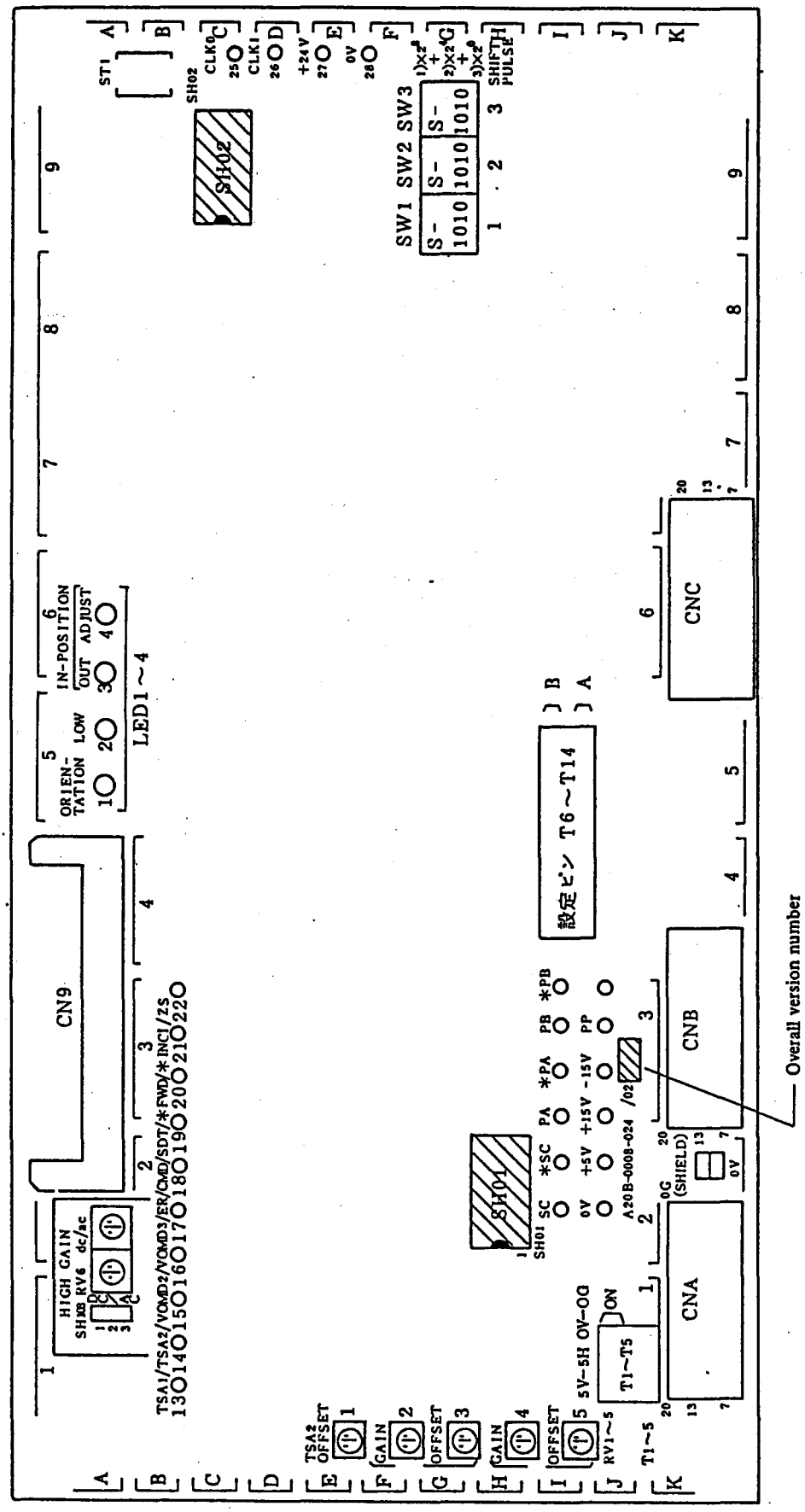


Fig. 7.2.1 Location of test pins, variable resistors, jumpers, and light-emitting diodes (LED) (PCB A20B-0008-0240 - 0241)

7.2.2 Setting and adjustment of spindle orientation control circuit in 3 or 4 stage spindle speed change

Application PCB drawing number A20B-1000-0460 (A06B-6041-J130 : Orientation E)
A20B-1000-0461 (A06B-6041-J131 : Orientation F)

1) Display contents
The following is displayed using the light-emitting diode (LED).
Refer to Fig. 7.2.2 for the installation position.

LED No.	Symbol	Contents
LED 1	ORIENTATION	Lights when orientation command (ORCM) is input.
LED 2	CTH	Lights when contact of gear HIGH/LOW switching signal (*CTH) is closed. (Note)
LED 3	CTM	Lights when contact of gear MEDIUM signal (CTM) is closed. (Note)
LED 4	IN-POSITION OUT	Lights when orientation operation is completed and is within setting pulse of stop position, and indicates that the orientation end signal has been sent. The width setting of the stop position is performed by SH02.
LED 5	IN-POSITION ADJUST	Lights when spindle enters within $\pm$2 pulses width of orientation command position. Adjust the variable resistor RV3 for offset adjustment when the orientation is completed, and adjust so that this LED lights.

Note) Corresponding to each speed change stage, the contact signal is controlled as follows.

Selection of speed change stage	Contact of *CTH signal	Contact of CTM signal	LED2	LED3
High-speed (HIGH)	OFF (Open)	OFF (Open)	OFF	OFF
Medium high-speed (MEDIUM-HIGH)	OFF (Open)	ON (Closed)	OFF	ON
Medium low-speed (MEDIUM-LOW)	ON (Closed)	OFF (open)	ON	OFF
Low-speed (LOW)	ON (closed)	ON (closed)	ON	ON

2) Setting jumper

Name	Contents	Setting
	Setting of power for position coder (+5 V)	Supply from unit ON side selection (Note)
		Supply from NC No mark side selection
T1-T9	Type of position coder (Balanced type/ unbalanced type)	Balanced type T1-9 A side selection
		Unbalanced type T1-9 B side selection
SH01-03	Refer to article 3).	

Note) When supplied from the unit, the +5 V power supply will short circuit, so do not connect with the NC.

3) Setting SH01 - 03
"o" mark in table indicates short circuit; "x" mark indicates open.

3)-1 Setting SH01

No.	Setting contents		SH01 1 | 16	SH01 2 | 15	SH01 3 | 14	SH01 4 | 13	SH01 5 | 12	SH01 6 | 11	SH01 7 | 10	SH01 8 | 9	Remarks
1	Setting of rotating direction in the first orientation after turning on the power switch.	CCW	o	x							Setting at shipment
		CW	x	o							
2	Setting of rotating direction in the second and subsequent orientation.	CCW direction only			x	(o)					(Note)
		CW direction only			x	x					(Note)
		Same as rotation direction			(o)	x					Setting at shipment (Note)
3	Determined by position gain. Setting to clamp the orientation speed.	1					x	x			
		2/3					o	x			
		1/3					x	o			

No.	Setting contents		SH01 1|16	2|15	3|14	4|13	5|12	6|11	7|10	8|9	Remarks
4	Setting by rotation direction of spindle and rotation direction of position coder.	Same direction							o	x	Differs for each machine tool. Hunting occurs if this setting is inverted.
		Opposite direction							x	o	

3)-2 Setting SH02

No.	Setting contents		SH01 1|16	2|15	3|14	4|13	5|12	6|11	7|10	8|9	Remarks
1	Setting of the in-position width when orientation end signals (ORAR1, 2) are output.	±2 pulses	o	o	o	o	o	o			1 pulse corresponds to 0.088°
		±4 pulses		o	o	o	o	o			
		±8 pulses			o	o	o	o			
		±16 pulses				o	o	o			
		±32 pulses					o	o			
		±64 pulses						o			
2	Setting by hysteresis of position coder	No compensation							x	x	Setting at shipment
		+1 pulse							o	x	
		-1 pulse							x	o	

Note) The sending conditions of the orientation end signal C are when the AND condition of the following 3 signals are effected.
C = (Angle position is located within the in-position width setting pulse) x (Speed zero signal (SST) is turned on) x (Orientation command (ORCM) is turned on)

3)-3 Setting SH03

No.	Contents		SH03 1 | 2	SH03 2 | 3	Remarks
1	Setting according to the type of AC spindle servo unit.	DC	o	x	
		AC	x	o	Setting at shipment

Note) Setting by the user is not necessary.

4) Setting stop position
Setting of stop position is performed by the digital switches SW1 - 3 which are the respective 16th divisions. Refer to Fig. 7.2.2 for the installation position of the digital switches.

Setting switch	Pulse number per 1 division	Angle per 1 division
SW1	4096/16 = 256 pulses	22.5°/1 division
SW2	256/16 = 16 pulses	1.4°/1 division
SW3	16/16 = 1 pulse	0.088°/1 division

The spindle motor can be stopped at any position in one rotation in the unit of 1/4096 x 360° = 0.088° by setting these switches in the order of SW1, SW2, and SW3.

5) Adjustment
Refer to Fig. 7.2.2 for the installation position of each variable resistor RV1 - 8.

No.	Item	Adjustment location	Standard adjustment	Measurement location	Contents
1	Speed loop gain	RV1AC	7th division		Check that it is not oscillating. If turned to the right, rigidity at stop increases.
2	Offset of speed feeback voltage	RV2	5th division	TSA2	Adjust so that it becomes 0 mV ±1 mV at spindle stop.
3	Fine adjustment of position	RV3	5th division	LED5	Adjust so that LED5 lights at gear HIGH.

No.	Item	Adjustment location	Standard adjustment	Measurement location	Contents
4	Position gain at gear LOW *CTH:ON, CTM:ON	RV4	2nd division	Spindle operation or TSA2	Set so that gain becomes highest in range that spindle does not overshoot.
5	Position gain at gear M.-LOW *CTH:ON, CTM:OFF	RV5	2nd division	Spindle operation or TSA2	Set so that gain becomes highest in range that spindle does not overshoot.
6	Position gain at M.-HIGH gear *CTH:OFF, CTH:ON	RV6	2nd division	Spindle operation or TSA2	Set so that gain becomes highest in range that spindle does not overshoot.
7	Position gain at HIGH gear *CTH:OFF, CTH:OFF	RV7	2nd division	Spindle operation or TSA2	Set so that gain becomes highest in range that spindle does not overshoot.
8	Offset adjustment of ER voltage	RV8	0 $\pm$1 mV	ER	Adjustment at shipment (Refer to precautions below.)
		Note 1) Set SW1 to 8th division; SW2 and SW3 to 0th division. Note 2) Set setting jumpers T2, 3, 5, and 6 OFF. Note 3) After orientation command ON motor rotation, perform the above adjustment.			

Note) It is not necessary to adjust RV1DC.

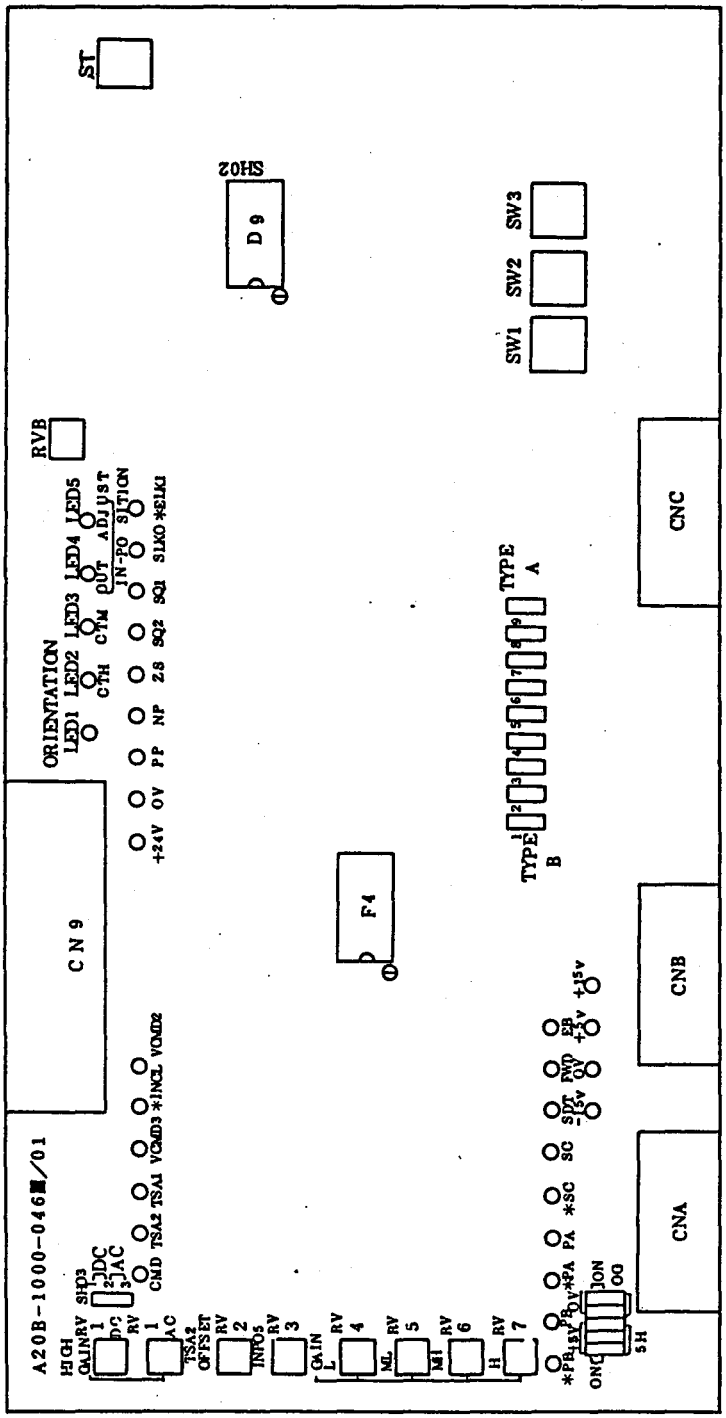


Fig. 7.2.2 Installation position of LEDs, setting jumpers, variable resistors, and check terminals PCB diagram number A20B-1000-0460,-0461

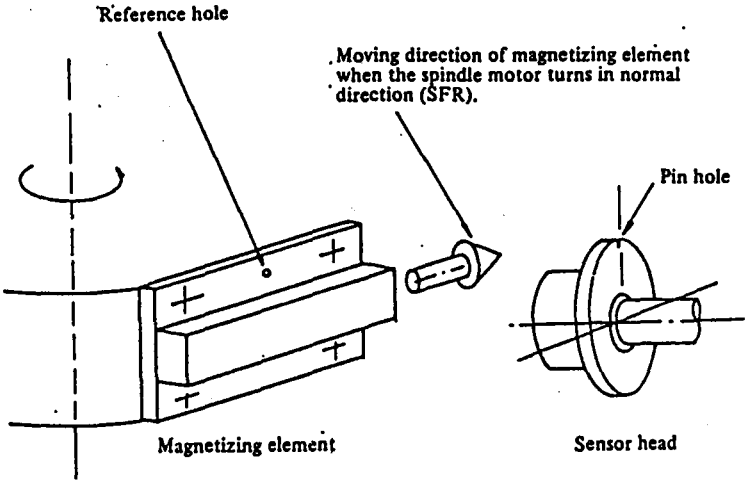
7.3 Adjusting Spindle Orientation Control Circuit of Magnetic Sensor Type

7.3.1 Mounting magnetizing element and magnetic sensor

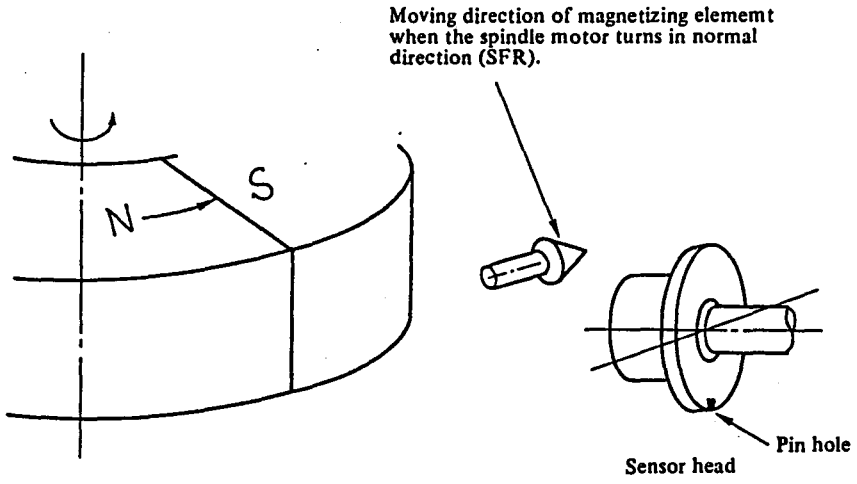
When mounting the magnetizing element in the spindle of the machine tool, because there is a polarity between the magnetic sensors, the mounting direction differs according to the configuration (belt, gear coupling, etc.) of the spindle.

