GE Fanuc Automation

Computer Numerical Control Products

S Series AC Spindle Servo Unit Serial Interface

Maintenance Manual

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Warnings, Cautions, and Notes as Used in this Publication

Warning

Warning notices are used in this publication to emphasize that hazardous voltages, currents, temperatures, or other conditions that could cause personal injury exist in this equipment or may be associated with its use.

In situations where inattention could cause either personal injury or damage to equipment, a Warning notice is used.

Caution

Caution notices are used where equipment might be damaged if care is not taken.

Note

Notes merely call attention to information that is especially significant to understanding and operating the equipment.

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CONTENTS

GENERAL

The models covered by this manual, and their abbreviations are :

Series Name	Model Name
FANUC AC SPINDOLE SERVO UNIT SERIAL INTERFACE S series	Model 1S, Model 2S, Model 3S, Model 6S, Model 8S, Model 12S, Model 15S, Model 18S, Model 22S, Model 26S, Model 30S, Model 40S, Model Small 6S, Model Small 15S
FANUC AC SPINDLE SERVO UNIT SERIAL INTERFACE HV series	Model 30HV, Model 40HV, Model 60HV

I. AC SPINDLE SERVO UNIT SERIAL INTERFACE S series

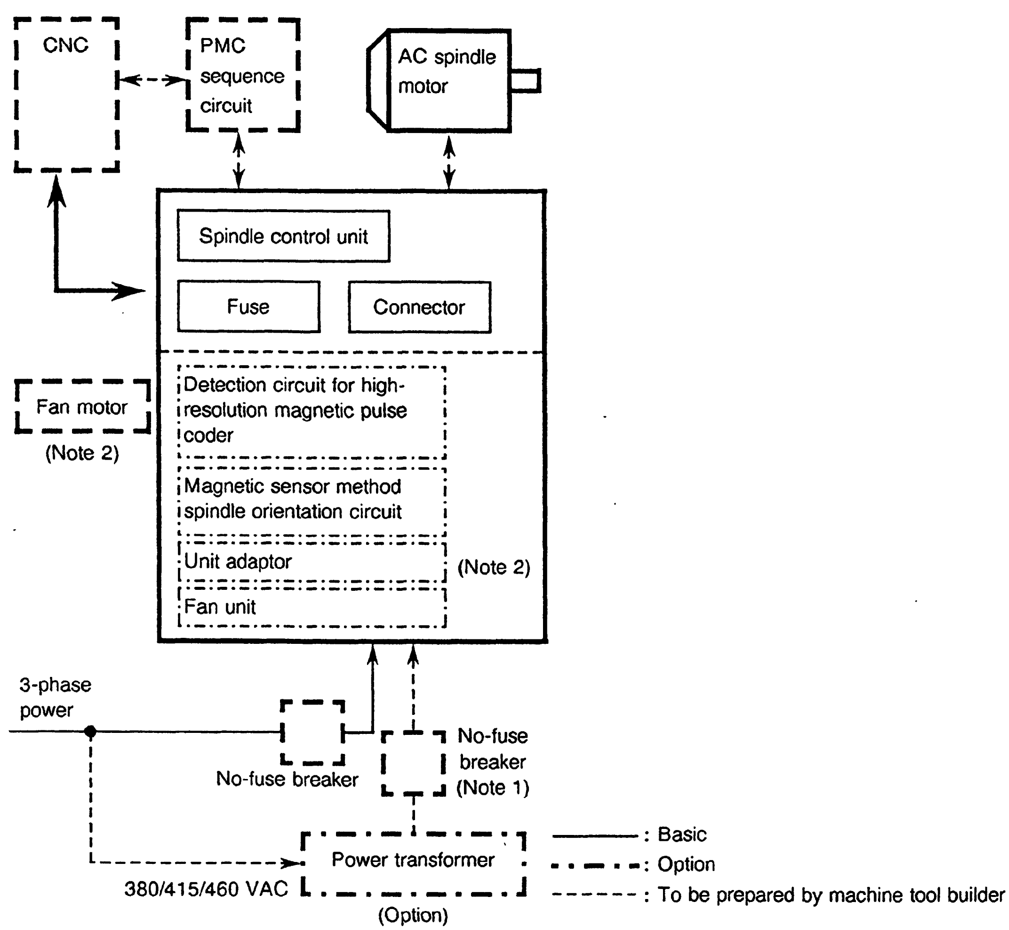
1. GENERAL

This manual describes maintenance of AC spindle servo units Serial Interface S series (models 1S, 2S, 3S, small 6S, 6S, 8S, 12S, small 15S, 15S, 18S, 22S, 26S, 30S, and 40S).

1.1 Configurations

Models 1S, 2S, 3S, small 6S, 6S, 8S, 12S, small 15S, 15S, 18S, 22S, 26S, 30S, and 40S of AC spindle servo units Serial Interface S series consist of the following units.

1) Spindle control unit (basic)
2) Space fuse (basic)
3) Connector spindle servo unit (basic)
4) Power transformer (option)
5) Detection circuit for high-resolution magnetic pulse coder (option)
6) Magnetic sensor method spindle orientation circuit (option dedicated to models 6S to 26S, but not required for the improved amplifier)
7) Unit adaptor (option dedicated to models 6S to 22S)
8) Fan unit (option dedicated to models 30S and 40S)



Note 1) An overcurrent protector (no-fuse breaker, etc.) should be provided by the MTB for the input circuit of spindle servo unit Serial Interface S series. Select an overvoltage protector with the capacity 1.2 times as large as a 30-minute rated power capacity of each spindle amplifier.
Note 2) Air-cool the spindle control unit forcibly with a fan motor at the specified wind speed in the specified cooling mechanism. However, when a unit adaptor is used, the fan motor need not be used.

1.2 Major Components

(1) Model 6S – 26S

Table 1.2(a) Major components

Model	Order specification	Unit	P.C.B	ROM	
				Specification	Type
Model 6S	A06B-6062-H206#H500	A06B-6062-H206	A20B-1003-0550	A06B-6062-H500	9A00
Model 8S	A06B-6062-H208#H500	A06B-6062-H208			
Model 12S	A06B-6062-H212#H500	A06B-6062-H212			
Model 15S	A06B-6062-H215#H500	A06B-6062-H215			
Model 18S	A06B-6062-H218#H500	A06B-6062-H218			
Model 22S	A06B-6062-H222#H500	A06B-6062-H222			
Model 6S	A06B-6063-H206#H510	A06B-6063-H206	A20B-1003-0920	A06B-6063-H510	9A10
Model 8S	A06B-6063-H208#H510	A06B-6063-H208			
Model 12S	A06B-6063-H212#H510	A06B-6063-H212			
Model 15S	A06B-6063-H215#H510	A06B-6063-H215			
Model 18S	A06B-6063-H218#H510	A06B-6063-H218			
Model 22S	A06B-6063-H222#H510	A06B-6063-H222			

(2) Models 1S to 3S, 30S, and 40S

Table 1.2(b) Major components

Model	Order specification	Unit	P.C.B Spindle control circuit/driver circuit	ROM Specification	ROM Type
Model 1S	A06B-6064-H201#H520	A06B-6064-H201	A16B-2201-0010/ A16B-2100-0030	A06B-6064-H520	9A20
Model 2S	A06B-6064-H202#H520	A06B-6064-H202			
Model 3S	A06B-6064-H203#H520	A06B-6064-H203			
Model 30S	A06B-6064-H030#H520	A06B-6064-H030	A16B-2201-0010/ A20B-1004-0230		
Model 40S	A06B-6064-H040#H520	A06B-6064-H040			
Model 1S	A06B-6064-H301#H550	A06B-6064-H301	A16B-2201-0440/ A16B-2100-0070	A06B-6064-H550	9A50
Model 2S	A06B-6064-H302#H550	A06B-6064-H302			
Model 3S	A06B-6064-H303#H550	A06B-6064-H303			
Model small 6S	A06B-6064-H305#H550	A06B-6064-H305			
Model 6S	A06B-6064-H306#H550	A06B-6064-H306	A16B-2201-0440/ A20B-2000-0220		
Model 8S	A06B-6064-H308#H550	A06B-6064-H308			
Model 12S	A06B-6064-H312#H550	A06B-6064-H312			
Model small 15S	A06B-6064-H313#H550	A06B-6064-H313			
Model 15S	A06B-6064-H315#H550	A06B-6064-H315			
Model 18S	A06B-6064-H318#H550	A06B-6064-H318			
Model 22S	A06B-6064-H322#H550	A06B-6064-H322			
Model 26S	A06B-6064-H326#H550	A06B-6064-H326			

2. DAILY MAINTENANCE AND MAINTENANCE TOOLS

Check and clean the following items once every 6 months or so when using the AC spindle motor and AC spindle servo units under normal conditions.
Increase the check frequency when conditions are more severe.

2.1 AC Spindle Motor

If the ventilation holes, cooling fan, and fan guard of the AC spindle motor become dusty, the cooling efficiency of the motor drops. Clean the AC spindle motor by using the factory air and a vacuum cleaner.

2.2 AC Spindle Servo Unit

Since a cooling fan is mounted at the upper part of the servo unit, nearby resistor and other parts may become dusty after long-time use. If they are dusty, clean them using the vacuum cleaner.

2.3 Maintenance Tools

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

Table 2.3 (a) Tools used for adjustments

Name	Specification	Use
AC voltmeter	1–300 V ±1% or less	AC power voltage measurement
+ , − screw-drivers	+ large, medium size − large, medium, small size	

Table 2.3 (b) Tools used for repairing troubles

Name	Specification	Use
AC voltmeter	1–300 V ±1% or less	AC power voltage measurement
DC voltmeter	1 mV–500 V ±1% or less	AC power voltage measurement and offset voltage check
Circuit tester		Resistance value check
+ , − screw-drivers	+ large, medium size − large, medium, small size	

2.4 Major Maintenance Parts

For maintenance parts, see appendix 7 Major maintenance parts.

3. TROUBLESHOOTING

Perform troubleshooting, referring to each item in Table 3 according to the trouble conditions.

Table 3 Sort of trouble conditions

Item	Trouble conditions	Reference item
1	Power voltage check	3.1
2	Power ON indicator lamp PIL does not light.	3.3
3	Alarm (AL-□□) is displayed on the PCB.	3.4
4	Motor rotation is not as specified.	3.5
5	Motor does not rotate.	3.5
6	Vibrations and noises are noticeable during rotation.	3.6
7	An abnormal noise is produced from motor during deceleration.	3.7
8	Motor speed overshoots or hunting occurs.	3.8
9	Cutting power drop	3.9
10	Acceleration/deceleration time is longer than specified.	3.10
11	Status error has been displayed on the PCB.	3.11

Note) Follow Section 6.2 when replacing the PCBs (spindle control circuit and driver circuit) and printed wiring board. (See Appendix 2.)

3.1 Power Voltage Check

Check AC power voltage and DC power voltage on the spindle control PCB. Test points and standard values are as specified in Table 3.1.
For the locations of the test points, see Appendix 6.

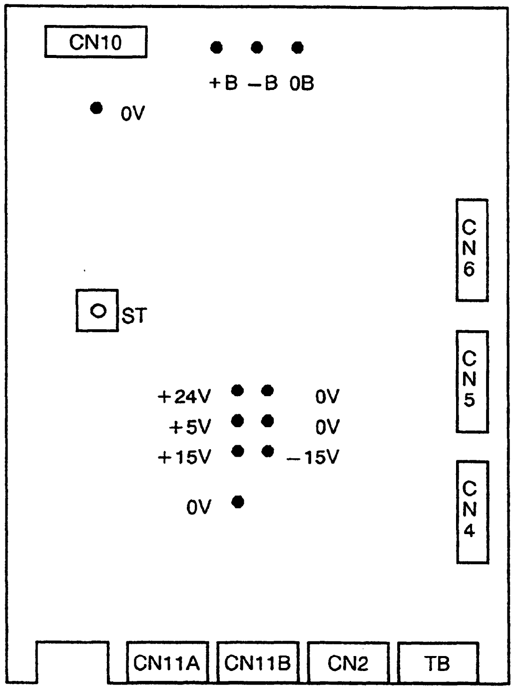
Table 3.1 Power voltage check

Item	Check procedure		
AC power voltage check	Check at INPUT terminals R,S,T (See 4.2)		
DC power voltage check on the spindle control PCB	Voltage	Test points	Standard value
	+24V	+24V–0V	20–26V
	+15V	+15V–0V	+15V ±4%
	+5V (Note)	+5V–0V	+5V ±2%
	–15V	–15V–0V	–15V ±4%

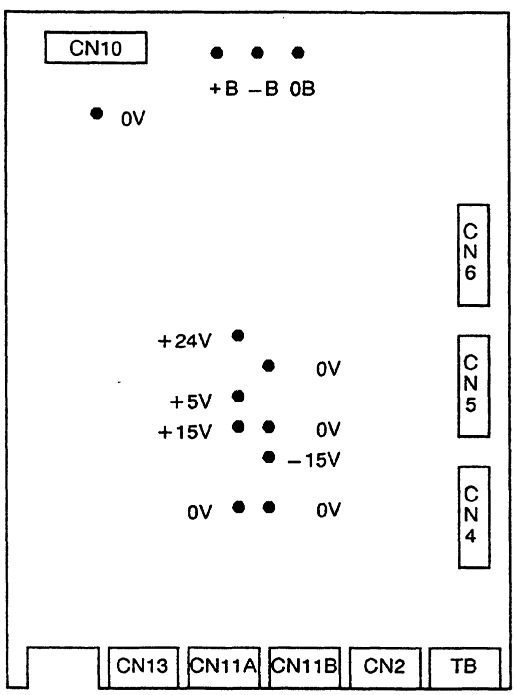
Note) Checked with RV (+5 V power supply voltage check) (models 30S and 40S). Never change the voltage because it is factory-set by FANUC.

Test points (refer to Appendix 6.)

1) A20B-1003-0550

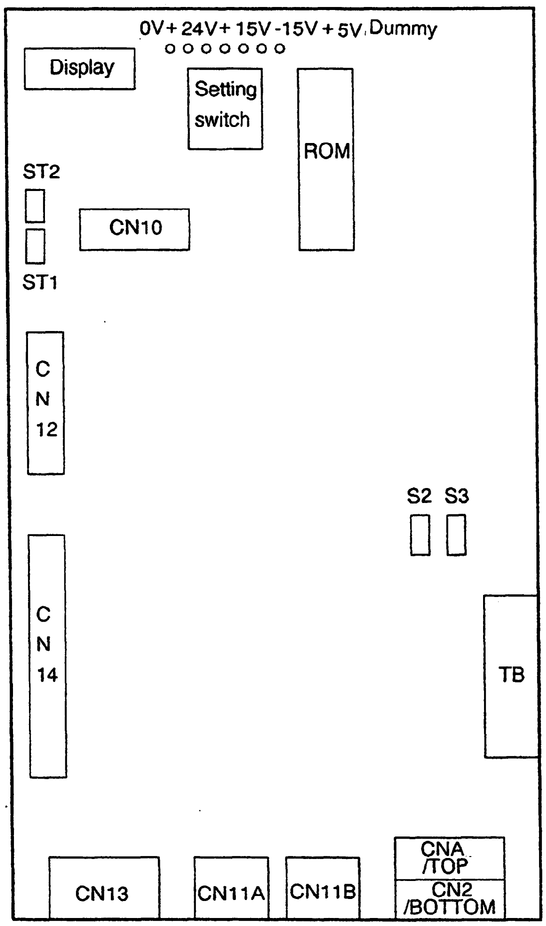


2) A20B-1003-0920



Caution) 300 VDC is output on +B and –B test points.

3) A16B-2201-0010, A16B-2201-0440



3.2 Verification of ROM Series and ROM Version

After power is tuned ON, "A□□□□" (where "□" represents a blank) appears in the PCB display. Approximately 1 second later the display changes to "10–02", and finally to "SU–01", which flashes. The ROM series and ROM version can be verified using the second displayed message, as shown below.

" 1 0 – 0 2 "

↓ Lower 2 digits of ROM series. Ex: If series is 9A10, "10" is displayed.

↓ ROM Version

Version	Version A	Version B	...
Display	01	02	...

3.3 Power-On Indicator Lamp PIL Not Turned On

For the mounting location of the indicator lamp PIL, see Section (1), (3), or (4) in Appendix 6.

Table 3.3 Check procedure and remedy

Item	Causes	Check procedure	Remedy
1	AC power is not supplied.	Check power input terminals R, S, and T. For mounting locations, see Sections (1) to (6) in Appendix 2.	
2	Fuse FUR, FUS or FUT (models 1S to 26S), or F4a or F4b (models 30S and 40S) is blown.	Check fuse. For mounting locations, see Appendix 5.	Replace FUR, FUS or FUR (models 1S to 26S), or F4a or F4b (models 30S and 40S).
3	Fuse F1 (models 1S to 26S), or AF1, AF2 or AF3 (models 30S and 40S) is blown.	Check if fuse alarm indication appears. For mounting locations of fuses, see Section (2), (4), or (5) in Appendix 6.	Check for pulse generator cable short circuit or position coder cable short circuit. Then replace fuse F1 (models 1S to 26S), or AF1, AF2 or AF3 (models 30S and 40S). If fuse is still blown, replace PCB.
4	PCB connectors CN4 to CN6 (models 1S to 26S) or CN4 to CN7 (models 30S and 40S) are not plugged correctly.	Check that connector guide groove appears on PCB connector surface. For mounting locations of connectors, see Sections (2) to (5) in Appendix 6.	Insert connectors correctly.
5	There is no 19A or 19B output due to transformer TF failure (models 30S and 40S). For mounting location of transformer TF, see Section (5) or (6) in Appendix 5.	Check voltages on PCB test points: 19A-CT 19B-CT About 19 V must be observed for both 19A-CT and 19B-CT. For mounting locations of test points 19A, 19B, and CT, see Section (5) in Appendix 6.	Replace transformer.
6	PCB power circuit is faulty.	Lamp PIL is turned on by +5 V. So check power supply voltage according to Table 3.1.	Check PCB.

3.4 AL-□□ is Indicated

The alarms of the AC spindle motor and servo unit are displayed by the five-digit seven-segment indicator on the spindle control circuit PCB.

Table 3.4 indicates the correspondence between the seven-segment indicator indications and alarms. For corrective action, follow the instructions provided in Table 3.4.

For the mounting location of the alarm indicator, see Sections (1), (3), or (4) in Appendix 6.

Table 3.4 Alarms (1/4)

Alarm No.	Meanings	Description	Remedy
"A" display	Program ROM abnormality (not installed)	Detects that control program is not started (due to program ROM not installed, etc.)	Install normal program ROM.
AL-01	Motor overheat	Detects internal motor temperature exceeding specified temperature.	Check load status. Cool motor, then reset alarm.
AL-02	Excessive speed deviation	Detects motor speed exceeding specified speed excessively.	Check load status. Reset alarm.
AL-03	DC link section fuse blown	Detects that fuse F4 in DC link section is blown (models 30S and 40S). For mounting location of fuse F4, see Section (5) and (6) in Appendix 5.	Check power transistors, and so forth. Replace fuse.
AL-04	Input fuse blown. Input power open phase.	Detects blown fuse (F1 to F3), open phase or momentary failure of power (models 30S and 40S). For mounting locations of fuses F1 to F3, see Section (5) or (6) in Appendix 5.	Replace fuse. Check open phase and power supply regenerative circuit operation.
AL-05	Control power supply fuse blown	Detects that control power supply fuse AF2 or AF3 is blown (models 30S and 40S). For mounting locations of fuses AF2 and AF3, see Section (5) in Appendix 6.	Check for control power supply short circuit. Replace fuse.
AL-07	Excessive speed	Detects that motor rotation has exceeded 115% of its rated speed.	Reset alarm.
AL-08	High input voltage	Detects that switch is flipped to 200 VAC when input voltage is 230 VAC or higher (models 30S and 40S).	Flip switch to 230 VAC.
AL-09	Excessive load on main circuit section	Detects abnormal temperature rise of power transistor radiator.	Cool radiator, then reset alarm.
Al-10	Low input voltage	Detects drop in input power supply voltage.	Correct cause, then reset alarm.
AL-11	Overvoltage in DC link section	Detects abnormally high direct current power supply voltage in power circuit section.	Correct cause, then reset alarm.
AL-12	Overcurrent in DC link section	Detects flow of abnormally large current in direct current section of power circuit.	Correct cause, then reset alarm.

Table 3.4 Alarms (2/4)

Alarm No.	Meanings	Description	Remedy
AL-13	CPU internal data memory abnormality	Detects abnormality in CPU internal data memory. This check is made only when power is turned on.	Correct cause, then reset alarm.
AL-15	Spindle switch/output switch alarm	Detects incorrect switch sequence in spindle switch/output switch operation.	Check sequence.
AL-16	RAM abnormality	Detects abnormality in RAM for external data. This check is made only when power is turned on.	Correct cause, then reset alarm.
AL-18	Program ROM sum check error	Detects program ROM data error. This check is made only when power is turned on.	Correct cause, then reset alarm.
AL-19	Excessive U phase current detection circuit offset	Detects excessive U phase current detection circuit offset. This check is made only when power is turned on.	Correct cause, then reset alarm.
AL-20	Excessive V phase current detection circuit offset	Detects excessive V phase current detection circuit offset. This check is made only when power is turned on.	Correct cause, then reset alarm.
AL-24	Serial transfer data error	Detects serial transfer data error (such as NC power supply turned off, etc.)	Correct cause, then reset alarm.
AL-25	Serial data transfer stopped	Detects that serial data transfer has stopped.	Correct cause, then reset alarm.
AL-26	Disconnection of speed detection signal for Cs contouring control	Detects abnormality in speed detection signal for Cs contouring control (such as unconnected cable and adjustment error).	Correct cause, then reset alarm.
AL-27	Position coder signal disconnection	Detects abnormality in position coder signal (such as unconnected cable and parameter setting error).	Correct cause, then reset alarm.
AL-28	Disconnection of position detection signal for Cs contouring control	Detects abnormality in position detection signal for Cs contouring control (such as unconnected cable and adjustment error).	Correct cause, then reset alarm.
AL-29	Short-time overload	Detects that overload has been continuously applied for some period of time (such as restraining motor shaft in positioning).	Correct cause, then reset alarm.
AL-30	Input circuit overcurrent	Detects overcurrent flowing in input circuit.	Correct cause, then reset alarm.

Table 3.4 Alarms (3/4)

Alarm No.	Meanings	Description	Remedy
AL-31	Speed detection signal disconnection motor restraint alarm	Detects that motor cannot rotate at specified speed (but rotates at very slow speed or has stopped). (This includes checking of speed detection signal cable.)	Correct cause, then reset alarm.
AL-32	Abnormality in RAM internal to LSI for serial data transfer	Detects abnormality in RAM internal to LSI for serial data transfer. This check is made only when power is turned on.	Correct cause, then reset alarm.
AL-33	Insufficient DC link section charging	Detects insufficient charging of direct current power supply voltage in power circuit section when magnetic contactor in amplifier is turned on (such as open phase and defective charging resistor).	Correct cause, then reset alarm.
AL-34	Parameter data setting beyond allowable range of values	Detects parameter data set beyond allowable range of values.	Set correct data.
AL-35	Excessive gear ratio data setting	Detects gear ratio data set beyond allowable range of values.	Set correct data.
AL-36	Error counter over flow	Detects error counter overflow.	Correct cause, then reset alarm.
AL-37	Speed detector parameter setting error	Detects incorrect setting of parameter for number of speed detection pulses.	Set correct data.
AL-39	Alarm for indicating failure in detecting 1-rotation signal for Cs contouring control	Detects 1-rotation signal detection failure in Cs contouring control.	Make signal adjustment. Check cable shield status.
AL-40	Alarm for indicating 1-rotation signal for Cs contouring control not detected	Detects that 1-rotation signal has not occurred in Cs contouring control.	Make 1-rotation signal adjustment.
AL-41	Alarm for indicating failure in detecting position coder 1-rotation signal.	Detects failure in detecting position coder 1-rotation signal.	Make signal adjustment for signal conversion circuit. Check cable shield status.
AL-42	Alarm for indicating position coder 1-rotation signal not detected	Detects that position coder 1-rotation signal has not occurred.	Make 1-rotation signal adjustment for signal conversion circuit.
AL-43	Alarm for indicating disconnection of position coder signal for differential speed mode	Detects that main spindle position coder signal used for differential speed mode is not connected yet (or is disconnected).	Check that main spindle position coder signal is connected to connector CN12. For mounting location of connector CN12, see Appendix 6.
AL-46	Alarm for indicating failure in detecting position coder 1-rotation signal in thread cutting operation.	Detects failure in detecting position coder 1-rotation signal in thread cutting operation.	Make 1-rotation signal adjustment for signal conversion circuit. Check cable shield status.

Table 3.4 Alarms (4/4)

Alarm No.	Meanings	Description	Remedy
AL-47	Position coder signal abnormality	Detects incorrect position coder signal count operation.	Make signal adjustment for signal conversion circuit. Check cable shield status.
AL-48	Position coder 1-rotation signal abnormality	Detects that occurrence of position coder 1-rotation signal has stopped.	Make 1-rotation signal adjustment for signal conversion circuit.
AL-49	The converted differential speed is too high.	Detects that speed of other spindle converted to speed of local spindle has exceeded allowable limit in differential mode.	Calculate differential speed by multiplying speed of other spindle by gear ratio. Check if calculated value is not greater than maximum speed of motor.
AL-50	Excessive speed command calculation value in spindle synchronization control	Detects that speed command calculation value exceeded allowable range in spindle synchronization control.	Calculate motor speed by multiplying specified spindle speed by gear ratio. Check if calculated value is not greater than maximum speed of motor.
AL-51	Undervoltage at DC link section	Detects that DC power supply voltage of power circuit has dropped (due to momentary power failure or loose contact of magnetic contactor).	Correct cause, then reset alarm.
AL-52	ITP signal abnormality I	Detects abnormality in synchronization signal (ITP signal) with CNC (such as loss of ITP signal).	Correct cause, then reset alarm.
AL-53	ITP signal abnormality II	Detects abnormality in synchronization signal (ITP signal) with CNC (such as loss of ITP signal).	Correct cause, then reset alarm.
AL-54	Overload current alarm	Detects that excessive current flowed in motor for long time.	Check if overload operation or frequent acceleration/ deceleration is performed.
AL-55	Power line abnormality in spindle switching/output switching	Detects that switch request signal does not match power line status check signal.	Check operation of magnetic contractor for power line switching. Check if power line status check signal is processed normally.

(1) Alarm "A" display

| A | ROM abnormality

Item	Cause of trouble	Check procedure	Remedy
1	Control ROM is not installed, or is not correctly installed.	Check that ROM is put in socket correctly and leads are not bent causing loose contact.	Install control ROM correctly.
2	Wrong control ROM	Check the ROM version by the stamp and the code displayed on the indicator for one second after the power is turned on.	Replace wrong control ROM with control ROM that has correct specifications.
3	Incorrect control ROM with the lower access speed	Check specification of control ROM from stamp.	Replace wrong control ROM with control ROM that has correct specifications.
4	Control circuit abnormality	Check operation after replacing control circuit.	Replace faulty control circuit with normal control circuit.

(2) Alarm No. 01

| AL-01 | Motor overheat

Item	Cause of trouble	Check procedure	Remedy
1	Defective fan motor of motor	Check if fan motor is rotating.	Replace fan motor.
2	Overload operation	Check cutting conditions and how tools are worn. Check load meter for cutting.	Review cutting conditions and tools.
3	Dirty motor cooling system	Check motor cooling system for dirt.	Clean motor cooling system with an air gun or vacuum cleaner.
4	Disconnection or loose contact of motor overheat signal line	Check signal line connection status.	Connect signal line correctly.

Note) See Appendix 2.

(3) Alarm No. 02

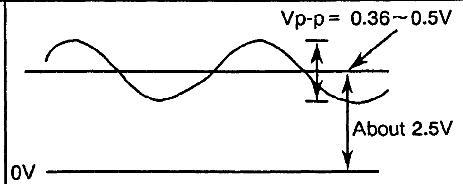
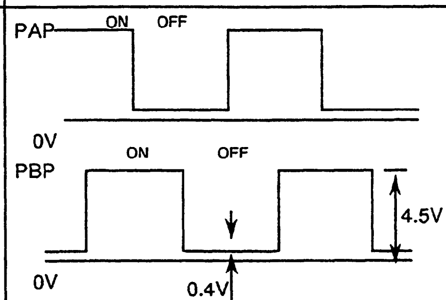
AL-02	Excessive speed deviation

Item	Cause of trouble	Check procedure	Remedy
1	Overload operation (overload)	Check with load meter.	Review cutting conditions and tools.
2	Defective transistor module	Check if transistor collector-emitter is open.	Replace transistor module (Note 1).
3	Fuse for protecting driver on PCB blown or not inserted correctly (disconnection, loose contact, etc.)	Check if fuses F3A to F3M (models 1S to 26S) or FA to FG (models 30S and 40S) are blown or removed. For mounting locations of fuses, see Sections (2) to (5) in Appendix 6.	Insert fuses firmly. Replace any blown fuse.
4	Speed feedback signal abnormality	Check level of speed feedback signal(Note 2).	Check motor speed detector and signal cable connection.
5	Wiring failure (disconnection, loose contact, etc.)	Check that cables are connected correctly.	

Note 1) See Section 6.3.

Note 2) Checking of speed feedback signal

Observe the speed feedback signal with an oscilloscope after turning on power and setting the rotation command off (motor stopped and drive power set off), Observe the test points indicated below, while turning the motor slowly by hand.

Test point	Normal waveform
PA-0V	
PB-0V	Same as above
RA-0V	DC 2.5V ± 0.2V
RB-0V	Same as above
PAA-0V PBA-0V (CW rotation)	 Check that the ON/OFF duty cycle is 50%. (The PAP and PBP signals are inverted in CCW direction.)

(4) Alarm No. 03

AL-03	Blown fuse in DC link section

This alarm indicates that the fuse (F4) in the DC link section is blown. In this case, the transistor module may have failed. Replace it according to Section 6.3. For the mounting location of fuse F4, see Section (5) or (6) in Appendix 6.

(5) Alarm No. 04

AL-04 Input fuse blown
Input power open phase

Item	Cause of trouble	Check procedure	Remedy
1	High impedance on AC power supply side. Example: Two transformers are connected in series, or variable autotransformer is connected.	Alarm No. 04 is on only at time of deceleration from high speed operation. Alarm No. 04 can be on when F1 to F3 are not blown.	Change power supply to one with low impedance. There may be loose connection of input power cable Example: Open phase due to screws not tightened firmly
2	Defective transistor module		Replace transistor module and fuse(Note). For mounting locations of transistor modules and fuses, see Appendixes 5 and 6.
3	Defective diode module or thyristor module	Disconnect diode modules DM1 to DM3 and thyristor modules SM1 to SM3, then check A-K connection with multimeter. (Defective modules are usually short-circuited.)	Replace defective part. Replace blown fuse.(Note)
4	Defective surge absorber or capacitor	Check surge absorbers Z1 to Z3 and capacitors C4 to C6. For mounting locations of surge absorbers and capacitors, see Appendix 5.	Replace defective part. Replace blown fuse.(Note)
5	When input fuse is not blown	Check if Item 1 is applicable.	When Item 1 is not applicable, replace PCB.

Note) See Chapter 6.

(6) Alarm No. 05

AL-05 Control power supply fuse blown

Item	Cause of trouble	Check procedure	Remedy
1	Defective PCB	Check AC input voltage. See (5) above.	Replace PCB.
2	Abnormal power supply voltage		

(7) Alarm No. 07

AL-07 Excessive speed

Item	Cause of trouble	Check procedure	Remedy
1	Incorrect setting of parameter for number of speed feedback pulses (No. 6511)	Check if number of speed feedback pulses matches parameter setting.	Set correct value in parameter.

Note) See Chapter 6.

(8) Alarm No. 08

AL-08 High input voltage

Item	Cause of trouble	Check procedure	Remedy
1	AC power supply voltage 10% higher than rated voltage	Check power supply voltage.	
2	Incorrect setting of toggle switch for voltage switching	Check power supply voltage.	Change setting from 200 V to 230 V.

(9) Alarm No. 09

AL-09 Heat sink is overheated.

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

(10) Alarm No. 10

AL-10 Input power voltage drops.

This alarm indicates abnormally low AC power voltage (−15% or less).
This alarm may be generated even during momentary power failures.

(11) Alarm No. 11

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

Item	Cause of trouble	Check procedure	Remedy
1	High power impedance.		Examine AC power specification. Refer to section 4.2.
2	PCB is defective.		Replace PCB. (Note)
3	Defective transistor module (TM1).		Replace transistor module. (Note)

Note) Refer to Section 6

(12) Alarm No. 12

AL-12 Overcurrent flows to DC link circuit.

Item	Cause of trouble	Check procedure	Remedy
1	Output terminals or internal circuit of motor is shorted.	Check connections.	
2	Transistor module is defective.	Check the transistor module.	Replace transistor module. (Note)
3	PCB is defective.		Replace PCB. (Note)

Note) Refer to Sections 6.2–6.3.

(13) Alarm No. 13

AL-13 CPU inter data memory alarm.

Replace PCB. Refer to Section 6.

(14) Alarm No. 16

Item	Cause of trouble	Check procedure	Remedy
1	External data memory (RAM) defective		Replace memory (RAM).
2	PCB defective		Replace PCB.

(15) Alarm No. 18

Item	Cause of trouble	Check procedure	Remedy
1	Program memory data (ROM) defective	Compare data displayed when power is turned ON with ROM labels.	Replace program memory (ROM).

(16) Alarm No. 19

Item	Cause of trouble	Check procedure	Remedy
1	A/D converter defective		Replace A/D converter.
2	U-phase current detector circuit defective	After power is turned on, check if offset voltage on check terminal IU is beyond range of about ±100 mV.	Replace PCB.
3	Loose contact of connectors between PCB and power circuit	Check connector connection between PCB and power circuit.	Ensure that PCB and power circuit are securely connected with each other.

(17) Alarm No. 20

Item	Cause of trouble	Check procedure	Remedy
1	V-phase current detector circuit defective	After power is turned on, check if offset voltage on check terminal IV is beyond range of about ±100 mV.	Replace PCB.
2	Loose contact of connectors between PCB and power circuit	Check connector connection between PCB and power circuit.	Ensure that PCB and power circuit are securely connected with each other.

(18) Alarm No. 24

Item	Cause of trouble	Check procedure	Remedy
1	CNC power supply is OFF	Check that CNC power is off.	Turn CNC power ON.
2	Defective optical cable for serial data transmission	Check that optical cable is fitted securely to the connector. Check that the cable is not broken. Check that transmission/reception surfaces of the cable are clean.	Connect securely. Replace optical cable. Clean optical cable transmission/reception surfaces.
3	Defective data transmission/reception elements in LSI used in serial data transmission		Replace LSI. Replace PCB.

(19) Alarm No. 25
See Alarm No. 24.

(20) Alarm No. 26

Item	Cause of trouble	Check procedure	Remedy
1	Signal level defective of spindle motor for Cs axis control is defective	Check the signal level, and if necessary adjust to the normal level using the variable resistor for signal level adjustment in the preamp. (Refer to "Detector Circuit for Cs Axis Control Function" in DESCRIPTIONS)	
2	Signal line defective of spindle motor for Cs axis control is defective	Check that signal cable is connected securely to connector. Check that signal cable is not broken.	Connect signal cable securely. Replace signal cable.
3	Defective detector circuit for Cs axis control		Replace detector circuit.
4	Incorrect parameter setting	Check that the parameter setting does not indicate that the Cs axis control detector is used when actually it is not.	Parameter CAXIS1 = 0 No. 3001#5 (Power Mate, Series 15) No. 6501#5 (Series 0-C) No. 4001#5 (Series 16)

(21) Alarm No. 27

Item	Cause of trouble	Check procedure	Remedy
1	Position coder signal line defective	Check that signal cable is connected securely to connector. Check that signal cable is not broken.	Connect signal cable securely. Replace signal cable.
2	Incorrect parameter setting	Check that the parameter setting does not indicate that the position coder signal is used when actually it is not.	Parameter MRDY2 = 0 No. 3001#2 (Power Mate, Series 15) No. 6501#2 (Series 0-C) No. 4001#2 (Series 16)

(22) Alarm No. 28

Item	Cause of trouble	Check procedure	Remedy
1	Signal level of spindle detector for Cs axis control is defective	Check the signal level, and if necessary adjust to the normal level using the variable resistor for signal level adjustment in the preamp. (Refer to "Detector Circuit for Cs Axis Control Function" in DESCRIPTIONS)	
2	Signal line of spindle detector for Cs axis control is defective	Check that signal cable is connected securely to connector. Check that signal cable is not broken.	Connect signal cable securely. Replace signal cable.
3	Defective detector circuit for Cs axis control		Replace detector circuit.

