BNP-A0801-72*-E

MITSUBISHI

AC SPINDLE DRIVE

FREQROL-SF

TROUBLESHOOTING MANUAL

W659J7001

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Contents

1. Troubleshooting

If any trouble occurs, before checking the cause, make sure to read and follow the contents of Table 1.1, "Precautions" for safety,

Table 1.1 Precautions for safety

◦ After turning off the power, do not immediately touch the controller. After checking that the power indication lamp LED 10 (SF-CA card) puts off, conduct the maintenance and inspection work (waiting for 3 minutes or more).
◦ An electric shock may result in a death accident. Regardless of whether the power supply is grounded or not, since each component of the equipment may be exposed to a high voltage, carefully select and use test apparatus. When installing any test apparatus on a portion to be tested, take care not to touch any portion being grounded. Generally, when conducting a test, do not ground the case of any test apparatus. Thus, because a high voltage may be applied between the test apparatus case and the ground, when operating the equipment while adjusting/repairing it, take care of it.
◦ While the power is supplied to the equipment or when the equipment is operated, do not attach/detach any printed circuit board. Otherwise, the equipment may be damaged.
◦ Do not put on a loose close which may be caught by the rotating portion of the equipment.

Next, thoroughly check the contents of Table 1.2, "Check Items upon Occurrence of Trouble". They will help you contact with Service Department of Mitsubishi Electric.

Table 1.2 Check items upon occurrence of trouble

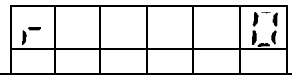
1	Check what alarm the alarm display of theamplifier indicates. In addition, check old alarms in the alarm mode of the indication lamp (see Appendix 8).
2	At which of phase R, S, and T a fuse is blown? (Control circuit input fuse)
3	Does the trouble or fault repeatedly occur?
4	Is the ambient temperature and temperature in the panel normal? (Is that 55°C or less?)
5	During what situation does the trouble or fault occur? During acceleration, deceleration, or constant speed? At what speed it occurs?
6	Does the trouble or fault differ between the forward rotation and reverse rotation?
7	Is there an instantaneous power failure?
8	Does the trouble or fault occur when a special operation or instruction is executed?
9	How often does the trouble or fault occur?
10	At what load situation does the trouble or fault occurs? Whether a load is applied or removed?
11	Is a suspicious part replaced with a new one or a temporary repair conducted against the trouble or fault?
12	How many years has the equipment been operated?
13	Is the power voltage normal? Does it vary remarkably depending on the time zone?

By referencing the trouble classification shown in Table 1.4, check the power voltage listed in Table 1.3 before conducting troubleshooting and countermeasures.

Table 1.3 Checking power voltage

Checking AC power voltage	Amplifier input pins Xl, X2, X3, and E	See Appendix l-l
Checking DC power supply voltage on printed circuit board	Checking DC output voltage at check pins on SF-PW card	See Appendixes 5, 6(4), and 9(4).

Table 1.4 Trouble classification

Classification		Situation	Section to be referenced
A	1	When the amplifier is powered on at the first time, it does not normally work.	1.2.1
	2	The equipment which has normally worked does not abruptly work.	1.2.2
	3	The equipment does not work in occasions. The orientation stop position deviates from the specific position. Although an alarm lights, it is recovered by turning off and then on the equipment or by resetting it.	1.2.3
B	1	When the power is turned on, the display of the operation panel does not appear at all. Alternatevely, the DC voltage of the printed circuit board is not correct.	1.3.1
	2	When the power is turned on, the display on the operation panel does not indicate rotations in the status display mode (as shown in the following figure). 	1.3.2
	3	The display on the amplifier printed circuit board (SF-CA card) indicates an alarm (as shown in the following figure). 	1.3.3

Continued on the next page.

Classification		Situation	Section to be referenced
B	4	The NC CRT (spindle monitor screen) indicates an alarm (as shown in the following figure). Spindle alarm 15 01	1.3.3
	5	The motor does not rotate.	1.3.4
	6	The motor speed do not conform with that being specified.	1.3.5
	7	The motor vibrates with a large noise during rotations.	1.3.6
	8	The motor overshoots at speed or hunts.	1.3.7
	9	The cutting force degrades.	1.3.8
	10	The orientation of the spindle is not correctly performed.	1.3.9
	11	The acceleration/deceleration time becomes long.	1.3.10
	12	The speed detection signal, up to speed signal, or zero speed signal is not issued.	1.3.11
	13	The tapping work is not correctly performed.	1.3.12
	14	The threading work is not correctly performed.	1.3.13

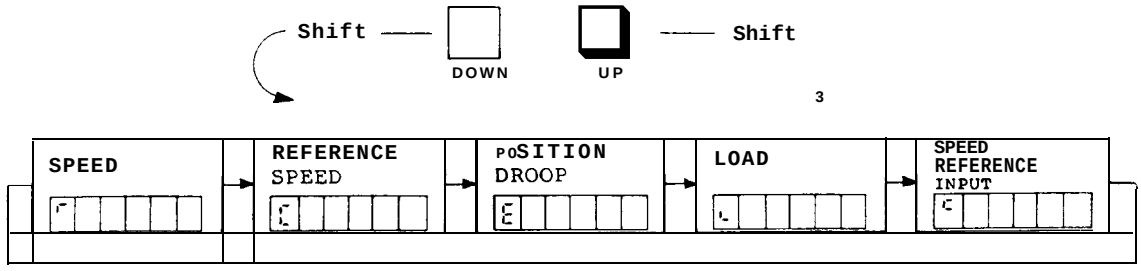
1.1 Status display and diagnosis

The status display and diagnosis are executed with the display and switches on the SF-CA card. When linking an NC and bus line, the status display and diagnosis can be executed on the NC CRT.

1.1.1 Status display and diagnosis from spindle amplifier

For instructions for operating the display and switches, see Reference 1.2.1.

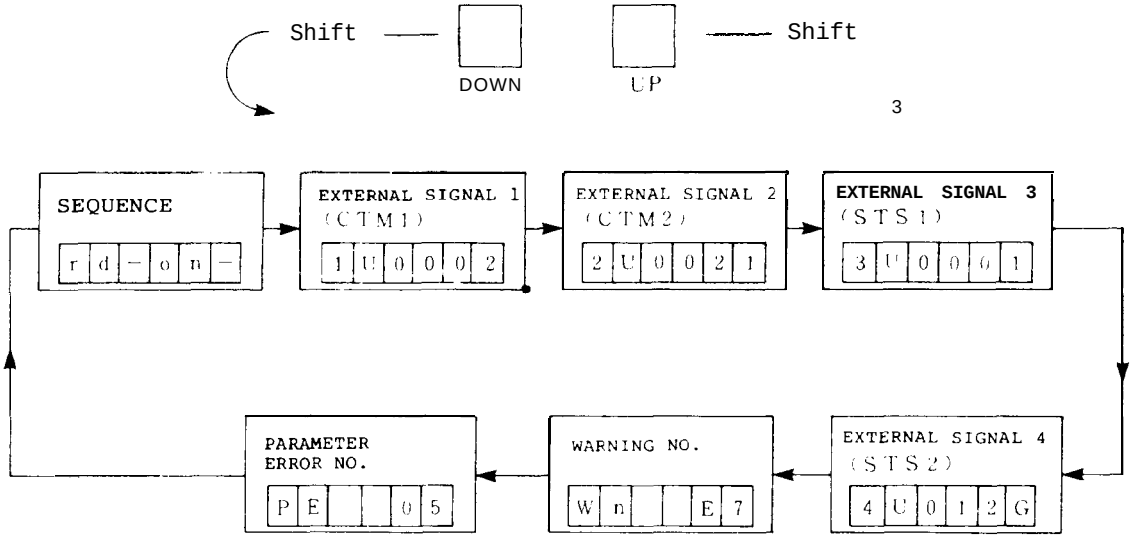
(1) Status display



The following table lists the contents of the four types of status display modes.

Item	Code	Unit	Description
SPEED	r	rpm	Represents the motor speed.
REFERENCE SPEED	C	rpm	Represents the motor reference speed.
POSITION DROOP	E	Pulse	Represents remaining pulses on the deviation counter. In the case of reverse side pulse (negative number), the decimal point indicator lights.
LOAD	L	%	Represents the load status assuming that 30-minute rating output is 100%.
SPEED REFERENCE INPUT	c	rpm	Bus linkage with NC . . . 2-port data of speed reference inputted from NC S analog . . . 12-bit conversion value of A/D converter Digital control . . . 12-bit value

(2) Diagnosis



① The following table lists the contents of the sequence diagnosis.

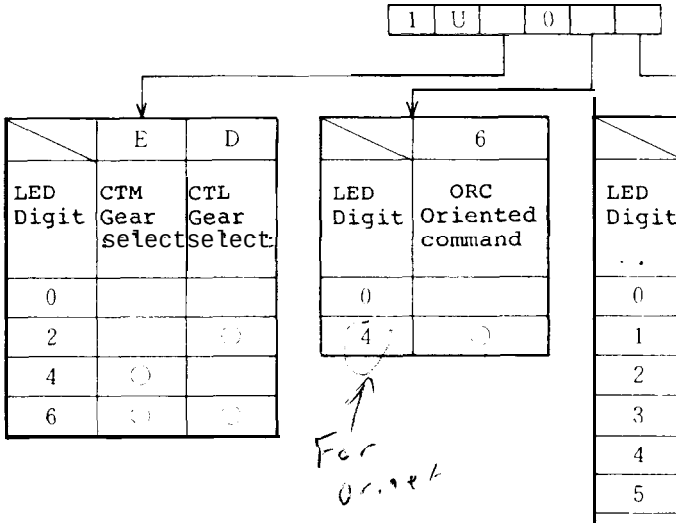
Item	Display	Description
I Sequence	r d - o n -	Represents the ready state.
	r d - o F F	Represents the non-ready state.

② Check the contents of the external signal 1 (CTM1) and external signal 2 (CTM2) of input signals and external signal 3 (STS1) and external signal 4 (STS2) of output signals by comparing them with the following table.

(Note) On the NC spindle monitor display (ALM/DGN3), the external signal 1 and external signal 4 are checked as a control input and control output, respectively.

(a) External signal 1 (CTM1)

Check the contents of signals by each digit of LED using the following table.



LED Digit	E CTM Gear select	D CTL Gear select
0		
2		○
4	○	
6	○	○

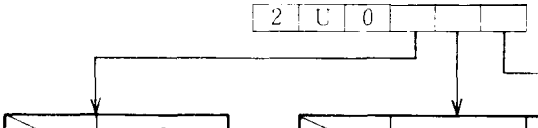
LED Digit	6 ORC Oriented command
0	
4	○

For Orient

LED Digit	3 TL2 Torque control H	2 TL1 Torque control L	1 SRI Reverse run	0 SRN Forward run
0				
1				○
2			○	
3			○	○
4		○		
5		○		○
6		○		
7		○	○	○
8	○			
9	○			○
A	○		○	
B	○		○	○
C	○	○		
D	○	○		○
E	○	○	○	
F	○	○	○	○

(b) External signal 2 (CTM2)

Check the signal contents by each digit of LED using the following table.



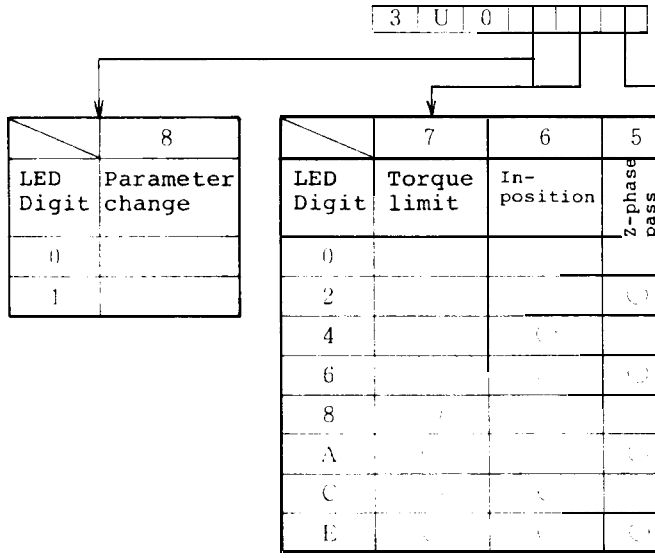
LED Digit	8 PCHG Parameter change
0	
1	○

LED Digit	7 DFIN Data set complete	4 N.RST NC reset
0		
1		○
8	○	
9	○	○

LED Digit	1 SVON Servo ON	0 RDY Ready ON
0		
1		○
2	○	
3	○	○

(c) External signal 3 (STS1)

Check the signal contents by each digit of LED using the following table.



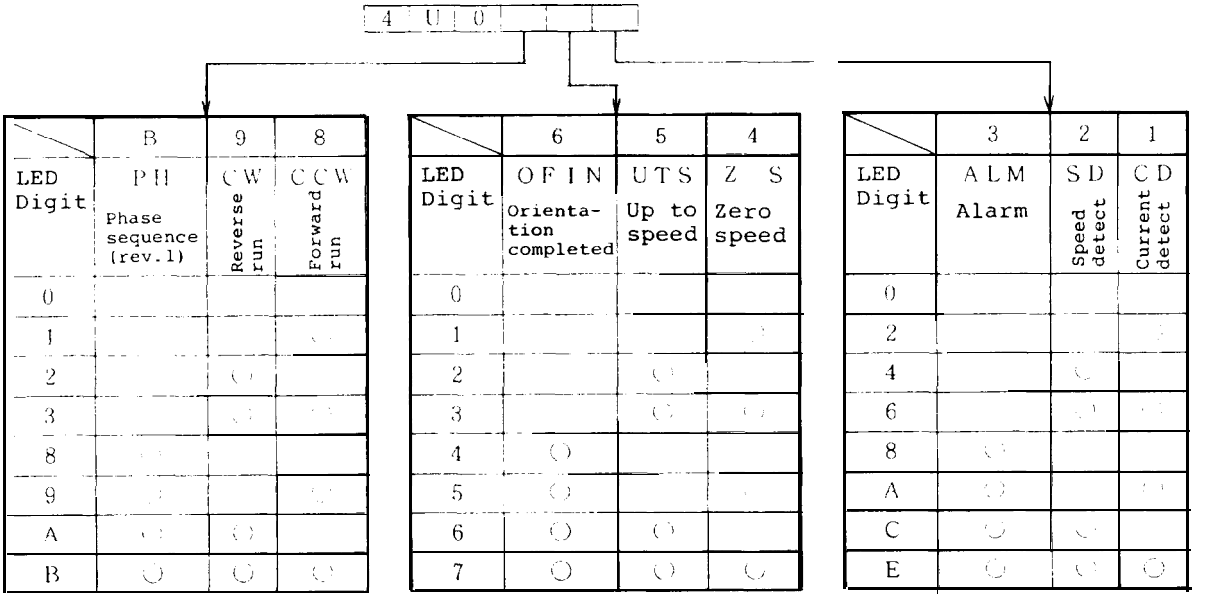
LED Digit	8 Parameter change
0	
1	

LED Digit	7 Torque limit	6 In-position	5 Z-phase pass
0			
2			○
4		○	
6			○
8			
A			○
C			
E			○

LED Digit	3 Alarm	2 Emergency stop	1 Servo ON	0 Ready ON
0				
1				○
2			○	
3			○	○
4		○		
5				○
6		○	○	
7		○	○	○
8	○			
9	○			○
A	○		○	
B	○		○	○
C	○	○		
D	○	○		○
E	○	○	○	
F	○	○	○	○

(d) External signal 4 (STS2)

Check the signal contents by each digit of LED using the following table.



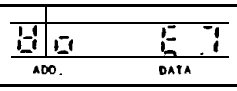
③ There are three types of warnings as listed in the table.

E0	IPF	INSTANTANEOUS POWER FAILURE	Warning which is issued when the power voltage temporarily drops.	C
E5			motor over heat with Fan on	
E4	WPE	PARAMETER SETTING ERROR	Warning which is issued when a parameter value exceeds the allowable range	C
E7	NCE	NC EMERGENCY STOP	∘Warning which is issued when an emergency stop signal is inputted from the CNC in bus linkage with the M300 series CNC. ∘Warning which is issued when an emergency stop signal is inputted from the outside while the external emergency stop signal is validated with the related parameter being set.	B

(Note 1) Motion B – The motor decelerations and stops with regenerative braking and then base shut-off takes place. Whether to open the trouble signal contact FA-FC can be selected with a parameter. (See "CON Pin Nos. 11 and 12", Appendixes l-4 and l-5.)

Motion C – Only the alarm lamp lights, but the operation continues.

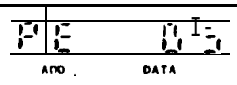
(Note 2) An example of the display is as follows.

	NC emergency stop

④ The parameter error No. represents which parameter is defective when the alarm No. 37 (PE, parameter error) occurs.

(Note 1) If a multiple of parameters is defective, check and correct the parameters in accordance with the parameter error **Nos.** until the alarm No. 37 does not occur.

(Note 2) An example of display is as follows:

	Indicating parameter error No.

1.1.2 Status display and diagnosis from NC

Pressing the ALM/DGN which is one of function selection keys and the SPINDLE MONITOR y which is one of menu keys causes the following spindle monitor screen (ALM/DGN 3) to appear.

```
[SPINDLE MONITOR]          ALM/DGN 3

GAIN                          10.0
DROOP                          675
Srpm (FB)                      100
RPM                            100
LOAD RATE                       40
ALARM NO.                    00 00
                            76543210
D/I  L                      00000100
     H                      00000001
D/O  L                      00000100
     H                      00000010

ALARM  SERVO  SPINDLE MONITOR  PLC-I/F
```

Display	Description
GAIN	Represents the position loop gain state. It represents 0 when no position loop is formed. Position loop gain is obtained from the equation $= \frac{\text{Motor speed (rad/s)}}{\text{Followed delay error (rad/)}}$ The standard value is 10.
POSITION DROOP	An error of real spindle rotation angle against referred spindle rotation angle is named droop. The unit is in pulses. When no position loop is formed, the position droop is 0.
RPM (Motor speed)	Represents the real motor speed. The unit is in rpm.
MOTOR RATE	Represents a ratio of load against the rating output. The unit is %. The 30-minute rating output is 100%. The motor rate is in the range 0 to 120%.
ALARM NO. (Spindle alarm)	Represents the contents of alarms which occurred in the spindle amplifier this time and last time with code numbers. However, the last alarm is the smallest number alarm which differs from this time alarm. For details of the contents of alarms, see 1.3.3.
D/I	Represents an input command to be issued to the spindle amplifier corresponding to bits.

D/I H

7	6	5	4	3	2	10
Gear selection						Tapping

0 0: Gear 0 0
0 1: Gear 0 1
1 0: Gear 1 0
1 1: Gear 1 1

D/I L

7	6	5	4	3	2	1	0
Oriented command	Reverse index	Forward index	Torque limit H	Torque limit L	Forward run	Reverse run	
			H	L	SRI	SRN	

Continued on the next page.

Display	Description
D/O	Represents a control output being outputted from the spindle amplifier corresponding to bits.

	D/O H								D/O L							
	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
					Phase sequence		Reverse run (CW) Clockwise rotation	Forward run (CCW) Counterclockwise rotation	Orientation completed		Up to speed	Zero speed	Alarm	Speed detect	Current detect	

1.2 Checking method and countermeasures of trouble classification A

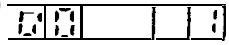
1.2.1 When the amplifier is turned on at the first time, it

Item	Cause	Check	Remedy
1	The amplifier is knocked and damaged when the equipment is operated or installed.	◦ Visually check there is an abnormal portion on the amplifier.	◦ Replace the portion which is damaged.
2	The external wiring is incorrect or broken.	◦ Visually check the external wiring. ◦ Check that the indication lamp LED 1 on the SF-PW card lights (see Appendix 6(4)).	◦ Correctly connect wires. ◦ Replace the broken wire with a new one.
3	The signal ON/OFF sequence is incorrect.	◦ Check the sequence among the NC ready ON signal, spindle amplifier CON1 ready signal (SET1, SET2), forward rotation signal, reverse rotation signal, and orientation signal taking care of the following items. ① The NC ready ON signal and spindle amplifier CON1 ready signal (SET1, SET2) become ready when both the signals are turned on. ② It takes 1 sec or more until tht command of the forward rotation signal, reverse rotation signal or orientation signal is received after the ready ON state. ③ When both the forward rotation signal and reverse rotation signal are turned on at a time, the motor does not rotate (it becomes the DC exciting state). ④ When the forward rotation signa or reverse rotation signal is inputted when the speed reference is 0, the motor becomes the DC exciting State. ⑤ Unless the forward rotation signal, reverse rotation signal or orientation signal is inputted the motor is in the free run state where the base shut-off takes place.	◦ Change the signal sequence.'
4	The ground wiring is not conducted.	◦ Check the ground wirings of the power, amplifier, and motor and shield ground wiring of the detector command.	◦ Correctly connect the ground wirings (see Appendix 1).
5	The E²PROM number is incorrect.	◦ Check that the E²PROM number conforms with the amplifier mode name and motor type name.	◦ Replace the incorrect E²PROM with a correct one.
6	The switch and setting pins are incorrectly set.	◦ Check the set positions of the switches and setting pins by comparing them with the attached setting pin list (Reference 1.11.	◦ Correctly set the switches and setting pins.

Continued on the next page.

Item	Cause	Check	Remedy
7	The parameters are incorrectly set.	∘ Check the parameters by comparing them with the parameter list provided by the machine manufacturer (Reference 1.2).	∘ Correctly set the parameters.
a	The motor speed cannot be increased (the alarm No. 23 occurs).	∘ Check that the phase sequence of U, V, and W between the amplifier and motor is correct.	∘ Correct the phase sequence.
9	The motor does not correctly rotate only when the orientation stop takes place (a runout occurs).	› Check and readjust the spindle orientation control circuit by referencing Chapter 7.	
10	The alarm disply of the amplifier lights.	› Check the cause and take the proper remedy by referencing Section 1.3.3 which describes the contents of alarms.	
11	An alarm appears on the NC CRT screen.	∘ Check the cause and take the proper remedy by referencing Section 1.1.2 which describes the status display and diagnosis.	
12	The LED3(red) on the amplifier lights.	∘ ROM is defective or incorrectly attached. ∘ The power supply (SF-PW Module) is defective. ∘ No data is transferred from NC in bus linkage state.	
13	The spindle does not rotate.	∘ Check that the spindle parameters slimit and smax are not 0. ∘ Check that the connection constants (MCW and inching) of the connection parameters are not 0.	

1.2.2 The motor which has normally rotated stops abruptly.

Item	Cause	Check	Remedy
1	The fuse (F1, F2, and/or F3) is blown. Alternatively, the NF (CB1) is tripped.	∘ Check the conductivity using a circuit tester (see Appendix 5).	∘ Replace the fuse (F1, F2, and/or F3) with a new one. (See Section 2.1). ∘ After replacing the fuse with a new one or resetting the NF, if the same situation takes place, see Section 1.2.3.
2	The power voltage is out of the range.	∘ Check the power voltage using the circuit tester. (See Table 1.3)	∘ Adjust the related control so that the input power votlage is in the specified range.
3	An input signal from the sequencer is abnormal.	∘ Check each bit of the external signals 1 and 2 in the diagnosis mode of the amplifier indicator. For example, the bits of ready ON, forward rotation, and reverse rotation signals. (See Section 1.1.1(2).)	∘ Check the input signal where bits are abnormal so that the signal is correctly received.
4	The input signal from the NC is abnormal.	∘ Check each bit of a control input by referencing Section 1.1.2 which describes the status display and diagnosis. ∘ At the same time, check the same items as the Item 3 above.	∘ Conduct the same countermeasures as the Item 3 above,
5	The signal from the encoder which contains a motor is abnormal.	∘ Set the parameter of the amplifier as follows. (Note)  In an open loop state, input the speed reference and start command to rotate the motor at a slow speed and check the signal from the encoder. (See Section 2.9.)	∘ Adjust the related control by referencing Section 2.9 which describes the adjusting procedure of motor built-in encoder so that the output signal is in the specified level. ∘ If the above adjustment cannot be conducted, replace the sensor section and printed circuit board with new ones.

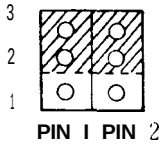
(Note) The parameter 00 is valid just after 1 is set. Since the parameter 00 is cleared when the power is turned off or the equipment is reset, after setting 1, immediately input the speed reference and start command.

1.2.3 The equipment does not work in occassions. The orientation stop position deviates. Although an alarm appears, after turning on and off the power or resetting the equipment, the equipment normally works.

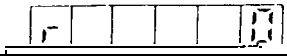
Item	Cause	Check	Remedy
1	An instantaneous power failure or voltage drop of the input power occurs. (Alarm No.101	∘ Check that an instantaneous power failure occurred in another facility in the same plant.	∘ Check the cause of the instantaneous power failure and take the proper countermeasures so that the same situation will not occur.
2	The machine is overloaded instantaneously due to affect of vibrations and so forth. (Note) This trouble often occurs when orientation is incorrectly conducted.	∘ Rotate the motor at a slow speed and check that the motor load changes through the status display. (See Section 1.1.1 or 1.1.2) ∘ Check the backlash between the spindle encoder and spindle.	∘ Remove the cause of the load change. ∘ Adjust the related control so that the backlash becomes small.
3	The equipment malfunctions with a too large noise. (Power supply line)	∘ Check the voltage waveform of the amplifier input pins Xl, x2, and X3 with an oscilloscope. ∘ While removing suspicious noise sources one by one, check the voltage waveform and find the real noise source.	∘ Place a serge killer near the noise source. (For example, 200 VAC, DCR-2-12003-5041, made by MATSUO)
4	The equipment malfunctions by noise which enters a signal from the motor built-in encoder.	∘ Check the signal waveforms at check pins CH44-CH9 (or AGA) for phase A signal and CH45-CH9 (or AGA) for phase B signal using an oscilloscope. (See Appendixes 6(1) and 9(1).) (Note) When measuring the waveforms, turn off the power of the amplifier before using the check pins.	∘ Correctly connect the ground wires of the power supply, amplifier, and motor. (See Appendix 1.) ∘ Correctly connect the shield ground wire of the signal line (CON2) to the motor built-in encoder (PLG) by referencing Appendix 1-4.

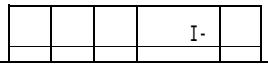
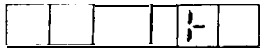
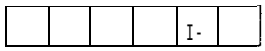
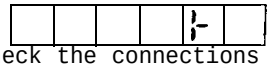
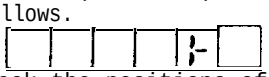
1.3 Checking method and remedy of trouble classification B

1.3.1 When the power is turned on, the display of the operation panel does not appear at all.

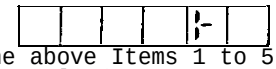
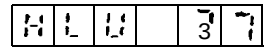
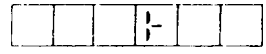
Item	Cause	Check	Remedy
1	The AC power is not supplied.	∘ Check the input pins Xl, X2, and X3 of the amplifier using a circuit tester.	∘ Supply the power.
2	The fuse (Fl, F2, and/or F3) of the control power is blown.	∘ Check that the indication lamp LED1 on the SF-PW module lights. (See Appendix 6(4).) ∘ Check the electric continuity using the circuit tester.	∘ Replace the fuse (Fl, F2, and/or F3) with a new one. (See Section 2.1.)
3	The power (P5A, P15A, N15A, or P24) outside the printed circuit board SF-CA card is shortcircuited.	∘ Disconnect the connectors which are connected to the outside of the SF-CA card in the order of CONl, CON3, and so on by referencing Appendixes 1-4 or 1-5, turn on the power again, and then check that the indication lamp LED1 on the SF-PW module lights.	∘ Open the shortcircuited portion of a circuit outside the SF-CA card. (See Appendix 1.2).
4	The power supply inside the printed circuit board SF-CA card is shortcircuited.	∘ Disconnect the connectors which are connected between the SF-CA card and SF-PW module (CON21 to CON24), turn on the power again, and check that the indication lamp LED1 lights.	∘ Replace the printed circuit board SF-CA card with a new one. (See Section 2.4.4)
5	The control power SF-PW module is defective.	∘ Check that 200 VAC power is supplied to the input terminals of the SF-PW module. ∘ Disconnect the connectors (CON21 to CON24), turn on the power again, and check that the indication lamp LED1 does not light. (See Appendix 6(4).)	∘ Replace the control power with a new one. (See Section 2.4.1.)
6	All the dip switches SW5-1 to SW5-4 on the printed circuit board are not placed in the OFF position.	∘ Check the switch position of switch SW5 by referencing Reference 1.1.1(1).	∘ Correctly set the dip switches SW5-1 to SWS-4. (See Appendix 6(1))
7	When the equipment is *not* linked with the NC through the bus, the setting pins PIN1 and PIN2 on the SF-CA card are not placed as follows.  PIN I PIN 2	∘ Compare the positions of the setting pins on the SF-CA card with those on the attached setting pin list by referencing Reference 1.1.1(4).	∘ Correctly set the setting pins.

1.3.2 When the power is turned on, the display on the operation panel does not indicate the speed in the status display mode (as shown in the following figure).

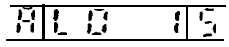


Item	Cause	Check	Remedy
1	When the equipment is linked with the NC through the bus, the power of the NC is not turned on.	∘ While the display on the operation panel is as follows, turn on the NC power and check that the display indicates the speed (as shown in the above figure). 	∘ Turn on the power of the NC.
2	When the equipment is linked with the NC through the bus, the rotary switch CS1 on the printed circuit board SF-TL card is not placed in the correct position.	∘ Even after the power of the NC is turned on, the display on the operation panel is as follows.  ∘ Check the position of the rotary switch CS1 on the SF-TL card by referencing Section 3.1.3. (See Appendix 6(3).)	∘ Correctly set the rotary switch CS1.
3	When the equipment is connected with the NC through the bus, the bus cable connectors (CN1A and CN1B) on the printed circuit board SF-TL card are not correctly connected.	∘ Even after the power of the NC is turned on, the display on the operation panel is as follows.  ∘ Check the position of the rotary switch CS1 on the SF-TL card by referencing Reference 1.1.3. (See Appendix 6(3).)	∘ Correctly connect the connectors CN1A and CN1B.
4	When the equipment is linked with the NC through the bus, the connectors CN1A and CN1B on the printed circuit board SF-TL card are nqt correctly connected.	∘ Even after the power of the NC is turned on, the display on the operation panel is as follows.  ∘ Check the connections by referencing Appendixes 1-6 to 1-9. Especially, check that a termination resistor is connected to the connector CN1B.	∘ Correctly connect the connectors CN1A and CN1B.
5	All the positions of the dip switches SW5-1 to SW5-4 on the printed circuit board SF-CA card are not turned off.	∘ Even after the power of the NC is turned on, the display on the operation panel is as follows.  ∘ Check the positions of the switch SW5 by referencing Reference 1.1.1(1).	∘ Correctly set the positions of the dip switches SW5-1 to SW5-4. (See Appendix 6(1).)

Continued on the next page

Item	Cause	Check	Remedy
6	The printed circuit board SF-CA card or SF-TL card is defective.	◦ Even after the power of the Nc is turned on, the display on the operation panel is as follows.  ◦ The above Items 1 to 5 cannot be applied. ◦ Replace the printed circuit boards SF-CA card and/or SF-TL card with new ones and check that the correct display appears.	◦ Replace the printed circuit boards with the new ones.
7	An alarm occurs.	◦ Check that the display on the operation panel is as follows. 	◦ Check the cause and take the proper countermeasures by referencing the description relating to alarm display, Section 1.3.3 (on display of the amplifier) and Section 1.3.4 (On NC CRT).
8	The transmission of parameters is required.	◦ Even after the power of the NC is turned on ,the display on the operation panel is as follows. 	◦ Check that the rotary switch "CS1" on the SF-TL card is placed in thecorrectposition ◦ Check that the bus cable CAM11 is securely connected to the connector CN1A on the SF-TL card. ◦ Replace the SF-TL card with a new one.
9	The equipment waits for the IT start of the servo amplifier.	◦ Even after the power of the NC is turned on, the display on the operation panel is as follows. 	◦ The amplifier of the servo motor does not correctly start up. Check an alarm of the servo amplifier.

1.3.3 An alarm appears on the display on the printed circuit board (SF-CA card) of the amplifier.

As an example: 

Alternatively, an alarm appears on the NC CRT.

As an example: Spindle alarm 15 32

The contents of the alarm which appears on the spindle amplifier are the same as those which appear on the NC CRT.
The contents of alarms are listed in the following table.
The details of each alarm are described in the following.

(Note) If the alarm No.12 (ME1) memory error 1 occurs, it should be reset by turning off the power of the spindle amplifier.
On the other hand, other alarm Nos. should be reset by turning off the NC power.

Alarm No.	Abbr.	Name	Description	Motion (Note)
10	UV	UNDER VOLTAGE	The input power voltage drops to a value less than the specification assured value or an instantaneous power failure occurs for 15 ms or more.	A
12	ME1	MEMORY ERROR 1	The internal memory for controlling the controller is not correclty read and written. (It is checked when the power of the controller is turned on.)	A
13		EXTERNAL CLOCK ERROR	The system clock which is sent from the NC is defective.	A
15	ME2	MEMORY ERROR 2	The 2-port memory for communication which is used for linkage with the M300 series CNC through the bus does not correctly work.	A
17	BE	P.C.B ERROR	Any part on the controlling printed circuit board does not correctly work.	A
20	NS1	IC MAC007 ERROR	The part ICMACOO7 on the controlling printed circuit board does not correctly work.	A
21	NS2	NO SIGNAL 2 (SPINDLE ENC)	A signal is not input from the orientation encoder or the signal is not in the correct level.	A
22	NSS	IC MAC012 ERROR	The part IC MAC012 on the controlling printed circuit board does not correctly works.	A
23	OSE	SPEED CONTROL ERROR EXCESS	The difference between the referenced speed and motor speed is 50 rpm or more and it takes for 12 sec or more.	A
24	BRT	BREAKER TRIP	A current which exceeds the specific value flows in the main circuit.	A
25	COC	CONVERTER OVER-CURRENT	An overcurrent which exceeds the specifc value flows in the converter.	A
26	PL	POWER PHASE LACK	One or more of 3 phases is missed in 3-phase power.	A
27	CPUE	CPU ERROR (DIVISION ERROR)	A division error occurs in CPU operation because of incorrect parameters being set.	A
31	OS	OVERSPEED	The motor speed exceeds 115% of the maximum speed	A
32	OC	INVERTER OVERCURRENT	An overcurrent which exceeds the specific value flows in the controller.	A
33	OV	OVER VOLTAGE	The voltage of the main circuit condenser exceeds the specific value because of regenerative energy in motor deceleration state.	A

Continued on the next page.

Alarm No.	Abbr.	Name	Description	Motion (Note)
34	DP	DATA PARITY	Parity error occurs in bus linkage with the M300 series CNC.	A
35	DE	DATA ERROR	In bus linkage with the M300 series CNC, the shift command which exceeds the specific value is issued from the CNC.	A
36	TE	TRANSFER ERROR	In the bus linkage with the M300 series CNC, data is not correctly transferred.	A
37	PE	PARAMETER ERROR	A parameter value which exceeds the allowable range is set. (It is set when the power of the controller is turned on.)	A
45	OHF	CONTROLLER OVERHEAT	The ambient temperature is abnormal or the main circuit devices are overheated because an overload is applied or the air cooling fan stops.	A
46	OHM	MOTOR OVERHEAT	The motor is overheated because an overload is applied or the motor cooling blower stops.	A
52	OD	OVERDROOP	In the position loop state, the position following error exceeds the specific value.	A
56	OA	OTHER AXIS FAULT	In the bus linkage with the M300 series CNC, any fault occurs in an other servo axis.	A
57	OPE	OPTION CARD ERROR	Any function which is not provided with the option card is selected.	A

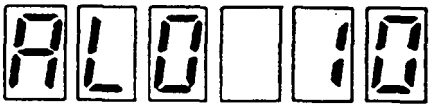
Motion A - The base shut-off occurs in the controller, the main circuit contactor is turned off, and the motor stops in the free-run state. In additon, the trouble signal contacts FA-FC are open.

(Note) For the main circuit contactor : See Appendixes l-4 and l-5 (contact MC1)

For the trouble signal contacts FA and FC : See Appendixes l-4 and 1-5 (CON1 pins 11 and 12)

(1) Alarm No.10(UV) Under Voltage

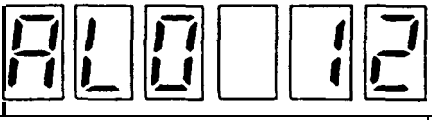
[The voltage drop of the input voltage (3-phase, 200/220 V) to the amplifier is detected. (Voltage between phase X_1 and phase X_2)]



Item	Cause	Check	Remedy
1	The AC input votlage of the amplifier drops to a voltage which is less than 170 V.	◦ Check the voltage at the amplifier input terminals Xl, X2, and X3 using a circuit tester.	◦ Check the cause of which the input voltage drops and take proper countermeasures.
2	An instantaneous power failure which lasts for 15 msec or more occurs (the input votlage drops to a value which is less than 170 V for 15 msec or more).	◦ Check the voltage waveforms at the amplifier input terminals Xl, X2, and X3 using an oscilloscope.	◦ Check the cause of the instantaneous power failure and take porper countermeasures.
3	The power capacity is insufficient.	◦ Check the voltage waveforms at the amplifier input terminals Xl, X2, and X3 using an oscilloscope. ◦ Check that the input voltage drops while the spindle motor is in the acceleration/deceleration state or while an overload is applied.	◦ Increase the power capacity.
4	The control power (SF-PW module) is defective.	◦ Check that the voltage between ACDOW and DO24 of the block A in the SF-PW module is + 5V. (See Appendix 6(4).)	◦ Replace the SF-PW module with a new one.

(2) Alarm No.12(MEl) Memory Error 1

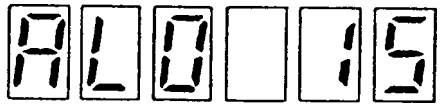
[The integrify of the contents Of ROM are compared with those of RAM during initialization.]



Item	Cause	Check	Remedy
1	EPROM is not installed in the correct position.	◦ Visually check that ROM's 1, 2, and 3 are installed at the correct positions on SF-CA card. (See Appendix 6(1).)	◦ Install each ROM in the correct position.
2	There is an imperfect connection between pins of EPROM and the socket.	◦ Visually check that pins of ROM's 1, 2, and 3 are not bent and they are correctly inserted into the sockets.	◦ Straighten the pins being bent and securely insert them into the socket.
3	The printed circuit board SF-CA card is defective.	◦ Replace the SF-CA card with a new one and check that the new one correctly works.	◦ Replace the SF-CA card with the new one. (See Section 2.4.4).

(3) Alarm No.15 (ME2) Memory Error 2

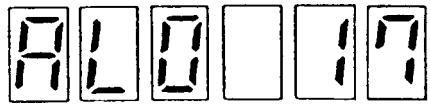
[The integrity of the contents of the 2-port RAM which communicates with the NC during initialization is checked.1



Item	Cause	Check	Remedy
1	The connector (CN1A) which is linked with the NC through the bus is not securely connected.	∘ Check the looseness of the connector. ∘ Check that the set screws of the connector are not loosen. (See Appendixes l-6 to l-9 and 2-3.)	∘ Securely connect the connector and tighten the screws.
2	The cable (CAM11) which is connected with the NC through the bus is defective.	∘ Replace the cable with a new one and check that the equipment correctly works. (See Appendix 3(2).)	∘ Replace the cable with the new one.
3	The ground wires of the NC, amplifier, and motor are not correctly connected.	∘ Visually check that the ground wires are correctly connected by referencing Appendix 1.	∘ Correclty connect the ground wires.
4	The signal cable is not correclty shielded.	∘ Visually check that the signal cable is correctly shielded by referencing Appendix 1.	∘ Correctly shield the signal cable.
5	The printed circuit board SF-TL card is defective_	∘ Replace the SF-TL card with a new one and check that the equipment correctly works. (See Appendix 6(3))	∘ Replace the SF-TL card with a new one. (See Section 2.4.3.)
6	The NC side printed circuit board MC611 or MC632 is defective.	∘ Replace the MC611 or MC632 cards with new ones and check that the equipment correctly work. (See "M300 Series Maintenance Manual".)	∘ Replace the MC611 or UC632 cards with the new ones. MC632: M310 MC611: All other

(4) Alarm No.17(BE) P.C.B error

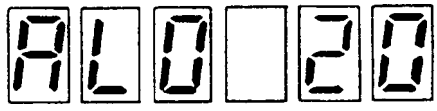
[Whether a component (especially A/D converter) on the printed circuit board is normal or abnormal is checked. 1



Item	Cause	Check	Remedy
1	A component (especially, A/D converter) on the printed circuit board SF-CA card is defective.	∘ Replace the SF-CA card with the new one and check that the equipment correctly works.	∘ Replace the SF-CA card with the new one. (See Section 2.4.4.)
2	The power of the equipment is turned on while the NF in the unit is turned off.	∘ Check that the NF is turned off.	∘ Turn on the NF. ∘ To check only the control circuit without appearance of alarm No.17, set the parameter X58 CVHS to "1". However, to return back to the normal operation mode, make sure to set the #58 CVHS to "0". Otherwise, the LED1 (which lights during regeneration) on the SF-CA card continuously lights.

(5) Alarm No.20(NS1) IC MAC007 Error

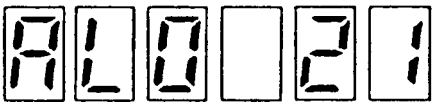
[The internal codes of the IC MAC007 on the SF-CA card are checked.]



Item	Cause	Check	Remedy
1	The IC (MAC 007) on the printed circuit board SF-CA card does not correctly work.	∘ Replace the SF-CA card with a new one and check that the equipment correctly works.	∘ Replace the printed circuit board SF-CA card with the new one. (See Section 2.4.4.)

(6) Alarm No.21(NS2) No Signal 2 (Spindle ENC)

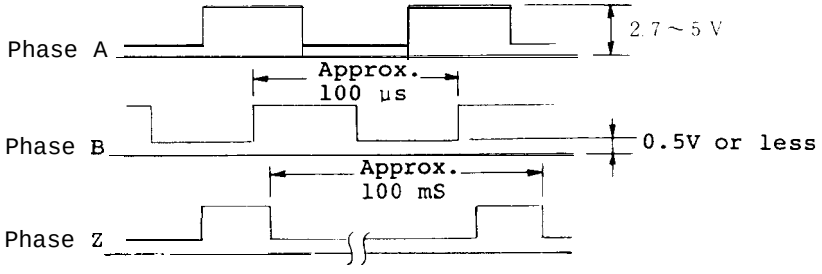
[The signals of phases A, B, and C of the spindle orientation encoder are checked during orientation and synchronous tapping state.1



Item	Cause	Check	Remedy
1	The cable (MR-20LF) to the spindle orientation encoder is defective.	∘ Observe the signal waveform from the encoder using an oscilloscope. ∘ Check the check pins on the printed circuit board SF-TL card. • Between CH1 and DGA, for phase A • Between CH2 and DGA, for phase B • Between CH3 and DGA, for phase Z (See Appendixes 6(3) and 9(3).) ∘ Replace the cable with a new one and check that the equipment correctly works. (See Appendix 1 - 7.)	∘ Replace the cable to the encoder with the new one. (See Appendix 3 (2).)
2	The encoder for the spindle orientation is defective.	∘ Check the wave form in the same manner as Item 1 above. ∘ Replace the encoder with a new one and check that the equipment correctly works. (See Appendix 7.)	∘ Replace the encoder with the new one.
3	The printed circuit board SF-TL card is defective.	∘ Observe the signal waveform from the encoder at CONB on the SF-TL card using the oscilloscope and check that it is normal. (See Appendix 1 - 7.)	∘ Replace the printed circuit board SF-TL card with a new one. (See Section 2.4.3.)
4	The 5V power is not supplied from the NC side to the encoder.	∘ Check the 5V power on the NC side. ∘ Replace the cable with a new one and check that the equipment correctly works.	∘ Repair the power supply on the NC side. Refer to M300 series Maintenance manual ∘ Replace the cable with a new one. ∘ If the 5 V power is not supplied from the NC side (namely, when CONAA is not connected with the NC), shortcircuit the pin 5 on the SF-TL card to pins 2 and 3 (no power supply form the NC).

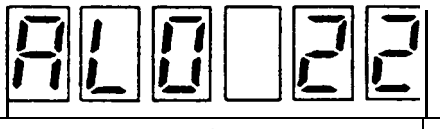
(Note) The correct output waveform of the encoder is as follows:

ⓐ When the spindle of the machine rotates counterclockwise at approx. 500 rpm while the bit 8 of the parameter ORS2 is 0:



ⓑ When the spindle of the machine rotates clockwise at approx. 500 rpm and when the bit 8 of the parameter OSR2 is 0, the same waveform as the above figure occurs.

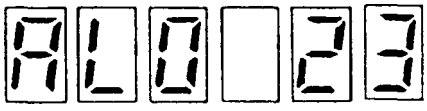
(7) Alarm No.22(NSS) IC MAC012 Error
[The internal codes of the IC MAC012 are checked. 1



Item	Cause	Check	Remedy
1	The IC (MAC 012) and the related circuits on the printed circuit board SF-CA card do not correctly work.	∘ Replace the SF-CA card with a new one and check that the equipment correctly works. (See Appendix 6(1))	∘ Replace the printed circuit board SF-CA card with the new one. (See Section 2.4.4.)

(13) Alarm No.23(OSE) Speed Control Error Excess

[The difference between the speed reference value and real speed is checked and if the deviation which is 50 rpm or more lasts for 12 sec. or more, an alarm occurs.1

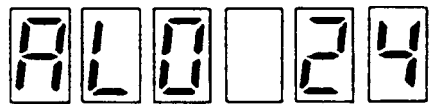


Item	Cause	Check	Remedy
1	The phase sequence of wires U, V, and W which are connected between the amplifier and the motor is incorrect.	∘ Increase the reference speed and check that the motor rotates at a low speed. ∘ Visually check the phase sequence of wires U, V, and W.	∘ Correctly connect the wires U, V, and W between the amplifier and the motor.
2	One of the wires U, V, and W which are connected between the amplifier and the motor is broken.	∘ Check that the motor does not smoothly rotate. ∘ Remove the wires U, V, and W on the amplifier side and check that there is no electric discontinuity in the wires U, V, and W.	∘ Replace the power wire which is broken with a ***new one.***
3	The motor is overloaded.	∘ Check whether the motor is overloaded using a load meter or load display in the status display mode. (See Section 1.1.1)	∘ Review the cutting condition and tool being used.
4	The printed circuit board SF-CA card is defective.	∘ Replace the SF-CA card with a new one and check that the equipment correctly works.	∘ Replace the printed circuit board SF-CA card with the new one. (See Chapter 2.)
5	The integration gain parameter VKI (amplifier parameter X37; NC parameter: #23) of the speed loop is set to 0.	∘ Check the parameters being set by referencing Section 1.1.1 or 1.1.2.	∘ Set the parameters to the standard values by referencing Reference 1.2.2 or 1.2.3. ∘ If the motor unstably rotates, set the parameters to correct values by referencing Alarm No. 31 Item 2.
6	The volume on the printed circuit board for the motor built-in encoder (in the motor terminal box) is not correctly adjusted.	∘ Check that the motor rotates at several ***ten*** rpm and the speed display is "0". ∘ Set the parameters of the amplifier as follows and input the speed reference and start command to rotate the motor at a low speed. The parameter 00 becomes valid just after it is set to "1". Since the parameter is cleared when the power is turned off or reset, after it is set to "1", input the speed reference and start command. 	∘ Adjust the volume VR1, VR2, VR3, and VR4 so that the output waveforms of phases A and B are in the standard value range by referencing the section relating to adjustment and replacement of motor built-in encoder (Section 6.9).

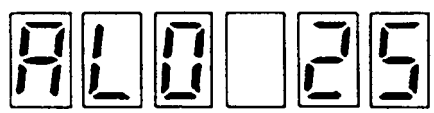
Continued on the next page.

Item	Cause	Check	Remedy
		◦ Check the signal waveform at the check pins on the printed circuit board SF-CA card using an oscilloscope. Phase A signal: CH44-CH9 (or AGA) Phase B signal: CH45-CH9 (or AGA) (See Appendixes 6(1) and 9(1).) (Note) Before using the check pins, the power of the amplifier should have been turned off.	
7	The printed circuit board in the motor built-in encoder (motor terminal box) is defective.	◦ Check that the motor rotates at several ten rpm and the speed display indicates "0". ◦ Like the same manner as the Item 6 above, in the open loop state, rotate the motor at a low speed. ◦ Like the same manner as the Item 6, check the signal waveform of the check pins on the SF-CA card using an oscilloscope. ◦ By referencing the description relating to adjustment and replacement of the motor built-in encoder described in Section 2.9, observe the waveforms between PA and PGA and between PB and PGA using an oscilloscope and check that they can be in the standard value range using volume resistors (VR1, VR2, VR3 and VR4).	◦ Replace the printed circuit board in the motor terminal box and adjust the controls by referencing Section 2.9.
a	The sensor in the motor built-in encoder is defective.	◦ Check that the output waveforms between PA and PGA and between PB and PGA on the encoder printed circuit board cannot be adjusted in the standard value range even after the printed circuit board has been replaced in the manner described in the Item 7 above.	◦ Replace the entire motor with a new one. ◦ If the motor cannot be replaced, replace it together with the sensor and printed circuit board by referencing Section 2.9.