When the magnetizing element is rotated by the motor forward rotation command (SFR: ON, VCMD: Forward), arrange the reference hole and stop position verify division to face as shown in the diagram below, and arrange the pin hole of the magnetic sensor to be as in the diagram below. (The direction of the pin hole differs in plate type and ring type.)

Set the gap of the magnetizing element and sensor head so that the gap minimum value ΔL becomes $\Delta L = 1.5 \pm 0.5$ mm.



(a) Plate type



(b) Ring type

Fig. 7.3.1 Mounting magnetizing element

7.3.2 Setting and adjustment of spindle orientation control circuit in 2-stage spindle speed change

Application PCB drawing number A20B-0008-0030 (A06B-6041-J120 : Orientation C)

1) LED
The following is displayed using the light-emitting diode (LED).
Refer to Fig. 7.3.2 for the installation position.

LED display contents		
LED	Display contents	Description
1	ORIENTATION	Lights when orientation command (ORCM) is input.
2	LOW	Lights when contact of gear HIGH/LOW switching signal (*CTH) is closed.
3	MS PEAK LEVEL	This adjusting indicator lights when the peak value of the magnetic flux detection signal (MS) exceeds ±10 V.
4	SLOWDOWN PERIOD	Lights when the spindle approaches the stop position and enters the low speed rotation area during spindle orientation motion.
5	IN POSITION FINE	Lights when the magnetic flux signal (output) value is within the setting range of 0.1° as a converted spindle angle. This LED5 may also light when the sensor is not positioned on the magnetizing element.
6	IN-POSITION	Lights when the spindle is within ±1° of the aimed adjusting position after completion of spindle orientation. The spindle orientation end signal (ORAR) is sent when this LED is lighting in a mode other than TEST mode.
7	TEST MODE	Lights when 2-3 of setting jumper SH01 is turned ON. The orientation end signal is not sent in this mode even if the orientation motion is executed.

2) Setting pin
Select the settings by the user. However, SH01 is provided for adjustment and testing at the site. Set this after turning on the power supply. Further, after adjustment is finished be certain to open (OFF) and check that LED7 goes out.
Refer to Fig. 7.3.2 for the installation position of the jumpers SH01 - 05.
o: Short circuit, x: open

Table 7.3.2 (a) Setting jumpers (SH)

Jumpers (The double frame indicates standard setting)				
Setting (Note 1)			Function	Remarks
SH	1-2	2-3		
01		o	Sets the test mode. (Note 2)	Set for adjustment only.
02	o	x	Rotates the motor shaft clockwise when the orientation command is given before operating the spindle after turning on the power.	SH03 setting takes precedence of SH02. This is effective only when 1-2 pins of SH03 are shorted.
	x	**o**	Rotates the motor shaft counter-clockwise when the orientation command is given before operating the spindle after turning on the power.	
03	**o**	**x**	Orients in the direction of the spindle rotation just before the orientation command was given.	SH02 setting becomes effective.
	x	o	Always orients the spindle counter-clockwise.	
	x	x	Always orients the spindle clockwise.	
04	x	x	Sets the initial orientation speed of the spindle: Approx. 60 x (spindle position loop gain, sec^{-1}) rpm	Since the position loop gain of spindle is 5 sec^{-1} in general, the initial speed is about 300 rpm without limitation.
	o	**x**	Limits the initial orientation speed to 1/3.	
	x	o	Limits the initial orientation speed to 2/3.	
05	o	x	For DC spindle servo unit.	It is not necessary to set by user.
	x	**o**	For AC spindle servo unit.	

Note 1) [ ] indicates standard settings.
Note 2) Use of the TEST MODE
(1) Turn on the spindle orientation command (ORCM).
(2) Spindle orientation end signals (ORAR) are not sent.
(3) The spindle turns at the initial orientation speed, while the SW1 (INITIALIZING BUTTON) is being pressed and the spindle stops at the specific position when SW1 is released.
(4) Red LED7 lights in this mode.

3) Setting variable resistors
Adjust the variable resistor as shown in the following table before starting adjustments.
Asterisked items are readjusted during adjustment procedure described later. Set these items also as the preliminary setting.
Refer to Fig. 7.3.2 for the installation position of each variable resistor RV1 - 12.

Adjusting variable, resistor

Orientation	Variable resistor											
	RV1 *	RV2 *	RV3	RV4	RV5	RV6 *	RV7 *	RV8	RV9 *	RV10 *	RV11 *	RV12 AC
C	5.0	6.0	See (a)	See (a)	See (b)	2.0	5.0	See (c)	2.0	5.0	5.0	7.0

It is not necessary to set RV12DC.

a) RV3, RV4
Follow the distance H between the rotational center of magnetic element and center of sensor head surface.

H (mm)	60 to 65	To 70	To 75	To 80	To 85	To 90	To 95	To 100	To 105	To 110
Division	7.0	6.0	5.0	4.0	3.0	2.5	2.0	1.5	1.0	0.5

b) RV5
Follow the number of HIGH spindle rotation (Nhm) at rated speed.

Nhm (rpm)	2000 to 2200	To 2500	To 2700	To 3100	To 3500	To 4000	To 4500	To 5000	To 5500	To 6000
Division	7.5	6.5	5.5	4.5	3.5	2.5	2.0	1.5	1.0	0.5

c) RV8
Follow the gear ratio Rh/l of HIGH/LOW gear.

Rh/l	To 2.0	To 2.2	To 2.5	To 2.8	To 3.2	To 3.7	To 4.4	To 5.3	To 6.0	To 7.0
Division	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	9.5	10.0

4) Adjusting variable resistors
Adjust RV1 - 12 according to the following table. Adjust the offset and gain of spindle control circuit PCB before adjusting the orientation circuit. When RV12 and RV13 of the spindle control circuit PCB are changed, the stop position may be deviated.
Set the test mode for the following adjustments by shorting SH01 pins.

Table 7.3.2 (b) Adjusting variable resistors

No.	Item	Adjustment location	Measurement location	Contents
1	Speed feedback voltage offset. TS OFFSET	RV1	CH16(TSA2)	Adjust so that voltage of TSA2 becomes 0 ±1 mV.
2	MS signal amplitude value. MS PEAK LEVEL	RV2	LED3	Set to the position where LED3 starts flickering by continuously pressing SW1 (INITIALIZING BUTTON).
3	Slowdown speed reference. SLOWDOWN REFERANCE	RV3		Refer to 7.3.2, 3) a).
4	AMS signal amplitude value. AMS PEAK LEVEL	RV4		Refer to 7.3.2, 3) a).
5	Slowdown time in gear high mode. SLOWDOWN TIME IN HIGH MODE	RV5	LED4	Set the orientation operation by pressing SW1 in the geart high state (*CTH:OFF). LED4 should clearly light momentarily immediately before stop.
6	Position gain in gear high mode. GAIN(H)	RV6	Spindle operation or CH16	Set the orientation operation by pressing SW1, and set the highest gain in the range that the spindle does not overshoot at stop.
7	Adjustment of stop position in gear high mode. IN-POSITION (H)	RV7	LED5, LED6	Set the orientation operation by pressing SW1, and adjust so that LED5 lights while LED6 is lit.
8	Slowdown time in gear low mode. SLOWDOWN TIME IN LOW MODE	RV8	LED4	Set the orientation operation by pressing SW1 in the gear low state (*CTH: ON). LED4 should clearly light momentarily immediately before stop.

No.	Item	Adjustment location	Measurement location	Contents
9	Position gain in gear low mode. GAIN(L)	RV9	Spindle operation or CH16	Set the orientation by pressing SW1, and set the highest gain in the range that the spindle does not overshoot at stop.
10	Adjustment of stop position in gear low mode. IN-POSITION(L)	RV10	LED5, LED6	Set the orientation operation by pressing SW1, and adjust so that LED5 lights while LED6 is lit.
11	Spindle stop position shift. POSITION SHIFT	RV11	Spindle operation	The stop position can be finely adjusted within a range of ±1° at the spindle angle.
12	High gain. HIGH GAIN AC	RV12AC	Spindle operation	Check that it does not oscillate. If turned to the right, the rigidity increases.

* It is not necessary to adjust RV12DC.

After adjustments are finished, release the test mode, and check that LED7 goes out.

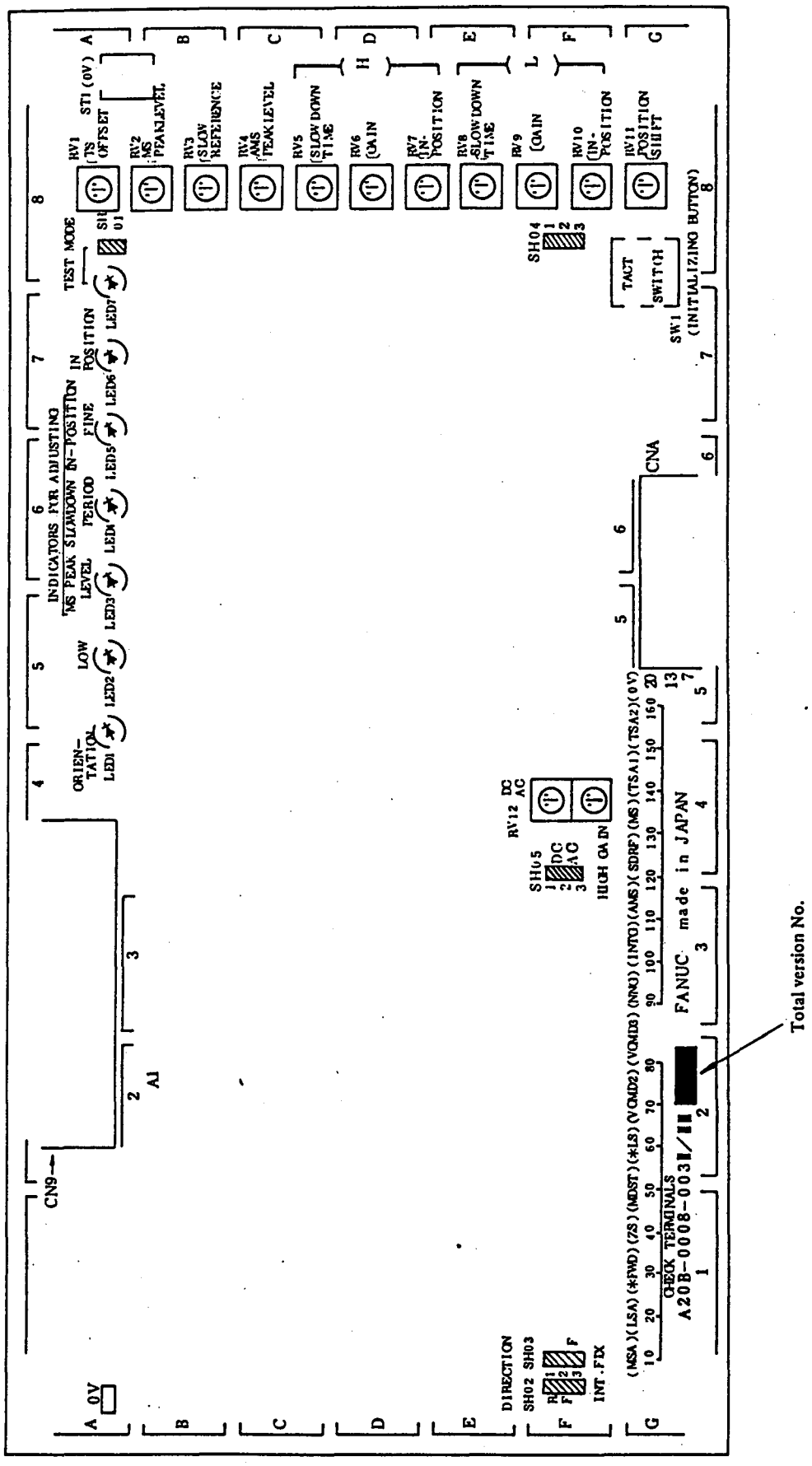


Fig. 7.3.2 Location of test pins, variable resistor, jumpers and LEDs (PCB: A20B-0008-0030,-0031)

7.3.3 Setting and adjustment of spindle orientation control circuit in 2-stage spindle speed change/high-speed spindle

Application PCB drawing number A20B-0008-0031 (A06B-6041-J122 : Orientation G)

1) Display contents
   Refer to item 7.3.2 (1).
   Refer to Fig. 7.3.2 for the installation position.
2) Setting jumper
   Refer to item 7.3.2 (2).
   Refer to Fig. 7.3.2 for the installation position.
3) Setting variable resistor
   First adjust, and set the division of the variable resistor as shown in the following table. Items with * mark in the table are readjusted by later described adjustment items, but apply as settings at the preparation stage.
   Refer to Fig. 7.3.2 for the installation position of each variable resistor RV1 - 12.

Setting and preparation of variable resistor

Variable resistor name / Name		RV1 *	RV2 *	RV3	RV4	RV5	RV6 *	RV7 *	RV8	RV9 *	RV10 *	RV11 *	RV12 AC
Division	G	5.0	6.0	a)	a)	b)	5.0	5.0	c)	5.0	5.0	5.0	8.0

Note) It is not necessary to set RV12DC.

a) Setting RV3, RV4
   Set RV3 and RV4 according to the distance between the rotation center of the magnetizing element and the center of the sensor head surface.

H (mm)	40-45	- 50	- 55	- 60	- 65	- 70	- 80	- 90	- 100	- 110
Division	9.5	7.0	5.0	4.0	3.0	2.5	2.0	1.5	1.0	1.0

b) Setting RV5
   Set RV5 according to the speed NHM in high gear mode at the rating rotation of the spindle motor.

N HM (rpm)	6000 -6500	-7000	-7500	-8000	-8500	-9000	-9500	-10000	-11000	-12000
Division	6.0	5.0	4.5	4.0	3.5	3.0	2.5	2.5	2.0	1.0

c) Setting RV8
   Set RV8 according to speed change ratio RH/L of gear high/low modes.

R H/L	- 2.2	- 2.5	- 2.8	- 3.2	- 3.7	- 4.5	- 5.0	- 6.0	- 7.0
Division	2.0	3.0	4.0	5.0	6.0	7.0	8.0	8.0	9.0

4) Adjusting variable resistor
Refer to item 7.3.2 (4).

7.3.4 Setting and adjustment of spindle orientation control circuit in 3-stage spindle speed change

Application PCB drawing number A20B-0009-0520 (A06B-6041-J121 : Orientation D)

Take care at application because there are the following restrictions for the spindle maximum speed range for each speed change stage.