(23) Alarm No. 29

Item	Cause of trouble	Check procedure	Remedy
1	Overloaded operation (Overload)	Use loadmeter to check that a load close to the load resistance limit is not imposed continuously for 30 seconds or more.	Re-examine cutting conditions and tools.

(24) Alarm No. 30

Item	Cause of trouble	Check procedure	Remedy
1	Defective of power transistor used for power	Check power transistor.	Replace power transistor.
2	Defective of power regeneration circuit		Replace PCB.

(25) Alarm No. 31

Item	Cause of trouble	Check procedure	Remedy
1	Motor constrained	Check that nothing is preventing the motor from accelerating.	Remove cause.
2	Defective motor speed reversion signal	Check signal waveform. (See item 3) (Alarm No. 2)	Remove cause.
3	Defective motor speed reversion signal cable	Check that cable is connected securely to connector. Check that cable is not broken.	Connect cable securely. Replace cable.

(26) Alarm No. 32

Item	Cause of trouble	Check procedure	Remedy
1	Defective LSI used in serial data transmission		Replace LSI. Replace PCB.

(27) Alarm No. 33

Item	Cause of trouble	Check procedure	Remedy
1	Defective relay used in DC link recharging. Disconnection of resistor used in limiting re-charge current	Check relevant parts.	Replace amp.

(28) Alarm No. 34

Item	Cause of trouble	Check procedure	Remedy
1	Incorrect parameter setting	Check if specified parameter value is beyond allowable range of values.	Specify value within allowable range.

Note) With 9A50 Series/Version B and later, $\boxed{\text{AL-34}}$ and $\boxed{\text{F-XXX}}$ are alternately displayed in the spindle amplifier indicator section if an AL-34 alarm is raised. "XXX" indicates the data number internal to the spindle for a parameter where a value beyond the allowable range is specified. For information about data numbers internal to the spindle, see the parameter list provided in Appendix 9.

(29) Alarm No. 35

Item	Cause of trouble	Check procedure	Remedy
1	Parameter data of gear ratio and position gain are too large.	Check gear ratio and position gain data.	Alter to suitable values.

(30) Alarm No. 37

Item	Cause of trouble	Check procedure	Remedy
1	Incorrect setting of parameter for number of speed feedback pulses (No. 6511)	Check if number of speed feedback pulses matches parameter setting.	Set correct value in parameter.

(31) Alarm No. 39

Item	Cause of trouble	Check procedure	Remedy
1	Incorrect data ROM type for Cs contouring control detector circuit, or incorrect setting	Check data ROM type for Cs contouring control detector circuit and setting.	Install correct type of ROM. Perform setting correctly.
2	Low level of Cs contouring control feedback signal, or noise on same feedback signal	Check feedback signal level and also check if feedback signal waveform includes noise.	Adjust feedback signal. Check shielding status.

32) Alarm No. 40

Item	Cause of trouble	Check procedure	Remedy
1	No occurrence of 1-rotation signal among Cs contouring control feedback signals, or 1-rotation signal offset adjustment error	Check 1-rotation signal among Cs contouring control feedback signals.	Make 1-rotation signal offset adjustment. Check cables.

(33) Alarm No. 41

Item	Cause of trouble	Check procedure	Remedy
1	Incorrect setting of parameter for number of position coder signal pulses (No. 6503#4,6,7).	Check number of position coder signal pulses and parameter setting.	Set correct value in parameter.
2	Incorrect amplitude and offset of position coder feedback signal, or noise on same feedback signal	Check feedback signal level and also check if feedback signal waveform includes noise.	Adjust feedback signal. Check shielding status.

(34) Alarm No. 47

Item	Cause of trouble	Check procedure	Remedy
1	Incorrect setting of parameter for number of position coder signal pulses (No. 6503#4,6,7).	Check number of position coder signal pulses and parameter setting.	Set correct value in parameter.
2	Incorrect amplitude and offset of position coder feedback signal, or noise on same feedback signal	Check feedback signal level and also check if feedback signal waveform includes noise.	Adjust feedback signal. Check shielding status.

3.5 Motor does not Rotate or its Rotation is Abnormal

Item	Cause of trouble	Check procedure	Remedy
1	Defective phases of motor power line	Alarm lamp lights on spin-dle servo unit when rotation command is given.	Repair phases. Refer to Appendix 2.
		Alarm lamp does not light.	Apply higher speed command.
2	Command signal connection failure	Check signal cable connection.	
3	Parameter is not proper.		Set parameters correctly. Refer to section 5.4.

3.6 Vibration or Noises are too Large during Rotation

Item	Cause of trouble	Check procedure	Remedy
1	Motor is defective.		Replace motor.
2	PCB is defective.	Run the motor idly. When the connector CN2 is disconnected from AC spin-dle servo unit while rotating the motor, overheat alarm (AL-01) occurs, and the motor runs idly. (Note) If vibrations and noises are reduced during idle run as compared with normal rotation time, the control circuit is defective.	Replace PCB. Refer to section 6.

Note) To perform idle run contact the MTB to determine if it is possible. Some sequences require brake operation.

3.7 Noise is Produced from Motor during Deceleration

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

Note) Parameter numbers for regenerative power control

Power Mate: No. 3080
Series 0: No. 6580
Series 15: No. 3080
Series 16: No. 4080

3.8 Speed Overshooting or Hunting Occurs

Item	Cause of trouble	Check procedure	Remedy
1	Overshooting		Adjust parameter value.
2	Spindle hunting		Refer to section 5.4.

Note) Parameter numbers for velocity loop proportional gain data

Power Mate: No. 3040 and over
Series 0: No. 6540 and over
Series 15: No. 3040 and over
Series 16: No. 4040 and over

3.9 Cutting Force is Low

Item	Cause of trouble	Check procedure	Remedy
1	ROM is not proper.	Check model name according to Table 1.2.	Setting parameter after check parameter.
2	Torque limit command is applied.	Check signal.	
3	Loosened belt	Check belt tension.	

Note) Motor model parameter numbers

Power Mate: No. 3133
Series 0: No. 6633
Series 15: No. 3133
Series 16: No. 4133

3.10 Acceleration/Deceleration Time is Long

Item	Causes of trouble	Check procedure	Remedy
1	Torque limit command is applied.	Check signal.	
2	Parameter is not adjusted correctly.	If regenerative power control parameter is set too low, the deceleration period becomes long. Refer to section 3.7.	Readjust regenerative power control parameter.

3.11 Er- □□ is Displayed

Status error display function

This displays Er-XX on the display unit on the spindle control PCB when there is an erroneous parameter setting or the sequence is inappropriate. When the operation of the spindle motor is defective, check the error number on the display unit and remove the error by performing the following countermeasures.

Note 1) Er- XX is not displayed on the NC screen.

Note 2) Refer to the related control input signals and spindle parameters on the next page.

Display	Contents	Countermeasure
Er-01	* Although ESP (there are 2 types: connection signal and PMC → CNC) and MRDY (machine ready signal) are not input, SFR/SRV is input. However, regarding MRDY, pay attention to the setting of use/not use spindle parameter MRDY.	* Confirm the sequence of ESP and MRDY.
Er-02	If spindle motor is not integrated with spindle in system with high-resolution magnetic pulse coder, speed detector of spindle motor is set to 128 p/rev. Attempt to excite motor fails if value other than 128 p/rev is set.	Set the spindle motor speed detector parameter to 128 p/rev.
Er-03	Parameter for high-resolution magnetic pulse coder is not set, but Cs contouring control command is entered. In this case, motor is not excited.	Check parameter setting for high-resolution magnetic pulse coder.
Er-04	Although parameter setting for using position coder was not performed, commands for servo mode and synchronous control are input. In this case, the motor will not be excited.	Confirm the parameter setting of the position coder.
Er-05	Although option parameter for orientation is not set, the orientation command (ORCM) is input.	Confirm the parameter setting of orientation.
Er-06	Although option parameter for output switchover is not set, LOW winding is selected.	Confirm the parameter setting for output switching and gravity line status signal.
Er-07	Although Cs contouring control command was entered, SFR/SRV is not entered.	Confirm the sequence.
Er-08	Although servo mode control command was input, SFR/SRV is not input.	Confirm the sequence.
Er-09	Although synchronous control command was input, SFR/SRV is not input.	Confirm the sequence.
Er-10	Cs control command was entered, but another mode (servo mode, synchronous control, orientation) is specified.	Never set another mode when Cs contouring control command is being processed. Before changing to another mode, clear Cs contouring control command.
Er-11	Servo mode command was entered, but another mode (Cs contouring control, synchronous control, orientation) is specified.	Do not command other modes during servo mode command. When moving to other modes, perform after releasing the servo mode command.

Display	Contents	Countermeasure
Er-12	Synchronous control command was entered, but another mode (Cs contouring control, servo mode, orientation) is specified.	Do not command other modes during synchronous control command. When moving to other modes, perform after releasing the synchronous control command.
Er-13	Orientation command was entered, but another mode (Cs contouring control, servo mode, synchronous control) is specified.	Do not command other modes during orientation command. When moving to other modes, perform after releasing the orientation command.
Er-14	SFR/SRV are simultaneously commanded.	Command one or the other.
Er-15	Cs contouring control command is entered when differential speed control function is enabled by parameter setting (No. 6500#5 = 1).	Check parameter setting and control input signal.
Er-16	Differential mode command (DEFMDA) is entered when differential speed function is disabled by parameter setting (No. 6500#5 = 0).	Check parameter setting and control input signal.
Er-17	Parameter setting (No. 6511#0,1,2) for speed detector is incorrect. (Specified speed detector is not present.)	Check parameter setting.
Er-18	Spindle orientation command of position coder type is entered when use of position coder signal is disabled by parameter setting (No. 6501#2 = 0).	Check parameter setting and control input signal.

Control input signal PMC → CNC

Series 0 : G229
Series 15 : G227
Series 16 : G070

MRDYA	ORCMA	SFRA	SRVA				

MRDYA 0: Electromagnetic contactor OFF
1: Electromagnetic contactor ON

ORCMA 0: –
1: Performs spindle orientation control.

SFRA : Forward rotation command

SRVA : Reverse rotation command

RCH	RSL					*ESP	

*ESP	0	:	Emergency stop	
	1	:	Normal operation	
RSL	0	:	Output switching request signal	High-speed output characteristics
	1	:	Output switching request signal	Low-speed output characteristics
RCH	0	:	Power line status confirm signal	High-speed output characteristics
	1	:	Power line status confirm signal	Low-speed output characteristics

Series 0 : G230
Series 15 : G226
Series 16 : G071

RCHA	RSLA					*ESPA	

*ESPA 0: Emergency stop
1: Normal operation

RSLA Output switching request signal
0: High-speed output characteristics
1: Low-speed output characteristics

RCHA Power line status confirm signal
0: High-speed output characteristics
1: Low-speed output characteristics

* Connection signal of ESP	ESP 1, 2 of spindle control printed board	Connection open: Emergency stop Connection close: Normal operation

Control input signal of Cs contouring control, servo mode PMC → CNC

Series 0 : G123

CON (M system)						COFF (T system)

CON 0: Spindle rotation control mode (turning mode)
1: Spindle contour control mode (contouring mode)

COFF 0: Spindle contour control mode (contouring mode)
1: Spindle rotation control mode (turning mode)

Series 15 : G067 1st axis
G071 2nd axis
G075 3rd axis
G079 4th axis
G083 5th axis
G087 6th axis

SCNTRj							

SCNTRj 0: Spindle rotation control mode (turning mode)
1: Spindle contour control mode (contouring mode)

Series 16 : G027

CON							

CON 0: Spindle rotation control mode (turning mode)
1: Spindle contouring control mode (contouring mode)

Control input signal of synchronous control PMC → CNC

Series 0 : G146
Series 16 : G038

				SPPHS			

SPPHS 0: Releases synchronous control mode.
1: Enters synchronous control mode.

Related spindle parameters

Power Mate : 3001
Series 0 : 6501
Series 15 : 3001
Series 16 : 4001

	CAXIS2	CAXIS1			POSC2		MRDY1

MRDY1 0: Does not use MRDYA signal.
(Normally MRDYA = 1)
1: Uses MRDYA signal.

POSC2 0: Does not use position coder signal.
1: Uses position coder signal.

CAXIS1 0: Does not use high-resolution magnetic pulse coder.
1: Uses high-resolution magnetic pulse coder.

CAXIS2 Uses position detection signal for high-resolution magnetic pulse coder as speed detection signal also
0: Does not use. (When spindle and spindle motor are different)
1: Uses. (When built-in motor)

Power Mate : 3011
Series 0 : 6511
Series 15 : 3011
Series 16 : 4011

					VDT3	VDT2	VDT1

VDT3	VDT2	VDT1	Setting of speed detector
0	0	0	64 p/rev
0	0	1	128 p/rev
0	1	0	256 p/rev
0	1	1	512 p/rev

Power Mate : 3015
Series 0 : 6515
Series 15 : 3015
Series 16 : 4015

					SPDSW		ORIENT

ORIENT 0: Without spindle orientation function
1: With spindle orientation function

SPDSW 0: Without output switching function
1: With output switching function

4. INSTALLATION

4.1 Installation Procedure

Observe the checking procedure shown in Table 4.1 at the installation.

Table 4.1 Installation procedures

Item	Description	Remarks
1	Check if specifications of motor, servo unit, options, etc. are correct.	Check if motor corresponds to units, PCB, and ROM correctly according to Tables 1.2(a) and (b).
2	Check appearance for damage	Check resistors, and parts on the PCB.
3	Check the voltage, voltage fluctuation, power capacity (kVA) and frequency of the working AC power supply.	See Tables 4.2.1(a) and (b).
4	Connect the ground wire, power cable and drive power cable.	Refer to sections 4.2, 4.3, 4.4 and Appendix 1.
5	Check setting and adjustment results.	Refer to section 5.1.
6	Turn on AC power supply, and make sure that green lamp PIL lights on-CB.	Refer to Appendix 6.
7	Give rotation command to check the normal rotation and reverse rotation movement.	
8	Check the operation over the entire speed range.	

4.2 Power Connection

4.2.1 Power voltage and capacity check

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

Table 4.2.1 (a) Action for AC Power Supply Voltage

AC power supply voltage	Nominal voltage	Remedy
170 V ~ 220 V	200 V	For models 30S and 40S, set toggle switch "SW" to 200 V. For models 1S to 26S, no particular action is required.
210 V ~ 253 V	230 V	For models 30S and 40S, set toggle switch "SW" to 230 V. For models 1S to 26S, no particular action is required.
254 V or higher	380 V to 550 V	Decrease input voltage to 200 V by using insulating transformer.

The input power specification of the AC spindle servo unit is as specified in Table 4.2.1 (b). Use a power source having the power capacity with sufficient allowance for voltage drop with the maximum load.

Table 4.2.1 (b) Input Power Specification of AC Spindle Servo Unit

<table>
<tr><td colspan="2">Nominal rated voltage</td><td colspan="5">200/220/230 VAC,
3 phases</td></tr>
<tr><td colspan="2">Allowable voltage fluctuation</td><td colspan="5">−15 % to +10 %</td></tr>
<tr><td colspan="2">Frequency</td><td colspan="5">50 Hz/60Hz ±1 Hz(Note 1)</td></tr>
<tr><td rowspan="6">Power capacity</td><td>Model</td><td colspan="2">1S</td><td colspan="2">2S</td><td>3S</td></tr>
<tr><td>Capacity with 30 minute rating (kVA)</td><td colspan="2">4</td><td colspan="2">7</td><td>9</td></tr>
<tr><td rowspan="4"></td><td>6S
Small 6S</td><td>8S</td><td>12S</td><td>15S
Small 15S</td><td>18S</td></tr>
<tr><td>12</td><td>17</td><td>22</td><td>26</td><td>32</td></tr>
<tr><td>22S</td><td>26S</td><td>30S</td><td>40S</td><td></td></tr>
<tr><td>37</td><td>44</td><td>54</td><td>63</td><td></td></tr>
</table>

Note 1) For model 40S, 50 Hz/60 Hz switching is required; this switching is not required for other models.

4.2.2 Protective ground connection

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

4.2.3 Power connection

Connect the power cable after protective ground connection.

A specific power phase rotation is not required for the AC spindle servo unit.The cooling fan motor employs three-phase power.

4.3 AC Spindle Motor Connection

Connect the AC spindle motor according to the connection diagram in Appendix 1.

If the drive power cable connection sequence is in error, vibration occurs, the motor does not rotate, or alarm (AL-02) occurs to stop the motor.

Always connect protective earth "G".

4.4 Signal Cable Connection

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

5. SETTING AND ADJUSTING

5.1 Unit and PCB Setting

For the parts locations on the units and PCBs, see the parts layout drawings in Appendixes 5 and 6. Before turning on power, be sure to confirm the settings below.

Table 5.1(a) Confirmation Before Power-On

No.	Confirmation item	Remarks
1	Setting of toggle switch (SW) for voltage switching (models 30S and 40S)	See Section 4.2.
2	Jumper setting	See Tables 5.1(b) and (c)

Table 5.1(b) Jumper Locations for Models 6S to 22S (PCB: A20B-1003-0550)

Jumper	Description	Location	Factory setting
S1	Increases +5 V power supply voltage by 10%.	B (+10%)	Not set
	Decreases +5 V power supply voltage by 10%.	A (−10%)	
S2	Contains filter circuit in dynamometer analog voltage output.	A	A
	Contains no filter circuit in dynamometer analog voltage output.	B	
S3	Contains filter circuit in speedometer analog voltage output.	A	A
	Contains no filter circuit in speedometer analog voltage output.	B	

Table 5.1(c) Jumper Locations for Models 1S to 40S

Jumper	Description	Location	Factory setting
S1	Serial transfer setting	(Note 1)	A
S2	Contains filter circuit in speedometer analog voltage output.	A	A
	Contains no filter circuit in speedometer analog voltage output.	B	
S3	Contains filter circuit in dynamometer analog voltage output.	A	A
	Contains no filter circuit in dynamometer analog voltage output.	B	
S4 (Note 3)	Increases +5 V power supply voltage by 10%.	B (+10%)	Not set
	Decreases +5 V power supply voltage by 10%.	A (−10%)	
S5 (Note 3)	Supplies no power to drive magnetic contactor in spindle amplifier.	A	A (Note 2)
	Supplies power to drive magnetic contactor in spindle amplifier.	B	

Note 1) For a system with two serial interface spindle amplifiers connected to one optical fiber cable, set jumper S1 for the first amplifier to B. Set the other jumper to A.
Note 2) Be sure to set the jumper to A.
Note 3) Models 30S and 40S do not have S4 and S5.

5.2 Automatic Setting Method for Spindle Parameters

This following describes the method to automatically set the spindle parameters.

[Automatic setting method]

1) Set the data shown below for the NC bit parameter to perform the automatic setting of spindle parameters.

NC	Parameter address	Data
Power Mate	3019#7	1
Series 0	6519#7	1
Series 15	5607#0	0
Series 16	4019#7	1

2) Set the parameter model codes for the motor to be automatically set.
   Regarding the model codes, refer to the table of parameters for each model in Appendix 8.
   Parameter address

NC	Parameter address
Power Mate	3133
Series 0	6633
Series 15	3133
Series 16	4133

3) Turn the NC electric power OFF once. If the electric power is turned on again, the model parameters determined by the codes will automatically be set.

5.3 Spindle Parameter Setting Confirmation Matters

After automatically setting the spindle parameters, confirm the parameter setting as shown below before operating the motor.

[Confirmation items]

(1) Setting of whether to use a high-resolution magnetic pulse coder.

NC	Parameter address
Power Mate	3001#5
Series 0	6501#5
Series 15	3001#5
Series 16	4001#5

(2) Setting of whether to use a high-resolution magnetic pulse coder also with the speedometer.

NC	Parameter address
Power Mate	3001#6
Series 0	6501#6
Series 15	3001#6
Series 16	4001#6

(3) Set the motor speed detector pulses.

NC	Parameter address
Power Mate	3001#0, 1, 2
Series 0	6511#0, 1, 2
Series 15	3011#0, 1, 2
Series 16	4011#0, 1, 2

Note) The speed detector of the spindle motor for Cs contouring control is normally set to 128 p/rev.

(4) Signal setting of the position coder contained in the high-resolution magnetic pulse coder

NC	Parameter address
Power Mate	3003#6, 7
Series 0	6503#6, 7
Series 15	3003#6, 7
Series 16	4003#6, 7

(5) The above are the main points. However as regards the bit parameters, the operation should be started after checking all of them.

5.4 Number of Content of Parameters

(1) Parameter numbers in the following descriptions are used for Series 0. If you are using other than a Series 0 CNC, refer to the parameter numbers which correspond to the Series 0 parameter numbers.

(2) The following model name abbreviations are used for parameter numbers:
PM : Power Mate
0C : Series 0
15 : Series 15
16 : Series 16

(3) Numbers shown below the parameter numbers are used for second spindles.

(1) Spindle parameters (common to all models)

Parameter No.

PM	0C	15	16	#7	#6	#5	#4	#3	#2	#1	#0
3000	6500	3000	4000	DEFRTO	DEFDRT	DEFMOD	RETSV	RETRN	POSC1	ROTA2	ROTA1
	6640	3140									
Standard setting :				0	0	0	0	0	0	0	0

ROTA1 : Indicates the relationship between the rotation directions of spindle and spindle motor.
- 0: Rotates the spindle and spindle motor in the same direction.
- 1: Rotates the spindle and spindle motor in the reverse direction.

Method of judging spindle and rotation direction
Judge the spindle rotation direction in the same state as that when the motor rotation direction was judged from the motor shaft direction.
For example, when the spindle and motor are connected by a belt, the setting becomes "same rotation direction".

ROTA2 : Indicates the spindle direction by the move command (+). (Only effective in Cs contouring control) The power mate does not have this function.
- 0: Rotates the spindle in CCW (counter clockwise) direction.
- 1: Rotates the spindle in CW (clockwise) direction.

POSC1 : Indicates the mounting direction of position coder.
- 0: Rotates the spindle and position coder in the same direction.
- 1: Rotates the spindle and position coder in the reverse direction.

Judge by rotation direction when position coder rotation direction is viewed from position coder shaft.

RETRN : Indicates the reference point return direction in Cs contouring control.
The power mate does not have this function.
- 0: Returns the spindle from the CCW direction to the reference point (counter clockwise direction).
- 1: Returns the spindle from the CW direction to the reference point (clockwise direction).

RETSV : Indicates reference point return direction (rigid tap/Cs axis control etc.) when in servo mode.
- 0: Spindle reference point returns CCW (counter clockwise)
- 1: Spindle reference point returns CW (clockwise)

DEFMOD : Differential mode function presence (9A11, 9A21, and 9A50)
- 0: Differential mode function absent
- 1: Differential mode function present

DEFDRT : Differential direction setting (9A11, 9A21, and 9A50)
- 0: Same as feedback signal
- 1: Opposite to feedback signal

DEFRTO : Indicates the number of position coder pulses of the other spindle in differential mode (9A11.G, 9A21.E, and 9A50.F)

0: 1024 p/rev × 4 (4096 p/rev)

1: 512 p/rev × 4 (2048 p/rev)

Parameter No.

PM	0C	15	16
3001	6501	3001	4001
	6641	3141	

DATA

	#7	#6	#5	#4	#3	#2	#1	#0
	CAXIS3	CAXIS2	CAXIS1		MGSEN	POSC2	MRDY2	MRDY1
Standard setting :	0	0	0	0	0	0	0	1

MRDY1 : Determines whether the MRDYA signal (machine ready signal) is used or not.

0: Not used. (The MRDYA signal should be always set to 1.)

1: Used.

MRDY2 : Cuts off power by the MRDYA signal (machine ready signal).
Set MRDY1 (6501#0) = 1 when using this function.

0: Turns off the MCC (magnetic contactor) when the MRDYA signal is set to 0.

1: Turns off the excitation only when the MRDYA signal is set to 0.

POSC2 : Determines whether the POSITION CODER signal is used or not.

0: Not used.

1: Used.

Set this bit to "1" when using the following functions: servo mode (rigid tap/Cs axis control etc.), spindle synchronization control and POSITION CODER spindle orientation. Beware that if this bit is set to "Use = 1" with no POSITION CODER signal input, then the POSITION CODER disconnection alarm (AL-27) will ring.

MGSEN : Indicates the mounting direction of magnetic sensor.

0: Rotates the motor and magnetic sensor in the same direction.

1: Rotates the motor and magnetic sensor in the reverse direction.

CAXIS1 : Determines whether the high-resolution magnetic pulse coder (set in the spindle) is used or not.
The Power Mate does not have this function.

0: Not used.

1: Used.

Set for 1 if Cs contouring control function is used.

CAXIS2 : Also used in speed detection of the high-resolution magnetic pulse coder position detection signal.The Power Mate does not have this function.

0: Not used. (when spindle and spindle motor are separated)

1: Used. (in case of built-in spindle motor)

CAXIS3 : Indicates the mounting direction of the high-resolution magnetic pulse coder.
The Power Mate does not have this function.

0: Rotates the spindle and position detection in the same direction.

1: Rotates the spindle and position detection in the reverse direction.

Parameter No.

PM	0C	15	16	DATA							
3002	6502 6642	3002 3142	4002	PCEN	SYCDRT	SVMDRT	CSDRCT		CSDET3	CSDET2	CSDET1
				#7	#6	#5	#4	#3	#2	#1	#0
Standard setting :				0	0	0	0	0	0	0	0

CSDET3-1 Cs contouring control detector (resolution) setting. The Power Mate does not have this function.

#2#1#0 (To be set to 0 usually)

0 0 0 : 360000p/rev.
0 0 1 : 180000p/rev.
0 1 0 : 120000p/rev.
0 1 1 : 90000p/rev.
1 0 0 : 60000p/rev.
1 0 1 : 40000p/rev.
1 1 0 : 20000p/rev.
1 1 1 : 10000p/rev.

CSDRCT : Setting of the rotation direction signal (SFR/SRV) function when Cs contouring control is used. The Power Mate does not have this function.

0: Rotation direction function enabled

When bit 1 of parameter No. 6500 is 0

With a + move command, the spindle rotates counterclockwise when SFR = 1, and the spindle rotates clockwise when SRV = 1.

When bit 1 of parameter No. 6500 is 1

With a + move command, the spindle rotates clockwise when SFR = 1, and the spindle rotates counterclockwise when SRV = 1.

1: Rotation direction function disabled

The rotation direction function of the SFR/SRV signal is disabled. Only the function for enabling spindle motor magnetization is available.

When bit 1 of parameter No. 6500 is 0

With a + move command, the spindle rotates counterclockwise when SFR = 1 or SRV = 1.

When bit 1 of parameter No. 6500 is 1

With a + move command, the spindle rotates clockwise when SFR = 1 or SRV = 1.

SVMDRT : Setting of the rotation direction signal (SFR/SRV) function in servo mode (rigid tapping/Cs axis control)

0: Rotation direction function enabled

With a + move command, the spindle rotates counterclockwise when SFR = 1, and the spindle rotates clockwise when SRV = 1.

1 : Rotation direction function disabled
The rotation direction function of the SFR/SRV signal is disabled. Only the function for enabling spindle motor magnetization is available.
With a + move command, the spindle rotates counterclockwise when SFR = 1 or SRV = 1.

SYCDRT: Setting of the rotation direction signal (SFR/SRV) function when spindle synchronization control is used

0: Rotation direction function enabled
With a + spindle synchronization speed command, the spindle rotates counterclockwise when SFR = 1, and the spindle rotates clockwise when SRV = 1.

1: Rotation direction function disabled
The rotation direction function of the SFR/SRV signal is disabled. Only the function for enabling spindle motor magnetization is available.
With a + spindle synchronization speed command, the spindle rotates counterclockwise when SFR = 1 or SRV = 1.

PCEN: Setting of the function of enabling CMR for a move command in servo mode (9A50.I)

0: Disables CMR.
1: Enables CMR.

$$CMR = \frac{4096}{\text{Number of pulses based on Cs detector resolution (according to bits 0, 1, and 2 of parameter No. 6502)}}$$

Parameter No.

PM 0C 15 16
3003 6503 3003 4003
6643 3143

DATA

	#7	#6	#5	#4	#3	#2	#1	#0
	PCPL2	PCPL1		PCTYPE	DIRCT2	DIRCT1	PCCNCT	PCMGSL
Standard setting :	0	0	0	0	0	0	0	0

PCMGSL : Selection of position coder method/magnetic sensor method spindle orientation
This function requires the spindle orientation function, (a CNC software option).
In addition, setting parameter ORIENT (No. 6515#0) to "1" is required.
0: Position coder method spindle orientation function
1: Magnetic sensor method spindle orientation function

PCCNCT: Setting for use of signal conversion circuit of unit mounting type (9A21, 9A50)
0: In cases other than below
1: When the signal conversion circuit of unit mounting type is used

DIRCT1-DIRCT2 : Setting of rotation direction at spindle orientation

DIRCT2	DIRCT1	Rotation direction at spindle orientation
0	0	By rotation direction immediately before
0	1	By rotation direction immediately before
1	0	CCW (counterclockwise) direction looking from shaft of motor
1	1	CW (clockwise) direction looking from shaft of motor

PCTYPE : Sets the type of position coder (number of pulses per revolution).

0: 1024p/rev

1: 512p/rev

Set this bit to "0" when using an equivalent POSITION CODER signal built into the high-resolution magnetic pulse coder.

PCPL1-PCPL2 : Setting of number of pulses of the equivalent POSITION CODER signal built into the high resolution magnetic pulse coder.

PCPL2	PCPL1	Position coder equivalent signal pulse number	Outer diameter of detector
0	0	1024p/rev	65ϕ
0	1	2048p/rev	130ϕ
1	0	3072p/rev	195ϕ
1	1	1536p/rev	97.5ϕ

Parameter No.

PM	0C	15	16
3006	6506 6646	3006 3146	4006

DATA

	#7	#6	#5	#4	#3	#2	#1	#0
	BLTRGD	PRMCHK	ALGOVR	DECPHS	SYCREF	SPDUNT	GRUNIT	
Standard setting :	0	0	0	0	0	0	0	0

GRUNIT : Gear ratio setting resolution setting

0: 1/100 units (Under normal circumstances, set to "0".)

1: 1/1000 units

This parameter is used for gear ratio data setting to select whether to set the number of motor revolutions for 1 revolution of the spindle as a multiple of 100 (normal) or as a multiple of 1,000.

When the gear ratio is a fraction at 1/100, there may be a constant synchronization error indicated in spindle synchronization control.

In this sort of situation, using setting units of 1/1000 makes the synchronization error appear much smaller.

These parameters change the following parameter settings.

Parameter No.						Description
Power Mate	Series 0		Series 15		Series 16	
	No.1	No.2	No.1	No.2		
3056	6556	6696	3056	3196	4056	Gear ratio (HIGH)
3057	6557	6697	3057	3197	4057	Gear ratio (MEDIUM HIGH)
3058	6558	6698	3058	3198	4058	Gear ratio (MEDIUM LOW)
3059	6559	6699	3059	3199	4059	Gear ratio (LOW)

SPDUNT : Setting per 10rpm (9A11.C, 9A21.A, 9A50.A)

0: 1 rpm setting ("0" is usually chosen)

1: 10 rpm setting

Choose "1" for motors with a maximum rpm of more than 32767.

These parameters change the following parameter settings.

Parameter No.						Description	Parameter setting unit	
Power Mate	Series 0		Series 15		Series 16		1rpm	10rpm
	No.1	No.2	No.1	No.2				
3020	6520	6660	3020	3160	4020	Maximum speed	1rpm	10rpm
3021	6521	6661	3021	3161	4021	Maximum speed in Cs contouring control (MXSPDC)	1rpm	10rpm
3030	6530	6670	3030	3170	4030	Soft start/stop setting time	1rpm/sec	10rpm/sec
3032	6532	6672	3032	3172	4032	Acceleration/deceleration time constant at spindle synchronization control	1rpm/sec	10rpm/sec
3033	6533	6673	3033	3173	4033	Spindle synchronization rotation speed arrival level	1rpm	10rpm
3074	6574	6714	3074	3214	4074	Origin return speed when Cs contouring or servo mode		
3098	6598	6738	3098	3238	4098	Maximum speed for 1 revolution signal detection	1rpm	10rpm
3100	6600	6740	3100	3240	4100	Base speed of motor output specifications	1rpm	10rpm
3102	6602	6742	3102	3242	4102	Base speed	1rpm	10rpm
3103	6603	6743	3103	3243	4103	Magnetic flux down start speed	1rpm	10rpm
3108	6608	6748	3108	3248	4108	Current loop integral gain zero point	1rpm	10rpm
3126	6626	6766	3126	3266	4126	Velocity command on automatic operation	1rpm	10rpm
3128	6628	6768	3128	3268	4128	Maximum output limit zero point	1rpm	10rpm
Low speed characteristic parameters for speed range switching control (when speed range switching function exists)								
3138	6902	6942	3282	3502	4138	Base speed of motor output specifications	1rpm	10rpm
3140	6904	6944	3284	3504	4140	Base speed	1rpm	10rpm
3141	6905	6945	3285	3505	4141	Magnetic flux down start speed	1rpm	10rpm
3144	6908	6948	3288	3508	4144	Current loop integral gain zero point	1rpm	10rpm
3158	6922	6962	3302	3522	4158	Maximum output limit zero point	1rpm	10rpm
3160	6924	6964	3304	3524	4160	Speed detection level hysteresis	1rpm	10rpm

SYCREF : Setting for function performing automatic detection of the 1 revolution signal in spindle synchronization control (9A10.E, 9A20.B)

0: Automatic detection of the 1 revolution signal carried out

1: Automatic detection of the 1 revolution signal not carried out. (When spindle phase synchronization is not carried out)

DECPHS : Setting for method of electromotive phase compensation when decelerating (9A10.G, 9A11.A, 9A20.D, 9A21.A, 9A50)

This is determined depending on the motor model.

ALGOVR: Setting of a spindle analog override range (9A50)

0: 0% to 100%

1: 0% to 120%

PRMCHK: Setting for checking the internal parameter of the serial spindle (9A10.K, 9A11.B, 9A20.E, 9A21.A, 9A50.A)

0: Checks data itself transferred from the CNC

1: Checks the internal data being currently used

BLTRGD: Setting for rigid tapping using the sensor contained in the motor (9A10.K, 9A11.B, 9A20.E, 9A21.A, 9A50.A)

0: In cases other than below

1: When rigid tapping is performed using the sensor contained in the motor

Parameter No.

PM 0C 15 16
3007 6507 3007 4007
6647 3147

DATA

#7	#6	#5	#4	#3	#2	#1	#0
PHAICL	PCALCH	PCLS					
0	0	0	0	0	0	0	0

Standard setting : 0 0 0 0 0 0 0 0

PCLS : Determines high-resolution magnetic pulse coder and position coder signal disconnection detection.

0: Performs disconnection detection.

1: Does not perform disconnection detection.

AL-26 (High-resolution magnetic pulse coder speed detecting signal disconnection),
AL-27 (Position coder signal disconnection) and
AL-28 (High-resolution magnetic pulse coder speed detecting signal disconnection) are checked.

Normally set to "0".

Set it to "1" temporarily when adjustment is difficult when adjusting location and speed feedback signal waves and the disconnection alarm occurs. After adjustment reset it to "0".

PCALCH: Enables or disables detection of the alarms (AL-41, 42, 47) related to the position coder signal (9A11.C, 9A21.A, 9A50.A).

0: Detects the alarms related to the position coder signal.

1: Does not detect the alarms related to the position coder signal. When the spindle is not connected with the position coder on a one-for-one basis, set this parameter to 1 to avoid erroneous detections.

PHAICL: Setting of a motor voltage pattern when no loads are imposed (9A10.J, 9A11.C, 9A20.D, 9A21.A, 9A50.A)

Usually, set this parameter to 0. This parameter may be useful when the motor slightly vibrates in high-speed, steady rotation with no loads. However, check for speed variation, which tends to occur more frequently in constant surface speed control.