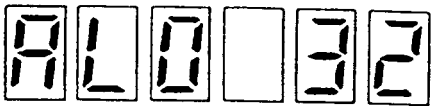
(9) Alarm No.24(BRT) Breaker Trip

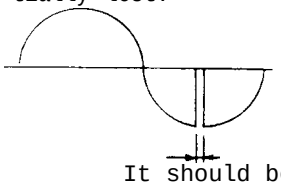
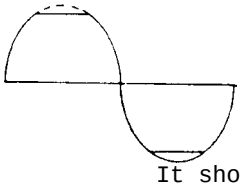


(10) Alarm No.25(COC) Converter Overcurrent



(11) Alarm No.32(OC) Inverter Overcurrent



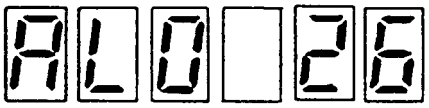
Item	Cause	Check	Remedy
1	The input power voltage waveform is defective.	◦ Observe the voltage waveforms at the input terminals Xl, X2, and X3 of the amplifier using an oscilloscope. ◦ Check that the voltage waveforms are as follows even in the acceleration or deceleration state. (a) If the waveform is partially lost:  It should be 100 us or less. (b) If the peak value drops:  It should be 2 to 3% or less.	◦ Increase the power capacity. ◦ Thicken the size of the cable between the input power supply and amplifier. ◦ Check other semiconductor devices which generate distorted waveforms and install surge killers and so force. (For example, MATSUO made, rating 200 VAC, DCR2-12003-5041, etc.)
2	The input power impedance is high. (Example, in the cases that two transformers are connected in series or a variable autotransformer is connected)	◦ Check that the alarm occurs only when the motor speed decelerates from a high speed. ◦ Check that the input voltage temporarily drops to 170 V or less when the motor decelerates.	◦ Replace the power supply with an other one whose power impedance is low. ◦ Tighten the screws of connections between the input power supply and amplifier.
3	The input power frequency remarkably changes.	◦ Check the voltage frequencies at the input terminals Xl, X2, and X3 of the amplifier using a frequency counter.	◦ Check the cause of the frequency variation and adjust the related controls so that it is in the specification range.
4	The motor selection parameters #01 and #02 are not correctly set.	◦ Check that the parameters are correctly set by referencing Reference 1.2.2.	◦ Correctly set the parameters. (See Reference 1.2.3.)
5	The transistor module is defective.	◦ Check that this alarm occurs even after the equipment is reset. ◦ Disconnect the cable between the amplifier and motor and check that this alarm occurs when only the amplifier is operated. (See Appendix l-2.1	◦ Replace the main circuit unit of the amplifier with a new one.

Continued on the next page.

	Cause	Check	Remedy
	The diode stack is defective.	◦ Check the diode stack in the same manner as the Item 5 above.	◦ Replace the main circuit unit of the amplifier with a new one. (Note) See Section 2.6 and 2.7.
	The surge absorbers and condensers are defective.	◦ Check them in the same manner as the Item 5 above.	◦ Replace the main circuit unit of the amplifier with a new one.
8	The current detection circuit is defective.	◦ Observe the waveforms at the following check pins using an oscilloscope and check that the peak value exceeds 10 V. Between CH39 and AGA: Regenerative converter side Between CH42 and AGA: Converter side Between CH43 and AGA: Inverter side (See Appendix 9(1).)	◦ Replace the printed circuit board SF-CA card with a new one. (See Section 2.4.4.) (Note) Normally, the peak voltage is in the range from 6 to 7 V while the motor accelerates or decelerates.
9	The motor is overloaded.	◦ Check that the motor is overloaded using a load meter or the load display in the status display mode (see Section 1.1.1).	◦ Review the cutting condition and tool being used.
10	The cable connections between the amplifier and motor are incorrect.	◦ Visually check the cable connections. ◦ Check that the screws of the cable connection terminal are loosen.	◦ Correctly connect the cables. ◦ Tighten the screws being loosen.
11	The wiring of the motor is rare-shortcircuited or earth-grounded.	Disconnect the cables between the amplifier and motor and check the insulation resistance between the following leads. Between U and W; between V and W; between U and W; between each of U, V, and W and E	◦ Replace the motor with a new one.

(12) Alarm No.26(PL) Power Phase Lack

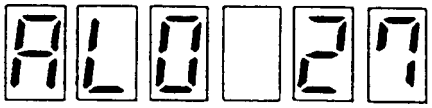
[When R and T of phases R, S, and T are normal, whether there is phase S is checked.]



Item	Cause	Check	Remedy
1	One of phases R, S, and T is lacked when the power is turned on.	∘ Check the voltage between any two phases of R, S, and T at the input power terminals S1, X2, and X3 using a circuit tester.	∘ Check the cause of the phase lack and take proper countermeasures.
2	One of the fuses F1, F2, and F3 has been blown when the power is turned on.	∘ Check the electric continuity of each fuse using the circuit tester.	∘ Replace the fuse being blown with a new one. (See Section 2.1.)

(13) Alarm No.27(CPUE) CPU Error (Division error)

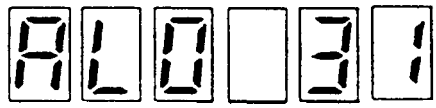
[This alarm occurs when an CPU operation where a value is divided by 0 is executed or the result of division is overflowed.)

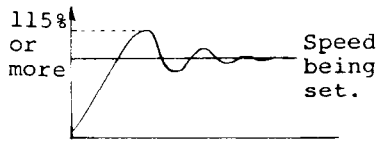


Item	Cause	Check	Remedy
1	The parameter relating to gear ratio is incorrectly set.	∘ Check the parameter by referencing Reference 1.2.2 for that which is set from the amplifier and Reference 1.2.3 for that which is set from the NC.	∘ Correctly set the parameter. (Note) Compare the parameter in the parameter list on the cover of the amplifier with that being set. (See Appendix 10)
2	The connector (CN1A) which is linked with the NC through the bus is loose.	∘ Check the cable in the same manner as the alarm No. 15 (ME2).	∘ Securely connect the connector and the set screws.
3	The cable (CAM11) which is linked with the NC through the bus is defective.	∘ Check the cable in the same manner as the alarm No. 15 (ME2).	∘ Replace the cable with a new one.
4	The following parameters relating to the gain of the speed loop are incorrect. VKP, VKI, ORS1.	∘ Check the parameters by referencing Reference 1.2.3.	∘ Correctly set the parameters. (Note) Compare the parameters in the parameter list on the amplifier cover with those being set. (See Appendix 10.)
5	When a special motor is used (when #01 and 02 are set), the motor constants #81 to #AF are incorrect.	∘ Compare the parameters in the parameter list on the amplifier cover with those being set. (See Appendix 10.)	∘ Correctly set the parameters

(14) Alarm No.31(OS) Overspeed

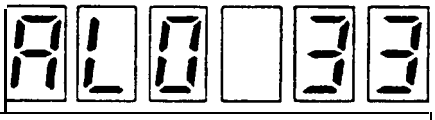
(The real speed of the motor is checked and when it exceeds 115% of the motor maximum speed, this alarm occurs.)



Item	Cause	Check	Remedy
1	The reference speed exceeds 115% of the maximum speed.	∘ Compare the reference speed with the following maximum speed being set. Parameter being set from the amplifier: #31(TSP) Parameter being set from the NC: #17(TSP) (See References 1.2.2(2) and 1.2.3(3).)	∘ Decrease the reference speed. ∘ Correctly set the parameter for motor maximum speed.
2	The speed control system is unstable and an overshoot occurs.	∘ Observe and check the signal between the speed signal terminals SMO and OM using an oscilloscope (See Appendixes l-4 and l-5).  ∘ If the signal output is saturated when it exceeds 10 V because a too high speed is set, check that the voltage rises to around 115% in the speed mode of the status display (see Section 1.1.1) or using the NC CRT monitor.	∘ Decrease the parameter values of the speed loop gain VKP and VKI (amplifier parameter #36 and #37 or NC parameters #22 and X23). (Note) To check the occurrence of the alarm: Set VKP and VKI to "63" and "1" respectively and check that the alarm occurs. (a) If the alarm occurs, replace the SF-CA card with a new one. (b) If the alarm does not occur, decrease the parameter values of VKP and VKI.
3	The motor built-in encoder is defective.	∘ In the same manner as the alarm No.23(OSE), check the encoder output signal waveform using the oscilloscope. ∘ Rotate the motor using the reference speed which is slower than the middle speed and check that the frequencies of the signals of the phase A or B satisfy the following relation. $f(Hz) = \frac{256}{60} \times (\text{motor speed(rpm)})$	∘ In the same manner as the alarm No.23(OSE), adjust or replace the motor built-in encoder with a new one.
4	The printed circuit board SF-CA card is defective.	∘ Replace the SF-CA card with a new one and check that it correctly works.	∘ Replace the printed circuit board with a new one. (See Section 2.4.4.)

(15) Alarm No.33(OV)Overvoltage

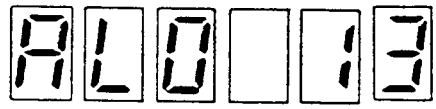
[The voltage in the converter circuit is checked and if it exceeds 400 V, this alarm occurs.)



Item	Cause	Check	Remedy
1	The input power voltage waveform is abnormal.	◦ In the same manner as the alarm No.24, No.25, and No.32, check the waveform.	◦ See the alarm No.24/No.25/ No.32. ◦ Increase the power capacity. ◦ Thicken the size of the cable between the input power supply and the amplifier. ◦ Improve other components which generate distorted waves by installing surge killers and so forth.
2	The input power impedance is high.	◦ In the same manner as the alarm No.24/No.25/No.32, check the input power.	◦ See the alarm No.24/No.25/ No.32. ◦ Replase the power supply with that whose impedance is low. ◦ Tighten the screws of the cable connections between the input power and amplifier.
3	An instantaneous power failure occurs in the input voltage or the voltage drops when the motor decelerates.	◦ In the same manner as the alarm No.10(UV), check the input power.	◦ See the alarm No.10(UV). ◦ Check the cause of the instantaneous power failure or voltage drop and improve the power condition.
4	The printed circuit board SF-CA card is defective.	◦ Replace the SF-CA card with a new one and check that the equipment correctly works.	◦ Replace the printed circuit board SF-CA card with a new one. (See Section 2.4.4.)
5	The main circuit unit is defective.	◦ Check the regenerative transistor module by referencing Section 2.5.	◦ Replace the amplifier main circuit unit with a new one. (Note) See Section 2.7.

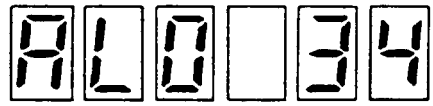
(16) Alarm No.13( ) External Clock Error

[This alarm occurs when the system clock which is sent from the NC is defective.]



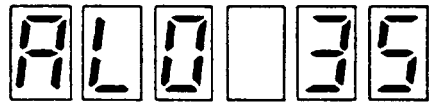
(17) Alarm No.34(DP) Data Parity

[The parity of the data whick is transmitted from the NC is checked.]



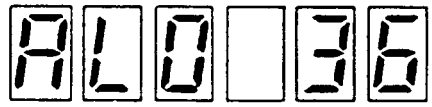
(18) Alarm No.35(DE) Data Error

[This alarm occurs when the position reference of the synchronous tap which is transmitted from the NC is too large.]



(19) Alarm No.36(TE) Transfer Error

[This alarm occurs when data from the NC is not completed.]



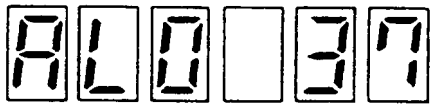
Item	Cause	Check	Remedy
1	The connector (CN1A) which is linked with the NC through the bus is loosed.	∘ In the same manner as the alarm No.15(ME2), check the connector.	∘ Tighten the connector and mounting screws.
2	The cable (CAM11) which is linked with the NC through the bus is defective.	∘ In the same manner as the alarm No.15(ME2), check the connector.	∘ Replace the cable with a new one.
3	The NC, amplifier, and motor are not correctly grounded.	∘ In the same manner as the alarm No.15(ME2), check the grounding.	∘ Correctly ground them.
4	The signal cable is not correctly shielded.	∘ In the same manner as the alarm No.15(ME2), check the shielding of the signal cable.	∘ Correctly sheild the signal cable.
5	The termination resistor of the bus connection is abnormal.	∘ Check that the termination resistor is correctly installed. (See Appendixes 1-6 to l-9.) ∘ Replace the termination resistor with a new one and check that the equipment correctly works.	∘ Replace the termination resistor. (See Appendix 3(2).)
6	The bus interface circuit of the printed circuit board SF-TL card is defective.	∘ Replace the SF-TL card with a new one and check that the equipment correctly works.	∘ Replace the printed circuit board SF-TL card with a new one. (See Section 2.4.3.)

Continued on the next page.

Item	Cause	Check	Remedy
7	The bus interface circuit of the printed circuit board MC611/MC632 card on the NC side is defective.	∘ Replace the MC611/MC632 card with a new one and check that the equipment correctly works.	∘ Replace the MC611/MC632 card with a new one.
8	A travel command which exceeds the specification value is issued from the program.	∘ Check that the spindle speed reference exceeds $\frac{6192 \times 10^4}{GRA}$ (rpm) . (Parameter GRA = number of gear teeth on spindle side)	∘ Correct the program.

(20) Alarm No.37(PE) Parameter Error

(This alarm occurs when a parameter which exceeds the allowable range is set.1



Item	Cause	Check	Remedy
1	A parameter which exceeds the allowable range is set.	∘ Check that the parameter being set accords with that in the parameter list by referencing Reference 1.2.2 for the parameter being set from the amplifier and Reference 1.2.3 for that being set from the NC.	∘ Correctly set the parameter value.

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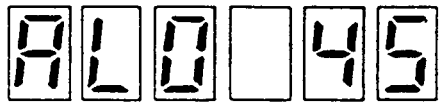
(21) Alarm No.45(OHF) Controller Overheat

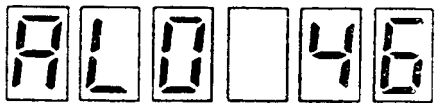
[This alarm occurs when the thermal protect which is installed in the controller exceeds the temperature being set.]
(Ambient temperature: 60°C,
Fin temperature : 100°C)



Item	Cause	Check	Remedy
1	The fan which cools the fin is defective.	∘ Check that the fan normally rotates.	∘ Replace the cooling fan with a new one. (See Section 2.3.)
2	The ambient temperature of the amplifier is high.	∘ Measure the ambient temperature of the amplifier in the high voltage panel.	∘ Unless the cooling unit in the high voltage panel correctly works, replace it with a new one. ∘ If the ambient temperature exceeds 55°C, strengthen the cooling power.
3	The equipment is overloaded.	∘ Check the load condition using a load meter or the load display (see Section 1.1.1) in the status display mode. ∘ Check that the equipment is frequently started and stopped.	∘ Review the cutting condition and tool. ∘ Decrease the frequency of start and stop operations.
4	The thermal protector (THS2) which is installed on the fin is defective. Alternatively, the thermal protector (THS1) which detects the ambient temperature of the amplifier is defective. THS1 setting temperature = 60°C (Ambient temperature) THS2 setting temperature = 100°C (Fin temperature)	∘ Check that electricity does not flow between the ends of the thermal protector by referencing Appendix 4, "Main circuit block diagram" and Appendix 5, "Spindle amplifier component layout". (Note) Separately check THS1 and THS2.	∘ Replace the thermal protector THS1 or THS2. (See Section 2.2.)
5	The alarm detection circuit in the printed circuit board SF-CA card is defective.	∘ Replace the SF-CA card with a new one and check that the equipment correctly works.	∘ Replace the printed circuit board SF-CA card with a new one. (See Section 2.4.4.)
6	The cooling fan is dirty by dust and the cooling effect is degraded.	∘ visually or by touching the cooling fan, check the degree of dirt.	∘ Clean the cooling fan using a factory utility air or vacuum cleaner.

(22) Alarm No.46(OHM) Motor Overheat

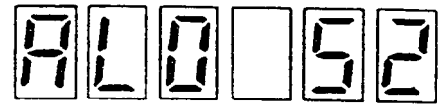
[This alarm occurs when the thermal protector which is installed in the motor exceeds the temperature being set (145°C).]



Item	Cause	Check	Remedy
1	The motor cooling fan is defective.	◦ Visually check that the fan motor normally rotates.	◦ Replace the motor cooling fan with a new one. (See Section 2.8.)
2	The motor cooling systen is dirty.	◦ Visually or by touching the cooling system, check the degree of dirt.	◦ Clean the cooling system using the factory utility air or vacuum cleaner.
3	Check that the air intake portion of the motor cooling fan is clogged with foreign matter or machine components.	◦ Visually check the position of the foreign matter or components.	◦ Remove the foreign matter. ◦ Change the position of the machine components.
4	The motor is overloaded.	◦ Check the load of the motor using a load meter or the load display in the status display mode (see Section 1.1.1). ◦ Check that the motor is frequently started and stopped.	◦ Review the cutting condition and tool. ◦ Decreas the frequency of the start and stop operations.
5	The motor built-in thermal protector is defective.	◦ After stopping the motor and turning the cooling fan to fully cool the motor, check that the motor leads OHS1 and OHS2 is shortcircuited. (When they are shortcircuited the thermal protector is normal.)	◦ Shortcircuit OHS1 and OHS2 of CON2 on the amplifier side as a temporary repair and continue the operation. (See Appendixes 1-4 and 1-5) ◦ At a convenient time, replace the motor with a new one.
6	The following cable connections are defective. Motor side — Amplifier side OHS1 - CON2 pin 3 OHS2 - CON2 pin 2	◦ Check the wire breakage or connector imperfect contact using a circuit tester.	◦ Replace the signal cable with a new one. ◦ Repair the connector's imperfect contact or replace the connector with a new one.

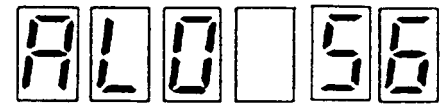
(23) Alarm No.52(OD) Over Droop

[This alarm occurs when the position error becomes too large in synchronous tapping mode (for 8 rotations against the reference value.)]



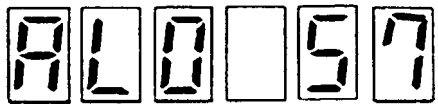
Item	Cause	Check	Remedy
1	The parameter #03 (PLG) which is set from the amplifier is not correctly set.	∘ Check the parameter being set by referencing Reference 1.2.2(2).	∘ Correctly set the parameter value.
2	The bits 8 and E of the parameter ORS2 (#30 for amplifier; #16(PR) for NC) are not correctly set.	∘ Check the parameter being set by referencing Reference 1.2.2 (2) and 1.2.3(3).	∘ Correctly set the parameter values.
3	The orientation encoder is defective.	∘ In the same manner as the alarm No.21(NS2), check the signal waveform from the encoder.	∘ Replace the encoder with a new one.
4	The reference time constant is small.	∘ Measure the acceleration time using a stop watch or observe the speed signal terminals SMO and OM using an oscilloscope and check that the acceleration time is shorter than the reference constant time. (See Appendixes 1-4 and l-5.)	∘ Increas the value of the acceleration time constant parameter CSN (amplifier parameter #33 or NC parameter #19(PR)).

(24) Alarm No.56(OA) Other Axis Fault



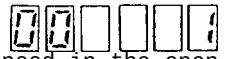
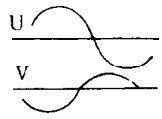
Item	Cause	Check	Remedy
1	The servo axis alarm occurs.	∘ Check that the servo axis alarm occurs.	∘ Remove the cause of the servo axis alarm.
2	The cable CAM11 which is linked with the NC through the bus is defective.	∘ Replace the cable CAM11 and check that the equipment correctly works. (See Appendix 3(2).)	∘ Replace the cable CAM11 with the new one.
3	The connectors (CN1A and CN1B) on the printed circuit board SF-TL card are not correctly connected.	∘ Visually check the following connections. CN1A - CAM11 cable CN1B - termination resistor ∘ Check that the connector screws are loosen.	∘ Correctly connect the CAM11 cable and termination resistor in place. ∘ Tighten the connector screws
4	The termination resistor is defective.	∘ Replace the termination resistor which is connected to the connector CN1B and check that the equipment correctly works. (See Appendix 3(2).)	∘ Replace the termination resistor with a new one.

(25) Alarm No.57(OPE) Option Card Error



Item	Cause	Check	Remedy
1	The option card does not conform with the specification.	∘ Check that the order list conforms with the option card name.	∘ Check the specification.

1.3.4 The motor does not rotate.

Item	Cause	Check	Remedy
1	Trouble analysis	∘ When a rotation command is issued, an alarm is indicated on the display on the spindle amplifier printed circuit board (SF-CA card).	∘ Review the cause and take a proper action by referencing Section 1.3.3.
		∘ When no alarm occurs:	∘ Go to the Item 2 or later.
2	The control signal cable or power cable is incorrectly connected or is broken.	∘ Check that the cables are correctly connected and they are not broken.	∘ Correctly connect them. ∘ Replace the broken cable with a new one.
3	The input power voltage is abnormal.	∘ Measure the voltages at the input terminals Xl, X2, and X3 of the amplifier using a circuit tester. (See Table 1.3.)	∘ Improve the power condition so that the input power voltage is in the allowable range.
4	The control power supply (SF-PW module) is defective.	∘ Measure all the DC output voltages of the SF-PW module using a circuit tester. (See Appendix 6(4).)	∘ Replace the control power supply (SF-PW module) with a new one. (See Section 2.4.1.)
5	The printed circuit board SF-CA card is defective.	∘ Set the amplifier parameterer as follows, input a reference  (Note) speed in the open loop state to cause the motor to rotate, and check that a reference sine wave occurs on the oscilloscope. Between CH23 - AGA Between CH14 - AGA  (See Appendix 9(1).)	∘ Replace the printed circuit board SF-CA card with a new one. (See Section 2.4.4.)
6	The external emergency stop signal or reset signal is input.	∘ Check that the bit 2 (emergency stop) of the external signal is turned on or the portion between CON1 pins No.47 and No.48 (emergency stop) or portion between pins No.19 and No.20 (alarm reset) is turned on.	∘ Correctly connect the external signal cable.

(NOte) The parameter 00 becomes valid just after it is set to 1. Since the parameter is cleared when the power is turned off or the equipment is reset, just after 1 is set, input the speed reference and start command.

Item	Cause	Check	Remedy
7	The PIN1 and PIN2 of the printed circuit board SF-CA card are incorrectly set.	∘ Check that the control power (SF-PW module) is normal and the amplifier display (LED) does not indicate any message. ∘ Check how the PIN1 and PIN2 are set. (See Reference 1.1.1(4).)	∘ Correctly set the PIN1 and PIN2 on the SF-CA card.

1.3.5 The motor does not rotate at a speed being specified.

Item	Cause	Check	Remedy
1	The phase sequence of the wires U, V, and W of the motor are not matched with that of the amplifier.	∘ Increas the value of the speed reference and check that the motor rotates only at a low speed.	∘ Match the phase sequence of the motor with that of the amplifier.
2	The output voltage of the amplifier is unbalance.	∘ Measure the voltage between any two points of the wires U, V, and W of the amplifier using a circuit tester.	∘ Check the cause of the unbalanced output voltage and improve the power condition.
3	The three phases of the input power voltage are unbalance.	∘ Measure the voltage between any two points of the amplifier input terminals Xl, X2 and X3 using a circuit tester.	∘ Check the cause of the unbalanced input power voltage and improve the power condition.
4	The external speed reference is incorrect.	∘ Increase the value of the speed reference and check that the motor speed proportionally increase. (Between CH46 and AGA of SF-CA card)	∘ Correctly set the value of the external speed reference.
5	The motor built-in encoder is defective.	∘ Check the signal waveform by referencing the alarm No.23 (OSE).	∘ See the alarm No.23 (OSE). ∘ Replace the encoder or the printed circuit board with a new one.
6	The parameter of the motor maximum speed is set to a low value.	∘ Compare the reference speed with the following maximum speed being set. ∘ Amplifier parameter: X31 (TSP. ∘ NC parameter: #17 (TSP) ... 9" CRT screen NC parameter: X49 (TSP) ... 14" CRT screen (See References 1.2.2(2) and 1.2.3(3).)	∘ Correctly set the parameter value.
7	The motor is overloaded.	∘ Check the load using a load meter or the load display in the status display mode (see Section 1.1.1).	∘ Review the cutting condition and tool.
8	The override command is input.	∘ Check the override command using the speed display in the status display mode of the amplifier (see Section 1.1.1).	∘ Turn off the override command.

1.3.6 The motor vibrates and is getting noisier during rotations.

(Note) To distinguish between a fault of the mechanical portion including the motor and that of the amplifier including the speed reference, take the following procedure.

(i) Rotate the motor at a high speed and press the pushbutton switch PB1 (see Appendix 6(1)) on the SF-CA card to cause the motor to rotate in the free run state.

(ii) In the free run state, when the vibration and noise become smaller than the normal operation of the motor, it is supposed that the mechanical portion is normal.

Item	Cause	Check	Remedy
1	The motion balance of the machine is bad.	∘ Rotate the motor at a high speed, cause the motor to rotate in the free run state, and check that the mechanical portion including the motor is bad. ∘ Remove the coupling between the motor and machine, separately rotate the motor, and check the mechanical portion is bad.	∘ Improve the motion balance of the rotation portion of the machine.
2	The motion balance of the motor is bad.	∘ Check that the motor significantly vibrates and generates noise in the Item 1 above.	∘ Replace the motor with a new one.
3	The mounting screws which fasten the motor to the machine are loosen.	∘ Check that the screws (flange portion or leg) which fasten the motor to the machine are loosen in the Item 1 above.	∘ Securely tighten the screws.
4	The reference sine waveforms of the control circuit are disordered.	∘ Observe that the waveforms are balanced at the following check terminals on the printed circuit board SF-CA card using an oscilloscope. - Between CH14 - CH9 (AGA): Phase V - Between CH15 - CH9: Phase W - Between CH23 - CH9: Phase U (See Appendixes 6(1) and 9(1).)	∘ Replase the printed circuit board SF-CA card with a new one. (See Section 2.4.4.)
5	The insulation resistance of the amplifier is degraded.	∘ Remove the wires of the phases R, S, and T of the input power and measure the following portions using a 500 V megger. (However, the wires which are connected to the ground (E) terminal should be removed.) (a) Between main circuit - ground (The main circuit consists of each terminal of Xl, x2, x3, u, v, W, MS1, and MS2.)	∘ Check the portions whose insulation is degraded and clean and/or dry them to restore the good insulation. ∘ If it is difficult to restore the good insulation, replace the printed circuit board or the entire amplifier with a new one.

Continued on the next page.

Item	Cause	Check	Remedy
		(b) Between control circuit common - ground (The control circuit common is the OM terminal of the terminal board TB1 on the SF-CA card.) (c) Between main circuit - control circuit common (between each terminal of the main circuit and OM terminal) (Note) The insulation resistance should be 20MΩ or more. (See Appendixes l-l and 6(1).)	

1.3.7 The motor overshoots in speed or hunts.

Item	Cause	Check	Remedy
1	The speed loop gain parameter is incorrectly set.	∘ Check that the speed loop proportional gain (VKP) and speed loop differentiation gain (VKI) are set to 63 and 60 as their standard values, respectively. ∘ Amplifier parameter No: #36 and X37. ∘ NC parameter: #22(PR),#23(PR) ... 9" CRT screen NC parameter: #54(PR),#55(PR) ... 14" CRT screen (See References 1.2.2 and 1.2.3.)	∘ Set both the parameter values to the standard values.
2	The speed loop gain is too high.	∘ Set the parameters VKP and VKI to low values and check that the motor does not hunt or overshoot. ∘ For the amplifier parameters: see Reference 1.2.2(2). ∘ For the NC parameters, see Reference 1.2.3(3).	∘ Set both the parameters so that they are nearly the same low values.

1.3.8 The cutting force degrades

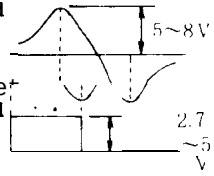
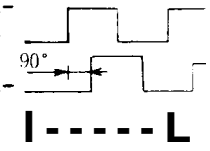
Item	Cause	Check	Remedy
1	The ROM No. is incorrect.	∘ Check the ROM No. using Appendix 11 Table 1.1.	∘ Replace the ROM with a correct one.
2	The torque limit command is issued.	∘ Check that CON1 pin No.5 (TL1) or No.21(TL2) is turned on by referencing Appendix l-4 or l-5.	∘ Turn off the limit command input TL1 and TL2 to release the torque limit.
3	The torque limit parameter is incorrectly set.	∘ Check the parameter TLM value by referencing Reference 1.2.2(2) or 1.2.3(3). ∘ Amplifier parameter No.#35. ∘ NC parameter: #21 (PR) ... 9" CRT screen NC parameter: #53 (PR) ... 14"CRT screen	∘ Correctly set the parameter value.
4	The belt is loosen.	∘ Check the tension of the belt.	∘ Correctly put on the belt.

1.3.9 The orientation of the spindle is not correct.

(a) The orientation speed is not obtained.

Item	Cause	Check	Remedy
1	The orientation command is not issued.	∘ On the NC spindle screen, check that the control input L bit 6 of ALM/DGN3 (see Section 1.1.2) is not set to "1".	∘ Check the signal which is sent from the operation panel to the NC.
		∘ On the spindle amplifier display, check that the external signal 1 (CTM1) bit 6 (see Section 1.1.1) is not set to "1".	∘ Since the cable is defective, replace it with a new one. ① In case of analog connection: Connection cable to CON1 ② In case of bus connection: Connection cable to CN1A (CAM11) (See Appendixes 1 and 2) ∘ Since the printed circuit board is defective, replace it with a new one. ① In case of analog connection: SF-CA card ② In case of SF-CA card: SF-TL card or SF-CA card (See the note of the Item 2 and Section 2.4)

(b) The motor rotates at the orientation speed but does not stop.

Item	Cause	Check	Remedy
1	The detector (magnesensor or encoder) is defective.	∘ Rotate the motor in the manner that it does not perform the orientation and check that the position feedback signal is normal. ① In case of magnesensor: (On the SF-OR or SF-TL card) • Waveform between CH4 and 0M (forward rotation) • Waveform between CH5 and 0M (forward rotation)  • Check that the above waveforms are normal. ② In case of encoder: (SF-OR or SF-TL card) • Waveform between CH1 and 0M • Waveform between CH2 and 0M • Waveform between CH3 and OM  Check that the above waveforms are normal. (Note) The OM terminal is located on the SF-CA card terminal board (lower right portion). (See Appendix 6(1).) (See the note of the alarm No.21, Section 3.5, and Appendix 9(2)(3).)	∘ Readjust the related controls by referencing the description of the orientation control circuit (Section 3). ∘ If it is impossible to readjust the controls, replace the detector with a new one.
2	The following printed circuit board is defective. ① In case of analog linkage: SF-OR card or SF-CA card. ② In case of bus linkage: SF-TL card or SF-CA card	∘ In the same manner as the Item 1 above, check the waveforms at the check terminals on the SF-OR card or SF-TL card.	∘ Readjust the related controls by referencing the description of the orientation control circuit (Section 3). ∘ If it is impossible to readjust the controls, replace the printed circuit board with a new one. (See Sections 2.4.2 and 2.4.3.)

Continued on the next page.

Item	Cause	Check	Remedy
	In the orientation operation using an encoder, 5 V power is not supplied to the encoder.	∘ Disconnect the connector CONE which is connected to the encoder and check that 5V power is applied between the pin 4 (or pin 5 or 6) and pin 20. (See Appendixes l-7 and l-8). ∘ Check the position of the shortcircuit ring of the pin. ① In the case that power is supplied from the spindle amplifier: . The side A of the PIN 3 is shortcircuited (on the SF-OR card). . The portions 2 and 3 of the PIN 5 are shortcircuited (on the SF-TL card). ② In the case that power is supplied from the NC: . The side B of the PIN 3 is shortcircuited (on the SF-OR card). . The portions 1 and 2 of the PIN 5 are shortcircuited (on the SF-TL card). (See References 1.1.2(1) and 1.1.3(3).)	∘ When 5 V power is applied, replace the cable which is connected from the CONB to the orientation encoder with a new one. ∘ When 5 V power is not applied and when the position of the shortcircuit ring is correct: ① Replace the control power SF-PW module with a new one. (See Section 5.3.1(5).) Alternatively, replace the SF-OR card (or SF-TL card) with a new one. ② Check the NC power. Alternatively, reolace the SF-OR card (or SF-TL card) with a new one.
4	The orientation parameter is incorrectly set.	∘ Check that the parameter (#4lOSL) which is set from the spindle amplifier accords with the orientation type. 1: Encoder 2: Magnesensor	∘ Correctly set the parameter.

(c) Although the motor performs the orientation stop, the stop state is abnormal.

Item	Cause	Check	Remedy
1	The orientation control circuit is abnormally set or defective. (Note) The following defective situations can be considered. ① The motor stops with a hunting. ② The servo rigidity is weak. ③ The motor over-shoots in speed.	∘ In the same manner as the Item 1 of (b), check that the position feedback signal is normal.	∘ Readjust the orientation control circuit by referencing Section 3.
2	The detector (magne-sensor or encoder) is defective.	∘ In the same manner as the Item 1 of (b) above, check that the position feedback signal is normal.	∘ Readjust the spindle orientation control circuit by referencing Section 3. ∘ If it is impossible to readjust such a circuit, replace the detector with a new one.
3	The following printed circuit board is defective. ① In case of analog linkage: SF-OR card or SF-CA card ② In case of bus linkage: SF-TL card or SF-CA card	∘ In the same manner as the Item 1 of (b) above, check that the position feedback signal is normal.	∘ Readjust the spindle orientation control circuit by referencing Section 3. ∘ If it is impossible to readjust such a circuit, replace the printed circuit board with a new one. (See Section 2.4.2 and 2.4.3)
4	The backlash of the portion where the encoder is mounted is large.	∘ In the multiple point orientation operation, check that the stop position of the forward orientation differs from that of the reverse orientation. ∘ Set the following address and data on the amplifier display in the status display debug mode. (See Reference 1.2.1.) Check that the display data of the forward orientation is the same as that of the reverse orientation and there is no electrical problem. An example of display data is as follows.	∘ Decrease the backlash of the portion where the encoder is mounted.

Continued on the next page.

Item	Cause	Check	Remedy
5	The parameter of the gear ratio is incorrectly set.	∘ Check that the stop situation depends on the gear being used. ∘ Check that the servo rigidity is weak.	∘ Parameters relating to gear ratio are as follows: GRA1, GRA2, GRA3, GRA4, GRB1, GRB2, GRB3. GRB4 ∘ NC parameter: #25(PR) to #32(PR ... 9" CRT screen NC parameter: #57(PR) to #64(PR . . . 14" CRT screen ∘ Spindle parameter: #39 and #40 (See References 1.2.2 and 1.2.3.)

1.3.10 The acceleration/deceleration time increases.

Item	Cause	Check	Remedy
1	The torque limit command is issued.	∘ Check that the CON1 pin No.5 (TL1) or No.21(TL2) are turned on by referencing Appendix 1-4 or 1-5.	∘ Turn off the limit command input TL1 and TL2 to release the torque limit.
2	The E² ROM No. is incorrect.	∘ Check the E² ROM No. by referencing Appendix 11 Table 1.1.	∘ Replace the ROM with a correct one or change the related parameter.
3	The parameter (#33CSN) value is too large.	∘ Check the parameter by referencing Reference 1.2.2.	∘ Correctly change the parameter value.

1.3.11 The speed detection signal, up to speed signal, or zero speed signal is not issued.

Item	Cause	Check	Remedy
1	The motor does not rotate.	◦ Check that the external signal 4 (STS2) bit 2 (SD speed detection) or bit 5 (UTS up to speed) is not turned on in the diagnosis mode on the status display. (See Section 1.1.1(2).)	◦ In the same manner as Section 1.3.4, take the required countermeasures.
2	The motor speed does not accord with that being specified.	◦ In the same manner as the Item 1 above, check the related signal.	◦ In the same manner as Section 1.3.5, take the proper countermeasures.
3	The output circuit of the SF-CA card is defective.	◦ Check that the external signal 4 (STS2) bit 2 (SD speed detection), bit 5 (UTS up to speed), or bit 4 (ZS zero speed) is turned on.	◦ Replace the SF-CA card with a new one. (See Section 2.4.4.)
4	The cable which is connected to the connector CON3 is defective.	◦ In the same manner as the Item 3 above, check that the external signal 4 bit 2, bit 5, or bit 4 is turned on in the diagnosis mode of the status display.	◦ Replace the cable with a ner one.

1.3.12 The tapping operation cannot be correctly performed.

(a) In case of synchronous tapping:

Item	Cause	Check	Remedy
1	The parameter relating to the synchronous tapping is incorrectly set.	∘ Compare the following parameters which are set on the NC CRT display with the parameter list on the machine and check them. • Fundamental specification parameter: • Axis Z specification parameter: • Spindle parameters: (See Reference 1.2.3.)	∘ Correctly set the parameter values.
2	The spindle speed is high.	∘ Compare the S command of the machining program with the speed being set by the machine manufacturer.	∘ Decrease the value of the S command of the machining program.
3	The spindle orientation encoder or printed circuit board (SF-TL card) is defective.	∘ Check that the waveforms at the check terminals (CH1, CH2, and CH3) on the SF-TL card are normal. (See the instructions for checking waveforms in the case of encoder ② as described in Section 1.3.9(b) Item 1.)	∘ Replace the detector or printed circuit board with a new one. (See Section 2.4.2 or 2.4.3.)
4	The cable between the spindle orientation encoder and the amplifier is defective.	∘ In the same manner as the Item 3 above, check the waveforms at the check terminals (CH1, CH2, and CH3) on the SF-TL card.	∘ Replace the cable with a new one.

(b) In case of un-synchronous tapping:

Item	cause	Check	Remedy
1	The speed of the spindle motor deviates for 10 rpm or more.	∘ Change the parameter value of the amplifier for the open loop state, input the speed reference and start command, rotate the motor at a low speed, and check the signal of the motor built-in encoder (in the same manner as the check method of the Item 6 of the alarm No.23(OSE)).	① When the signal waveform in the open loop state deviates: replace the printed circuit board SF-CA card with a new one. ② When the signal waveform in the open loop state does not deviate, in accordance with the Items 6, 7, and 8 of the alarm No.23 (OSE), (i) adjust the variable resistor in the motor built-in encoder and (ii) replace the printed circuit board or sensor with a new one.
2	The up to speed signal or zero speed signal is not issued.	∘ Check the external signal in the status display diagnosis mode by referencing Section 1.3.11.	∘ Take proper countermeasures by referencing Section 1.3.11.
3	The orientation encoder of the spindle is defective.	∘ In the same manner as the Item 1 of the alarm No.21 (NS2), check the signal waveform. ∘ Replace the encoder with a new one and check that the equipment correctly works. (See Appendix 7.)	∘ Replace the encoder with the new one.

1.3.13 The threading operation cannot be correctly performed.

Item	Cause	Check	Remedy
1	The orientation encoder of the spindle or the printed circuit board (SF-TL card or SF-OR card) is defective.	∘ In the same manner as the Item 3 of Section 1.3.12(a), check that the waveforms at the check terminals (CH1, CH2, and CH3) on the SF-TL card or SF-OR card are normal.	∘ Replace the detector or printed circuit board with a new one. (See Section 2.4.2 or 2.4.3.)
2	The cable between the orientation encoder of the spindle and the amplifier is defective.	∘ In the same manner as the Item 1 above, check the waveforms at the check terminals on the SF-TL card or SF-OR card.	∘ Replace the cable with a new one.
3	The speed of the spindle motor deviates for 10 rpm or more.	∘ In the same manner as the step 1 of Section 2.3.12(b), check the signal of the motor built-in encoder.	∘ In the same manner as the Item 1 of Section 2.3.12(b), ① replace the printed circuit board SF-CA card with a new one or ② replace the motor built-in encoder with a new one.

2. Checking and replacing parts

When replacing (i) the entire amplifier or (ii) printed circuit board SF-CA card (see Section 2.4.4), perform the items in the note.

Note Remove the E²PROM (ROM3) on the SF-CA card (see Appendix 6(1)) from the old card and mount it on the new card in the following manner.

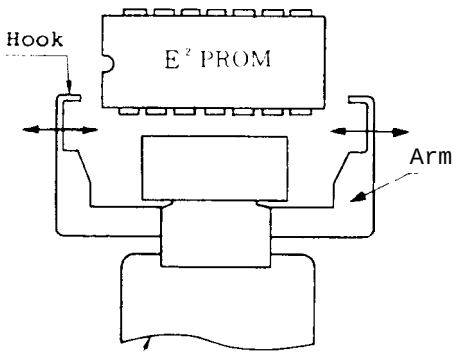
How to replace the E²PROM:

(1) Using the ROM extractor listed in Table 1.1(c) of Appendix 12, "Maintenance instruments", remove the E²PROM from the new amplifier (or SF-CA card) and store it.

(2) Then, remove the E²PROM from the old amplifier (or SF-CA card) and mount it on the new amplifier (or SF-CA card).

(3) Last, mount the E²PROM which was extracted from the new amplifier (or SF-CA card) on the old amplifier (or SF-CA card).

How to extract E²PROM:

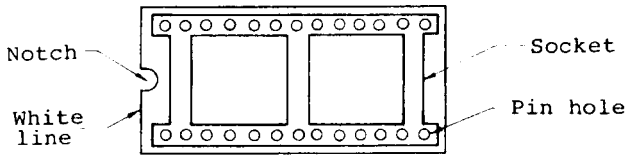


ROM extractor

① Widen the arms of the ROM extractor in the arrow direction as shown in the left-hand figure and insert both the hooks under the ROM.

② Narrow the width of the arms, place them on both the ends of the ROM, and gradually extract the ROM extractor in the straight direction perpendicular to the printed circuit board (without swinging it horizontally and vertically).

How to insert E²PROM:



① Lightly insert one side of the pins of the E²PROM into the socket.

② Push and insert the other side pins into the socket.

③ After checking that all the pins of the E²PROM are completely inserted into the socket holes, equally push the top side of the E²PROM.

The sections that follow describe how to replace the fuses, thermal protectors, amplifier cooling fan, printed circuit boards, and motor cooling fan and how to check the transistor module and diode stack.

2.1 Replacing fuses

By referencing Appendix 5, open the hinge panel which houses the printed circuit board SF-CA card, manually remove white fuses (F1, F2, and F3) which are inserted into the control circuit filter (FIL1) on the small panel, and replace them with new ones.

2.2 Replacing thermal protectors

By referencing Appendixes 5(1) to (4), unsolder the two leads which are soldered, loosen the mounting screws, and replace the thermal protectors with new ones.

THS1 . . . Fixed on the small panel with screws.
THS2 . . . Fixed on the heat radiation fin with screws.

2.3 Replacing amplifier cooling fan

By referencing Appendix 5(1) to (4), remove parts which fasten the cooling fan on the bottom plate in the following manner.

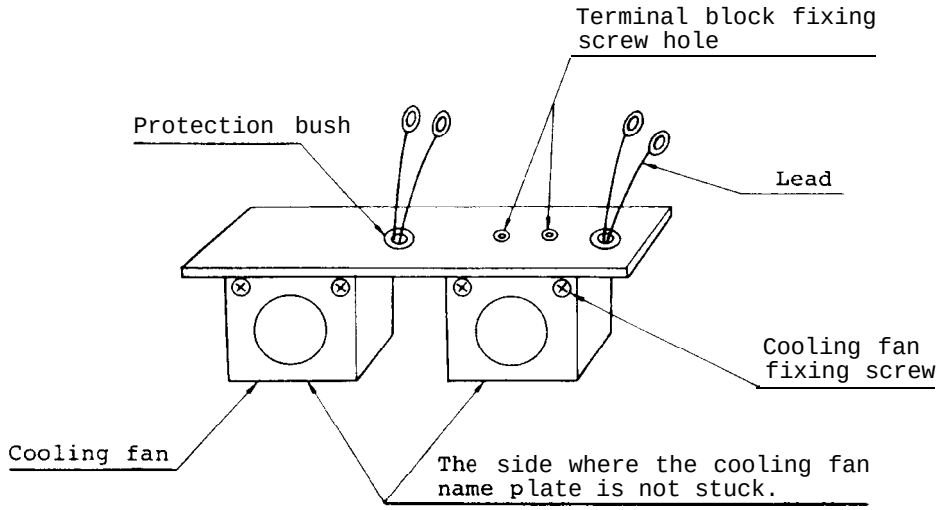
(i) Remove the leads for the cooling fan from the terminals RO and SO on the terminal block TB11.

(ii) Loosen the mounting screws on the terminal block TB11 and remove the terminal plate from the bottom plate.

(iii) Loosen the mounting screws of the cement resistor RO (1 or 2 pieces) and remove the cement resistor(s).

(iv) For the amplifier where the electromagnetic relay RA1 is mounted on the bottom plate, loosen the mounting screws and remove the electromagnetic relay from the bottom plate.

(v) Extract the base plate where the cooling fan is mounted from the amplifier main unit. (See the following figure.)



(vi) Extract the leads from the protection bush hole.

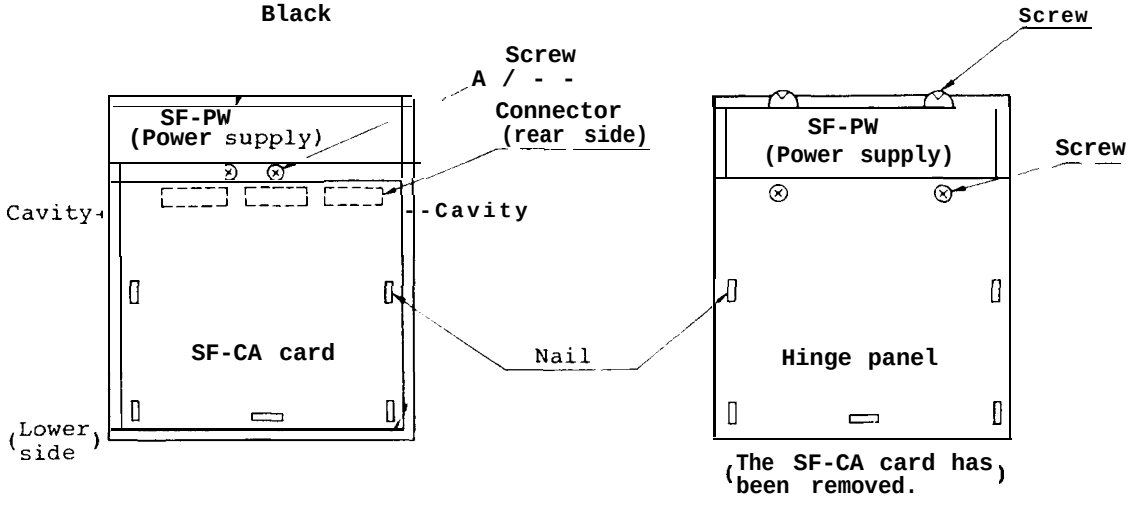
(vii) Loosen the cooling fan mounting screws and replace the cooling fan with a new one.

(Note) When mounting the cooling fan, the side where the cooling fan name plate is not stuck is located as shown in the figure.

(viii) When assembling the amplifier cooling fan, perform the reverse procedure as the disassembling procedure.
(Note) After the cooling fan is replaced with the new one, check that the cooling fan name plate is observed from the outside of the amplifier.

2.4 Replacing printed circuit board

2.4.1 Replacing SF-PW module



(i) By referencing Appendix 2-1 or 2-2, keep the following connectors and cable connections as they are.

On SF-CA card CON1, CON2, CON3, TB2
On SF-OR card . . . . . CON4, CONB, CONAA, CONC
(On SF-OR10 card)
Or, on SF-TL card . . . CN1B, CONB, CONAA

(ii) By referencing Appendix 5, open the hinge panel and remove the leads from the following three terminals on the terminal board TB11.

R0, S0 . . . . . White leads (Remove either of them.)
E ..... Green lead

(iii) Remove the five nails on the SF-CA card (left figure) and loosen the two screws.

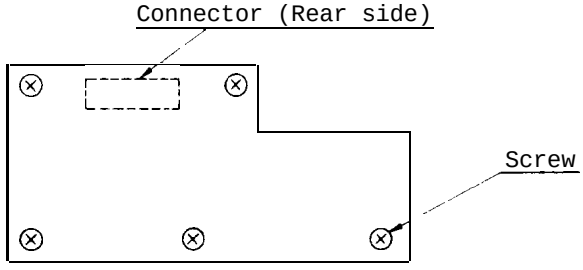
(iv) Raise and remove the SF-CA card from the hinge panel. Last, insert your fingers into the cavities (2 positions) on the hinge panel and remove the entire SF-CA card from the hinge panel.

(v) By referencing the right figure, loosen the four screws which fasten the SF-PW (power supply) and remove it.

(vi) After replacing the SF-PW (power supply) module, assemble the parts in the reverse order of the disassembling procedure.

(Note) When mounting the SF-CA card, push the connector by your fingers from the front side of the card so that the connector on the rear side of the SF-CA card is securely connected to the SF-CA card.

2.4.2 Replacing SF-OR or SF-OR10 card



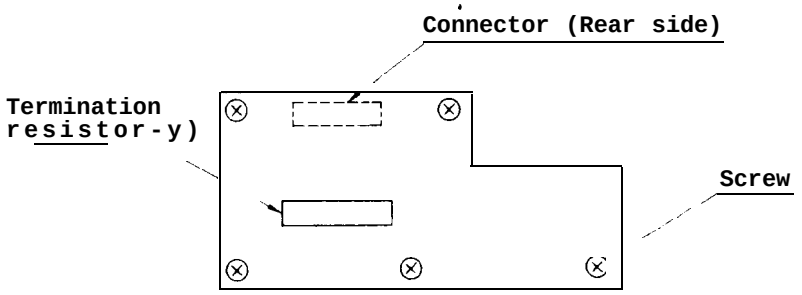
(i) By referencing Appendix 2-l or 2-2, remove the connectors (CON4, CONB, CONAA, and CONC).