	Spindle maximum speed range
High-speed (HIGH)	4000 - 8000 rpm
Medium-speed (MEDIUM)	1000 - 2000 rpm
Low-speed (LOW)	250 - 677 rpm

1) Display contents
Displays the following by using a light-emitting diode (LED).
Refer to Fig. 7.3.4 for the installation position.

LED	Display contents	Description
LED1	ORIENTATION	Lights when orientation command (ORCM) is input.
LED2H	GEAR/CLUTCH	Lights when gear HIGH is selected.
LED2M		Lights when gear MEDIUM is selected.
LED2L		Lights when gear LOW is selected.
LED3	MS PEAK LEVEL	Lights only when peak value of the magnetic detection signal (MS) of one adjustment indicator (INDICATOR FOR ADJUSTING) is exceeding the range of $\pm$10 V.
LED4	SLOWDOWN PERIOD	Lights if the spindle position approaches the stop position during spindle orientation operation, and enters the low speed rotation area.
LED5	IN-POSITION FINE	Lights when the value of magnetic detection signal (output) is inside the range of 0.1° by converting the spindle angle. However, there are cases it lights even when the sensor is not in the range of the magnetizing element.
LED6	IN-POSITION	Lights when spindle orientation is complete, and spindle is inside range of target position $\pm$1°. In other than TEST MODE, the spindle orientation ready signal (ORAR) is sent when this LED is lit.
LED7	TEST MODE	Lights when 2-3 of setting jumper SH01 are set ON. In this mode, the orientation ready signal is not sent even if the orientation operation is performed.

2) Setting jumper
Refer to item 7.3.2 (2).
Refer to Fig. 7.3.4 for installation position.

3) Setting variable resistors RV3, RV4
Set RV3 and RV4 according to the distance between the rotation center of the magnetizing element and the center of the sensor head surface.

H (mm)	- 50	- 60	- 70	- 80	- 90	- 100	- 110	- 120
Division	9.5	6.5	4.5	3.0	2.5	1.5	1.0	0.5

4) Adjusting variable resistor
Adjust RV1 - 15 according to the following table. Adjust the orientation circuit after the adjustment of each offset gain, etc. of the spindle control circuit PCB is finished. If the adjustment on the spindle control circuit is changed, there are cases when the stop position slips.
Further, the following adjustments are carried out in the test mode by shorting SH01.
Refer to Fig. 7.3.4 for the installation position of each variable resistor RV1 - 15.

No.	Item	Adjustment location	Measurement location	Contents
1	Speed feedback voltage offset. TS OFFSET	RV1	CH15(TSA2)	Adjust so that voltage of TSA2 becomes 0 $\pm$1 mV.
2	MS signal amplitude value. MS PEAK LEVEL	RV2	LED3	Set to the position where LED3 starts flickering by continuously pressing SW1 (INITIALIZING BUTTON).
3	Slowdown speed reference. SLOWDOWN REFERENCE	RV3		Refer to 7.3.4 3).
4	AMS signal amplitude value. AMS PEAK LEVEL	RV4		Refer to 7.3.4 3).
5	Slowdown time in gear high mode. SLOWDOWN TIME IN HIGH MODE	RV5	LED4	Set the orientation operation by pressing SW1 in the gear high state (*CTH: OFF). LED4 should clearly light momentarily immediately before stop.
6	Position gain in gear low mode. GAIN (H)	RV6	Spindle operation or CH15	Set the orientation operation by pressing SW1, and set the highest gain in the range that the spindle does not overshoot at stop.
7	Adjustment of stop position in gear high mode. IN-POSITION (H)	RV7	LED5, LED6	Set the orientation operation by pressing SW1, and adjust so that LED5 lights while LED6 is lit.

No.	Item	Adjustment location	Measurement location	Contents
8	Slowdown time in gear low mode. SLOWDOWN TIME IN LOW MODE	RV8	LED4	Set the orientation operation by pressing SW1 in the gear low state (*CTH: ON). LED4 should clearly light momentarily immediately before stop.
9	Position gain in gear low mode. GAIN (L)	RV9	Spindle operation or CH15	Set the orientation operation by pressing SW1, and set the highest gain in the range that the spindle does not overshoot at stop.
10	Adjustment of stop position in gear low mode. IN-POSITION (L)	RV10	LED5, LED6	Set the orientation operation by pressing SW1, and adjust so that LED5 lights while LED6 is lit.
11	Slowdown time in gear medium mode. SLOWDOWN TIME IN MEDIUM MODE	RV12	LED4	Set the orientation operation by pressing SW1 in the gear medium state. LED4 should cleary light momentarily immediately before stop.
12	Position gain in gear medium mode. GAIN (M)	RV13	Spindle operation or CH15	Set the orientation operation by pressing SW1, and set the highest gain in the range that the spindle does not overshoot at stop.
13	Adjustment of stop position in gear medium mode. IN-POSITION (M)	RV14	LED5, LED6	Set the orientation operation by pressing SW1, and adjust so that LED5 lights while LED6 is lit.
14	Spindle stop position shift POSITION SHIFT	RV11	Spindle operation or CH15	The stop position can be finely adjusted within a range of $\pm 1°$ at the spindle angle.
15	High gain. HIGH GAIN AC	RV15AC	Spindle operation or CH15	Check that it does not oscillate. If turned to the right, the rigidity increases.

Note) It is not necessary to adjust RV15DC.

After adjustments are finished, release the test mode, and check that LED7 goes out.

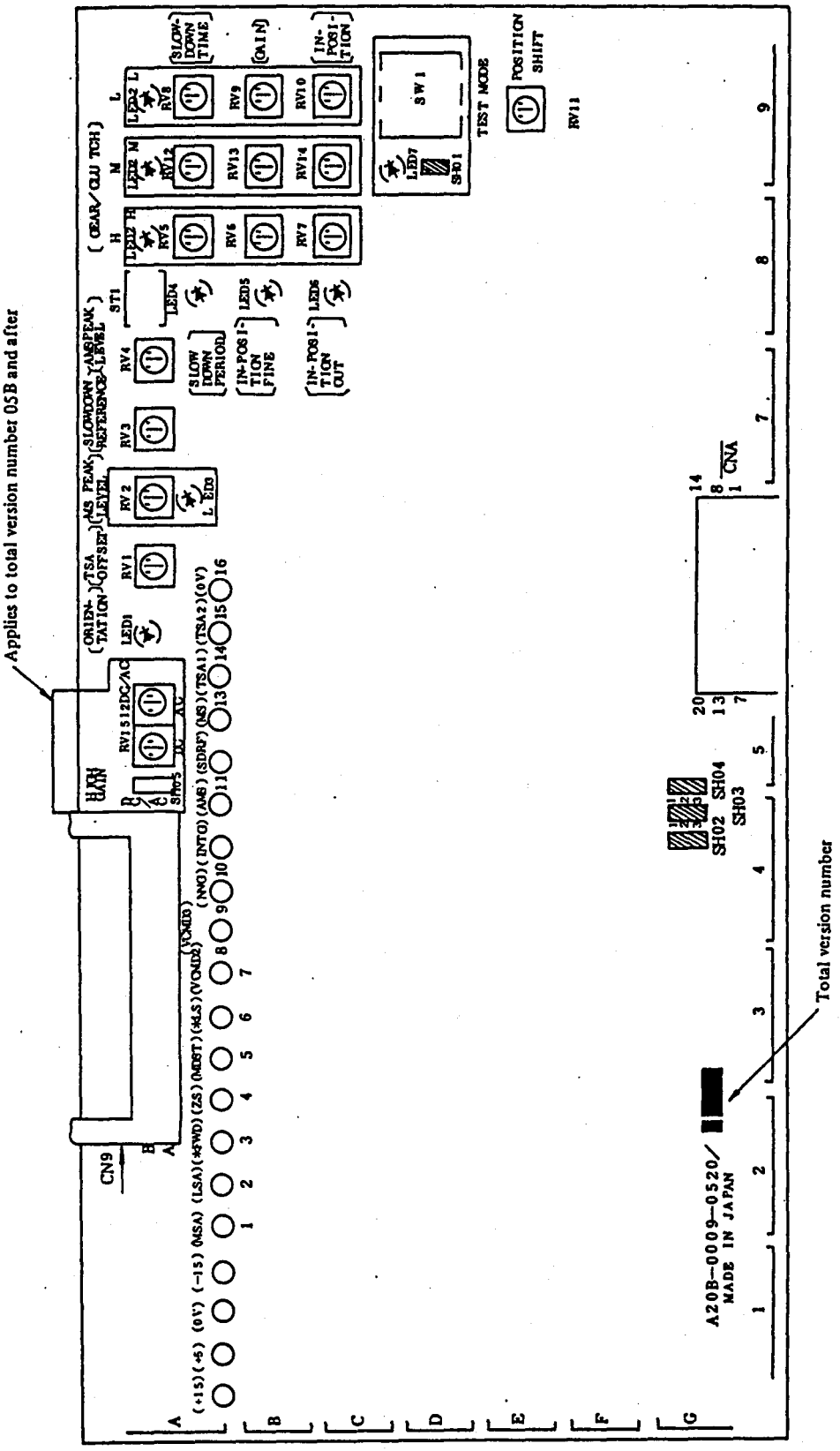


Fig. 7.3.4 Installation position of LEDs, setting jumpers, variable resistor, and check terminals PCB diagram number A20B-0009-0520

7.3.5 Checking method of spindle system positon loop gain

The spindle position loop gain can be checked according to the following procedure.
Check it after adjusting the spindle orientation control circuit.

Item	Procedure
1	Set to TEST mode (LED7 ON) after shorting between 2 - 3 setting SH01 terminals.
2	Release the restrictions on orientation speed by opening 1 - 2 and 2 - 3 setting SH04 terminals.
3	Measure the rotation speed $N_{S(H)}$, $N_{S(L)}$, (rpm) when SW1 (initializing button) is ON, for spindle gear HIGH (*CTH: OFF) and spindle gear LOW (*CTH: ON) respectively.
4	The spindle system position loop gain can be obtained by the following formula: $K_{P(H \text{ or } L)} \fallingdotseq N_{S(H \text{ or } L)} \div 55(sec^{-1})$ Where, $K_{P(H)}$ is the position loop gain at gear HIGH, and $K_{P(L)}$ is the position loop gain at gear LOW.

8. VELOCITY GAIN SELECTOR CIRCUIT

This describes the maintenance when the velocity gain selector circuit is added to control by switching the velocity loop gain inside the unit to the AC spindle servo unit by external signal.

8.1 Configuration

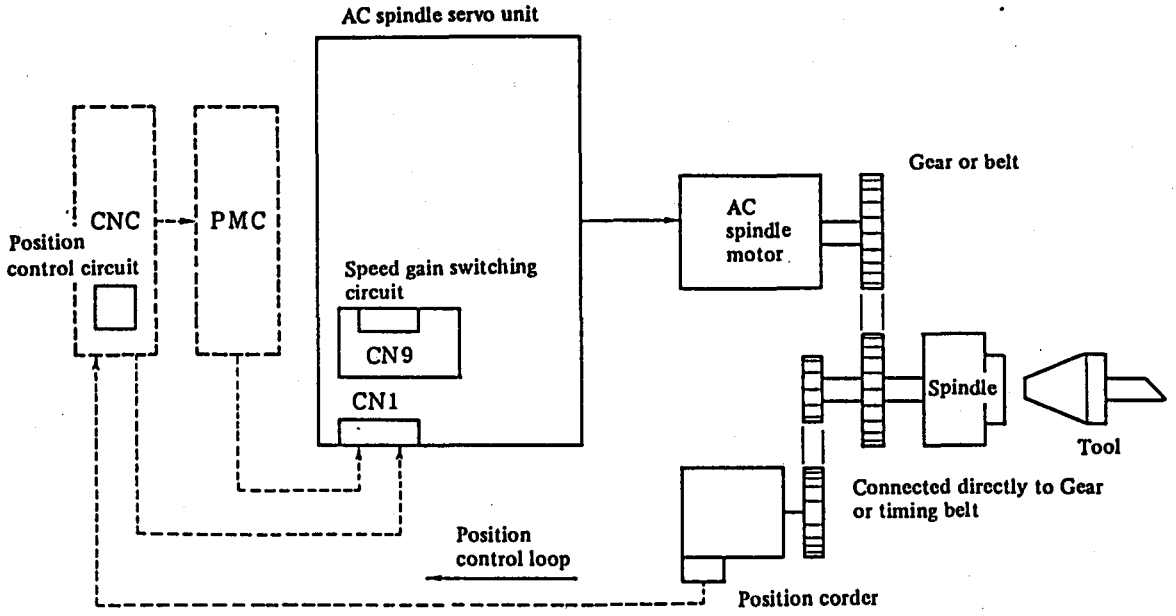


Table 8.1 Configuration elements

Applied unit	Name	Specification No.	PCB drawing No.
Models 8P, 15P, 22P, 40P	Velocity gain selector circuit	A06B-6044-J701	A20B-1700-0020

8.2 Adjusting velocity gain selector control circuit

Application PCB drawing number A20B-1700-0020 (A06B-6044-J701)

1) Display contents
Refer to Fig. 8.2 for the installation position of the light-emitting diode.

Name	Lighting color	Description
LED1 (ORIENTATION)	Green	The orientation command (ORCM) is used as the speed loop gain switching signal, and it lights if this signal is inputted. (Note)

Note) Differs from the contents of spindle orientation (refer to chapter 7).

2) Adjustment
Refer to Fig. 8.2 for the installation position of the variable resistor RV1.

No.	Item	Adjustment location	Standard adjustment	Measurement location	Contents
1	Speed loop gain	RV1	7th division	TSA1	Check that it does not oscillate. If turned to the right, the rigidity increases.