PM 0C 15 16
3009 6509 3009 4009
6649 3149

#7	#6	#5	#4	#3	#2	#1	#0
							VLPGAN
0	0	0	0	0	0	0	0

Standard setting : 0 0 0 0 0 0 0 0

VLPGAN: Setting unit of speed control loop gain (9A11.D, 9A21.A, 9A50.A)
0: To be set usually
1: Multiplies the normal setting by 1/16.

Parameter No.

PM	0C	15	16	#7	#6	#5	#4	#3	#2	#1	#0
3010	6510	3010	4010								MCCDLY
6650	3150										
Standard setting :				0	0	0	0	0	0	0	0

MCCDLY : Setting for the delay timer when the internal electromagnetic contactor goes on.
0: 2 seconds (unit models 1S to 12S) or 5 seconds (small 15S, 15S to 26S, small 30S)
1: 0 seconds (unit models 30S,40S)

PM	0C	15	16	#7	#6	#5	#4	#3	#2	#1	#0
3011	6511	3011	4011	POLE2	RGI2	ADJG	MXPW	POLE1	VDT3	VDT2	VDT1
6651	3151										
Standard setting :				X	X	X	X	X	X	X	X

X : Depends on the motor model.

VDT1-VDT3 : Setting of speed detector

VDT3	VDT2	VDT1	Setting of speed detector
0	0	0	64p/rev
0	0	1	128p/rev
0	1	0	256p/rev
0	1	1	512p/rev
1	0	0	192p/rev
1	0	1	384p/rev

POLE2, POLE1 No. of motor poles

POLE2	POLE1	No. of motor poles
0	0	2 poles
0	1	4 poles
1	X	8 poles

PWMX : Settings of maximum output when accelerating and decelerating
Depends on the motor model

ADJG : Settings of acceleration and deceleration judging conditions on maximum output when accelerating and decelerating
Depends on the motor model

RGI2 : Settings for secondary electrical current coefficients on rigid tap
Depends on the motor model

Parameter No.

PM 0C 15 16 3012 6512 3012 4012 6652 3152	DATA							
				CLMT2	CLMT1	PWM3	PWM2	PWM1
	#7	#6	#5	#4	#3	#2	#1	#0
Standard setting :	0	0	0	0	0	X	X	X

X : Depends on the motor model.

PWM3-PWM1 : Setting of PWM carrier frequency
Normally set to "000".

CLMT2-CLMT1 : Current limit clock setting
In normal circumstances, set to "00".

PM 0C 15 16 3013 6513 3013 4013 6653 3153	PWM3K	DTCLK	DS4	DS3	DS2	DS1	ESED	ESEC
	#7	#6	#5	#4	#3	#2	#1	#0
Standard setting :	0	0	X	X	X	X	1	0

X : Depends on the servo unit model.

ESEC : Setting of detection edge of POSITION CODER one rotation signal
0 : CCW = Rising edge CW = Falling edge (Normally set to "0")
1: CCW, CW = Rising edge

ESED : Setting of detection edge of one rotation signal of position detection signal in Cs contouring control
0 : CCW = Rising edge CW = Falling edge
1: CCW, CW = Rising edge (Normally set to "1")

DS4-DS1 : Set the current dead band data.
0110 Unit for 1S to 12S, small 15S
1001 Unit for 15S to 26S, small 30S
1111 Unit for 30S,40S

DTCLK : Current dead band clock setting
Determined depending on the motor model.
Normally, set to "0".

PWM3K : Setting PWM carrier frequency in low speed characteristic area of speed range switching control
Determined depending on the motor model.
Normally, set to "0".

Parameter No.

PM	0C	15	16		#7	#6	#5	#4	#3	#2	#1	#0
3014	6514	3014	4014	DATA					CHGSLT	AXSLCT	AXSUB	AXISSL
6654	3154											
Standard setting :					0	0	0	0	0	0	0	0

AXISSL : Spindle switching function presence (9A11, 9A21, 9A50)
- 0: Spindle switching function absent
- 1: Spindle switching function present

AXSUB : Presence of spindle switching function when SUB spindle is rotating (9A11, 9A21, 9A50)
- 0: No spindle switching function when SUB spindle is rotating
- 1: Spindle switching function available when SUB spindle is rotating

AXSLCT: Specifies whether to check the contacts of the main magnetic contactor and sub-magnetic contactor for spindle switching (9A11.H, 9A21.F, 9A50.H)
- 0: Makes a check by using the power line status check signal (MCFN).
- 1: Checks the contacts of the main magnetic contactor and sub-magnetic contactor.

CHGSLT: Specifies whether to check the contacts of the high and low magnetic contractors for output switching (9A11.H, 9A21.F, 9A50.H)
- 0: Makes a check by using the power line status check signal (RCH).
- 1: Checks the contacts of the high and low magnetic contactors.

PM	0C	15	16	#7	#6	#5	#4	#3	#2	#1	#0
3015	6515	3015	4015						SPDSW		ORIENT
6655	3155										
Standard setting :				0	0	0	0	0	0	0	0

ORIENT : Presence of spindle orientation function (CNC software option)
- 0: Without spindle orientation function
- 1: With spindle orientation function

SPDSW : Presence of speed range switching function (CNC software option)
- 0: Without speed range switching function
- 1: With speed range switching function

PM	0C	15	16	#7	#6	#5	#4	#3	#2	#1	#0
3016	6516	3016	4016	RFCHK3	RFCHK2	RFCHK1	CMTVL	FFSMTH			
6656	3156										
Standard setting :				0	0	0	0	0	0	0	0

FFSMTH : Presence of smoothing function on feedforward control
- 0: Without smoothing function
- 1: With smoothing function

  Sets the presence of smoothing function on feedforward control of servo mode (rigid tap, Cs axis control etc.) and Cs contouring control.

CMTVL : Control properties settings in Cs contouring control
The power mate does not have this function.
Set "0" as normal, and check that the motor voltage in Cs contouring control (NO.6586) is "100".
When NO. 6586 is set to less than 100, set this bit to "1".

RFCHK1 : Presence of 1 rotation signal error detection function in Cs contouring control (AL-39).
The Power Mate does not have this function.
0: 1 rotation signal error detection (AL-39) function not present
1: 1 rotation signal error detection (AL-39) function present

RFCHK2 : Presence of 1 rotation signal error detection function for position coder signal (AL-41)
0: 1 rotation signal error detection (AL-41) function not present
1: 1 rotation signal error detection (AL-41) function present

RFCHK3 : Presence of function for redetecting the 1 rotation signal for the position coder signal each time spindle orientation/spindle synchronization control/rigid tap zero return mode is entered.
0 : The 1 rotation signal is not detected each time the operating mode changes.
Once the 1 rotation signal has been detected, it is not detected again until the power goes off.
1: The 1 rotation signal is detected each time the operating mode changes.

Parameter No.

PM	0C	15	16
3017	6517	3017	4017
	6657	3157	

DATA

	#7	#6	#5	#4	#3	#2	#1	#0
						RFCHK4		
Standard setting :	0	0	0	0	0	0	0	0

RFCHK4: Specifies whether to use the position coder 1- rotation signal detection function in normal rotation (9A11.G, 9A21.E, 9A50.F).
0: Does not detect the 1-rotation signal in normal rotation.
1: Detects the 1-rotation signal in normal rotation.

Parameter No.

PM	0C	15	16	DATA							
3019	6519 6659	3019 3159	4019	PRLOAD			SDTCHG	VDCCAL	SSTTRQ		DTTMCS
				#7	#6	#5	#4	#3	#2	#1	#0
Standard setting :				0	0	0	0	0	0	0	0

PRLOAD : Parameter automatic setting function (Power Mate, Series 0-C, Series 16)

0: Parameter automatic setting is not executed.

1: Parameter automatic setting is executed.

Set the bit to "1" and the motor model code to NO. 6633. Then, when the CNC power source is turned ON, PRLOAD automatically sets the serial spindle parameters between NO. 6500 and 6635, and between NO. 6900 and 6939 which correspond to the model codes.

When the automatic settings are complete, the bit is automatically set to "0".

(Note) In Series 15, this function is located in a different area (NO. 5607#0). Be aware that the data meanings become opposite.

The model code is set for NO. 3133.

0: Parameter automatic setting is executed.

1: Parameter automatic setting is not executed.

DTTMCS: Specifies whether to apply dead zone compensation in Cs contouring control (9A11.B, 9A21.A, 9A50.A)

0: Does not apply dead zone compensation.

1: Applies dead zone compensation.

SSTTRQ: Specifies whether to use torque clamping at speed of 0 (9A11.F, 9A21.D, 9A50.E).

0: Uses clamping.

1: Does not use clamping.

VDCCAL: Setting of a DC link voltage calculation method (9A50.F)

0: Performs processing, regarding the DC link voltage as constant.

1: Uses data that matches voltage levels.

Set this parameter according to the current state in power supply regeneration (in deceleration). Usually, set this parameter to 0.

SDTCHG: Specifies whether to switch from the high-speed to low-speed range in output switching at the speed detection level (SDT = 1) or lower (9A11.H, 9A21.F, 9A50.H)

0: Switches from the high-speed to low-speed range regardless of the speed detection signal.

1: Switches from the high-speed to low-speed range at the speed detection level (SDTA = 1) or lower.

PM	0C	15	16	
3020	6520 6660	3020 3160	4020	Maximum speed

Data unit : 1 rpm

(when parameter SPDUNT (No. 6506#2) = 1, 10 rpm)

Data range : 0 to 32767

Standard setting : Depends on a motor model.
This data is used to set the maximum speed of AC spindle motor.

Parameter No.

PM	0C	15	16	DATA
3021	6521 6661	3021 3161	4021	Maximum speed in Cs contouring control

Data unit : 1 rpm
(when parameter SPDUNT (No. 6506#2) = 1, 10 rpm)
Data range : 0 to 250
Standard setting : 100
Set maximum spindle speed in Cs contouring control.

PM	0C	15	16	
3022	6522 6662	3022 3162	4022	Speed arrival level

Data unit : 0.1%
Data range : 0 to 1000 (0 to 100%)
Standard setting : 150 (15%)
This data is used to set the detecting range of speed arrival signal (SARA).
When the motor speed reaches the range within ±(setting data/10)% of commanded speed, the bit of speed arrival signal (SARA) is set to "1".

PM	0C	15	16	
3023	6523 6663	3023 3163	4023	Speed detecting level

Data unit : 0.1%
Data range : 0 to 1000 (0 to 100%)
Standard setting : 30 (3%)
This data is used to set the detecting range of speed detecting signal
(SDTA).
When the motor speed reaches (setting data/10) % or less of maximum speed, the bit of speed arrival signal (SDTA) is set to "1".

PM	0C	15	16	
3024	6524 6664	3024 3164	4024	Speed zero detecting level

Data unit : 0.01%
Data range : 0 to 10000 (0 to 100%)
Standard setting : 75 (0.75%)
This data is used to set the detecting range of speed zero signal (SSTA).
When the motor speed reaches (setting data/100)% or less of maximum speed, the bit of speed zero signal (SSTA) is set to "1".

PM	0C	15	16	
3025	6525 6665	3025 3165	4025	Setting of torque limit value

Data unit : 1%
Data range : 0 to 100 (0 to 100%)
Standard setting : 50 (50%)

This data is used to set the torque limit value for maximum output torque when the torque limit command HIGH (TLMHA) or torque limit command LOW (TLMLA) is commanded.

Data represents limiting values when the maximum torque is assumed to be 100%.

Torque limit command LOW TLMLA	Torque limit command HIGH TLMHA	Details
0	0	No torque limitation exists.
0	1	Limited to the setting value of this parameter.
1	0	Limited to approximately half as compared with that of TLMH.
1	1	Limited to approximately half as compared with that of TLMH.

Parameter No.

PM	0C	15	16	DATA
3026 6666	6526 3166	3026	4026	Load detecting level 1

Data unit : 1%
Data range : 0 to 100 (0 to 100%)
Standard setting : 83 (83%)

This data is used to set the detecting range of load detecting level 1 (LD T1A).
When the motor output reaches the setting data % or more of maximum rated output, the bit of load detecting signal 1 (LDT1A) is set to "1".

PM	0C	15	16	
3027 6667	6527 3167	3027	4027	Load detecting level 2

Data unit : 1%
Data range : 0 to 100 (0 to 100%)
Standard setting : 95 (95%)

This data is used to set the detecting range of load detecting level 2 (LD T2A).
When the motor output reaches the setting data % or more of maximum rated output, the bit of load detecting signal 2 (LDT2A) is set to "1".

PM	0C	15	16	
3028 6668	6528 3168	3028	4028	Output limit pattern setting

Data unit :
Data range : 0 to 6
Standard setting : 0

Select a proper pattern from the following.

A : When the acceleration/deceleration are slowly performed by limiting the output on acceleration/deceleration only and operation is performed at rated output in normal rotation: (Setting data: 1 or 4)

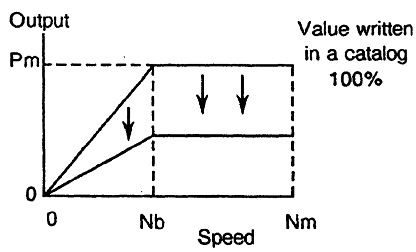
(The function is similar to the soft start/stop.)

B : When the acceleration/deceleration are performed at the maximum rated output and the output is limited in normal rotation: (Setting data: 2 or 5)

C : When a machine with different output specifications is produced using the same motor and servo unit: (Setting data: 3 or 6)

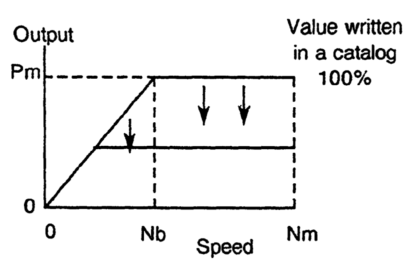
Details	Setting data	
	Pattern 1	Pattern 2
Output is not limited.	0	0
Output is limited on acceleration/deceleration only.	1	4
Output is not limited on acceleration/deceleration and it is limited on normal rotation.	2	5
Output is limited over all operations.	3	6

[Output limit pattern 1] — Setting data = 1, 2, 3 —



$$\text{Pout} = \frac{\text{Setting value of parametr (No. 6529)}}{100} \times \text{Pm}$$

[Output limit pattern 2] — Setting data = 4, 5, 6 —



$$\text{Pout} = \frac{\text{Setting value of parametr (No. 6529)}}{100} \times \text{Pm}$$

Parameter No.

PM	0C	15	16
3029	6529	3029	4029
	6669	3169	

DATA

Output limit value

Data unit : 1%

Data range : 0 to 100 (0 to 100%)

Standard setting : 100

This data is used to set the value limited when the maximum output (allowable overload capacity) is 100%.
This setting value is valid when output is limited by setting the data on parameter No.6528.

Output limit value = Maximum output × (Setting data)%

Parameter No.

PM	0C	15	16	DATA
3030	6530 6670	3030 3170	4030	Soft start/stop setting time

Data unit : 1 rpm/sec
(when parameter SPDUNT (No. 6506#2) = 1, 10 rpm)
Data range : 0 to 32767
Standard setting : 0 (0 rpm/sec)
This data is used to set the soft start/stop time constant. When set data = 0 the soft start/stop function is not effective.

PM	0C	15	16	
3031	6531 6671	3031 3171	4031	Position coder method orientation stop position

Data unit : 1 pulse (360°/4096)
Data range : 0 to 4095
Standard setting : 0
This data is used to set the stop position of position coder method spindle orientation.
It can be set at every 360 degrees/4096.
When stop position external command type spindle orientation is set, this parameter becomes invalid.
12BITS stop position command instructed by PMC becomes valid.

PM	0C	15	16	
3032	6532 6672	3032 3172	4032	Acceleration/deceleration time constant at spindle synchronization control

Data unit : 1 rpm/sec
(when parameter SPDUNT (No. 6506#2) = 1, 10 rpm)
Data range : 0 to 32767
Standard setting : 0 (0 rpm/sec)
When the synchronization speed command at spindle synchronization control is changed, set the acceleration/deceleration time constant.
When set data = 0, time constant does not function.
Set exactly the same data for No.1 spindle and No.2 spindle.

PM	0C	15	16	
3033	6533 6673	3033 3173	4033	Spindle synchronization speed arrival level

Data unit : 1 rpm
(when parameter SPDUNT (No. 6506#2) = 1, 10 rpm)
Data range : 0 to 32767

Standard setting : 10 (10 rpm)

For the synchronization speed command at spindle synchronization control, if the deviations of the respective spindle motor speeds are within the setting level, the spindle synchronization control complete signal becomes "1".

Parameter No.

PM	0C	15	16	DATA
3034	6534 6674	3034 3174	4034	Shift amount at spindle phase synchronization control

Data unit : 1 pulse (360°/4096)

Data range : 0 to 4095

Standard setting : 0 (0 pulse)

Sets the shift amount from the reference point at spindle phase synchronization control (1 rotation signal).

PM	0C	15	16	
3035	6535 6675	3035 3175	4035	Spindle phase synchronization compensation data

Data unit : pulse/2 msec

Data range : 0 to 4095

Standard setting : 10

This parameter reduces speed fluctuations when aligning phase of spindles in spindle phase synchronization control.

When this parameter is "0", since the phase alignment amount is only issued once, the position deviation quickly becomes large, and there are large speed changes on phase alignment.

Using this parameter it is possible to perform smooth phase alignments through issuing separate commands for phase alignment amounts for the number of 2 msec pulses set in this parameter.

PM	0C	15	16	
3036	6536 6676	3036 3176	4036	Feedforward coefficient

Data unit : 1%

Data range : 0 to 100 (0 to 100%)

Standard setting : 0%

Set the feedforward coefficient when feedforward control is executed in servo mode (rigid tap/Cs axis control etc.) and Cs contouring control.

PM	0C	15	16	
3037	6537 6677	3037 3177	4037	Velocity loop feedforward coefficient

Data unit :

Data range : 0 to 32767

Standard setting : 0

Set the velocity loop feedforward coefficient when feedforward control is executed in servo mode (rigid tap/Cs axis control etc.) and Cs contouring control.

Parameter No.

PM	0C	15	16	DATA
3040	6540 6680	3040 3180	4040	Velocity loop proportion gain on normal operation (HIGH gear)

PM	0C	15	16	
3041	6541 6681	3041 3181	4041	Velocity loop proportion gain on normal operation (LOW gear)

Data unit :
Data range : 0 to 32767
Standard setting : 10

This data is used to set the velocity loop proportion gain on normal operation.
When the clutch/gear signal (CTH1A) in the spindle control signals sent from the PMC to NC is set to "0" and "1", the parameters of HIGH and LOW gears are selected, respectively.

PM	0C	15	16	
3042	6542 6682	3042 3182	4042	Velocity loop proportion gain on orientation (HIGH gear)

PM	0C	15	16	
3043	6543 6683	3043 3183	4043	Velocity loop proportion gain on orientation (LOW gear)

Data unit :
Data range : 0 to 32767
Standard setting : 10

This data is used to set the velocity loop proportion gain on spindle orientation.

PM	0C	15	16	
3044	6544 6684	3044 3184	4044	Velocity loop proportion gain on servo mode/on synchronization control (HIGH gear)

PM	0C	15	16	
3045	6545 6685	3045 3185	4045	Velocity loop proportion gain on servo mode/on synchronization control (LOW gear)

Data unit :
Data range : 0 to 32767
Standard setting : 10

This sets velocity loop proportion gain in servo mode (rigid tap/Cs axis control etc.) and in synchronization control.

PM	0C	15	16	
3046	6546 6686	3046 3186	4046	Velocity loop proportion gain in Cs contouring control (HIGH gear)

PM	0C	15	16	
3047	6547 6687	3047 3187	4047	Velocity loop proportion gain in Cs contouring control (LOW gear)

Data unit :
Data range : 0 to 32767
Standard setting : 30
This sets the velocity loop proportion gain in Cs contouring control.

Parameter No. PM	0C	15	16	DATA
3048	6548 6688	3048 3188	4048	Velocity loop integral gain on normal operation (HIGH gear)

PM	0C	15	16	
3049	6549 6689	3049 3189	4049	Velocity loop integral gain on normal operation (LOW gear)

Data unit :
Data range : 0 to 32767
Standard setting : 10
This data is used to set the velocity loop integral gain on normal operation.

PM	0C	15	16	
3050	6550 6690	3050 3190	4050	Velocity loop integral gain on orientation (HIGH gear)

PM	0C	15	16	
3051	6551 6691	3051 3191	4051	Velocity loop integral gain on orientation (LOW gear)

Data unit :
Data range : 0 to 32767
Standard setting : 10
This data is used to set the velocity loop integral gain on spindle orientation.

PM	0C	15	16	
3052	6552 6692	3052 3192	4052	Velocity loop integral gain on servo mode/on synchronization control (HIGH gear)

PM	0C	15	16	
3053	6553 6693	3053 3193	4053	Velocity loop integral gain on servo mode/on synchronization control (LOW gear)

Data unit :
Data range : 0 to 32767
Standard setting : 10
This sets velocity loop integral gain in servo mode (rigid tap/Cs axis control etc.) and in synchronization control.

PM	0C	15	16	
3054	6554 6694	3054 3194	4054	Velocity loop integral gain in Cs contouring control (HIGH gear)

PM	0C	15	16	
3055	6555 6695	3055 3195	4055	Velocity loop integral gain in Cs contouring control (LOW gear)

Data unit :
Data range : 0 to 32767
Standard setting : 50
This sets the velocity loop integral gain in Cs contouring control.

Parameter No.

PM	0C	15	16	DATA
3056	6556 6696	3056 3196	4056	Gear ratio (HIGH)
3057	6557 6697	3057 3197	4057	Gear ratio (MEDIUM HIGH)
3058	6558 6698	3058 3198	4058	Gear ratio (MEDIUM LOW)
3059	6559 6699	3059 3199	4059	Gear ratio (LOW)

Data unit : Motor rotation for one rotation of spindle × 100 (or 1000)
Data range : 0 to 32767
Standard setting : 100 (Gear ratio = 1:1)
These data are used to set the gear ratio between spindle and AC spindle motor.
Set the gear or clutch status to correspond to the clutch/gear signal (CTH1A, CTH2A) in the spindle control signals sent from the PMC to NC.

(Example) When the spindle rotates once, set "250" as the data when the motor rotates 2.5 times.
When parameter GRUNIT (No. 6506#1) = 1, set the data for the number of motor revolutions × 1000.

PM	0C	15	16	DATA
3060	6560 6700	3060 3200	4060	Position gain on orientation (HIGH)
3061	6561 6701	3061 3201	4061	Position gain on orientation (MEDIUM HIGH)
3062	6562 6702	3062 3202	4062	Position gain on orientation (MEDIUM LOW)
3063	6563 6703	3063 3203	4063	Position gain on orientation (LOW)

Data unit : 0.01 sec^{-1}
Data range : 0 to 32767

Standard setting : 1000

These data are used to set the position gain on spindle orientation.

Parameter No.

PM	0C	15	16	DATA
3064	6564 6704	3064 3204	4064	Modification rate of position gain on orientation completion

Data unit : 1%

Data range : 0 to 1000

Standard setting : 100 (100%)

This data is used to set the modification rate of position gain on spindle orientation completion.

PM	0C	15	16	
3065	6565 6705	3065 3205	4065	Position gain on servo mode/on synchronization control (HIGH)

PM	0C	15	16	
3066	6566 6706	3066 3206	4066	Position gain on servo mode/on synchronization control (MEDIUM HIGH)

PM	0C	15	16	
3067	6567 6707	3067 3207	4067	Position gain on servo mode/on synchronization control (MEDIUM LOW)

PM	0C	15	16	
3068	6568 6708	3068 3208	4068	Position gain on servo mode/on synchronization control (LOW)

Data unit : 0.01 sec^{-1}

Data range : 0 to 32767

Standard setting : 1000

This sets position gain in servo mode (rigid tap/Cs axis control etc.) and in synchronization control.

PM	0C	15	16	
3069	6569 6709	3069 3209	4069	Position gain in Cs contouring control (HIGH)

PM	0C	15	16	
3070	6570 6710	3070 3210	4070	Position gain in Cs contouring control (MEDIUM HIGH)

PM	0C	15	16	
3071	6571 6711	3071 3211	4071	Position gain in Cs contouring control (MEDIUM LOW)

PM	0C	15	16	
3072	6572 6712	3072 3212	4072	Position gain in Cs contouring control (LOW)

Data unit : 0.01 sec $^{-1}$
Data range : 0 to 32767
Standard setting : 3000
This sets the position gain in Cs contouring control.

Parameter No.

PM	0C	15	16	DATA
3073	6573 6713	3073 3213	4073	Grid shift amount in servo mode

Data unit : 1 pulse unit (360°/4096)
Data range : 0 to 4095
Standard setting : 0
Set this parameter when shifting reference point in servo mode (rigid tap/Cs axis control etc.).
In + data, spindle reference point shifts for set pulse in CCW direction.

PM	0C	15	16	
3074	6574 6714	3074 3214	4074	Speed for return to reference position in Cs contouring control/servo mode

(9A50.I)

Data unit: rpm
Data range: 0 to 32767
Standard setting: 0
When this parameter is set to 0

In returning to the reference position in Cs contouring control, the feedrate set in the parameter (No. 6521) for specifying the maximum feedrate for Cs contouring control is used. When a high feedrate is used in returning to the reference position, set a desired feedrate in this parameter.

In returning to the reference position in the servo mode (spindle index/rigid tapping), the feedrate determined by the spindle orientation mode feedrate limit parameter (No. 6576) is used. When a high feedrate is used in returning to the reference position, set a desired feedrate in this parameter.

When this parameter is set to a value other than 0

In returning to the reference position in Cs contouring control/servo mode, the spindle feedrate in this parameter is used.

PM	0C	15	16	
3075	6575 6715	3075 3215	4075	Orientation completion signal detection level

Data unit : Position coder method → ±1 pulse unit
Magnetic sensor method → ±0.1 degree unit
Data range : 0 to 100
Standard setting : 10
This data is used to set the detecting level of orientation completion signal (ORARA).
When the spindle position is located within the setting data on orientation completion, the bit of orientation completion signal (ORARA) in the spindle status signals is set to "1".

Parameter No.

PM	0C	15	16	DATA
3076	6576	3076	4076	Motor speed limit value on orientation
	6716	3216		

Data unit : 1%
Data range : 0 to 100
Standard setting : 33
This data is used to set the motor speed limit value on orientation.

Speed limit value = Orientation speed of motor × (Setting data)/100 rpm
Orientation speed of motor = Position gain × Gear ratio x 60 rpm

PM	0C	15	16	
3077	6577	3077	4077	Orientation stop position shift value
	6717	3217		

Data unit : Position coder method → ±1 pulse unit
Magnetic sensor method → ±0.1 degree unit
Data range : Position coder method → −4095 to 4095
Magnetic sensor method → −100 to 100
Standard setting : 0
In the position coder method orientation, set this data to shift stop position.
Spindle is shift No. of setting pulse in CCW direction, and stops by data (+).
This data is used to set the position shift amount from the position where the magnetic sensor faces the magnetizing element on magnetic sensor method orientation stop.
The spindle is shifted in CCW direction by data (+).

PM	0C	15	16	
3078	6578	3078	4078	MS signal constant = $(L/2)/(2\times\pi\times H)\times 4096$
	6718	3218		

L : Length of magnetizing element (mm)
H : Distance from spindle center to magnetizing element (mm)
Data unit :
Data range : 80 to 1000
Standard setting : 200
In the magnetic sensor method orientation, substitute the followings into the expression above to set the MS signal constant.
L : Length of magnetizing element (mm)
H : Distance from spindle center to magnetizing element (mm)
Normally, calculate the magnetic generating object length as L = 50 mm.

(Example) When H = 100 mm, L = 50 mm
MS signal constant = $(50/2)/(2\times 3.14\times 100)\times 4096$
= approximately 163
In this case, set "163" as the data.

Parameter No.

DATA

PM	0C	15	16
3079	6579 6719	3079 3219	4079

MS signal gain adjustment

Data unit :
Data range : − 128 to + 127
Standard setting : 0

Use this parameter when adjusting the amplitude of the MS signal in the magnetic sensor method orientation.

PM	0C	15	16
3080	6580 6720	3080 3220	4080

Limitation of regenerative power (DECDT)

Data unit : 1%
Data range : 0 to 100
Standard setting : Depends on the motor model.

This parameter is used to adjust the deceleration time to be equal to the acceleration time.

If it is set to be larger, the deceleration time becomes shorter.

On the other hand, if it is set to be smaller, the deceleration time becomes longer.

However, when the regenerative power is excessive, the regenerative limit circuit is activated and current waveform of motor changes so that an abnormal sound may be produced from the motor. In this case, set a smaller value for eliminating an abnormal sound.

PM	0C	15	16
3081	6581 6721	3081 3221	4081

Delay time until the motor power is cut off

Data unit : 10 ms
Data range : 0 to 1000
Standard setting : 20 (200 ms)

The motor power is cut off after stopping the motor (zero speed is detected).

However, when the power is cut off immediately after detecting the zero speed signal, the motor may be operated at low speed due to force of habit.

Detect the zero speed signal and then set the time until the motor power is cut off by this parameter.

PM	0C	15	16
3082	6582 6722	3082 3222	4082

Time setting during acceleration/deceleration

Data unit : 1 sec
Data range : 0 to 255
Standard setting : 10 (10 sec)

When the deviation between the velocity command and motor speed exceeds the setting level, an velocity error excess alarm occurs.

However, if the velocity command is changed during acceleration/deceleration, the motor speed cannot follow it. Thus, a velocity error excess alarm occurs.

In this case, set the acceleration/deceleration time for preventing velocity error excess alarm from occurring even if there is a speed error during the time set by this parameter.
When the lathe load inertia is large, the acceleration/deceleration time becomes longer. Thus, set the value accordingly.

Parameter No. PM	0C	15	16	DATA
3083	6583 6723	3083 3223	4083	Motor voltage setting on normal rotation
3084	6584 6724	3084 3224	4084	Motor voltage setting on orientation
3085	6585 6725	3085 3225	4085	Motor voltage setting on servo mode/on synchronization control
3086	6586 6726	3086 3226	4086	Motor voltage setting in Cs contouring control

Data unit : 1%
Data range : 0 to 100
Standard setting : Depends on the motor mode.
Set the motor voltage to "100", when Cs contouring control is in operation.
Set parameter CMTVL (No. 6516#4) = 1, when the motor voltage during Cs contouring control is set for less than "100".

PM	0C	15	16	
3087	6587 6727	3087 3227	4087	Overspeed level (OVSDT)

Data unit : 1%
Data range : 0 to 200
Standard setting : 115 (115%)
This data is used to set the overspeed level.
When the speed exceeds the value of "maximum speed × (setting data) %", an overspeed alarm occurs.

PM	0C	15	16	
3088	6588 6728	3088 3228	4088	Velocity error excess detecting level on motor shaft lock condition

Data unit : 0.01%
Data range : 0 to 10000
Standard setting : 75 (0.75%)
This data is used to set the velocity error excess detecting level on motor shaft lock condition.
When the motor is locked and the velocity error exceeds the value of "maximum speed × (setting data)%", a motor shaft lock alarm (AL-31) occurs.

Parameter No.

DATA

PM	0C	15	16	
3089	6589	3089	4089	Velocity error excess detecting level on motor rotation
	6729	3229		

Data unit : 0.1%
Data range : 0 to 1000
Standard setting : 200

This data is used to set the velocity error excess detecting level on motor rotation. When the velocity error exceeds the value of "maximum speed × (setting data) %", a velocity error excess alarm (AL-02) occurs.

PM	0C	15	16	
3090	6590	3090	4090	Overload detecting level
	6730	3230		

Data unit : 1%
Data range : 0 to 100
Standard setting : 90

This data is used to set the overload detecting level.
When the motor load remains to be equal to or more than the value of "maximum output × (setting data)%" for a long time, a short-time overload alarm (AL-29) occurs.

PM	0C	15	16	
3091	6591	3091	4091	The reduction rate of position loop gain in returning to the reference point on servo mode
	6731	3231		

Data unit : 1%
Data range : 0 to 100
Standard setting : 100 (100%)

This sets the reduction rate of position gain in returning to the reference point in servo mode (rigid tap/Cs axis control etc.)

PM	0C	15	16	
3092	6592	3092	4092	The reduction rate of position loop gain in returning to the reference point on Cs contouring mode
	6732	3232		

Data unit : 1%
Data range : 0 to 100
Standard setting : 100 (100%)

This sets the reduction rate of position gain in returning to the reference point in Cs contouring control.

PM	0C	15	16	
3093	6594	3094	4094	The constant of the torque disturbance compensating
	6734	3234		

Data unit :
Data range : 0 to 32767
Standard setting : 0

This sets a constant when compensating for torque disturbance in Cs contouring control.

Parameter No. PM	0C	15	16	DATA
3095	6595 6735	3095 3235	4095	Adjustment of speed meter output voltage

Data unit : 0.1%
Data range : −1000 to +100 (−100% to +10%)
Standard setting : 0
This parameter is set when carrying out minute adjustments of speed meter output voltage.
Output voltage becomes large in + data.

PM	0C	15	16	
3096	6596 6736	3096 3236	4096	The adjustment of load meter output voltage

Data unit : 0.1%
Data range : −1000 to +100 (−100% to +10%)
Standard setting : 0
This parameter is set when carrying out minute adjustments of load meter output voltage.
Output voltage becomes large in + data.

PM	0C	15	16	
	6597 6737	3097 3237	4097	Spindle speed feedback gain

Data unit : 0
Data range : 0 to 32767
Standard setting : 0
This parameter is set to feed back spindle speed and compensate for torque disturbance in Cs contouring control in systems where spindles and spindle motors are linked by gears or belts.

PM	0C	15	16	
3098	6598 6738	3098 3238	4098	Maximum speed of position coder 1 revolution signal detection

Data unit : 1rpm
(When parameter SPDUNT (No. 6506#2) = 1, 10rpm)
Data range : 0 to 32767
Standard setting : 0
Parameter for setting the maximum speed of position coder 1 rotation signal detections possible.
If the parameter is set to "0", the speed of detections possible is the same as the maximum speed for the motor .

PM	0C	15	16	
3099	6599 6739	3099 3239	4099	Delay time for motor magnetization

Data unit : 1ms
Data range : 0 to 32767
Standard setting : 0
Parameter for setting the time until motor magnetization is stable in rigid tap and Cs contouring control modes.

Parameter No.

PM	0C	15	16	DATA
3100	6600	3100	4100	Base speed of motor output specifications
	6740	3240		

Data unit : 1 rpm
(when parameter SPDUNT (No. 6506#2) = 1, 10 rpm)
Data range : 0 to 32767
Standard setting : Depends on the motor model.

PM	0C	15	16	
3101	6601	3101	4101	Limit value for motor output specifications
	6741	3241		

Data unit : 1%
Data range : 0 to 100
Standard setting : Depends on the motor model.

PM	0C	15	16	
3102	6602	3102	4102	Base speed
	6742	3242		

Data unit : 1 rpm
(when parameter SPDUNT (No. 6506#2) = 1, 10 rpm)
Data range : 0 to 32767
Standard setting : Depends on the motor model.

PM	0C	15	16	
3103	6603	3103	4103	Magnetic flux down start speed
	6743	3243		

Data unit : 1 rpm
(when parameter SPDUNT (No. 6506#2) = 1, 10 rpm)
Data range : 0 to 32767
Standard setting : Depends on the motor model.

PM	0C	15	16	
3104	6604	3104	4104	Current loop proportion gain data
	6744	3244		

Data unit :
Data range : 0 to 32767
Standard setting : Depends on the motor model.

Parameter No.

DATA

PM	0C	15	16	
3105	6605	3105	4105	Current loop proportion gain data (in Cs contouring control)
	6745	3245		

Data unit :
Data range : 0 to 32767
Standard setting : Depends on the motor model.

PM	0C	15	16	
3106	6606	3106	4106	Current loop integral gain data
	6746	3246		

Data unit :
Data range : 0 to 32767
Standard setting : Depends on the motor model.

PM	0C	15	16	
3107	6607	3107	4107	Current loop integral gain data (in Cs contouring control)
	6747	3247		

Data unit :
Data range : 0 to 32767
Standard setting : Depends on the motor model.