(ii) Loosen the five screws and remove the SF-OR (or SF-OR10) card.

(iii) After replacing the SF-OR (or SF-OR10) card, assemble the parts being disassembled in the reverse procedure as the assembling procedure.

(Note) When mounting the card, by pushing the connector (rear side) from the front side with your fingers and check that the connector is securely connected to the card.

2.4.3 Replacing SF-TL card



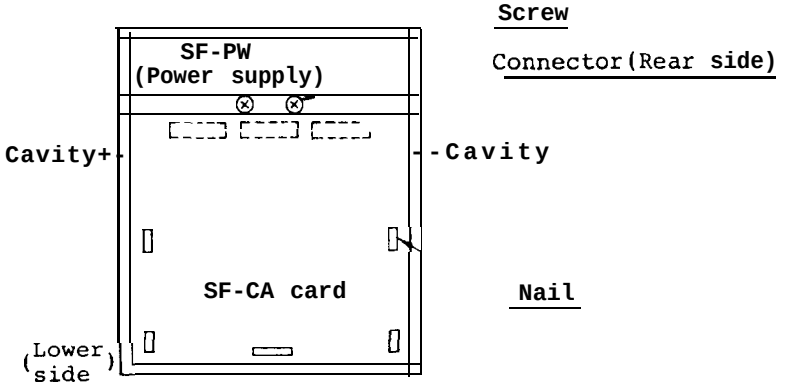
(i) By referencing Appendix 2-3, remove the connectors (CN1A, CONB, CONAA) and termination resistor (CN1B).

(ii) Loosen the five screws and remove the SF-TL card.

(iii) After the SF-TL card is replaced, assemble the parts being disassembled in the reverse order of the assembling procedure.

(Note) When mounting the card, by pushing the connector (rear side) from the front side with your fingers and check that the connector is securely connected to the card.

2.4.4 Replacing SF-CA card



(i) By referencing Appendixes 2-l to 2-3, remove the following option card from the SF-CA card.
SF-OR card or SF-OR10 card or SF-TL card

(ii) Remove the connectors (CON1, CON2, and CON3) on the SF-CA card and the connections on the terminal block TB2.

(iii) Remove the five nails on the SF-CA card and loosen the two screws.

(iv) Raise the SF-CA card from the lower side and remove it from the hinge panel.
Last, insert your fingers into the hinge panel cavities (2 positions) and remove the entire SF-CA card from the hinge panel.

(v) After the SF-CA card is replaced, assemble the parts being disassembled in the reverse order of the assembling procedure.

(Note) When mounting the card, by pushing the connector (rear side) from the front side with your fingers and check that the connector is securely connected to the card.

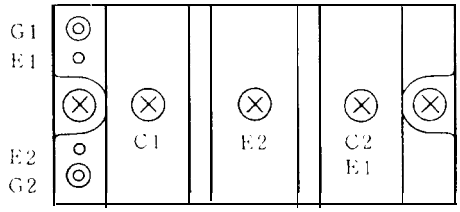
(vi) Adjust the offset volume vR2 and VR3 using A DC voltmeter.

Volume No.	Description	Check pin	Adjustment value
VR2	U phase current feedback zero adjustment	CH40-0M	±5 mV or less
VR3	V phase current feedback zero adjustment	CH41-0M	

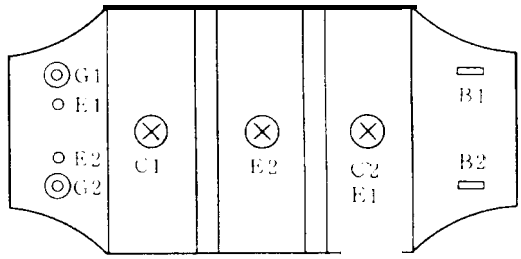
(Note) When replacing the SF-CA card, first remove the E^2ROM from the old card and then mount it on the new card.

2.5 Checking transistor module (This method is the same both in the power side and regeneration side.)

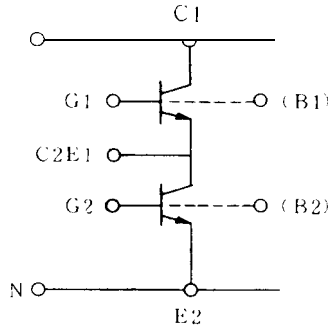
(a) 75 A or less



(b) 100 A or more



(Note) The following figure shows the relationship between the terminal symbols and circuit diagram of the above transistor module.



(i) On the terminal block TB3, remove the wires U, V, and W which are connected to the motor.

(ii) In the same manner as Section 2.4.4, to open CON101 to 103, remove the SF-CA card from the hinge panel.

(iii) In accordance with the following criteria, check the electric continuity of each terminal and determine whether the transistor module is good or bad.

(Note) Even if part of the transistor module is defective, replace the entire amplifier with a new one. In addition, if the transistor module should be replaced, to prevent the transistors from being damaged by your static electricity, ground yourself and replace it by referencing Section 2.7.

Criterion list
(when x 10 Ω range of the circuit tester is used)

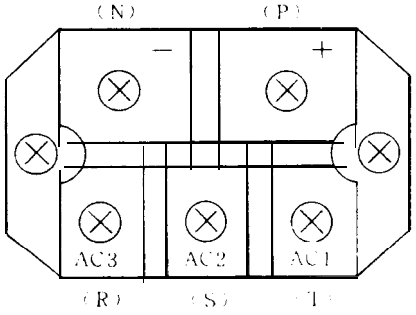
Terminal to be checked	Circuit tester terminal	OK	No good
Between C1 and C2E1	C1 :⊕ terminal	Several 10Ω	Shortcircuited, indefinite
	C1 :⊖ terminal	Indefinite	Shortcircuited, several 100 Ω
Between C1 and G1	C1 :⊕ terminal	Indefinite	Shortcircuited, several 100 Ω
	C1 :⊖ terminal	Indefinite	Shortcircuited, several 100 Ω
Between G1 and C2E1	G1 :⊕ terminal	Several 100Ω	Several 100 Ω, indefinite
	G1 :⊖ terminal	Indefinite	Shortcircuited, several 100 Ω
Between C2E1 and E2	G2E1: ⊕ terminal	Several 10Ω	Shortcircuited, indefinite
	G2E1: ⊖ terminal	Indefinite	Shortcircuited, several 100 Ω
Between C2E1 and G2	C2E1: ⊕ terminal	Indefinite	Shortcircuited, several 100 Ω
	C2E1: ⊖ terminal	Indefinite	Shortcircuited, several 100 Ω
Between G2 and E2	G2 :⊕ terminal	Several 100Ω	Shortcircuited, indefinite
	G2 :⊖ terminal	Indefinite	Shortcircuited, several 100 Ω
Between B1 and C1	B1 :⊕ terminal	Indefinite	Shortcircuited, several 100 Ω
	B1 :⊖ terminal	Several 10Ω	Shortcircuited, indefinite
Between B2 and C2E1	B2 : ⊕ terminal	Indefinite	Shortcircuited, several 100 Ω
	B2 :⊖ terminal	Several 10Ω	Shortcircuited, indefinite

(Note) ⊕ terminal: Red lead of circuit tester

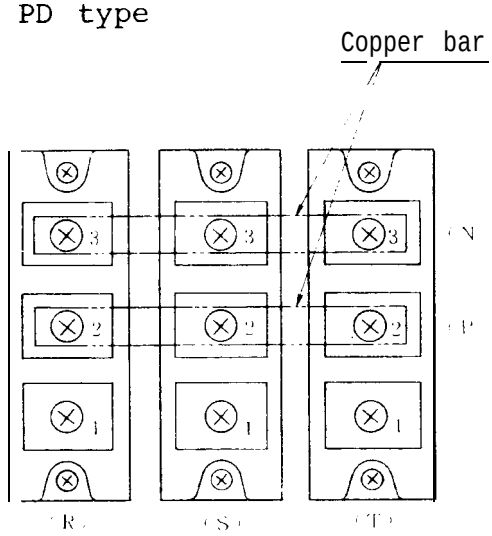
⊖ terminal: Black lead of circuit tester

2.6 Checking diode stack

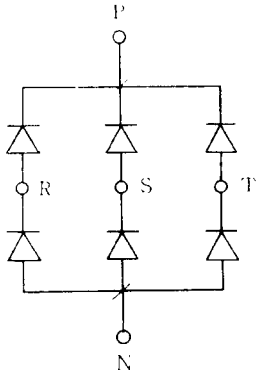
(a) PT type

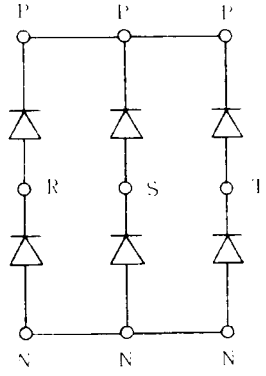


(b) PD type



(Note) The following figures show the relationship between the terminal symbols and circuit diagram of the above diode stack.





(i) Remove the leads which are connected to the terminals P and N.

(ii) Check the electric continuity of each two terminals in accordance with the criterion list and check that the diode stack is good or no good.
(First, check the electric continuity between P and N.)

(Note) Even if part of the diode stack is defective, replace the entire amplifier with a new one. If it is necessary to replace the diode stack, by referencing Section 2.7, replace it with a new one.

Criterion list
(when x 10 Ω range of the circuit tester is used)

Terminal to be checked	Circuit tester terminal	OK	No good
Between P and R	P : ⊕ terminal	Indefinite	Shortcircuited, several 100Ω
	P : ⊖ terminal	Several 10Ω	Shortcircuited, indefinite
Between P and S	P : ⊕ terminal	Indefinite	Shortcircuited, several 100Ω
	P : ⊖ terminal	Several 10Ω	Shortcircuited, indefinite
Between P and T	P : ⊕ terminal	Indefinite	Shortcircuited, several 100Ω
	P : ⊖ terminal	Several 10Ω	Shortcircuited, indefinite
Between N and R	N : ⊕ terminal	Several 10Ω	Shortcircuited, indefinite
	N : ⊖ terminal	Indefinite	Shortcircuited, several 100Ω
Between N and S	N : ⊕ terminal	Several 10Ω	Shortcircuited, indefinite
	N : ⊖ terminal	Indefinite	Shortcircuited, several 100Ω
Between N and T	N : ⊕ terminal	Several 10Ω	Shortcircuited, indefinite
	N : ⊖ terminal	Indefinite	Shortcircuited, several 100Ω
Between P and N	P : ⊕ terminal	Indefinite	Shortcircuited, several 100Ω
	P : ⊖ terminal	Several 100Ω	Shortcircuited, indefinite

(Note) ⊕ terminal: Red lead of circuit tester

⊖ terminal: Black lead of circuit tester

2.7 Replacing transistor module and diode stack

(i) Disconnect the leads which are connected to the transistor module or stack and remove them from the heat radiation fin.

(Note) Since part of the terminals G and E of the transistor module is of the insert type, when removing them, take care of it.

(ii) Equally apply silicone grease on the rear side of the module or stack.

(iii) At the specified tightening torque (see the following table), mount the devices in the same direction as the old ones and then connect the leads.

(Note) Put on the tube on the terminal G of the transistor module.

Tightening torque table

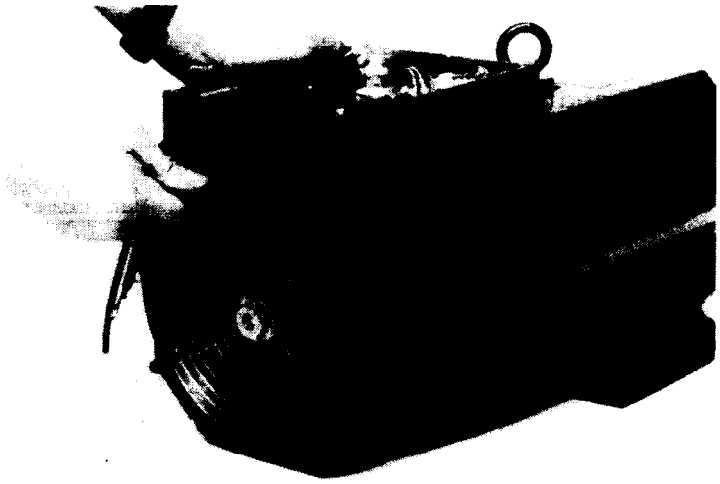
	Model	Screw size	Maximum tightening torque (kg-cm)	Recommended tightening torque (kg-cm)
Diode	PT768 PD608 PD1008	M5 x 0.8	20	17 ± 2
Transistor	UM75CDY-10 UM100CDY-10 UM150CDY-10	M5 x 0.8	20	17 ± 2

(Note) Since the diodes and transistors used in the equipment conform with the detail specifications, they which are replaced or prepared for spares should be purchased from Mitsubishi.

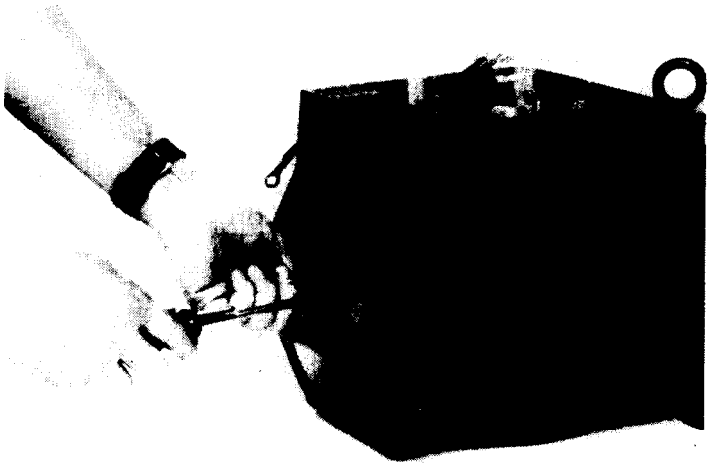
2.8 Replacing motor cooling

(a) In the case of 132 frames or less

(1) Remove the hex socket bolts which fasten the finger guard.

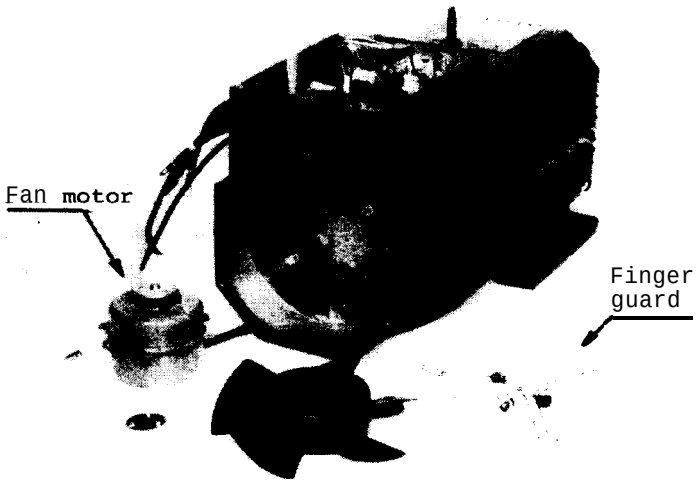


(2) Remove the P flat head screw which is located at the center of the cooling fan and only the fan can be dismounted.



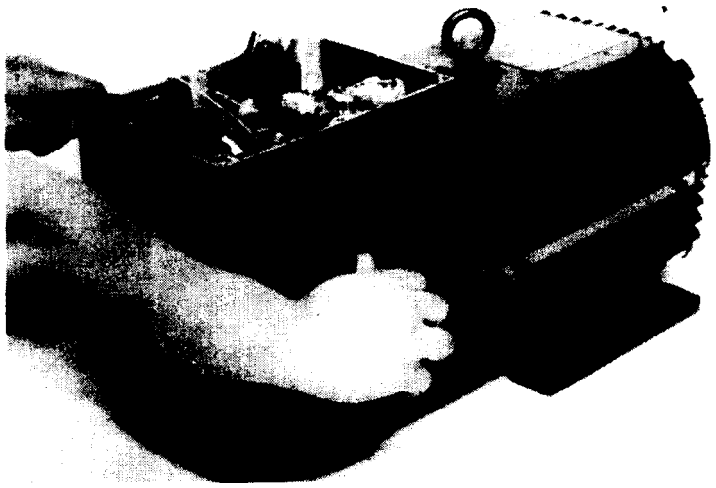
(3) Cut the four leads of the cooling fan which are connected in the terminal box. Remove the P flat head screw which fastens the fan motor main body and the fan motor main unit can be dismounted from the fan case.

(4) Assemble the parts in the reverse order of the disassembling procedures (1) to (3).

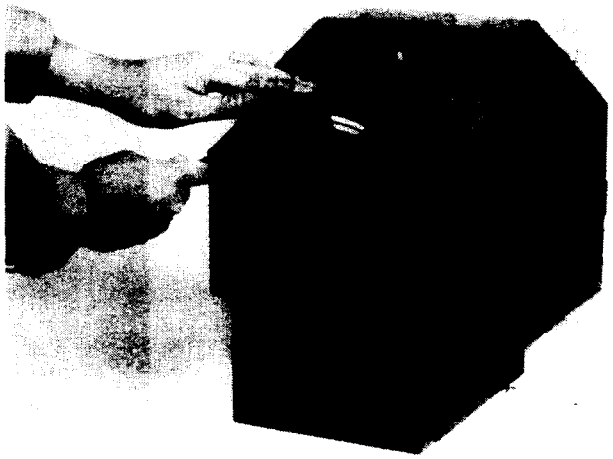


(b) In the case of 160 frames or more:

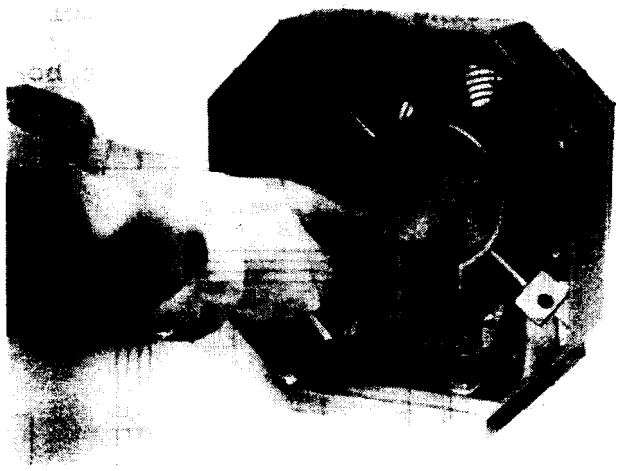
(1) Remove the three hex. socket bolts which fasten the fan case and pull the fan case in the rear direction and the fan case with the cooling fan can be dismounted.



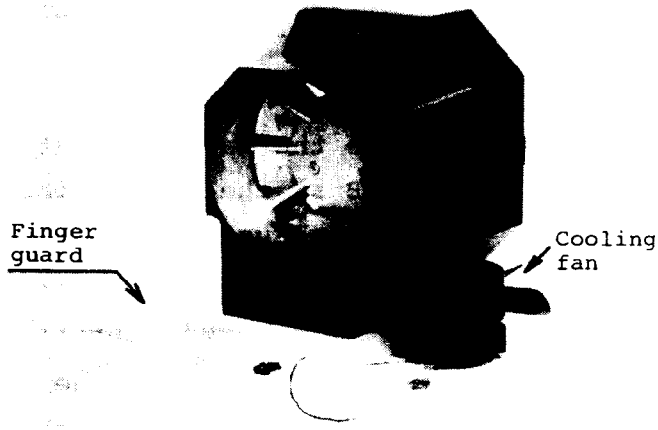
(2) Remove the hex. socket bolts which fasten the finger guard.



(3) Cut the three leads of the cooling fan which are connected in the terminal box. Remove the P flat head screw which fastens the cooling fan from the inside of the fan case and the cool fan can be dismounted from the fan case.

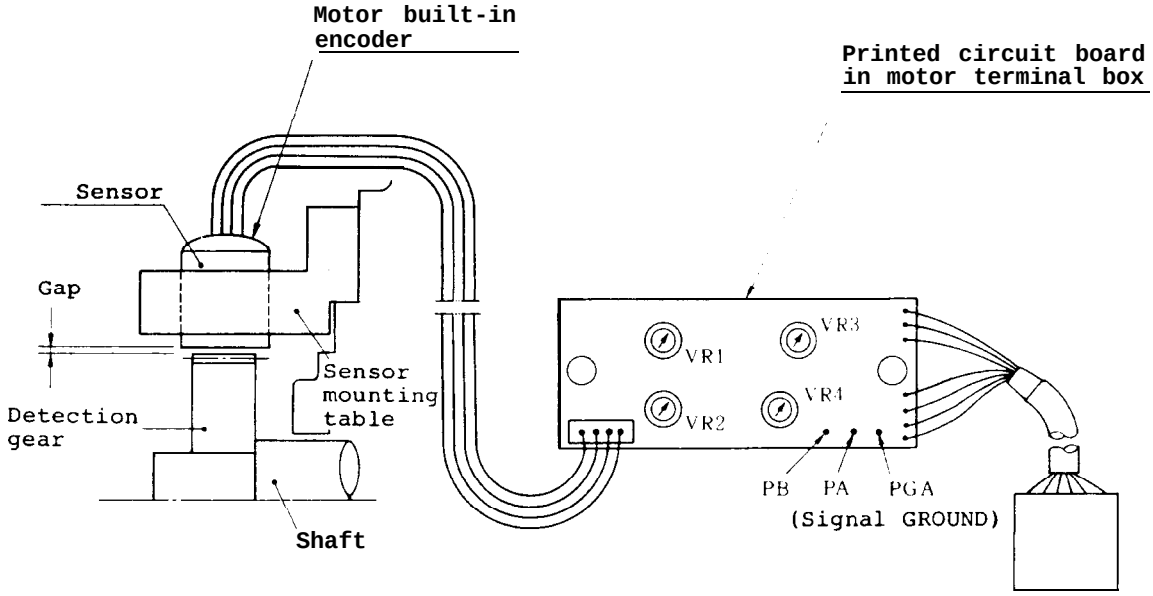


(4) Assemble the parts in the reverse order of the disassembling procedures (1) to (3).



2.9 Adjusting and replacing motor built-in encoder

2.9.1 Adjusting printed circuit board



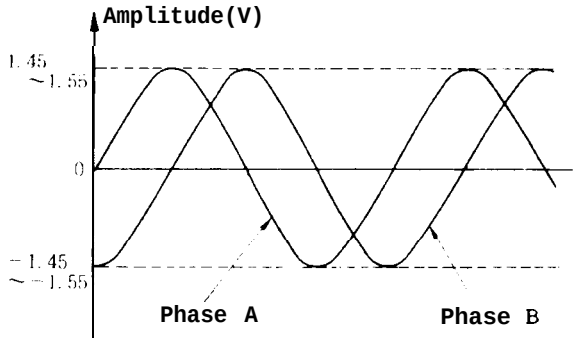
(i) Observe the waveforms at the same time for phases A and B at the check pins on the above printed circuit board using an oscilloscope.

Phase A output . . . . . Between PA and PGA

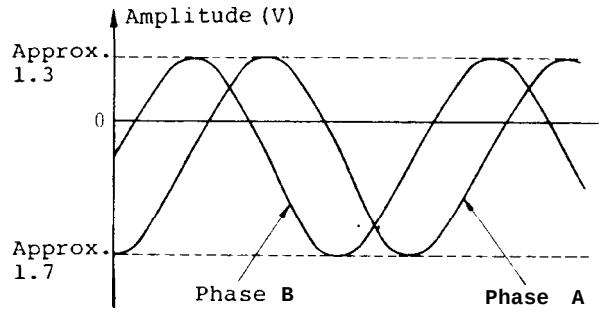
Phase B output . . . . . Between PB and PGA

(ii) Rotate the motor in the forward direction (counter-clockwise viewed from the shaft end) at a low speed so that the waveform can be easily observed and adjust the following four volumes until the following output waveforms can be observed.

Volumes	Adjustment function
VR1	Zero level adjustment of phase A
VR2	Amplitude adjustment of phase A
VR3	Zero level adjustment of phase B
VR4	Amplitude adjustment of ohase B

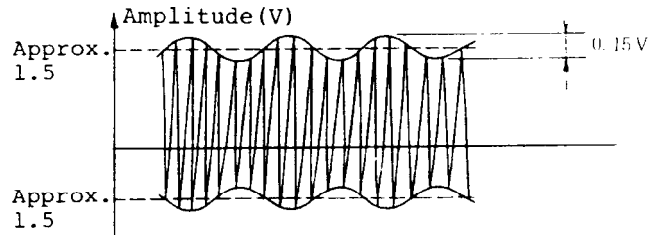


(iii) Rotate the motor in the reverse direction (clockwise) and check that the following waveforms can be observed at the nearly same speed as (ii) above.



(iv) Press the pushbutton switch PB1 (see Reference 1.1(2) and Appendix 6(1)) to reset the equipment to the closed loop. Rotate the motor at the maximum speed and check that the amplitudes of the signal outputs for the forward rotation and reverse rotation are ± 0.8 V or more.

(v) Check that the motor speed is the middle speed of the base speed (approx. 1500 rpm) and the envelopes of the signal waveforms of the phases A and B are 0.3 V or less.
The following figure exemplifies a waveform of phase A.



(vi) Rotate the motor from a low speed to the maximum speed and check that it does not generate noise both in the forward rotation and reverse rotation.

(Note 1) If the printed circuit board is defective:
If the items for (ii) to (vi) cannot be adjusted on the printed circuit board which is mounted on the motor, replace the board with a new one and try to adjust the same items.

(Note 2) If the gap between the sensor in the motor and the detection gear is incorrect:
By referencing Section 4.2, replace the set of sensor and printed circuit board with new ones and try to readjust the items (ii) to (vi) again.

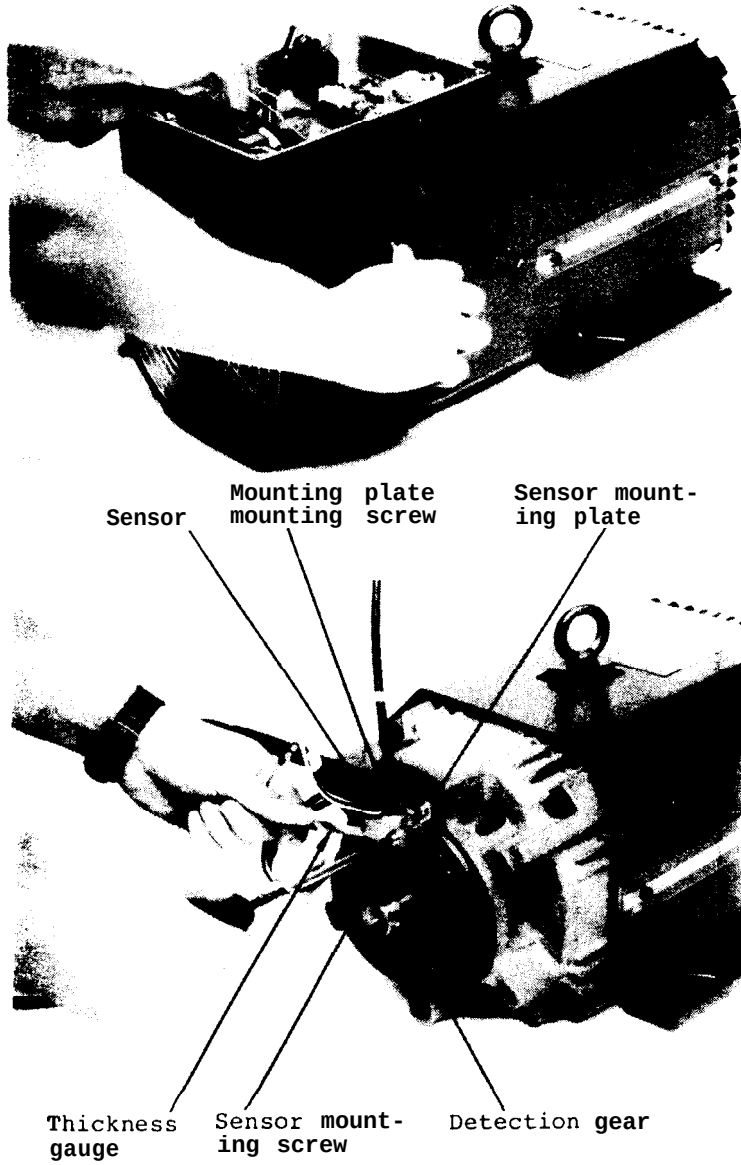
2.9.2 Replacing encoder and printed circuit board

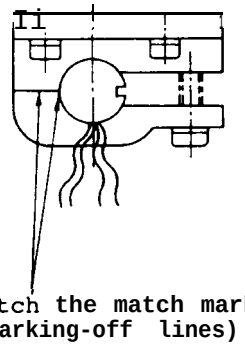
(1) Remove the connector of the sensor from the printed circuit board in the terminal box.

(2) Remove the three hex. socket bolts which fasten the fan case and pull the fan case in the rear direction. At the time, the fan case with the cooling fan can be dismounted.

(3) Remove the two P flat head screws which fasten the sensor fixing plate to dismount the mounting plate with the sensor. At the time, take care not to collide the sensor with the detection gear.

(4) To adjust the sensor position, loosen the sensor mounting screw while the sensor mounting plate is fastened and adjust the gap between the detection gear and the sensor using a thickness gauge (the gap is marked on the sensor mounting plate). At the time, check that the sensor's match mark (marking-off lines) matches that of the mounting plate and tighten the sensor mounting screws. (See the right-hand figure.)





(5) Apply screw lock paint on the sensor mounting screws and plate mounting screws.

(6) When assembling the fan case, fully extend the sensor leads into the terminal box to prevent them from getting caught.

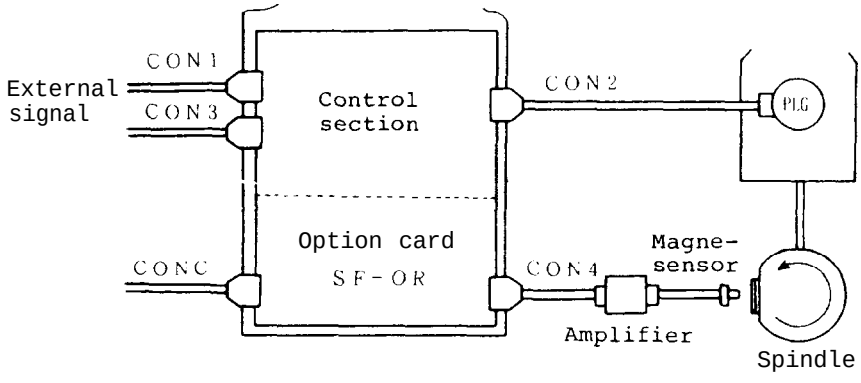
3. Spindle orientation control circuit

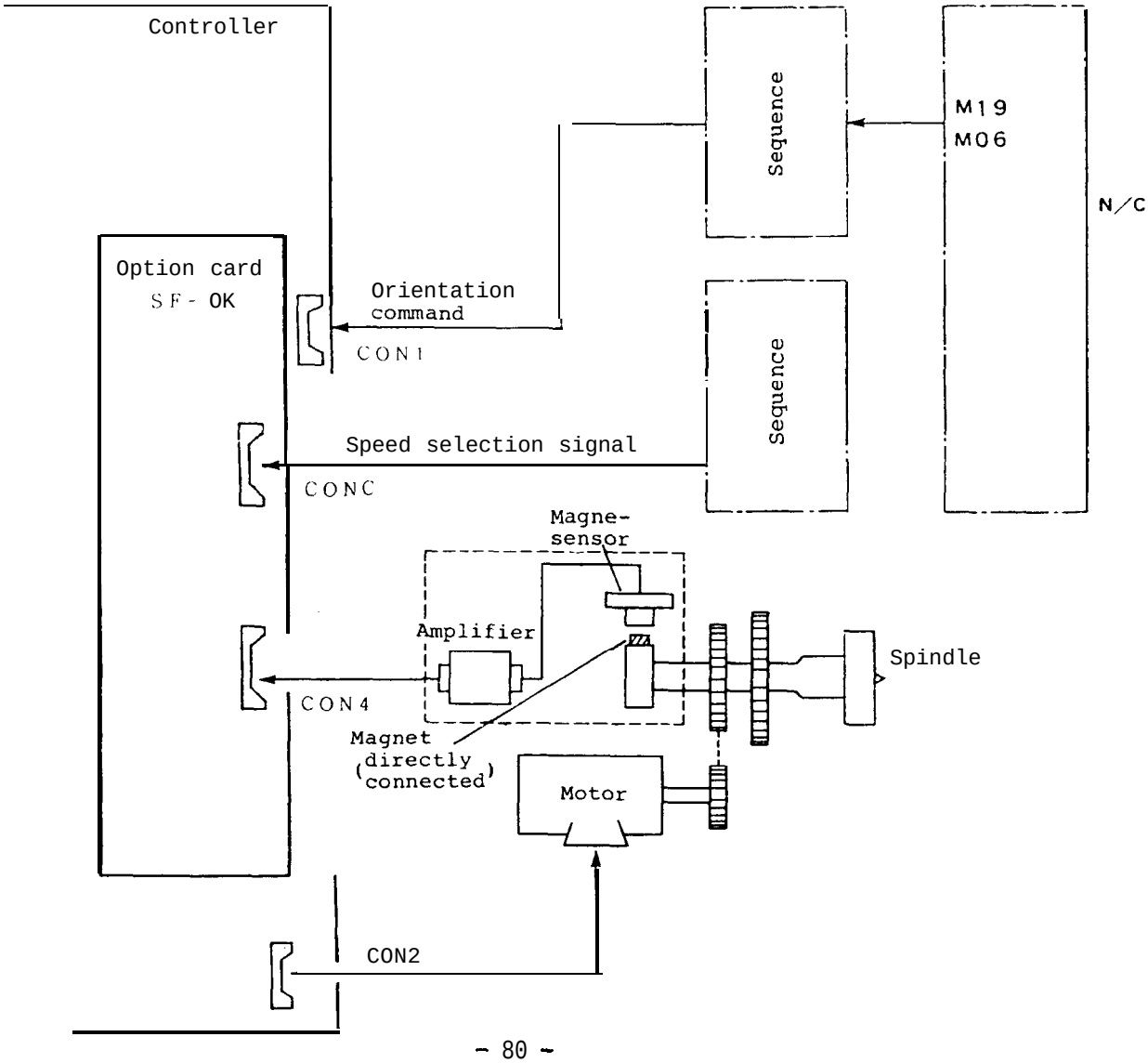
This chapter describes the maintenance, installation, and adjustment procedures for the electric orientation (fixed position stop) function which is provided to the spindle of an NC machine.

3.1 Structure

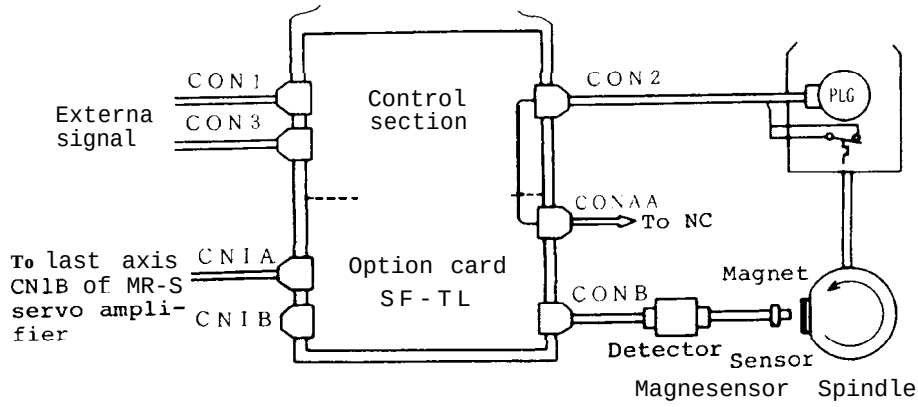
3.1.1 Spindle orientation using magnesensor (1 point)

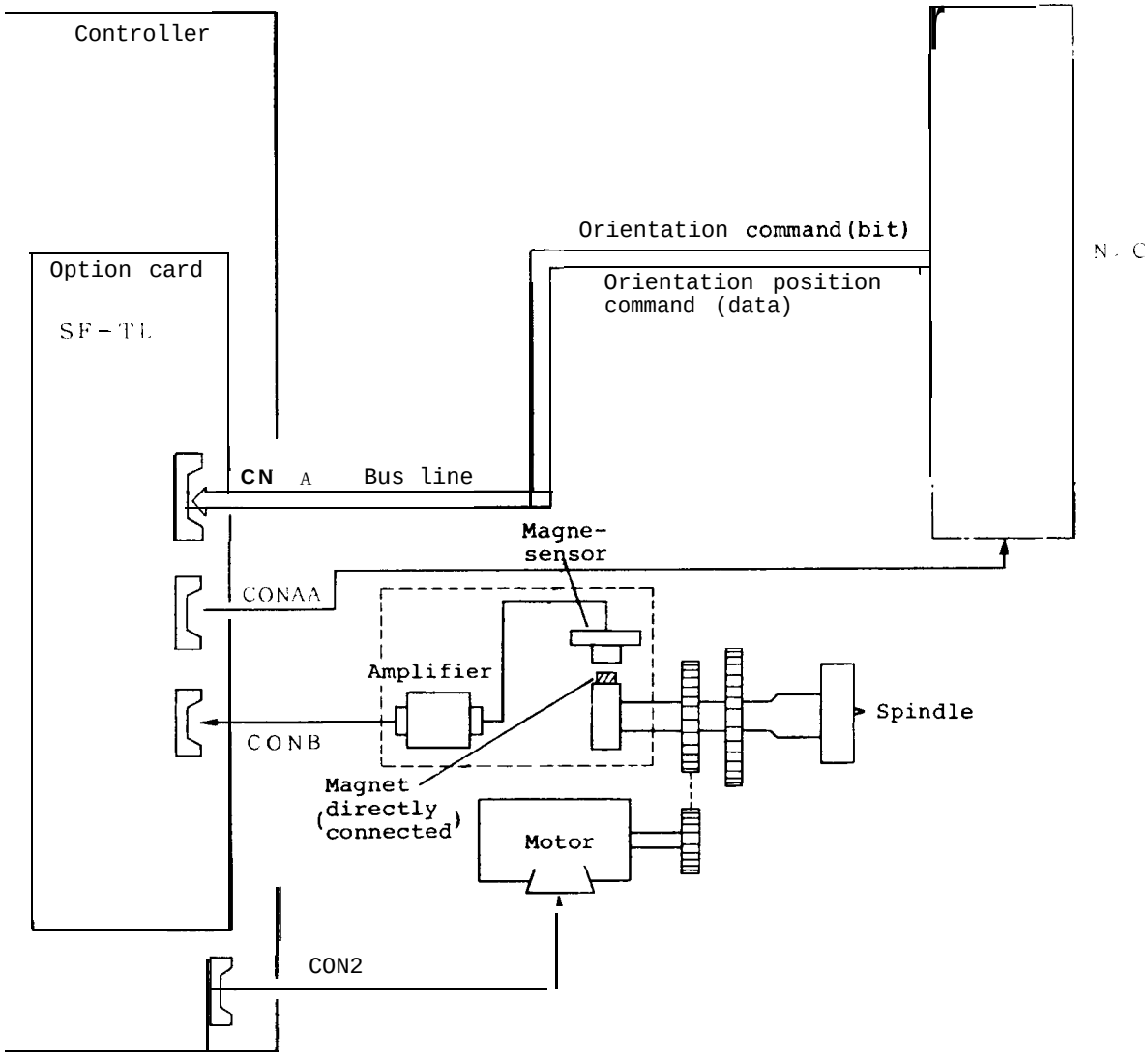
(a) Where speed selection signal function is provided:





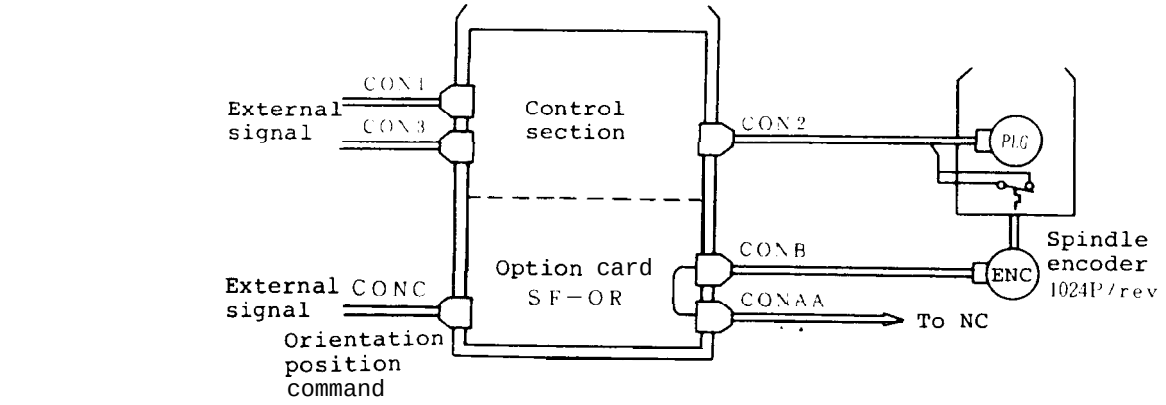
(b) Where the equipment is lined with the NC through the bus:

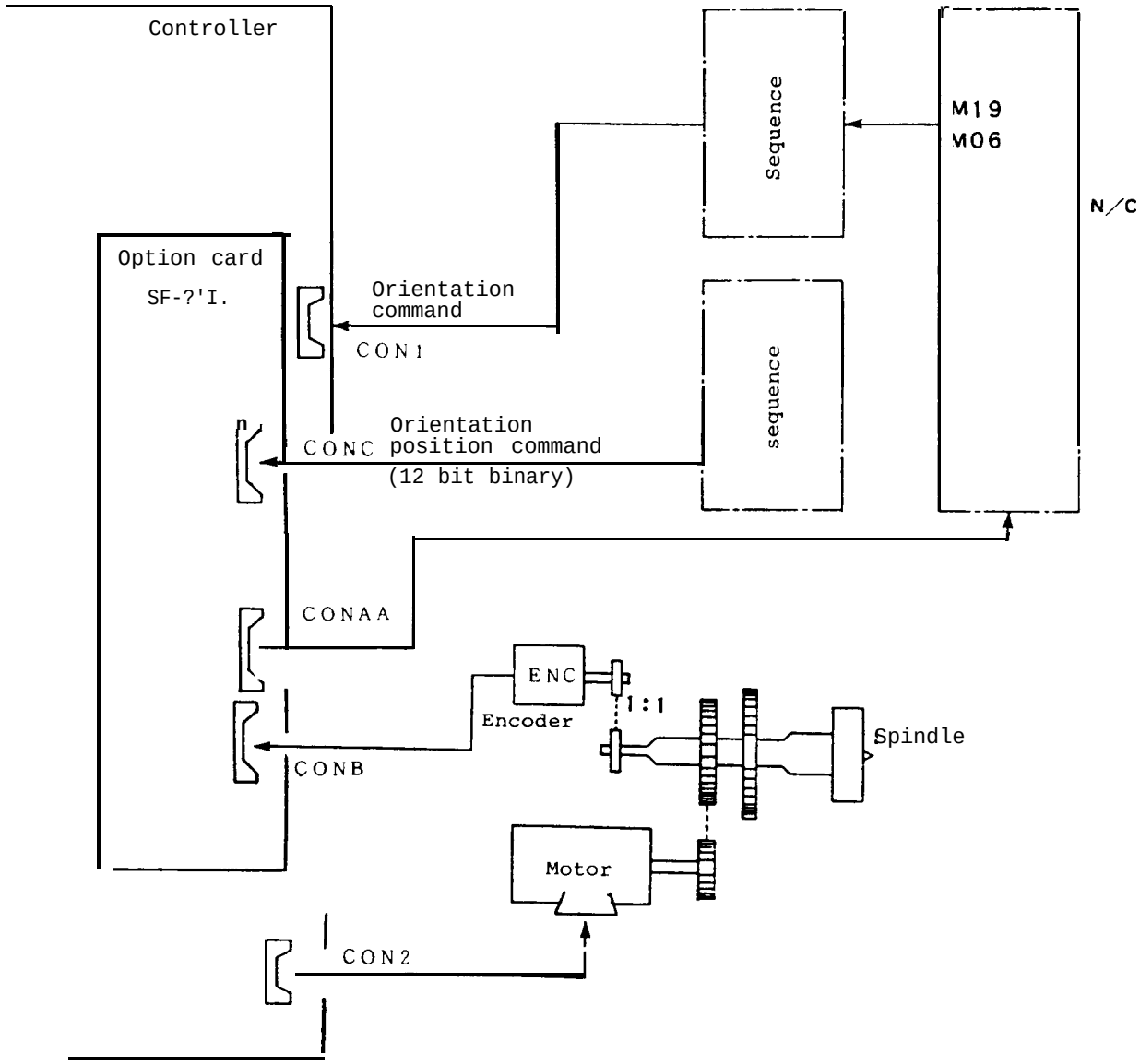




3.1.2 Spindle orientation using encoder (4096 points, with index function)

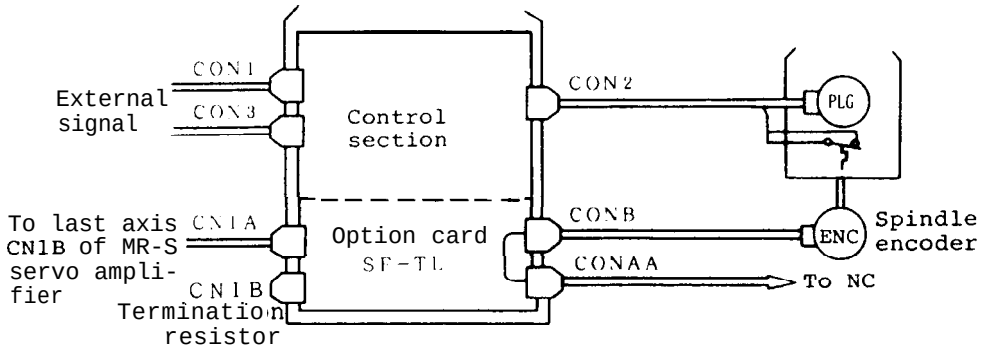
(a) Where the equipment is linked with te NC using analog or digital signals:

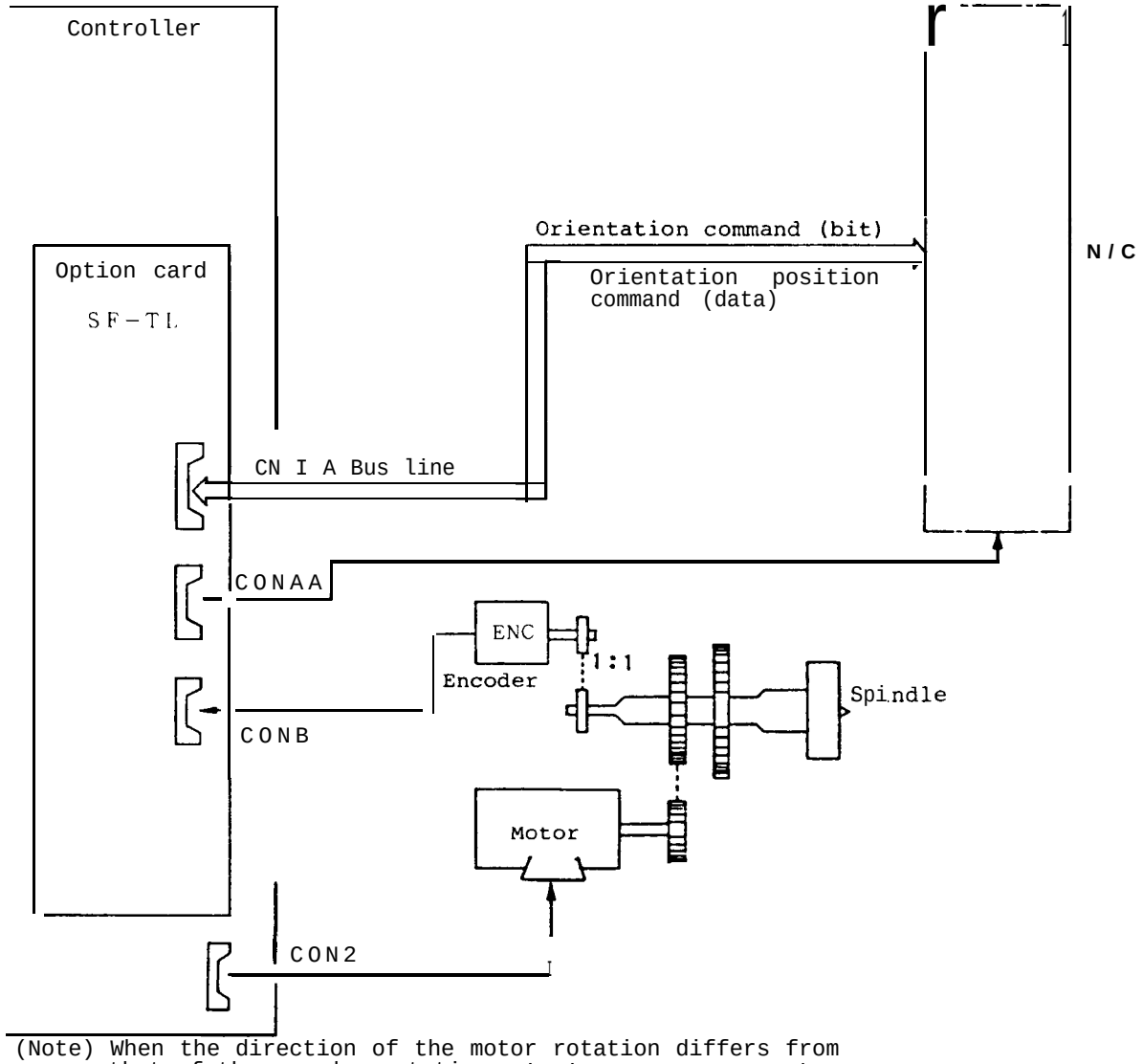




(Note) When the direction of the motor rotation differs from that of the encoder rotation, it is necessary to change the bit 8 and bit E of the parameter 0RS2 (amplifier parameter #30).