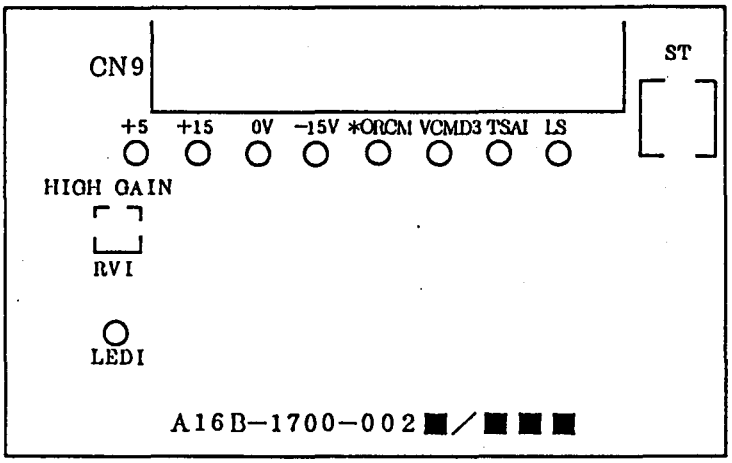


Fig. 8.2 Installation position of LEDs, setting jumpers, variable resistor, and check terminals PCB diagram number A16B-1700-0020

APPENDIX

APPENDIX 1 CONNECTION DIAGRAMS

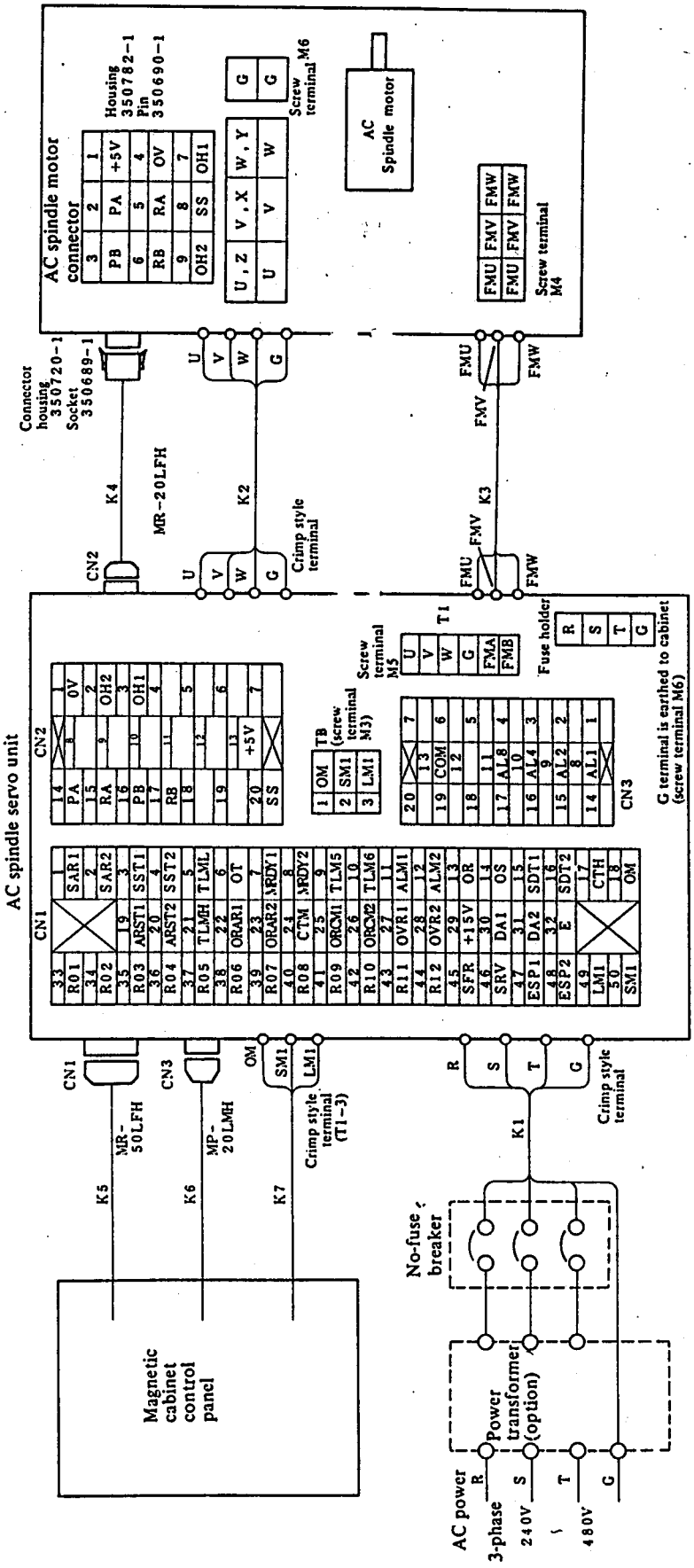
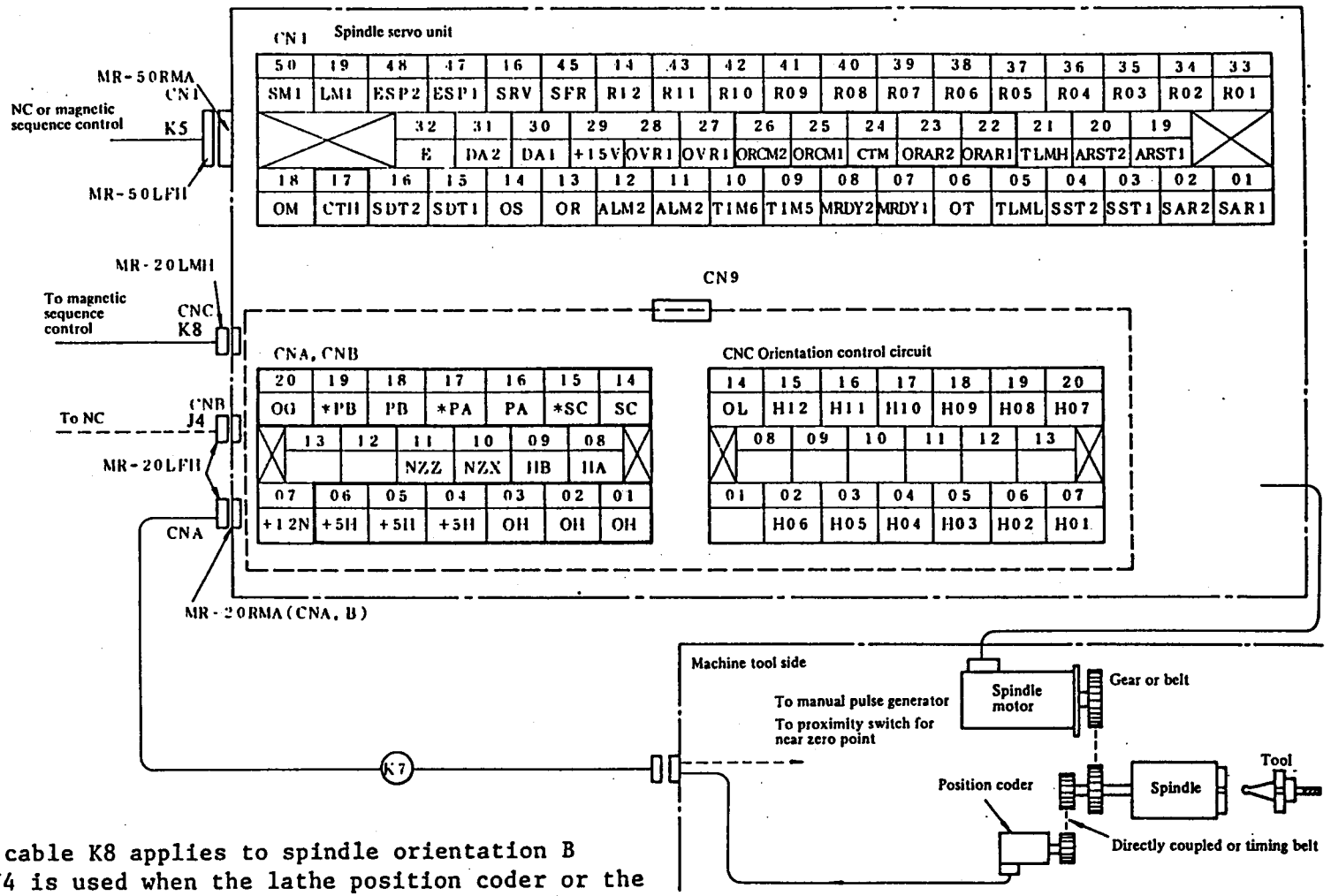


Fig. 1 (a) Connection diagram



Note 1) Signal cable K8 applies to spindle orientation B
Note 2) Cable J4 is used when the lathe position coder or the synchronous feed position coder for machining center is used concurrently.

Fig. 1 (b) Connection diagram of spindle orientation (with position coder employed)

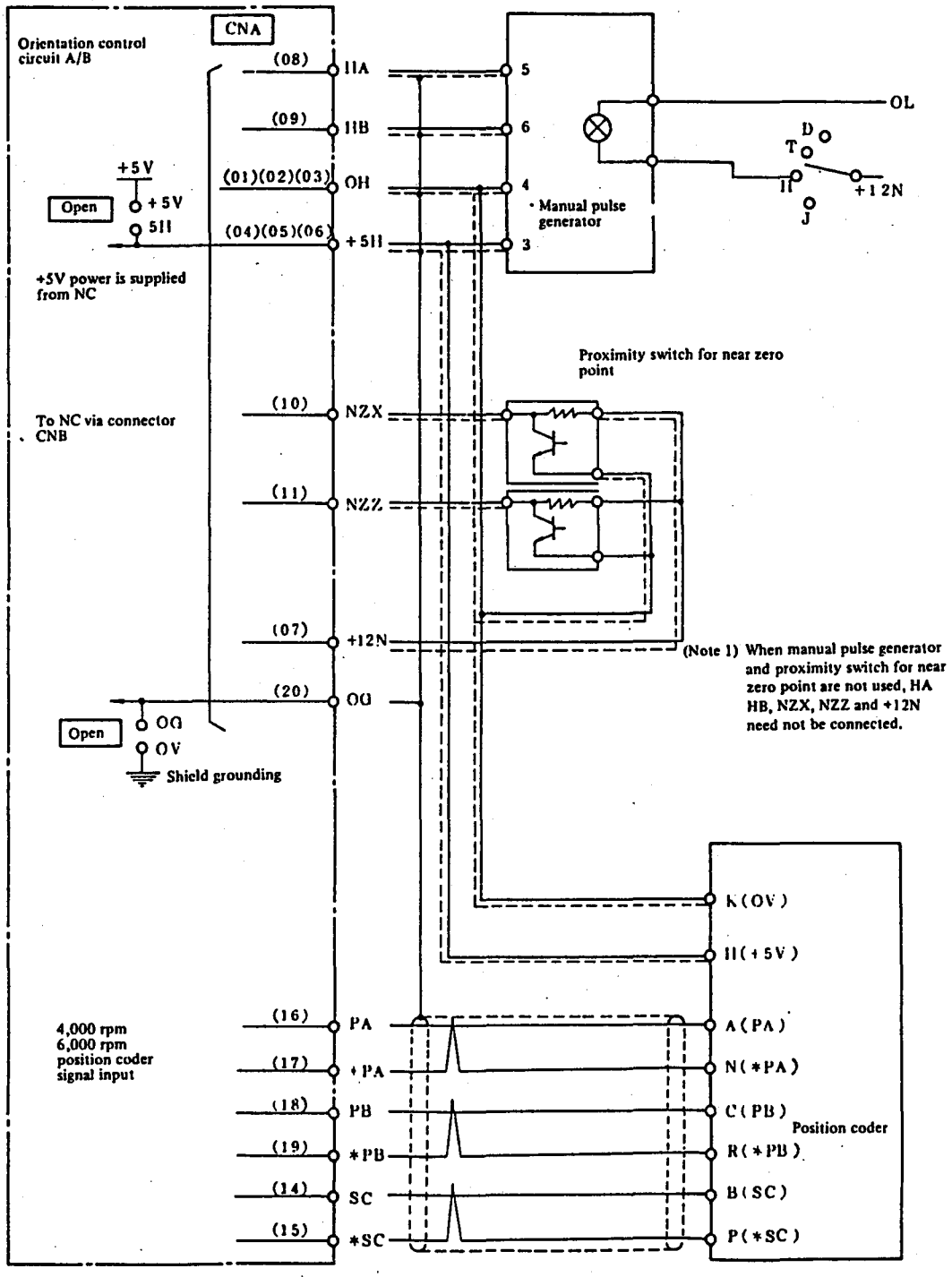
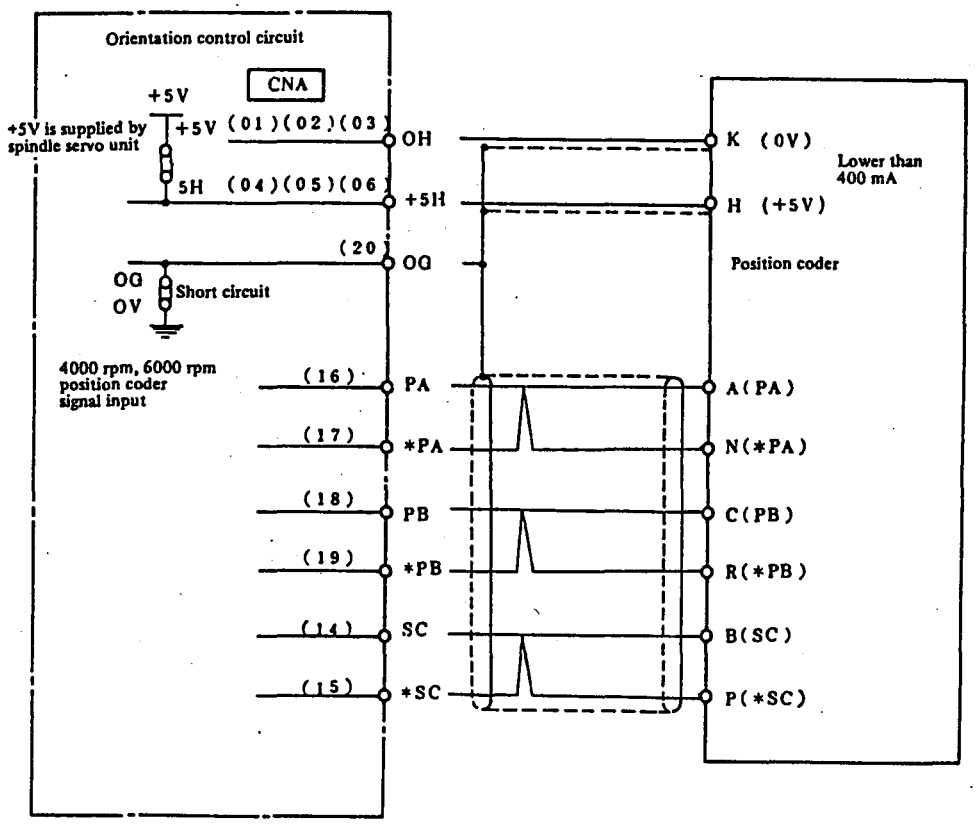


Fig. 1 (c) Detailed connection diagram of spindle orientation with position coder employed (when synchronous feed is combined with turning machine and machining centers etc)



Note) The cable length should be shorter than 20 m between the servo unit and the position coder.

Fig. 1 (d) Detailed connection diagram of spindle orientation using position coder (when spindle orientation only is used for machining centers)

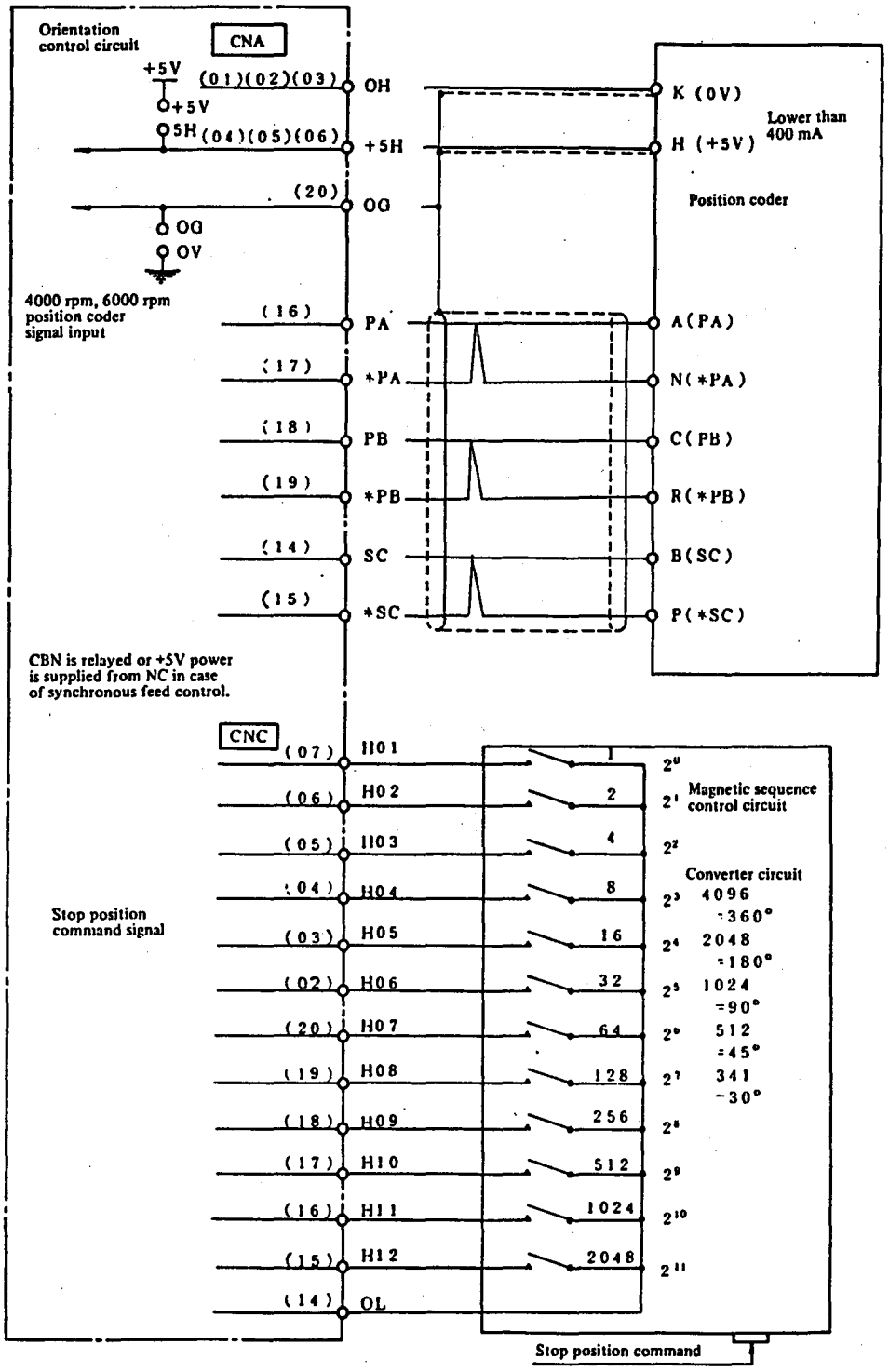


Fig. 1 (e) Detailed connection diagram of spindle orientation using position coder (when the stop position is externally set)