PM	0C	15	16	
3108	6608	3108	4108	Current loop integral gain zero point
	6748	3248		

Data unit : 1rpm
(when parameter SPDUNT (No. 6506#2) = 1, 10 rpm)
Data range : 0 to 32767
Standard setting : Depends on the motor model.

PM	0C	15	16	
3109	6609	3109	4109	Current loop proportion gain speed coefficient
	6749	3249		

Data unit : 1%
Data range : 0 to 100
Standard setting : Depends on the motor model.

PM	0C	15	16	
3110	6610	3110	4110	Current conversion constant
	6750	3250		

Data unit :
Data range : 0 to 32767
Standard setting : Depends on the motor model.

Parameter No.				DATA
PM	0C	15	16	
3111	6611	3111	4111	Secondary current coefficient for excitation current
	6751	3251		

Data unit :
Data range : 0 to 100
Standard setting : Depends on the motor model.

PM	0C	15	16	
3112	6612	3112	4112	Current prediction constant
	6752	3252		

Data unit :
Data range : 0 to 32767
Standard setting : Depends on the motor model.

PM	0C	15	16	
3113	6613	3113	4113	Slip constant
	6753	3253		

Data unit :
Data range : 0 to 32767
Standard setting : Depends on the motor model.

PM	0C	15	16	
3114	6614	3114	4114	Slip compensation constant of high-speed rotation
	6754	3254		

Data unit :
Data range : 0 to 255
Standard setting : Depends on the motor model.

PM	0C	15	16	
3115	6615	3115	4115	Motor applied voltage compensation constant by dead time
	6755	3255		

Data unit : 1%
Data range : 0 to 100
Standard setting : Depends on the motor model.

PM	0C	15	16	
3116	6616	3116	4116	Electromotive voltage compensation coefficient
	6756	3256		

Data unit : 1%
Data range : 0 to 200
Standard setting : Depends on the motor model.

Parameter No.	DATA
PM 0C 15 16 3117 6617 3117 4117 6757 3257	Electromotive voltage phase compensation coefficient

Data unit : 1%
Data range : 0 to 100
Standard setting : Depends on the motor model.

PM 0C 15 16 3118 6618 3118 4118 6758 3258	Electromotive voltage compensation speed coefficient

Data unit : 1%
Data range : 0 to 100
Standard setting : Depends on the motor model.

PM 0C 15 16 3119 6619 3119 4119 6759 3259	Time constant for voltage filter used for electromotive force compensation

(9A11.D, 9A21.A, 9A50.A)

Data unit: 1 ms
Data range: 0 to 8191
Standard setting: 0

PM 0C 15 16 3120 6620 3120 4120 6760 3260	Dead time compensation data

Data unit :
Data range : 0 to 100
Standard setting : Depends on the motor model.

PM 0C 15 16 3121 6621 3121 4121 6761 3261	Time constant of torque change

Data unit : 1 ms
Data range : 0 to 1000
Standard setting : 5

PM 0C 15 16 3122 6622 3122 4122 6762 3262	Speed detection filter time constant

Data unit : 0.1 ms
Data range : 0 to 10000
Standard setting : 0

Parameter No.

PM	0C	15	16	DATA
3123	6623 6763	3123 3263	4123	Overload detecting time

Data unit : 1 sec
Data range : 0 to 500
Standard setting : 30

PM	0C	15	16	
3125	6625 6765	3125 3265	4125	Timer setting for automatic operation

Data unit : 0.1 sec
Data range : 0 to 32767
Standard setting : 100

PM	0C	15	16	
3126	6626 6766	3126 3266	4126	Velocity command on automatic operation

Data unit : 1 rpm
(when parameter SPDUNT (No. 6506#2) = 1, 10 rpm)
Data range : 0 to maximum speed of motor
Standard setting : 1000

PM	0C	15	16	
3127	6627 6767	3127 3267	4127	Load meter display value on maximum output

Data unit : 1%
Data range : 0 to 500
Standard setting : Depends on the motor model.

PM	0C	15	16	
3128	6628 6768	3128 3268	4128	Maximum output limit zero point

Data unit : 1 rpm
(when parameter SPDUNT (No. 6506#2) = 1, 10 rpm)
Data range : 0 to 32767
Standard setting : Depends on the motor model.

PM	0C	15	16	
3129	6629 6769	3129 3269	4129	Secondary electrical current coefficient on rigid tap

Data unit :
Data range : 0 to 100
Standard setting : Depends on the motor model.

Parameter No. PM	0C	15	16	DATA
3130	6630 6770	3130 3270	4130	Electromotive voltage phase compensation constant on deceleration

Data unit : 1%
Data range : 0 to 100
Standard setting : Depends on the motor model.

PM	0C	15	16	
3131	6631 6771	3131 3271	4131	Speed detection filter time constant (on Cs contouring control)

Data unit : 0.1ms
Data range : 0 to 10000
Standard setting : 0

PM	0C	15	16	
3132	6632 6772	3132 3272	4132	V-phase current conversion constant

Data unit :
Data range : 0 to 32767
Standard setting : 0

PM	0C	15	16	
3133	6633 6773	3133 3273	4133	Motor model code

Data unit :
Data range : 0 to 63 (for standard motors)
64 to 93 (for speed range switch motors)
Standard setting : Depends on the motor model. (Refer to Appendix 8.)
Set the model code when setting the first parameters of the spindle motor.
At this time it is necessary to set the following parameters simultaneously.

Power Mate : Parameter PRLOAD (No.3019#7) = 1
Series 0 : Parameter PRLOAD (No.6519#7) = 1
Series 15 : Parameter PRLOAD (No.5607#0) = 0
Series 16 : Parameter PRLOAD (No.4019#7) = 1

PM	0C	15	16	
3134	6635 6775	3135 3275	4135	Grid shift amount in Cs contouring control (LONG WORD)

Data unit : Number of pulses (0.001 degrees)
Data range : −360000 to +360000
Standard setting : 0
Set the pulse from one rotation signal to machine zero point in Cs contouring control.

(2) Low speed area parameters for speed range switching control

Parameter No.

PM	0C	15	16	DATA
3136	6900 6940	3280 3500	4136	Motor voltage setting on normal rotation

Data unit : 1%
Data range : 1 to 100
Standard setting : Depends on the motor model.

PM	0C	15	16	
3137	6901 6941	3281 3501	4137	Motor voltage setting on servo mode/on synchronization control

Data unit : 1%
Data range : 1 to 100
Standard setting : Depends on the motor model.

PM	0C	15	16	
3138	6902 6942	3282 3502	4138	Base speed of motor output specifications

Data unit : 1 rpm
(when parameter SPDUNT (No. 6506#2) = 1, 10 rpm)
Data range : 0 to 32767
Standard setting : Depends on the motor model.

PM	0C	15	16	
3139	6903 6943	3283 3503	4139	Limit value for motor output specifications

Data unit : 1%
Data range : 0 to 100
Standard setting : Depends on the motor model.

PM	0C	15	16	
3140	6904 6944	3284 3504	4140	Base speed

Data unit : 1 rpm
(when parameter SPDUNT (No. 6506#2) = 1, 10 rpm)
Data range : 0 to 32767
Standard setting : Depends on the motor model.

PM	0C	15	16	
3141	6905 6945	3285 3505	4141	Magnetic flux down start speed

Data unit : 1 rpm
(when parameter SPDUNT (No. 6506#2) = 1, 10 rpm)
Data range : 0 to 32767
Standard setting : Depends on the motor model.

Parameter No.

DATA

PM	0C	15	16	
3142	6906	3286	4142	Current loop proportion gain data
	6946	3506		

Data unit :
Data range : 0 to 32767
Standard setting : Depends on the motor model.

PM	0C	15	16	
3143	6907	3287	4143	Current loop integral gain data
	6947	3507		

Data unit :
Data range : 0 to 32767
Standard setting : Depends on the motor model.

PM	0C	15	16	
3144	6908	3288	4144	Current loop integral gain zero point
	6948	3508		

Data unit : 1 rpm
(when parameter SPDUNT (No. 6506#2) = 1, 10 rpm)
Data range : 0 to 32767
Standard setting : Depends on the motor model.

PM	0C	15	16	
3145	6909	3289	4145	Current loop proportion gain speed coefficient
	6949	3509		

Data unit : 1%
Data range : 1 to 100
Standard setting : Depends on the motor model.

PM	0C	15	16	
3146	6910	3290	4146	Current conversion constant
	6950	3510		

Data unit :
Data range : 0 to 32767
Standard setting : Depends on the motor model.

PM	0C	15	16	
3147	6911	3291	4147	Secondary current coefficient for excitation current
	6951	3511		

Data unit :
Data range : 0 to 100
Standard setting : Depends on the motor model.

Parameter No.

PM	0C	15	16	DATA
3148	6912	3292	4148	Current prediction constant
	6952	3512		

Data unit :
Data range : 0 to 32767
Standard setting : Depends on the motor model.

PM	0C	15	16	
3149	6913	3293	4149	Slip constant
	6953	3513		

Data unit :
Data range : 0 to 32767
Standard setting : Depends on the motor model.

PM	0C	15	16	
3150	6914	3294	4150	Slip compensation constant of high-speed rotation
	6954	3514		

Data unit :
Data range : 0 to 255
Standard setting : Depends on the motor model.

PM	0C	15	16	
3151	6915	3295	4151	Motor applied voltage compensation constant by dead time
	6955	3515		

Data unit : 1%
Data range : 0 to 100
Standard setting : Depends on the motor model.

PM	0C	15	16	
3152	6916	3296	4152	Electromotive voltage compensation coefficient
	6956	3516		

Data unit : 1%
Data range : 0 to 200
Standard setting : Depends on the motor model.

PM	0C	15	16	
3153	6917	3297	4153	Electromotive voltage phase compensation coefficient
	6957	3517		

Data unit : 1%
Data range : 0 to 100
Standard setting : Depends on the motor model.

PM	0C	15	16	
3154	6918	3298	4154	Electromotive voltage compensation speed coefficient
	6958	3518		

Data unit : 1%
Data range : 0 to 100
Standard setting : Depends on the motor model.

Parameter No.

PM	0C	15	16	DATA
3157	6921 6961	3301 3521	4157	Time constant of torque change

Data unit : 1ms
Data range : 0 to 100
Standard setting : Depends on the motor model.

PM	0C	15	16	
3158	6922 6962	3302 3522	4158	Maximum output limit zero point

Data unit : 1 rpm
(when parameter SPDUNT (No. 6506#2) = 1, 10 rpm)
Data range : 0 to 32767
Standard setting : Depends on the motor model.

PM	0C	15	16	
3159	6923 6963	3303 3523	4159	Secondary electrical current coefficient on rigid tap

Data unit :
Data range : 0 to 100
Standard setting : Depends on the motor model.

PM	0C	15	16	
3160	6924 6964	3304 3524	4160	Speed detection level hysteresis

Data unit : 1 rpm
(when parameter SPDUNT (No. 6506#2) = 1, 10 rpm)
Data range : 0 to 32767
Standard setting : 0

Set the hysteresis for the speed detection level.

The speed detection level is set by parameter, but the speed detection signal changes from 1 to 0 with the set speed detection level + hysteresis number of revolutions, and changes from 0 to 1 with the set speed detection level number of revolutions. If this data is set to 20rpm or less, the hysteresis is automaitcally set to 20rpm.

If the speed detection signal (SDT) is used in speed range switching control, increase the data setting in situations where the switching circuit is likely to cause chattering close to the number of revolutions for the speed detection level.

PM	0C	15	16	
3161	6925 6965	3305 3525	4161	Electromotive voltage phase compensation constant on deceleration

Data unit : 1%
Data range : 0 to 100
Standard setting : Depends on the motor model.

Parameter No.

PM	0C	15	16	DATA
3162	6926 6966	3306 3526	4162	Speed loop integral gain on Cs contouring control cutting feed (HIGH)

PM	0C	15	16	
3163	6927 6967	3307 3527	4163	Speed loop integral gain on Cs contouring control cutting feed (LOW)

Data unit :
Data range : 0 to 32767
Standard setting : 0

Set the velocity loop integral gain when cutting feed (G01, G02, G03) is operating in the Cs contouring control mode.

When the data is "0", parameters (No. 6554 and 6555) data become valid.

PM	0C	15	16	
3164	6928	3308	4164	V-phase current conversion constant

Data unit :
Data range : 0 to 32767
Standard setting : 0

PM	0C	15	16	
3165	6929 6969	3309 3529	4165	Time constant for voltage filter used for electromotive force compensation

(9A11.D, 9A21.A, 9A50.A)

Data unit: 1 ms
Data range: 0 to 8191
Standard setting: 0

PM	0C	15	16	
3166	6930 6970	3310 3530	4166	Regenerative power limit

(9A11.D, 9A21.A, 9A50.A)

Data unit: 1%
Data range: 0 to 100
Standard setting: 0

PM	0C	15	16	
3168	6932 6972	3312 3532	4168	Overload current alarm detection level (for low-speed characteristics)

(9A50.I)

Data unit:
Data range: 0 to 32767
Standard setting: Depends on the motor model.

Parameter No.

PM	0C	15	16	DATA
3169	6933 6973	3313 3533	4169	Overload current alarm detection time constant

(9A50.H)

Data unit: 1 second
Data range: 0 to 32767
Standard setting: Depends on the motor model.

PM	0C	15	16	DATA
3170	6934 6974	3314 3534	4170	Overload current alarm detection level (for high-speed characteristics)

(9A50.H)

Data unit:
Data range: 0 to 32767
Standard setting: Depends on the motor model.

PM	0C	15	16	DATA
3165	6939 6979	3319 3539	4175	Setting of delay timer when magnetic contactor in the unit is on

(9A11.B, 9A21.A, 9A50.A)

Data unit: 0.1 second
Data range: 0 to 2600
Standard setting: 0

(3) SUB spindle parameters for spindle selector control (9A11, 9A21, 9A50)

Parameter No.

0C	15	16	#7	#6	#5	#4	#3	#2	#1	#0
6140 6320	3320 3540	4176				RETSV		POSC1		ROTA1
Standard setting :			0	0	0	0	0	0	0	0

ROTA1 : Indicates the relationship between the rotation directions of spindle and spindle motor.
- 0: Rotates the spindle and spindle motor in the same direction.
- 1: Rotates the spindle and spindle motor in the reverse direction.

POSC1 : Indicates the mounting direction of position coder.
- 0: Rotates the spindle and position coder in the same direction.
- 1: Rotates the spindle and position coder in the reverse direction.

RETSV : Indicates reference point return direction (rigid tap/Cs axis control etc.) when in servo mode.
- 0: Spindle reference point returns CCW (counter clockwise)
- 1: Spindle reference point returns CW (clockwise)

Parameter No.

0C	15	16
6141	3321	4177
6321	3541	

DATA

#7	#6	#5	#4	#3	#2	#1	#0
				MGSEN	POSC2	MRDY2	MRDY1
Standard setting : 0	0	0	0	0	0	0	1

MRDY1 : Determines whether the MRDYA signal (machine ready signal) is used or not.
0: Not used. (The MRDYA signal should be always set to 1.)
1: Used.

MRDY2 : Cuts off power by the MRDYA signal (machine ready signal).
0: Turns off the MCC (magnetic contactor) when the MRDYA signal is set to 0.
1: Turns off the excitation only when the MRDYA signal is set to 0.

POSC2 : Determines whether the POSITION CODER signal is used or not.
0: Not used.
1: Used.

MGSEN : Indicates the mounting direction of magnetic sensor.
0: Rotates the motor and magnetic sensor in the same direction.
1: Rotates the motor and magnetic sensor in the reverse direction.

0C	15	16
6142	3322	4178
6332	3542	

#7	#6	#5	#4	#3	#2	#1	#0
		SVMDRT					
Standard setting : 0	0	0	0	0	0	0	0

SVMDRT : Rotation direction signal (SFR/SRV) function setting when in servo mode (rigid tap/Cs contouring control)
0: Rotation direction function present
With a + move command, spindle rotation is CCW when SFR = ON spindle rotation is CW when SRV = ON
1: Rotation direction function absent
With a + move command, spindle rotation is CCW when SFR = ON or SRV = ON

0C	15	16
6143	3323	4179
6333	3543	

#7	#6	#5	#4	#3	#2	#1	#0
			PCTYPE	DIRCT2	DIRCT1	PCCNCT	PCMGSL
Standard setting : 0	0	0	0	0	0	0	0

PCMGSL : Selection of position coder method/magnetic sensor method spindle orientation
0: Position coder method spindle orientation function
1: Magnetic sensor method spindle orientation function

PCCNCT: Setting for use of signal conversion circuit of unit mounting type (9A21, 9A50)
0: In cases other than below
1: When the signal conversion circuit of unit mounting type is used

DIRCT1-DIRCT2 : Setting of rotation direction at spindle orientation

DIRCT2	DIRCT1	Rotation direction at spindle orientation
0	0	By rotation direction immediately before
0	1	By rotation direction immediately before
1	0	CCW (counterclockwise) direction looking from shaft of motor
1	1	CW (clockwise) direction looking from shaft of motor

PCTYPE : Sets the type of position coder (number of pulses per revolution).

0: 1024p/rev

1: 512p/rev

Parameter No.

0C	15	16	#7	#6	#5	#4	#3	#2	#1	#0
6146 6326	3326 3546	4182	BLTRGD	PRMCHK	ALGOVR	DECPHS		SPDUNT	GRUNIT	
Standard setting :			0	0	0	0	0	0	0	0

DATA

GRUNIT : Gear ratio setting resolution setting

0: 1/100 units (Under normal circumstances, set to "0".)

1: 1/1000 units

These parameters change the following parameter settings.

Parameter No.					Description
Series 0		Series 15		Series 16	
No.1	No.2	No.1	No.2		
6180 6181	6360 6361	3360 3361	3580 3581	4216 4217	Gear ratio (HIGH) Gear ratio (LOW)

SPDUNT : Setting per 10rpm

0: 1 rpm setting ("0" is usually chosen)

1: 10 rpm setting

Choose "1" for motors with a maximum rpm of more than 32767.

These parameters change the following parameter settings.

Parameter No.					Description	Parameter setting unit	
Series 0		Series 15		Series 16		1rpm	10rpm
No.1	No.2	No.1	No.2				
6160	6340	3340	3560	4196	Maximum speed	1rpm	10rpm
6220	6400	3400	3620	4256	Base speed of motor output specifications	1rpm	10rpm
6222	6402	3402	3622	4258	Base speed	1rpm	10rpm
6223	6403	3403	3623	4259	Magnetic flux down start speed	1rpm	10rpm
6226	6406	3406	3626	4262	Current loop integral gain zero point	1rpm	10rpm
6239	6419	3419	3639	4275	Maximum output limit zero point	1rpm	10rpm
Low speed characteristic parameters for speed range switching control (when speed range switching function exists)							
6250	6430	3430	3650	4286	Base speed of motor output specifications	1rpm	10rpm
6252	6432	3432	3652	4288	Base speed	1rpm	10rpm
6253	6433	3433	3653	4289	Magnetic flux down start speed	1rpm	10rpm
6256	6436	3436	3656	4292	Current loop integral gain zero point	1rpm	10rpm
6268	6448	3448	3668	4304	Maximum output limit zero point	1rpm	10rpm

DECPHS : Setting for method of electromotive phase compensation on deceleration.

Depends on the motor model.

ALGOVR: Setting of a spindle analog override range (9A50)

0: 0% to 100%

1: 0% to 120%

PRMCHK: Setting for checking the internal parameter of the serial spindle (9A11.B, 9A21.A, 9A50.A)

0: Checks data itself transferred from the CNC

1: Checks the internal data being currently used

BLTRGD : Setting for rigid tapping based on a position coder (built-in sensor) contained in a motor (9A11.B, 9A21.A, 9A50)

0: Rigid tapping performed using a detector attached to the spindle (including a case where a built-in motor is used)

1: Rigid tapping performed using a position coder (built-in sensor) contained in a motor

Parameter No.

0C	15	16	DATA							
6147	3327	4183	PHAICL	PCALCH	PCLS					
6327	3547		#7	#6	#5	#4	#3	#2	#1	#0
Standard setting :			0	0	0	0	0	0	0	0

PCLS : Whether the position coder signal open circuit detector is enabled or not.

0: Performs disconnection detection.

1: Does not perform disconnection detection.

PCALCH: Enables or disables detection of the alarms (AL-41, 42, 47) related to the position coder signal (9A11.C, 9A21.A, 9A50.A).

0: Detects the alarms related to the position coder signal.

1: Does not detect the alarms related to the position coder signal. When the spindle is not connected with the position coder on a one-for-one basis, set this parameter 1 to avoid erroneous detections.

PHAICL: Setting of a motor voltage pattern when no loads are imposed (9A11.C, 9A21.A, 9A50.A)
Usually, set this parameter to 0. This parameter may be useful when the motor slightly vibrates in high-speed, steady rotation with no loads. However, check for speed variation, which tends to occur more frequently in constant surface speed control.

Parameter No.

0C	15	16	DATA							
6151	3331	4187	POLE2	RGI2	ADJG	MXPW	POLE1	VDT3	VDT2	VDT1
6331	3551		#7	#6	#5	#4	#3	#2	#1	#0
Standard setting :			X	X	X	X	X	X	X	X

VDT1-VDT3 : Setting of speed detector

VDT3	VDT2	VDT1	Setting of speed detector
0	0	0	64p/rev
0	0	1	128p/rev
0	1	0	256p/rev
0	1	1	512p/rev

POLE2, POLE1 : No. of motor poles

POLE2	POLE1	No. of motor poles
0	0	2 poles
0	1	4 poles
1	X	8 poles

X : Depends on the motor model.

PWMX : Settings of maximum output when accelerating and decelerating
Depends on the motor model.

ADJG : Settings of acceleration and deceleration judging conditions on maximum output when accelerating and decelerating.
Depends on the motor model.

RGI2 : Settings for secondary electrical current coefficients on rigid tap
Depends on the motor model.

Parameter No.

0C	15	16
6152	3332	4188
6332	3552	

DATA

	#7	#6	#5	#4	#3	#2	#1	#0
				CLMT2	CLMT1	PWM3	PWM2	PWM1
Standard setting :	0	0	0	0	0	X	X	X

X : Depends on the motor model.

PWM3 to PWM1 : Setting of PWM carrier frequency
Normally set to "000".

CLMT2 to CLMT1 : Current limit clock setting
In normal circumstances, set to "00".

0C	15	16
6153	3333	4189
6333	3553	

	#7	#6	#5	#4	#3	#2	#1	#0
			DS4	DS3	DS2	DS1		ESEC
Standard setting :	0	0	X	X	X	X	1	0

X : Depends on the servo unit model.

ESEC : Setting of detection edge of POSITION CODER one rotation signal
0 : CCW = Rising edge CW = Falling edge (Normally set to "0")
1: CCW, CW = Rising edge

DS4-DS1 : Set the current dead band data.
0110 Unit for 6S to 12S
1001 Unit for 15S to 26S

0C	15	16
6156	3336	4192
6336	3556	

	#7	#6	#5	#4	#3	#2	#1	#0
	RFCHK3	RFCHK2			FFSMTH			
Standard setting :	0	0	0	0	0	0	0	0

FFSMTH : Presence of smoothing function on feedforward control
1: Without smoothing function
0: With smoothing function
Sets the presence of smoothing function on feedforward control of servo mode (rigid tap, Cs axis control etc.) and Cs contouring control.

RFCHK2 : Presence of 1 rotation signal error detection (AL-41) function for position coder signal
0: 1 rotation signal error detection (AL-41) function not present
1: 1 rotation signal error detection (AL-41) function present

RFCHK3 : Presence of function for redetecting the 1 rotation signal for the position coder signal each time spindle orientation/spindle synchronization control/rigid tap zero return mode is entered.

0: The 1 rotation signal is not detected each time the operating mode changes.
Once the 1 rotation signal has been detected, it is not detected again until the power goes off.
1: The 1 rotation signal is detected each time the operating mode changes.

Parameter No.

0C	15	16	DATA #7	#6	#5	#4	#3	#2	#1	#0
6157	3337	4193						RFCHK4		
6337	3557									
Standard setting :			0	0	0	0	0	0	0	0

RFCHK4: Specifies whether to use the position coder 1-rotation signal detection function in normal rotation (9A50.F).
0: Does not detect the 1-rotation signal in normal rotation.
1: Detects the 1-rotation signal in normal rotation.

0C	15	16	#7	#6	#5	#4	#3	#2	#1	#0
6159	3339	4195	PRLOAD				VDCCAL	SSTTRQ		
6339	3559									
Standard setting :			0	0	0	0	0	0	0	0

SSTTRQ: Specifies whether to use torque clamping at speed of 0 (9A11.F, 9A21.D, 9A50.E).
0: Uses clamping.
1: Does not use clamping.

VDCCAL: Setting of a DC link voltage calculation method (9A50.F)
0: Performs processing, regarding the DC link voltage as constant.
1: Uses data that matches voltage levels.
Set this parameter according to the current state in power supply regeneration (in deceleration). Usually, set this parameter to 0.

PRLOAD : Parameter automatic setting function (Series 0-C; Series 16)
0: Parameter automatic setting is not executed.
1: Parameter automatic setting is executed.
Set the bit to "1" and the motor model code to NO. 6273. Then, when the CNC power source is turned ON, PRLOAD automatically sets the serial spindle parameters between NO. 6140 and 6315.
When the automatic settings are complete, the bit is automatically set to "0".

(Note) In Series 15, this function is located in a different area (NO. 5607#0). Be aware that the data meanings become opposite.
The model code is set for NO. 3453.
In this case, the parameter at the MAIN side is also set automatically.
0: Parameter automatic setting is executed.
1: Parameter automatic setting is not executed.

Parameter No.

0C	15	16	DATA
6160	3340	4196	Maximum speed
6340	3560		

Data unit : 1 rpm
(when parameter SPDUNT (No. 6146#2) = 1, 10 rpm)
Data range : 0 to 32767
Standard setting : Depends on the motor model.
This data is used to set the maximum speed of AC spindle motor.

0C	15	16	
6161	3341	4197	Speed arrival level
6341	3561		

Data unit : 0.1%
Data range : 0 to 1000 (0 to 100%)
Standard setting : 150 (15%)
This data is used to set the detecting range of speed arrival signal (SARA).
When the motor speed reaches the range within ±(setting data/10)% of commanded speed, the bit of speed arrival signal (SARA) is set to "1".

0C	15	16	
6162	3342	4198	Speed detecting level
6342	3562		

Data unit : 0.1%
Data range : 0 to 1000 (0 to 100%)
Standard setting : 30 (3%)
This data is used to set the detecting range of speed detecting signal (SDTA).
When the motor speed reaches (setting data/10)% or less of maximum speed, the bit of speed arrival signal (SDTA) is set to "1".

0C	15	16	
6163	3343	4199	Speed zero detecting level
6343	3563		

Data unit : 0.01%
Data range : 0 to 10000 (0 to 100%)
Standard setting : 75 (0.75%)
This data is used to set the detecting range of speed zero signal (SSTA).
When the motor speed reaches (setting data/100)% or less of maximum speed, the bit of speed zero signal (SSTA) is set to "1".

0C	15	16	
6164	3344	4200	Setting of torque limit value
6344	3564		

Data unit : 1%
Data range : 0 to 100 (0 to 100%)
Standard setting : 50 (50%)

This data is used to set the torque limit value for maximum output torque when the torque limit command HIGH (TLMHA) or torque limit command LOW (TLMLA) is commanded.

Data represents limiting values when the maximum torque is assumed to be 100%.

Torque limit command LOW TLMLA	Torque limit command HIGH TLMHA	Details
0	0	No torque limitation exists.
0	1	Limited to the setting value of this parameter.
1	0	Limited to approximately half as compared with that of TLMH.
1	1	Limited to approximately half as compared with that of TLMH.

Parameter No.

DATA

0C	15	16	
6165	3345	4201	Load detecting level 1
6345	3565		

Data unit : 1%

Data range : 0 to 100 (0 to 100%)

Standard setting : 83 (83%)

This data is used to set the detecting range of load detecting level 1 (LDT1A).

When the motor output reaches the setting data % or more of maximum rated output, the bit of load detecting signal 1 (LDT1A) is set to "1".

0C	15	16	
6166	3346	4202	Output limit pattern setting
6346	3566		

Data unit :

Data range : 0 to 6

Standard setting : 0

Select a proper pattern from the following.

A : When the acceleration/deceleration are slowly performed by limiting the output on acceleration/deceleration only and operation is performed at rated output in normal rotation: (Setting data: 1 or 4)

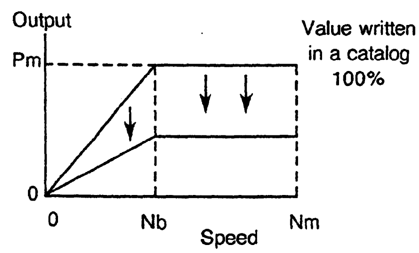
(The function is similar to the soft start/stop.)

B : When the acceleration/deceleration are performed at the maximum rated output and the output is limited in normal rotation: (Setting data: 2 or 5)

C : When a machine with different output specifications is produced using the same motor and servo unit: (Setting data: 3 or 6)

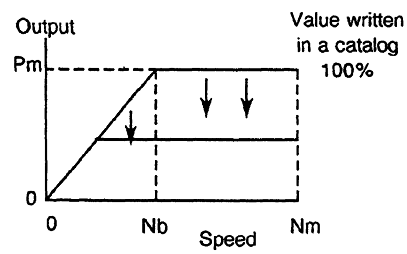
Details	Setting data	
	Pattern 1	Pattern 2
Output is not limited.	0	0
Output is limited on acceleration/deceleration only.	1	4
Output is not limited on acceleration/deceleration and it is limited on normal rotation.	2	5
Output is limited over all operations.	3	6

[Output limit pattern 1] — Setting data = 1, 2, 3 —



$$Pout = \frac{\text{Setting value of parameter (No. 6167)}}{100} \times Pm$$

[Output limit pattern 2] — Setting data = 4, 5, 6 —



$$Pout = \frac{\text{Setting value of parameter (No. 6167)}}{100} \times Pm$$

Parameter No.

DATA

0C	15	16	
6167	3347	4203	Output limit value
6347	3567		

Data unit : 1%
Data range : 0 to 100 (0 to 100%)
Standard setting : 100
This data is used to set the value limited when the maximum output (allowable overload capacity) is 100%.
This setting value is valid when output is limited by setting the data on parameter (No.6166).

Output limit value = Maximum output × (Setting data)%

0C	15	16	
6168	3348	4204	Position coder method orientation stop position
6348	3568		

Data unit : 1 pulse (360°/4096)

Data range : 0 to 4095

Standard setting : 0

This data is used to set the stop position of position coder method spindle orientation. It can be set at every 360 degrees/4096.

When stop position external command type spindle orientation is set, this parameter becomes invalid.

Parameter No.

0C	15	16	DATA
6170	3350	4206	Velocity loop proportion gain on normal operation (HIGH gear)
6350	3570		

0C	15	16	
6171	3351	4207	Velocity loop proportion gain on normal operation (LOW gear)
6351	3571		

Data unit :

Data range : 0 to 32767

Standard setting : 10

This data is used to set the velocity loop proportion gain on normal operation.

When the clutch/gear signal (CTH1A) in the spindle control signals sent form the PMC to NC is set to "0" and "1", the parameters of HIGH and LOW gears are selected, respectively.

0C	15	16	
6172	3352	4208	Velocity loop proportion gain on orientation (HIGH gear)
6352	3572		

0C	15	16	
6173	3353	4209	Velocity loop proportion gain on orientation (LOW gear)
6353	3573		

Data unit :

Data range : 0 to 32767

Standard setting : 10

This data is used to set the velocity loop proportion gain on spindle orientation.

0C	15	16	
6174	3354	4210	Velocity loop proportion gain on servo mode (HIGH gear)
6354	3574		

0C	15	16	
6175	3355	4211	Velocity loop proportion gain on servo mode (LOW gear)
6355	3575		

Data unit :

Data range : 0 to 32767

Standard setting : 10

This sets velocity loop proportion gain in servo mode (rigid tap/Cs axis control etc.).

Parameter No.

0C	15	16	DATA
6176 6356	3356 3576	4212	Velocity loop integral gain on normal operation

Data unit :
Data range : 0 to 32767
Standard setting : 10

This data is used to set the velocity loop integral gain on normal operation.

0C	15	16	
6177 6357	3357 3577	4213	Velocity loop integral gain on orientation

Data unit :
Data range : 0 to 32767
Standard setting : 10

This data is used to set the velocity loop integral gain on spindle orientation.

0C	15	16	
6178 6358	3358 3578	4214	Velocity loop integral gain on servo mode

Data unit :
Data range : 0 to 32767
Standard setting : 10

This sets velocity loop integral gain in servo mode (rigid tap/Cs axis control etc.).

0C	15	16	
6180 6360	3360 3580	4216	Gear ratio (HIGH)

0C	15	16	
6181 6361	3361 3581	4217	Gear ratio (LOW)

Data unit : Motor rotation for one rotation of spindle × 100 (or 1000)
Data range : 0 to 32767
Standard setting : 100 (Gear ratio = 1:1)

These data are used to set the gear ratio between spindle and AC spindle motor.
Set the gear or clutch status to correspond to the clutch/gear signal (CTH1A) in the spindle control signals sent from the PMC to NC.

(Example) When the spindle rotates once, set "250" as the data when the motor rotates 2.5 times.
When parameter GRUNIT (No. 6146#1) = 1, set the data for the number of motor revolutions × 1000.

Parameter No.			DATA
0C	15	16	
6182	3362	4218	Position gain on orientation (HIGH)
6362	3582		

0C	15	16	
6183	3363	4219	Position gain on orientation (LOW)
6363	3583		

Data unit : 0.01 sec^{-1}
Data range : 0 to 32767
Standard setting : 1000
These data are used to set the position gain on spindle orientation.

0C	15	16	
6184	3364	4220	Modification rate of position gain on orientation completion
6364	3584		

Data unit : 1%
Data range : 0 to 1000
Standard setting : 100 (100%)
This data is used to set the modification rate of position gain on spindle orientation completion.

0C	15	16	
6185	3365	4221	Position gain on servo mode (HIGH)
6365	3585		

0C	15	16	
6186	3366	4222	Position gain on servo mode (LOW)
6366	3586		

Data unit : 0.01 sec^{-1}
Data range : 0 to 32767
Standard setting : 1000
This sets position gain in servo mode (rigid tap/Cs axis control etc.)

0C	15	16	
6187	3367	4223	Grid shift amount in servo mode
6367	3587		

Data unit : 1 pulse (360°/4096)
Data range : 0 to 4095
Standard setting : 0
Set this parameter when shifting reference point in servo mode (rigid tap/Cs axis control etc.).
In + data, spindle reference point shifts for set pulse in CCW direction.

0C	15	16	
6190	3370	4226	Orientation completion signal detection level
6370	3590		

Data unit : Position coder method → ±1 pulse unit
Magnetic sensor method → ±0.1 degree unit
Data range : 0 to 100

Standard setting : 10

This data is used to set the detecting level of orientation completion signal (ORARA). When the spindle position is located within the setting data on orientation completion, the bit of orientation completion signal (ORARA) in the spindle status signals is set to "1".

Parameter No. 0C	15	16	DATA
6191 6371	3371 3591	4227	Motor speed limit value on orientation

Data unit : 1%
Data range : 0 to 100
Standard setting : 33

This data is used to set the motor speed limit value on orientation.

Speed limit value = Orientation speed of motor × (Setting data)/100 rpm
Orientation speed of motor = Position gain x Gear ratio × 60 rpm

0C	15	16	
6192 6372	3372 3592	4228	Orientation stop position shift value

Data unit : Position coder method → ±1 pulse unit
Magnetic sensor method → ±0.01 degree unit
Data range : Position coder method → −4095 to 4095
Magnetic sensor method → −100 to 100
Standard setting : 0

In the position coder method orientation, set this data to shift stop position.
Spindle is shift No. of setting pulse in CCW direction, and stops by data (+).
This data is used to set the position shift amount from the position where the magnetic sensor faces the magnetizing element on magnetic sensor method orientation stop.
The spindle is shifted in CCW direction by data (+).