(b) Where the equipment is linked with the NC through the bus:





(Note) When the direction of the motor rotation differs from that of the encoder rotation, it is necessary to change the bit 8 and bit E of the parameter ORS2 (amplifier parameter #30; NC parameter #16 (PR)).

3.2 Control circuit and parameter setting

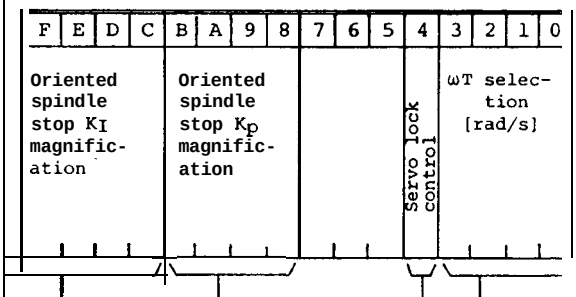
3.2.1 Where the speed selection signal function is provided (SF-OR card):

(1) Setting parameters

Although the contents of the parameters which are set by the amplifier are listed in Reference 1.2.2(2), only the parameters relating to the orientation function are listed in the following.
For instructions of setting parameters, see Reference 1.2.2(1).

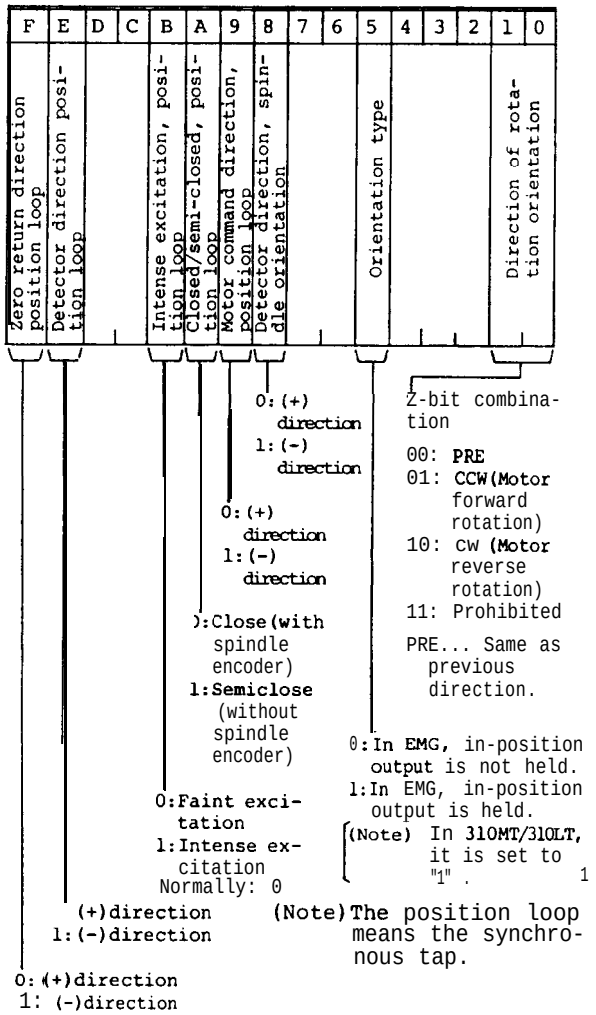
#	Parameter		Description	Setting range (unit)	
03	PLG	Position loop encoder type	The setting depends on the number of pulses of the encoder. 0: 1024 pulses (encoder orientation, tapperless) 1: 90000 pulses(for axis c control)	Decimal notation	
21	PG1	Orientation 1st deceleration point	Encoder orientation: Angle from which creep speed starts is set. Standard setting: 180 Magnesensor orientation: Time taken for start of creep speed after passing over liner zone is set. Standard setting: 133	Encoder 0 - 359(deg.)	Magnesensor 0 - 500ms
22	PG2	Orientation 2nd deceleration point	Angle at which creep speed for position loop starts is set. Standard setting: 20		0 - 40 (deg.)
24	ZRZ	Orientation in-position range	Positioning range within which 'orientation complete" signal is output is set. Standard setting: 16 (NC display standard setting: 1.00)	Encoder 1 - 5760 (1/16 deg.) For parameter on NC display. 0 - 359(deg.)	Magnesensor 1 - 512 (1/16 deg.) 0 - 39 (deg.)
25	OSP	Spindle orientation speed	Orientation speed is set. Standard setting: 200	0 - 1000 rpm	
26	CSP	Creep speed	Creep speed is set. Standard setting: 20	0 - 1000 rpm	
27	PST	Position shift	Oriented spindle stop position is set. Encoder: Stop position is set within 360 deg. with increment of 360/4096. Magnesensor: Stop position is set within range from -5 deg. to +5 deg. with increment 10/1024 (2048 for 0 deg.) Standard setting:2048	Encoder 0 - 4095	Magnesensor 1536 - 2560

#	Parameter		Description	Setting range (unit)
2F	)RS1	)riented spindle stop :ontrol 1	:ontrol type (such as gain) during orien-:ation stop is set. Standard setting:4400 (When spindle GD² is small like a dedicated machine, it should be set to 6601.)	Hexadecimal notation



4-bit combination [times]	4-bit combination [times]		4-bit combination [rad/s]
0: 0.6	0: 0.6	0: Delay/ advance	0: 0.55
1: 0.7	1: 0.7	1: PI	1: 1.1
2: 0.8	2: 0.8		2: 1.65
3: 0.9	3: 0.9		3: 2.2
4: 1	4: 1		4: 2.75
5: 1.2	5: 1.2		5: 3.3
6: 1.4	6: 1.4		6: 3.85
7: 1.6	7: 1.6		7: 4.4
8: 1.8	8: 1.8		8: 4.95
9: 2	9: 2		9: 5.5
A: 2.2	A: 2.2		A: 6.05
B: 2.4	B: 2.4		B: 6.6
C: 2.6	C: 2.6		c: 7.15
D: 2.8	D: 2.8		D: 7.7
E: 3	E: 3		E: 8.25
F: 3.2	F: 3.2		F: 8.8

(Note) The Kp magnification should be set to the magnification for X36 VKP. The Ki magnification should be set to the magnification for #37 VKI.

#	Parameter		Description	Setting range (unit)
30	RS2	Oriented spindle stop control 2	The spindle orientation direction, detector installed direction, and motor rotation direction are set. [Magnesensor orientation] Standard setting: 0020 (0120 when the detector installation direction is reversed) [Encoder orientation] Standard setting: 0120 (0020 when the detector installation direction is reversed)  	Hexadecimal notation
41	SSL	Spindle orientation type	Type of spindle orientation is set. 0: Motor built-in encoder 1: Encoder 2: Magnesensor	Hexadecimal notation

#	Parameter		Description	Setting range (unit)
42	ISL	Bit assignment	F E D C B A 9 8 7 6 5 4 3 2 1 0 C: Position command, oriented spindle stop 8: Speed reference input 4: Load meter output 2: MRDY input in NC mode 1: EMG input in NC mode 0: Alarm display in case of EMG. Position command, oriented spindle stop 0: Open emitter 1: open collector Speed reference input 0: Open emitter 1: Open collector Load meter output 0: Load meter output 10V 1: Load meter output 3v Machine ready signal in NC mode 0: Invalid 1: Valid External EMG in NC mode 0: Invalid 1: Valid Alarm code output in case of external EMG 0: Presence 1: Absence	Hexadecimal notation
C1 C2	M1	PG1 magnification for respective gear	The magnification for #21PG1 (first deceleration point for orientation) for respective gear is set. C1: F 8 7 0 — Gear 01 | Gear 00 C2: F 8 7 0 — Gear 11 | Gear 10 10H (16D) is regarded as 1 time. Set to adjust orientation for the respective gear. If 0 is set, it becomes 1 time.	$\frac{1}{16}$ to 15 times (16 times)
C3 C4	M2	PG2 magnification for respective gear	The magnification for #22PG2 (second deceleration point for orientation) for respective gear is set. C3: F 8 7 0 — Gear 01 | Gear 00 C4: F 8 7 0 — Gear 11 | Gear 10 10H (16D) is regarded as 1 time. Set to adjust orientation for the respective gear. If 0 is set, it becomes 1 time.	$\frac{1}{16}$ to 15 times (16 times)

(2) Check terminals

See Appendix 9(2).

3.2.2 Where the equipment is linked with the NC through the bus (SF-TL card):

(1) Setting pins

Although all setting pins are described in Reference 1.1.3(3), only the setting pins relating to the orientation are listed in the following.

No.	Name	Setting	Description
PIN 1 PIN 2 (Bare board drawing No. 52 is not used.)	CONNA output selection		Outputs an encoder feedback signal from CONB to CONAA.
			Outputs a feedback signal from the CON2 motor detector to CONNA. However, the phase Z outputs the linear zone of the magnesensor.
			outputs a feedback signal from the CON2 motor detector to CONAA.
PIN 5	Orientation encoder power		No power is supplied from NC.
			Power is supplied from NC.

(2) Setting parameters

There are two types of parameters: one of which is set from the amplifier and the other is set from the NC CRT (being asterisked). The contents of the parameters are the same as those in Section 3.2.1(1).

For instructions for setting parameters, see Reference 1.2.3.

The following table lists parameters which are set from the NC CRT.

ⓐ Spindle parameter (1/2) screen

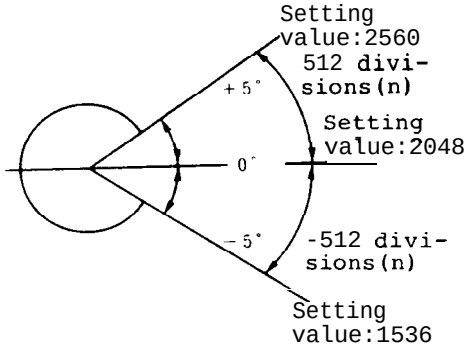
#	Parameter		Description	Setting range (unit)
11	sgear	Encoder gear ratio	Sets the gear ratio between spindle and encoder.	0: 1/1 1: 1/2 2: 1/4 3: 1/8

ⓑ Spindle parameer (2/2) screen

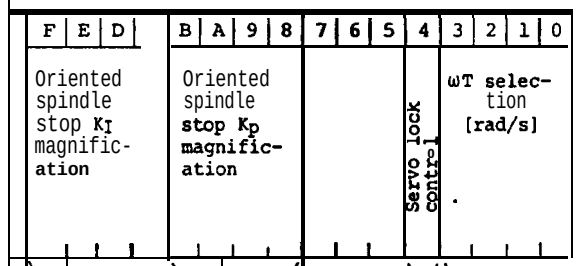
Parameter No. of parameter error

#	No.	Parameter		Description	Setting range (unit)	
1	21	PG1	Spindle orientation, 1st deceleration point	Encoder spindle orientation: The spindle rotational angle at which creep speed starts is set. Standard setting: 180 Magnesensor spindle orientation: The time in which creep speed starts after passing through linear zone is set. Standard setting: 133	Encoder 0 - 359(deg.)	Magnesensor 0 - 500 ms
2	22	PG2	Spindle orientation, 2nd deceleration point	Angle at which creep speed run changes to position control loop is set. Standard setting: 20		0 - 40(deg.)
4	24	ZRZ	Spindle orientation, in-position range	The error range within which spindle orientation complete signal is output is set. Standard setting: 1.00	Encoder 0 - 359(deg.)	Magnesensor 0 - 39(deg.)
5	25	OSP	Spindle orientation speed	Spindle orientation speed is set. Standard setting: 220	0 - 1000 (rpm)	
6	26	CSP	Creep speed	The creep speed is set. Standard setting: 20	0 - 1000 (rpm)	

↓ Parameter No. of parameter error

#	No.	Parameter		Description	Setting range (unit)	
					Encoder	Magnesensor
7	27	'ST	Position shift	[Encoder orientation] Oriented spindle stop position is set. The stop position is set within 360 deg. with increment of 360/4096. Data change during orientation stop state is valid from the next orientation. [Magnesensor orientation] The stop position is set within range from -5 deg. to +5 deg.  When 0 deg. is 2048, in the + direction, 2048 + n; in the - direction, 2048 - n. Data during orientation stop can be changed.	0 - 4095 (pulse)	1536 - 2560
8	28	3RC		Not used. Set to "0".		

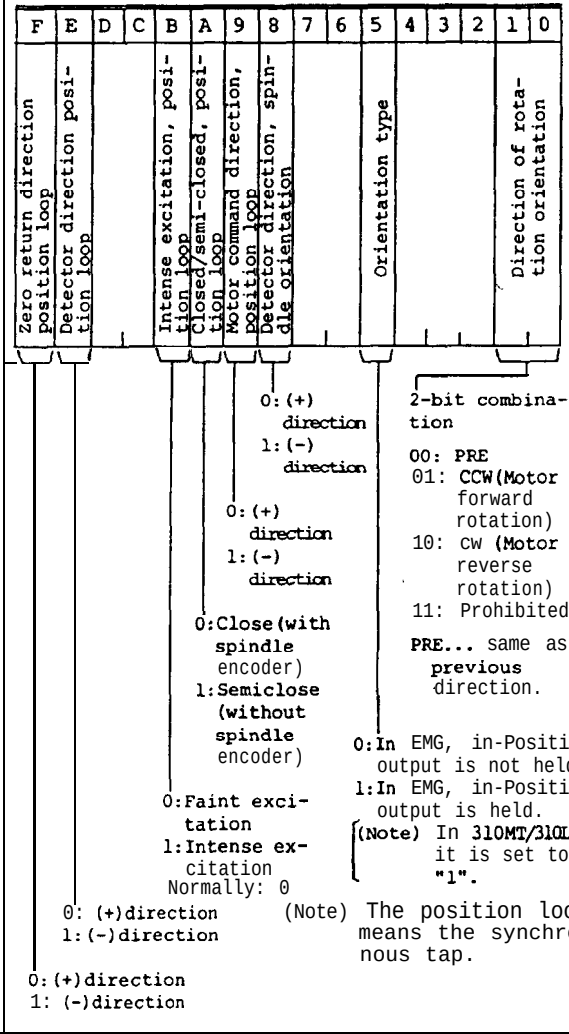
#	No.	Parameter	Description	Setting range (unit)
	2F	ORS1 Oriented spindle stop control 1	Control type (such as gain) during orientation stop is set. Standard setting:4400 (When spindle GD² is small like a dedicated machine, it should be set to 6601.)	Hexadecimal notation



4-bit combination [times]	4-bit combination [times]		4-bit combination [rad/s]
0: 0.6	0: 0.6	0: Delay/ advance	0: 0.55
1: 0.7	1: 0.7	1: PI	1: 1.1
2: 0.8	2: 0.8		2: 1.65
3: 0.9	3: 0.9		3: 2.2
4: 1	4: 1		4: 2.75
5: 1.2	5: 1.2		5: 3.3
6: 1.4	6: 1.4		6: 3.85
7: 1.6	7: 1.6		7: 4.4
8: 1.8	a: 1.8		a: 4.95
9: 2	9: 2		9: 5.5
A: 2.2	A: 2.2		A: 6.05
B: 2.4	B: 2.4		B: 6.6
c: 2.6	C: 2.6		c: 7.15
D: 2.8	D: 2.8		D: 7.7
E: 3	E: 3		E: a.25
F: 3.2	F: 3.2		F: 8.8

(Note) The Kp magnification should be set to the magnification for #36 VKP. The Ki magnification should be set to the magnification for #37 VKI.

Continued on the next page.

#	No.	Parameter		Description	Setting range (unit)
.6 >R	30	0RS2	Oriented spindle stop control 2	The spindle orientation direction, detector installed direction, and motor rotation direction are set. [Magnesensor orientation] Standard setting: 0020 (0120 when the detector installation direction is reversed) [Encoder orientation] Standard setting: 0120 (0020 when the detector installation direction is reversed)  (Note) The position loop means the synchronous tap.	Hexadecimal notation
24 >R	38	TYP	Position loop IN type	Position loop, IN type Sets the process for switching from speed loop to position loop. 0: To perform position loop/zero return operation after orientation operation. 1: Not to perform position loop/zero return operation.	

(3) Display lamps

See Appendix 8(2).

(4) Check terminals

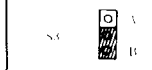
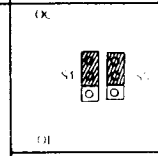
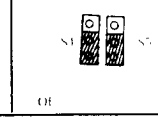
See Appendix 9(3).

3.2.3 Where the equipment is linked with the NC using analog or digital signals (SF-OR card).

(1) Setting pins

Although all the setting pins are listed in Section 3.1.2(1), the following table lists only the setting pins relating to the orientation using an encoder.

(Note) The setting pin No. for bare board drawing BN624A905G52 card or later ones becomes "PIN".

No.	Name	Setting	Description	Remarks
S3 (PIN3)	Orientation encoder power supply		No power is supplied from the NC.	
			The power is supplied from the NC.	
S4 (PIN4)	Speed selection signal interface setting		Synchronous drive (open-collector)	
S5 (PIN5)			Source drive (open-emitter)	

(2) Setting parameters

See Section 3.2.1(1).

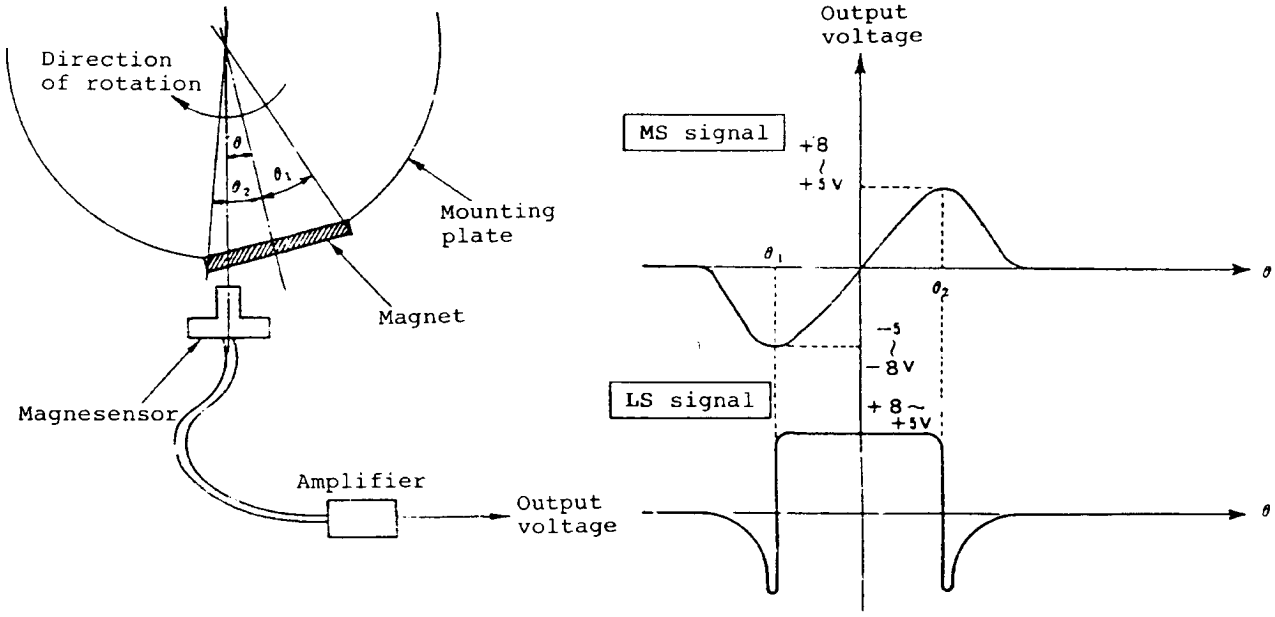
(3) Check terminals

See Appendix 9(2).

3.3 Mounting position detector

3.3.1 In the case of magnesensor type

The amplifier output voltage of the sensor generates the MS signal and LS signal depending on the position against the magnet as shown in the following figure.



MS signal ..... When the sensor is at the center of the magnet, 0 V is output. When the sensor is at one of the ends of the magnet, the maximum voltage is output. The constant position is controlled so that the voltage becomes 0 V.

LS signal ..... In the area of the magnet, the voltage becomes constant. This signal is used to verify that the magnetic sensor is stopped in the area of the magnet.

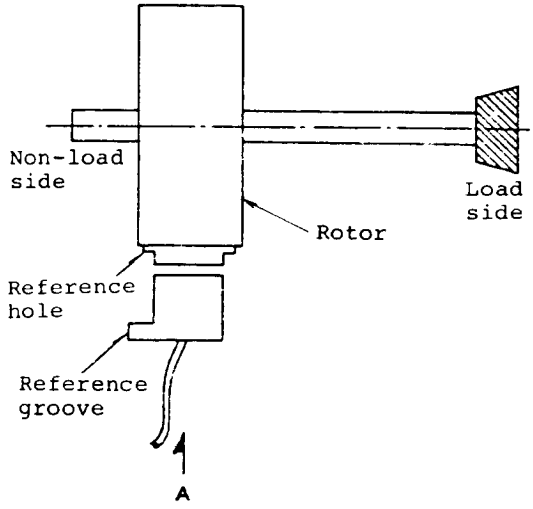
(1) Mounting direction of magnet and magnesensor

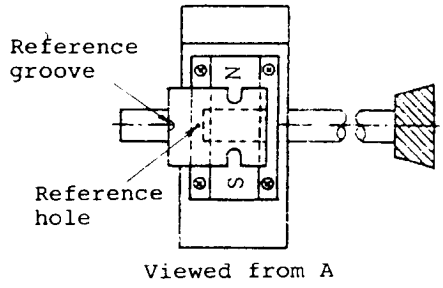
Mount the magnet and magnesensor by referencing (a) case 1 and (b) case 2.
In any case, comply with the following condition.

> The center reference hole of the magnet is positioned on the same side of the reference groove of the detection head.

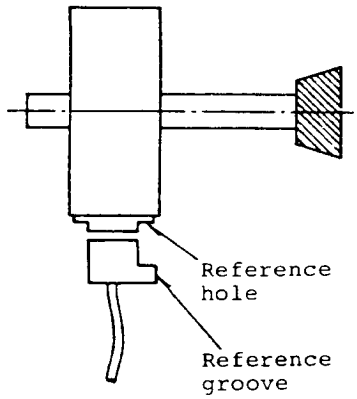
(a) Case 1: Where the magnet is mounted around the rotating part:

① When the reference hole and reference groove are positioned on the non-load side of the rotor:



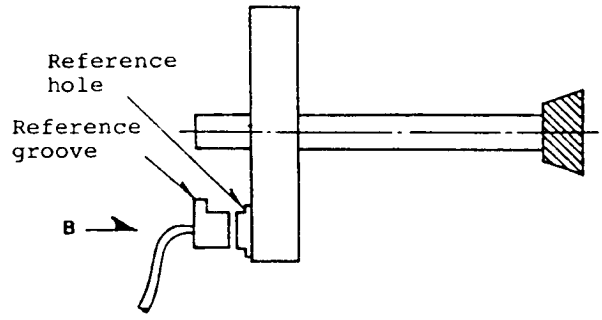


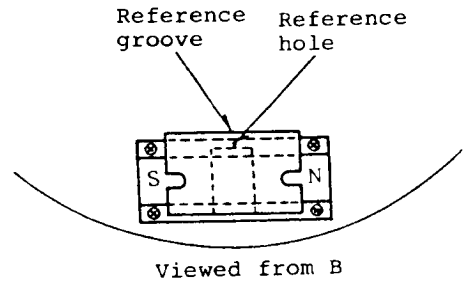
② When the reference hole and reference groove are positioned on the load side of the rotor:



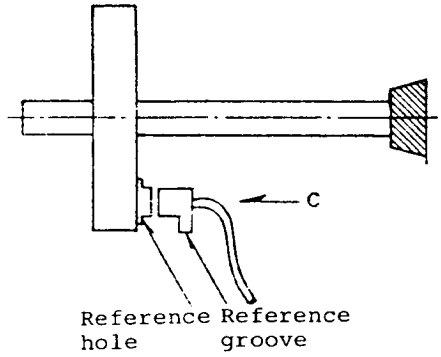
(b) Case 2: When the magnet is mounted on the plane side of the rotor:

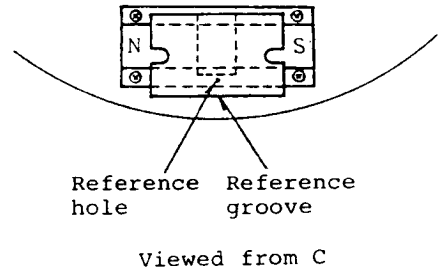
① When the magnet is mounted on the non-load side of the rotor:



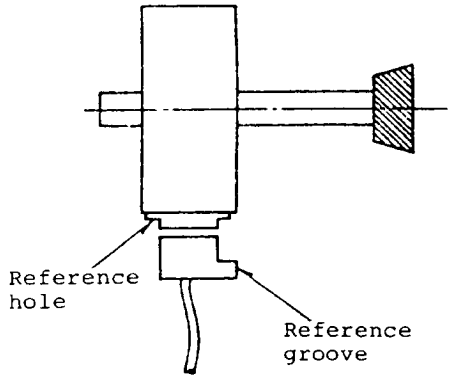


② When the magnet is mounted on the load side of the rotating part:





(Note) As shown in the following figure, if the direction of the magnet does not match that of the magnetic sensor, the spindle remarkably vibrates at both the ends of the magnet, so it cannot be oriented.



(2) Precautions on mounting magnet

1) Do not place a ferromagnetic material near the magnet.
2) Do not shock the magnet.
3) Securely fasten the magnet to the spindle using M4 screws.
4) Mount the magnet to the plate so that the rotation of the entire spindle is balanced.
5) The center reference hole of the magnet is positioned at the center of the mounting disk in the direction as defined in the case 1 or case 2.
6) Fully clean the surrounding portion of the magnet to prevent the magnet from gathering iron powder and cutting chips which degrade the accuracy.
7) Apply lock paint on the mounting screws to prevent them from getting loosen.
8) When mounting the magnet onto the ground disk, since it may be magnetized, it should be demagnetized.
9) The diameter of the disk where the magnet is mounted should be in the range from 80 mm to 120 mm. However, if the spindle speed is slow, the diameter of the disk can be increased.
10) When the spindle speed where the magnet is mounted exceeds 6000 rpm, it should be of the high speed type magnet (which can be used up to 12000 rpm).

(3) Precautions on mounting magnesensor

1) The direction of the reference groove of the magnesensor should be the same as that of the reference hole of the magnet.
2) Mount the magnesensor in that manner that the center line of the end of the magnesensor matches that of the magnet.

3) The gap between the magnet and magnesensor for the case 1 and case 2 mounting methods should conform with Table 1 and Table 2, respectively.
   * For quantity production, it is recommended to create a jig.
4) The pre-stage amplifier connector is of the oil-resisting type. However, it should be mounted at a place which is free of oil if possible.
5) The cable from the pre-stage amplifier to the controller should be routed separately from a high voltage circuit cable.
6) Check the connector wiring, properly insert it into the receptacle, and tighten the lock screws of the connector.

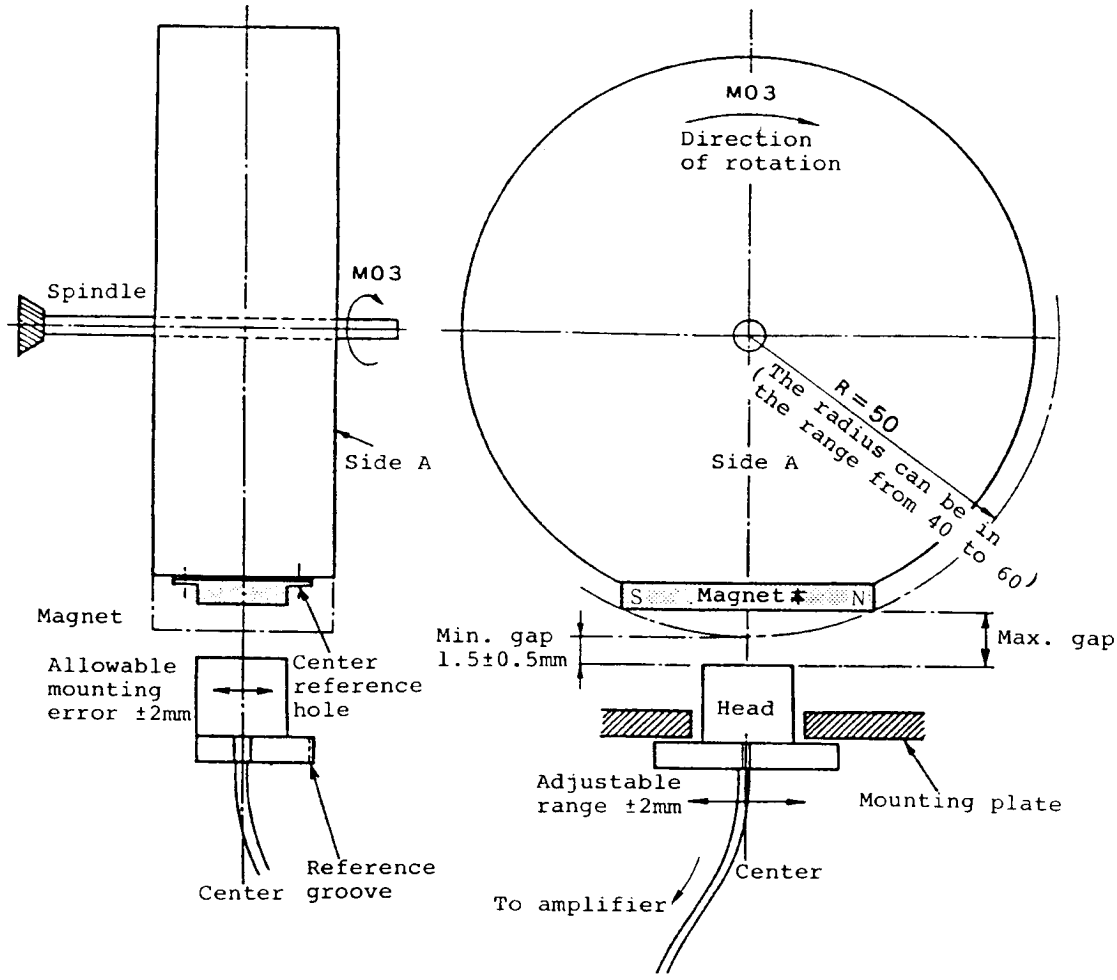
Table 1

	BKO-C1810H03	
R(radius) mm	Max. gap mm	Min. gap mm
40	11.5±0.5	2.7±0.5
50	9.5±0.5	2.8±0.5
60	8.5±0.5	3.0±0.5
70	8.0±0.5	3.4±0.5

Table 2

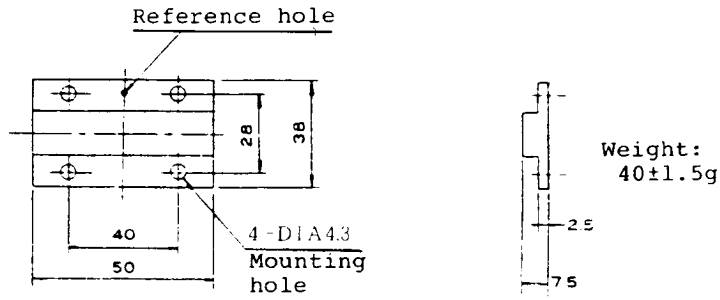
	BKO-C1810H03
R(radius) mm	Gap mm
40	6±0.5
50	6±0.5
60	6±0.5

(4) Example of mounting magnet and sensor

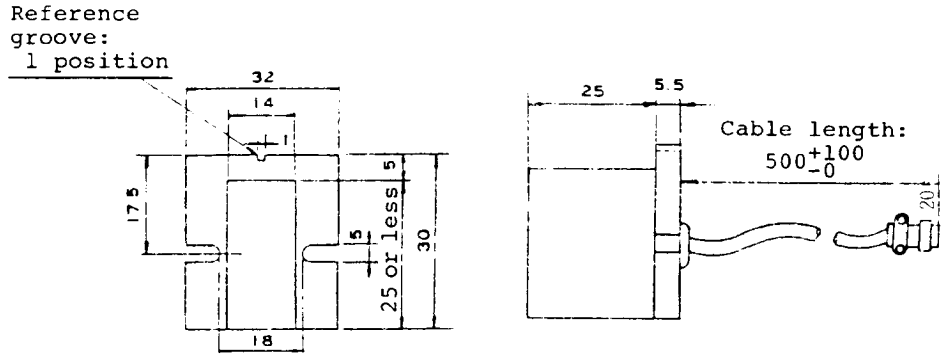


(5) External dimensions

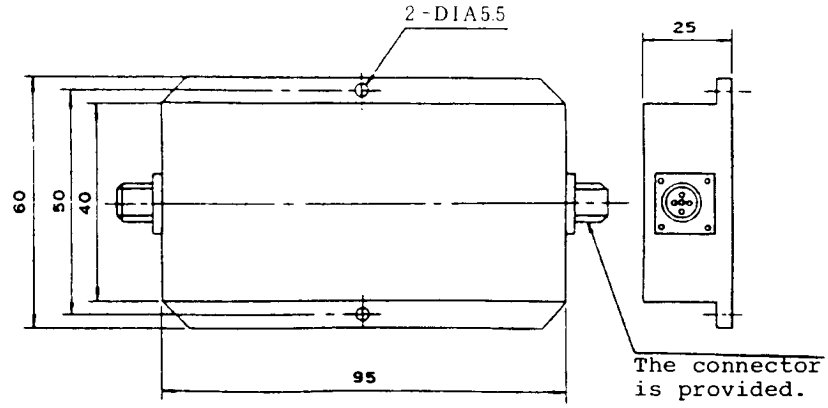
(a) Magnet (BLO-C1810H03)



(b) Magnesensor (BKO-C1810H02)



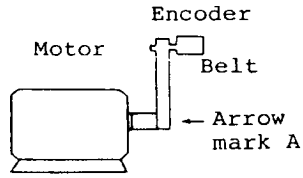
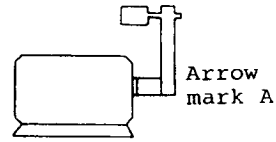
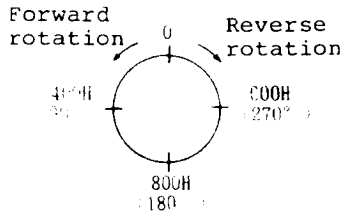
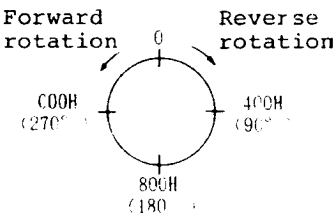
(c) Amplifier (BKO-C1810H01)



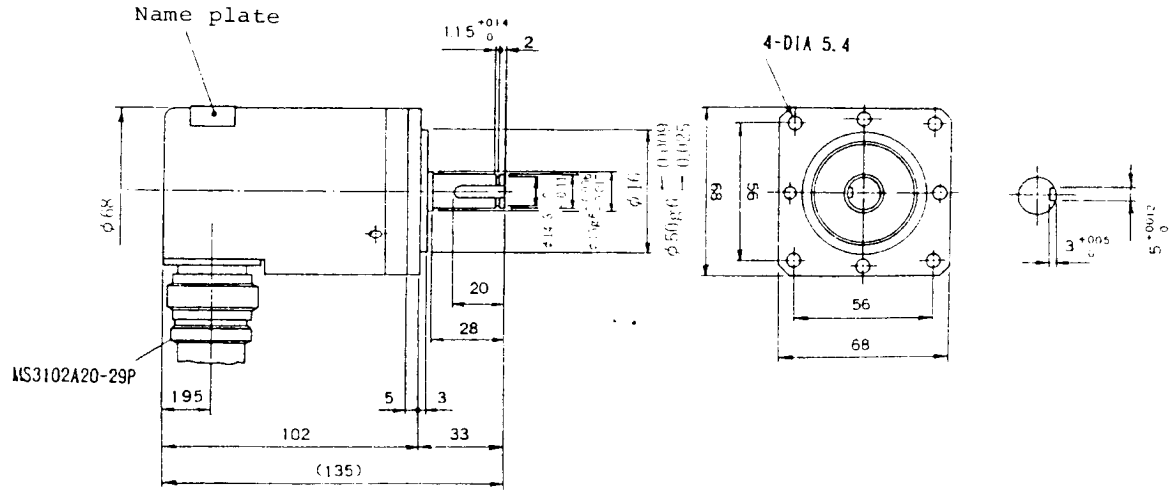
3.3.2 In the case of encoder type

(1) Mounting direction of encoder

The mounting directions of the encoder are classified into (a) case 1 and (b) case 2 as shown in the following table.

	Case 1	Case 2
Mounting direction		
Normal orienta-tion	Viewed from arrow mark A 	Viewed from arrow mark A 
	(Parameter ORS2 bit 8 = 0)	(Parameter ORS2 bit 8 = 1)

(2) External dimensions (RFH-1024-22-1M-68, 1024p/rev)



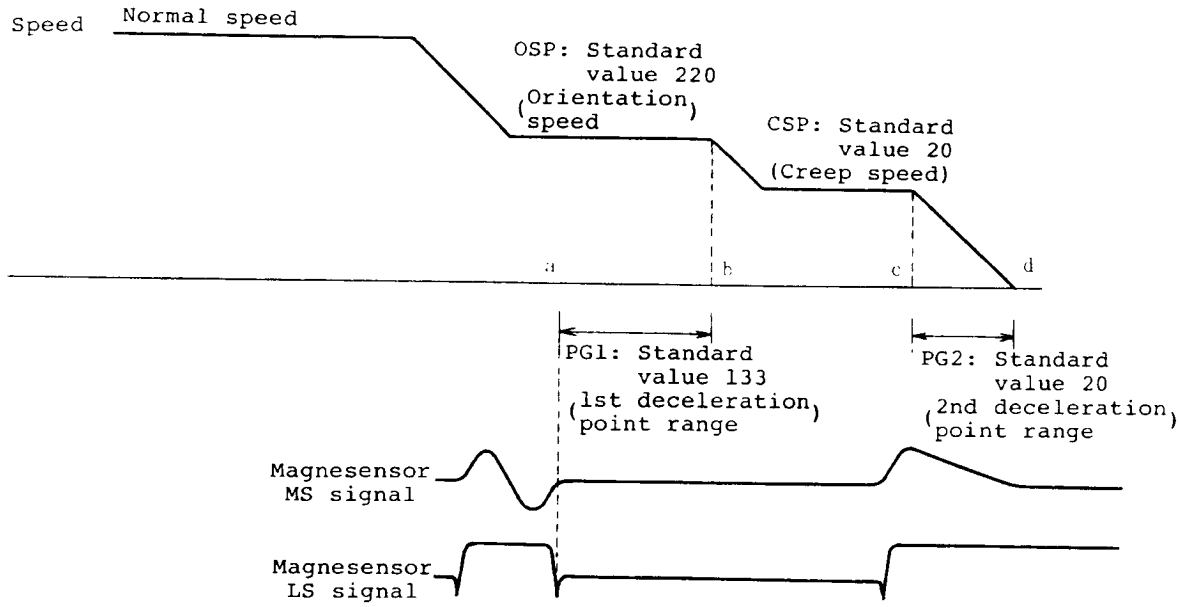
DIM IN mm

A	1chA	K	0V
B	2chZ	L	
C	1chB	M	
D		N	1ch$\overline{A}$
E	Case earth	P	2ch$\overline{Z}$
F		R	1ch$\overline{B}$
G		S	
H	+5V	T	
J			

Note: The maximum speed of the encoder should be 6000 rpm or less.

3.4 Adjustment

3.4.1 In the case of magnesensor



Adjust the orientation parameters (OSP, CSP, PG1, PG2, and PST) in the following manner so that the maximum values can be obtained.

(Note) PG1: Based on point a, move point b. When a small value is set to PG1, point b approaches point a.

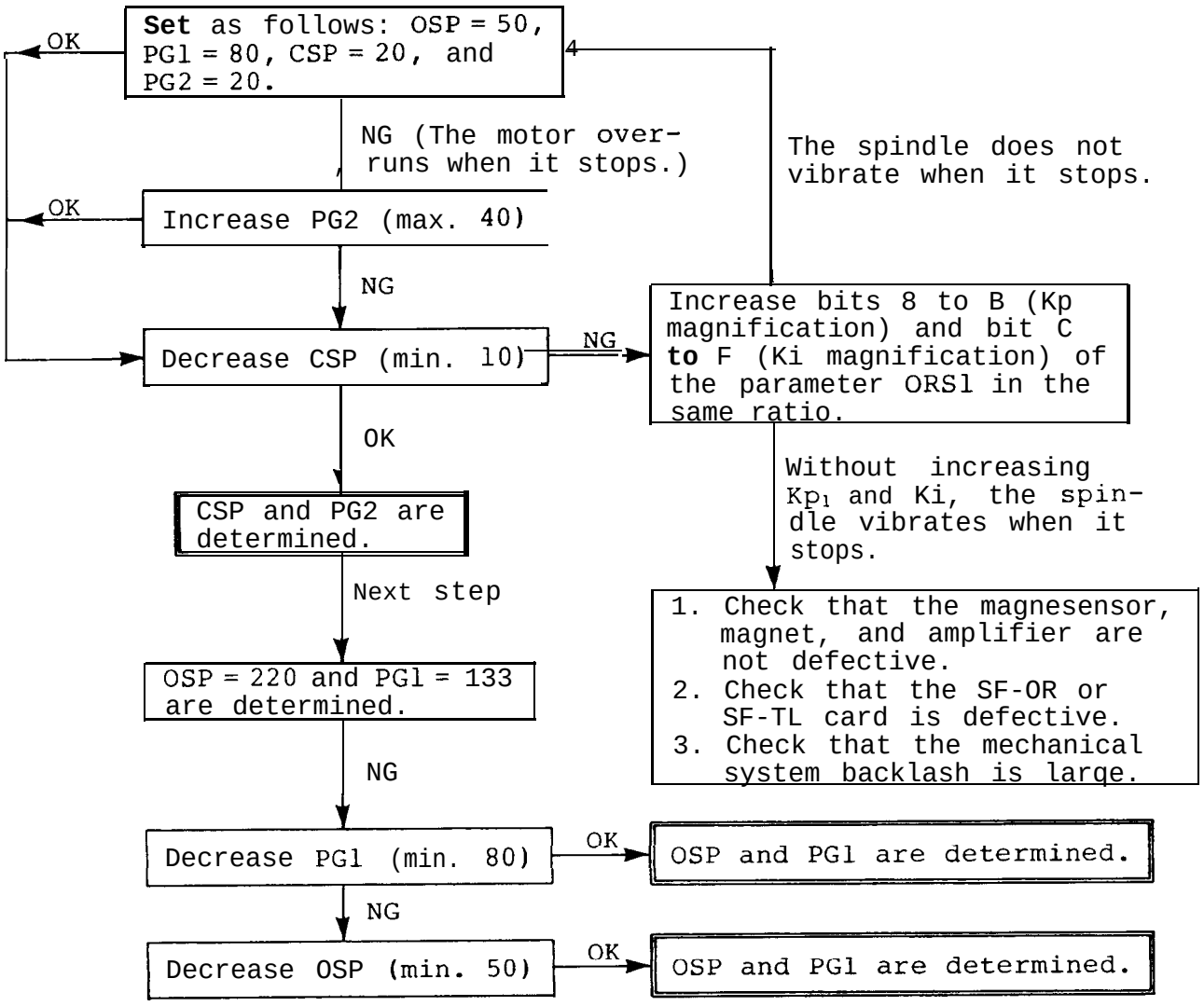
PG2: Based on point d, move point c. When a small value is set to PG2, point c approaches point d.

In the adjustment using the following flowchart, since a gear where spindle speed is high tends to overrun, it should be adjusted first.

In addition, use the parameters being adjusted and check that each gear and each speed can be used.

(Note) Adjust the stop position (point d) using the parameter (PST).

(Note) If the spindle hunts when the motor is stopped by the orientation operation, the selection of the mounting direction of the orientation detector is inverted. At the time, correct the selection using the parameter ORS2 bit 8.



(Note) 1. When the orientation time is long because the time period (point b to c) on which the spindle rotates at a creep speed, increase OSP and PG1 in the manner that the spindle doesn't overrun when it stops. (The maximum value of OSP = 300; the maximum value of PG1 = 200)

2. The parameter ORS1 bits 0 to 3 (WT selection) are the compensation gain for delay/advance of bit 4 (control method in servo lock situation). Increase WT and the temporary servo rigidity increases and the torque against the position deviation decreases.

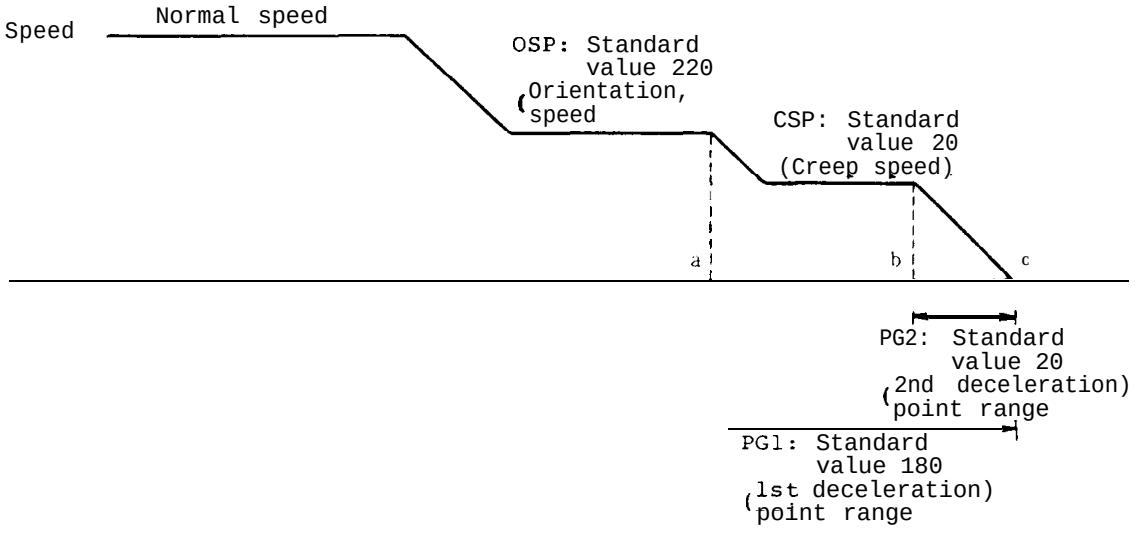
The effects of four major parameters relating to the stability of the orientation are listed in the following table.

Phenomenon	Adjustment procedure			
	OSP	CSP	PG1	PG2
The spindle overruns when it stops.	↘	↘	↘	↗
The orientation time is long.	↗	→	↗	→
The spindle hunts when it stops.	→	↘	→	↗

(Note 1) ↗ : Increase the parameter value.
→ : Do not change the parameter value.
↘ : Decrease the parameter value.

(Note 2) When the spindle remarkably hunts in the orientation stop state, since the selection of the mounting direction of the orientation detector is reversed, correct the selection with the parameter 0RS2 bit 8.