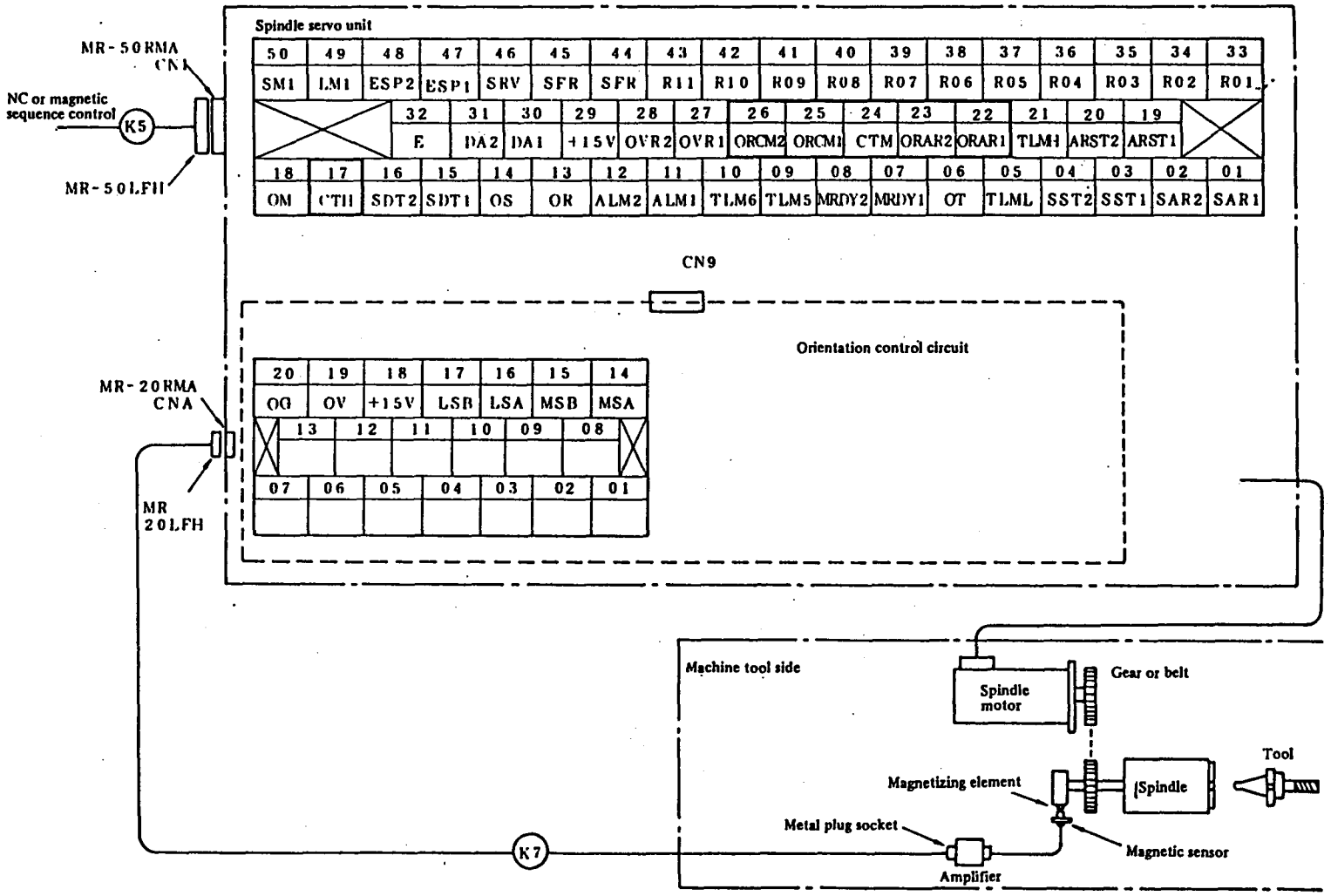
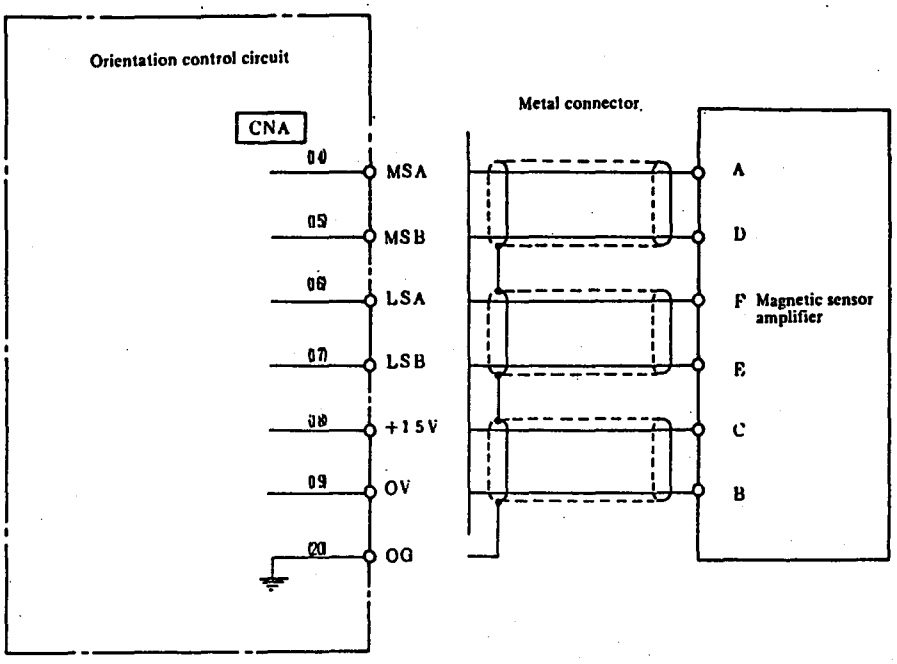


Fig. 1 (f) Connection diagram of spindle orientation (when magnetic sensor is used)

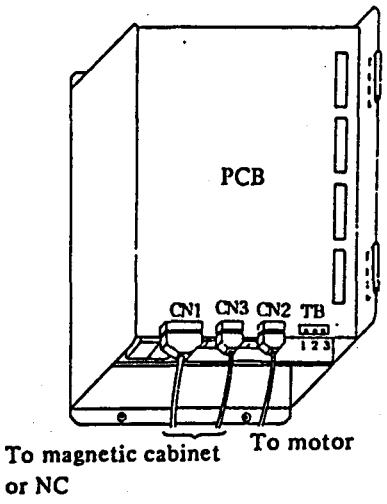


(Note) The cable length should be shorter than 20m between the servo unit and the magnetic sensor amplifier.

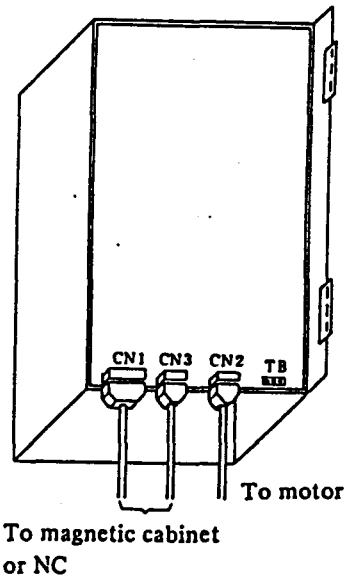
Fig. 1 (9) Detailed connection diagram of spindle orientation (when magnetic sensor is used)

APPENDIX 2 CABLE ROUTING

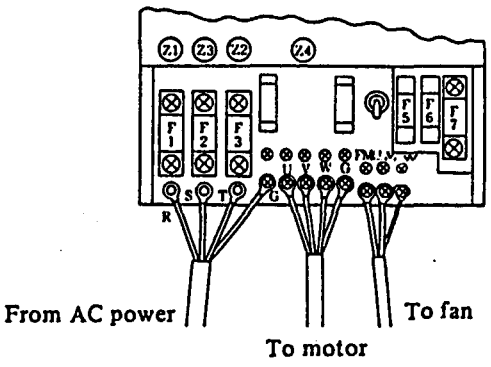
(1-1) Model 8P (A06B-6055-H306)



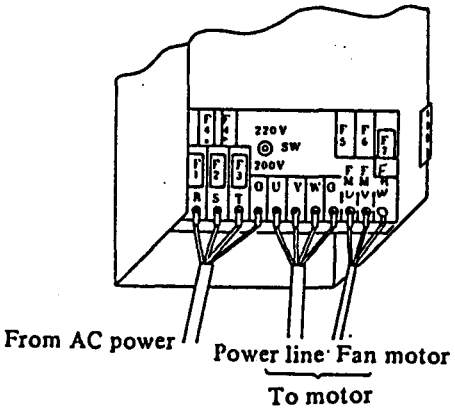
(2-1) Model 15P (A06B-6055-H308)



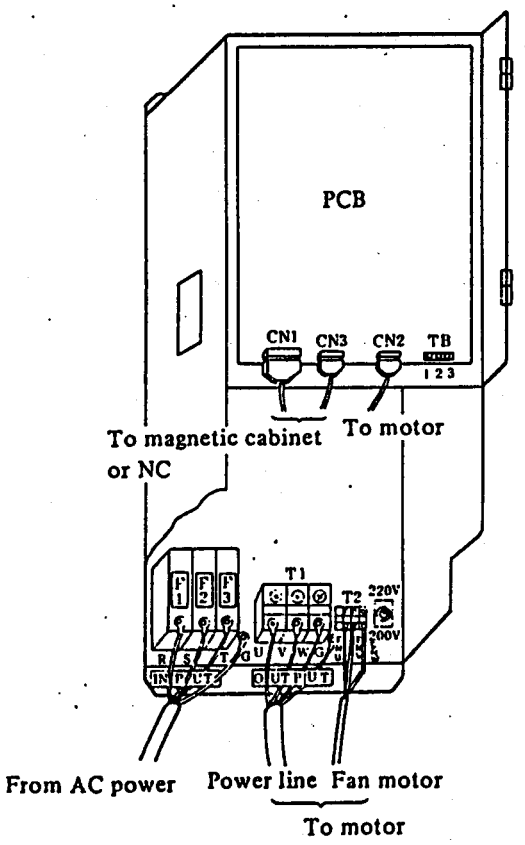
(1-2) PCB mount plate is open.



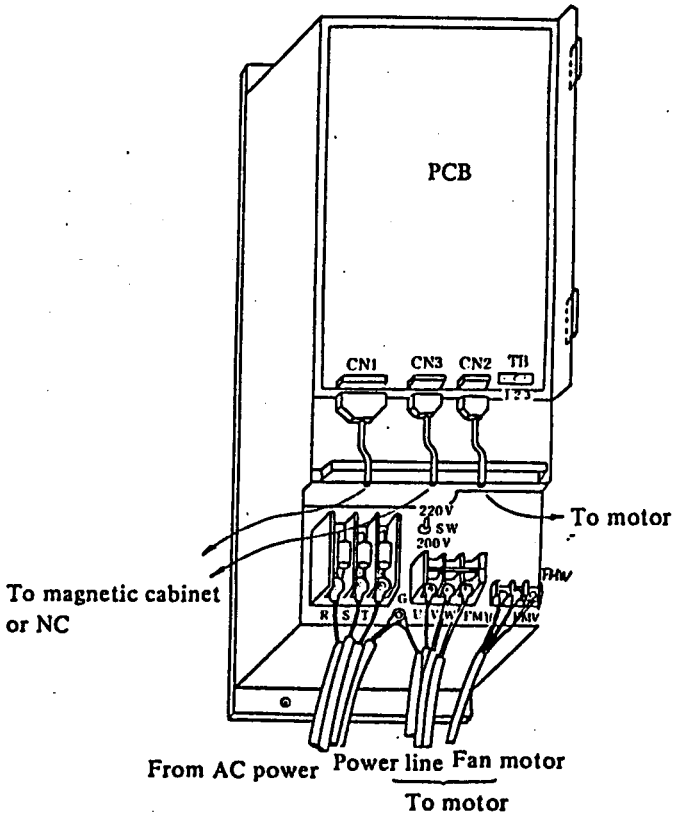
(2-2) PCB mount plate is open.



(3-1) Model 22P (A06B-6055-H315)

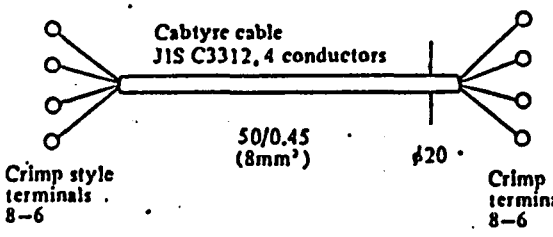
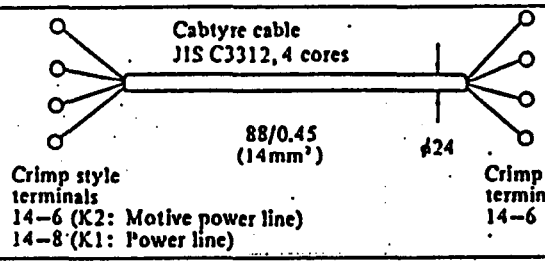
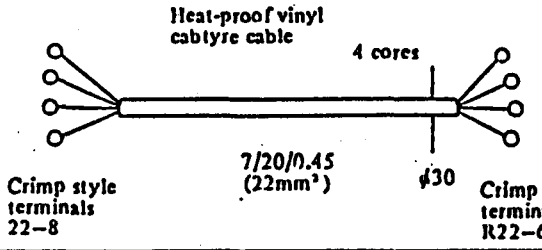
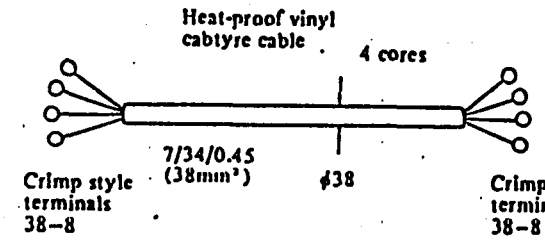


(4-1) Model 40P (A06B-6055-H322)



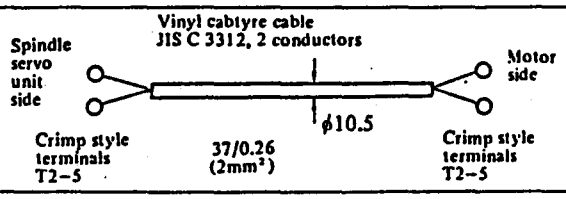
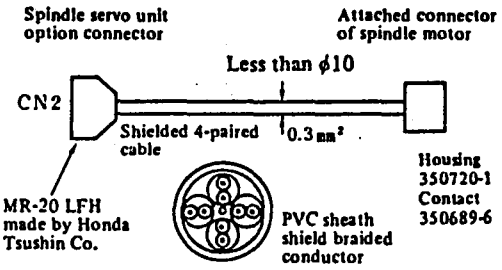
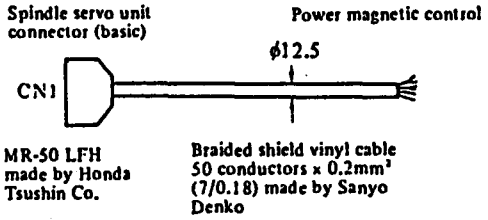
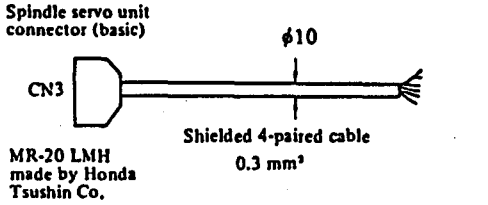
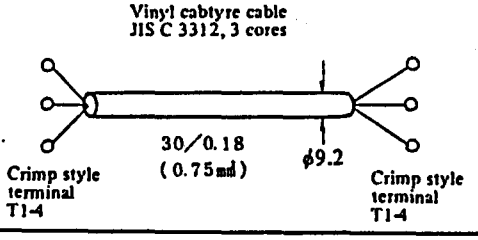
The cable specifications are as shown below.
Prepare cables by users.