0C	15	16	
6193 6373	3373 3593	4229	MS signal constant = $(L/2)/(2\times\pi\times H)\times 4096$

L : Length of magnetizing element (mm)
H : Distance from spindle center to magnetizing element (mm)

Data unit :
Data range : 80 to 1000
Standard setting : 200

In the magnetic sensor method orientation, substitute the followings into the expression above to set the MS signal constant.
L : Length of magnetizing element (mm)
H : Distance from spindle center to magnetizing element (mm)
Normally, calculate the magnetic generating object length as L = 50 mm.

Parameter No.

0C	15	16	DATA
6194	3374	4230	MS signal gain adjustment
6374	3594		

Data unit :
Data range : −128 to +127
Standard setting : 0

Use this parameter when adjusting the amplitude of the MS signal in the magnetic sensor method orientation.

0C	15	16	
6195	3375	4231	Limitation of regenerative power (DECDT)
6375	3595		

Data unit : 1%
Data range : 0 to 100
Standard setting : Depends on the motor model.

0C	15	16	
6196	3376	4232	Delay time until the motor power is cut off
6376	3596		

Data unit : 10 ms
Data range : 0 to 1000
Standard setting : 20 (200 ms)

The motor power is cut off after stopping the motor (zero speed is detected).
However, when the power is cut off immediately after detecting the zero speed signal, the motor may be operated at low speed due to force of habit.
Detect the zero speed signal and then set the time until the motor power is cut off by this parameter.

0C	15	16	
6197	3377	4233	Time setting during acceleration/deceleration
6377	3597		

Data unit : 1 sec
Data range : 0 to 255
Standard setting : 10 (10 sec)

When the deviation between the velocity command and motor speed exceeds the setting level, an velocity error excess alarm occurs.
However, if the velocity command is changed during acceleration/deceleration, the motor speed cannot follow it. Thus, a velocity error excess alarm occurs.
In this case, set the acceleration/deceleration time for preventing velocity error excess alarm from occurring even if there is a speed error during the time set by this parameter. When the lathe load inertia is large, the acceleration/deceleration time becomes longer. Thus, set the value accordingly.

Parameter No.

DATA

0C	15	16
6200	3380	4236
6380	3600	

Motor voltage setting on normal rotation

0C	15	16
6201	3381	4237
6381	3601	

Motor voltage setting on orientation

0C	15	16
6202	3382	4238
6382	3602	

Motor voltage setting on servo mode

Data unit : 1%
Data range : 0 to 100
Standard setting : Depends on the motor mode.

0C	15	16
6203	3383	4239
6383	3603	

The reduction rate of position loop gain in returning to the reference point on servo mode

Data unit : 1%
Data range : 0 to 100
Standard setting : 100 (100%)

This sets the reduction rate of position gain in returning to the reference point in servo mode (rigid tap/Cs axis control etc.)

0C	15	16
6204	3384	4240
6384	3604	

Feedforward coefficient

Data unit : 1%
Data range : 0 to 100 (0 to 100%)
Standard setting : 0

Set the feedforward coefficient when feedforward control is executed in servo mode (rigid tap, Cs axis control).

0C	15	16
6205	3385	4241
6385	3605	

Velocity loop feedforward coefficient

Data unit :
Data range : 0 to 32767
Standard setting : 0

Set the velocity loop feed forward coefficient when feed forward control is executed in servo mode (rigid tap, Cs axis control).

0C	15	16
6220	3400	4256
6400	3620	

Base speed of motor output specifications

Data unit : 1 rpm
(when parameter SPDUNT (No. 6146#2) = 1, 10 rpm)

Data range : 0 to 32767
Standard setting : Depends on the motor model.

Parameter No.

0C	15	16	DATA
6221 6401	3401 3621	4257	Limit value for motor output specifications

Data unit : 1%
Data range : 0 to 100
Standard setting : Depends on the motor model.

0C	15	16	
6222 6402	3402 3622	4258	Base speed

Data unit : 1 rpm
(when parameter SPDUNT (No. 6146#2) = 1, 10 rpm)
Data range : 0 to 32767
Standard setting : Depends on the motor model..

0C	15	16	
6223 6403	3403 3623	4259	Magnetic flux down start speed

Data unit : 1 rpm
(when parameter SPDUNT (No. 6146#2) = 1, 10 rpm)
Data range : 0 to 32767
Standard setting : Depends on the motor model.

0C	15	16	
6224 6404	3404 3624	4260	Current loop proportion gain data

Data unit :
Data range : 0 to 32767
Standard setting : Depends on the motor model.

0C	15	16	
6225 6405	3405 3625	4261	Current loop integral gain data

Data unit :
Data range : 0 to 32767
Standard setting : Depends on the motor model.

0C	15	16	
6226 6406	3406 3626	4262	Current loop integral gain zero point

Data unit : 1 rpm
(when parameter SPDUNT (No. 6146#2) = 1, 10 rpm)
Data range : 0 to 32767

Standard setting : Depends on the motor model.

Parameter No.

0C	15	16	DATA
6227	3407	4263	Current loop proportion gain speed coefficient
6407	3627		

Data unit : 1%
Data range : 0 to 100
Standard setting : Depends on the motor model.

0C	15	16	
6228	3408	4264	Current conversion constant
6408	3628		

Data unit :
Data range : 0 to 32767
Standard setting : Depends on the motor model.

0C	15	16	
6229	3409	4265	Secondary current coefficient for excitation current
6409	3629		

Data unit :
Data range : 0 to 100
Standard setting : Depends on the motor model.

0C	15	16	
6230	3410	4266	Current prediction constant
6410	3630		

Data unit :
Data range : 0 to 32767
Standard setting : Depends on the motor model.

0C	15	16	
6231	3411	4267	Slip constant
6411	3631		

Data unit :
Data range : 0 to 32767
Standard setting : Depends on the motor model.

0C	15	16	
6232	3412	4268	Slip compensation constant of high-speed rotation
6412	3632		

Data unit :
Data range : 0 to 255
Standard setting : Depends on the motor model.

0C	15	16	
6233	3413	4269	Motor applied voltage compensation constant by dead time
6413	3633		

Data unit : 1%
Data range : 0 to 100
Standard setting : Depends on the motor model.

Parameter No.

0C	15	16	DATA
6234	3414	4270	Electromotive voltage compensation coefficient
6414	3634		

Data unit : 1%
Data range : 0 to 200
Standard setting : Depends on the motor model.

0C	15	16	
6235	3415	4271	Electromotive voltage phase compensation coefficient
6415	3635		

Data unit : 1%
Data range : 0 to 100
Standard setting : Depends on the motor model.

0C	15	16	
6236	3416	4272	Electromotive voltage compensation speed coefficient
6416	3636		

Data unit : 1%
Data range : 0 to 100
Standard setting : Depends on the motor model.

0C	15	16	
6237	3417	4273	Time constant of torque change
6417	3637		

Data unit : 1 ms
Data range : 0 to 1000
Standard setting : 5

0C	15	16	
6238	3418	4274	Load meter display value on maximum output
6418	3638		

Data unit : 1%
Data range : 0 to 500
Standard setting : Depends on the motor model.

0C	15	16	
6239	3419	4275	Maximum output limit zero point
6419	3639		

Data unit : 1 rpm
(When parameter SPDUNT (No. 6146#2) = 1, 10rpm)
Data range : 0 to 32767
Standard setting : Depends on the motor model.

Parameter No.

0C	15	16	DATA
6240	3420	4276	Secondary electrical current coefficient on rigid tap
6420	3640		

Data unit :
Data range : 0 to 100
Standard setting : Depends on the motor model.

0C	15	16	
6241	3421	4277	Electromotive voltage phase compensation constant on deceleration
6421	3641		

Data unit : 1%
Data range : 0 to 100
Standard setting : Depends on the motor model.

0C	15	16	
6242	3422	4278	Speed detection filter time constant
6422	3642		

Data unit : 0.1 ms
Data range : 0 to 10000
Standard setting : 0

0C	15	16	
6244	3424	4280	Time constant for voltage filter used for electromotive force compensation
6424	3644		

(9A11.D, 9A21.A, 9A50.A)

Data unit: 1 ms
Data range: 0 to 8191
Standard setting: 0

(4) Low speed area parameters for sub spindle both with speed range switching control and with spindle selector control

Parameter No.

0C	15	16	DATA
6248	3428	4284	Motor voltage setting on normal rotation
6428	3648		

0C	15	16	
6249	3429	4285	Moror voltage setting on servo mode
6429	3649		

Data unit : 1%
Data range : 0 to 100
Standard setting : Depends on the motor model.

Parameter No.

0C	15	16	DATA
6250	3430	4286	Base speed of motor output specifications
6430	3650		

Data unit : 1 rpm
(when parameter SPDUNT (No. 6146#2) = 1, 10 rpm)
Data range : 0 to 32767
Standard setting : Depends on the motor model.

0C	15	16	
6251	3431	4287	Limit value for motor output specifications
6431	3651		

Data unit : 1%
Data range : 0 to 100
Standard setting : Depends on the motor model.

0C	15	16	
6252	3432	4288	Base speed
6432	3652		

Data unit : 1 rpm
(when parameter SPDUNT (No. 6146#2) = 1, 10 rpm)
Data range : 0 to 32767
Standard setting : Depends on the motor model.

0C	15	16	
6253	3433	4289	Magnetic flux down start speed
6433	3653		

Data unit : 1 rpm
(when parameter SPDUNT (No. 6146#2) = 1, 10 rpm)
Data range : 0 to 32767
Standard setting : Depends on the motor model.

0C	15	16	
6254	3434	4290	Current loop proportion gain data
6434	3654		

Data unit :
Data range : 0 to 32767
Standard setting : Depends on the motor model.

0C	15	16	
6255	3435	4291	Current loop integral gain data
6435	3655		

Data unit :
Data range : 0 to 32767
Standard setting : Depends on the motor model.

Parameter No.

0C	15	16	DATA
6256	3436	4292	Current loop integral gain zero point
6436	3656		

Data unit : rpm
(when parameter SPDUNT (No. 6146#2) = 1, 10 rpm)
Data range : 0 to 32767
Standard setting : Depends on the motor model.

0C	15	16	
6257	3437	4293	Current loop proportion gain speed coefficient
6437	3657		

Data unit : 1%
Data range : 0 to 100
Standard setting : Depends on the motor model.

0C	15	16	
6258	3438	4294	Current conversion constant
6438	3658		

Data unit :
Data range : 0 to 32767
Standard setting : Depends on the motor model.

0C	15	16	
6259	3439	4295	Secondary current coefficient for excitation current
6439	3659		

Data unit :
Data range : 0 to 100
Standard setting : Depends on the motor model.

0C	15	16	
6260	3440	4296	Current prediction constant
6440	3660		

Data unit :
Data range : 0 to 32767
Standard setting : Depends on the motor model.

0C	15	16	
6261	3441	4297	Slip constant
6441	3661		

Data unit :
Data range : 0 to 32767
Standard setting : Depends on the motor model.

0C	15	16	
6262	3442	4298	Slip compensation constant of high-speed rotation
6442	3662		

Data unit :
Data range : 0 to 255
Standard setting : Depends on the motor model.

Parameter No.

0C	15	16	DATA
6263	3443	4299	Motor applied voltage compensation constant by dead time
6443	3663		

Data unit : 1%
Data range : 0 to 100
Standard setting : Depends on the motor model.

0C	15	16	
6264	3444	4300	Electromotive voltage compensation coefficient
6444	3664		

Data unit : 1%
Data range : 0 to 200
Standard setting : Depends on the motor model.

0C	15	16	
6265	3445	4301	Electromotive voltage phase compensation coefficient
6445	3665		

Data unit : 1%
Data range : 0 to 100
Standard setting : Depends on the motor model.

0C	15	16	
6266	3446	4302	Electromotive voltage compensation speed coefficient
6446	3666		

Data unit : 1%
Data range : 0 to 100
Standard setting : Depends on the motor model.

0C	15	16	
6267	3447	4303	Time constant of torque change
6447	3667		

Data unit : 1 ms
Data range : 0 to 1000
Standard setting : 5

0C	15	16	
6268	3448	4304	Maximum output limit zero point
6448	3668		

Data unit : 1 rpm
(when parameter SPDUNT (No. 6146#2) = 1, 10 rpm)
Data range : 0 to 32767
Standard setting : Depends on the motor model.

Parameter No.

0C	15	16	DATA
6269 6449	3449 3669	4305	Secondary electrical current coefficient on rigid tap

Data unit :
Data range : 0 to 100
Standard setting : Depends on the motor model.

0C	15	16	
6270 6450	3450 3670	4306	Electromotive voltage phase compensation constant on deceleration

Data unit : 1%
Data range : 0 to 100
Standard setting : Depends on the motor model.

0C	15	16	
6271 6451	3451 3671	4307	Regenerative power limit

(9A11.D, 9A21.A, 9A50.A)

Data unit : 1%
Data range : 0 to 100
Standard setting : 0

0C	15	16	
6272 6452	3452 3672	4308	Time constant for voltage filter used for electromotive force compensation

(9A11.D, 9A21.A, 9A50.A)

Data unit : 1 ms
Data range : 0 to 8191
Standard setting : 0

0C	15	16	
6273 6453	3453 3673	4309	Motor model code (MODELD)

Data unit :
Data range : 0 to 63 (for standard motors)
64 to 93 (for speed range switch motors)
Standard setting : Depends on the motor model.

Set the model code when setting the first parameter of the spindle motor.
At this time it is necessary to set the following parameters simultaneously.

Series 0-C : Parameter (PRLOAD No.6159#7) = 1
Series 15 : Parameter (PRLOAD No.5607#0) = 0
Series 16 : Parameter (PRLOAD No.4195#0) = 1

Parameter No.

0C	15	16	DATA
6312	3492	4348	Overload current alarm detection level (for low-speed characteristics)
6492	3712		

(9A50.I)

Data unit :
Data range : 0 to 32767
Standard setting : Depends on the motor model.

0C	15	16	
6313	3493	4349	Overload current alarm detection time constant
6493	3713		

(9A50.H)

Data unit : 1 second
Data range : 0 to 32767
Standard setting : Depends on the motor model.

0C	15	16	
6314	3494	4350	Overload current alarm detection level (for high-speed characteristics)
6494	3714		

(9A50.H)

Data unit :
Data range : 0 to 32767
Standard setting : Depends on the motor model.

0C	15	16	
6315	3495	4351	Current detection offset compensation
6495	3715		

Data unit :
Data range : 0 to ± 32767
Standard setting : 0

5.5 Parameter Setting Method

Method of determining the shift amount at spindle phase synchronous control (parameter)

This describes the method of determining the shift amount from the reference point at spindle phase synchronous control (1 rotation signal) and the method of confirming its value.

(Method of determination)

① First, perform phase synchronous control under the following conditions.

* HEAD1 (tool post 1), HEAD2 (tool post 2)
  Excitation of both ON : M03
* Speed synchronization command = 0 : S0
* Shift amount at spindle phase synchronous control = 0

Shift amount at spindle phase synchronous control

When Power Mate
When Series 0, No.6534 = 0
When Series 15, No.3034 = 0
When Series 16

② After phase synchronization, set excitation of HEAD2 to OFF. (M05)
At this time, HEAD 2 is rotated manually.

③ Manually move HEAD 2 up to the position desired for phase synchronization. HEAD2 reads the number of pulses moved from the position phase synchronized in ① by the diagnostic screen.

Number of pulses moved

When Power Mate
When Series 0, No.755
When Series 15, No.1510
When Series 16

④ Set the number of pulses read in ③ as the shift amount at spindle phase synchronous control.

(Method of confirmation)

⑤ Release the speed synchronization and phase synchronous control.

⑥ Perform phase synchronization under the following conditions and confirm that the planned phase synchronization status occurs.

* Excitation of both HEAD1 and HEAD2 is ON : M03
* Speed synchronization command = 0 : S0

6. REPLACING FUSE AND PCB

6.1 Replacing Fuses

(1) Models 1S to 3S

See Appendixes 5 and 6 when replacing fuses on the driver circuit PCB and printed wiring board.

(2) Models 6S to 26S

See Appendixes 5 and 6 when replacing fuses on the spindle control circuit PCB and printed wiring board.

(3) Models 30S and 40S

Before the fuses, F1, F2, F3, F4a, F4b, F5, F6, and F7, on the AC spindle servo unit can be replaced, the unit cover must be opened. Open the cover according to Fig. 6.1.

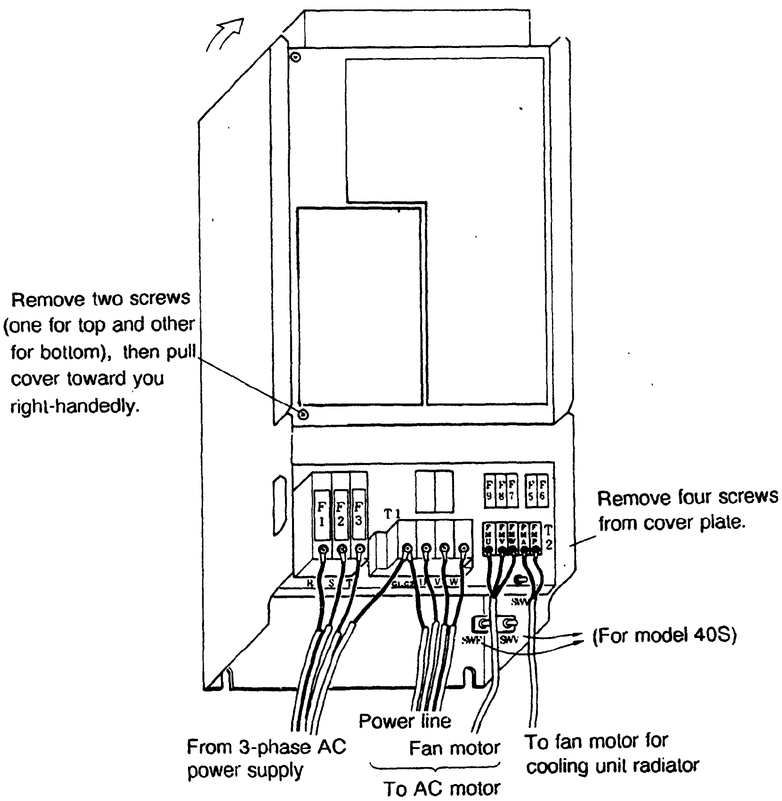


Fig. 6.1 Opening Cover of AC Spindle Servo Unit

6.2 Replacing Spindle Control Circuit PCB, Driver Circuit PCB, and Printed Wiring Board (Models 1S to 26S) (See Appendix 2.)

Note) Before replacing the spindle control circuit PCB or driver circuit PCB or driver circuit PCB, or handling the printed wiring board (models 1S to 26S), be sure to check that the LED indicator (red) used to indicate that charging is in progress is off.

(1) Models 1S to 3S

Table 6.2(a) Replacing PCBs (models 1S to 3S)

Step	Contents
1	Turn off AC power supply (by flipping magnetics cabinet breaker to OFF), then remove motor power line.
2	Remove cable from connector CN14.
3	Remove spindle control circuit PCB by pushing seven PCB holders outward. Then, replace spindle control circuit PCB.
4	Remove driver circuit PCB by removing four screws fastening the PCB to frame, then opening frame stopper outward. Then, replace driver circuit PCB.
5	To replace printed wiring board (Appendix 2), remove all screws except those for fixing electronic parts at top of printed wiring board. Then, replace transistor modules and so forth as required (according to Section 6.3). After replacement, ensure that all screws are firmly tightened.

(2) Models 6S to 26S.

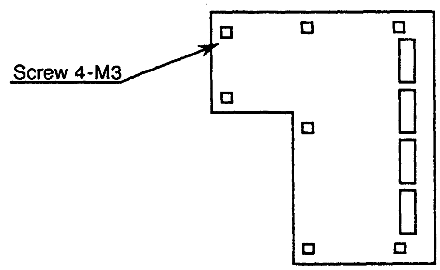
Table 6.2(b) Replacing PCBs (models 6S to 26S)

Steps	Contents
1	Turn off the breaker in the magnetics cabinet supplying AC inputpower, and then remove the motor power line.
2	Remove the spindle control circuit PCB by pushing ten PCB holders outward. Replace the PCB with new one.
3	To replace printed wiring board (Appendix 2), remove all screws except those for fixing electronic parts at top of circuit. Then, replace transistor modules and so forth as required (according to Section 6.3). After replacement, ensure that all screws are firmly tightened.
4	When mounting spindle control circuit PCB, ensure that ten PCB holders and three connectors for connection with printed wiring board are secured.

Note) Always confirm the voltage between plus and minus terminals of capacitor C1 is less than 60 VDC using a tester before handling the control circuit.

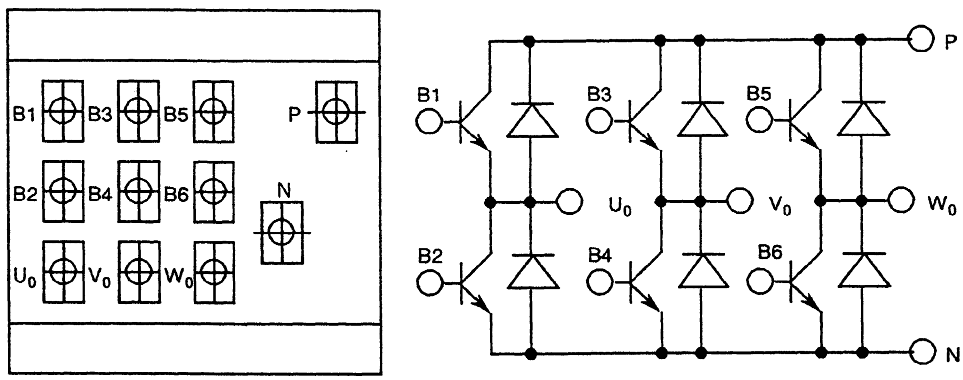
(3) Models 30S and 40S

Table 6.2(c) Replacing PCBs (models 30S, 40S)

Step	Contents
1	Turn off AC power supply (by flipping magnetics cabinet breaker to OFF), then remove motor power line.
2	Remove cable from connector CN14.
3	Remove spindle control circuit PCB by pushing seven PCB holders outward. Then, replace spindle control circuit PCB.
4	Remove driver circuit PCB by removing four screws fastening the PCB to frame. Then, replace driver circuit PCB. 

6.3 Checking Transistor Module

(1) Models 1S to 26S (conventional types)

<table>
<tr><th>Step</th><th>Contents</th></tr>
<tr><td>1</td><td>Turn off the AC power at the circuit breaker of the magnetics cabinet. After the LED on the PCB is turned off, disconnect cables connected to the unit and remove control circuit and driver circuit (1S to 3S) or control circuit (6S to 26S).</td></tr>
<tr><td>2</td><td>Check resistance between the pins of the transistor module on the PCB by using a multimeter.
① +(P) (collector) – U_0, V_0, W_0 (emitter)
② U_0, V_0, W_0 (collector) – -(N) (emitter)
③ +(P) (collector) – B1, B3, B5 (base)
④ U_0, V_0, W_0 (collector) – B2, B4, B6 (base)
⑤ B1, B3, B5 (base) – U_0, V_0, W_0 (emitter)
⑥ B1, B3, B5 (base) – -(N) (emitter)


Criteria (when multimeter range of x 10 ohms is used)
<table>
<tr><th>Terminals subject to check</th><th>Multimeter terminal</th><th>Normal</th><th>Abnormal</th></tr>
<tr><td rowspan="2">C – E
①②</td><td>C: +</td><td>Several hundred ohms</td><td>Short-circuited, infinity</td></tr>
<tr><td>C: –</td><td>Several kilohms to several ten kilohms(*1)</td><td>Short-circuited, several hundred ohms</td></tr>
<tr><td rowspan="2">C – B
③④</td><td>C: +</td><td>Several hundred ohms</td><td>Short-circuited, infinity</td></tr>
<tr><td>C: –</td><td>Several kilohms to several ten kilohms(*1)</td><td>Short-circuited, several hundred ohms</td></tr>
<tr><td rowspan="2">B – E
⑤⑥</td><td>B: +</td><td>Several hundred ohms</td><td>Short-circuited, infinity</td></tr>
<tr><td>B: –</td><td>Several hundred ohms</td><td>Short-circuited, infinity</td></tr>
</table>
*1 Read the multimeter after the multimeter needle stops fluctuation.
When the transistor module fails, short circuit usually results between collector and emitter and between collector and base.</td></tr>
<tr><td>3</td><td>If the transistor module is faulty, replace the AC spindle servo unit.</td></tr>
<tr><td>4</td><td>Connect the motor power line to restart operation.</td></tr>
</table>

Replacing a transistor module determined to be faulty

The method of replacing a transistor module without replacing the AC spindle servo unit is described below. When a transistor module is faulty, the driver circuit (1S to 3S) or control circuit (6S to 26S) may also be faulty. So replace the driver circuit or control circuit at the same time.

1	Replace faulty parts. First remove lower PCB. (See Section 6.2.) Be sure to apply thin coat of silicone grease(*1) at time of replacement.
2	After replacement, mount lower PCB, and tighten all screws firmly. Then recheck resistance between pins of transistor module.
3	Replace driver circuit (1S to 3S) or control circuit (6S to 26S).
4	Connect motor power line to restart operation.

*1 The following silicone grease is recommended:
Shin-Etsu Silicone (G-746): Available from Shin-Etsu Chemical Co., Ltd.

If a transistor module is faulty, the driver circuit may also be faulty. The method of checking if the driver circuit (1S to 3S) or control circuit (6S to 26S) is faulty is described below. This method checks the waveform of the driver circuit.

1 Mount control circuit and driver circuit (1S to 3S) or control circuit (6S to 26S), then check driver waveform.

① Turn on AC power. Never enter rotation direction command (SFR, SRV).
② Set emergency stop signal (*ESP) or machine ready signal (MRDY) to 0.
③ With multimeter, check base-emitter voltages of phases U, V, W, R, S, and T of transistor module at the pins of the connectors. When making measurements, be careful not to damage connectors.

> Pay particular attention to high voltage (300 VDC) appearing around each connector.

Connector pin assignment

CN4

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		B1	B3	B5	B2	B4	B6	N1	N1	U0	V0	W0		

CN5

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		B2R	B4R	B6R	N2	N2	R2	S2	T2					

CN6

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
										B1R	B3R	B5R		

1 (Continued)

Measurement points (with underlined points used as reference)

① B1−<u>U0</u>	⑦ B5R−<u>R2</u>
② B3−<u>V0</u>	⑧ B3R−<u>S2</u>
③ B5−<u>W0</u>	⑨ B1R−<u>T2</u>
④ B2−<u>N1</u>	⑩ B6R−<u>N2</u>
⑤ B4−<u>N1</u>	⑪ B4R−<u>N2</u>
⑥ B6−<u>N1</u>	⑫ B2R−<u>N2</u>

Criteria (voltage between base and emitter, with emitter used as reference)

Normal	About -0.8 V to -1.3 V
Abnormal	Voltage beyond normal range

2

[Checking driver waveform]

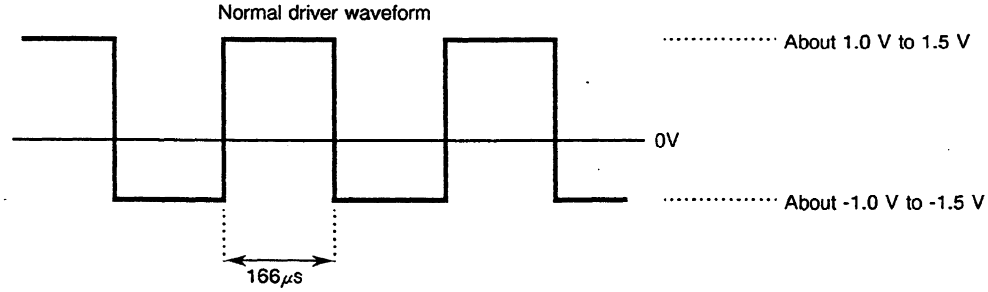
Normal driver waveform obtained when rotation command (SFR, SRV) is entered is shown below. Waveform not conforming to waveform shown below is abnormal. Use this waveform when checking by using multimeter is difficult.

Procedure:

① Turn off AC power.
② Flip setting pin S5 on driver circuit or control circuit to B (OFF) to turn off MCC.
③ Turn on AC power.
④ Set emergency stop signal (*ESP) and machine ready signal (MRDY) to 1. (At this time, MCC is not turned on.)
⑤ Enter rotation direction command (SFR, SRV). At this time, specify speed of 0 rpm.
⑥ Check waveform between emitters and bases of transistor module. ① to ⑥ are all available measurement points.

Be sure to use insulated oscilloscope to check waveform.

Normal driver waveform



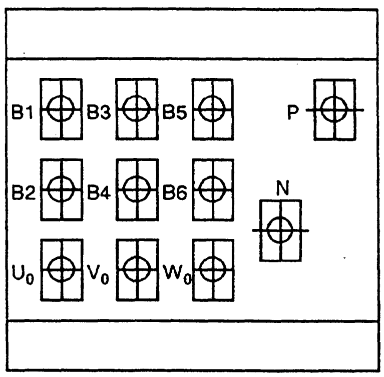
3

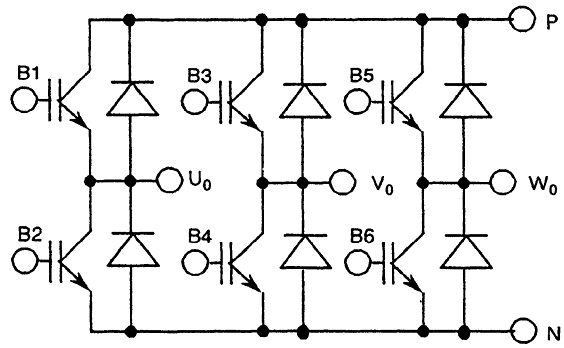
If driver circuit is determined to be faulty, take actions below.

(1) Driver circuit has fuses F3A to F3M. With multimeter, check if these fuses have blown.
(2) Replace blown fuse if any. Then, by checking driver waveform, check that all trouble has been corrected.

(2) Models 1S to 26S (improved types)

<table>
<tr><th>Step</th><th>Contents</th></tr>
<tr><td>1</td><td>Turn off AC power (by flipping magnetics cabinet breaker to OFF), then disconnect cables connected to unit and remove driver circuit and control circuit after LED on PCB is turned off.</td></tr>
<tr><td>2</td><td>
Check resistance values between pins of IGBT module on PCB by using multimeter.
① +(P) (collector) – U_0, V_0, W_0 (emitter)
② U_0, V_0, W_0 (collector) – -(N) (emitter)
③ +(P) (collector) – B1, B3, B5 (gate)
④ U_0, V_0, W_0 (collector) – B2, B4, B6 (gate)
⑤ B1, B3, B5 (gate) – U_0, V_0, W_0 (emitter)
⑥ B1, B3, B5 (gate) – -(N) (emitter)





Criteria (when multimeter range of x 10 ohms is used)
<table>
<tr><th>Terminals subject to check</th><th>Multimeter terminal</th><th>Normal</th><th>Abnormal</th></tr>
<tr><td rowspan="2">C – E
①②</td><td>C: +</td><td>Several hundred ohms</td><td>Short-circuited, infinity</td></tr>
<tr><td>C: –</td><td>Several kilohms to several ten kilohms(*1)</td><td>Short-circuited, several hundred ohms</td></tr>
<tr><td rowspan="2">C – B
③④</td><td>C: +</td><td>Several kilohms to several ten kilohms</td><td>Short-circuited, several hundred ohms</td></tr>
<tr><td>C: –</td><td>Several kilohms to several ten kilohms</td><td>Short-circuited, several hundred ohms</td></tr>
<tr><td rowspan="2">B – E
⑤⑥</td><td>B: +</td><td>Several kilohms to several ten kilohms</td><td>Short-circuited, several hundred ohms</td></tr>
<tr><td>B: –</td><td>Several kilohms to several ten kilohms</td><td>Short-circuited, several hundred ohms</td></tr>
</table>

*1 Read multimeter after multimeter needle stops fluctuation.
When IGBT module fails, short circuit usually results between collector and emitter and between collector and gate.
</td></tr>
<tr><td>3</td><td>If IGBT module is faulty, replace AC spindle servo unit.</td></tr>
<tr><td>4</td><td>Connect motor power line to restart operation.</td></tr>
</table>

Replacing an IGBT module determined to be faulty

The method of replacing an IGBT module without replacing the AC spindle servo unit is described below. When an IGBT module is faulty, the driver circuit may also be faulty. So replace the driver circuit at the same time.

1	Replace faulty part. First remove lower PCB. (See Section 6.2.) Be sure to apply thin coat of silicone grease(*1) at time of replacement.
2	After replacement, mount lower PCB, and tighten all screws firmly. Then recheck resistance values between pins of IGBT module.
3	Replace driver circuit.
4	Connect motor power line to restart operation.

*1 The following silicone grease is recommended:
Shin-Etsu Silicone (G-746): Available from Shin-Etsu Chemical., Ltd.

If an IGBT module is faulty, the driver circuit may also be faulty. The method of checking if the driver circuit is faulty is described below. This method checks the waveform of the driver circuit.

1 Mount control circuit and driver circuit, then check driver waveform.

① Turn on AC power. Never enter rotation direction command (SFR, SRV).
② Set emergency stop signal (*ESP) or machine ready signal (MRDY) to 0.
③ With multimeter, check gate-emitter voltages of phases U, V, W, R, S, and T of IGBT module by using connectors. When making measurements, be careful not to damage connectors.

> Pay particular attention to high voltage (300 VDC) appearing around each connector.

Connector signal assignment

CN4

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		B1	B3	B5	B2	B4	B6		N1	U0	V0	W0		

CN5

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		B2R	B4R	B6R	N2		R2	S2	T2					

CN6

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
										B1R	B3R	B5R		

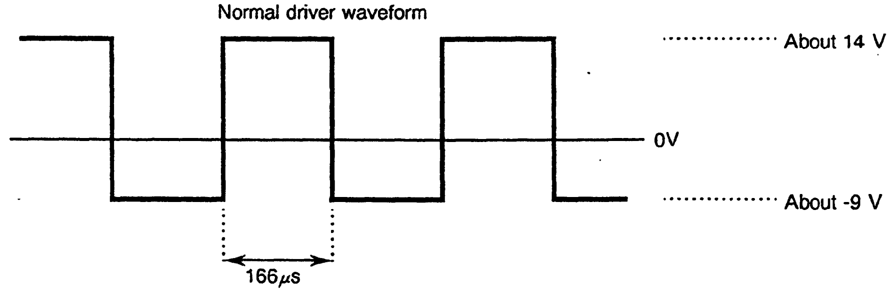
<table>
<tr><td>1
(Conti-
nued)</td><td>Measurement points (with underlined points used as reference)
① B1−<u>U0</u> ⑦ B5R−<u>R2</u>
② B3−<u>V0</u> ⑧ B3R−<u>S2</u>
③ B5−<u>W0</u> ⑨ B1R−<u>T2</u>
④ B2−<u>N1</u> ⑩ B6R−<u>N2</u>
⑤ B4−<u>N1</u> ⑪ B4R−<u>N2</u>
⑥ B6−<u>N1</u> ⑫ B2R−<u>N2</u>

Criteria (voltage between gate and emitter, with emitter used as reference)
<table><tr><td>Normal</td><td>About -9 V</td></tr><tr><td>Abnormal</td><td>Voltage other than normal voltages</td></tr></table></td></tr>
<tr><td>2</td><td>[Checking driver waveform]

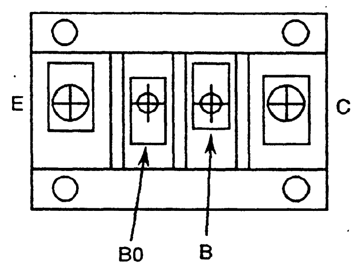
Normal driver waveform obtained when rotation command (SFR, SRV) is entered is shown below. Waveform not conforming to waveform shown below is abnormal. Use this waveform when checking by using multimeter is difficult.

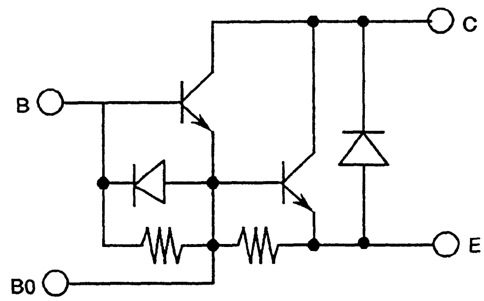
Procedure:
① Turn off AC power.
② Flip setting pin S5 on driver circuit to B (OFF) to turn off MCC.
③ Turn on AC power.
④ Set emergency stop signal (*ESP) and machine ready signal (MRDY) to 1. (At this time, MCC is not turned on.)
⑤ Enter rotation direction command (SFR, SRV). At this time, specify speed of 0 rpm.
⑥ Check waveform between gates and emitters of IGBT module. ① to ⑥ are all available measurement points.