3.4.2 Encoder type

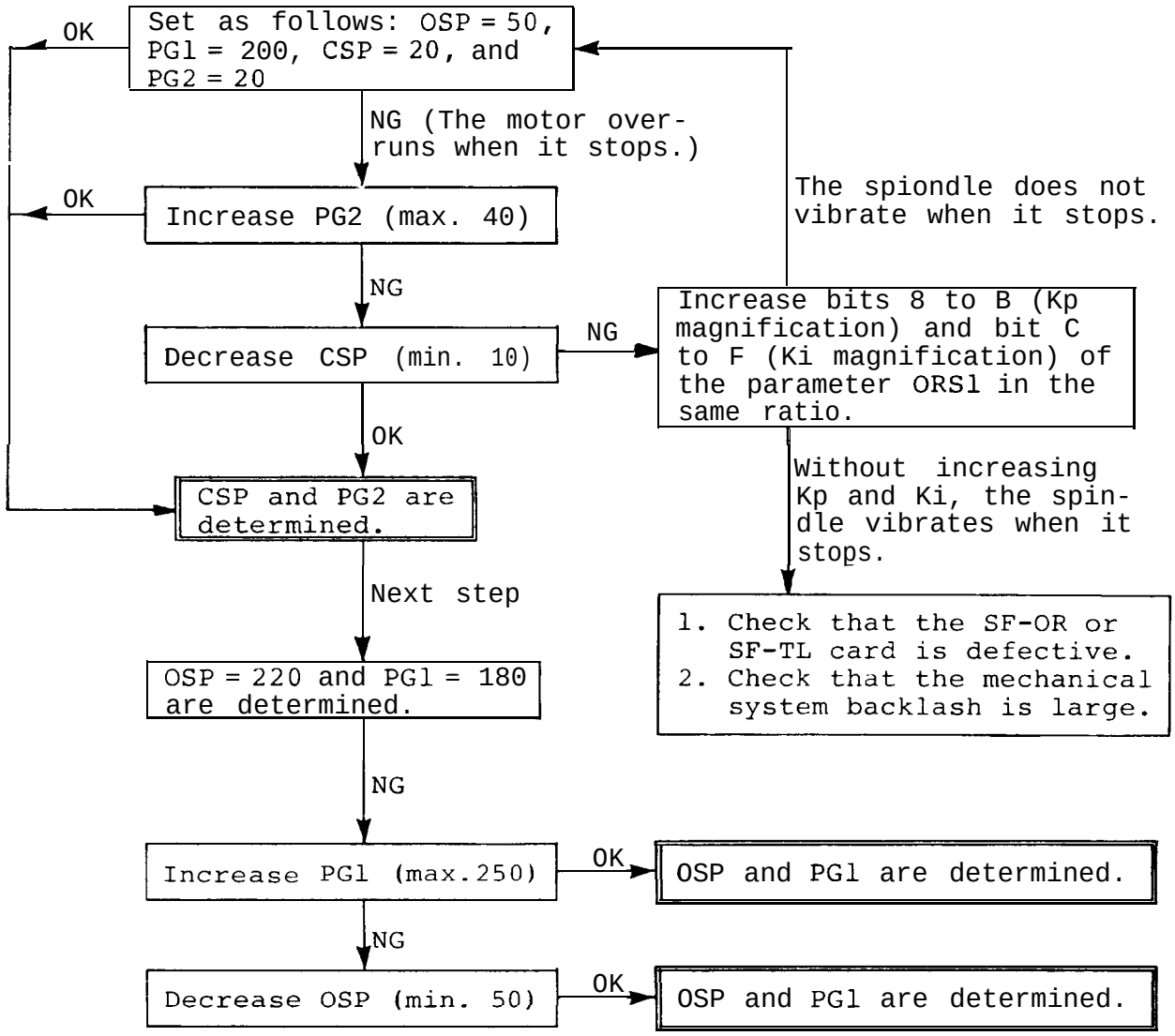


Adjust the orientation parameters (OSP, CSP, PG1, PG2, and PST) in the following manner so that the best values can be obtained.

(Note) PG1: Based on point c, move point a.
When decreasing PG1, point a approaches point c.
PG2: Based on point c, move point b.
When decreasing PG2, point b approaches point c.

In the adjustment using the following flowchart, generally, a gear where the spindle speed is high tends to overrun, so it should be adjusted first.
In addition, with the parameters obtained by the adjustment, check that the spindle correctly rotates at each speed and by each gear.

(Note) The stop position (point c) is adjusted by the parameter (PST).



(Note) 1. When the orientation time becomes long because the time period on which the spindle rotates at a creep speed (point b to c) is long, decrease PG1 or increase OSP in the manner that the spindle does not overrun when it stops. (PG1 > PG2, the maximum value of OSP = 300.)

2. The parameter ORS1 bits 0 to 3 (W_T selection) are the compensation gain for delay/advance of bit 4 (control method in servo lock situation). Increase WT and the temporary servo rigidity increases and the torque against the position deviation decreases.

The effects of four major parameters relating to the stability of the orientation are listed in the following table.

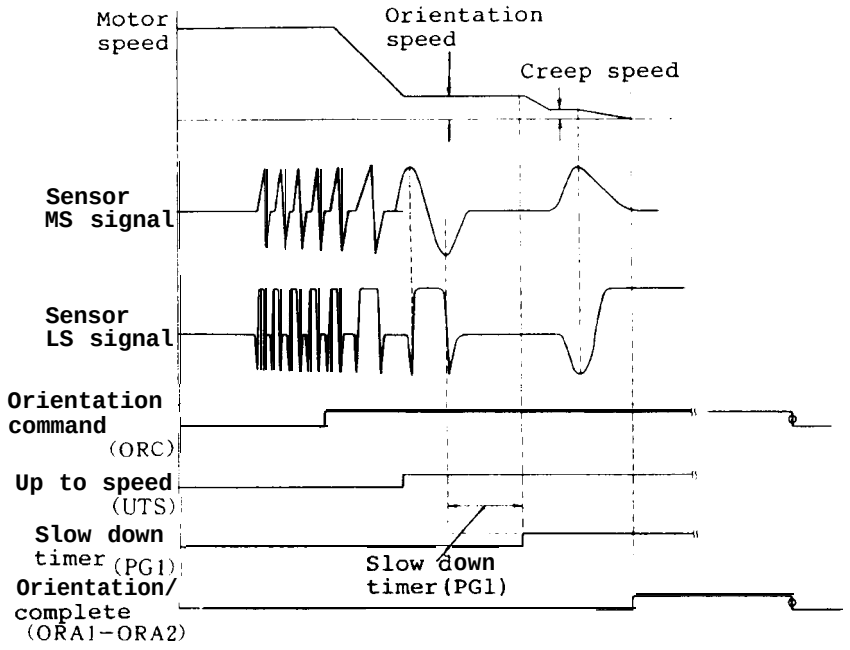
Phenomenon	Adjustment procedure			
	OSP	CSP	PG1	PG2
The spindle overruns when it stops.	↘	↘	↗	↗
The orientation time is long.	↗	→	↘	
The spindle hunts when it stops.		↘		↗

(Note 1) ↗ : Increase the parameter value.
→: Do not change the parameter value.
↘ : Decrease the parameter value.

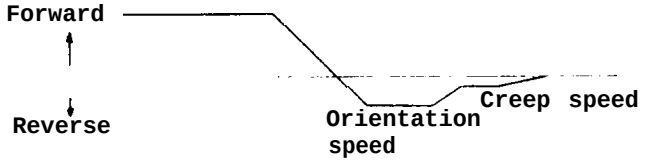
(Note 2) When the spindle remarkably hunts in the orientation stop state, since the selection of the mounting direction of the orientation detector is reversed, correct the selection with the parameter ORS2 bit 8.

3.5 Operation mode and motions

3.5.1 In the case of magnesensor



In the case where the rotation direction is reverse from the oriented rotation direction while the orientation direction is fixed to a specific direction (which is selected by a parameter).



(2) Operation

(a) When the orientation command is turned on, the motor speed is switched from the operation speed to the orientation speed.

(b) When the motor speed comes to the orientation speed, the up to speed signal is turned on.

(c) After the up to speed signal is turned on, when the sensor LS signal goes low, the slow down timer starts. (Software timer)

(d) When the slow down timer (software timer . . . . . parameter PG1) times out, the motor speed is switched from the orientation speed to the creep speed.

(e) When the sensor LS signal goes high by the creep speed, the position loop becomes valid.

(f) The spindle stops under control of the position loop when the sensor MS signal is at 0 V.

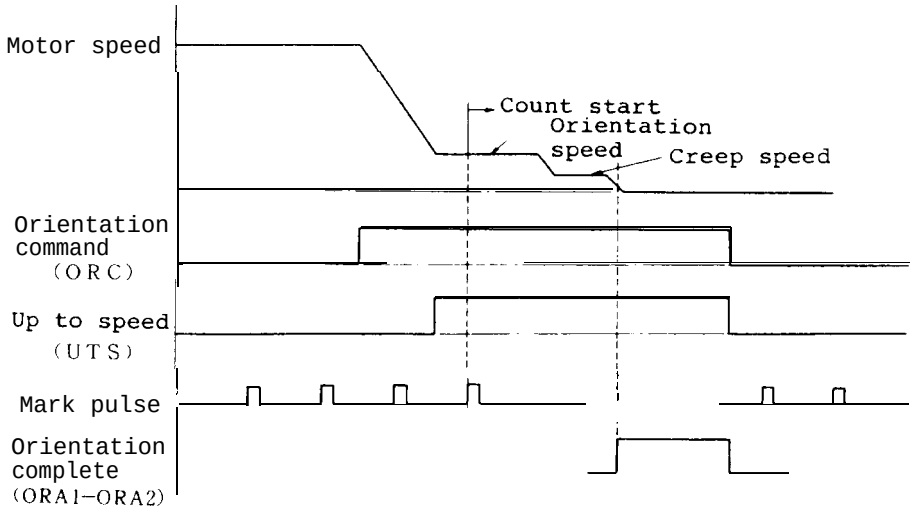
(g) The orientation complete signal is turned on (closed).

Direction of orientation rotation (set by parameter ORS2)

(1) PRE	Same orientation direction as former rotation
(2) Forward rotation	Orientation of motor forward rotation
(3) Reverse rotation	Orientation of motor reverse rotation

3.5.2 Encoder type

(1) Operation mode



(2) Operation

(a) When the orientation command is turned on, the orientation position being specified by the parameter PST is read and the motor speed is changed from the operation speed to the orientation speed.

(b) When the motor speed reaches the orientation speed, the up to speed signal is turned on.

(c) After the up to speed signal is turned on, when a mark pulse is received, the counting starts.
At the time the motor speed remains as the orientation speed.

(d) Before 146 to 225 deg. of the target value, the orientation speed is changed to the creep speed.

(e) Before 15 to 25 deg. of the target value, the position loop becomes valid and the spindle stops at the target value.

(f) In the range of the target value ± in-position range (parameter ZRZ), the contact of the orientation complete signal (ORA1-ORA2) is closed.

(g) When the orientation command is released, the motor restores the speed at the speed reference which has been specified.

(h) When the orientation operation is performed in the orientation state, the spindle rotates for one turn and then performs the orientation operation.
However, depending on the orientation position and position shift (parameter PST) being set from the outside, the spindle rotates for 1 or more turns.

(i) In the orientation stop state, even if the machine ready complete signal (SETl, SET2) are turned off and then turned on, the orientation state remains unchanged.

(Note) The stop position is controlled by a l2-bit contact signal (01H to l2H) and is controlled by the following equation. When all signals are turned off (open), the stop position is at the reference stop position (0 deg.).

$$\text{Stop position} = \frac{360}{4096}[(Hl2)\cdot 2^{11} + (Hll)\cdot 2^{10} + \cdots\cdots\cdots\cdots (Hl)\cdot 2^{0}]$$

[Example]

When only the Hl0 is turned on:

$$\frac{360}{4096} \times 512(2^{9}) = 45^{0}$$

The minimum traveling unit is

$$360°/4096 = 0.088'$$

l deg., 10 deg. . . . . The integer indexing is a multiple of integer of minimum traveling unit (0.088^{0}), resulting in a setting error.

4. Adjusting synchronous tap

4.1 Setting parameters

The following table lists the parameters relating to synchronous tap. They should be set by referencing the settting method.

Selection screen	Parameter	Setting value	Setting method
Fundamental specification	tap-t1	500-1000(msec)	Set the time constant of the position command for synchronous tap. Sets the start up time +a when the tap is rotated up to the maximum speed by the S command (α = 200 msec).
Axis specification, axis Z	tag-g	10 - 20 Standard setting: 15	Sets the position loop gain in the synchronous tapping. It should be the same as the spindle parameter PGC.
Spindle parameter	sgear	0	Sets the gear ratio between the spindle and spindle encoder. If the spindle encoder is not used, 0 (1:1) should be set.
Spindle parameter	PGC	10 - 20 Standard setting: 15	Sets the position loop gain in the synchronous tapping. It should be the same as tap g of the axis specification, axis z.
Spindle parameter	ORS2		bit F . . . Sets the zero return direction before the synchronous tapping. bit E . . . Sets the rotation direction of the position loop detector. In the semi-close state, it is 0. bit B ... When it is set to 1, excitation takes place in the position loop state. The response increases against the impact load. Normally, it is set to 0. bit A . . . 0: Close (when an encoder is provided with the spindle). 1: Semi-close (when an encoder is not provided with the spindle.) bit 9 . . . Determines the direction of the spindle rotation for position loop motor command direction G84.
Spindle parameter	TYP	0001	0000 . . . . Performs the zero return at the beginning of the synchronous tapping. 0001 . . . . Enters the position loop without zero return.
Spindle parameter	GRA1 - GRA4 GRB1 - GRB4	Number of gear teeth on spindle side Number of gear teeth on motor side	The number of gear teeth of each gear should be precisely input. Motor speed x (number of gear teeth of motor / number of gear teeth of spindle) = spindle speed

4.2 Checking operation

1) Check the operation of the spindle at a low speed.
   Example: G84 Z10, F1, 0 S50
2) The spindle speed should be 50 rpm. Check that it rotates for 10 turns until it comes to the hole bottom and returns to the start position.
3) When the spindle normally rotates, perform a cutting work using a floating tapper.
4) When the floating tapper works correctly without expansion and contraction of the tapper, perform a cutting work using a tool which contains the floating tapper.
5) If there is a defect, take proper countermeasures in accordance with the following table.

No.	Phenomenon	Remedy
1	Over droop (AL052) occurs.	1) The position loop detection direction of spindle parameter 0RS2 bit E is reversed. 2) The fundamental specification (tap tl) is too short.
2	The spindle rotating traveling amount does not conform with that being specified.	1) The setting of close/semi-close of spindle parameter ORS2 bit A is incorrect. 2) The spindle parameter gear ratio settings GRA1 to GRA4 and GRB1 to GRB4 are incorrect (in the semi-close state).
3	The tap is broken. The tapping accuracy is bad.	1) The axis specification axis Z tap-g and the spindle parameter PGC are incorrect. 2) The fundamental specification tap-tl is short. 3) The screw pitch F of the program differs from the real screw pitch. 4) The tap slips at the chuck. Replace the existing chuck with an other one whose tightening torque is large.

Continued on the next page.

No.	Phenomenon	Remedy
		5) The lower hole is shallow and cutting chip is not correctly removed. 6) A tap where cutting chip is not correctly removed is used.
4	The load is heavy and the spindle stops during tapping operation.	1) Set the spindle parameter 0RS2 bit B to 1 to select strong excitation. 2) Increase the speed loop gain. Increase the spindle parameters (ORSl Kl magnification and Kp magnification).

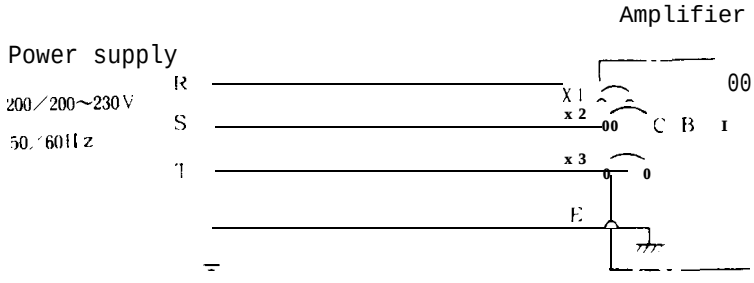
4.3 Notes

1) When the spindle is driven by a belt in the semi-close type (which does not use a spindle encoder), due to slippage of belt, it is difficult to perform accurate tapping operation.
   In the case of belt driving type, use a spindle encoder and perform the synchronous tapping operation using the spindle encoder.

2) When the spindle is connected to the encoder in the ratio of 2 to 1 in the closed type (which uses the spindle encoder), set the spindle parameter PGC to a value which is double of axis specification A axis tap-g.
   Set the spindle parameter s-gear to 1.

Appendix 1 Machine Connection

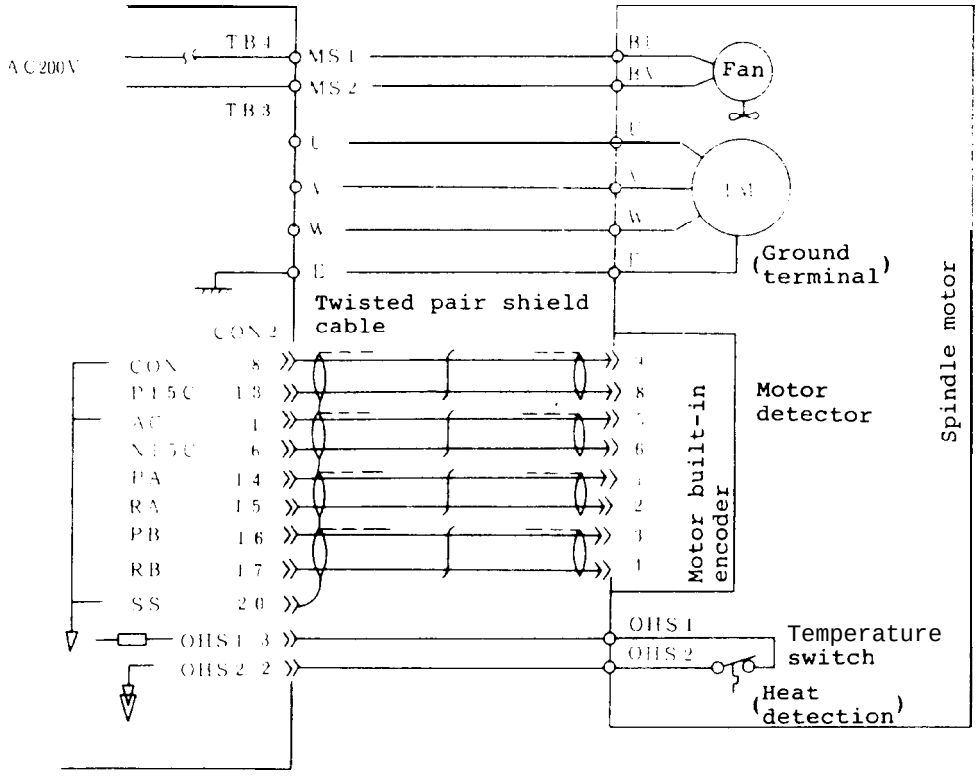
Appendix 1-1 Power connection



ⓐ The power capacity should conform with the specification.

ⓑ The power cable should conform with the cable size described in Appendix 3. When the length of the power cable is long, its size should be large to prevent power fluctuation.

Appendix 1-2 Connection with motor (for standard motor)



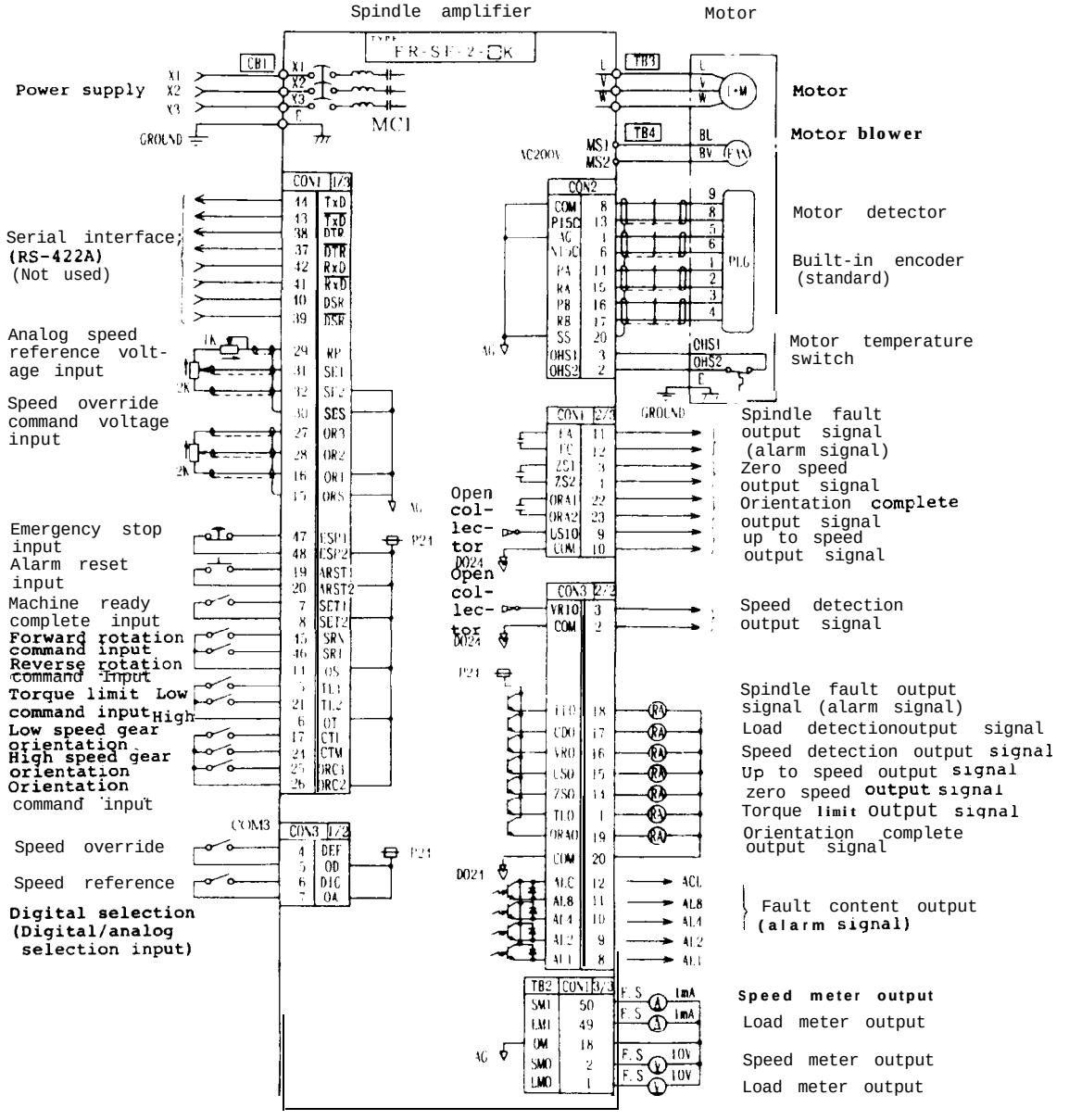
ⓐ The motor cooling fan rotates while the machine ready signal is turned on.

ⓑ For the main circuit cable size for the motor, see Appendix 3 [(1) Main circuit cables].

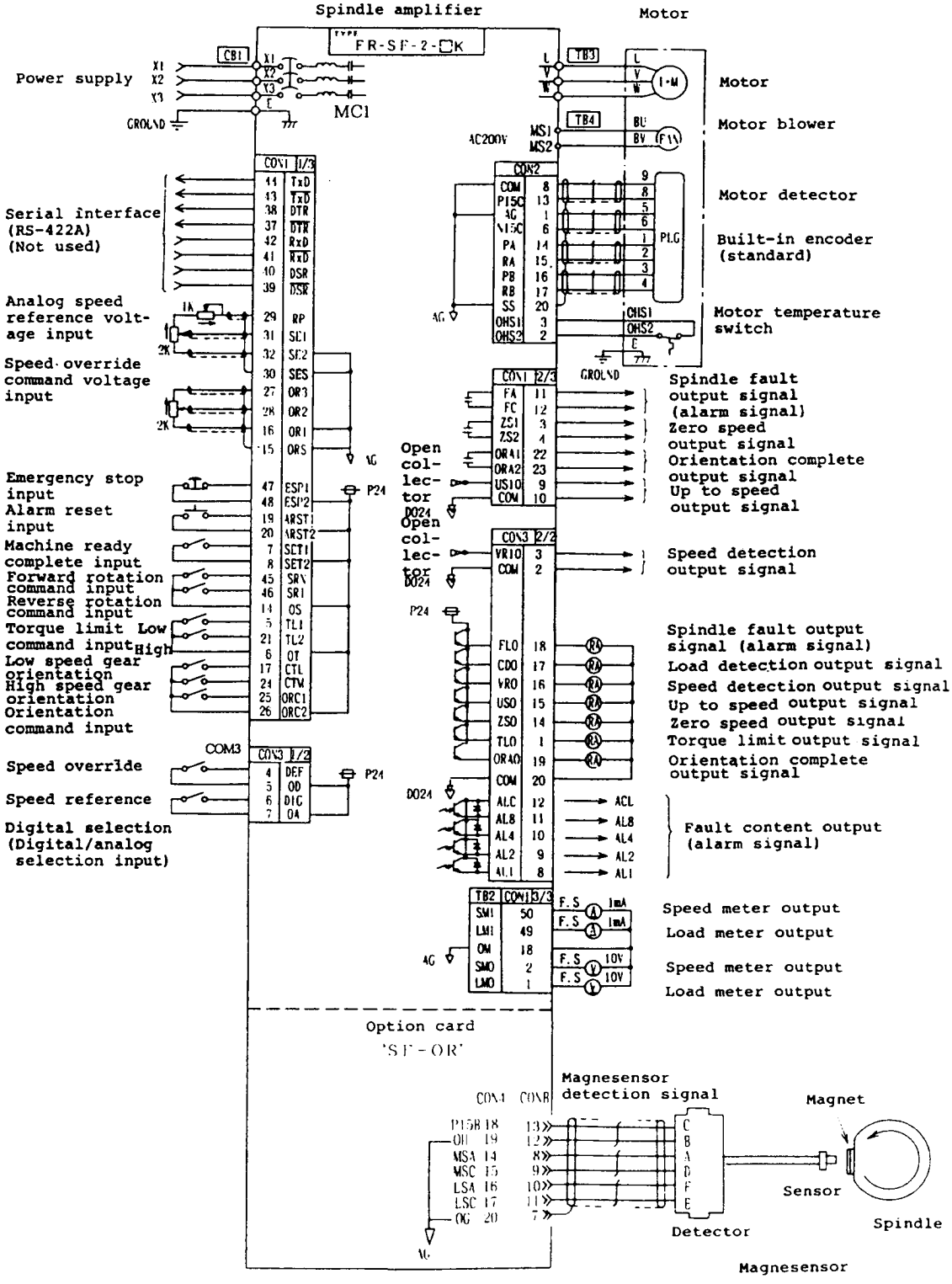
ⓒ The cable for the motor detector should be a twisted pair shield cable whose length is 20 m or less.

ⓓ Ground a cable which connects the motor ground and controller ground.

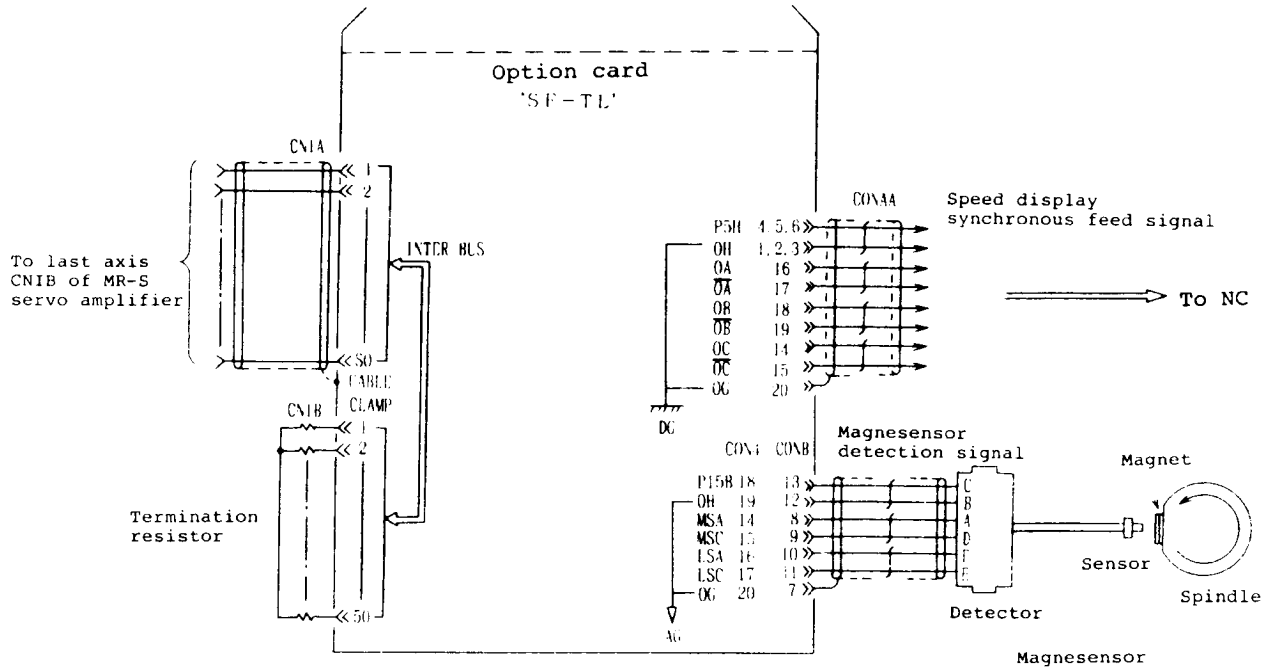
Appendix 1-3 Machine connection (without orientation (Standard))



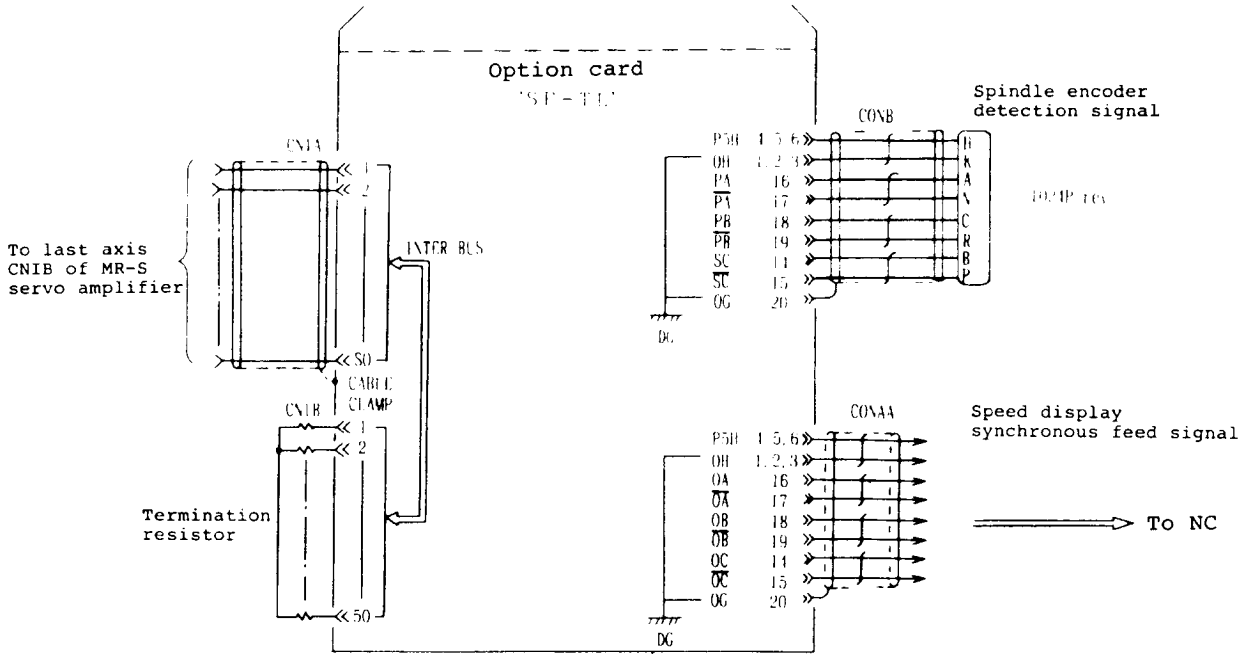
Appendix 1-4 Macine Connection
(Magnesensor orientation (1 point) specification)



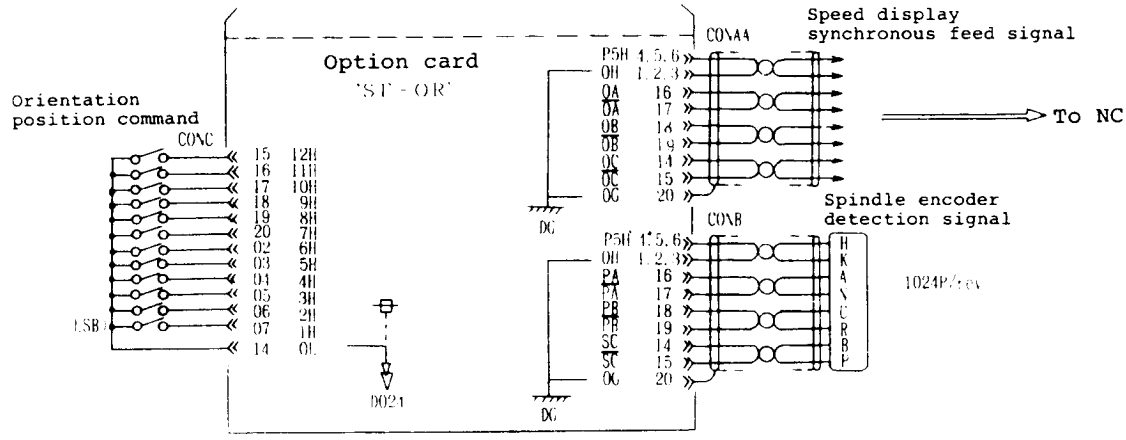
Appendix 1-5 Machine connection (Bus linkage with NC) (Magnesensor orientation (1 point) specification)



Appendix 1-6 Machine connection (Bus linkage with NC) (with encoder synchronous tap, orientation (4096 points) specification/indexing function)

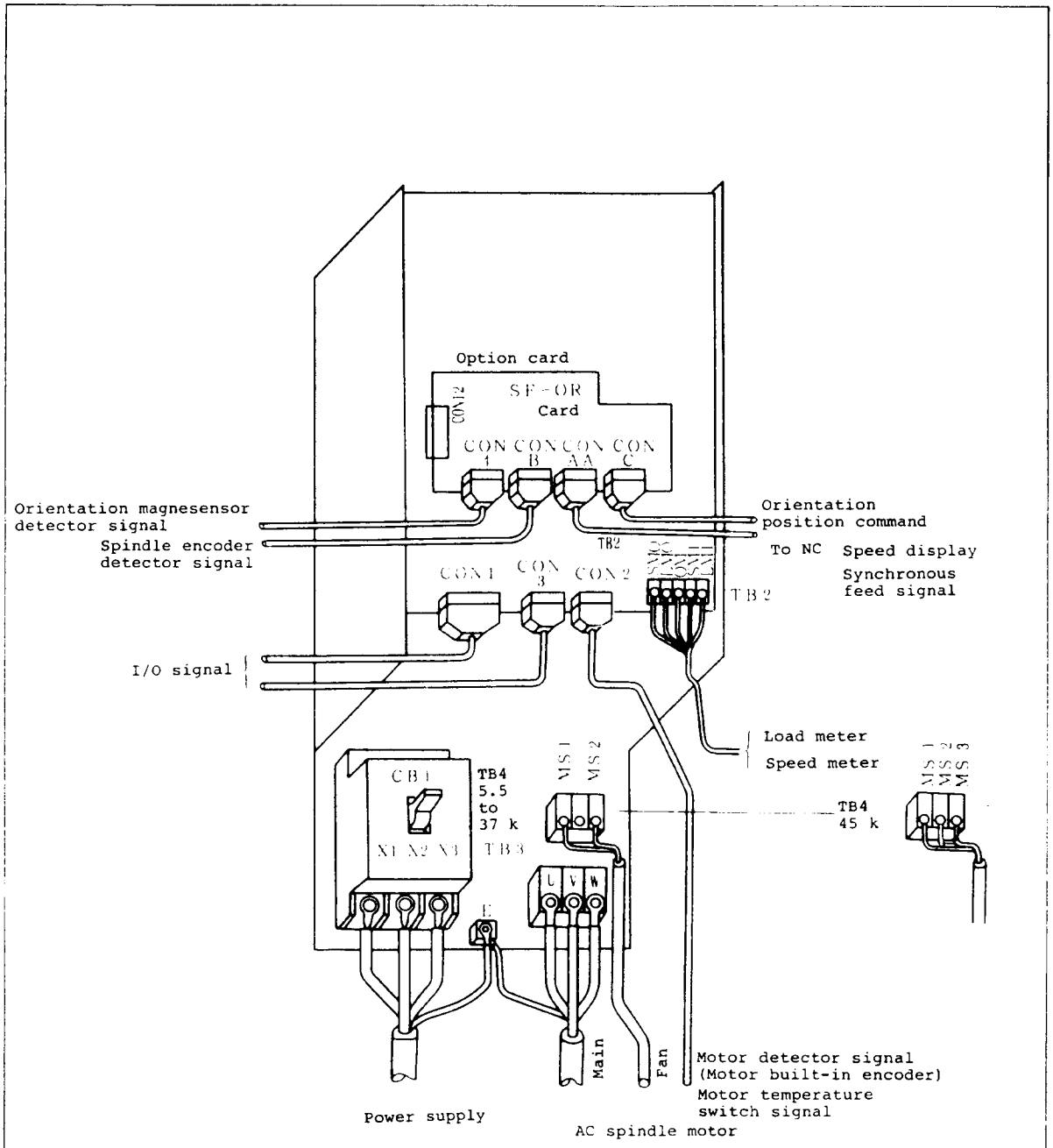


Appendix 1-7 Machine connection (with encoder orientation rather than NC) (with 4096 point orientation/indexing function)



Appendix 2 Cable Connections

Appendix 2-1 Cable connection (without orientation(standard))

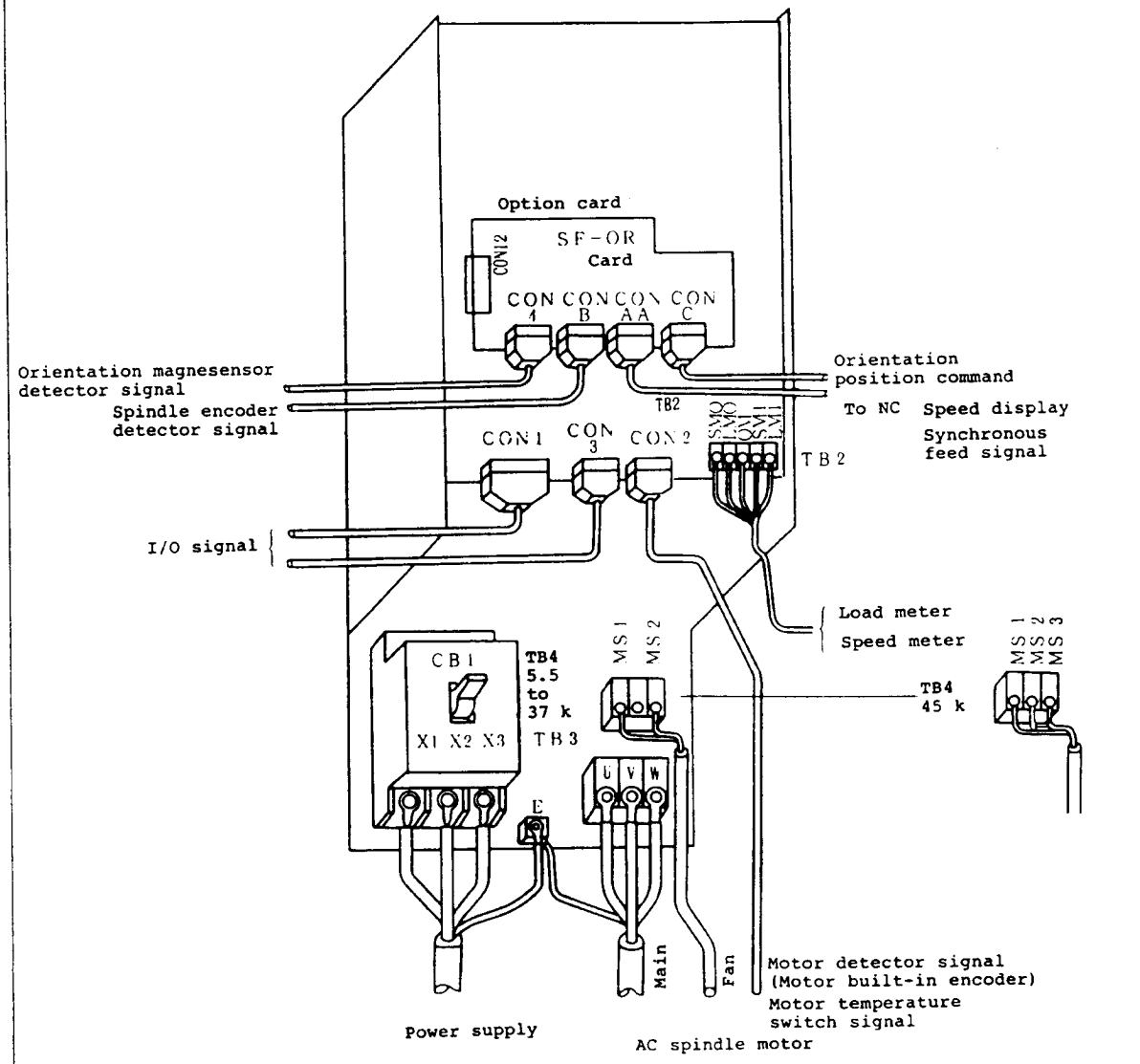


(Note) For the terminal board screw size, see external dimensions of the amplifier.

Appendix 2-2 Cable connection

(a) With magsensor orientation without NC

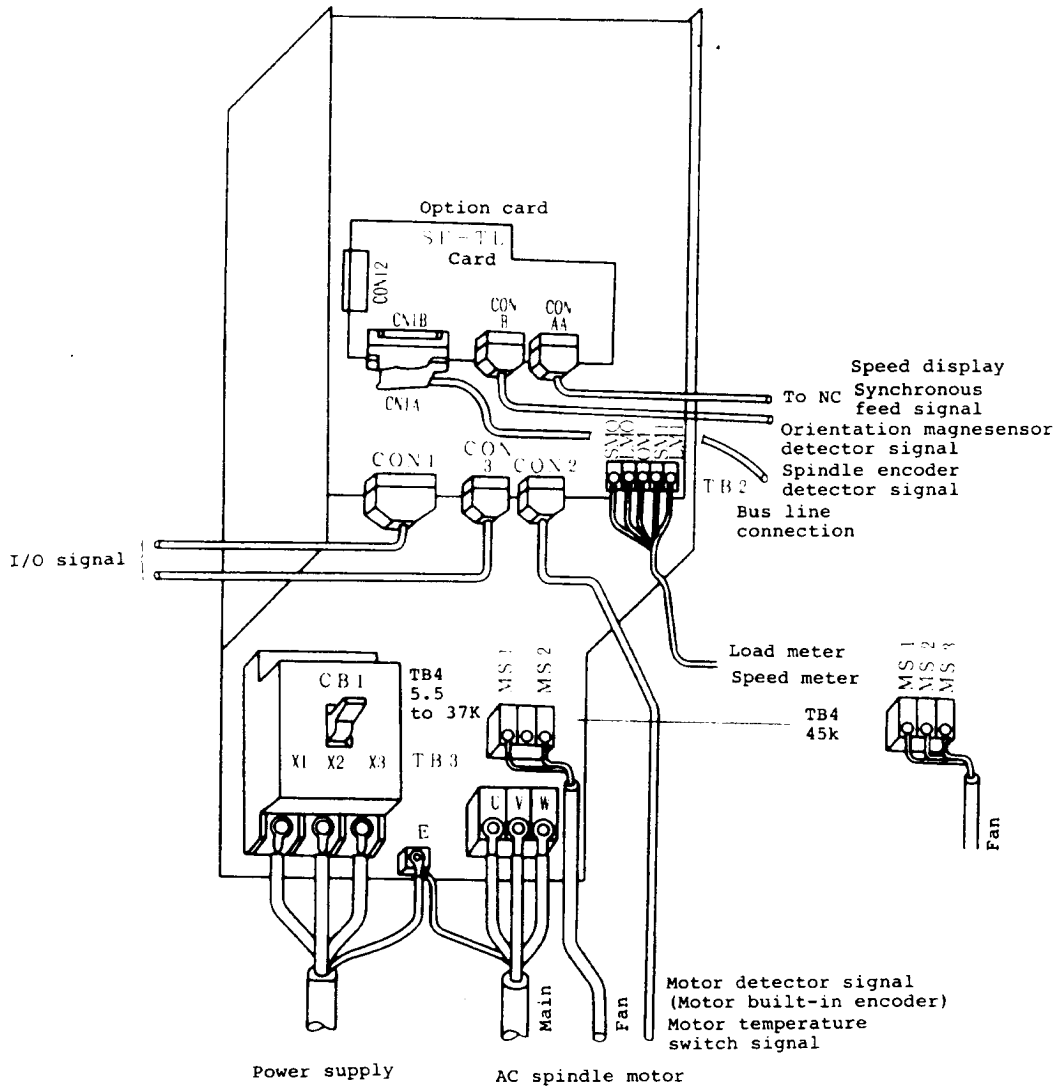
(b) With encoder orientation without NC
(4096 point orientation/indexing function)



(Note) For the terminal board screw size, see external dimensions of the amplifier.

Appendix 2-3 Cable connections (Bus linkage with NC)

Note 1. CN1B of the bus line connectors other than CN1A faces the vertical direction of the figure.
When using CN1B, the depth of the equipment increases by 20 mm.



(Note) For the terminal board screw size, see external dimensions of the amplifier.

Appendix 3 Cable and Connector Specifications

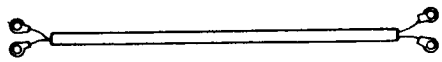
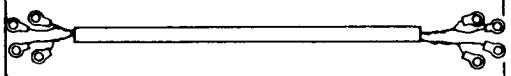
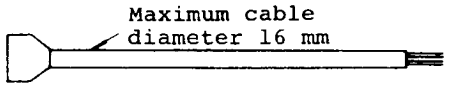
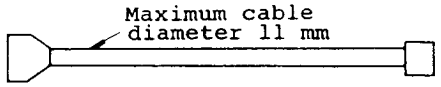
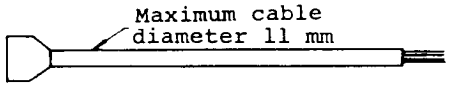
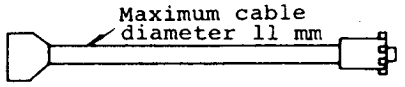
(1) Main circuit cable

The power and motor main circuit cables should be selected and prepared in accordance with the following table.

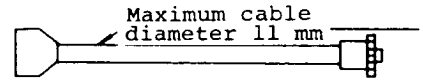
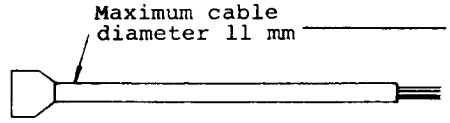
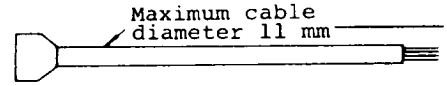
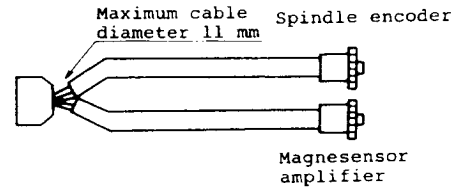
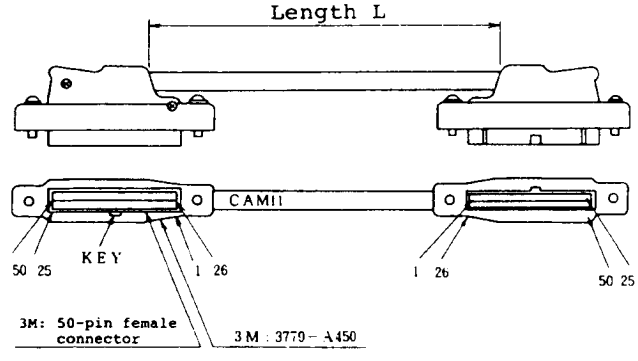
Amplifier type	FR-SF-2-						
	5.5K	7.5K	11K	15K	18.5K	22K	26K
Power feed cable	IV3.5SQ	IV8SQ	IV14SQ	IV22SQ	IV30SQ	IV38SQ	IV50SQ
Motor output cable	IV3.5SQ	IV5.5SQ	IV8SQ	IV14SQ	IV22SQ	IV30SQ	IV38SQ

1. The power feed cable should withstand the following conditions:
   Ambient temperature: 30°, 3 cables routing, power capacity (30 minute rating load).
2. The motor output cable should withstand the following conditions:
   Ambient temperature, 30°; 3 cables routing; continuing rated load?
3. By considering the ambient temperature, cable materials, and wiring conditions, select the proper cables using the above table.

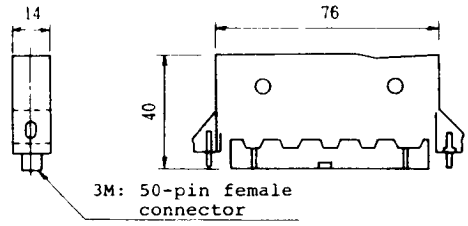
(2) Control circuit cables

Usage	Code	Connecting unit (Part name / Maker)	Supplied/ not supplied	Cable finish shape	Connecting unit (Part name / Makers)	Supplied/ not supplied
Motor cooling fan	TB4	Controller Crimp terminal 2SQ-4 2 pieces -	Not supplied	Vinyl cap tire cable; Other cables are 2SQ, 2 wires 	Motor (lead terminal) Crimp terminal 2SQ-4 2 pieces -	Not supplied
Indicator	TB2	Controller Crimp terminal 2SQ-3 4 pieces -	Not supplied	2 sets of twisted pair cables 0.3 SQ, for speed meter and load meter 	Indicator Crimp terminal -	Not supplied
I/O signals	CON1	Controller MR-50LF HONDA	Not supplied	General shield vinyl cable 0.2 SQ, 50 wires 	Signal reception/ transmission side - -	Not supplied
Motor detector signal, motor temperature switch signal	CON2	Controller MR-20LF HONDA	Not supplied	5 sets of twisted pair shield cable 0.3 SQ  The cable length should be 20 m or less.	Motor(connector) Motor(lead terminal) Connector AMP-350720-1 Pin AMP-350689-1 Japan AMP	Motor accessory
I/O signals	CON3	Controller MR-20LM HONDA	Not supplied	Vinyl cable 0.3 SQ, 20 wires 	Signal reception/ transmission side - -	-
Orientation magnesensor detection signals	CON4 CONB	Controller MR-20LF HONDA	Not supplied	3 sets of twisted pair sheild cables 0.3 SQ  The cable length should be 20 m or less.	Magnesensor amplifier TRC116 -12A10 -7F10.5 Tajimi	Provided with magnesensor amplifier

Continued on the next page.