1) Power line and motive power line for respective motor models

Use	Symbol	Specifications	FANUC specification No.
For MODEL 8P (Lower than 16kVA)	K1 K2		A02B-0008-K854 7m long
For MODEL 15P (Lower than 25kVA)	K1 K2		A06B-6044-K017 7m long A06B-6044-K018 7m long
For MODEL 22P (Lower than 30kVA)	K1 K2		A06B-6044-K019 7m long
For MODEL 40P (Lower than 45kVA)	K1 K2		A06B-6044-K021 7m long

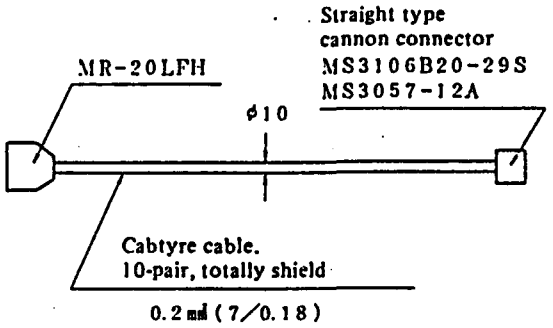
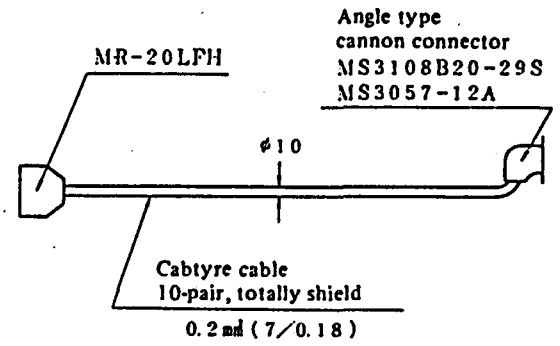
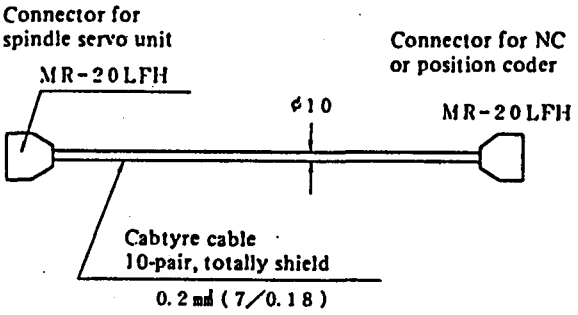
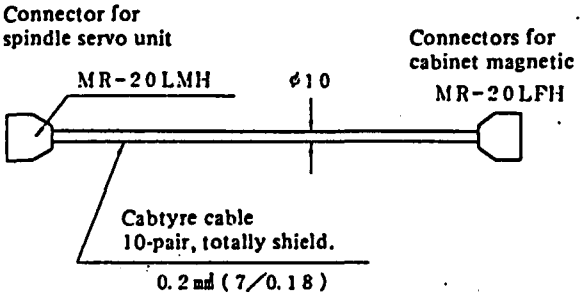
2) Common line

The following cables are common to each model.

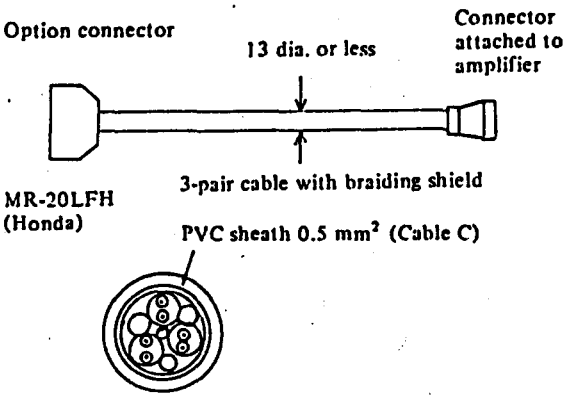
Use	Symbol	Specifications	FANUC specification No.
Spindle servo unit ↕ AC spindle motor (Cooling fan)	K3		A06B-6044-K022 7m long
Spindle servo unit ↕ AC spindle motor (for signal)	K4		A06B-6044-K200 7m long
Spindle servo unit ↕ Power magnetic control (for signal)	K5		A06B-6044-K023 7m long
Spindle servo unit ↕ Power magnetic control (for signal)	K6		A06B-6044-K024 7m long
Speedometer load meter ↕ AC spindle servo unit (for meter)	K7		A06B-6044-K201 7m long

3) For spindle orientation

a) For position coder

Use	Name	Specification	FANUC specification No.
Spindle servo unit ↕ Position coder	K10		A06B-6041-K201 7m long
Spindle servo unit ↕ Position coder	K10		A06B-6041-K204 7m long
Spindle servo unit ↕ NC or position coder	K11		A06B-6041-K202 7m long
Spindle servo unit ↕ Magnetic cabinet	K12		A06B-6041-K205 Shield line is connected to 14 pin of magnetic cabinet connector.

b) For magnetic sensor

Use	Name	Specification	FANUC Specification No.
Spindle servo unit ↕ Magnetic sensor	K13		A06B-6041-K203 7m long

< Reference >

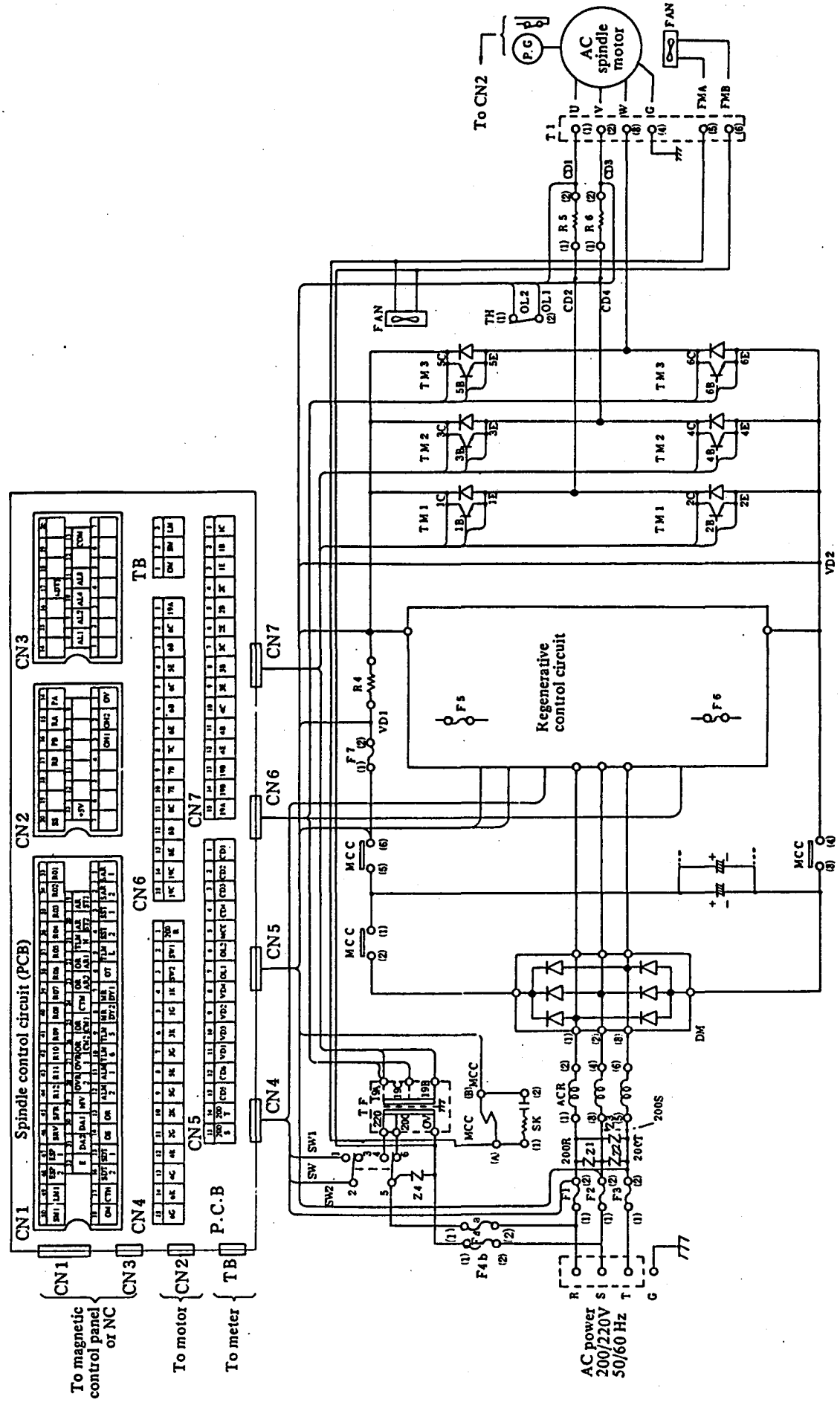
Detail of Cable specification

Name	Conductor		Sheath thickness	Finished outer diameter	Electrical characteristics		Specification (Note)
	Diameter	Configu-ration			Conductor resistance	Current tolerance	
Cable A (10-pair)	1.05 mm	7/0.18	1.4 mm	10.0 mm	110 Ω/km	1.6A	A66L-0001-0041
Cable B (50-core)	1.05 mm	7/0.18	1.5 mm	12.5 mm	106 Ω/km	1.6A	A66L-0001-0042
Cable C (3-pair)	0.93 mm	45/0.12	1.0 mm	10.8 mm	38.7Ω/km	1.6A	A66L-0001-0108

(Note) Cable length should be specified separately.