Be sure to use insulated oscilloscope to check waveform.

Normal driver waveform

</td></tr>
<tr><td>3</td><td>If driver circuit is determined to be faulty, replace it.</td></tr>
<tr><td>4</td><td>Connect motor power line to restart operation.</td></tr>
</table>

(3) Models 30S, 40S

<table>
<tr><th>Step</th><th>Contents</th></tr>
<tr><td>1</td><td>Turn off AC power (by flipping magnetics cabinet breaker to OFF), then disconnect cables connected to unit and remove driver circuit.</td></tr>
<tr><td>2</td><td>Check resistance values between pins of transistor module by using multimeter.
① C1 (collector) – E1 (emitter)
C2 (collector) – E2 (emitter)
② C1 (collector) – E1 (base)
C2 (collector) – E2 (base)
③ B1 (base) – E1 (emitter)
B2 (base) – E2 (emitter)




Criteria (when multimeter range of x 10 ohms is used)
<table>
<tr><th>Terminals subject to check</th><th>Multimeter terminal</th><th>Normal</th><th>Abnormal</th></tr>
<tr><td rowspan="2">C – E ①</td><td>C: +</td><td>Several hundred ohms</td><td>Short-circuited, infinity</td></tr>
<tr><td>C: –</td><td>Several kilohms(*1)</td><td>Short-circuited, several hundred ohms</td></tr>
<tr><td rowspan="2">C – B ②</td><td>C: +</td><td>Several hundred ohms</td><td>Short-circuited, infinity</td></tr>
<tr><td>C: –</td><td>Several kilohms(*1)</td><td>Short-circuited, several hundred ohms</td></tr>
<tr><td rowspan="2">B – E ③</td><td>B: +</td><td>Several hundred ohms</td><td>Short-circuited, infinity</td></tr>
<tr><td>B: –</td><td>Several hundred ohms</td><td>Short-circuited, infinity</td></tr>
</table>
*1 Read multimeter after multimeter needle stops fluctuation.
When transistor module fails, short circuit usually results between collector and emitter and between collector and base.</td></tr>
<tr><td>3</td><td>If transistor module is faulty, replace AC spindle servo unit.</td></tr>
<tr><td>4</td><td>Connect motor power line to restart operation.</td></tr>
</table>

Replacing a transistor module determined to be faulty

The method of replacing a transistor module without replacing the AC spindle servo unit is described below. When a transistor module is faulty, the driver circuit may also be faulty. So replace the driver circuit at the same time.

1	Replace faulty part after disconnecting cables and removing short bar. Be sure to apply thin coat of silicone grease(*1) at time of replacement.
2	After replacement, tighten all screws firmly. Then recheck resistance values between pins of transistor module.
3	Replace driver circuit.
4	Connect motor power line to restart operation.

*1 The following silicone grease is recommended:
Shin-Etsu Silicone (G-746): Available from Shin-Etsu Chemical., Ltd.

If a transistor module is faulty, the driver circuit may also be faulty. The method of checking if the driver circuit is faulty is described below. This method checks the waveform of the driver circuit.

1 Mount control circuit and driver circuit, then check driver waveform.

① Turn on AC power. Never enter rotation direction command (SFR, SRV).
② Set emergency stop signal (*ESP) or machine ready signal (MRDY) to 0.
③ With multimeter, check base-emitter voltages of phases U, V, and W, and phase for regenerative circuit of transistor module by using connectors. When making measurements, be careful not to damage connectors.

> Pay particular attention to high voltage (300 VDC) appearing around each connector.

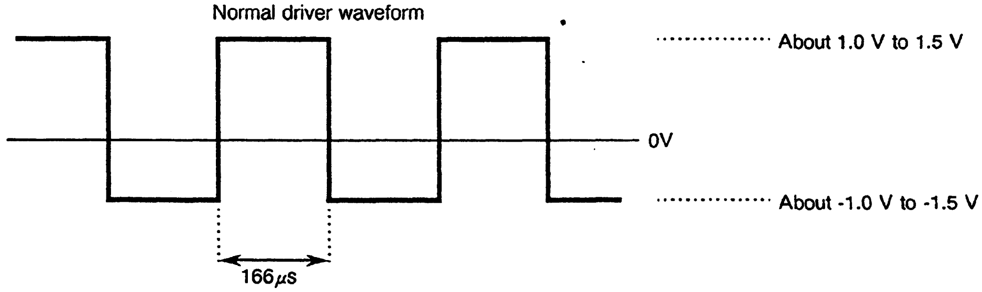
Connector signal assignment

CN6

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

CN7

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

<table>
<tr><td>1
(Conti-
nued)</td><td>
Measurement points (with underlined points used as reference)
① 1B−1E   ⑦ 7B−7E
② 2B−2E   ⑧ 8B−8E
③ 3B−3E
④ 4B−4E
⑤ 5B−5E
⑥ 6B−6E
Criteria (voltage between base and emitter, with emitter used as reference)
<table>
<tr><td>Normal</td><td>About -0.8 V to -1.3 V</td></tr>
<tr><td>Abnormal</td><td>Voltage beyond normal range</td></tr>
</table>
</td></tr>
<tr><td>2</td><td>
[Checking driver waveform]
Normal driver waveform obtained when rotation command (SFR, SRV) is entered is shown below. Waveform not conforming to waveform shown below is abnormal. Use this waveform when checking by using multimeter is difficult.
Procedure:
① Turn off AC power.
② Remove DC link fuse F4.
③ Turn on AC power.
④ Set emergency stop signal (*ESP) and machine ready signal (MRDY) to 1.
⑤ Enter rotation direction command (SFR, SRV). At this time, specify speed of 0 rpm.
⑥ Check waveform between emitters and bases of transistor module. ① to ⑥ are all available measurement points.
Be sure to use insulated oscilloscope to check waveform.
Normal driver waveform


</td></tr>
<tr><td>3</td><td>
If driver circuit is determined to be faulty, take actions below.
(1) Driver circuit has fuses FA to FH. With multimeter, check if these fuses have blown.
(2) Replace blown fuse if any. Then, by checking driver waveform, check that all trouble has been corrected.
</td></tr>
</table>

7. SIGNAL CONVERSION CIRCUIT

This section describes the maintenance operations for the signal conversion circuit which, on the one hand, receives signals from the built-in sensor used in AC spindle motors and built-in motors and, on the other hand, outputs speed detection signals and position coder signals.

An upgraded model A06B-6063-H730 has been added. This model is compatible with the existing three models such as A06B-6044-H603, H605, and H606. (For compatibility, see (1)-(c) in Subsection 7.2.)

7.1 Configurations

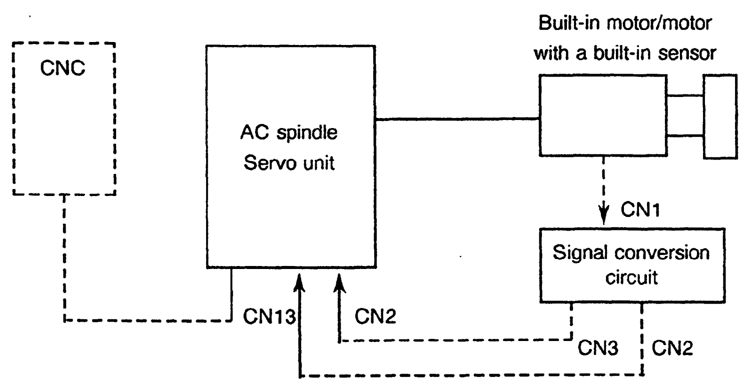


Table 7.1 Configuration elements

Applicable unit	Name	Order drawing No.	Printed circuit board drawing No.	Remarks
Common for all models	Signal conversion circuit	A06B-6044-H603	A20B-9000-0180	
		A06B-6044-H605	A16B-1600-0370	High-speed type
		A06B-6044-H606	A16B-1600-0390	Special type (Note)
		A06B-6063-H730	A16B-1600-0440	Unified upgraded type compatible with the 3 types shown above

Note) This type is used to convert a sensor signal of 512 pulses/rev. to that of 1024 pulses/rev. Normally a signal of 256 pulses/rev. is converted to that of 1024 pulses/rev. However, some models such as 1S, 2S, 3S and 6S/12000 rpm convert it to a signal of 512 pulses/rev.

7.2 Adjusting a Signal Conversion Circuit

It is necessary to execute the following adjustment and output waveform checking procedures especially when the built-in sensor is attached by the user.

(1) Jumper

For the mounting positions for each jumper, see Figures 7.2(a) to (d).

(a) With respect to the printed circuit board with the drawing number of A20B-9000-0180 the figure is applied to those with version number 07C and the later.

No.	Pin No.	Content	Setting	Standard setting
1	SH1, 2 (Note)	Specifying the power source to the signal conversion circuit	A: AC spindle servo unit, supplied from the CN2 side	B
			B: AC spindle servo unit, supplied from the CN13 side	
2	SH3	Phase Z temperature drift	OPEN: With drift offset	OPEN
			SHORT: No drift offset	

Note) Make sure to set both SH01 and 02 on the same side.

(b) In case of the printed circuit board with the drawing number of A16B-1600-0370 or A16B-1600-0390.

No.	Pin No.	Content	Setting	Standard setting
1	SH1, 2 (Note 1)	Specifying the power source to the signal conversion circuit	A: AC spindle servo unit, supplied from the CN2 side	B
			B: AC spindle servo unit, supplied from the CN13 side	
2	SH3	Phase Z temperature drift	A: No drift offset	B
			B: With drift offset	
3	SH4 (Note 2)	Adjusting phase A (between CH7-10) output gain	A: 0.9	B
	SH5 (Note 2)	Adjusting phase B (between CH8-10) output gain	B: 1.0	
			OPEN: 1.1	

Note 1) Make sure to set both SH01 and 02 on the same side.

Note 2) When the Vp-p for the signal between CH20-CH10 or CH21-CH10 is out of the standard range, the signal amplitude can be changed without changing the sensor attaching position. See (2)-(a). However, the Vs does not meet the standard value even after the setting is changed, it is needed to change the attaching position. In addition, this function cannot be used for the printed circuit board with the drawing number of A20B-9000-0180.

(c) In case of the printed circuit board with the drawing number of A!6B-1600-0440

No.	Pin No.	Content	Setting	Standard setting
1	SH1, 2 (Note 1)	Specifying the power source to the signal conversion circuit	A: AC spindle sero unit, supplied from the CN2 side	B
			B: AC spindle sero unit, supplied from the CN13 side	
2	SH3	Phase Z temperature drift	A: No drift offset	B
			B: With drift offset	
3	SH4 (Note 2)	Adjusting phase A (between CH7-10) output gain	A: 0.9	OPEN
			OPEN: 1.0	
	SH5	Adjusting phase B (between CH8-10) output gain	B: 1.1	
4	SH6, 7 (Note 3)	Adjusting the magnifications for number of input signals (SIN wave) and that of output signals (pulse). an example is shown below.		SH6: B SH7: A

SH6	SH7	Magnification	Number of input signals (SIN wave) ⇒ Number of output signals (pulse)	Remarks (on compatibility)
A	A	2	512 ⇒ 1024	Compatible with A16B-1600-0390
B	A	4	256 ⇒ 1024 128 ⇒ 512	Compatible with A20B-9000-0180 and A16B-1600-0370
A	B	8	Not used	
B	B	16	Not used	

Note 1) Make sure to set both SH01 and 02 on the same side.

Note 2) When the Vp-p for the signal between CH20-CH10 or CH21-CH10 is out of the standard range, the signal amplitude can be changed without changing the sensor attaching position. See (2)-(a). However, the Vs does not meet the standard value even after the setting is changed, it is needed to change the attaching position. In addition, this function cannot be used for the printed circuit board with the drawing number of A20B-9000-0180.

Note 3) This function cannot be used for the printed circuit board with the drawing number of A20B-9000-0180, A16B-1600-0370 or 0390.

(2) Adjustment

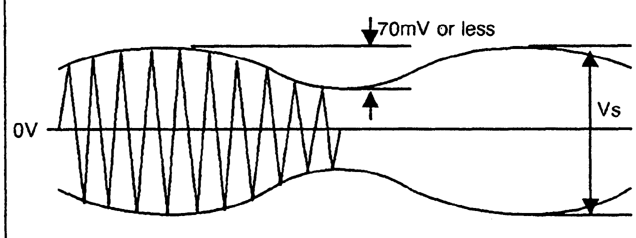
For the mounting positions for each variable resistor and jumper, see Figures 7.2(a) to (d).

(a) Checking an output signal (for speed detection)

Conditions for measurement:

Rotating direction: Normal (CCW)/reverse (CW)

Speed: 1500 rpm

Point to be measured	Vs	Example waveform
CH20-CH10 CH21-CH10 (For A16B-1600-0440) CH28-CH10 CH29-CH10	0.36 to 0.5V	

Note) During mounting, check to make sure that the ripple voltage of the output signal is 70mV or less. If it is over 70mV, the following adjustment may be impossible.

(b) Adjusting offset

Conditions for measurement:

Rotating direction: Normal (CCW)/reverse (CW)

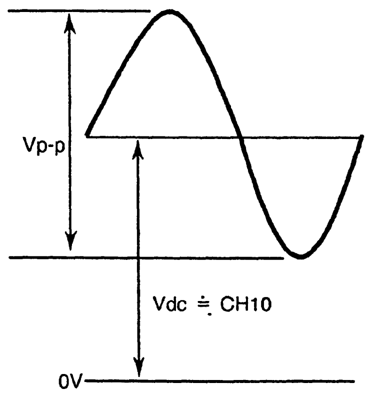
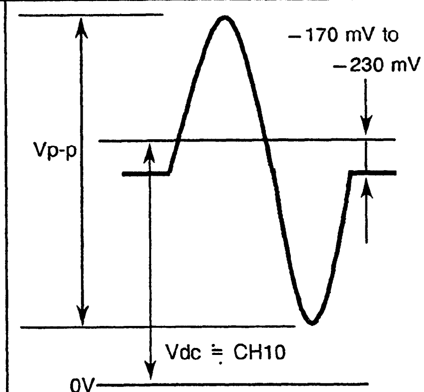
Speed: 1500 rpm

Use a digital voltmeter as a measuring device. (Use its DC range.)

Adjusting part	Point to be measured	Target value for A20B-9000-0180, A16B-1600-0370 and 0390	Target value for A16B-1600-0440	Remarks
VR1	CH7 - CH10	0 ± 56 mV	0 ± 35 mV	Adjust so that the target value is satisfied both clockwise and counterclockwise.
VR2	CH8 - CH10			
VR3	CH9 - CH10	−170mV to −230mV		

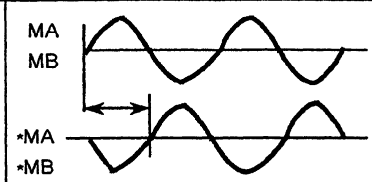
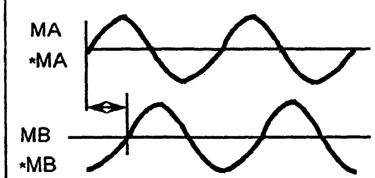
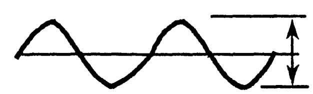
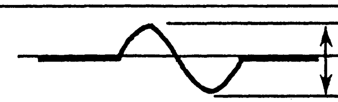
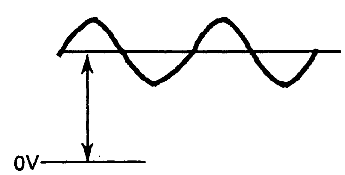
(c) Example waveforms for each adjusted point

When any abnormality is left while adjusting or even after adjustment, monitor the waveform using a synchroscope and the like.

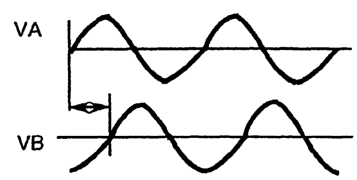
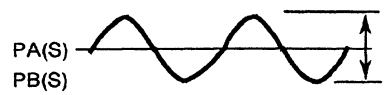
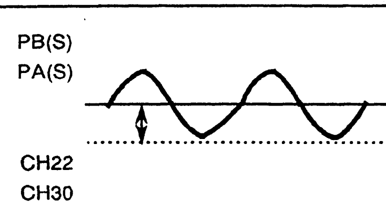
<table>
<tr><th>Point to be measured</th><th colspan="2">CH7-CH11 (0V), CH8-CH11 (0V)</th><th colspan="2">CH9-CH11 (0V)</th></tr>
<tr><td>Example of waveform</td><td colspan="2">
</td><td colspan="2">
</td></tr>
<tr><td rowspan="2">Vp-p
Voltage range</td><td>In case of
A16B-1600-0370, 390 and
A20B-9000-0180</td><td>1.44V to
1.84V</td><td>In case of
A16B-1600-0370, 390 and
A20B-9000-0180</td><td>0.9V to
2.0V</td></tr>
<tr><td>In case of
A16B-1600-0440</td><td>0.9V to
1.15V</td><td>In case of
A16B-1600-0440</td><td>0.9V to
2.0V</td></tr>
<tr><td rowspan="2">CH10
Voltage range
(Voltage between CH10 and CH11)</td><td>In case of
A16B-1600-0370, 390 and
A20B-9000-0180</td><td>2.35V to
2.65V</td><td>In case of
A16B-1600-0370, 390 and
A20B-9000-0180</td><td>2.35V to
2.65V</td></tr>
<tr><td>In case of
A16B-1600-0440</td><td>2.61V to
2.94V</td><td>In case of
A16B-1600-0440</td><td>2.61V to
2.94V</td></tr>
<tr><td rowspan="2">Vdc
Voltage range</td><td>In case of
A16B-1600-0370, 390 and
A20B-9000-0180</td><td>Voltage at
CH10
±56 mV</td><td>In case of
A16B-1600-0370, 390 and
A20B-9000-0180</td><td>2.35V to
2.65V</td></tr>
<tr><td>In case of
A16B-1600-0440</td><td>Voltage at
CH10
±35 mV</td><td>In case of
A16B-1600-0440</td><td>2.61V to
2.94V</td></tr>
</table>

(3) Waveform for each part

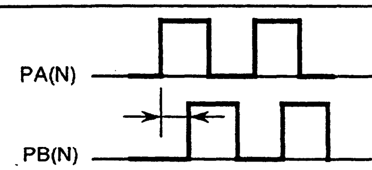
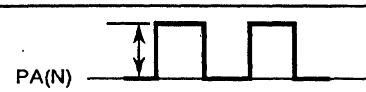
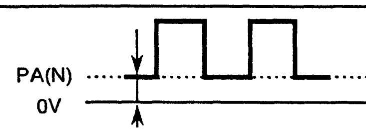
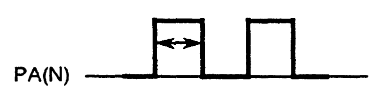
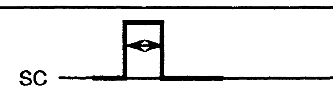
(a) Input waveform (at a constant speed of 1500 rpm)

<table>
<tr><th colspan="2">Point to be measured</th><th>Standard</th><th>Example waveform</th></tr>
<tr><td colspan="2">Phase differences between CH1 (MA) and CH2 (*MA), and CH3 (MB) and CH4 (*MB) (Each waveform is measured using the CH11 (0V) as common.)</td><td>180 ± 6°</td><td>
</td></tr>
<tr><td colspan="2">Phase differences between CH1 (MA) and CH3 (MB), and CH2 (*MA) and CH4 (*MB) (Each waveform is measured using the CH11 (0V) as common.)</td><td>90 ± 3°
(When rotating clockwise viewed from the detection gear side)</td><td>
</td></tr>
<tr><td rowspan="2">Amplitude</td><td>CH1 (MA)
CH2 (*MA)
CH3 (MB)
CH4 (*MB)</td><td>0.33 to 0.46V</td><td></td></tr>
<tr><td>CH5 (MZ)</td><td>0.9 to 2.0V</td><td></td></tr>
<tr><td rowspan="2">Neutral point voltage</td><td>CH1 (MA)
CH2 (*MA)
CH3 (MB)
CH4 (*MB)</td><td>2.5V ± 25mV</td><td rowspan="2">
</td></tr>
<tr><td>CH5 (MZ)</td><td>2.5V ± 35mV</td></tr>
</table>

(b) Output signal 1 (Speed feedback signal) at a constant speed of 1500 rpm

Point to be measured	Standard	Example waveform
Phase differences between CH20 (PA(S)) and CH21 (PB(S)) (Each waveform is measured using the CH11 (0V) as common.)	90 ± 10° (When rotating clockwise viewed from the detection gear side)	
CH20 (PA(S)) CH21 (PB(S)) Amplitude Note) CH28 (PA(S)) CH29 (PB(S)) for A16B-1600-0440	0.32 to 0.54V	
CH22 (RA(S), RB(S)) voltage Note) CH30 (PA(S), PB(S)) for A16B-1600-0440	2.35 to 2.65V Note) 2.61 to 2.91V for A16B-1600-0440	
CH20 (PA(S)) CH21 (PB(S)) neutral point voltage Note) CH28 (PA(S)) CH29 (PB(S)) for A16B-1600-0440	Voltage at CH22 ±15mV Note) Voltage at CH30 ±15mV for A16B-1600-0440	

(c) Output signal 2 (for position coder) at a constant speed of 1500 rpm

Point to be measured		Standard	Example waveform
Phase difference between CH15 (PA(N)) and CH16 (PB(N)) Note) Phase difference between CH16 (PA(N)) and CH17 (PB(N)) for A16B-1600-0440		90 ± 10° (When rotating clockwise viewed from the detection gear side)	
PA (N), PB (N) SC	High level	Minimum 2.5V	
	Low level	Maximum 0.5V	
Duty ratio between PA(N) and PB(N)		50 ± 7%	
Width of CH17 (SC) Note) CH18 (SC) for A16B-1600-0440		116 ± 21μs	

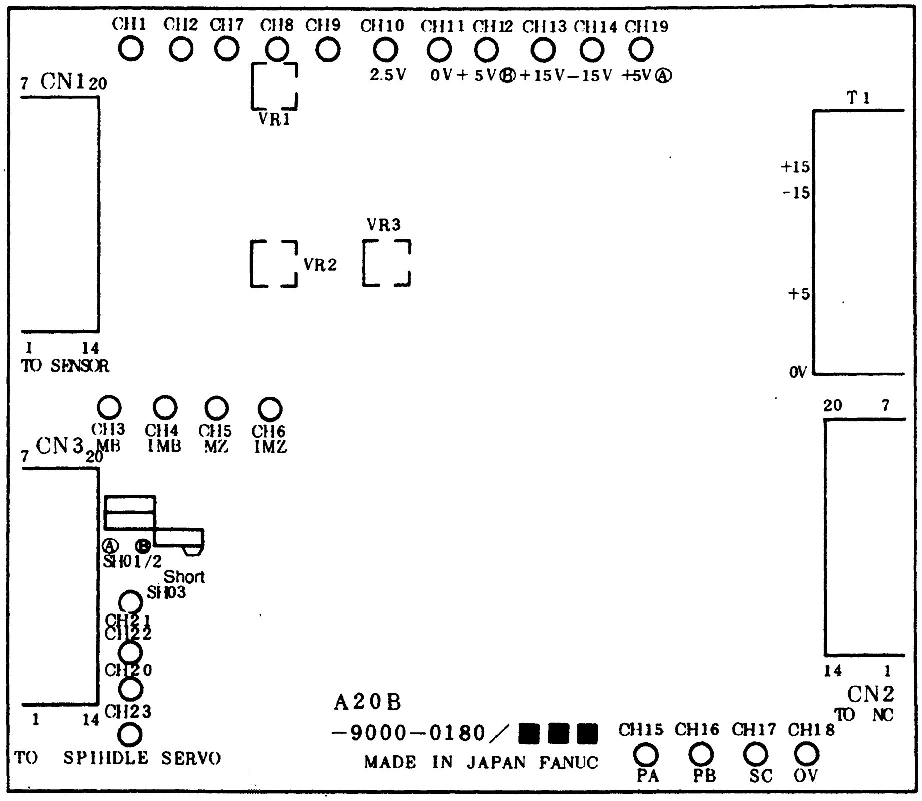


Figure 7.2 (a) Mounting positions for jumper, variable resistors and test points
Printed Circuit board Drawing No. : A20B-9000-0180

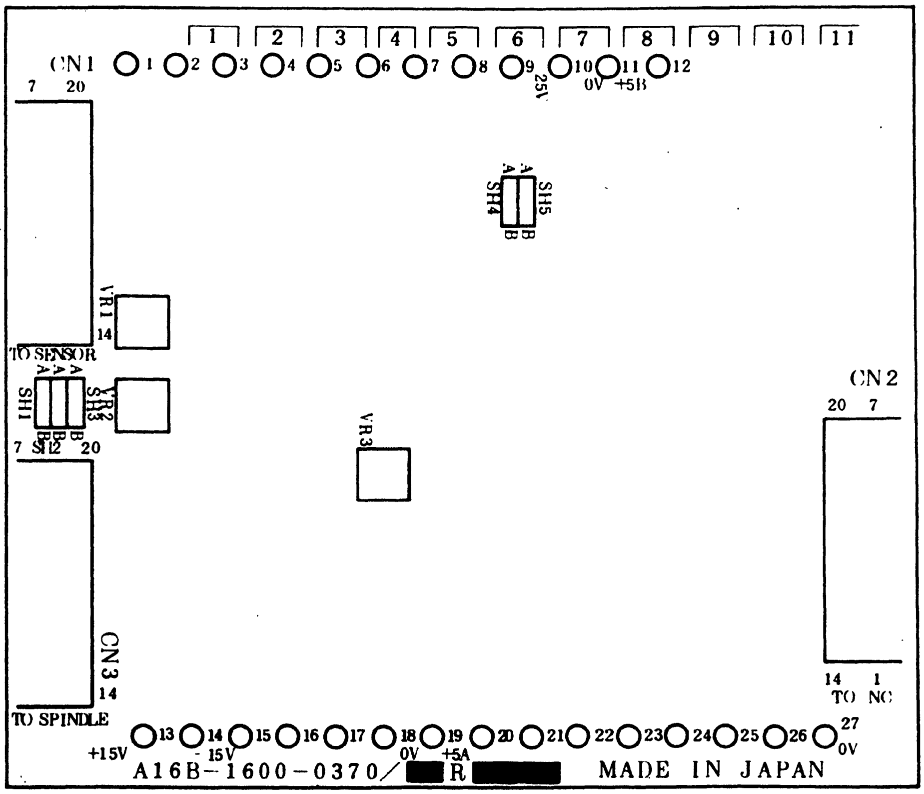


Figure 7.2 (b) Mounting positions for jumper, variable resistors and test points printed circuit board Drawing No. : A16B-1600-0370

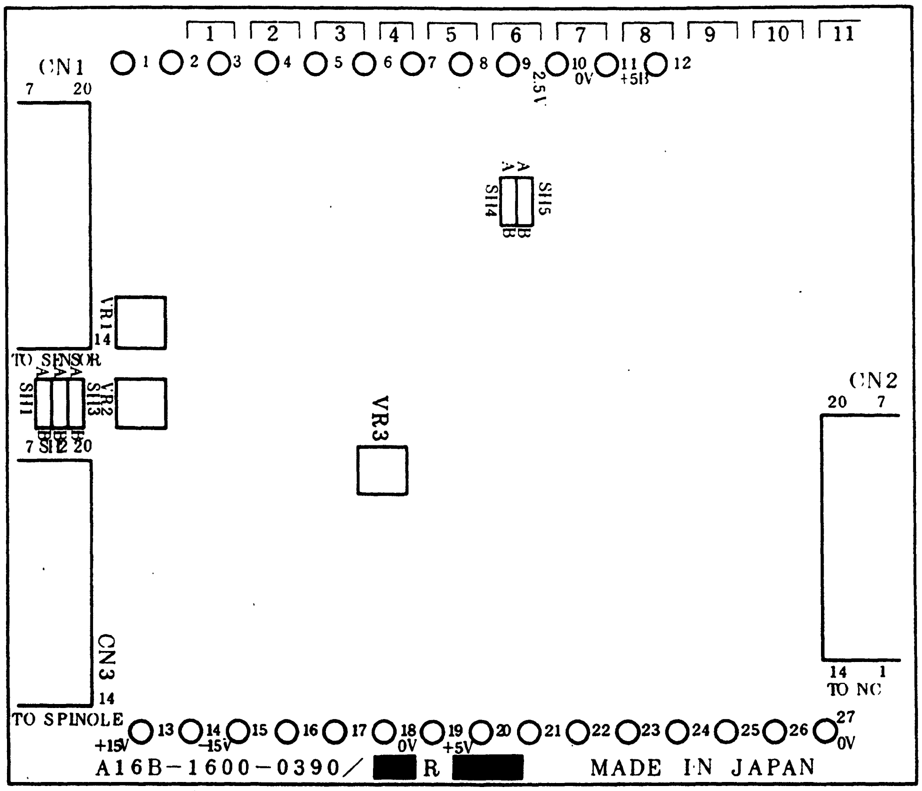


Figure 7.2 (c) Mounting positions for jumper, variable resistors and test points printed circuit board Drawing No. : A16B-1600-0390

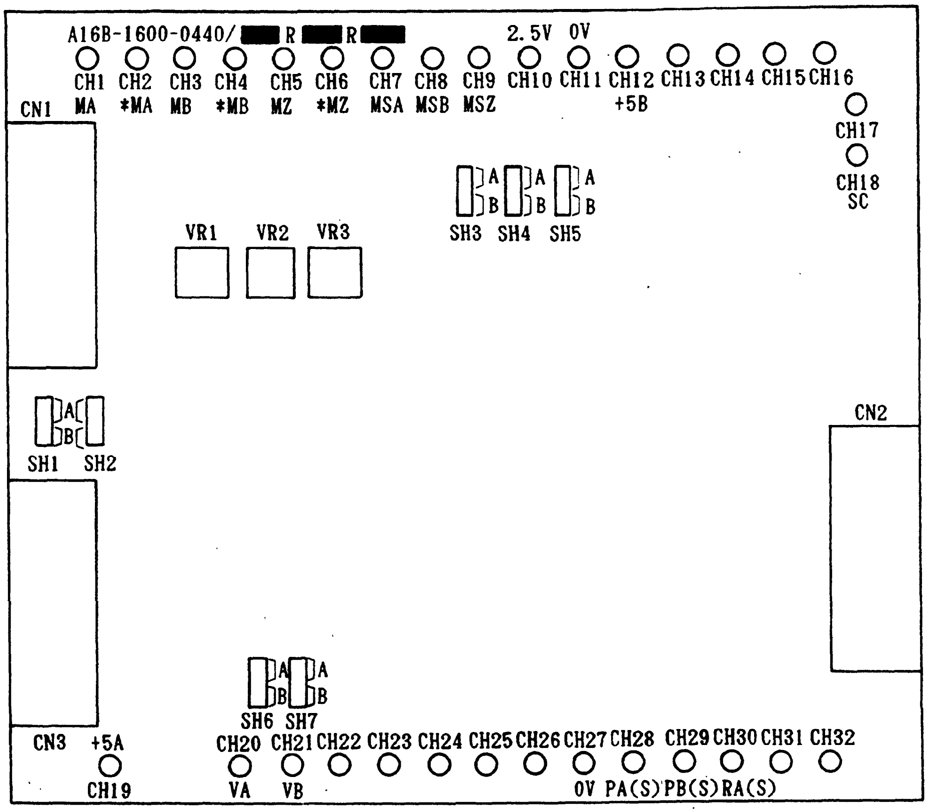


Figure 7.2 (d) Mounting positions for jumper, variable resistors and test points printed circuit board Drawing No. : A16B-1600-0440

II AC SPINDLE SERVO UNIT SERIAL INTERFACE HV series

1. GENERAL

This manual describes how to maintain the AC spindle servo unit serial interface HV series, models 30HV, 40HV, and 60HV.
For items other than those explained below, see Part I, "AC Spindle Servo Unit Serial Interface S series."

1.1 Configuration

Models 30HV, 40HV, and 60HV consist of the following units and components.

(1) Spindle control unit

(2) Spare fuses

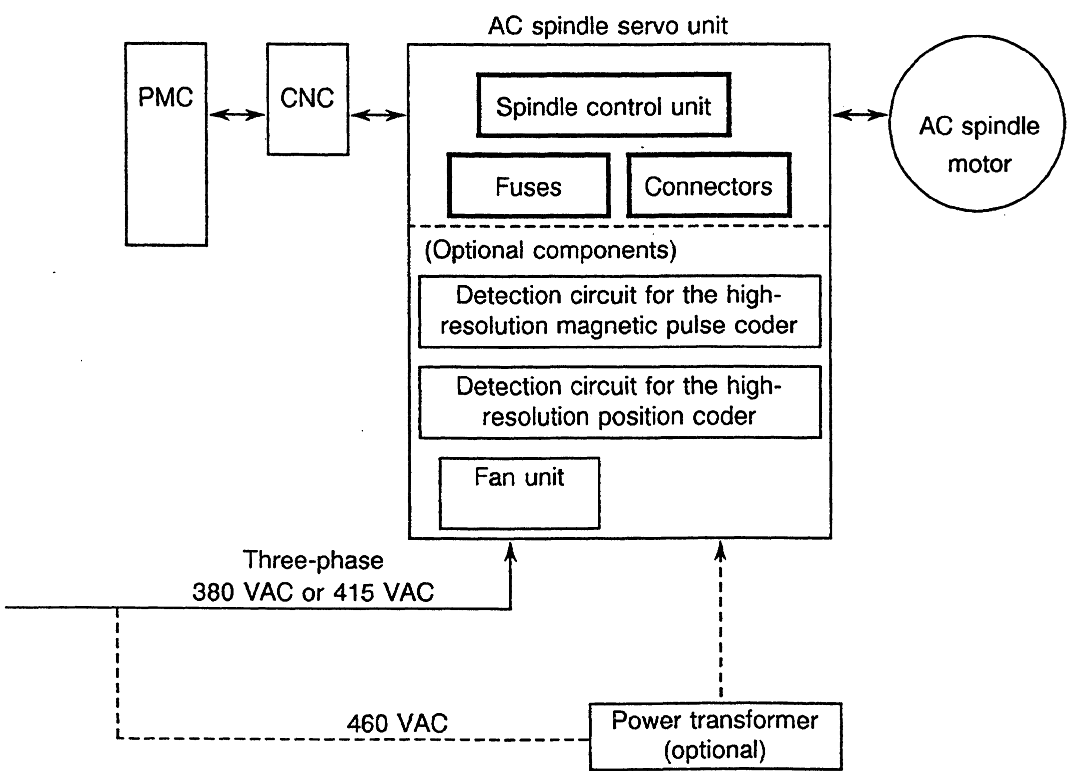
(3) Connectors

(4) Detection circuit for the high-resolution magnetic pulse coder (optional)

(5) High-resolution position coder (optional)

(6) Power transformer (optional for 30HV and 40HV)

(7) Fan unit (optional)



1.2 Ordering Codes and Drawing Numbers

Table 1.2 Ordering Codes and Drawing Numbers

AC spindle servo unit	Ordering code	Unit drawing number	Drawing numbers of the spindle control circuit/ driver circuit PCBs	ROM	
				Number	Series
Model 30HV	A06B-6065-H030#550	A06B-6065-H030	A16B-2201-0440/ A16B-2400-0010	A06B-6064-H550	9A50
Model 40HV	A06B-6065-H040#550	A06B-6065-H040			
Model 60HV	A06B-6065-H060#550	A06B-6065-H060			

2. DAILY MAINTENANCE AND MAINTENANCE PARTS

See Part I, "AC Spindle Servo Unit Serial Interface S series."

3. TROUBLESHOOTING

See Part I, "AC Spindle Servo Unit Serial Interface S series."

4. INSTALLATION

As for items other than those described below, see Part I, "AC Spindle Servo Unit Serial Interface S series."