Usage	Code	Connecting unit: Part name / Maker	Supplied/not supplied	Cable finish shape	Connecting unit: Part name / Makers	Supplied/not supplied
Spindle orientation encoder detection signals	CONB	Controller MR-20LF HONDA	Not supplied	4 sets of twisted pair shield cables 0.3 SQ 	Encoder MS3106A20-29S Canon	Provided with encoder
Synchronous feed signal speed display	CONAA	Controller MR-20LF HONDA	Not supplied	4 sets of twisted pair shield cables 0.3 SQ 	Signal reception side - -	-
Orientation position command	CONC	Controller MR-20LM HONDA	Not supplied	Vinyl cable 0.3 SQ, 20 wires 	Signal reception side - -	-
Magnesensor detection signal and spindle encoder detection signal for orientation	CONB	Controller MR-20LF HONDA	Not supplied	4 sets of twisted pair shield cables 0.3SQ  The cable length should be 20 m or less.	Encoder / Magnesensor amplifier MS3106A20-29 TRC116-12A10-7F10.5 Canon Tajimi	Provided with encoder and magnesensor amplifier
Bus line linkage with NC	CN1A (CN1B)	Linkage between controller and CNC and between servo amplifier and CNC CAM11 Mitsubishi	Not supplied (to be provided by the user of CNC)			

Continued on the next page.

Usage	Code	Connecting unit		Cable finish shape	Connecting unit	
		Part name / Maker	Supplied/ not supplied		Part name / Makers	Supplied/ not supplied
Termination resistor of bus line linkage with NC (to be inserted into last stage amplifier CN1B)		Controller				
		CABLE END	Not supplied (to be provided by the user of CNC)			
		Mitsubishi				

(3) Connectors

① Motor detection signal connector (motor side) pin assignment

The motor cable side connector (AMP-350720-1) is provided with the equipment.

Standard PLG (Motor built-in encoder)

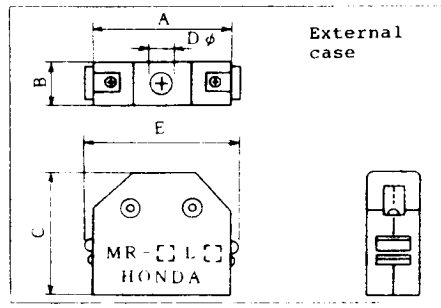
3 PB	2 RA	1 PA
6 N15C	5 AG	4 PB
9 COM	8 P15C	7

② Controller connector external dimensions

The controller cable side connector is not provided with the equipment. It should be repared by the user.

Manufacturer: Honda

Product name: MR- L



Dimension table

Unit:mm

Number ofwires	Product name	A	B	C	Dφ	E
50	MR-50L	67.9	18	44.8	16	(73.5)
20	MR-20L	39.3	18	39.8	11	(44.9)

③ Controller standard (no option) connector pin assignment

FR-SF-2-□K

CON1

MR-50LF

I/O signal

50	49	48	47	46	45	44	43	42	41	40	39	38	37	36	35	34	33
SM1	LM1	ESP2	ESP1	SR1	SRN	TXD	$\overline{TXD}$	RXD	$\overline{RXD}$	DSR	$\overline{DSR}$	DTR	$\overline{DTR}$				

32	31	30	29	28	27	26	25	24	23	22	21	20	19
SE2	SE1	SES	P15A	OR2	OR3	ORC2	ORC1	CTM	ORA2	ORA1	TL2	ARST2	ARST1

18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
OM	CTL	OR1	ORS	OS		FC	FA	D024	$\overline{USO}$	SET2	SET1	OT	TL1	ZS2	ZS1	SMO	LMO

CON2

MR-20LF

Motor detector signal

Motor temperature switch signal

20	19	18	17	16	15	14
SS		PZ	RB	PB	RA	PA

13	12	11	10	9	8
P15C					COM

7	6	5	4	3	2	1
	N15C			OHS1	OHS2	AG

CON3

MR-20LM

I/O signal

14	15	16	17	18	19	20
ZSO	USO	VRO	CDO	FLO	ORAO	COM

8	9	10	11	12	13
AL1	AL2	AL4	AL8	ALC	

1	2	3	4	5	6	7
TLO	COM	VR10	DEF	OD	DIG	OA

④ Option SF-OR card connector pin assignment (only optional connectors)

CON4

MR-20LF Magnesensor detection signal

20	19	18	17	16	15	14
0G	0H	P15B	LSC	LSA	MSC	MSA
	13	12	11	10	9	8
7	6	5	4	3	2	1

CONB

MR-20LF Spindle encoder detection signal

20	19	18	17	16	15	14
0G	$\overline{PB}$	PB	$\overline{PA}$	PA	$\overline{SC}$	SC
	13	12	11	10	9	8
	P15B	0H	LSC	LSA	MSC	MSA
7	6	5	4	3	2	1
0G	P5H	P5H	P5H	0H	0H	0H

CONAA

MR-20LF Speed display synchronous feed signal

20	19	18	17	16	15	14
0G	$\overline{0B}$	0B	$\overline{0A}$	0A	$\overline{0C}$	0C
	13	12	11	10	9	8
7	6	5	4	3	2	1
	P5H	P5H	P5H	0H	0H	0H

CONC

MR-20LM Orientation position command

14	15	16	17	18	19	20
0L	12H	11H	10H	09H	08H	07H
	8	9	10	11	12	13
1	2	3	4	5	6	7
	06H	05H	04H	03H	02H	01H

⑤ Option SF-TL card connector pin assignment (only optional connectors)

CONB

MR-20LF Magnesensor detection signal

20	19	18	17	16	15	14
13	12	11	10	9	8	
P15B	0H	LSC	LSA	MSC	MSA	
7	6	5	4	3	2	1

CONB

MR-20LF Spindle encoder detection signal

20	19	18	17	16	15	14
0G	$\overline{PB}$	PB	$\overline{PA}$	PA	$\overline{SC}$	SC
13	12	11	10	9	8	
7	6	5	4	3	2	1
	P5H	P5H	P5H	0H	0H	0H

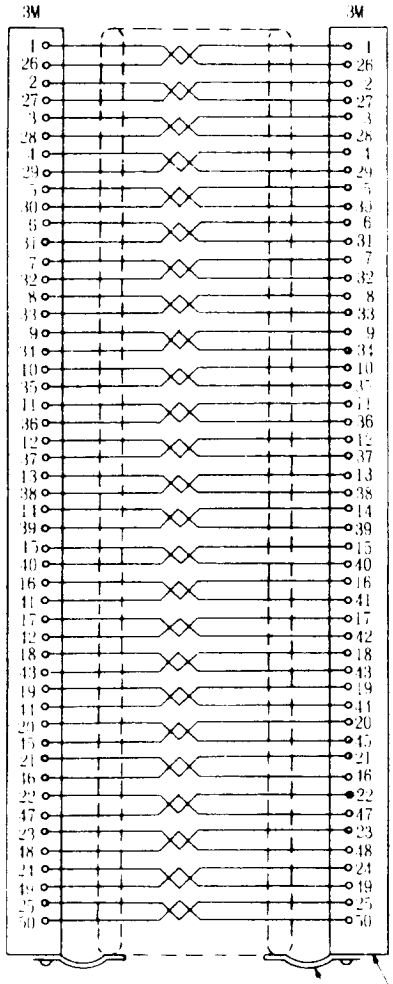
CONAA

MR-20LF
Speed display
synchronous feed signal

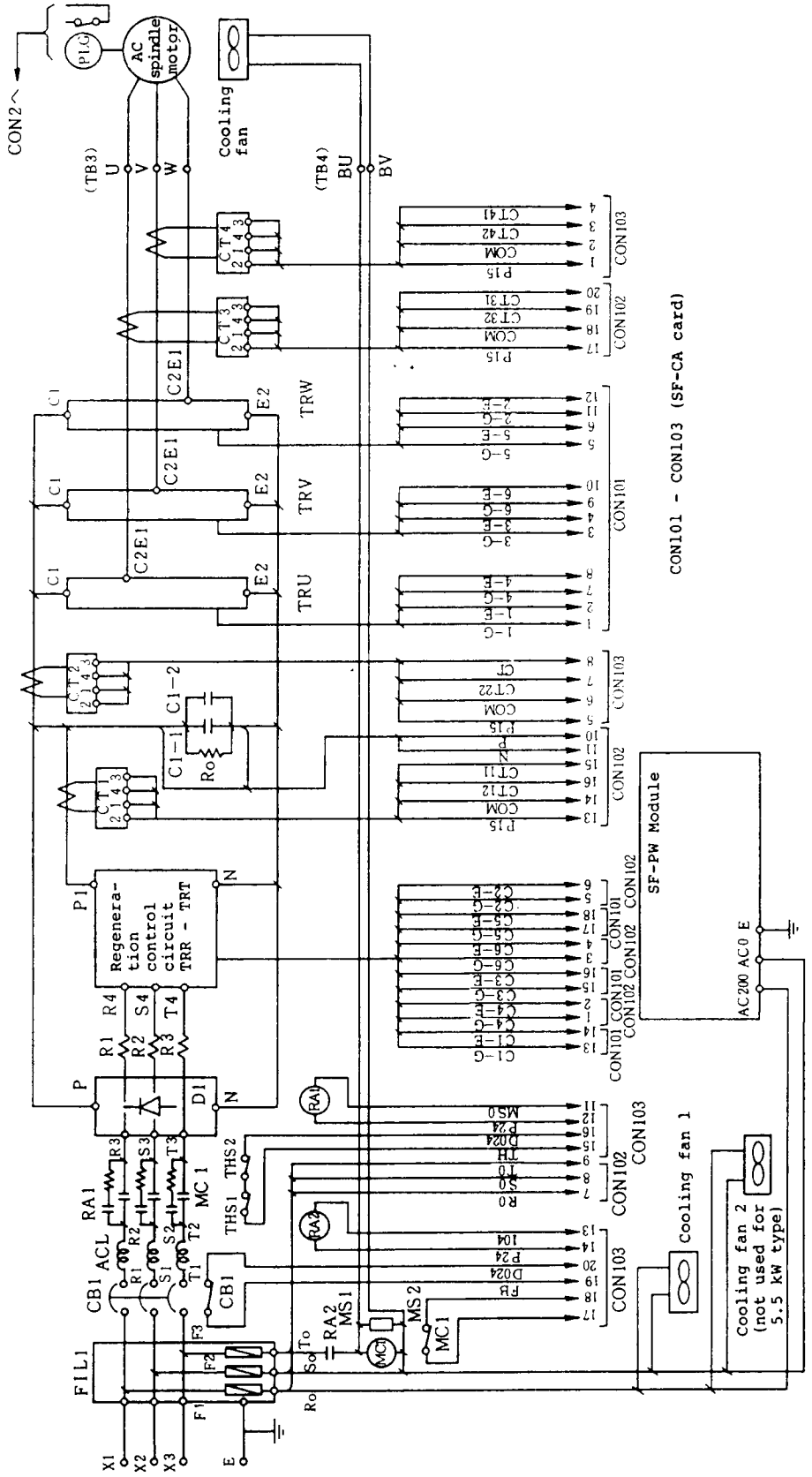
20	19	18	17	16	15	14
0G	$\overline{PB}$	PB	$\overline{PA}$	PA	$\overline{SC}$	SC
13	12	11	10	9	8	
7	6	5	4	3	2	1
	P5H	P5H	P5H	0H	0H	0H

CN1A and CN1B are connectors which are linked through the bus line.

Cable specification



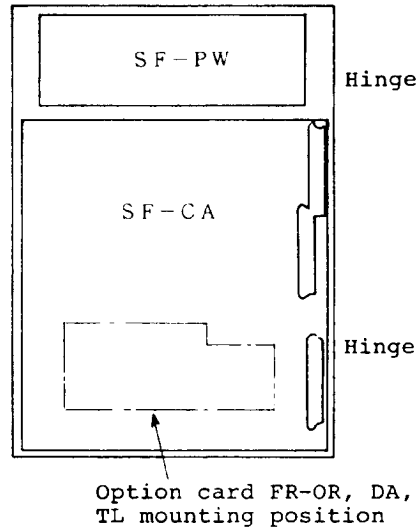
Appendix 4 Main Circuit Configuration



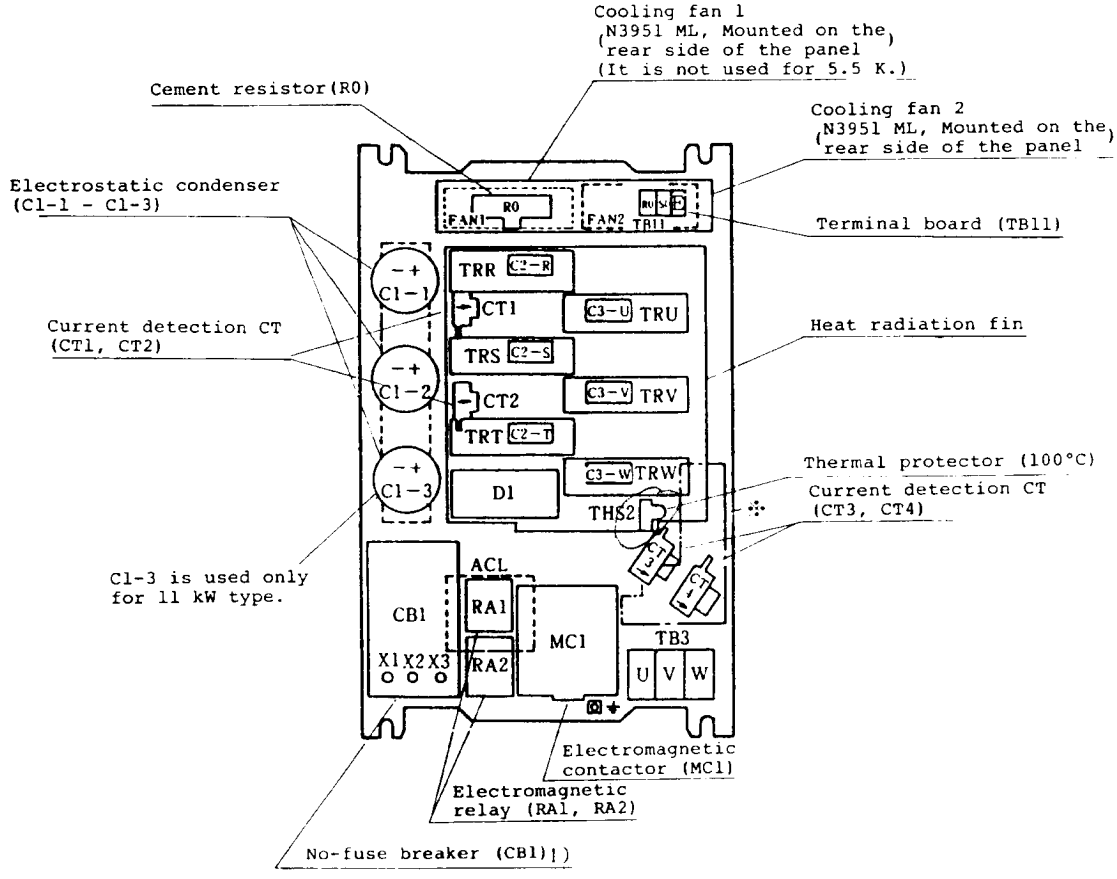
Appendix 5 Spindle Part Layout

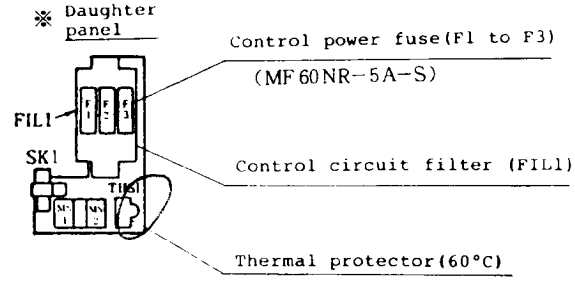
(Excluding printed circuit boards)

When opening the hinge panel which is mounted on the upper portion of the amplifier main panel (which mounts the control circuit printed circuit board), the main circuit parts are visible.

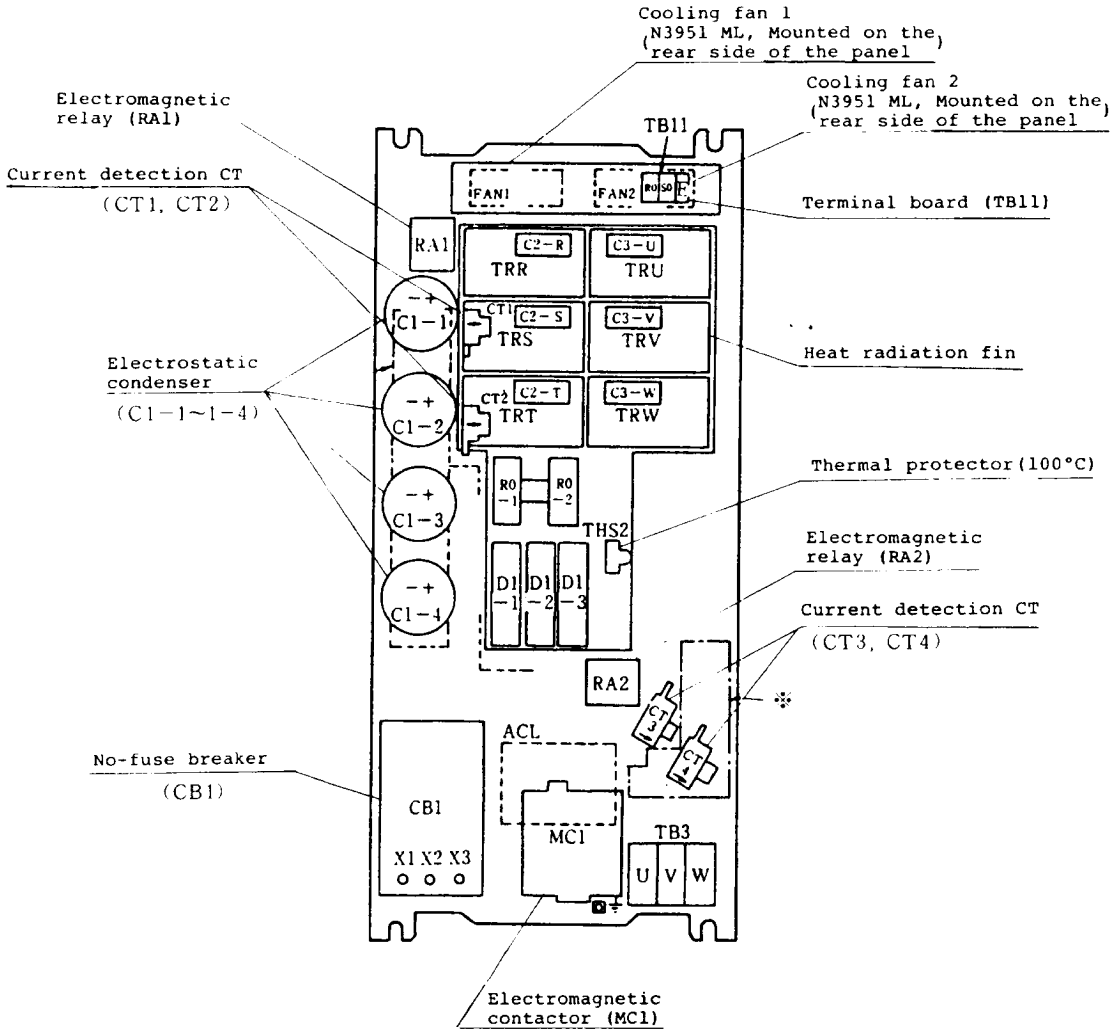


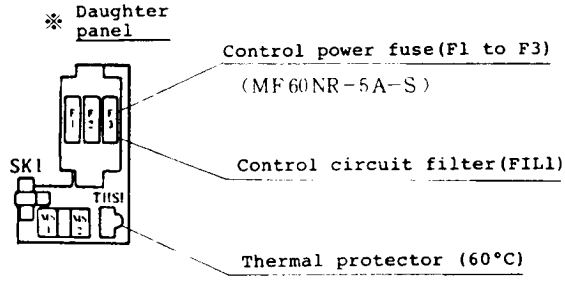
(1) FR-SF-2-5.5K, 7.5K, 11K



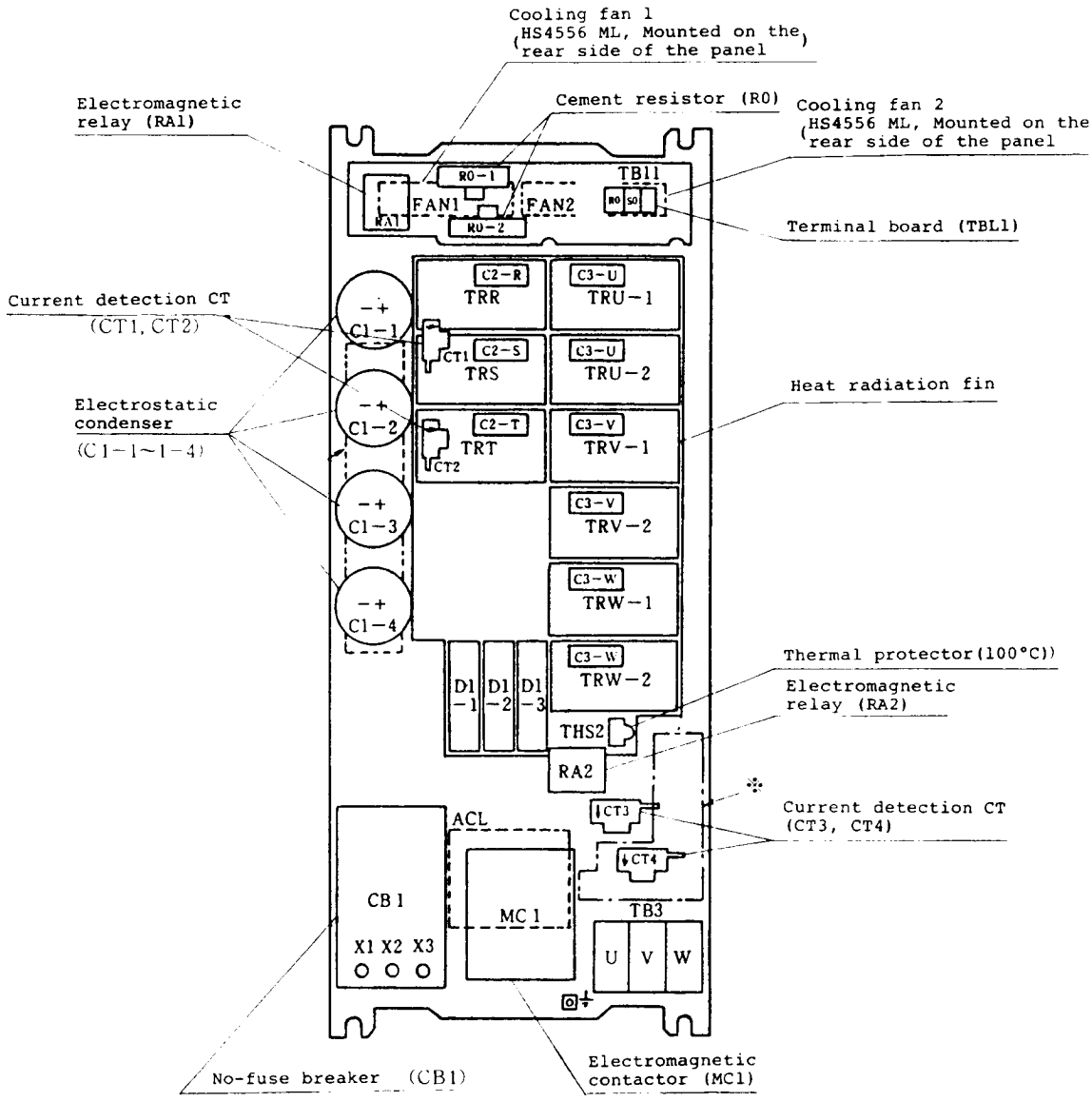


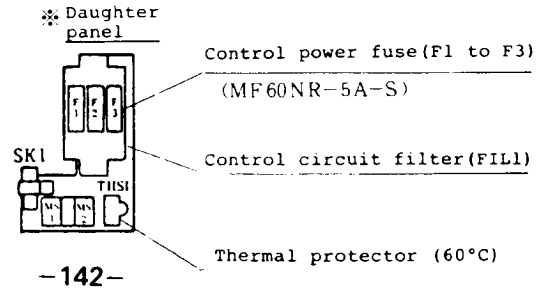
(2) FR-SF-2-15K


Cooling fan 1
(N3951 ML, Mounted on the rear side of the panel)
Cooling fan 2
(N3951 ML, Mounted on the rear side of the panel)
Electromagnetic relay (RA1)
Current detection CT
(CT1, CT2)
TB11
FAN1
FAN2
Terminal board (TB11)
RA1
C2-R
TRR
C3-U
TRU
C1-1
CT1
C2-S
TRS
C3-V
TRV
Heat radiation fin
Electrostatic condenser
(C1-1~1-4)
C1-2
CT2
C2-T
TRT
C3-W
TRW
Thermal protector (100°C)
C1-3
THS2
Electromagnetic relay (RA2)
C1-4
Current detection CT
(CT3, CT4)
RA2
ACL
No-fuse breaker
(CB1)
CB1
X1 X2 X3
MC1
TB3
U V W
Electromagnetic contactor (MC1)

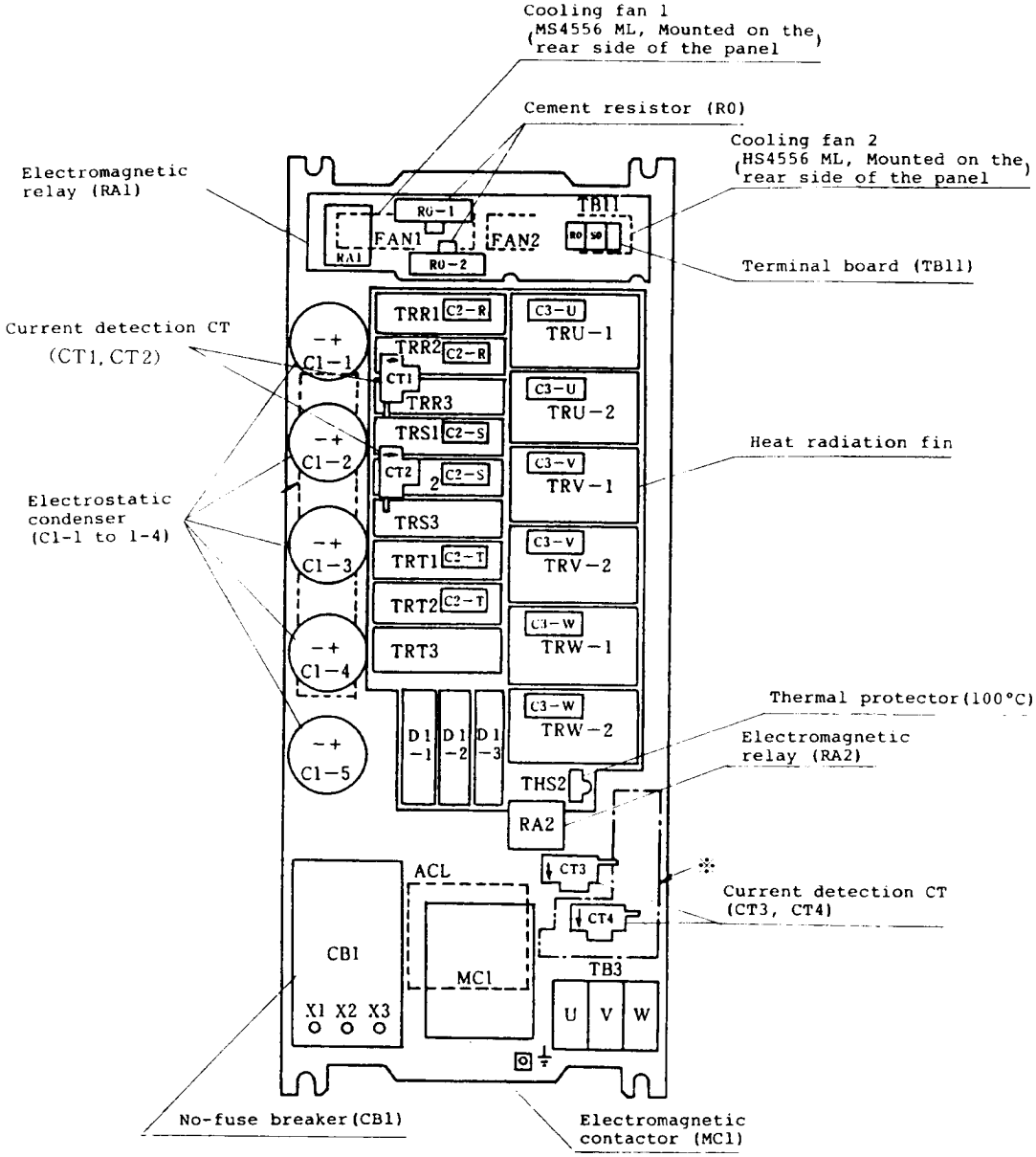

※ Daughter panel
Control power fuse (F1 to F3)
(MF60NR-5A-S)
SK1
Control circuit filter (FIL1)
THS1
Thermal protector (60°C)

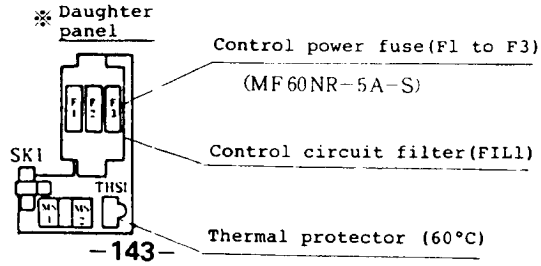
(3) FR-SF-2-18.5K


Cooling fan 1
(HS4556 ML, Mounted on the rear side of the panel)
Electromagnetic relay (RA1)
Cement resistor (R0)
Cooling fan 2
(HS4556 ML, Mounted on the rear side of the panel)
R0-1
TB11
FAN1
FAN2
RA1
R0-2
R0
S0
Terminal board (TBL1)
Current detection CT
(CT1, CT2)
C2-R
C3-U
TRR
TRU-1
C1-1
CT1
C2-S
C3-U
TRS
TRU-2
Heat radiation fin
Electrostatic condenser
(C1-1~1-4)
C1-2
C2-T
C3-V
TRT
TRV-1
CT2
C1-3
C3-V
TRV-2
C3-W
TRW-1
C1-4
C3-W
TRW-2
Thermal protector(100°C))
D1-1
D1-2
D1-3
Electromagnetic relay (RA2)
THS2
RA2
CT3
Current detection CT
(CT3, CT4)
CT4
ACL
CB1
MC1
TB3
X1 X2 X3
U
V
W
No-fuse breaker (CB1)
Electromagnetic contactor (MC1)


Daughter panel
Control power fuse(F1 to F3)
(MF60NR-5A-S)
SK1
THS1
Control circuit filter(FIL1)
Thermal protector (60°C)

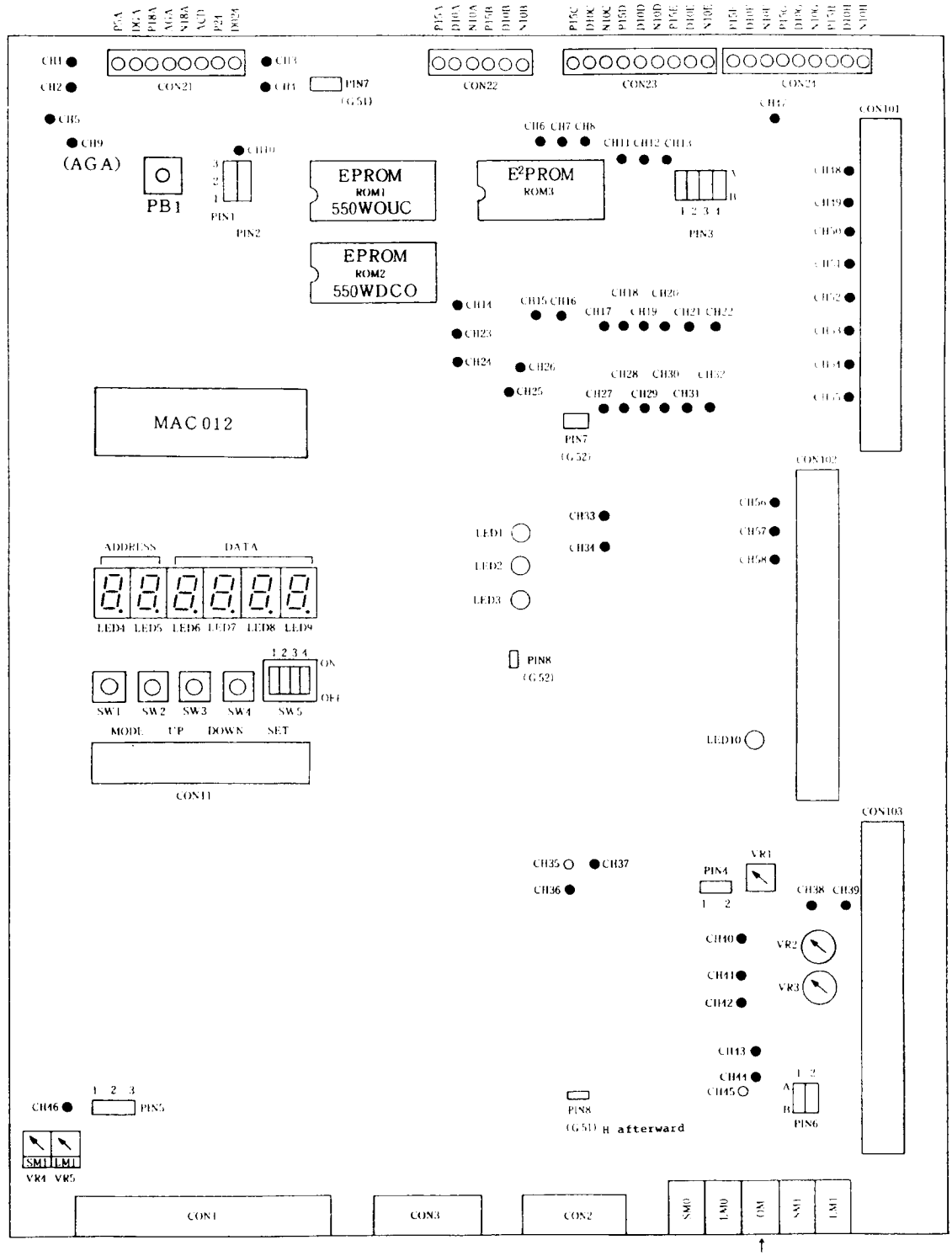
(4) FR-SF-2-22K, 26K





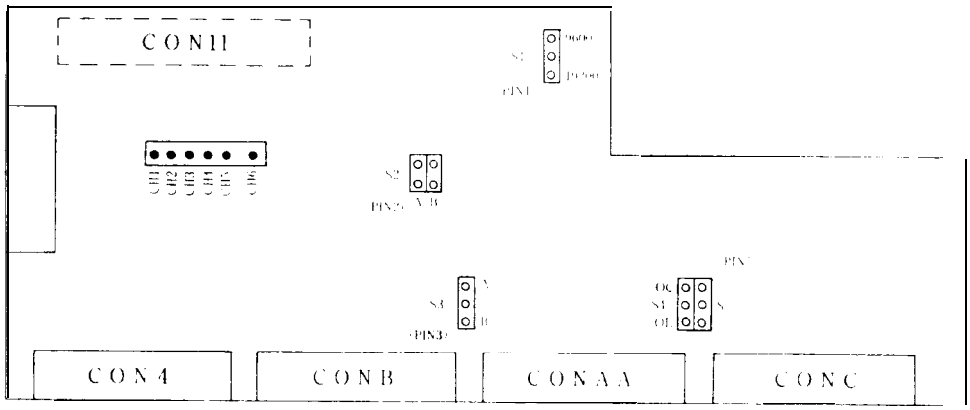
Appendix 6 Control Circuit Printed Circuit Board Part Layout

(1) SF-CA card (Note 1) The positions of PIN7 and PIN8 of the bare board drawing number G51 differ from those of G52.



(Terminal whose function is equivalent to CH9(AGA))

(2) SF-OR card

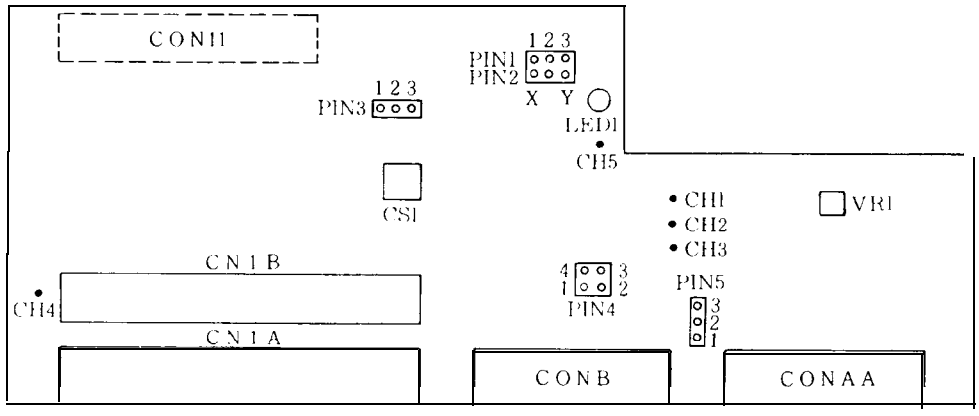


Note) The setting pin names of the bare board drawing number G51 differ from those of G52. Number in parentheses are pin number of G52.

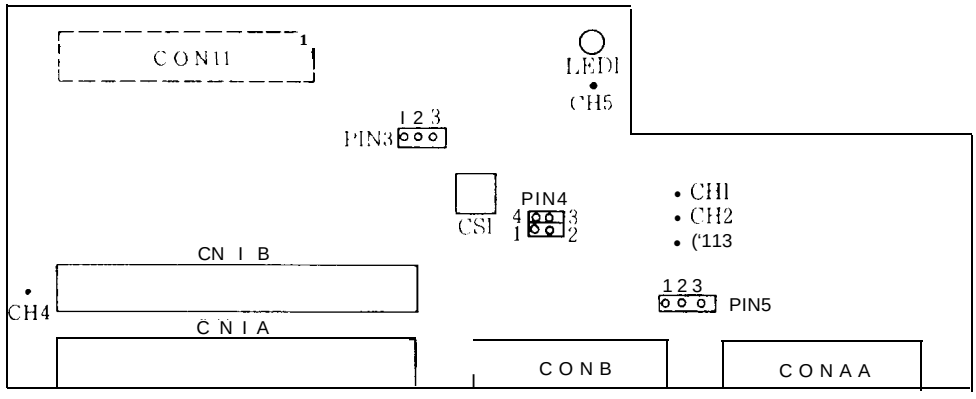
Example: S1 . . . . . Name for G51
(PIN1) . . . Name for G52

(3) SL-TL card

1) Bare board drawing G51 part layout

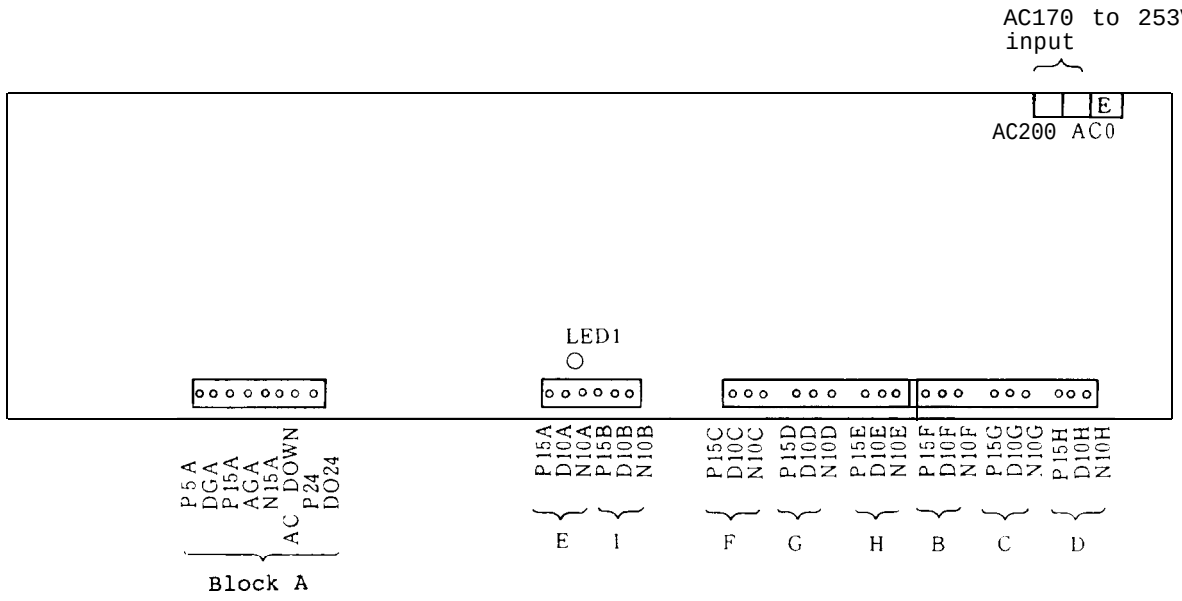


2) Bare board drawing G52 part layout



(4) SF-PW module

This module supplies all DC current to the entire FR-SF.



(Note) 1. The blocks B, C, D, E, F, G, H, and I are power supplies for the base amplifier of the main circuit power transistors_ Note that they are not insulated from the main circuit.

2. The 0 V lines of the block A (DGA, AGA, D024) are mutually connected.

Appendix 7 Major Part Table

(Note) Spare part class A ..... The part should be replaced every 2 years.
Spare part class B . . . . . The part should be replaced every 5 years.
Spare part class C ..... The part should be stocked by the machine manufacturer.

Item No.	Part name	Capacity kW	Model name		Maker	Code	Q'ty	Spare part class: Standard accessory	Selection: A	B	C	Remarks
1	No-fuse breaker	5.5	NF50CS 3P	40A05	Mitsubishi	CB1	1	0	0	0	1	
		7.5										
		11		50A05								
		15	NG100CS 3P	75A05								
		18.5										
		22		100A05								
		26										
	Transistor module	5.5	UM75CDY-10		Mitsubishi	TRR TRS TRT	3	0	0	0	3	
		7.5										
		11	UM100CDY-10									
		15	UM150CDY-10									
		18.5										
		22	UM75CDY-10			TRR1-3 TRS1-3 TRT1-3	9	0	0	0	9	
		26										
3	Transistor module	5.5	UM75CDY-10		Mitsubishi	TRU TRV TRW	3	0	0	0	3	
		7.5	UM100CDY-10									
		H 11 15	UM150CDY-10									
		18.5	UM100CDY-10			TRU1,2 TRV1,2 TRW1,2	6	0	0	0	6	
		22	UM150CDY-10									
		26										
4	Diode stack	5.5	PT768		Nippon international	DI	1	0	0	0	1	
		7.5										
		11										
		15	PD608			D1-1 D1-2 D1-3	3	0	0	0	3	
		18.5										
		22	PD1008									
		26										

Continued on the next page.

Appendix 7
Major Part Table

Item No.	Part name	Capacity kW	Model name	Maker	Code	Q'ty	Spare part class: Standard accessory	Selection A	Selection B	Selection C	Remarks
5	Electrolytic condenser	5.5 7.5 11 15	2900UFX350V BKO-NC1043-H19	Nippon Chemicon	C1-1, 2	2	0	0	2	2	
					C1-1-3	3	0	0	3	3	
					C1-1-4	4	0	0	4	4	
		18.5 22 26	3200UFX350V BKO-NC1043-H20	Nippon condenser	C1-1-5	5	0	0	5	5	
6	Electro-magnetic contactor	5.5 7.5 11 15	SK50-AC200V	Mitsu-bishi	MC1	1	0	0	0	1	
		18.5 22 26	SK65-AC200V								
7	Cooling fan	5.5 7.5 11 15	N3951MVL	Tobishi Kosan	FAN1	1	0	1	0	1	
					FAN1 FAN2	2	0	2	0	2	
		18.5 22 26	HS4556MVL								
8	AC reactor	5.5	BKO-NC6321- H02	Chuo Denki	ACL	1	0	0	0	1	
		7.5	H03								
		11	H04								
		15	H05								
		18.5	H06								
		22	H07								
		26	H07								
9	Condenser	5.5 7.5	MEUZ105K600A BKO-NA1061-05	Sizuki	C2-R,S,T C3-U,V,W	6	0	0	6	6	
		11			C2-R,S,T	3	0	0	3	3	

co inued on the next page.

Appendix 7
Major Part Table

Item No.	Part name	Capacity kW	Model name	Maker	Code	Q'ty	Spare part class: Standard accessory	Selection A	Selection B	Selection C	Remarks
10	Surge absorber	11 15 18.5 22 26	BKO-C1916H02	SHIZUKI	C3-U,V	3	O	O	O	3	
					C3-U1, C3-V1, C3-W1,	6	O	O	O	6	
11	Surge absorber	15 18.5 22 26	BKO-C1916H01	SHIZUKI	C2-R1, T1	3	O	O	O	3	
					C2-R1, C2-S1, C2-T1,	6	O	O	O	6	
12	Resistor	5.5 7.5 11 15 18.5 22 26	BKO-NC1120-H02 BKO-NC1120-H03 BKO-NC1120-H04 BKO-NC1120-H05 BKO-NC1120-H06 BKO-NC1120-H07 BKO-NC1120-H07	Micron Denki	R1 R2 R3	3	O	O	O	3	
13	Resistor	5.5 7.5 11 15 18.5 22 26	MFS30A802K	Micron Denki	RO	1	O	O	O	1	
					RO-1 RO-2	2	O	O	O	2	
14	Relay	5.5 - 26	G4J3342-TDC24V	OMRON	RA1	1	O	O	O	1	
15	Relay	5.5 - 26	G4J1142-TDC24V	OMRON	RA2	1	O	O	O	1	
16	Thermal protector	5.5 - 26	OHD-60B	Tohoku Metal	THS1	1	O	O	O	1	

Continued on the next page.

Appendix 7
Major Part Table

Item NO.	Part name	Capacity kW	Model name	Maker	Code	Q'ty	Spare part class: Stand-ard Acces-sory	Selection: A	B	C	Remarks
17	Thermal protector	5.5 - 26	OHD-100B	Tokoku Metal	THS2	1	0	0	0	1	
18	Current detector (CT)	5.5	BKO-NC6131-H02	KOSHIN	CT1 CT2 CT3 CT4	4	0	0	0	4	
		7.5	BKO-NC6131-H03								
		11	BKO-NC6131-H04								
		15	BKO-NC6131-H05								
		18.5	BKO-NC6131-H06								
		22	BKO-NC6131-H07								
		26	BKO-NC6131-H08								
19	Terminal board	5.5	TE-K14-3	Mitsu-bishi	TB3	1	0	0	0	1	
		7.5	TE-K14-3								
		11	TE-K22B-3								
		15	TE-K22B-3								
		18.5	TE-K60B-3								
		22	TE-K60B-3								
		26	TE-K60B-3								
20	Terminal board	5.5 - 26	TE-K2-3	Mitsu-bishi	TB4 TB11	2	0	0	0	2	
21	Noise filter	5.5 - 26	BKO-NC6143H01	SHIZUKI	FIL1	1	0	0	0	1	
22	Fuse	5.5 - 26	MF60NR-5A-S	Toyo Fuse	F1 F2 F3	3	3	0	0	3	Tube fuse Arc erasing agent contained
23	Surge killer	5.5 - 26	DCR2-12003 -5041	Matsuo Electric	SK1	1	0	0	0	1	
24	Module	5.5 - 26	BKO-NC6233	Yamabishi Electric	SF-PW	1	0	0	0	1	
25	Printed circuit board	5.5 - 26	SF-CA (TN990A376G61)	Mitsu-bishi	SF-CA	1	0	0	0	1	

Continued on the next page.

Item No.	Part name	Capacity kW	Model name	Maker	Code	Q'ty	Spare part class: Standard accessory	Selection: A	Selection: C	Remarks
26	Printed circuit board (for option)	-	SF-OR	Mitsubishi	SF-OR	1	0	0	1	
		-	SF-TL	Mitsubishi	SF-TL	1	0	0	1	
27	Yagnesensor (option)	Magnet	BKO-C1810H03	Sony Magnescale		1	0	0	1	
		Sensor	BKO-C1810H02	Sony Magnescale	-	1	0	0	1	
		Amplifier	BKO-C1810H01	Sony Magnescale	-	1	0	0	1	
	Encoder (option)		RFH1024-22-1M-68	TAMAGAWA		1	0	0	1	
28	Motor built-in encoder		TS1860N14	TAMAGAWA		1	0	0	1	
29	Cooling fan	A112	IA-15101	Union Seikou			0	0	1	1	
		B112								
		B132								
		C132								
		A160	PFR-680-A	Akamatsu Denki						
		B160								
30	Bearing (load side)	A112	6307M2ZZCS19	NTN		1	0	0	1	1	
		B112								
		B132	6310M2ZZCS22							
		C132								
		A160	6312M2ZZCS28							
		B160								

Continued on the next page.