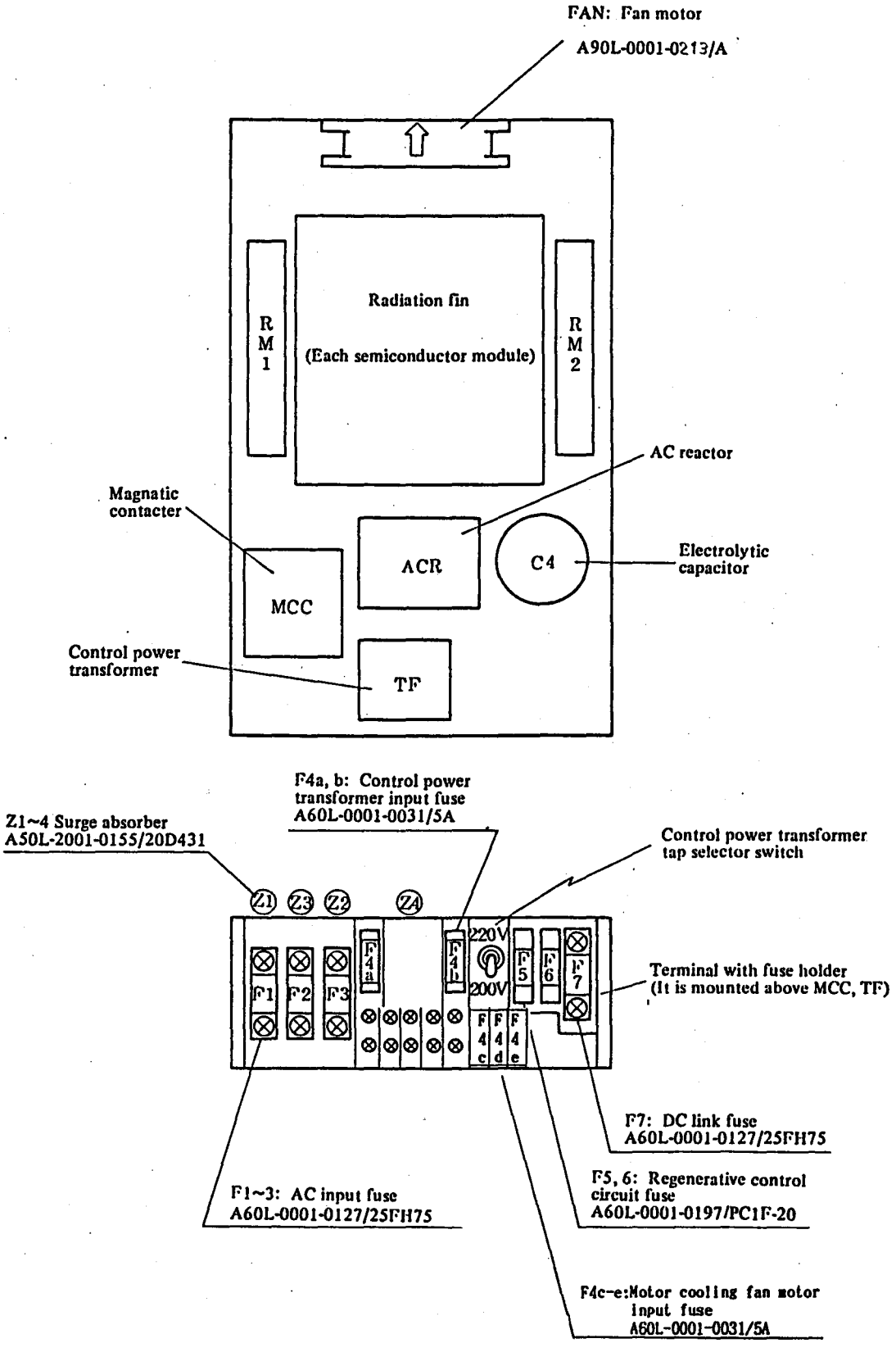
APPENDIX 4 MAIN CIRCUIT DIAGRAM

4.1 Main Circuit

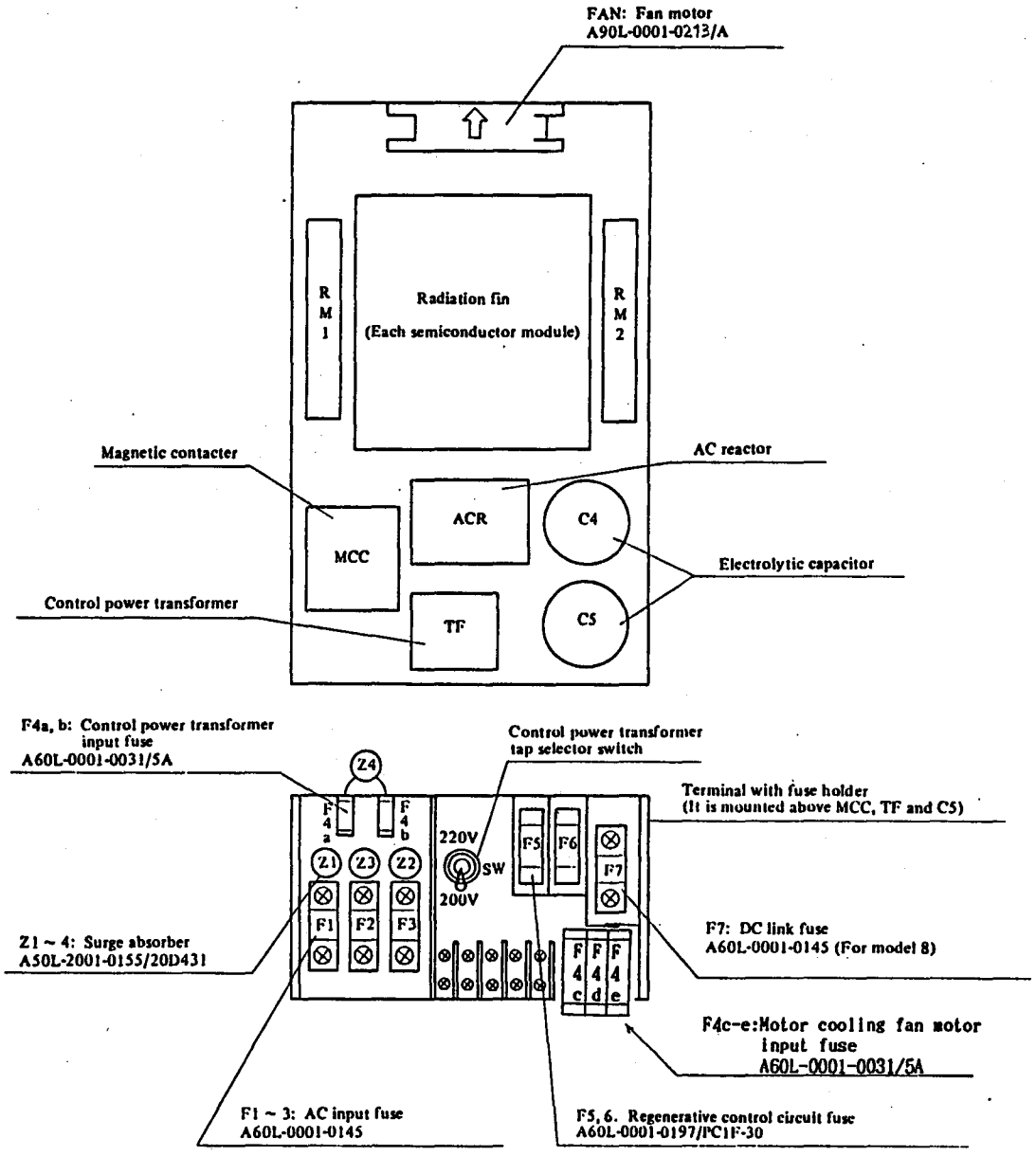


APPENDIX 5 MOUNTING LAYOUT OF SPINDLE SERVO UNIT PARTS (OTHER THAN PCB)

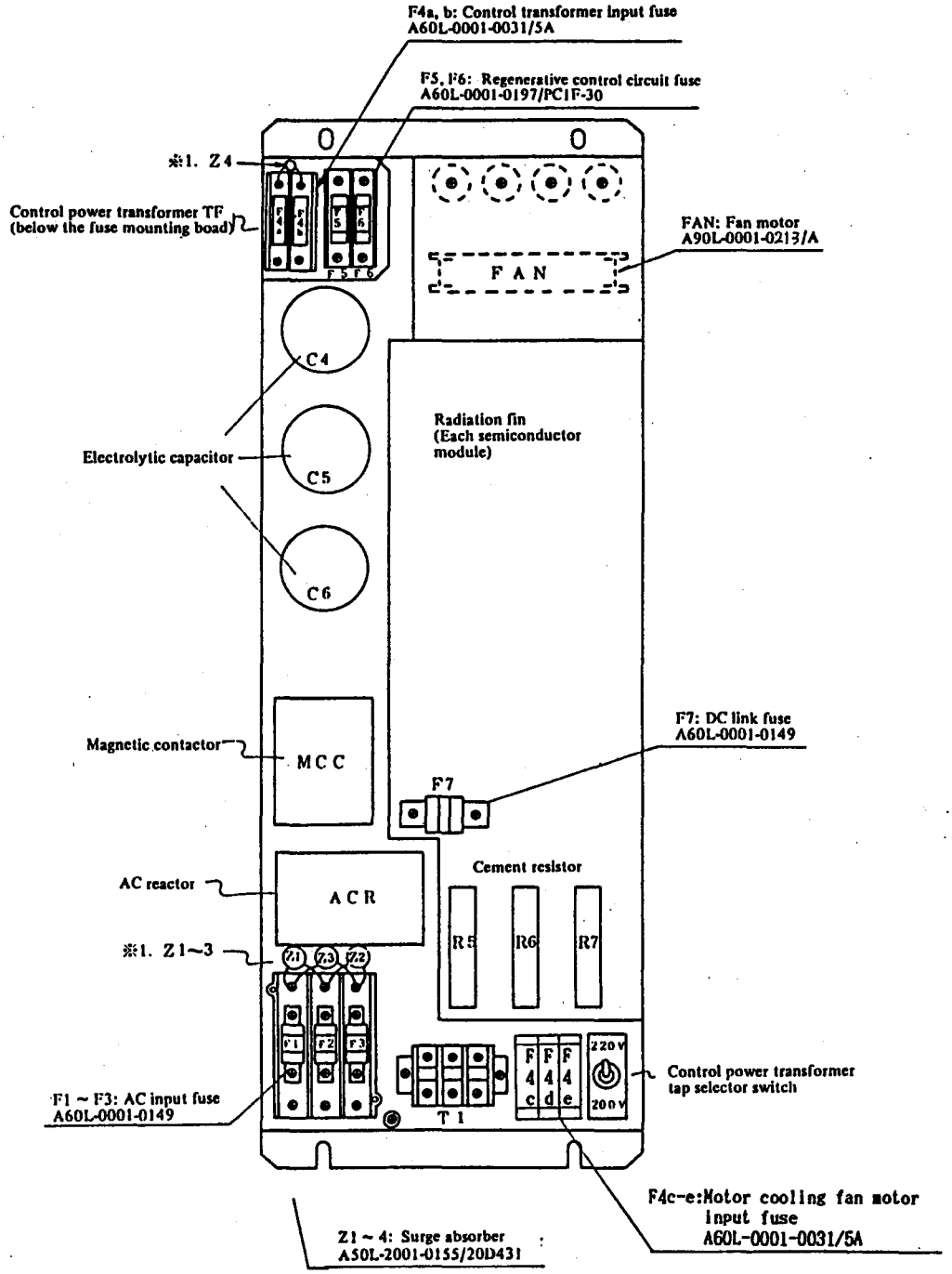
(1) MODEL 8P(A06B-6055-H306#H536)



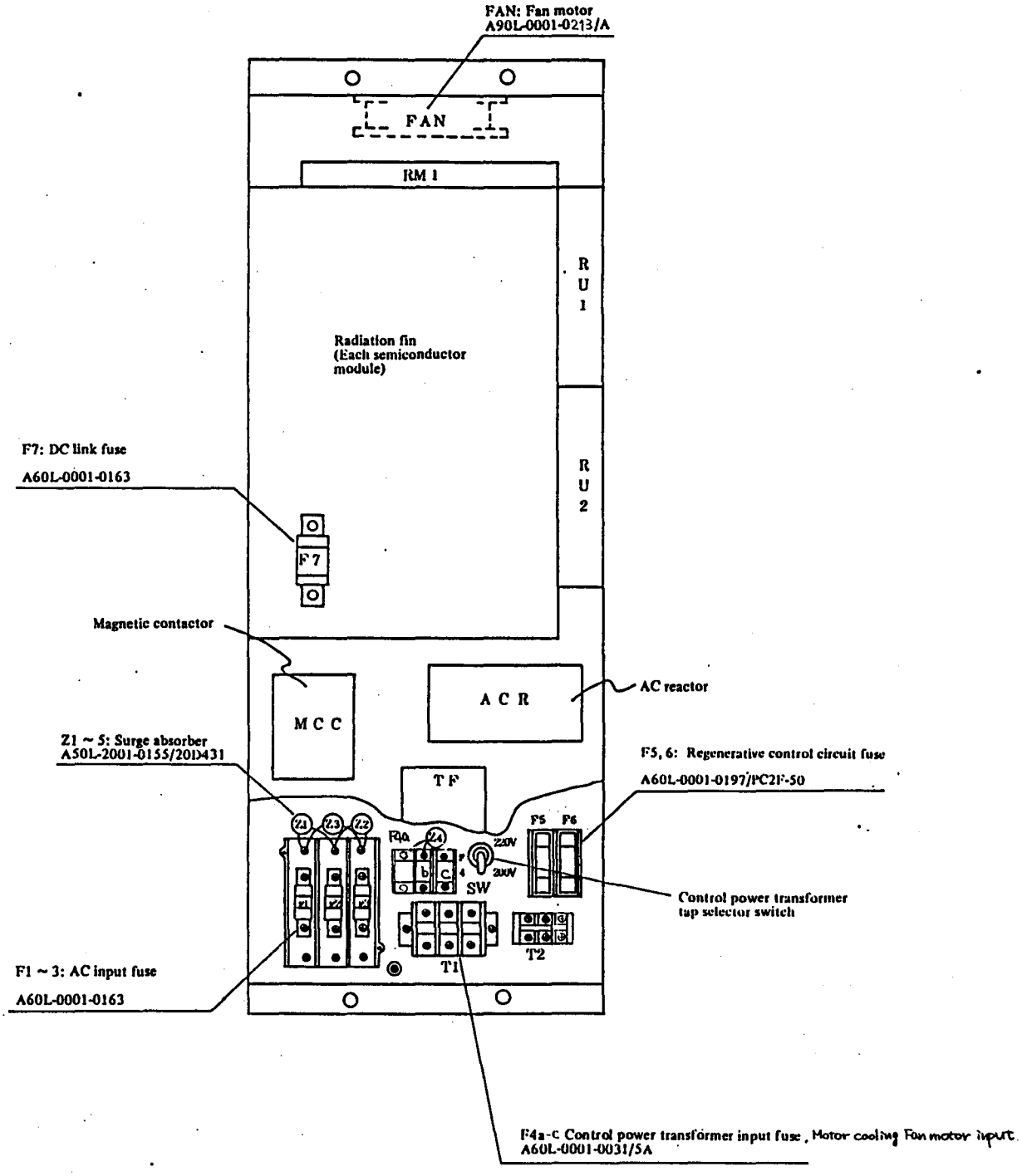
(2) MODEL 15P(A06B-6055-H308#H531)



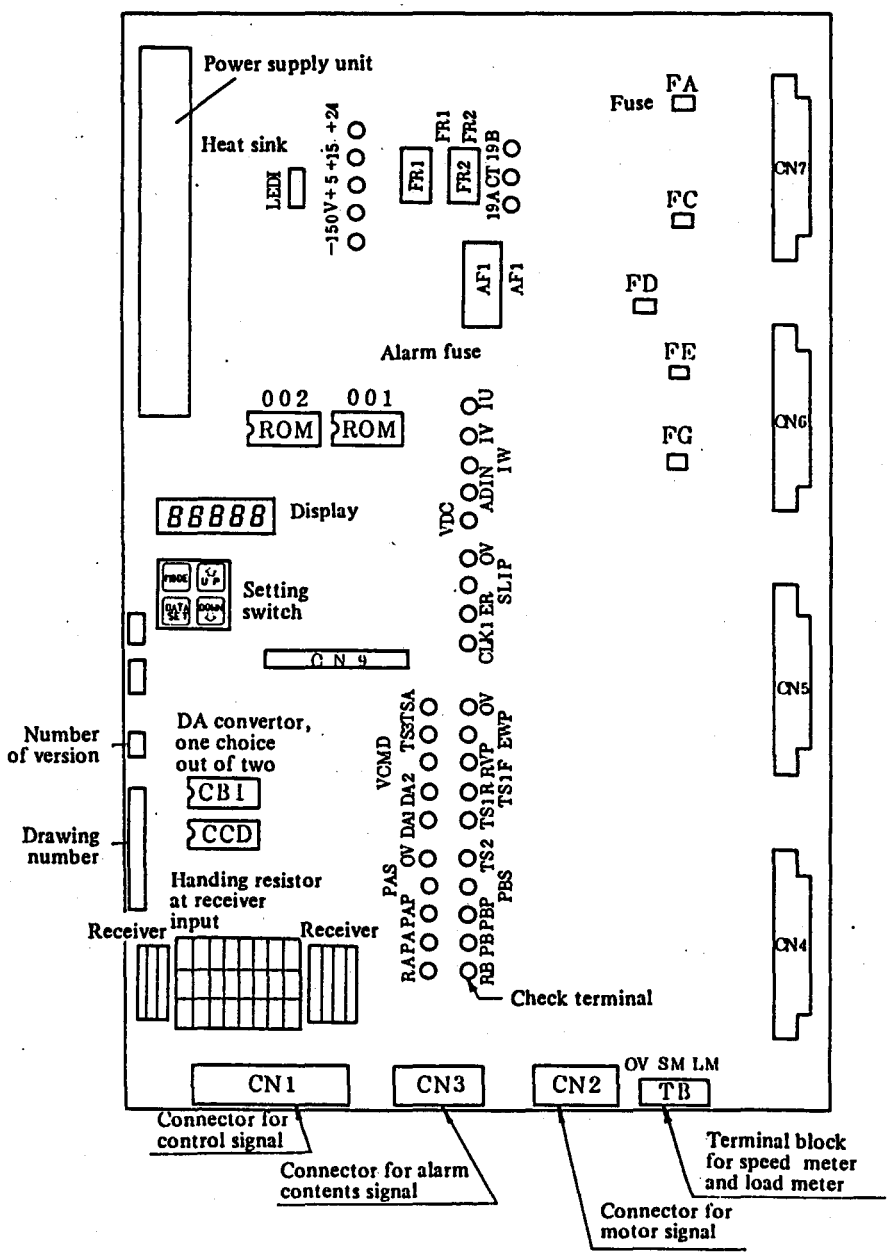
(3) MODEL 22P(A06B-6055-H315#H530)



(4) MODEL 40P(A06B-6055-H322#H540)