4.1 Installation Procedure

Check the items listed in Table 4.1.

Table 4.1 Installation Procedure

No.	Description	Remarks
1	Check the specifications of the motor, servo unit, and options.	Check that the appropriate unit, printed circuit boards, and ROM are used with the motor according to Table 1.2.
2	Check that there are no defects in the appearance.	Check that the resistors and printed circuit boards mounted at the top are not damaged.
3	Check the voltage, voltage fluctuation, capacity (kVA), and frequency of the AC power to be used.	See Tables 4.2.1 (a) and (b).
4	Connect the ground wire, wire for the power supply, and power line.	See Section 4.2, Appendix 1, and Chapter 4 of Part I.
5	Check the settings and results of measurement.	See Chapter 5 of Part I.
6	Turn on the AC power. Check that green lamp PIL on the printed circuit board goes on.	See Appendix 6.
7	Issue a rotation command to check the forward and reverse rotation of the motor.	
8	Check that the motor rotates normally in the specified speed range.	

4.2 Connecting the Power

4.2.1 Checking the voltage and capacity of the power

Measure the voltage of the AC power. Depending on the measurement, take action as follows:

Table 4.2.1 (a) Action to be Taken for the AC Power

AC power voltage	Nominal voltage	Action
323 to 418 V	380V	The power can directly be connected. Set the switch for the tap of the transformer used for the control power supply to 380 V.
353 to 456 V	415V	The power can directly be connected. Set the switch for the tap of the transformer used for the control power supply to 415 V.
457 to 506 V	460V	It is necessary to lower the voltage input to the servo unit in the range of 380 to 415 V by using a power transformer.

Table 4.1.1 (b) lists the input voltage specifications of the AC spindle servo unit. Use the AC power with sufficient capacity so that the servo unit does not malfunction due to a voltage drop if the maximum load is applied.

Table 4.2.1 (b) Input Voltage Specifications of the AC Spindle Servo Unit

Nominal rated voltage		Three-phase 380/415 VAC		
Allowable input-voltage fluctuation		-15% to +10%		
Frequency		50/60 ±Hz		
Power capacity	Model	30HV	40HV	60HV
	30-minute rated capacity (kVA)	54	63	100

5. SETTINGS AND ADJUSTMENT

5.1 Settings for the Unit and Printed Circuit Boards

For the locations of parts in the unit and on the printed circuit boards, see Appendix 5, "Part Layout in the Unit" and Appendix 6, "Part Layout on the Printed Circuit Boards."
For settings specified before the power is turned on, see Part I, "AC Spindle Servo Unit Serial Interface S series."

6. HOW TO REPLACE THE FUSES AND PRINTED CIRCUIT BOARDS

6.1 Replacing the Fuses

To replace fuses F1 to F9 in the AC spindle servo unit, open the unit cover as shown in Fig. 6.1.

Replace the fuses on the spindle control circuit PCB and driver circuit PCB according to Appendix 5, "Part Layout in the Unit" and Appendix 6, "Part Layout on the Printed Circuit Boards."

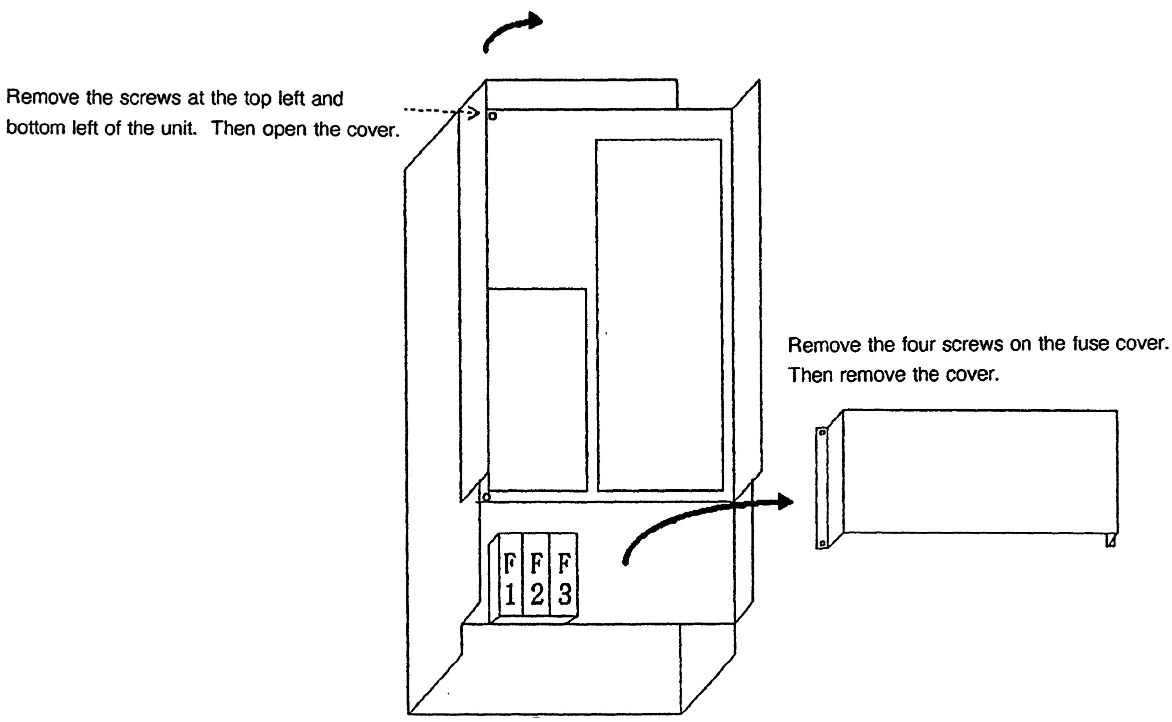
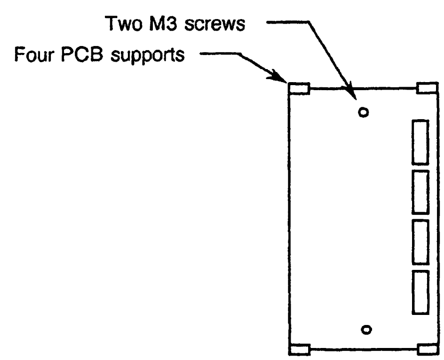


Fig. 6.1 How to Open the Cover of the AC Spindle Servo Unit

6.2 Replacing the Spindle Control Circuit PCB and Driver Circuit PCB (See Appendix 2.)

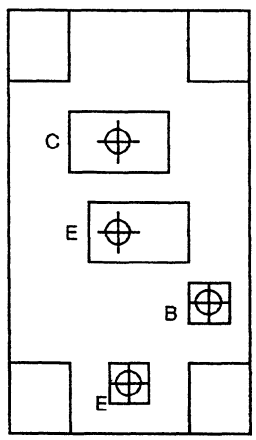
Table 6.2 Procedure for Replacing the PCBs

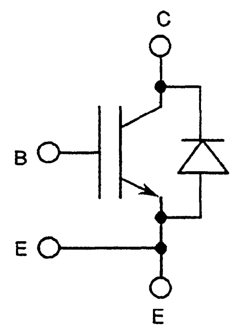
Step	Description
1	Turn off the AC power at the circuit breaker in the power magnetics cabinet. Remove the motor power line.
2	Remove the flat cable connected to CN14.
3	While releasing the seven PCB supports mounted on the frame by pinching them on the outside, replace the spindle control circuit PCB.
4	Remove the two screws at the unit. While releasing the seven PCB supports mounted on the frame by pinching them on the outside, replace the driver circuit PCB. 

6.3 Checking the IGBT Module

<table>
<tr><th>Step</th><th>Contents</th></tr>
<tr><td>1</td><td>Turn off the AC power at the circuit breaker in the magnetics cabinet. After the LED on the PCB goes off, disconnect the cables connected to unit. Remove the driver circuit from the connector.</td></tr>
<tr><td>2</td><td>Measure the resistance between the pins of the IGBT module using a multimeter.

① C (collector) - E (emitter)
② C (collector) - B (gate)
③ B (gate) - E (emitter)





Criteria when the multimeter range of X10 ohms is used

<table>
<tr><th>Resistance to be measured</th><th>Connection of multimeter terminals</th><th>Normal</th><th>Abnormal</th></tr>
<tr><td rowspan="2">Between C and E</td><td>C: +ve</td><td>Several hundred ohms</td><td>Short-circuited, infinity</td></tr>
<tr><td>C: -ve</td><td>About 16 kilohms (Note)</td><td>Short-circuited, several hundred ohms</td></tr>
<tr><td rowspan="2">Between C and B</td><td>C: +ve</td><td>Infinity</td><td>Short-circuited, several hundred ohms</td></tr>
<tr><td>C: -ve</td><td>Infinity</td><td>Short-circuited, several hundred ohms</td></tr>
<tr><td rowspan="2">Between B and E</td><td>C: +ve</td><td>Infinity</td><td>Short-circuited, several hundred ohms</td></tr>
<tr><td>C: -ve</td><td>Infinity</td><td>Short-circuited, several hundred ohms</td></tr>
</table>

Note) Read the multimeter after the needle has completely stopped.
If the IGBT module fails, a short-circuit usually results between the collector and emitter and between the collector and gate.</td></tr>
<tr><td>3</td><td>If the IGBT module is faulty, replace the AC spindle servo unit.</td></tr>
<tr><td>4</td><td>Connect the motor power line to restart operation.</td></tr>
</table>

Replacing an IGBT module determined to be faulty

The procedure for replacing a defective IGBT module without replacing the AC spindle servo unit is described below. When an IGBT module is faulty, the driver circuit may also be faulty. So replace the driver circuit at the same time.

1	Remove the cable and bar plug. Replace the defective IGBT module. Be sure to apply a thin coat of silicone grease (Note) at replacement.
2	After replacement, tighten all the screws firmly. Then check the resistance between the pins of the IGBT module again.
3	Replace the driver circuit.
4	Connect the motor power line to restart operation.

Note) The following silicone grease is recommended:
Shin-Etsu Silicone (G-746): Available from Shin-Etsu Chemical Co., Ltd.

If an IGBT module is faulty, the driver circuit may also be faulty. The procedure for checking if the driver circuit is faulty is described below. This procedure checks the waveform of the driver circuit.

1

Mount the control PCB and driver circuit, then check the IGBT driver circuit.

① Turn on the AC power. Never enter a rotation direction command (SFR or SRV).

② Check the gate-emitter voltage of phases U, V, W, and the regenerative circuit of the IGBT module at the connectors with a multimeter. Be careful not to damage the connectors.

> To prevent electrical shock, do not touch the connectors or their surroundings while carry a high voltage (500 to 600 VDC).

Connector pin assignment

CN4

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

CN5

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

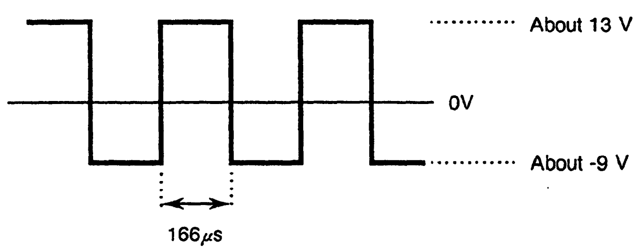
Measure the voltage at the following points. The underlined test pins are used as a reference.

① 1B-<u>1E</u> ⑤ 4B-<u>4E</u>
② 3B-<u>3E</u> ⑥ 6B-<u>6E</u>
③ 5B-<u>5E</u> ⑦ 7B-<u>7E</u>
④ 2B-<u>2E</u> ⑧ 8B-<u>8E</u>

<table>
<tr><td>1
(Continued)</td><td>Criteria (voltage between the gate and emitter, with the emitter used as a reference)
<table><tr><td>Normal</td><td>About -9 V</td></tr><tr><td>Abnormal</td><td>Voltage other than normal voltages</td></tr></table></td></tr>
<tr><td>2</td><td>[Checking driver waveform]
The driver signal normally has the waveform shown below when a rotation command (SFR or SRV) is entered. A waveform not conforming to that shown below is abnormal. When it is difficult to determine whether the driver circuit is defective in procedure 1 described above which uses a multimeter, use this waveform to determine it.

Procedure:
① Turn off the AC power.
② Set pin S5 on the driver circuit to B (OFF) to turn off the MCC.
③ Turn on the AC power.
④ Reset the emergency stop signal (ESP). Set the machine ready signal (MRDY) to 1. (At this time, the MCC is not turned on.)
⑤ Enter a rotation direction command (SFR, SRV). At this time, specify a speed of 0 rpm.
⑥ Check the waveform between the gates and emitters of the IGBT module at ① to ⑥ only.

Be sure to use an insulated oscilloscope to check the waveforms.

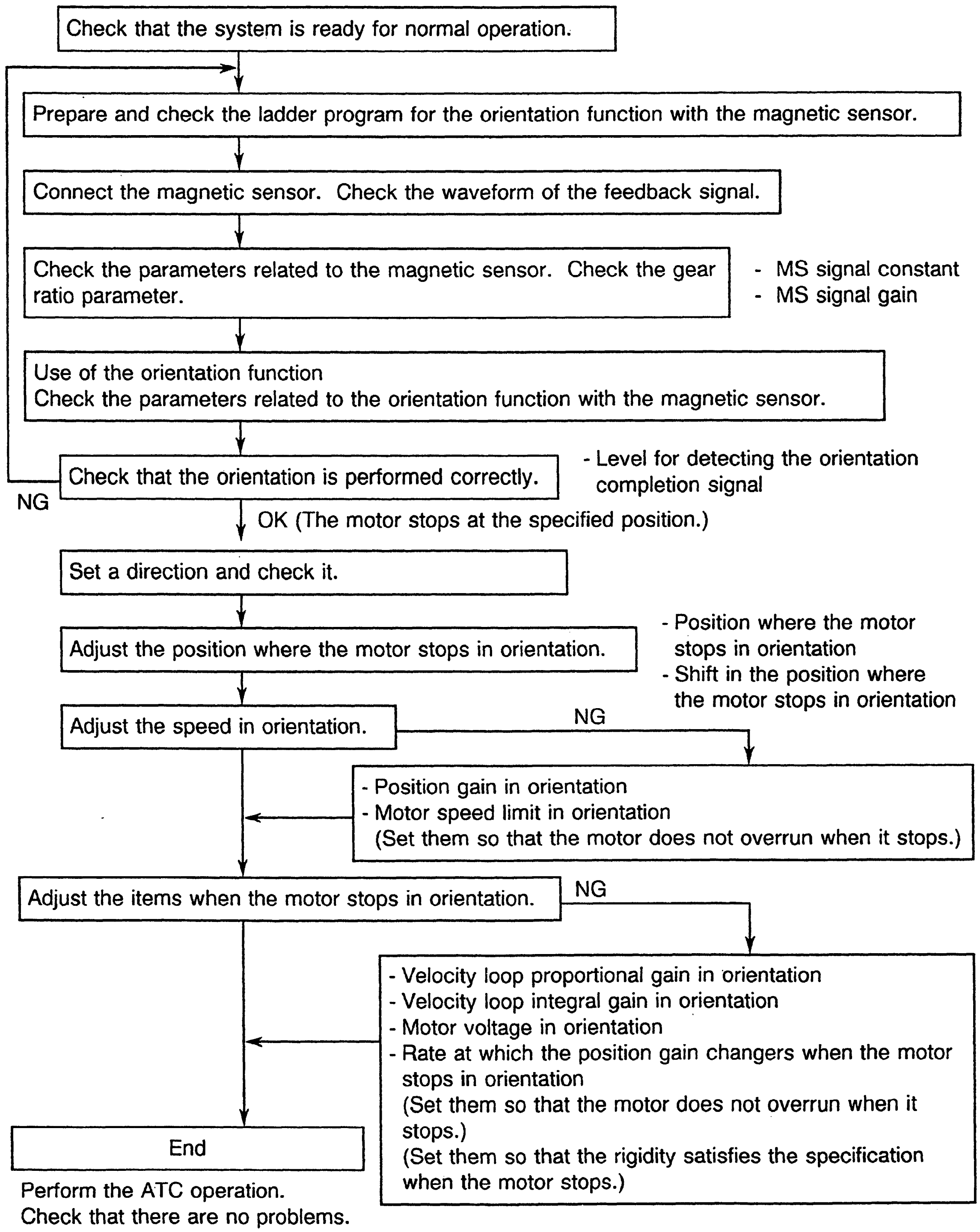
Normal driver waveform
</td></tr>
<tr><td>3</td><td>If the driver circuit is determined to be faulty, replace it.</td></tr>
<tr><td>4</td><td>Connect the motor power line to restart operation.</td></tr>
</table>

III SPINDLE ORIENTATION WITH THE MAGNETIC SENSOR

1. START-UP PROCEDURE FOR THE ORIENTATION FUNCTION WITH THE MAGNETIC SENSOR

The following flowchart explains how to start-up the orientation function with the magnetic sensor in the AC spindle amplifier with the serial interface when the system operates normally.

[Flowchart]

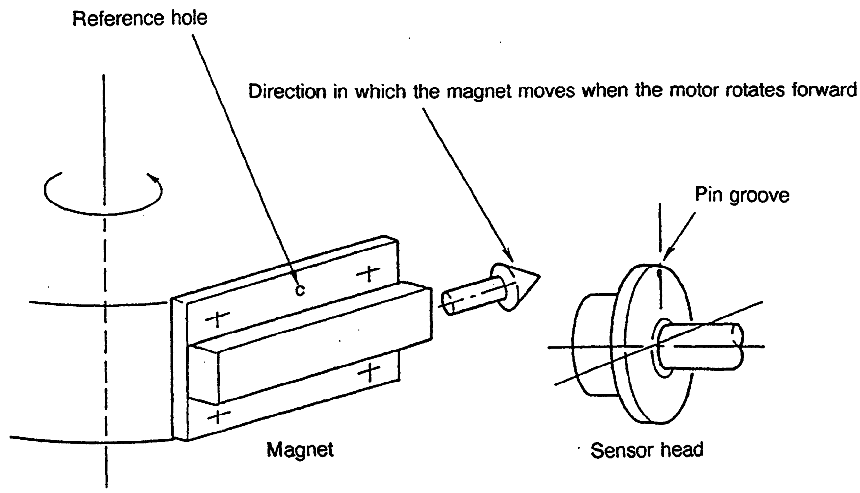


2. INSTALLING THE MAGNET AND MAGNETIC SENSOR

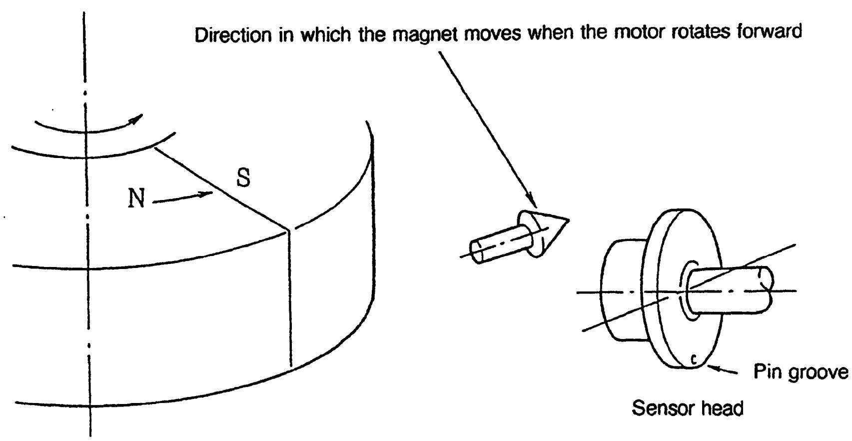
When installing the magnet on the spindle of a machine tool, orient the magnet properly according to the configuration of the spindle, such as whether it is belt-driven or gear-driven. This is because the magnet has polarity against the magnetic sensor.

Place the reference hole of the plate magnet and the pin groove of the magnetic sensor as shown in the following figure when the motor is rotated by a forward rotation command (SFR is on). When the ring magnet is used, place the stop position line of the ring magnet and the pin groove of the magnet as shown in the following figure when the motor is rotated by a forward rotation command. Note that the position of the pin groove of the magnetic sensor is different for the plate magnet and ring magnet.

Place the magnetic sensor so that the minimum gap (L) between the magnet and sensor is 1.5 ±0.5 mm.



(a) Plate magnet

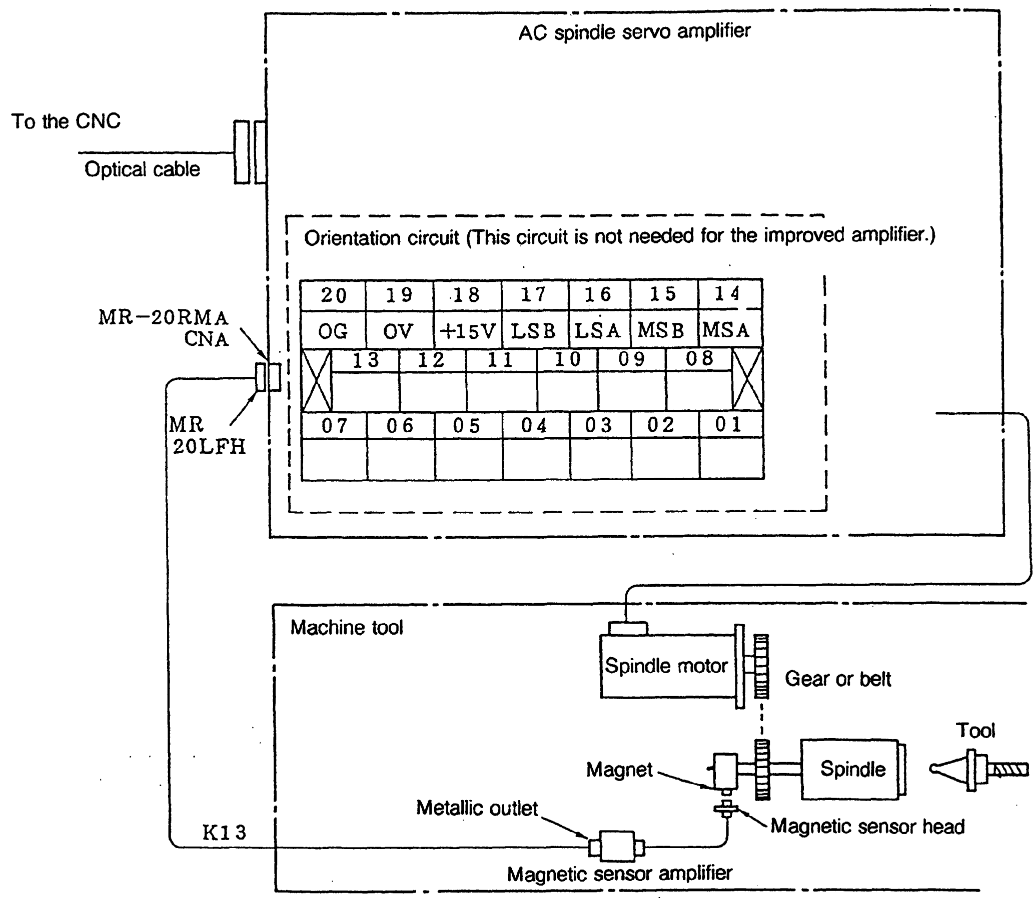


(b) Ring magnet

Fig. 2 Installing the Magnet

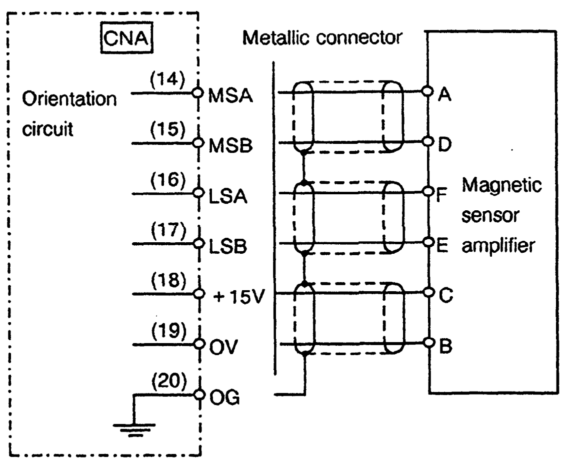
3. CONNECTION

3.1 Interface



3.2 Connection when the Magnetic Sensor is Used

Use a cable 20 m long or less to connect the magnetic sensor amplifier to the AC spindle servo unit.



4. PARAMETERS RELATED TO SPINDLE ORIENTATION WITH THE MAGNETIC SENSOR

First spindle	Second spindle	Data #7	#6	#5	#4	#3	#2	#1	#0
15 : 3000	3140								ROTA1
0 : 6500	6640								
16 : 4000									
PM : 3000									

ROTA1: Indicates the relationship between the directions in which the spindle rotates and the spindle motor rotates.

0: The spindle and motor rotate in the same direction.
1: The spindle and motor rotate in opposite directions.

Determining the direction in which the spindle rotates
Determine the direction in which the spindle rotates viewed from the shaft of the motor.
When the spindle is belt-driven, for example, set the parameter to 0, the same direction.

First spindle	Second spindle	Data #7	#6	#5	#4	#3	#2	#1	#0
15 : 3001	3141	CAXIS3	CAXIS2	CAXIS1		MGSEN			
0 : 6501	6641								
16 : 4001									
PM : 3001									

MGSEN: Indicates the relationship between the directions in which the motor rotates and the magnetic sensor rotates.

0: The motor and sensor rotate in the same direction.
1: The motor and sensor rotate in opposite directions.

CAXIS1: Determines whether the position detector (mounted on the spindle) used for controlling the Cs-axis is used.

0: Not used.
1: Used.

CAXIS2: Determines whether the position detection signal used for controlling the Cs-axis is also used for detecting the speed.

0: Not used (when the spindle is separate from the spindle motor)
1: Used (when a built-in motor is used)

CAXIS3: Indicates the relationship between the directions in which the spindle rotates and the position detector for controlling the Cs-axis rotates.

0: The spindle and detector rotate in the same direction.
1: The spindle and detector rotate in opposite directions.

First spindle	Second spindle	Data							
15 : 3003	3143					DIRCT2	DIRCT1		PCMGSL
0 : 6503	6643	#7	#6	#5	#4	#3	#2	#1	#0
16 : 4003									
PM : 3003									

PCMGSL: Determines whether the spindle orientation function with the position coder or with the magnetic sensor is used.

0: The spindle orientation function with the position coder is used.
1: The spindle orientation function with the magnetic sensor is used.

DIRCT1, DIRCT2: Determines the direction in which the spindle rotates in orientation.

DIRCT2	DIRCT1	Direction
0	0	Direction in which the spindle rotated immediately before the parameter was set
0	1	Direction in which the spindle rotated immediately before the parameter was set
1	0	The spindle rotates counterclockwise viewed from the motor shaft.
1	1	The spindle rotates clockwise viewed from the motor shaft

First spindle	Second spindle	Data							
15 : 3015	3155								ORIENT
0 : 6515	6655	#7	#6	#5	#4	#3	#2	#1	#0
16 : 4015									
PM : 3015									

ORIENT: Indicates whether the spindle orientation function is provided. (Optional CNC software)

0: The function is provided.
1: The function is not provided.

First spindle	Second spindle	Data
15 : 3042	3182	Velocity loop proportional gain for the high gear in orientation
0 : 6542	6682	
16 : 4042		
PM : 3042		
15 : 3043	3183	Velocity loop proportional gain for the low gear in orientation
0 : 6543	6683	
16 : 4043		
PM : 3043		

Data unit :
Data range : 0 to 32767
Standard setting : 10

Specify the proportional gain of the velocity loop in orientation.

When the clutch/gear signal CTH1A, one of the spindle control signals sent from the PMC to NC, is 0, the parameter for the high gear is used. When the CTH1A signal is 1, the parameter for the low gear is used.

First spindle	Second spindle	Data
15 : 3050 0 : 6550 16 : 4050 PM : 3050	3190 6690	Velocity loop integral gain for the high gear in orientation
15 : 3051 0 : 6551 16 : 4051 PM : 3051	3191 6691	Velocity loop integral gain for the low gear in orientation

Data unit :
Data range : 0 to 32767
Standard setting : 10

Specify the integral gain of the velocity loop in orientation.

First spindle	Second spindle	Data
15 : 3056 0 : 6556 16 : 4056 PM : 3056	3196 6696	Gear ratio (HIGH)
15 : 3057 0 : 6557 16 : 4057 PM : 3057	3197 6697	Gear ratio (MEDIUM HIGH)
15 : 3058 0 : 6558 16 : 4058 PM : 3058	3198 6698	Gear ratio (MEDIUM LOW)
15 : 3059 0 : 6559 16 : 4059 PM : 3059	3199 6699	Gear ratio (LOW)

Data unit : Number of motor rotations per on spindle rotation x 100
Data range : 0 to 32767
Standard setting : 100 (gear ratio = 1:1)

Specify the gear ratio between the spindle and AC spindle motor.

The gear or clutch must operate corresponding to the clutch/gear signals CTH1A and CTH2A, which are two of the spindle control signals sent from the PMC to NC.

Example) When the motor rotates two and a half times per rotation of the spindle, specify 250.

	First spindle	Second spindle	Data
15	: 3060	3200	Position gain in orientation (HIGH)
0	: 6560	6700	
16	: 4060		
PM	: 3060		
15	: 3061	3201	Position gain in orientation (MEDIUM HIGH)
0	: 6561	6701	
16	: 4061		
PM	: 3061		
15	: 3062	3202	Position gain in orientation (MEDIUM LOW)
0	: 6562	6702	
16	: 4062		
PM	: 3062		
15	: 3063	3203	Position gain in orientation (LOW)
0	: 6563	6703	
16	: 4063		
PM	: 3063		

Data unit : 0.01 S^{-1}
Data range : 0 to 32767
Standard setting : 1000

Specify the position gain in orientation.

	First spindle	Second spindle	Data
15	: 3064	3204	Rate of changing the position gain when orientation is complete
0	: 6564	6704	
16	: 4064		
PM	: 3064		

Data unit : 1%
Data range : 0 to 1000
Standard setting : 100 (100%)

Specify the rate at which the position gain changes when orientation is complete.

	First spindle	Second spindle	Data
15	: 3075	3215	Level for detecting the orientation completion signal (ORAR)
0	: 6575	6715	
16	: 4075		
PM	: 3075		

Data unit : ±1 pulse for the orientation function with the position coder
±0.1 pulses for the orientation function with the magnetic sensor

Data range : 0 to 100
Standard setting : 10

Specify the level for detecting the orientation completion signal (ORAR).

When the spindle is located at the area specified by the parameter when orientation is complete, the bit corresponding to the orientation completion signal (ORAR) goes to 1 in the spindle status.

	First spindle	Second spindle	Data
15	: 3076	3216	Motor speed limit in orientation
0	: 6576	6716	
16	: 4076		
PM	: 3076		

Data unit : 1%
Data range : 0 to 100
Standard setting : 33

Specify the limit for the motor speed in orientation.
Speed limit = Orientation speed × Setting / 100 rpm
(Orientation speed = Position gain × Gear ratio × 60 / 2 rpm)

	First spindle	Second spindle	Data
15	: 3077	3217	Shift in the position where the spindle stops in orientation
0	: 6577	6717	
16	: 4077		
PM	: 3077		

Data unit : ±1 pulse for the orientation function with the position coder
±0.1 pulses for the orientation function with the magnetic sensor
Data range : -4096 to +4096 for orientation with the position coder
-100 to +100 for orientation with the magnetic sensor
Standard setting : 10

Specify this parameter to shift the position where the spindle stops in orientation with the position coder. When a positive value is specified, the position is shifted counterclockwise by the number of specified pulses.

Specify a distance from the position where the magnetic sensor mates to the magnet to the position where the spindle is to be stopped in orientation with the magnetic sensor. When a positive value is specified, the position where the spindle stops is shifted counterclockwise.

	First spindle	Second spindle	Data
15	: 3078	3218	MS signal constant = $(L/2)/(2 \times \pi \times H) \times 4096$
0	: 6578	6718	
16	: 4078		
PM	: 3078		

L: Length of the magnet (mm)
H: Distance from the center of the spindle to the magnet (mm)

Data unit :
Data range : 80 to 1000
Standard setting : 200

Specify the MS signal constant by substituting values for L and H in orientation with the magnetic sensor. Normally use L = 50 mm.

Example) H = 100 mm, L = 50 mm
MS signal constant = (50/2) / (2 × 3.14 × 100) × 4096
= about 163

In this case, use 163 as the constant.

	First spindle	Second spindle	Data
15	: 3079	3219	MS signal gain factor
0	: 6579	6719	
16	: 4079		
PM	: 3079		

Data unit :
Data range : -128 to +127
Standard setting : 0

This parameter is used to adjust the amplitude of the MS signal in orientation with the magnetic sensor.

Specify this parameter by referring to the list in Chapter 5 as the setting varies according to the type of the magnet.

	First spindle	Second spindle	Data
15	: 3084	3224	Motor voltage in orientation
0	: 6584	6724	
16	: 4084		
PM	: 3084		

Data unit : 1%
Data range : 0 to 100
Standard setting : Depends on the motor model.

5. SETTING THE PARAMETER FOR THE MS SIGNAL GAIN ACCORDING TO THE MAGNET USED

Parameter No.

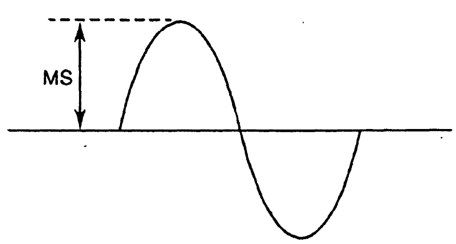
		First spindle	Second spindle	Gap between the magnetic sensor and magnet
Series 15	:	3079	3219	
Series 0	:	6579	6719	
Series 16	:	4079		1.0 to 2.0 mm
Power Mate	:	3079		

Code name	Code No.	Magnet	MS signal gain
Standard	A57L-0001-0037	Standard magnet (TYPE II)	0
Magnetic sensor N	A57L-0001-0037/N	Standard magnet (TYPE II)	0
Magnetic sensor P	A57L-0001-0037/P	Compact magnet (TYPE III)	-20
Magnetic sensor Q	A57L-0001-0037/Q	(TYPE IV) Cylinder magnet with an inside diameter of 40	70
Magnetic sensor R	A57L-0001-0037/R	(TYPE V) Cylinder magnet with an inside diameter of 50	50
Magnetic sensor S	A57L-0001-0037/S	(TYPE VI) Cylinder magnet with an inside diameter of 60	70
Magnetic sensor T	A57L-0001-0037/T	(TYPE VII) Cylinder magnet with an inside diameter of 70	40

Calculating the MS signal gain

MS signal gain = 500/MS - 100

where MS is the peak voltage (V) of the MS signal at test point MS on the input circuit of the magnetic sensor signal or on the control circuit printed circuit board



6. DI/DO SIGNALS

Spindle orientation command	:	ORCMA
(For the second spindle)		ORCMB

[Type] Input signals

[Function] These signals are used in spindle orientation control.

[Operation] When the signals are high, spindle orientation is controlled.
When the signals are low, spindle orientation is not controlled.

Spindle orientation completion signals	:	ORARA
(For the second spindle)		ORARB

[Type] Output signals

[Function] After a spindle orientation command has been input, these signals are issued when the spindle stops at a location near the specified point.
Specify the area for which these signals are issued in parameters No. 3075 and 3215 for the levels used for detecting the spindle orientation completion signals.

[Operation] These signals go high at following time:

- After a spindle orientation command has been input, when the spindle stops at a location near the specified point

These signals go low at the following times:

- After a spindle orientation command has been input, when the spindle does not stop at a location near the specified point
- When a spindle orientation command is not input

7. ADDRESSES OF DI/DO SIGNALS

PM	Series 0	Series 15	Series 16								
G112	G229	G227	G070	MRDYA	ORCMA	SFRA	SRVA	CTH1A	CTH2A	TLMHA	TLMLA
F228	F281	F229	F045	ORARA	TLMA	LDT2A	LDT1A	SARA	SDTA	SSTA	ALMA
–	G233	G235	G074	MRDYB	ORCMB	SFRB	SRVB	CTH1B	CTH2B	TLMHB	TLMLB
–	F285	F245	F049	ORARB	TLMB	LDT2B	LDT1B	SARB	SDTB	SSTB	ALMB

8. CHECKING THE SIGNAL OF THE MAGNETIC SENSOR

8.1 Scope

This chapter covers how to check the following items by observing the output signal of the magnetic sensor (code: A57L-0001-0037) used in spindle orientation with the magnetic sensor.