Appendix 7
Major Part Table

Item No.	Part name	Capacity kW	Model name	Maker	Code	Q'ty	Spare part class: Standard accessory	Selection: A	B	C	Remarks
31	Bearing (non-load) side			NTN		1	0	0	1	1	
		All2	6306M2ZZCS16								
		B112									
		B132	6408M2ZZCS19								
		Cl32									
		A160									
		B160									

Appendix 8 Display Lamps (LED diodes)

(1) SF-CA card

Number	Description
LED1	Lights when the converter regenerates.
LED2	Lights when the base of the inverter/converter transistor cuts off.
LED3	Watchdog alarm. Lights when the power is turned on or the machine is reset. In the bus linkage state, lights until the NC startup initializing operation is completed.
LED4 - LED9	Status display and alarm display
LED10	Lights when the converter voltage is charged.

(2) SF-TL card

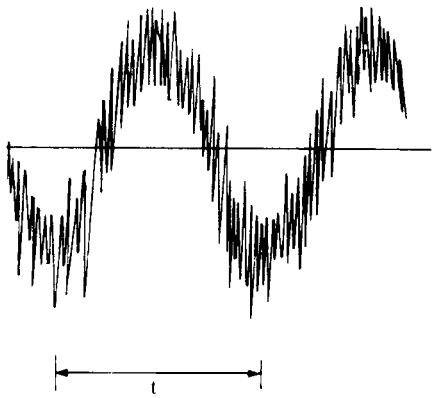
Number	Description
LED1	Encoder circuit breakage detection.

(3) SF-PW module

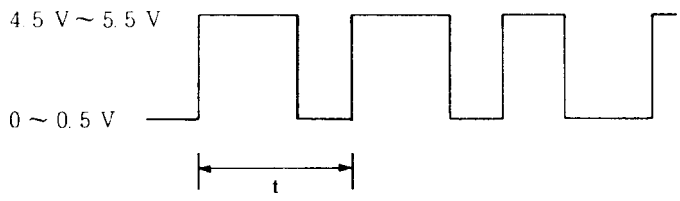
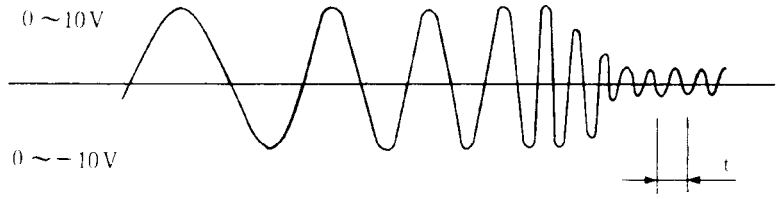
Number	Description
LED1	Puts off when the AC input votlage is not supplied. Puts off when the DC voltage terminals (P5A, P15A, N15A, and P24) of the block A are shortcircuited to the ground.

Appendix 9 Check Terminals

(1) SF-CA card

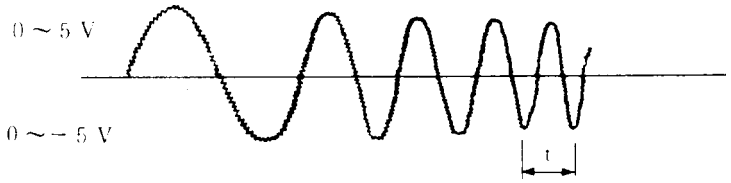
No.	Common	Signal, description, waveform
CH 1	DGA	+5V (4.85 ∿ 5.15V)
CH 2		OV, DGA
CH 3		OV, DGA
CH 4	DGA	+24V (21.6 ∿ 26.4V)
CH 5	AGA	+15V (14.25 ∿ 15.75V)
CH 6 CH 7 CH 8	AGA AGA AGA	Phase U voltage command Phase V voltage command Phase W voltage command Example of waveform) Regular motor rotation 0 ∿ 15 V  0 ∿ -15v $t \fallingdotseq \frac{30}{N}$ (sec) N: Motor speed (rpm)
CH9		OV, AGA (Analog ground)
CH10	AGA	-15V (-14.25 ∿ -15.75V)

Continued on the next page.

No.	Common	Signal, description, waveform
CH11 CH12 CH13	AGA AGA AGA	Phase V PWM modulation waveform Phase W PWM modulation waveform Phase U PWM modulation waveform Example of waveform) Orientation stop  t ≒ 300 μsec
CH14 CH15 CH23	AGA AGA AGA	Phase V reference sine wave Phase W reference sine wave Phase U reference sine wave Example of waveform) Motor acceleration  $t \fallingdotseq \frac{30}{N}$ (sec) N: Motor speed (rpm)

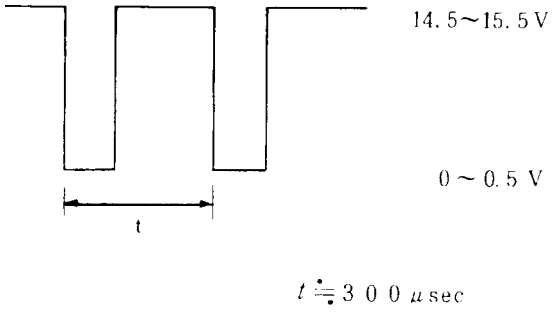
Continued on the next page

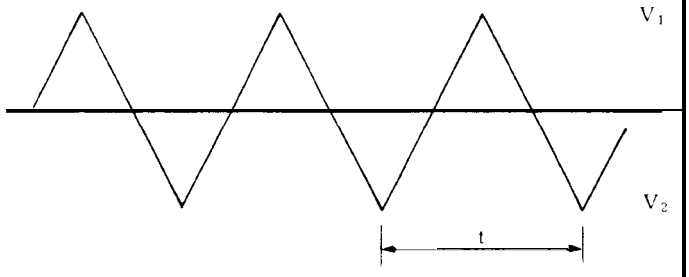
<table>
<tr><th>No.</th><th>Common</th><th>Signal, description, waveform</th></tr>
<tr><td>CH16
CH40
CH41</td><td>AGA
AGA
AGA</td><td>Phase W inverter current detector
Phase U inverter current detector 2.5V at 1008
Phase V inverter current detector

Example of wavefor) Motor acceleration
 

$t \fallingdotseq \frac{30}{N}$ (sec)
N: Motor speed (rpm)
<table><tr><th>Controller capacity</th><th>Current value</th></tr><tr><td>5.5K</td><td>15.2A/V</td></tr><tr><td>7.5K</td><td>20.4A/V</td></tr><tr><td>11 K</td><td>30.4A/V</td></tr><tr><td>15 K</td><td>38.0A/V</td></tr><tr><td>18.5K</td><td>44.0A/V</td></tr><tr><td>22 K</td><td>53.2A/V</td></tr><tr><td>26 K</td><td>65.2A/V</td></tr></table></td></tr>
<tr><td>CH17
CH18
CH19
CH20
CH21
CH22</td><td>AGA
AGA
AG
AGA
AGA
AGA</td><td>Phase U base amplifier driving signal
Phase V base amplifier driving signal
Phase W base amplifier driving signal
Phase $\overline{U}$ base amplifier driving signal
Phase $\overline{V}$ base amplifier driving signal
Phase $\overline{W}$ base amplifier driving signal</td></tr>
</table>

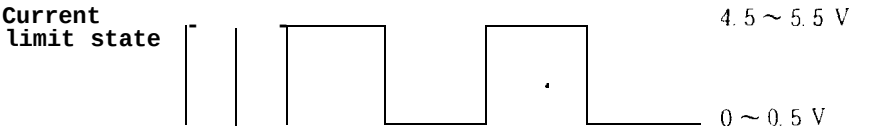
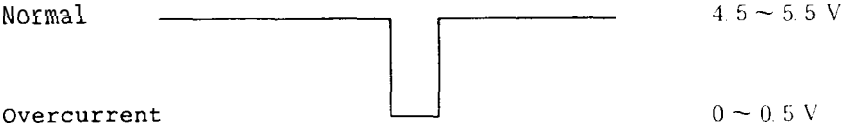
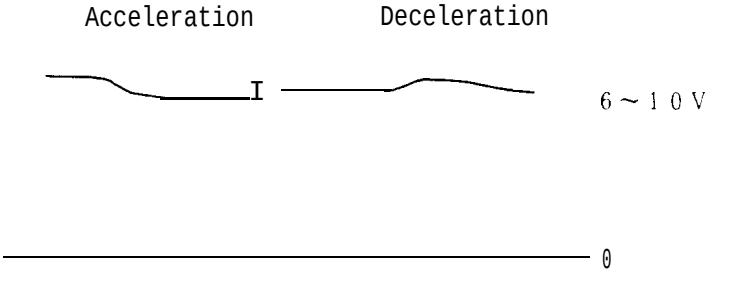
Continued on the next page.

<table>
<tr><th>No.</th><th>Common</th><th>Signal, description, waveform</th></tr>
<tr><td>CH27
CH28
CH29
CH30
CH31
CH32</td><td>AGA
AGA
AGA
AGA
AGA
AGA</td><td>Phase R base amplifier driving signal
Phase S base amplifier driving signal
Phase T base amplifier driving signal
Phase $\overline{R}$ base amplifier driving signal
Phase $\overline{S}$ base amplifier driving signal
Phase T base amplifier driving signal
Example of waveform) Orientation stop state
 

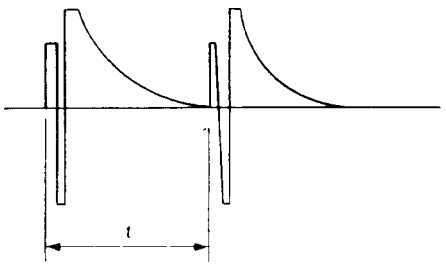
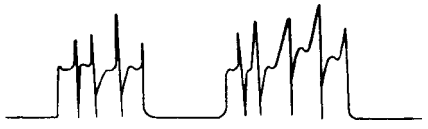
$t \fallingdotseq 300\ \mu sec$</td></tr>
<tr><td>CH24</td><td>AGA</td><td>Triangle wave carrier
Example of waveform) Ready on state
 

$t \fallingdotseq 300\ \mu sec$
<table>
<tr><th>Controller capacity</th><th>V_1</th><th>V_2</th></tr>
<tr><td>15kW or less</td><td>1 ∿ 4.5V</td><td>-1 ∿ -4.5V</td></tr>
<tr><td>18.5kW or less</td><td>3 ∿ 13V</td><td>-3 ∿ 13V</td></tr>
</table></td></tr>
</table>

Continued on the next page

NO.	Common	Signal, description, waveform
CH25	AGA	Current amplitude command 0 ∿ 10V
CH26	AGA	-10 V reference voltage -9.7 ∿ -10.6V
CH33	DGA	Regeneration current limit state Example of waveform) Motor deceleration state 
CH34	AGA	Regeneration overcurrent Example of waveform) 
CH35	AGA	10 V at converter voltage 400V Example of waveform) 

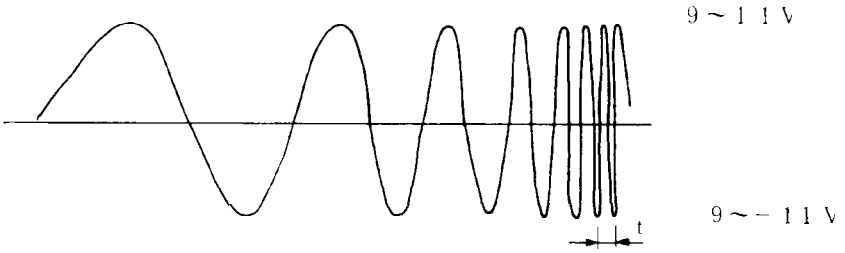
Continued on the next page.

No.	Common	Signal, description, waveform
CH36	AGA	Power voltage peak current Example of waveform) Motor stop state(M05) 5.5 ~ 10 V 0
CH37	AGA	AD converter input (speed feedback and voltage command detection) Example of waveform) READY ON, Motor stop state (M05)  0 ~ - 11 V t = 1.8 msec
CH38	AGA	+10 V reference voltage 9.7 - 10.5 v
CH39	AGA	Regeneration converter current detection Example of waveform) Motor deceleration  0 ~ 3.5 V

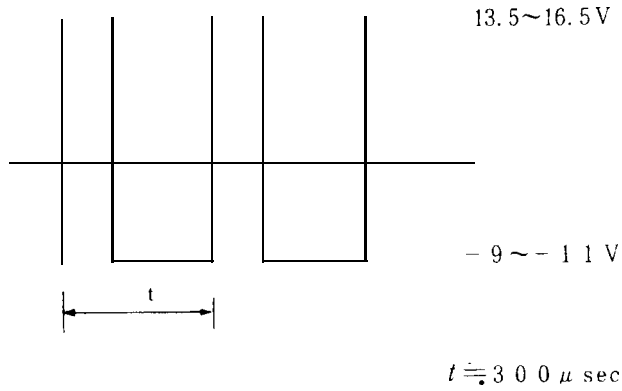
Continued on the next page.

<table>
<tr><th>No.</th><th>Common</th><th>Signal, description, waveform</th></tr>
<tr><td></td><td></td><td>
<table>
<tr><th>Controller capacity</th><th>Current value</th></tr>
<tr><td>5.5kW</td><td>15.2A/V</td></tr>
<tr><td>7.5kW</td><td>20.4A/V</td></tr>
<tr><td>11kW</td><td>30.4A/V</td></tr>
<tr><td>15kW</td><td>38.0A/V</td></tr>
<tr><td>18.5kW</td><td>44.0A/V</td></tr>
<tr><td>22kW</td><td>53.2A/V</td></tr>
<tr><td>26kW</td><td>65.2A/V</td></tr>
</table>
</td></tr>
<tr><td>CH42
CH43</td><td>AGA
AGA</td><td>Converter DC current detection 10V at 200%
Example of waveform) Regular motor rotation state
 
-1~10V
<table>
<tr><th>Controller capacity</th><th>Current value</th></tr>
<tr><td>5.5kW</td><td>30.4A/V</td></tr>
<tr><td>7.5kW</td><td>40.8A/V</td></tr>
<tr><td>11kW</td><td>60.8A/V</td></tr>
<tr><td>15kW</td><td>76.0A/V</td></tr>
<tr><td>18.5kW</td><td>88.0A/V</td></tr>
<tr><td>22kW</td><td>106.4A/V</td></tr>
<tr><td>26kW</td><td>130.4A/V</td></tr>
</table>
</td></tr>
</table>

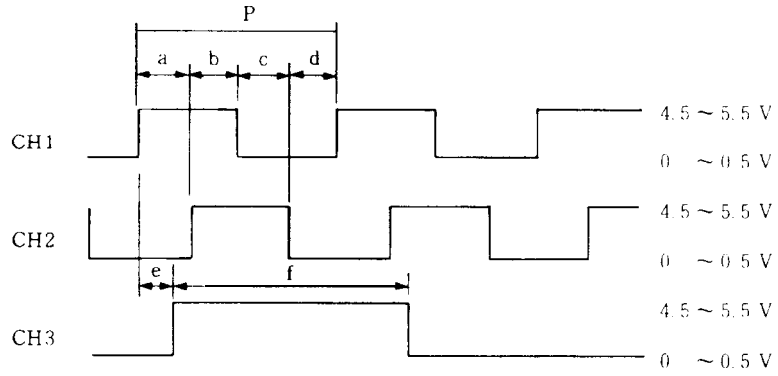
Continued on the next page.

No.	Common	Signal, description, waveform
CH44	AGA	Speed feedback phase B
CH45	AGA	Speed feedback phase A Example of waveform) Motor acceleration state  $t \fallingdotseq \frac{15}{64} \cdot \frac{1}{N}$ (sec) N: Motor speed (rpm)
CH46	AGA	Analog speed reference voltage Example of waveform) Regular motor rotation state 0 ~ 10 V
CH47	CON24-2	Inverter base amplifier output Phase U
CH48	CON24-6	Inverter base amplifier output Phase V
CH49	CON24-1	Inverter base amplifier output Phase W
CH50	CON22-2	Inverter base amplifier output Phase $\overline{U}$
CH51	CON22-2	Inverter base amplifier output Phase $\overline{V}$
CH52	CON22-2	Inverter base amplifier output Phase $\overline{W}$
CH53	CON23-2	Converter base amplifier output Phase R
CH54	CON23-6	Converter base amplifier output Phase S
CH55	CON23-1	Converter base amplifier output Phase T
CH56	CON22-5	Converter base amplifier output Phase $\overline{R}$
CH57	CON22-5	Converter base amplifier output Phase $\overline{S}$
CH58	CON22-5	Converter base amplifier output Phase $\overline{T}$

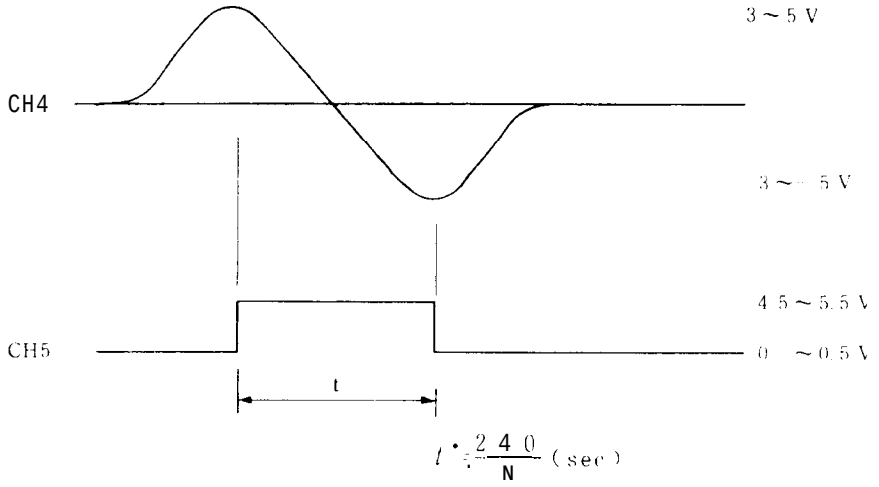
Continued on the next page.

No.	Common	Signal, description, waveform
		Example of waveform) Orientation stop state  $t \fallingdotseq 300\ \mu$sec

(2) SF-OR card

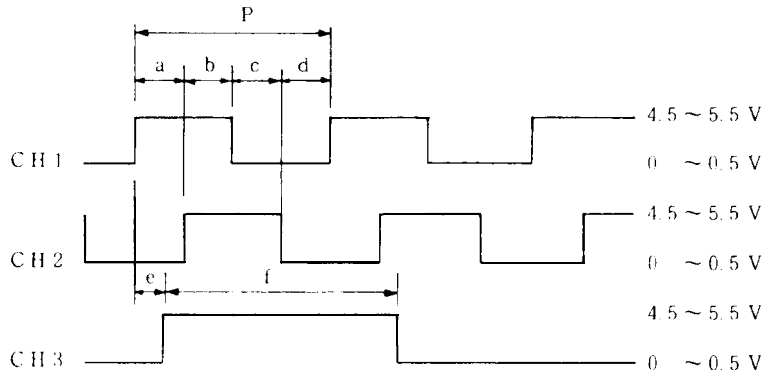
No.	Common	Signal, description, waveform
CH 1 CH 2 CH 3	DGA DGA DGA	Position feedback phase A Position feedback phase B Position feedback phase Z) Encoder orientation state (1024 P/r) Example of waveform) State of clockwise rotation viewed from encoder axis  a, b, c, d = $\frac{1}{4}$ P ± $\frac{1}{12}$P e : 0 < e < P / 2 f : P < f < 3 / 2 P $P = \frac{15}{256} \cdot \frac{1}{N}$ (sec) N : Position feedback encoder speed (rpm)
CH 4 CH 5	AGA DGA	Magnesensor output Magnesensor linear zone output) Magnesensor orientation state

Continued on the next page.

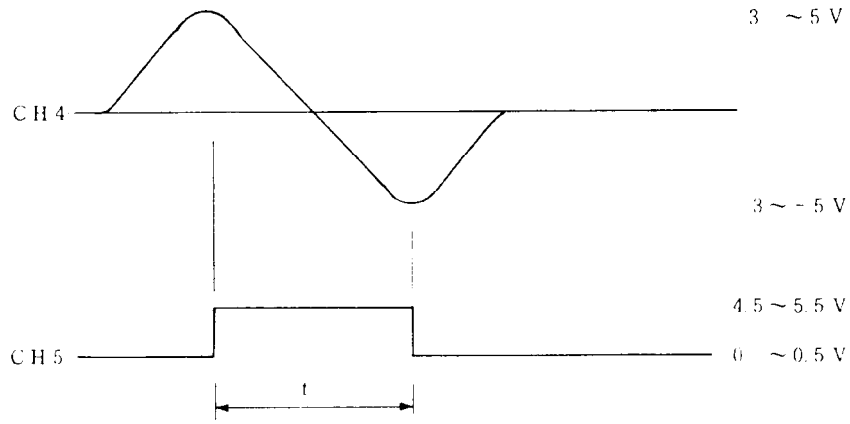
No.	Common	Signal, description, waveform
		Example of waveform) State which the magnesensor mounting disk rotates at 10 rpm  $t = \frac{240}{N}$ (sec) N: Speed of magnesensor mounting disk (rpm)
CH 6		0 V, DGA

For AGA (analog common), use the SF-CA card terminal board OM.

(3) SF-TL card

No.	Common	Signal, description, waveform
CH 1 CH 2 CH 3	DGA DGA DGA	Position feedback phase A\ Position feedback phase B Position feedback phase Z) Encoder orientation state (1024 P/r) Example of waveform) State of clockwise rotation viewed from encoder axis  a, b, c, d = 1 / 4 P + 1 / 12 P e : 0 ≤ e ≤ P / 2 f : P ≤ f ≤ 3 / 2 P $P = \frac{15}{256} \cdot \frac{1}{N}$ (sec) N: Position feedback encoder speed (rpm)
CH 4 CH 5	AGA DGA	Magnesensor output Magnesensor linear zone output) Magnesensor orientation state

Continued on the next page.

No.	Common	Signal, description, waveform
		Example of waveform) State which the magnesensor mounting disk rotates at 10 rpm  $t \fallingdotseq \frac{240}{N}$ (sec) N: Speed of magnesensor mounting disk (rpm)

For commons DGA and AGA, use the SF-CA card.

(4) SF-PW module

Block	Check terminal		DC output voltage
A	Between P5A and DGA	Common connection	+5V ±3%
	Between P24A and DO24		+24V ±10%
	Between P18A and AGA and between N18A and AGA		+18V ±10% -18V ±10%
	Between ACDOWN and DO24		+5V (0 V when AC input voltage is not supplied or it is 160 V or less)
B	Between P15F and D10F and between N10F and D10F		+15V +10% -10%
			-lov +10% -10%
C	Between P15G and D10G and between N10G and D10G		+15V +10% -10%
			-lov +10% -10%
D	Between P15H and D10H and between N10H and D10H		+15V +10% -10%
			-lov +10% -10%
E	Between P15A and D10A and between N10A and D10A		+15V +10% -10%
			-lov +10% -10%
F	Between P15C and D10C and between N10C and D10C		+15V +10% -10%
			-lov +10% -10%
G	Between P15D and D10D and between N10D and D10D		+15V +10% -10%
			-lov +10% -10%
H	Between P15E and D10E and between N10E and D10E		+15V +10% -10%
			-lov +10% -10%
I	Between P15B and D10B and between N10B and D10B		+15V +10% -10%
			-lov +10% -10%

Appendix 10 Parameter Setting List and Short Pin Switch

(1) Example of parameter setting list

(2) Example of short pin setting description in the card.

Mitsubishi Spindle Control Unit
FREQROL-SF
Setting List

Customer

Machine name

1. Parameter setting list

No.	Symb	Data	Type
01	NOX		
02	MSL		
03	PLG		
04	MOD		
05	DSR		
06	MON		
07	O1SL		
08	O2SL		
09	I1SL		
0A	I2SL		
0B	VOP		
0C	VON		
0D	VGP		
0E	VGN		
0F	CSN2		
10	DTYP		
11	DT01		
12	DT02		
13	DT03		
14	DT04		
15	DT05		
16	DT06		
17	DT07		
18	DT08		
19	DT09		
1A	DT10		
1B	DT11		
1C	DT12		
1D	DT13		
1E	DT14		
1F	DT15		
20	DT16		
● 21	PG1	180	
● 22	PG2	20	
● 23	PGC	40	
● 24	ZRZ	16	
● 25	OSP	220	
● 26	CSP	30	
● 27	PST	2048	
28	BRC		
29			
2A			
2B			
2C			
2D			
2E			
● 2F	ORS1	4400	HEX
30	ORS2		〃
● 31	TSP	450	
● 32	ZSP	25	
● 33	CSN	30	
● 34	SDT	10	
● 35	TLM	20	
● 36	VKP	100	
● 37	VKI	60	
38	TYP		
● 39	GRA1	1	HEX
● 3A	GRA2	1	〃
● 3B	GRA3	1	〃
● 3C	GRA4	1	〃
● 3D	GRB1	1	〃
● 3E	GRB2	1	〃
● 3F	GRB3	1	〃
● 40	GRB4	1	〃

No.	Symb	Data	Type
41	OSL		HEX
42	BSL		〃
43			
44	CPI		
45	CWT		
46			
47			
48			
49	GAH1		HEX
4A	GAH2		〃
4B	GAH3		〃
4C	GAH4		〃
4D	GBH1		〃
4E	GBH2		〃
4F	GBH3		〃
50	GBH4		〃
● 51	SERR	50	
● 52	SETM	12	
● 53	ZSTM	200	
● 54	UTTM	1000	
● 55	SDEF	25	
● 56	SADN	4	
● 57	PEKO	FF30	HEX
58	CVHS		
● 59	SVSP	40	
● 5A	PDT	80	
● 5B	IPOS	10	HEX
5C	PZSF L		〃
5D	〃 M		〃
5E	DCSN		
5F	PYX		
60			
61			
62			
63			
64			
65			
66			
67			
68			
69			
6A			
6B			
6C			
6D			
6E			
6F			
70			
71			
72			
73			
74			
75			
76			
77			
78			
79			
7A			
7B			
7C			
7D			
7E			
7F			
● 80	TOUT	1000	HEX

No.	Symb	Date	Type
81	SMAX		
82	TOPR		
83	BUNH		
84	FBCX		
85	KWP		
86	KWI		
87	KWF		
88	TMST		
89	TMLD		
8A	TMLS		
8B	ERLT		
8C	WRP		
8D	WRB		
8E	FLXC		
8F	MMAX		
90	MMIN		
91	MB		
92	MA		
93	KM		
94	KFP		
95	KFI		
96	PYMX		
97	K1P		
98	KWS0		
99	KWS		
9A	GCD		
9B	GCQ		
9C	KUV		
9D	KDI		
9E	KQI		
9F	DILT		
A0	QILT		
A1	KI1		
A2	I1LD		
A3	I1LS		
A4	X1,X2		
A5	X3,X4		
A6	Y0,Y1		
A7	Y2,Y3		
A8	Y4		
A9	SPO	# 1 Parameter when NOX = 1	
AA	SBS		
AB	SIQ		
AC	DPO		
AD	DBS		
AE	DIQ		
AF	BSD		
B0			
B1	CSMAX	# 3 Parameter when PLG = 1 #44.45	
B2	CTOPR		
B3	CBUNH		
B4	CFBCX		
B5	CKWP		
B6	CKWI		
B7	CKWF		
B8	CKWS0		
B9	CKWS		
BA	CKI1		
BB	CSFT		
BC			
BD			
BE			
BF			
C0			

1 Parameter when NOX = 2 (special specification)

No.	Symb	Date	Type
C1	OM1		HEX
C2	〃		〃
C3	OM2		〃
C4	〃		〃
C5			
C6			
C7			
C8			
C9			
CA			
CB			
CC			
CD			
CE			
CF			
D0			
D1			
D2			
D3			
D4			
D5			
D6			
D7			
D8			
D9			
DA			
DB			
DC			
DD			
DE			
DF			
E0			
E1			
E2			
E3			
E4			
E5			
E6			
E7			
E8			
E9			
EA			
EB			
EC			
ED			
EE			
EF			
F0			
F1			
F2			
F3			
F4			
F5			
F6			
F7			
F8			
F9			
FA			
FB			
FC			
FD			
FE			
FF			
00			

☐ The value can be set from the NC.

● Fixed parameter being set when E²ROM is initially set.

MITSUBISHI ELECTRIC CORPORATION

Date of issue			
Issued	Checked	Designed	Approved

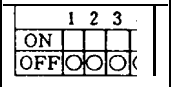
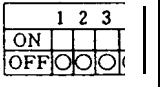
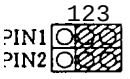
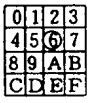
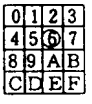
Order list No.

BN40 U RO

2. Setting description of short pins switch in cards

1. For pin **settings** in the table, ▨ means that the pin is to be inserted; ○ means that the pin is to be removed.
2. SW5 should be set in the o mark side.
3. CS1 marks the setting value of the rotary switch with o.

Notch number

Description of symbols and numbers / Card name	Card group								
SF-CA card	G51	 PIN1 PIN2	 PIN3	 PIN4 or shipment test	 PIN5	 PIN6 or shipment test	 PIN7		 SW5
	G52 or later	 PIN1 PIN2	 PIN3	 PIN4 or shipment test	 PIN5	 PIN6 or shipment test	 PIN7	 PIN8	 SW5
SF-TI card	G51	 PIN1 PIN2	 PIN3	 PIN4 or shipment test	 PIN5	 CS1			
	G52 or later		 PIN3	 PIN4 or shipment test	 PIN5	 CS1			
SF-OR card	G51	 S1	 S2	 S3	 S4 S5				
	G52 or later	 PIN1	 PIN2	 PIN3	 'IN4 PIN				

Revision

Order list No.

BN40 U R0

Table 1.1 Major structural components (1/3)

(Note) Number of ROM3 (E²PROM) designates the model of corresponding motor which is identical with the description on a sub-plate (model of corresponding motor) stuck next to the name plate for rating of amplifier.

Applicable amplifier or name		No. of specification drawing (List of order)	No. of amplifier drawing (Detailed list)	Printed circuit board		ROM drawing No.			Applicable AC spindle motor		
				Reference	Option	ROM1	ROM2	ROM3	Model	List of rating/outline drawing	
										With legs	With flange
FR-SF-2 -5.5K (2.2K)	-V	BN404U612S00	BN404U612	SF-CA	SF-OR10	550W000 2F	550W000 4F	SJ-2.2A	SJ-2.2A	RSJ 88521 / BE87872	RSJ 88522 / BE87871
	-RV	BN404U613S00	BN404U613		SF-OR						
	-T (Encoder)	BN404U598S00	BN404U598		SF-TL						
					SF-TL						
FR-SF-2 -5.5K (3.7K)	-V	BN404U614S00	BN404U614	SF-CA	SF-OR10	550W000 2F	550W000 4F	SJ-3.7A	SJ-3.7A	RSJ 88523 / BE87873	RSJ 88524 / BE87575
	-RV	BN404U615S00	BN404U615		SF-OR						
	-T (Encoder)	BN404U616S00	BN404U616		SF-TL						
					SF-TL						
FR-SF-2 -5.5K (5.5K)	-V	BN404U517S00	BN404U517	SF-CA	SF-OR10	550W000 2F	550W000 4F	SJ-5.5A	SJ-5.5A	RSJ 87472 / BE87457	RSJ 87473 / BE87458
	-RV	BN404U518S00	BN404U518		SF-OR						
	-T (Encoder)	BN404U519S00	BN404U519		SF-TL						
	-T (Magnetic sensor)	BN404U520S00	BN404U520		SF-TL						
FR-SF-2 -7.5K	-V	BN404U489S00	BN404U489	SF-CA	SF-OR10	550W000 2F	550W000 4F	SJ-7.5A	SJ-7.5A	RSJ 87400 / BE87459	RSJ 87402 / BE87460
	-RV	BN404U409S00	BN404U409		SF-OR						
	-T (Encoder)	BN404U462S00	BN404U462		SF-TL						
	-T (Magnetic sensor)	BN404U464S00	BN404U464		SF-TL						
FR-SF-2 -11K	V	BN404U490S00	BN404U490	SF-CA	SF-OR10	550W000 2F	550W000 4F	SJ-11A	SJ-11A	RSJ 87401 / BE87461 / I / /	RSJ 87481 / BE87462
	-RV	BN404U521S00	BN404U521		SF-OR						
	-T (Encoder)	BN404U461S00	BN404U461		SF-TL						
	-T (Magnetic sensor)	BN404U522S00	BN404U522		SF-TL						

Table 1.1 Major structural components (2/3)

Applicable amplifier or name		No. of specification drawing (List of order)	No. of amplifier drawing Detailed (list)	Printed circuit board		ROM drawing No.			Applicable AC spindle motor		
									Model	List of rating/ outline drawing	
				Reference	Option	ROM1	ROM2	ROM3		With legs	With flange
FR-SF-2 -15K	-V	BN404U523S00	BN404U523	SF-CA	SF-OR10	550W000 2F	550W000 4F	SJ-15A	SJ-15A	RSJ 87474 / BE87461	RSJ 87475 / BE87462
	-RV	BN404U524S00	BN404U524		SF-OR						
	-T (Encoder)	BN404U403S00	BN404U403		SF-TL						
	-T (Magnetic sensor)	BN404U525S00	BN404U525		SF-TL						
FR-SF-2 -18.5K	-V	BN404U491S00	BN404U491	SF-CA	SF-OR10	550W000 2F	550W000 4F	SJ-18.5A	SJ-18.5A	RSJ 87455 / BE87818	RSJ 87476 / BE87830
	-RV	BN404U527S00	BN404U527		SF-OR						
	-T (Encoder)	BN404U528S00	BN404U528		SF-TL						
	-T (Magnetic sensor)	BN404U529S00	BN404U529		SF-TL						
FR-SF-2 -22K	-V	BN404U526S00	BN404U526	SF-CA	SF-OR10	550W000 2F	550W000 4F	SJ-22A	SJ-22A	RSJ 87477 / BE87831	RSJ 87478 / BE87832
	-RV	BN404U530S00	BN404U530		SF-OR						
	-T (Encoder)	BN404U531S00	BN404U531		SF-TL						
	-T (Magnetic sensor)	BN404U532S00	BN404U532		SF-TL						
FR-SF-2 -26K	-V	BN404U533S00	BN404U533	SF-CA	SF-OR10	550W000 2F	550W000 4F	SJ-26A	SJ-26A	RSJ 87479 / BE87831	RSJ 87480 / BE87832
	-RV	BN404U534S00	BN404U534		SF-OR						
	-T (Encoder)	BN404U535S00	BN404U535		SF-TL						
	-T (Magnetic sensor)	BN404U536S00	BN404U536		SF-TL						
FR-SF-2 -26K (15xW8)	-V	BN404U617S00	BN404U617	SF-CA	SF-OR10	550W000 2F	550W000 4F	SJ-15XW8	SJ-15XW8	RSJ 87498 / BE87843	RSJ 87514 / BE87869
	-RV	BN404U618S00	BN404U618		SF-OR						
	-T	BN404U619S00	BN404U619		SF-TL						
					SF-TL						

Table 1.1 Major structural components (3/3)

Name		No. of specification drawing	Printed circuit board name	Printed circuit board drawing	Remarks
Magnetic sensor for orientation	Magnetizer	BKO-C1810H03	———	———	
	Magnetic sensor	BKO-C1810H02	———	———	
	Amplifier	BKO-C1810H01	———	———	
With speed select signal function		———	SF-OR10	TN990A547G61	
Speed select signal function plus magnetic sensor orientation		———	SF-OR	TN990A518G62	
Connection with NC by bas connection plus magnetic sensor or encoder orientation		———	SF-TL	TN990A377G61	

Appendix 12 Maintenance Instruments

(1) Instruments for adjustment

Instruments in Table 1.2(a) are for adjustment and those in Table 1.2(b) are for repair of troubles.

Table 1.1(a) Instruments for adjustment

Name	Specifications	Application
AC volt meter	Within 1V - 300V ±2%	Check of AC power supply voltage
Plus, minus driver	⊕ large, small ⊖ large, medium, small	-

Table 1.1(b) Instruments for repair of troubles

Name	Specifications	Application
AC volt meter	Within 1V - 300V ±1%	Check of AC power supply voltage
DC volt meter	Within 1mV - 500V ±1%	Check of DC power supply voltage, off-set voltage
Tester		Resistance check
Plus, minus driver	⊕ large, small ⊖ large, medium, small	
Synchroscope	10 MHz or over	Check of waveform of encoder

Table 1.1(c) Instruments for replacement of E²ROM

Name	Specifications	Application
ROM remover (IC REMOVER)	Example, OMRON's XY2C-0103	Removal of E²ROM

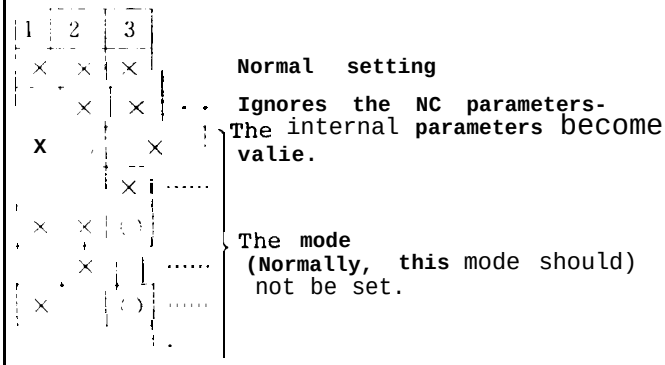
Reference. Setting and Adjustment

1.1 Set switches, setting pins, and volumes

For the parts positions of the main panel and hinge panel of the amplifier, see the component layout (Appendix 5). For the parts positions on the control circuit printed circuit board, see the component layout (Appendix 6).

1.1.1 SF-CA card

(1) Dip switches

Switch No.	Name	Description
SW5-1 - 3	Test mode selection	Selects the test mode. 
SW5-4	Meter calibration	1 Meter full-scale output × Meter normal mode Calibrates the full-scales of the speed meter and load meter. When SW5-4 is turned on, the meter full-scale voltage is output, so that the speed meter and load meter are adjusted using VR4 and VR5, respectively.

: ON Position of dip switch.

: OFF Position of dip switch.

(2) Pushbutton switches

No.	Name	Description
SW1	MODE	Switches the LED display mode. Whenever this switch is pressed, the mode is rolled over in the order of status display → diagnosis → alarm → parameter (1) → parameter (8) → debug.
SW2	UP	Changes the current page to the next page in the same mode. In the parameter mode, when the UP switch is pressed after the SET switch is pressed, the parameter DATA is incremented.
SW3	DOWN	Changes the current page to the previous page. In the parameter mode, when the DOWN switch is pressed after the SET switch is pressed, the parameter data is decremented.
SW4	SET	Rewrites the contents of a parameter. When the SET switch is pressed in the parameter mode, the data of the parameter blinks. When data is rewritten using the UP and DOWN switches and then SET switch is pressed, the parameter of the E^2PROM is written.
PB1		Resets CPU. Press this switch after a parameter is written. Do not press this switch while the motor rotates.

(3) Volumes

No.	Description	
VR1	Converter voltage gain adjustment	(Note) Since VR1 to VR3 have been adjusted at factory, the user does not need to readjust them.
VR2	Phase U current feedback zero adjustment CH40	
VR3	Phase V current feedback zero adjustment CH41	
VR4	Speed meter adjustment	
VR5	Load meter adjustment	

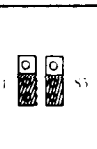
(4) Setting pins

No.	Name	Setting	Description
PIN1 PIN2	Bus interface setting * The parameter should be set at the same time. (#04MOD)		When the equipment is not linked to the M300 series machine through the bus.
			When the equipment is linked to the M300 series through the bus.
PIN3	Up/down short-circuit protection time setting		Sets an up/down shortcircuit protection time of a transistor. If the setting is changed, the transistor may be damaged. Make sure that the setting conforms to the order list.
PIN4	Converter check test pin		Test pin for delivery test. Do not insert the pin when operating the equipment.
PIN5	Analog speed reference selection * The parameter should be set at the same time. (#05DSR)		When unipolarity type (0 to +10V) input is used: If an offset voltage near 0 V should be considered, the following bipolarity type (-10V to +10V) should be used.
			Bipolarity type (-10V to +10V) input is used:
PIN6	Control circuit check test pin		Test pin for delivery test. When 1A and 1B are shortcircuited, the controller overheat alarm can be canceled. When 2A and 2B are shortcircuited, the breaker trip alarm can be canceled.
PIN7	Current loop gain selection		When the capacity of FR-SF is 5.5kW to 15kW.
			When the capacity of FR-SF is 18.5kW to
PIN8			(Currently not used)

1.1.2 SF-OR card

(1) Setting pions

(Note) The set pin No. after the bare board drawing BN624A905G52 card is represented as "PIN".

No.	Name	Setting	Description	Remarks
S1 (PIN1)	Baud rate selection		The baud rate of the CON60 serial interface becomes 9600.	Not used
			The baud rate of the CON60 serial interface becomes 19200.	Not-used
S2 (PIN2)	Not used			
			-	-
S3 (PIN3)	Orientation encoder power supply		Not supplied from NC	—
			Supplied from NC	—
S4 (PIN4) S5 (PIN5)	Orientation position command (speed selection signal) interface setting		Synchronous drive (open collector)	
			Source drive (open emitter)	

Continued on the next page.

1.1.3 SF-TL card

(1) Rotary switch

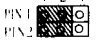
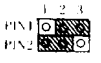
Name	Description
CS1	Axis number setting rotary switch.

(2) Volume

(Note) After the bare board drawing number G52, VR1 is not provided.

Name	Description
VR1	Sensitivity of magnesensor

(3) Setting pins

No.	Name	Setting	Description
PIN1 **PIN2** (The bare board drawing No.G52 does not provide PIN1 and PIN2.)	**CONAA** output selection		Outputs an encoder feedback signal from **CONB** to CONAA.
			Outputs a feedback signal from the **CON2** motor detector to CONAA. However, the phase Z outputs the linear zone of the magnesensor.
			Outputs a feedback signal from the CON2 motor detector to CONAA.
PIN4	Test pin		For normal operation, 1 and 2 should be shortcircuited. When the pin is removed from the positions 1 and 2 and then it is inserted into positions 3 and 4, ignores an emergency stop signal from the bus linkage cable.

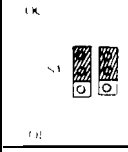
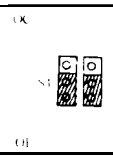
Continued on the next page.

No.	Name	Setting	Description
PIN5	Orientation encoder power supply		Not supplied from NC
			Supplied from NC

1.1.4 SF-OR card . . . . . with encoder orientation

(1) Setting pins

(Note) After the bare board drawing BN624A905G52 card, the pin No. **becomes** "PIN".

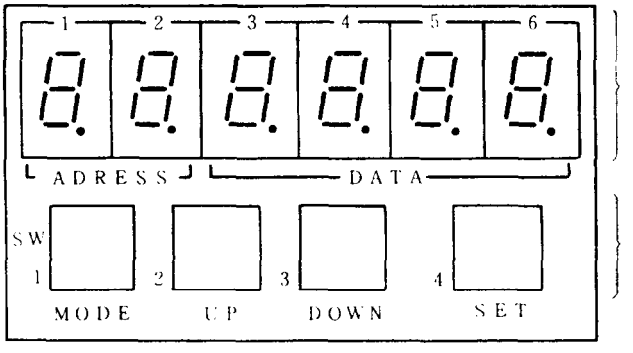
No.	Name	Setting	Description	Remarks
s3 PIN3)	Orientation encoder power supply		Not supplied from NC	
			Supplied from NC	
s4 PIN4) s5 PIN5)	Speed selection signal interface setting		Synchronous drive (open collector)	
			Source drive (open emitter)	

1.2 Setting parameters

When driving a machine using the spindle motor, it is necessary to determine parameters so that the performance of the machine can be maximized in accordance with the machine specifications and motor characteristics. Because the contents of the parameters just depend on the machine to be used, refer to the parameter list provided by the machine manufacturer. The parameters are set using the display and set switches on the SF-CA card. On the other hand, when the equipment 'is linked with the machine through the bus line, part of parameters can be set from the NC. (Parameters #21 to #40 are set from the NC CRT.)

(Note) When changing parameters, it is necessary to change those on the parameter list at the same time.

1.2.1 Display and set switches (on SF-CA card)

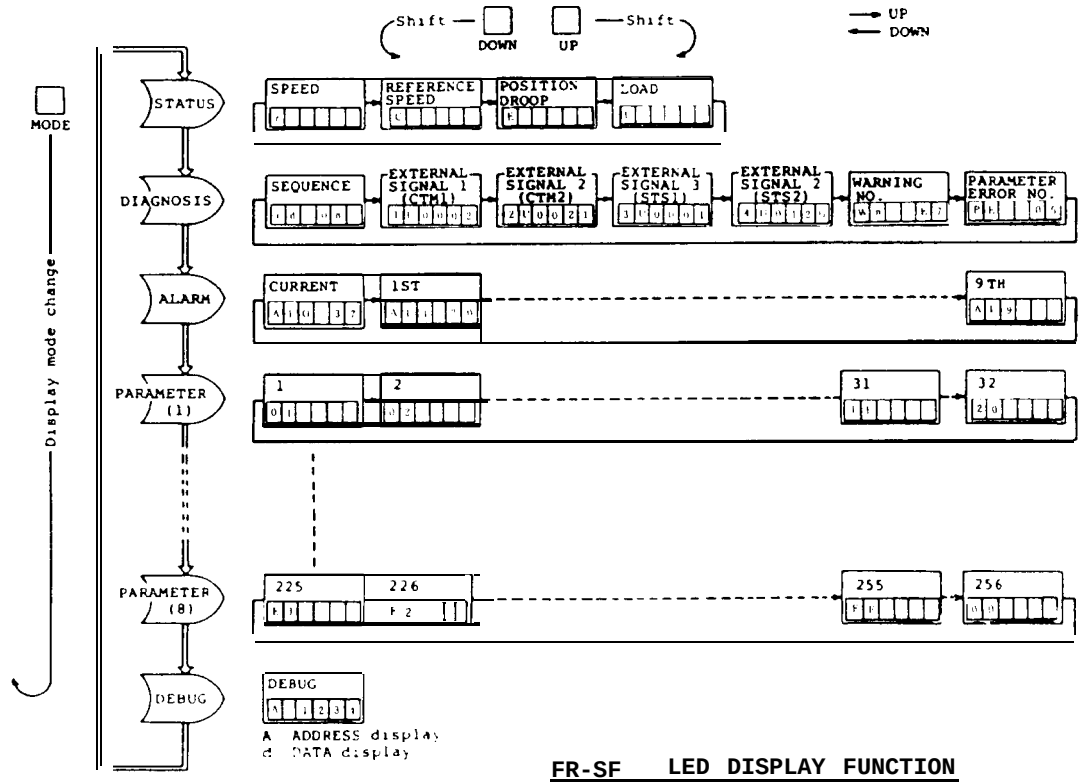


On SF-CA card

Display — Displays the contents of status, diagnosis, alarm, parameters (1) to (8), and debug.

Setting —
MODE: Changes the display mode.
UP : Increments a value on the display area.
DOWN: Decrements a value on the display area.
SET : Stores set data of the parameter.

a) The display modes are roughly categorized as 12 modes consisting of status display, diagnosis, alarm, parameters (1) to (8), and debug.
b) After the equipment power is turned on, unless there is an alarm cause, the display area on the set panel displays the speed in the status display mode.
c) When an alarm occurs, the alarm display mode takes place.
d) To change the current display, press the MODE switch.
e) For the display mode transition and its contents, see Figure 1.2.1, "LED Display mode".



FR-SF LED DISPLAY FUNCTION

- To change the current display mode into the status display, diagnosis, alarm, parameter (1) to (8), etc., press the MODE switch.
- To change the current display in the same mode, press the UP and (or) DOWN switches.
- The parameters are categorized as groups (1) to (8). To display the next group, press the MODE switch.

Parameter (1):	#01 - #20	Parameter (5):	#81 - #A0
Parameter (2):	#21 - #40	Parameter (6):	#Al - #CO
Parameter (3):	#41 - #60	Parameter (7):	#Cl - #EO
Parameter (4):	#61 - #80	Parameter (8) :	#El - #00

Fig. 1.2.1 LED display modes

1.2.2 Setting parameters from spindle amplifier

(1) Setting parameters

To set parameters, the machine ready complete READY signals SET1 and SET2 (see the description of "Connecting machines" in Appendixes 1-4 and 1-5) have been set to OFF.

Turn on the power.

- Unless an alarm cause occurs, the display area of the setting panel indicates the speed in the status display mode (Figure 1). (When emergency stop is released.)

Fig. 1 Speed indication

Select the mode.

- Whenever pressing the MODE switch, the mode changes step by step. (Example) In the state as shown in Figure 1, when the MODE switch is pressed three times in succession, the parameter (1) display mode takes place (Figure 2).

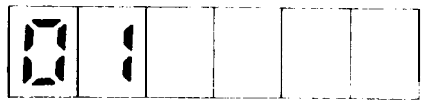


Fig. 2

Select the address.

- When pressing the UP and DOWN switches, the address in the same mode can be selected.

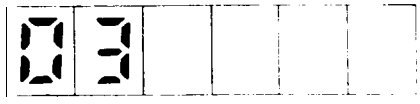


Fig. 3

In addition, the data corresponding to the address appears.