APPENDIX 6 MOUNTING LAYOUT OF SPINDLE CONTROL CIRCUIT PCB



APPENDIX 7 CHECKING METHOD FOR PCB

7.1 Check Terminal

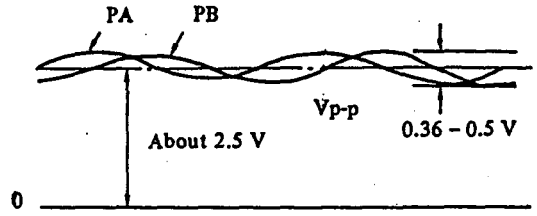
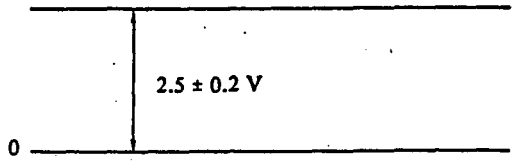
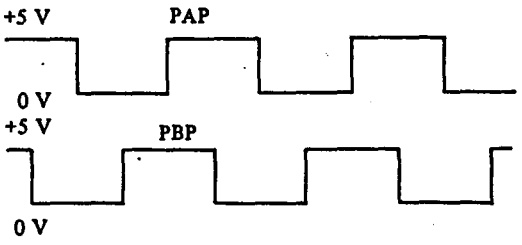
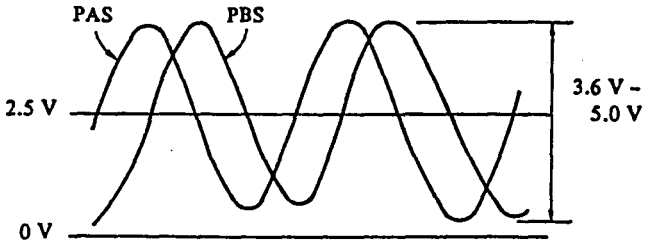
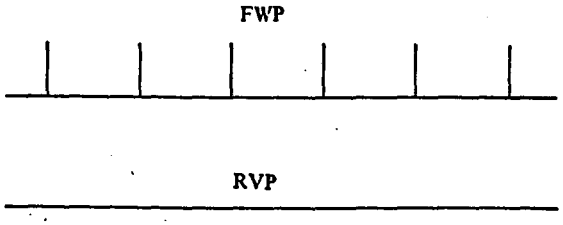
Table 7.1 Check terminal

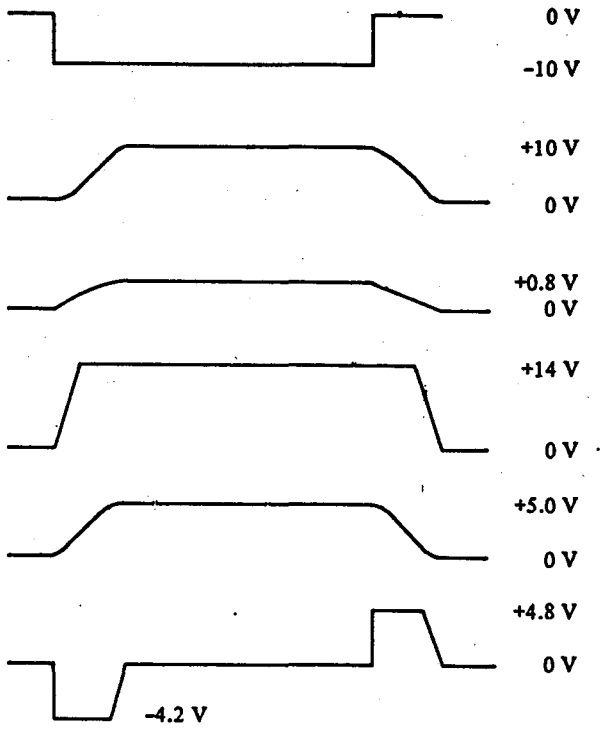
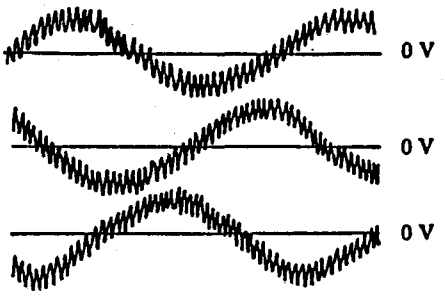
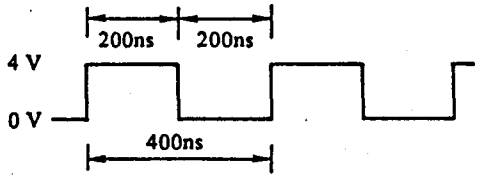
Name of terminal	Signal data	Remarks
DA1	D/A converter output voltage	0 - +10 V
DA2	Analog command voltage	0 - +10 V
PA	Pulse generator output A-phase	PA leads PB by 90° in CW rotation
PB	Pulse generator output B-phase	PB leads PA by 90° in CW rotation
RA	A-phase reference voltage	+2.5 V
RB	B-phase reference voltage	+2.5 V
PAP	A-phase square wave	Duty = 50%
PBP	B-phase square wave	Duty = 50%
PAS	A-phase signal	Waveform of the signal PA 10 times amplified when based on RA
PBS	B-phase signal	Waveform of the signal PB 10 times amplified when based on PR
TS1F	Forward rotation speed detection signal	+0.82 V at 6000 rpm in CCW (forward) rotation
TS1R	Reverse rotation speed detection signal	+0.82 V at 6000 rpm in CW (reverse) rotation

Name of terminal	Signal data	Remarks
TS2	Low speed detection signal	+1.4 V at 22.5 rpm in CW (forward) rotation
TS3	Velocity pulse F/V signal	-4.65V - -6.15 V at 6000 rpm in CCW (forward) rotation
VCMD	Velocity command voltage	0 - ±10 V, +: CCW -: CW
FWP	Forward rotation speed pulse	Pulse width 3.2 μs generated during forward rotation only
RVP	Reverse rotation speed pulse	Pulse width 3.2 μs generated during reverse rotation only
ER	Error voltage	-4.2 V - +4.8 V
CLK1	Clock signal	2.5 MHz, Duty = 50%
SLIP	Slip pulse	
VDC	DC link voltage signal	Signal devided by 100 of DC link voltage
ADIN	AC converter input signal	
IU	U phase current signal	<table><tr><td>Model</td><td>8P</td><td>15P</td><td>22P</td><td>40P</td></tr><tr><td>Value of current</td><td>22</td><td>33</td><td>67</td><td>83</td></tr></table> Unit:A/V
IV	V phase current signal	
IW	W phase current signal	
+24	+24 V	
+15	+15 V	+15 V
+5	+5 V	+5 V
-15	-15 V	-15 V
0 V	0 V	0 V

7.2 Waveform at Check Terminal

Table 7.2 Waveform at Check Terminal

Check terminal	Waveform	Remarks
PA PB		
RA RB		
PAP PBP		
PAS PBS		
FWP RVP		When spindle rotation direction is forward. The waveform appears at RVP and not appears at FWP in reverse rotation.

Check terminal	Waveform	Remarks
VCMD TSA TS1R TS2 TS3 ER		
IU IV IW		
CLK1		2.5 MHz

APPENDIX 8 MAGNETIC SENSOR SIGNALS CHECKING METHOD

8.1 Application

This document applies to following check procedure by observing output signals of the magnetic sensor (specification : A57L-0001-0037) employed for magnetic sensor system spindle orientation.

Item	Check item
1	Whether magnetizer, magnetic sensor head, and magnetic sensor amplifier are defective or not.
2	Whether magnetizer and magnetic sensor head are properly mounted or not.
3	Whether magnetic sensor signal cables are properly connected withour any connection failure and short-circuit.

8.2 Check procedure

(1) Preparetion

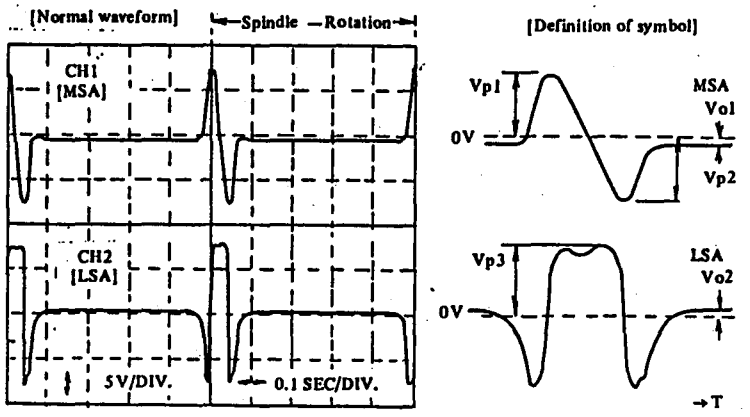
① Rotate the spindle at about 120rpm.
Select the counterclockwise(CCW) rotating direction as viewed from the AC spindle motor shaft (in such a direction as the voltage at check terminal VCMD of AC Spindle control circuit becomes positive (+) to 0V.
PCB : A20B-1001-0120

② Check the peak voltage and offset voltage levels of the following signal waveforms at the check terminal of the orientation circuit(Drawing No.: A20B-0008-0030,-0031 or A20B-0009-0520) using an oscilloscope. The names of check terminals and signal contents are common, irrespective of the kinds of orientation circuit.

Check terminal No.	Signal name	Symbol	Prove common terminal
CH1	Magnetic sensor output signal A	MSA	0V
CH2	Magnetic sensor output signal B	LSA	

2) Decision method

1 Examples of normal waveforms and their criteria are as shown below. If a trouble occurred, refer to the causes and remedy shown in the following table.

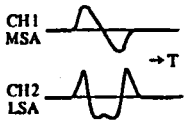
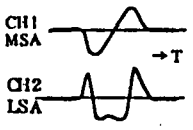
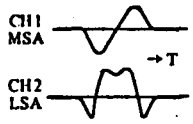


(Criteria table)

Item	Criteria (normal, if these conditions are satisfied.)
Offset voltage	$V_{o1\sim2} < 0.5V$
Peak voltage	$3V < V_{p1\sim2}$ 10V

2 Remedy to be observed when the above criteria are not satisfied.

Item	Symptoms	Causes	Remedy
1	Offset voltage of either or both signals is high. Offset voltage is normal. Peak voltage of either signal only is low.	a. Magnetic sensor head or magnetic sensor amplifier is defective.	Replace defective parts.
2	Waveform of either signal does not appear, or waveform of both signals don't appear.	a. Magnetic sensor head, amplifier, or magnetic sensor amplifier is defective. b. Poor connection or short-circuit of cables or connectors.	a. Replace defective parts. b. Repair defective parts.
3	Offset voltage is normal, but the entire peak voltage is low.	a. Mounting gap of the magnetic sensor head and the magnetizer is wider than specified.	Readjust the gap.

Item	Symptoms		Causes	Remedy
4	Offset voltage and peak voltage levels are normal, but waveforms are different from specified ones.		Observe the following procedure according to waveforms.	
	Observation waveform		a. Magnetic sensor head is not mounted properly. b. Wrong cable connection.	a. Reverse the pin groove direction of the magnetic sensor head. b. Replace LSA and LSB with each other.
			a. Magnetizer is not properly mounted. b. Wrong cable connection.	a. Reverse the direction of the reference hole of magnetizer. b. Replace MSA and MSB with each other. Replace LSA and LSB with each other.
			a. Magnetizer and magnetic sensor head are not properly mounted. b. Wrong cable connection.	a. Reverse the mounting directions of both magnetizer and magnetic sensor head. b. Replace MSA and MSB with each other.

Reference) For normal mounting methods and connection methods of signal cables of the magnetizer and magnetic sensor head, refer to 7.3.1 in text and appendix 1 "Connections".

APPENDIX 9 PARAMETER LIST

<table>
<tr><th>Mode</th><th>Contents</th><th>Standard setting</th><th>Data</th></tr>
<tr><td>F-00</td><td>Motor speed indication</td><td></td><td></td></tr>
<tr><td>F-01</td><td>Use/Non-use of machine ready signal (MRDY)
Use : 1
Non-use : 0</td><td>1</td><td></td></tr>
<tr><td>F-02</td><td>Use/Non-use of override function
Use : 1
Non-use : 0</td><td>1</td><td></td></tr>
<tr><td>F-03</td><td>Override range setting
~ 120% : 1
~ 100% : 0</td><td>1</td><td></td></tr>
<tr><td>F-04</td><td>Setting of kind of velocity command
Use of external analog voltage : 0
Use of D/A converter : 1</td><td>0</td><td></td></tr>
<tr><td>F-05</td><td>Setting of maximum rotation speed
<table>
<tr><th>Standard specification</th><th>High speed specification</th><th>Setting</th></tr>
<tr><td>3900~ 5000rpm</td><td>7800~10000rpm</td><td>0</td></tr>
<tr><td>4900~ 6300rpm</td><td>9800~12600rpm</td><td>1</td></tr>
<tr><td></td><td>12400~16400rpm</td><td>2</td></tr>
<tr><td></td><td>16000~20000rpm</td><td>3</td></tr>
</table></td><td>Based on the motor specifi-cation</td><td></td></tr>
<tr><td>F-06</td><td>Setting of output limit pattern
<table>
<tr><th>Contents</th><th>Setting</th></tr>
<tr><td>No output limiting</td><td>0</td></tr>
<tr><td>Output limit is made only at acceleration/deceleration</td><td>1</td></tr>
<tr><td>Output limit is made only at normal operation, not at acceleration/deceleration</td><td>2</td></tr>
<tr><td>Output limit is made for all operations</td><td>3</td></tr>
</table></td><td>0</td><td></td></tr>
<tr><td>F-07</td><td>Setting of limit value at output limit
Rated maximum output is 100</td><td>100</td><td></td></tr>
<tr><td>F-08</td><td>Setting of delay time before shut-off of motor power
Delay time = (Set value) x 40 msec.</td><td>5</td><td></td></tr>
</table>

Mode	Contents		Standard setting	Data
F-09	Use/Non-use of motor power shutting-off by machine ready signal(MRDY)	Use : 1 Non-use : 0	0	
F-10	Adjustment of speed error offset at the time of the forward rotation command(SFR)		128	
F-11	Adjustment of speed error offset at the time of the reverse rotation command(SRV)		128	
F-12	Adjustment of speed error offset at the time of the orientation command(ORCM)		128	
F-13	Adjustment of speed at forward rotation command(SFR)		Based on the motor specification	
F-14	Adjustment of speed at reverse rotation command(SRV)			
F-15	Setting of rotation speed at velocity command voltage is 10V Setting data = (Set value) x 100 rpm			
F-16	Setting of detection range of velocity arrival signal(SAR) Detection range = (Command speed) x within (Set value) %		15	
F-17	Setting of detaction range of velocity detection signal(SDT) Detection range = (Maximum speed) x (Set value) % or less		3	
F-18	Setting of torque limit value Torque limit value = (Maximum reted torque) x (Set value) %		50	
F-19	Setting of acceleration/deceleration time Setting data = (Acceleration time) x 2 sec		10	
F-20	Limiting of regenerating power (Adjustment of deceleration time) Setting range = 0 to 100		40	
F-21	Setting of velocity loop gain proportion gain on normal operation : High gear (CTH=1)		50	
F-22	Setting of velocity loop gain proportion gain on normal operation : Low gear (CTH=0)		50	
F-23	Setting of velocity loop gain proportion gain on orientation : High gear (CTH=1)		100	
F-24	Setting of velocity loop gain proportion gain on orientation : Low gear (CTH=0)		100	
F-25	Setting of velocity loop gain integral gain on normal operation : High gear (CTH=1)		30	
F-26	Setting of velocity loop gain integral gain on normal operation : Low gear (CTH=0)		30	

Mode	Contents	Standard setting	Data
F-27	Setting of velocity loop gain integral gain on orientation : High gear (CTH=1)	30	
F-28	Setting of velocity loop gain integral gain on orientation : Low gear (CTH=0)	30	
F-29	Adjustment of velocity detection offset (Adjusted at shipping)		
F-30	Motor speed indication		
F-31	Setting of rigid tapping mode	0	
F-32	Setting of motor voltage at normal operation	10	
F-33	Setting of motor voltage at orientation	10	
F-34	Setting of motor voltage at rigid tapping mode	100	
F-35	Setting of detection range of zero-speed signal(SST) Detection range = (Maximum speed) x (Set value/100)% or less	75	
F-36	Setting of detection range of load detection signal(LDT) Detection range = (Maximum output torque) x (Set value)% or more	90	
F-37	Time constant of torque deviation at deceleration start	0	
F-38	Setting of cheracteristics of control in deceleration	0	
F-39	Setting of cheracteristics of control in stable rotation with no load	0	
F-40	Setting of characteristics of control in torque limitation	0	

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