(Example)

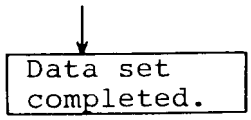
- When pressing the [UP] switch in the state as shown in Figure 2, 02 appears. When the switch is pressed once again, 03 appears. (Figure 3).
- When pressing the [DOWN] switch in the state as shown in Figure 3, 02 appears. When pressing the same switch once again, 04 appears. (Figure 2)

Rewrite the data

- When pressing the [SET] switch, data can be rewritten. At the time, the address display LED blinks and indicates that the data can be rewritten.
- Select data using the [UP] and [DOWN] switches. To increment the data value, press the [UP] switch. To decrement the data value, press the [DOWN] switch. (Note 1)
- When pressing the [SET] switch once again, data rewrite operation is completed. At the time, the address display LED steadily lights rather than blinking. (Note 2)

(Note 1) For the position of the pushbutton switch PB1, see Appendix 6(1) "SF-CA card".

(Note 2) It is possible to press the pushbutton switch PB1 only once after all data write operation is completed.



- Press the PB 1 switch to reset the FR-SF. Alternatively, turn off the power and then turn on it. Now that the data set operation has been completed.

(2) Contents of parameters

#	Parameter		Description	Setting range (Unit)
)1	NOX	Motor type	The setting depends on the motor specification. 0: Standard specification 2: Special specification When selecting "0", #02 MSL parameter is set and the applicable motor is selected. When selecting "2", the parameters of #81 to #AF are set. (The parameters #81 to #AF have been set at factory.)	Decimal
02	MSL	Motor selc-tion	The suitable motor constant is selected depending on the type of the motor.	Decimal

Data No.	Motor type		Motor maximum speed
0	SJ-2.2A	1.5/2.2kW	6000
1	SJ-3.7A	2.2/3.7kW	6000
2	SJ-5.5A	3.7/5.5kW	6000
3	SJ-7.5A	5.5/7.5kW	6000
5	SJ-11A	7.5/11kW	6000
6	SJ-15A	11/15kW	6000
7	SJ-18.5A	15/18.5kW	6000
8	SJ-22A	18.5/22kW	6000
9	SJ-26A	22/26kW	6000
16	SJ-2.2A	1.5/2.2kW	10000
17	SJ-3.7A	2.2/3.7kW	10000
18	SJ-5.5A	3.7/5.5kW	10000
19	SJ-7.5A	5.5/7.5kW	10000

(Note 1) In the range of motor maximum speed from 6001 rpm to 10000 rpm, the motor constants at the maximum 10000 rpm should be selected.

(Note 2) Make sure that the spindle amplifier conforms with the motor model name as shown in the following.

(Example) SJ-5.5A/FR-SF-2-5.5K

Continued on the next page.

#	Parameter		Description	Setting range (Unit)
03	PLG	Position loop encoder type	The setting depends on the number of pulses of the encoder. 0: 1024 pulses (Encoder orientation tapperless) 1: 90000 pulses (for controlling the axis C) (not used)	Decimal
04	MOD	External interface mode selection	This parameter is set by interface with the external machine (NC). 0: When the equipment is linked with the NC using analog or digital signals. 2: When the equipment is linked with the NC using the bus.	Decimal
05	DSR	Speed reference signal	The speed reference signal input type is selected. This parameter is valid when #04MOD is set to 0. 0: 12 bits, binary (0 to +10 V input) 1: 12 bits with sign, binary(±10V input) 2: BCD (2 digits) (not used) 3: BCD (3 digits) (not used) In the case of the analog speed reference "0" or "1" is selected.	Decimal
06	MON	Output monitor selection	The contents of the SF-CA card load meter output (analog output) are set. 0: Load meter 1: Torque meter Standard setting: 0	Decimal
07	01SL		Not used. 0 should be set.	
OS	02SL		Not used. 0 should be set.	
09	11SL	Auxiliary input/selection	TL1/TL2 input functions are set. 0: Torque control input 1: Indexing input Standard setting: 0	Decimal
OA	12SL		Not used. 0 should be set.	

(Note) While the equipment is linked with the NC using analog signal or digital signal, #09 serves to set TL1 and TL2, which are usually used as torque control input signals, as indexing input signals.
Thus, when the indexing operation is performed, the torque cannot be limited.
However, while the equipment is linked with the NC through the bus, the torque limit signal is separated from the indexing input signal.
Thus, in this case, they can be used at the same time.

#	Parameter		Description	Setting range (Unit)
0B	VOP	Speed reference offset	The offset value where the analog speed reference signal is used is set. Generally, it is adjusted using the offset variable resistor on the NC. Standard setting: 0	Signed decimal notation -999 ~ +999)
0C	VON		Not used. 0 should be set.	
0D	VGP	Speed reference signal gain	The gain against the speed reference signal is set. Assume that 1000 is 1 unit, the real speed reference signal is made by multiplying the set data by the external speed reference signal. Generally, it si adjusted by the gain volume of the NC. Standard setting: 1000	Decimal (0 - 1150)
0E	VGN		Not used. 0 should be set.	
0F	CSN2	2nd cushion time constant	Not used. 0 should be set.	Decimal
10	DTYP	Data type	Whether data of the parameters #11 to #20 is valid or invalid is set. 0: Invalid 1: Valid as speed setting unit data When this parameter is set to "1", the input signals to the SF-OR card connector CONC becomes valid as data being set to the parameters #11 to #20. For details, see the "Speed selection signal function specification BNP-A0801-22".	Decimal
11 12 13 14 15 16 17 18 19 1A 1B 1C	DT01 DT02 DT03 DT04 DT05 DT06 DT07 DT08 DT09 DT10 DT11 DT12	Data 1 Data 2 Data 3 Data 4 Data 5 Data 6 Data 7 Data 8 Data 9 Data 10 Data 11 Data 12	When the #10 data parameter type is set to "1", these parameters become valid. The speed reference which is selected by the speed selection signal is set to each data. The data is set by the motor speed in such a manner that it does not exceed the motor maximum speed which is set by #31 TSP.	Decimal
1D	DT13		Not used. 0 should be set.	
1E	DT14		Not used. 0 should be set.	
1F	DT15		Not used. 0 should be set.	
20	DT16	Input signal check times	Standard setting: 40 times (The input signal is checked every approx. 1.3 msec.)	0 to 9999 times

Parameter No. on the NC screen when the equipment is linked with M330HM/335M through the bus:

Parameter No. on the NC screen when the equipment is linked with M310/320/330 through the bus:

#	#	#	Parameter		Description	Setting range (Unit)	
						Encoder	Magnesensor
21	33	1	PG1	Orientation 1st deceleration point	Encoder orientation: The angle of the creep speed is set. Standard setting: 180 Magnesensor orientation: The time taken for start of creep speed after passing over linear zone is set. Standard setting: 133	0 - 359 (deg)	0 - 500 ms
22	34	2	PG2	Orientation 2nd deceleration point	The angle at which creep speed for position loop state is set. Standard setting: 20		0 - 40 (deg)
23	35	3	PGC	Synchronous tap position loop gain	The position loop gain of the spindle in synchronous tap state is set. It should conform with the position loop gain of the feed axis in the synchronous tap state. (NC screen standard setting: 15.00)	1 to 512 (1/4 rad/s) However, the parameter of the NC screen is in the range from 0.01 to 999.99 (rad/s)	
						Encoder	Magnesenso
24	36	4	ZRZ	Orientation in-position range	The position error range where the orientation complete signal is output is set. Standard setting: 16 NC screen standard setting:1.00	1 - 5760 (1/16 deg) The parameter on NC screen is as follows: 0 - 359 (deg)	1 - 512 (1/16 deg) 0 - 39 (deg)
25	37	5	OSP	Orientation speed	The orientation speed is set. Standard setting: 220	0 - 1000 rpm	
26	38	6	CSP	Creep speed	The creep speed is set. Standard setting: 20	0 - 1000 rpm	
						Encoder	Magnesenso
27	39	7	PST	Position shift	The orientation stop position is set. Encoder: A value where 360" is divided into 4096 is set. Magnesensor: The angle from -5° to +5° is divided into 1024 and 0° is treated as 2048. Standard setting:2048	0 - 4095	1536 - 2560
28	40	8	BRC		Not used. 0 should be set.		
29					Not used. 0 should be set.		

Continued on the next page.

* The parameters being asterisked are set from the NC when the equipment is linked with the M300 series machine through the bus line.

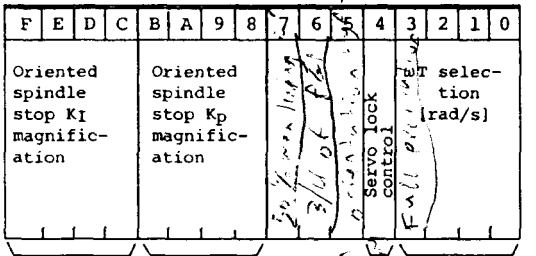
Parameter No. on the NC screen when the equipment is linked with M330HM/335M through the bus:

Parameter No. on the NC screen when the equipment is linked with M310/320/330 through the bus:

#	#	#	Parameter	Description	Setting range (Unit)
2A				Not used. 0 should be set.	
2B					
2C					
2D					
2E					

Parameter No. on the NC screen when the equipment is linked with M330HM/335M through the bus:

Parameter No. on the NC screen when the equipment is linked with M310/320/330 through the bus:

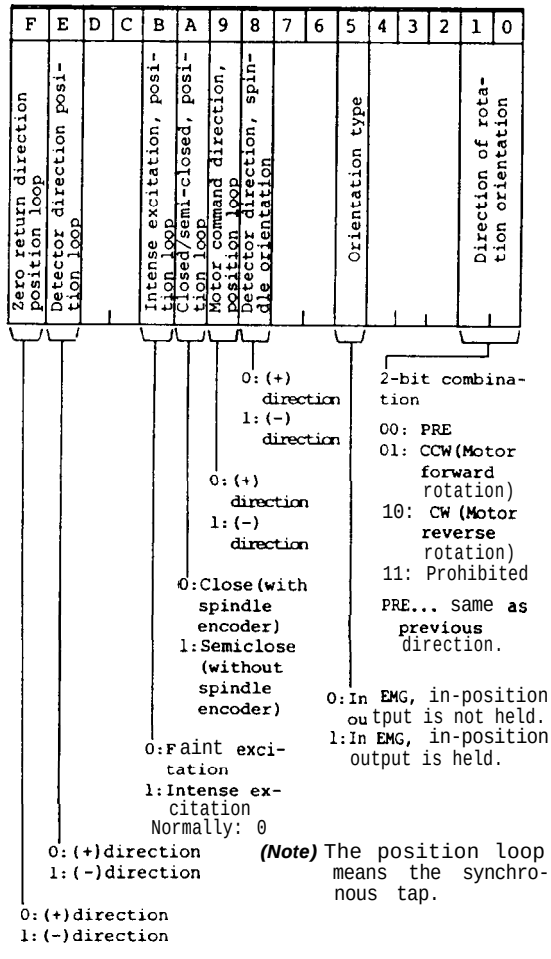
#	#	No.	Parameter	Description	Setting range (unit)
*	2F	47	15 ORS1 Oriented spindle stop control 1	Control type (such as gain) during orientation stop is set. Standard setting:4400 (When spindle GD² is small like a dedicated machine, it should be set to 6601.1  4-bit combination [times]: 0: 0.6, 1: 0.7, 2: 0.8, 3: 0.9, 4: 1, 5: 1.2, 6: 1.4, 7: 1.6, a: 1.8, 9: 2, A: 2.2, B: 2.4, C: 2.6, D: 2.8, E: 3, F: 3.2 4-bit combination [times]: 0: 0.6, 1: 0.7, 2: 0.8, 3: 0.9, 4: 1, 5: 1.2, 6: 1.4, 7: 1.6, 8: 1.8, 9: 2, A: 2.2, B: 2.4, C: 2.6, D: 2.8, E: 3, F: 3.2 0: Delay/advance, 1: PI 4-bit combination [rad/s]: 0: 0.55, 1: 1.1, 2: 1.65, 3: 2.2, 4: 2.75, 5: 3.3, 6: 3.85, 7: 4.4, 8: 4.95, 9: 5.5, A: 6.05, B: 6.6, C: 7.15, D: 7.7, E: 8.25, F: 8.8 (Note) The Xp magnification should be set to the magnification for #36 VKP. The Ki magnification should be set to the magnification for #37 VKI.	6601 Hexadecimal notation

• The parameters being asterisked are set from the NC when the equipment is linked with the M300 series machine through the bus line.

Parameter No. on the NC screen when the equipment is linked with M330HM/335M through the bus:

Parameter No. on the NC *screen* when the equipment is linked with M310/320/330 through the bus:

#	#	No.	Parameter		Description	Setting range (unit)
0	48	16	0RS2	Oriented spindle stop control 2	The spindle orientation direction, detector installed direction, and motor rotation direction are set. [Magnesensor orientation] Standard setting: 0020 (0120 when the detector installation direction is reversed) [Encoder orientation] Standard setting: 0120 (0020 when the detector installation direction is reversed)	Hexadecimal notation



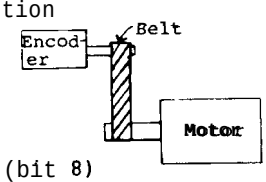
(Note) The position loop means the synchronous tap.

* The parameters being asterisked are set from the NC when the equipment is linked with the M300 series machine through the bus line.

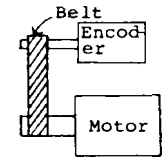
(Note) Set the ORS2 orientation detector's direction (bit 8) and position loop detector's direction (bit E) from the relationship between rotations of the motor and detector by referencing the following mounting schematic.

1) Encoder (bit 8, bit E)

0: (+) direction

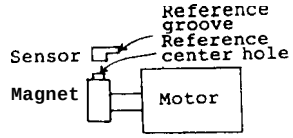


1: (-) direction

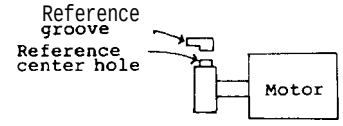


2) Magnesensor (bit 8)

0: (+) direction



1: (-) direction



3) To perform the synchronous tap operation without the spindle encoder, bit E should be set to 0.

- Parameter No. on the NC screen when the equipment is linked with M330HM/335M through the bus:
- Parameter No. on the NC screen when the equipment is linked with M310/320/330 through the bus:

#	#	#	Parameter		Description	Setting range (Unit)
31	49	17	TSP	Motor maximum speed	The motor maximum speed is set.	1 to 3276 (10 rpm). However, the parameter on the NC display, 10 to 32760 (rpm).
32	50	18	ZSP	Zero speed	The speed for the zero speed output is set. Standard setting: 50	1 - 1000 (rpm)
33	51	19	CSN	Acceleration time constant	The time constant of the speed reference from 0 to the maximum speed is set. (In the position loop state, this parameter setting is invalid.) Standard setting: 30 (Standard setting on NC screen: 300)	2 to 3276 (10 msec). However, the parameter on the NC screen should be in the range from 20 to 3276 msec.
34	52	20	SDT	Speed detection rate	The speed for which the speed detection against the motor maximum speed is set in percentage. Standard setting: 10	0 - 100 (%)
35	53	21	TLM	Torque limit	The limit rate of the torque control signal TL2 (TLH) is set. Standard setting: 10	0 - 120 (%)
36	54	22	VKP	Speed loop proportional gain	The proportional gain of the speed loop is set. Although increasing this parameter value (around 100 to 150) causes the responsibility to be increased, vibration and sound levels also increase. Standard setting: 63	0 - 1000(rad/s)
37	55	23	VKI	Speed loop integral type	The integration gain of the speed loop is set. This parameter value should be set in the manner that the ratio of the speed loop to the proportional gain VKP becomes nearly constant. Standard setting: 60	0 - 1000 (1/10 rad/s)
38	56	24	TYP	Position loop IN type	The process where the speed loop is switched to the position loop is set. 0: Position loop IN after orientation 1: Position loop IN at the current position If the zero return is required, "0" should be set. If not required, "1" should be set. Standard setting: 1	Decimal

- The parameters being asterisked are set from the NC when the equipment is linked with the M300 series machine through the bus line.

(Note) The #33CSN acceleration/deceleration time constant does not serve to shorten the acceleration/deceleration time even if a shorter time constant than that calculated by the motor torque and load GD² torque is set. The parameter can be used to elongate the acceleration/deceleration time.

Parameter No. on the NC screen when the equipment is linked with M330HM/33M through the bus:

Parameter No. on the NC screen when the equipment is linked with M310/ 20/330 through the bus:

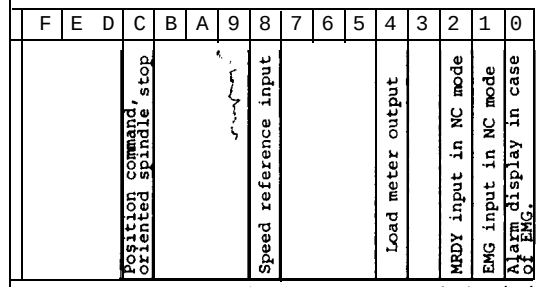
#	#	#	Parameter		Description	Setting range (Unit)
39	57	25	GRA1	Number of gear teeth on spindle side	The number of gear teeth on the spindle side against the gear 00 is converted into hexadecimal notation and set.	1 to 7FFF (Hex). However, on the NC screen, it is in the range from 1 to 32767 (in decimal notation), which is not required to convert into hexadecimal notation. The gear rate is set by the number of gear teeth on the spindle side and that on the motor shaft side. Spindle speed $\times \frac{\text{number of gear teeth on spindle side (GRA1 to 4)}}{\text{number of gear teeth on motor shaft side (GRB1 to 4)}}$ = motor speed
3A	58	26	GRA2		The number of gear teeth on the spindle side against the gear 01 is converted into hexadecimal notation and set.	
3B	59	27	GRA3		The number of gear teeth on the spindle side against the gear 10 is converted into hexadecimal notation and set.	
3c	60	28	GRA4		The number of gear teeth on the spindle side against the gear 11 is converted into hexadecimal notation and set.	
3D	61	29	GRB1	Number of gear teeth on motor shaft side	The number of gear teeth on the motor shaft side against the gear 00 is converted into hexadecimal notation and set.	1 to 7FFF (Hex). However, on the NC screen, it is in the range from 1 to 32767 (in decimal notation), which is not required to convert into hexadecimal notation. The gear rate is set by the number of gear teeth on the spindle side and that on the motor shaft side. Spindle speed $\times \frac{\text{number of gear teeth on spindle side (GRA1 to 4)}}{\text{number of gear teeth on motor shaft side (GRB1 to 4)}}$ = motor speed
3E	62	30	GRB2		The number of gear teeth on the motor shaft side against the gear 01 is converted into hexadecimal notation and set.	
3F	63	31	GRB3		The number of gear teeth on the motor shaft side against the gear 10 is converted into hexadecimal notation and set.	
40	64	32	GRB4		The number of gear teeth ont he motor shaft side against the gear 11 is converted into hexadecimal notation and set.	
41			OSL	Orientation type	The orientation method is set. 0: Motor built-in encoder 1: Encoder 2: Magnesensor	Hexadecimal

continued on the next page.

* The parameters being asterisked are set from the NC when the equipment is linked with the M300 series machine through the bus line.

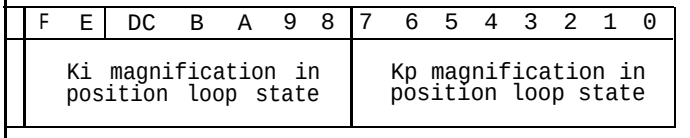
Parameter No. on the NC screen when the equipment is linked with M330HM/33M through the bus:

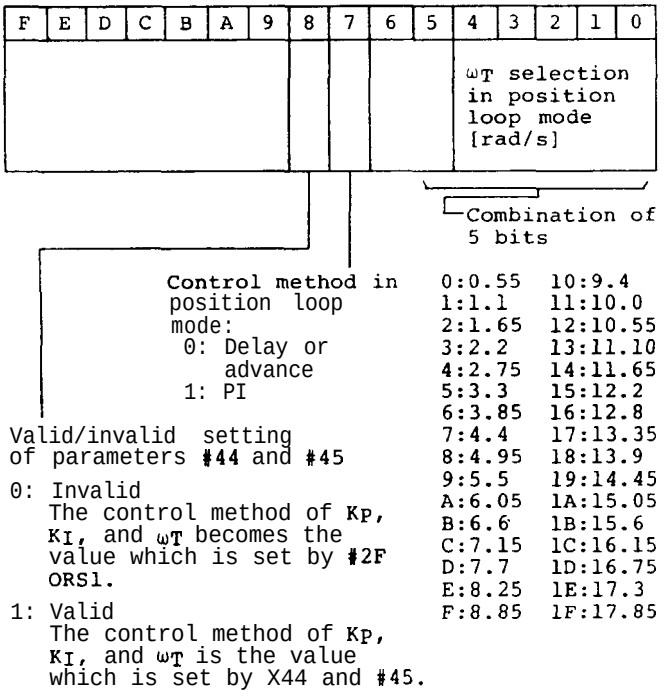
Parameter No. on the NC screen when the equipment is linked with M310/320/330 through the bus:

		#	Parameter		Description	Setting range (unit)
		42	BSL	Bit assignment		Hexadecimal notation

Continued on the next page.

- The parameters being asterisked are set from the NC when the equipment is linked with the M300 series machine through the bus line.

<table>
<tr><th>#</th><th colspan="2">Parameter</th><th>Description</th><th>Setting range (Unit)</th></tr>
<tr><td>43</td><td colspan="2"></td><td>Not used. 0 should be set.</td><td></td></tr>
<tr><td>44</td><td>CPI</td><td>Position loop, Kp, Ki magnification</td><td>When "1" is set to #45ωT bit 8, this parameter is valid.
In the synchronous tap state, Kp and ki magnifications which are differ from those of the orientation are set.
 

The Ki magnification and Kp magnification can be set in the range from 1/16 to 15 assuming that 10H (16D) is 1. Although increasing the magnification value causes the response against the impact load to be increased, gear sound also increases. It should be set in the range from 1 time to 2 times (1010H to 2020H). Normally, the Ki magnification should be the same as the Kp magnification.</td><td>Hexadecimal</td></tr>
<tr><td>45</td><td>CWT</td><td>In the position loop mode, switch for valid/invalid Kp, Ki and ωT setting according to the control method</td><td> 

Valid/invalid setting of parameters #44 and #45
0: Invalid
The control method of Kp, KI, and ωT becomes the value which is set by #2F ORS1.
1: Valid
The control method of Kp, KI, and ωT is the value which is set by X44 and #45.</td><td>Hexadecimal</td></tr>
<tr><td>46</td><td></td><td></td><td>Nat used. 0 should be set.</td><td></td></tr>
<tr><td>47</td><td></td><td></td><td>Not used. 0 should be set.</td><td></td></tr>
<tr><td>48</td><td></td><td></td><td>Not used. 0 should be set.</td><td></td></tr>
</table>

Continued on the next page.

#	Parameter		Description	Setting range (Unit)	
49	GAH1	Number of auxiliary gear teeth on spindle side	When the number of gear teeth exceeds the setting range of the normal gear teeth parameters (GRA1 to 4 and GRB1 to 4), assuming that the number of gear teeth is X x Y, X and Y are set to the gear teeth parameter and auxiliary teeth parameter, respectively. However, the number of auxiliary gear teeth is set in the semi-close position loop state which requires the precise gear ratio. In the full-close position loop state, a proximity value which satisfies the normal gear teeth parameter is set and the number of auxiliary gear teeth is set to 0. The parameters GAH1 to 4 and GBH1 to 4 accord with GRA1 to 4 and GRB1 to 4, respectively.	1 - 7FFF (Hexadecimal)	
4A	GAH2				
4B	GAH3				
4C	GAH4				
4D	GBH1	Number of auxiliary gear teeth on motor side			
4E	GBH2				
4F	GBH3				
50	GBH4				
59	SVSP	Servo shift speed	The spindle speed on which the speed loop is switched to the position loop is set. Standard setting: 40	10 - 200(rpm)	
5A	PDT	Zero return deceleration point	The deceleration point on which the spindle speed is decelerated from the servo traveling speed to the stop point is set. If the spindle overruns when it stops, this parameter value should be increased. Standard setting: 88	1 - 2000 (pulse)	
5B	IPOS	Position loop in-position range	The range for which the position loop in-position is output is set. Standard setting: Frequency tap 10	Hexadecimal	
5C	PZSFL	Position loop zero return shift amount (Low Byte)	The shift amount from the phase Z at the zero return position on which the speed loop is switched to the position loop is set. Standard setting: 0	Tapperless	Axis C
5D	PZSFH	Position loop zero return shift amount (High Byte)		0 - FFF$_H$	57E40$_H$
5E	DCSN	Dual cushion	This parameter serves to cushion the amount of change of the speed reference. Of Invalid 1: Valid It suppresses gear noise during speed change operation. Standard setting: 1	Decimal notation	
5F	PYX	Excitation ratio	The excitation ratio is set. When the gear noise is large, a small value is selected for this parameter. However, for the impact load response, a large value is effective. Standard setting: 0 0: 50% 1: 25% 2: 75% 3: 100%		

(Note) #59 to 5D are parameters which are used in the synchronous tap state.

	#	Parameter		Description	Setting range (Unit)
A	81	SMAX		Motor constant. This parameter becomes valid when #01 NOX is set to 2. The setting value depends on the motor type to be used. Standard setting: 0	0 - FFFF (Hexadecimal)
A	82	TOPR		"	"
A	83	BUNH		"	"
A	84	FBCX		"	"
A	85	KWP		"	"
A	86	KWI		"	"
A	87	KWF		"	"
A	88	TMST		"	"
A	89	TMLD		"	"
Δ	8A	TMLS		"	"
Δ	8B	ERLT		"	"
Δ	8C	WRP		"	"
Δ	8D	WRB		"	"
Δ	8E	FLXC		"	"
Δ	8F	MMAX		"	"
Δ	90	MMIN		"	"
Δ	91	MB		"	"
Δ	92	MA		"	"
Δ	93	KM		"	"
Δ	94	KFP		"	"
Δ	95	KFI		"	"
Δ	96	PYMX		"	"
Δ	97	KIP		"	"
Δ	98	KWS0		"	"
Δ	99	KWS		"	"
Δ	9A	GCD		"	"
Δ	9B	GCQ		"	"
Δ	9C	KUV		"	"
Δ	9D	KDI		"	"
Δ	9E	KQI		"	"
Δ	9F	DILT		"	"
Δ	A0	QILT		"	"
Δ	A1	KIl		"	"

Continued on the next page.

Δ marked parameters are those being set by Mitsubishi.
For the setting values, see "Parameter list" provided with the controller.

#	Parameter		Description	Setting range (Unit)
Δ A2	IlLD		Motor constant. This parameter becomes valid when #01 NOX is set to 2. The setting value depends on the motor type to be used. Standard setting: 0	0 - FFFF (Hexadecimal)
Δ A3	IlLS		"	"
Δ A4	x2, Xl		"	"
Δ A5	x4, x3		"	"
Δ A6	Yl, Y0		"	"
Δ A7	Y3, Y2		"	"
A A8	Y4		"	"
Δ A9	SPO		Motor constant. This parameter becomes valid when 01 NOX is set to 1 or 2. The setting value depends on the motor type to be used. Standard setting: 0	0 - FFFF (Hexadecimal)
Δ AA	SBS		"	"
A AB	SIQ		"	0 - 96 (Hexadecimal)
Δ AC	DPO		"	0 - 7FFF (Hexadecimal)
A AD	DBS		"	"
Δ AE	DIQ		"	0 - 78 (Hexadecimal)
A AF	BSD		"	0 - 7FFF (Hexadecimal)
Δ BO			Not used. 0 should be set.	
A Bl	CSMAX		Motor constant. The setting value depends on the motor type to be used. Standard setting: 0	0 - FFFF (Hexadecimal)
A B2	CTOPR		"	"
A B3	CBUNH		"	"
A B4	CFBCX		"	"
A B5	CKWP		"	"
A B6	CKWI		"	"
A B7	CKWF		"	"
A B8	CKWSO		"	"
Δ B9	CKWS		"	"
A BA	CKIl		"	"
A BB	CSFT		"	"

Continued on the next page.

A marked parameters are those being set by Mitsubishi.
For the setting values, see "Parameter list" provided with the controller.

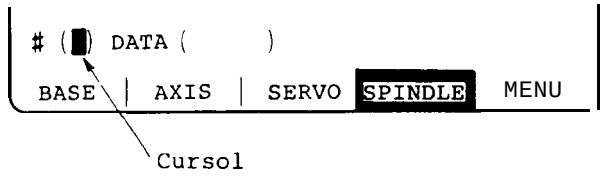
#	Parameter		Description	Setting range (Unit)
BC			Not used. 0 should be set.	
BD			"	
BE			"	
BF			"	
CO			"	
C1 C2	OM1	PG1 magnification by gear	The magnification of #21 PG1 (orientation 1st deceleration point) by gear is st. C1: F 87 0 — Gear 01 | Gear 00 C2: F 87 0 — Gear 11 | Gear 10 10_H (16_D) becomes 1 time of magnification. This parameter is set when the orientation should be adjusted by each gear. When 0 is set, the magnification **becomes 1.**	1 to FF (1/16 times) Hexadecimal
C3 C4	0M2	PG2 magnification by gear	The magnification of #22 PG2 (orientation 2nd deceleration point) by gear is st. C3: F 87 0 — Gear 01 | Gear 00 C4: F 87 0 — Gear 11 | Gear 10 10_H (16_D) becomes 1 time of magnification. This parameter is set when the orientation **should be adjusted by each gear. When 0 is set, the magnification** becomes 1.	1 to FF (1/16 times) Hexadecimal

1.2.3 Setting parameters from NC (On 9" CRT screen)

By pressing the menu key [Spindle param.], the spindle parameter screen appears.
The spindle parameters are categorized as parameters which are controlled on the NC side and those which are controlled on the spindle side where the spindle controller FR-SF is linked with the NC through the bus line.

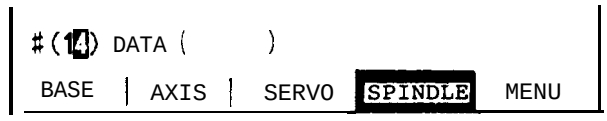
(1) Setting data

Data is set in the order of "① data No. entry", "② cursor shift", "③ data key entry", and "④ input key entry".
When one screen is selected, the cursor appears at the right end of the first ( ) in the setting area.



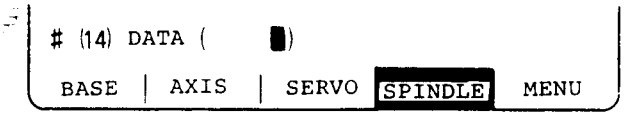
① Data No. entry

Enter a data No. to be set.
(Example) To set data to #14, enter [1] [4]



② Cursor shift

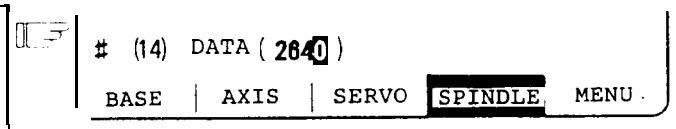
Press the [→] key to move the cursor to the next ( ).



③ Data key entry

While observing the contents of the data display area, enter data to be changed.

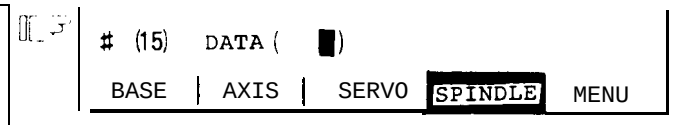
(Example) To change the data to **2640**, enter [2] [6] [4] [0] in the order.



④ Input key entry

Check the contents being displayed in the setting area and set the data by the following operation.

Press the [INPUT] key.



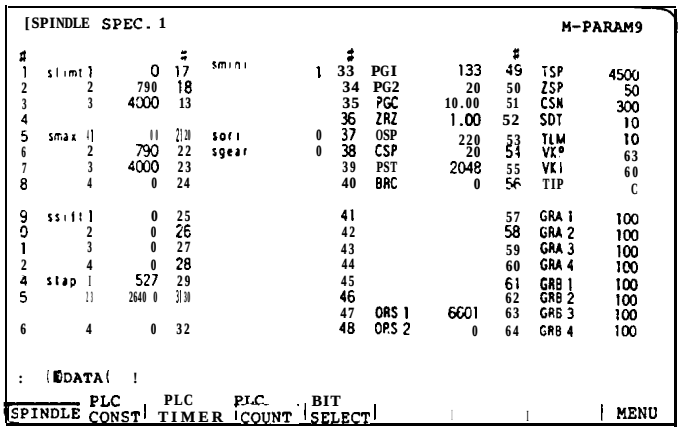
1) Depending on the contents of the setting area, data setting operation is performed and the results are displayed in the data display are.

2) The data No. of the setting area is incremented by 1 and the cursor is positioned at the right end of the 2nd (). However, after the last data No. is input, no data No. appears and the cursor is positioned at the right end of the first ().

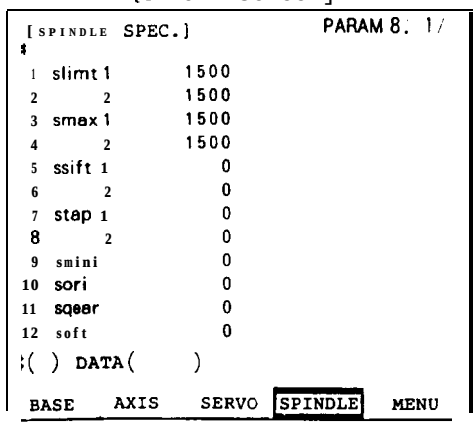
(2) Parameters being controlled on NC side

By pressing the menu key [Spindle param.], the spindle parameter screen appears.

114" CRT screen1



[9" CRT screen]

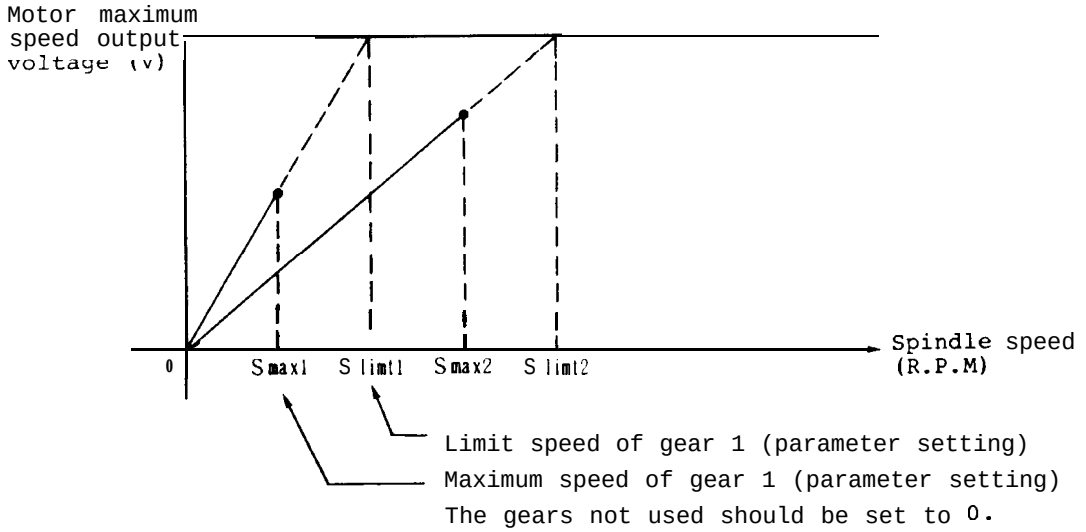


#	Item		Description	Setting range (Unit)
1 2	slimt 1	Speed limit	For gears 0 and 1, the spindle speed against the motor maximum speed (spindle parameter "TSP") is set. It accords with 10 V of S analog output.	0 - 99999 (rpm)
3 4	smax 1 2	Max. speed	For gears 0 and 1, the spindle maximum speed is set. Slimt should be set to a value which is Smax or more.	
5 6	ssift 1 2	Shift speed	For gears 0 and 1, the spindle speed for gear shift is set.	0 - 32767 (rpm)
7 8	stap 1 2	Tap speed	For gears 0 and 1, the spindle maximum speed in tap cycle state is set.	0 - 99999 (rpm)

Continued on the next page.

#	Item		Description	Setting range (Unit)
9	mini	Min. speed	The spindle minimum speed is set, Even if the S command which is less than this value is issued, the spindle rotates at this speed.	0 - 32767(rpm)
10	;ori		Not used. Normally, 0 should be set.	
11	;gear	Encoder gear ratio	The gear ratio between the spindle and encoder is set.	0: 1/1 1: 1/2 2: 1/4 3: 1/8
12	;soff	Spindle bus linkage selection	Whether the spindle unit is linked with the NC through the bus is set. To link through the bus, "0" should be set. At the time, when the bus line has not been linked, an alarm (Y03 amplifier has not been installed) occurs. Not to link through the bus, "1" should be set.	:When the equipment is linked through the bus: .:When the equipment is not linked through the bus: (Note) When the spindle amplifier is FR-SF, 0 should be set. (The spindle amplifier parameter #04 MOD should be set to 2.)

Relationship between spindle limit speed and maximum speed:



(3) Parameters to be controlled on spindle amplifier side (PARAM8. 2/2)

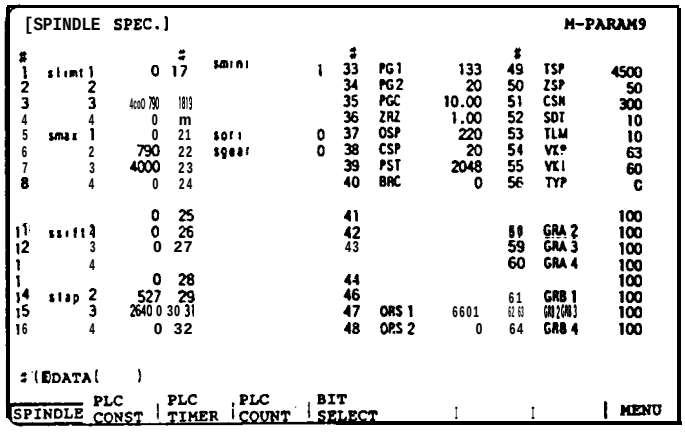
By pressing the NEXT PAGE key, the spindle parameter screen (PARAM 8. 2/2) appears.

These parameters are sent from the NC when the spindle amplifier is linked with the bus line.

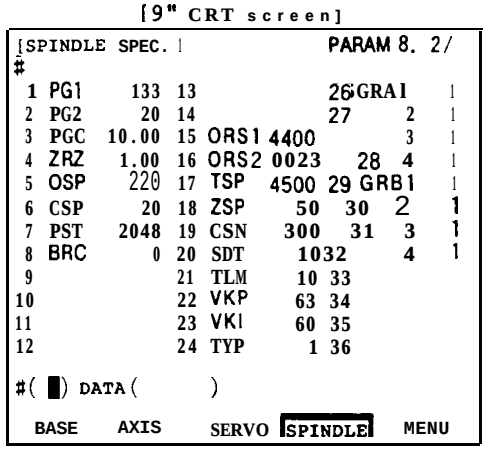
(Note 1) Although the same parameters can be set from the spindle amplifier, when the bus line is linked, those being set from the NC become valid.

(Note 2) When the SF-CA card dip switch (see Section 3.1.1(1) and Appendix 6(1)) SW5-1 is turned on (○ mark), the parameters being set from the NC are invalidated and those set from the spindle amplifier is validated.

[14" CRT screen]

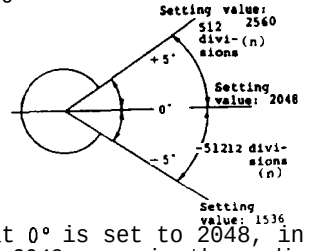


[9" CRT screen]



(Note 3) After these parameters are set, the power of the NC should be turned off. After it is turned on, the parameters are validated.

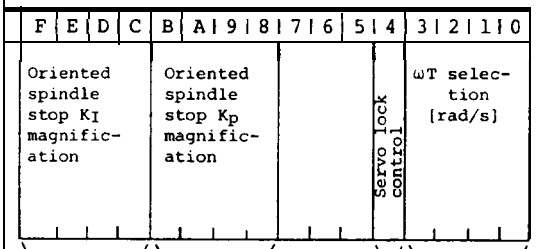
Parameter No. of parameter error.

#	#	No	Parameter		Description	Setting range (Unit)	
						Encoder	Magnesensor
1	33	21	PG1	Orientation 1st deceleration point	Encoder orientation: The angle of the creep speed is set. Standard setting: 180 Magnesensor orientation: The time taken for start of creep speed after passing over linear zone is set. Standard setting: 133	0 - 359 (deg)	0 - 500ms
2	34	22	PG2	Orientation 2nd deceleration point	The angle at which creep speed for position loop state is set. Standard setting: 20		0 - 40(deg
3	35	23	PGC	Synchronous tap position loop gain	The position loop gain of the spindle in the synchronous tap cycle is set. Standard setting: 15.00 It should conform with the position loop gain in the synchronous tap state of the feed axis.	0.01 - 999.99 (rad/s)	
						Encoder	Magnesensor
4	36	24	ZRZ	Orientation in-position range	The position error range of which the orientation complete signal is output is set. Standard setting: 1.00	0 - 359 (deg)	0 - 39 (deg)
5	37	25	OSP	Orientation speed	The orientation speed is set. Standard setting: 220	0 - 1000 (rpm)	
6	38	26	CSP	Creep speed	The creep speed is set. Standard setting: 20	0 - 1000 (rpm)	
						Encoder	Magnesensor
7	39	27	PST	Position shift	[Encoder orientation] The orientation stop position is set. The setting value 1 accords with $\frac{360°}{4096}$. The data change during the orientation stop becomes valid from the next orientation. [Magnesensor orientation] The orientation stop position is set in the range from -5" to +5°.  Assuming that 0° is set to 2048, in the + direction, 2048 + n; in the - direction, 2048 - n. The data during orientation stop can be also changed.	0- 4095 (pulse)	1536 -2560
8	40	28	BRC		Not used. 0 should be set.		

Continued on the next page-

Parameter No. of parameter error

#	#	No.	Parameter		Description	Setting range (unit)
L5 PR	17	2F	RS1	Oriented pindle stop ontrol 1	Control type (such as gain) during orientation stop is set. Standard setting:4400 (When spindle GD² is small like a dedicated machine, it should be set to 6601.)	Hexadecimal notation



4-bit combination [times]	4-bit combination [times]		4-bit combination [rad/s]
0: 0.6	0: 0.6	0: Delay/ advance	0: 0.55
1: 0.7	1: 0.7	1: PI	1: 1.1
2: 0.8	2: 0.8		2: 1.65
3: 0.9	3: 0.9		3: 2.2
4: 1	4: 1		4: 2.75
5: 1.2	5: 1.2		5: 3.3
6: 1.4	6: 1.4		6: 3.85
7: 1.6	7: 1.6		7: 4.4
8: 1.8	8: 1.8		8: 4.95
9: 2	9: 2		9: 5.5
A: 2.2	A: 2.2		A: 6.05
B: 2.4	B: 2.4		B: 6.6
C: 2.6	C: 2.6		c: 7.15
D: 2.8	D: 2.8		D: 7.7
E: 3	E: 3		E: 8.25
F: 3.2	F: 3.2		F: 8.8

(Note) The Kp magnification should be set to the magnification for #36 VKP. The Ki magnification should be set to the magnification for #37 VKI.

Continued on the next page.

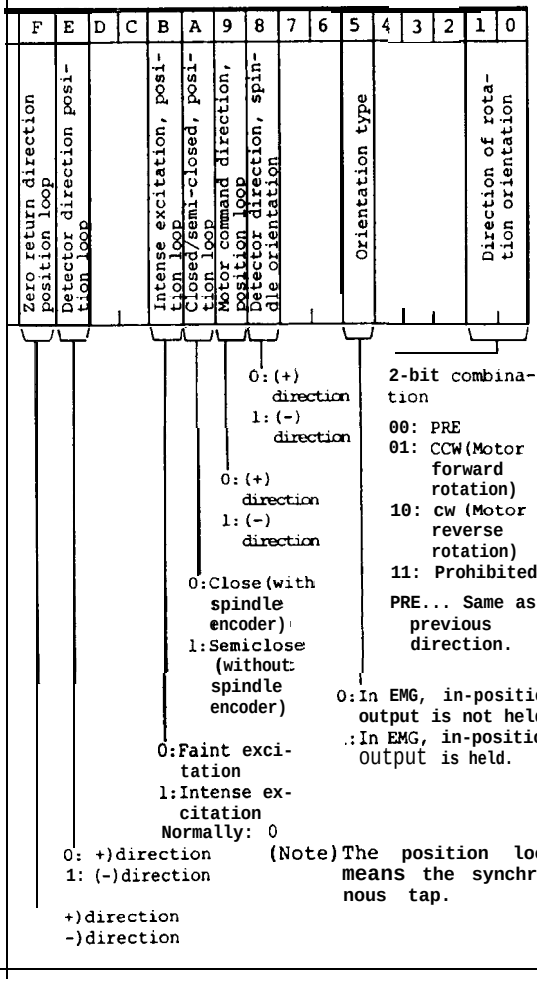
Parameter No. of parameter error.

#	P	o.	Parameter	Description	Setting range (unit)
16 PR	18	30	RS	riented pindle stop ontrol 2	Hexadecimal notation

The spindle orientation direction, detec- installed direction, and motor rota- n direction are set.

[Magnesensor orientation]
Standard setting: 0020
120 when the detector installation irection is reversed)

[Encoder orientation]
Standard setting: 0120
020 when the detector installation irection is reversed)



(Note) The position loop means the synchronous tap.

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Parameter No. of parameter error

#	#	No	Parameter		Description	Setting range (Unit)
17 (PR)	49	31	SSP	Motor maximum speed	The motor maximum speed is set. (The speed when the analog reference speed is 10 V)	0 - 32767 (rpm)
18 (PR)	50	32	CSP	Motor zero speed	The speed for the zero speed output is set. Standard setting: 50	0 - 1000 (rpm)
19 (PR)	51	33	CSN	Acceleration/ deceleration time constant	The time constant of the speed reference from 0 to maximum speed is set. (This parameter is invalid in the position loop state.) Standard setting: 300	0 - 32767 (msec)
20 (PR)	52	34	SDT	Speed detection rate	The speed for the speed detection output against the motor maximum speed is set in percentage. Standard setting: 10	0- 100 (%)
21 (PR)	53	35	PLM	Torque limit	The limit ratio of the torque limit signal TL2 is set. Standard setting: 10	0 - 120 (%)
22 (PR)	54	36	JKP	Speed loop proportional gain	The proportional gain of the speed loop is set. Although increasing the parameter value (around 100 to 150) cause the responsibility to be increased, vibration and sound become large. Standard setting: 63	0 - 1000 (rad/s)
23 (PR)	55	37	JKI	Speed loop integration gai	The speed loop integration gain is set. It should be set in such a manner that the ratio against VKP becomes nearly same. Standard setting: 60	0- 1000 ($\frac{1}{10}$ rad/s)
24 (PR)	56	3E	TYI	Position loop IN type	The process for which the speed loop is switched to the position loop is set. 0: Position loop/zero return is required after orientation operation. 1: Position loop/zero return is not required at the current position. Standard setting: 1	

Continued on the next page.

+-Parameter No. or parameter error

#	#	No	Parameter		Description	Setting range (Unit)
25 (PR)	57	39	GRA1	Number of gear teeth on spindle side	For gear 00, the number of gear teeth on the spindle side is set. This signal is used for synchronous tap cycle and orientation operation.	1 - 32767
26 (PR)	58	3A	GRA2		For gear 01, the number of gear teeth on the spindle side is set. (Same as above)	
27 (PR)	59	3B	GRA3		Not used. 1 should be set.	
28 (PR)	60	3C	GRA4		Not used. 1 should be set.	
29 (PR)	61	3D	GRB1	Number of gear teeth on motor shaft side	For gear 00, the number of gear teeth on the motor shaft side is set. This signal is used for synchronous tap cycle and orientation operation.	The number of gear teeth should be set in the manner that the following relationship is satisfied Motor speed $\times \frac{\text{number of gear teeth on motor shaft side}}{\text{number of gear teeth on spindle side}}$ = spindle speed The number of gear teeth on the spindle and that on the motor side should be set in such a manner that they have a relation of minimum integer in the setting range. 1 to 32767 (In the case of FR-SFJ:100 to 32767)
30 (PR)	62	3E	GRB2		For gear 01, the number of gear teeth on the motor shaft side is set. This signal is used for synchronous tap cycle and orientation operation.	
31 (PR)	63	3F	GRB3		Not used. 1 should be set.	
32 (PR)	64	40	GRB4		Not used. 1 should be set.	

1.3 Adjusting speed and load meter

(1) Adjusting speed meter

The speed meter can be adjusted when a speed meter (DC ammeter full-scale: 1 mA) is connected between the ammeter terminals SM1 and OM (see Appendixes 1-4 and l-5).
Turn on the dip switch SW5-4 on the SF-CA card (see Reference 1.1.1 (3)) so that the speed meter reads the full Section 3.1.1 (3)) so that the speed meter reads the full scale (the maximum speed which is set by the parameter #17 TSP becomes the full-scale).

(2) Adjusting load meter

The load meter can be adjusted when a load meter (DC ammeter full-scale: 1 mA) is connected between the ammeter terminals LM1 and OM (see Appendixes l-4 and l-5).
Turn on the dip switch SW5-4 on the SF-CA card and adjust the VR5 so that the load meter reads the full scale.

(Note 1) After the speed meter or load meter is adjusted, return the dip switch SW5-4 back to the OFF position.

(Note 2) Since other volume have been set at factory, do not adjust them.

1.4 Setting and adjusting spindle orientation control circuit

See Section 3, "Spindle orientation control circuit".