Drawing numbers of applicable printed circuit boards

A16B-1700-0200 (optional PCB) for motors 6S to 26S (conventional types)

A16B-2201-0010 (control circuit PCB) and A16B-2201-0440 (control circuit PCB) for the other motors

No.	Items to be checked
1	Whether the magnet, magnetic sensor head, or amplifier for the magnetic sensor is out of order
2	Whether the magnet or magnetic sensor head is erroneously installed
3	Whether the signal cable of the magnetic sensor is erroneously connected, is disconnected, or is short-circuited

8.2 Procedure

(1) Measurement

① Turn the spindle counterclockwise at about 120 rpm.

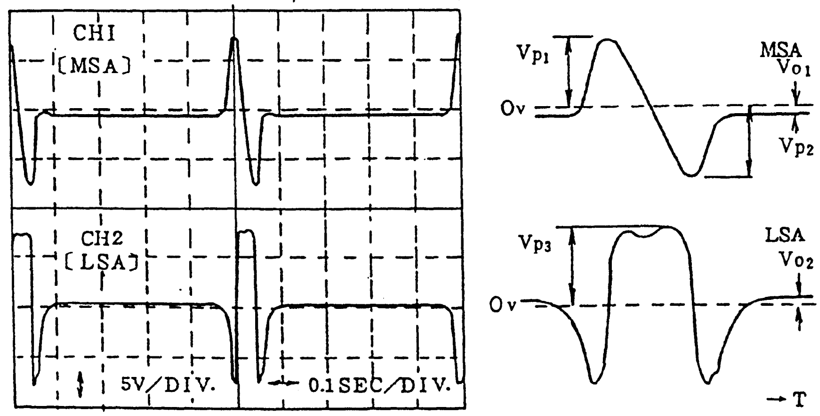
② Check the peak and offset voltages of the following signals at the test points in the orientation circuit using an oscilloscope.

Test point	Signal	Signal code	Test point used for the reference voltage
MSA	Output signal A of the magnetic sensor	MSA	0V
LSA	Output signal B of the magnetic sensor	LSA	

(2) Criteria

① The following figure shows the normal signal waveforms. The following table lists the standard criteria. If the signals do not conform to the standard, take action according to the table shown on the next page.

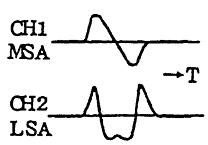
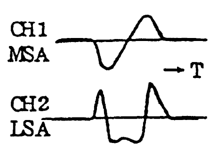
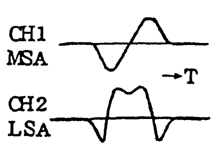
[Normal waveform] ← When the spindle rotates → [Definition of the symbols]



[Criteria]

Item	Standard (When the signals conform to this standard, they are normal.)
Offset voltage	$V_{01\sim2} < 0.5V$
Peak voltage	$3V < V_{P1\sim2} < 10V$

② Action to be taken when the signals do not satisfy the standard

No.	State	Cause	Action
1	One or both of the offset voltages of the signals are high. The offset voltage is normal, however, the peak voltage of one signal is low.	(a) Defective magnetic sensor head or defective amplifier of the magnetic sensor	(a) Replace the defective part.
2	The offset voltage is normal, however, one or neither of the signals is output.	(a) Defective magnetic sensor head, defective amplifier, or defective magnet (b) Loose contact or short circuit at cables or connectors	(a) Replace the defective part. (b) Repair the defective part.
3	The offset voltage is normal, however, the peak voltage of the signals are low.	(a) The gap between the magnet and magnetic sensor head is too large.	(a) Adjust the gap again.
4	The offset and peak voltage is normal, however, the waveform is abnormal.	The cause and action are explained below according to the waveform observed.	
		(a) Erroneous installation of the magnetic sensor head (b) Erroneous cable wiring	(a) Turn the magnetic sensor head by 180 degrees and install it. (b) Exchange LSA and LSB.
	Observed waveform 	(a) Erroneous installation of the magnet (b) Erroneous cable wiring	(a) Turn the magnet by 180 degrees and install it. (b) Exchange MSA and MSB, and LSA and LSB.
		(a) Erroneous installation of the magnet and magnetic sensor head (b) Erroneous wiring of cables	(a) Turn the magnet and magnetic sensor head by 180 degrees and install them. (b) Exchange MSA and MSB.

Note) For details of orientation of the magnet and magnetic sensor head and how to connect the signal lines, see Chapters 2 and 3.

IV BUILT-IN SENSOR SIGNAL CONVERSION CIRCUIT

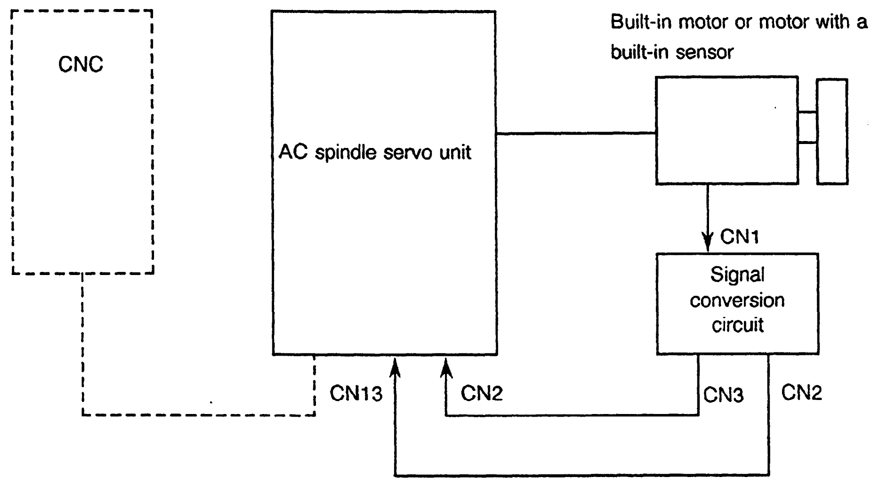
1. OVERVIEW

This section describes the maintenance operations for the signal conversion circuit. The circuit receives signals from the built-in sensors used in AC spindle motors and built-in motors and outputs speed detection signals and position coder signals.

A built-in model, A06B-6064-J704, has been added to the existing four models A06B-6044-H603, A06B-6044-H605, A06B-6044-H606, and A06B-6063-H730.

2. CONFIGURATION

2.1 Separate Model



2.2 Built-in Model

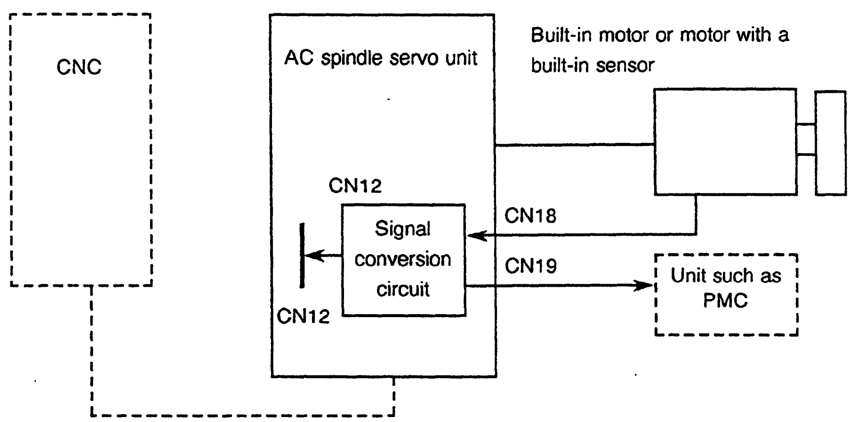


Table 2.2 Configuration Elements

Applicable unit	Name	Order drawing No.	PCB drawing No.	Remarks
Common to all models	Signal conversion circuit	A06B-6044-H603	A20B-9000-0180	
		A06B-6044-H605	A16B-1600-0370	High-speed type
		A06B-6044-H606	A16B-1600-0390	Special type(*1)
		A06B-6063-H730	A16B-1600-0440	Unified type upward compatible with the above three types
A06B-6064-Hxxx		A06B-6064-J704	A16B-1300-0220	Built-in type having the same function as that of A06B-6063-H730

(*1) This type is used to convert a sensor signal of 512 pulses/rev. to that of 1024 pulses/rev. Normally a signal of 256 pulses/rev. is converted to that of 1024 pulses/rev. However, some models such as 1S, 2S, 3S, and 6S/12000 rpm convert it to a signal of 512 pulses/rev.

3. ADJUSTING THE SIGNAL CONVERSION CIRCUIT

It is necessary to make the following adjustments and to check the output waveform, especially when the built-in sensor is attached by the user.

(1) Jumpers
For the mounting positions of each jumper, see Figures 3(a) to 3(e).

(a) PCB with drawing number A20B-9000-0180
The drawing is applied to PCBs of version 07C or later.

No.	Pin No.	Description	Setting	Standard setting
1	SH01 and SH02(*1)	Specifying the power source for the signal conversion circuit	A : Power supplied from CN2 of AC spindle servo unit	B
			B : Power supplied from CN13 of AC spindle servo unit	
2	SH03	Phase-Z temperature drift	OPEN : With drift offset	OPEN
			SHORT : Without drift offset	

*1 Be sure to set both SH01 and SH02 to the same setting.Unless orientation is required, no cable is connected between CN13 of the spindle amplifier and CN2 of the signal conversion circuit. In this case only, set them to A.

(b) PCBs with drawing numbers A16B-1600-0370 and A16B-1600-0390

No.	Pin No.	Description	Setting	Standard setting
1	SH1 and SH2(*1)	Specifying the power source for the signal conversion circuit	A: Power supplied from CN2 of AC spindle servo unit	B
			B: Power supplied from CN13 of AC spindle servo unit	
2	SH3	Phase-Z temperature drift	A: Without drift offset	B
			B: With drift offset	
3	SH4(*2)	Adjusting phase-A output gain (between CH7 and CH10)	A: 0.9 times	B
			B: 1.0 times	
	SH5(*2)	Adjusting phase-B output gain (between CH8 and CH10)	OPEN: 1.1 times	

*1 Be sure to set both SH1 and SH2 to the same setting. Unless orientation is required, no cable is connected between CN13 of the spindle amplifier and CN2 of the signal conversion circuit. In this case only, set them to A.

*2 When $V_{P\text{-}P}$ for the signal between CH20 and CH10 or between CH21 and CH10 is out of the standard range, the signal amplitude can be changed without changing the sensor location. See (a) in (2). However, if $V_{P\text{-}P}$ does not satisfy the standard range after the setting is changed, the location of the sensor must be changed. Note that this function cannot be used for the PCB with drawing number A20B-9000-0180.

(c) PCB with drawing number A16B-1600-0440

No.	Pin No.	Description	Setting	Standard setting
1	SH1 and SH2(*1)	Specifying the power source for the signal conversion circuit	A: Power supplied from CN2 of AC spindle servo unit B: Power supplied from CN13 of AC spindle servo unit	B
2	SH3	Phase-Z temperature drift	A: Without drift offset B: With drift offset	B
3	SH4(*2)	Adjusting phase-A output gain (between CH7 and CH10)	A: 0.9 times OPEN: 1.0 times B: 1.1 times	OPEN
	SH5(*2)	Adjusting phase-B output gain (between CH8 and CH10)		
4	SH6 and SH7(*3)	Adjusting the magnifications for the number of input signals (pulses) and that of output signals (pulses). An example is shown below.		SH6:B SH7:A

SH6	SH7	Magnification	Number of input signals (pulses) → Number of output signals (pulses)	Remarks (on compatibility)
A	A	2 times	512 → 1024	Compatible with A16B-1600-0390
B	A	4 times	256 → 1024 128 → 512	Compatible with A20B-9000-0180 and A16B-1600-3700
A	B	8 times	64 → 512	For motor model 0.5S only
B	B	16 times	Not used	

*1 Be sure to set both SH1 and SH2 to the same setting. Unless orientation is required, no cable is connected between CN13 of the spindle amplifier and CN2 of the signal conversion circuit. In this case only, set them to A.

*2 When V_{P-P} for the signal between CH28 and CH10 or between CH29 and CH10 is out of the standard range, the signal amplitude can be changed without changing the sensor location. See (a) in (2). However, if V_{P-P} does not satisfy the standard range after the setting is changed, the location of the sensor must be changed. This function cannot be used for the PCB with drawing number A20B-9000-0180.

*3 This function cannot be used for the PCBs with drawing numbers A20B-9000-0180, A16B-1600-0370, and A16B-1600-0390.

(d) PCB with drawing number A16B-1300-0220

No.	Pin No.	Description	Setting	Standard setting
1	SH3	Phase-Z temperature drift	A: Without drift offset B: With drift offset	B
2	SH4(*1)	Adjusting phase-A output gain (between CH7 and CH10)	A: 0.9 times OPEN: 1.0 times B: 1.1 times	OPEN
	SH5(*1)	Adjusting phase-B output gain (between CH8 and CH10)		
3	SH6 and SH7 (*2)	Adjusting the magnifications for the number of input signals (pulses) and that of output signals (pulses). An example is shown below.		SH6:B SH7:A

SH6	SH7	Magnification	Number of input → Number of output signals (pulses) signals (pulses)	Remarks (on compatibility)
A	A	2 times	512 → 1024	Compatible with A16B-1600-0390
B	A	4 times	256 → 1024 128 → 512	Compatible with A20B-9000-0180 and A16B-1600-0370
A	B	8 times	64 → 512	For motor model 0.5S only
B	B	16 times	Not used	

*1 When V_{P-P} for the signal between CH28 and CH10 or between CH29 and CH10 is out of the standard range, the signal amplitude can be changed without changing the sensor location. See (a) in (2). However, if V_{P-P} does not satisfy the standard range after the setting is changed, the location of the sensor must be changed. This function cannot be used for the PCB with drawing number A20B-9000-0180.

*2 This function cannot be used for the PCBs with drawing numbers A20B-9000-0180, A16B-1600-0370, and A16B-1600-0390.

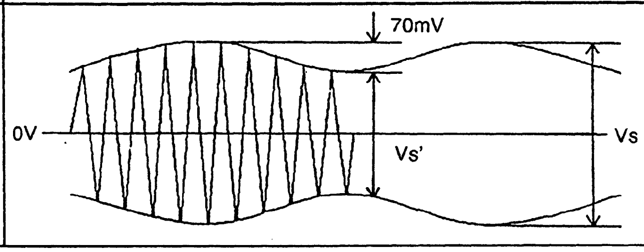
(2) Adjustment

For the mounting positions for each variable resistor and jumper, see Figures 3(a) to 3(e).

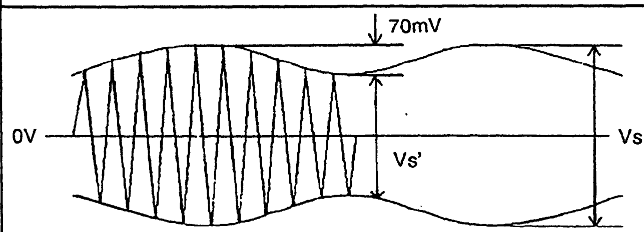
(a) Checking an output signal (for speed detection)

Measurement conditions: Direction of rotation: Normal (CCW) or reverse (CW)
Speed: 1500 rpm

For A20B-9000-0180 and A16B-1600-0370, and A16B-1600-0390

Point to be measured	Vs and Vs'	Example of the waveform
CH20-CH10 CH21-CH10	0.36 to 0.5 V	

For A16B-1600-0440 and A16B-1300-0220

Point to be measured	Vs and Vs'	Example of the waveform
CH28-CH10 CH29-CH10	0.36 to 0.5 V	

Note) When mounting the built-in sensor, make sure that the ripple voltage of the output signal is 70 mV or less. If it is over 70 mV, the following adjustment may become impossible. Therefore, check again that the built-in sensor is mounted normally.

(b) Adjusting offset

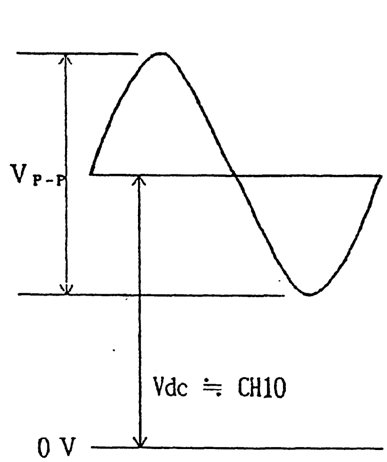
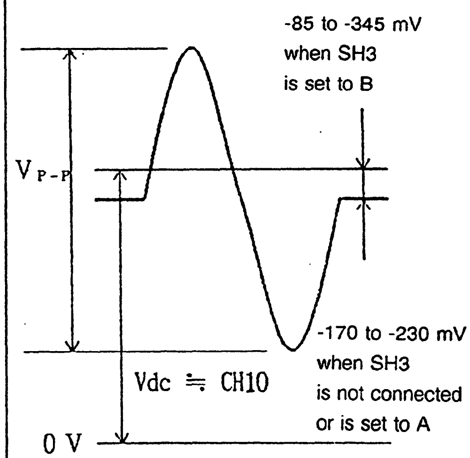
Measurement conditions: Direction of rotation: Normal (CCW) or reverse (CW)
Speed: 1500 rpm

Measure the voltage using a digital voltmeter. (Use its DC range.)

Variable resistor to be adjusted	Point to be measured	Target value for A20B-9000-0180, A16B-1600-0370, and A16B-1600-0390	Target value for A16B-1600-0440 and A16B-1300-0220	Remarks
VR1	CH7-CH10	0# ± 56mV	0# ± 35mV	Adjust so that the center value for CCW and CW approaches 0 mV.
VR2	CH8-CH10			
VR3	CH9-CH10	-85 to -345 mV		Adjust so that the center value for CCW and CW approaches 200 mV.

(c) Example of the waveforms for each adjusted point

If a failure still occurs during or after adjustment, observe the waveforms with the oscilloscope.

Point to be measured	CH7-CH11 (0V), CH8-CH11 (0V)		CH9-CH11 (0V)	
Example of the waveform				
V_{P-P} voltage range	For A16B-1600-0370, A16B-1600-0390, and A20B-9000-0180	1.32 to 1.84 V	For A20B-9000-0180	0.9 to 2.0 V
	For A16B-1600-0440 and A16B-1300-0220	0.83 to 1.15 V	For A16B-1600-0370, A16B-1600-0390, A16B-1600-0440, and A16B-1300-0220	1.08 to 2.4 V
CH10 voltage range (voltage between CH10 and CH11)	For A16B-1600-0370, A16B-1600-0390, and A20B-9000-0180	2.35 to 2.65 V	For A16B-1600-0370, A16B-1600-0390, and A20B-9000-0180	2.35 to 2.65 V
	For A16B-1600-0440 and A16B-1300-0220	2.61 to 2.94 V	For A16B-1600-0440 and A16B-1300-0220	2.61 to 2.94 V
Vdc voltage range(*1)	For A16B-1600-0370, A16B-1600-0390, and A20B-9000-0180	Voltage at CH10 ±56 mV	For A16B-1600-0370, A16B-1600-0390, and A20B-9000-0180	2.35 to 2.65 V
	For A16B-1600-0440 and A16B-1300-0220	Voltage at CH10 ±35 mV	For A16B-1600-0440 and A16B-1300-0220	2.61 to 2.94 V

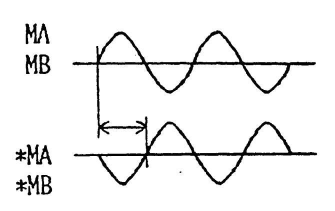
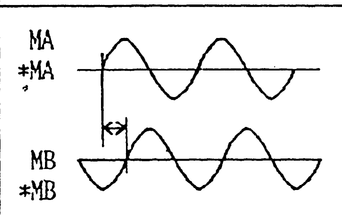
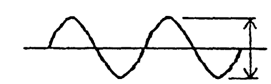
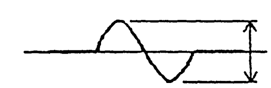
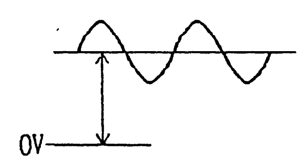
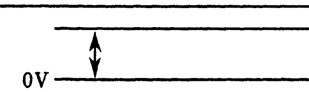
*1 Adjust the Vdc voltage range using the DC range of the digital voltmeter by rotating the motor counterclockwise and clockwise at 1500 rpm as follows:

① Between CH7 and CH11 and between CH8 and CH11
Adjust so that the center value for CCW and CW rotations approaches the voltage at CH10.

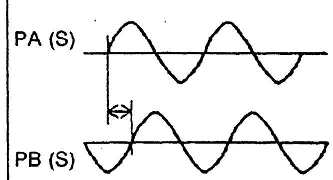
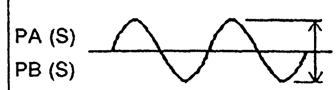
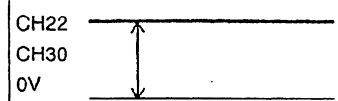
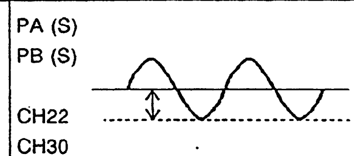
② Between CH9 and CH11
Adjust so that the center value for CCW and CW rotations approaches the voltage at CH10 - 200 mV.

(3) Waveforms for each part

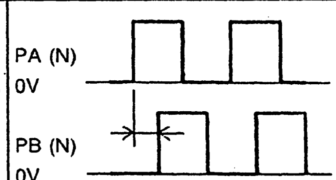
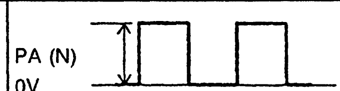
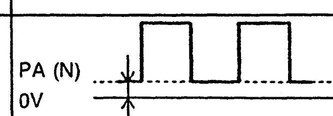
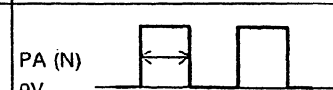
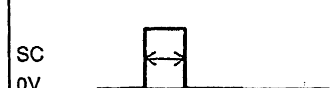
(a) Input waveforms (at a constant speed of 1500 rpm)

Point to be measured		Standard	Example of the waveform
Phase differences between CH1(MA) and CH2(*MA) and between CH3(MB) and CH4(*MB) (Each waveform is measured using the CH11(0V) as common.)		180±6°	
Phase differences between CH1(MA) and CH3(MB) and between CH2(*MA) and CH4(*MB) (Each waveform is measured using the CH11(0V) as common.)		90±3° (When the motor is rotated counterclockwise when viewed from the detector)	
Amplitude	CH1 (MA), CH (*MA) CH3 (MB), CH (*MB)	0.33 to 0.46 V	
	CH5 (MZ) (*MZ lacks AC portion.)	0.45 to 1.00 V	
Voltage of neutral point	CH1 (MA), CH (*MA) CH3 (MB), CH (*MB)	2.5V±25mV	
	CH5 (MZ)	2.5V±35mV	
	CH6 (*MZ)	2.5V±35mV	

(b) Output signal 1 (speed feedback signal) at a constant speed of 1500 rpm

Point to be measured	Standard	Example of the waveform
Phase difference between CH20(PA(S)) and CH21(PB(S)) **Note)** CH28 and CH29 for A16B-1600-0440 and A16B-1300-0220 (Each waveform is measured using CH11(0V) as common.)	90±10° (When the motor is rotated counterclockwise when viewed from the detector)	
CH20(PA(S)) and CH21(PB(S)) amplitude **Note)** CH28(PA(S)) and CH29(PB(S)) for A16B-1600-0440 and A16B-1300-0220	0.35 to 0.5 V	
CH22(RA(S), RB(S)) voltage **Note)** CH30(RA(S), RB(S)) for A16B-1600-0440 and A16B-1300-0220	2.35 to 2.65 V **Note)** 2.61 to 2.91 V for A16B-1600-0440 and A16B-1300-0220	
CH20(PA(S)) and CH21(PB(S)) neutral point voltage **Note)** CH28(PA(S)) and CH29(PB(S)) for A16B-1600-0440 and A16B-1300-0220	Voltage at CH22 ±15 mV **Note)** Voltage at CH30 ±15 mV for A16B-1600-0440 and A16B-1300-0220	

(c) Output signal 2 (for the position coder) at a constant speed of 1500 rpm

Point to be measured		Standard	Example of the waveform
Phase difference between CH15(PA(N)) and CH16(PB(N)) Note) Phase difference between CH16(PA(N)) and CH17(PB(N)) for A16B-1600-0440 and A16B-1300-0220		90±10° (When the motor is rotated counterclockwise when viewed from the detector)	
PA (N), PB (N), SC	High level	2.5 V min.	
	Low level	0.5 V max.	
Duty ratio between PA(N) and PB(N)		50±7%	
Width of CH17(SC) **Note)** CH18(SC) for A16B-1600-0440 and A16B-1300-0220		116±21μs	

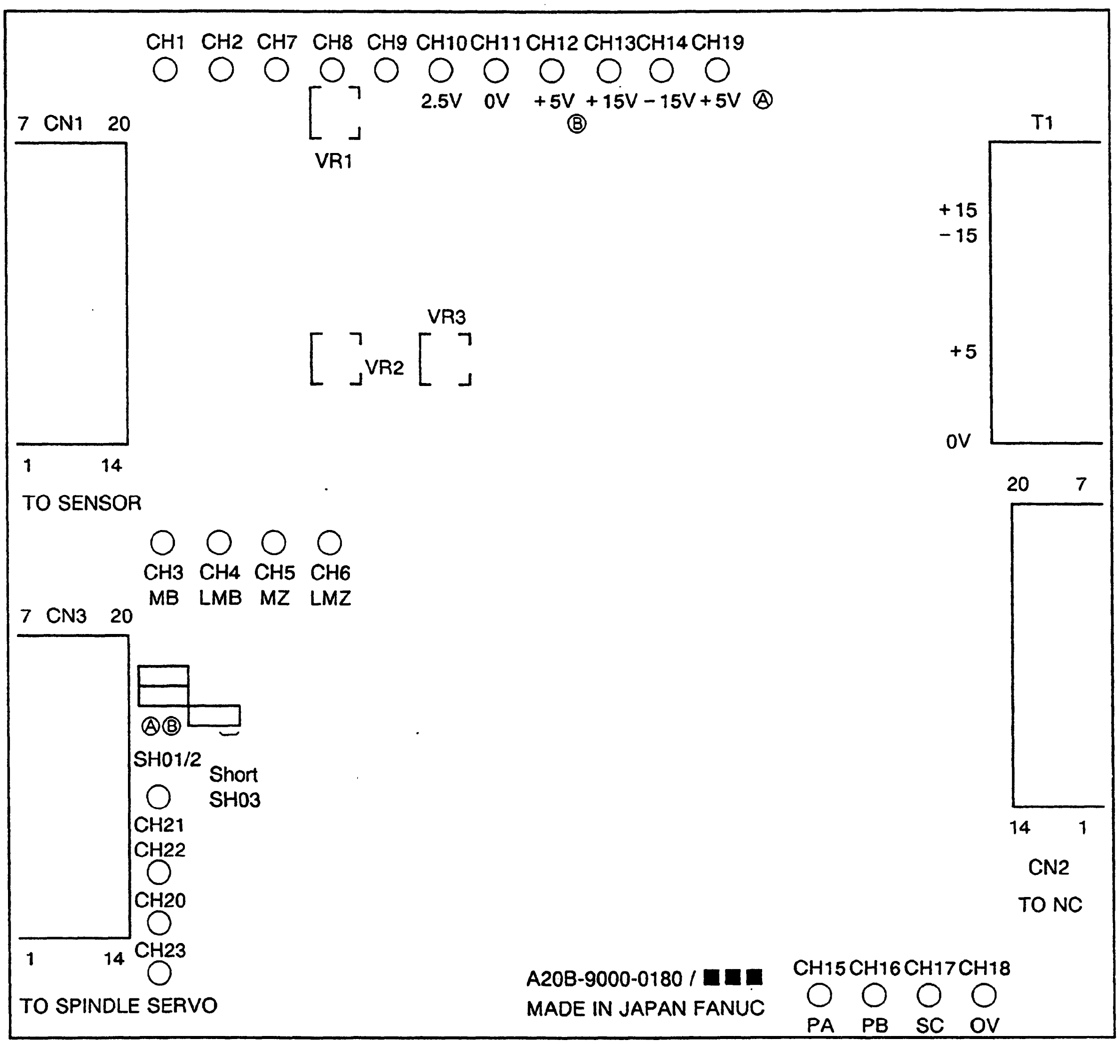


Figure 3(a) Mounting Positions of Jumpers, Variable Resistors, and Test Points (PCB drawing No.: A20B-9000-0160)

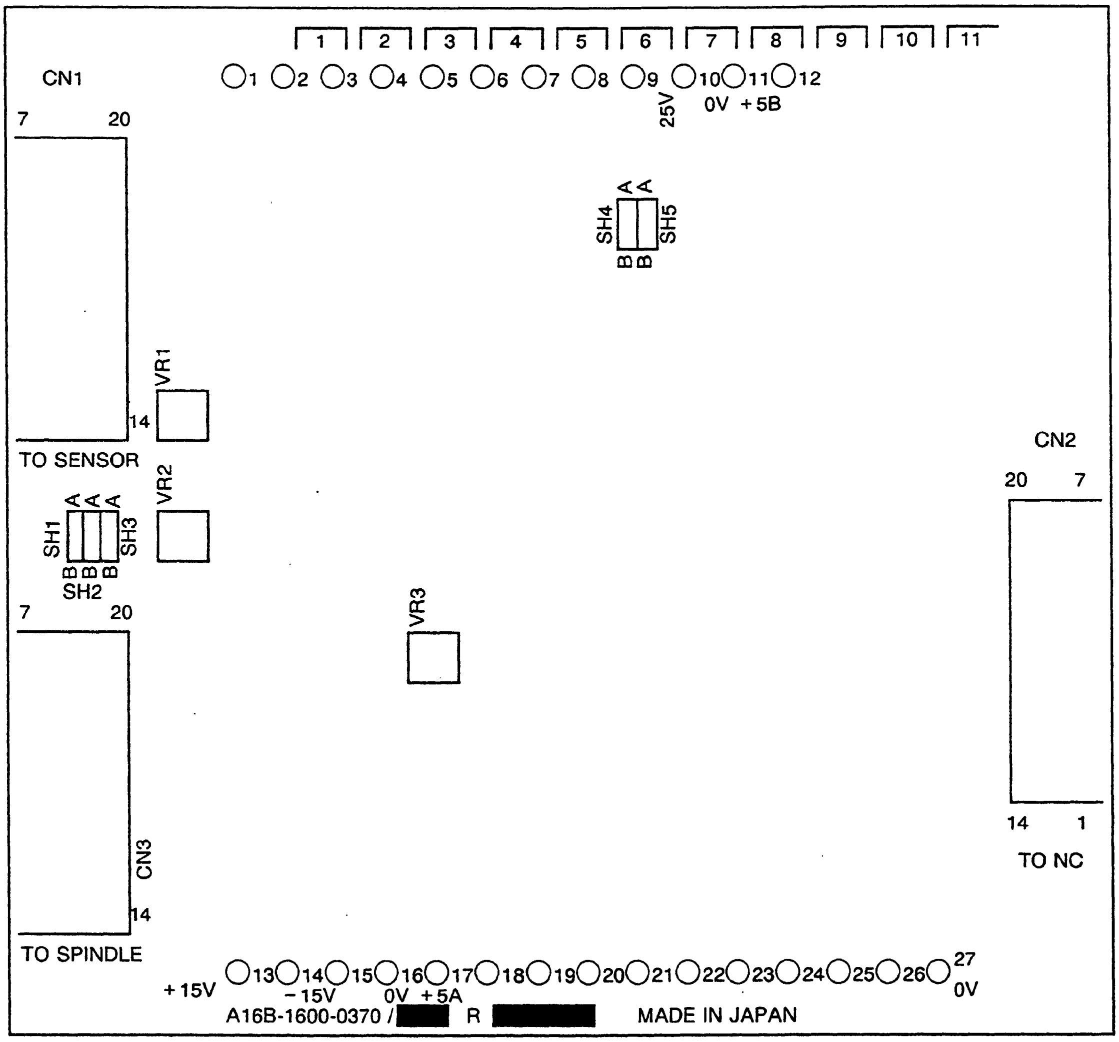


Figure 3(b) Mounting Positions of Jumpers, Variable Resistors, and Test Points (PCB drawing No.: A16B-1600-0370)

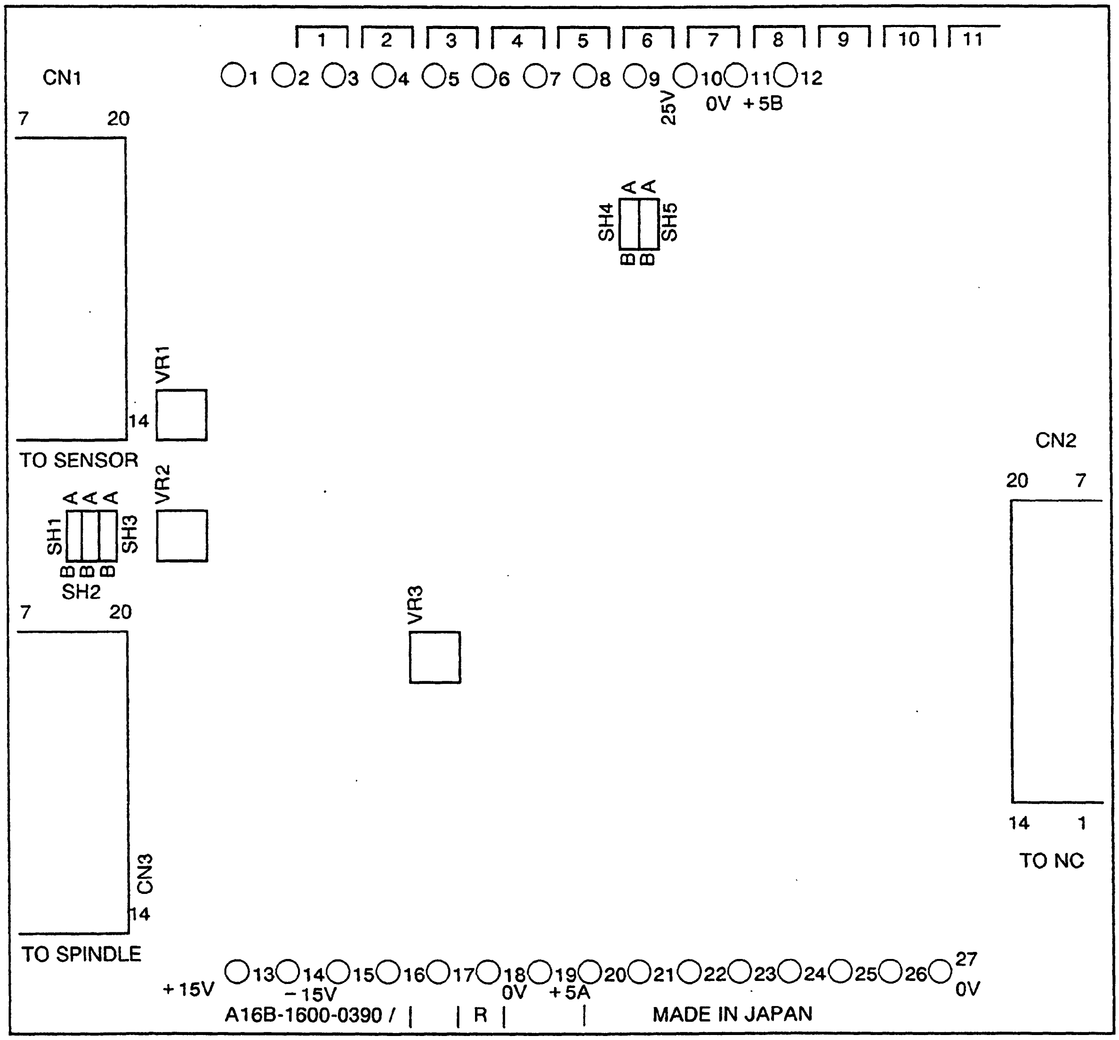


Figure 3(c) Mounting Positions of Jumpers, Variable Resistors, and Test Points (PCB drawing No.: A16B-1600-0390)

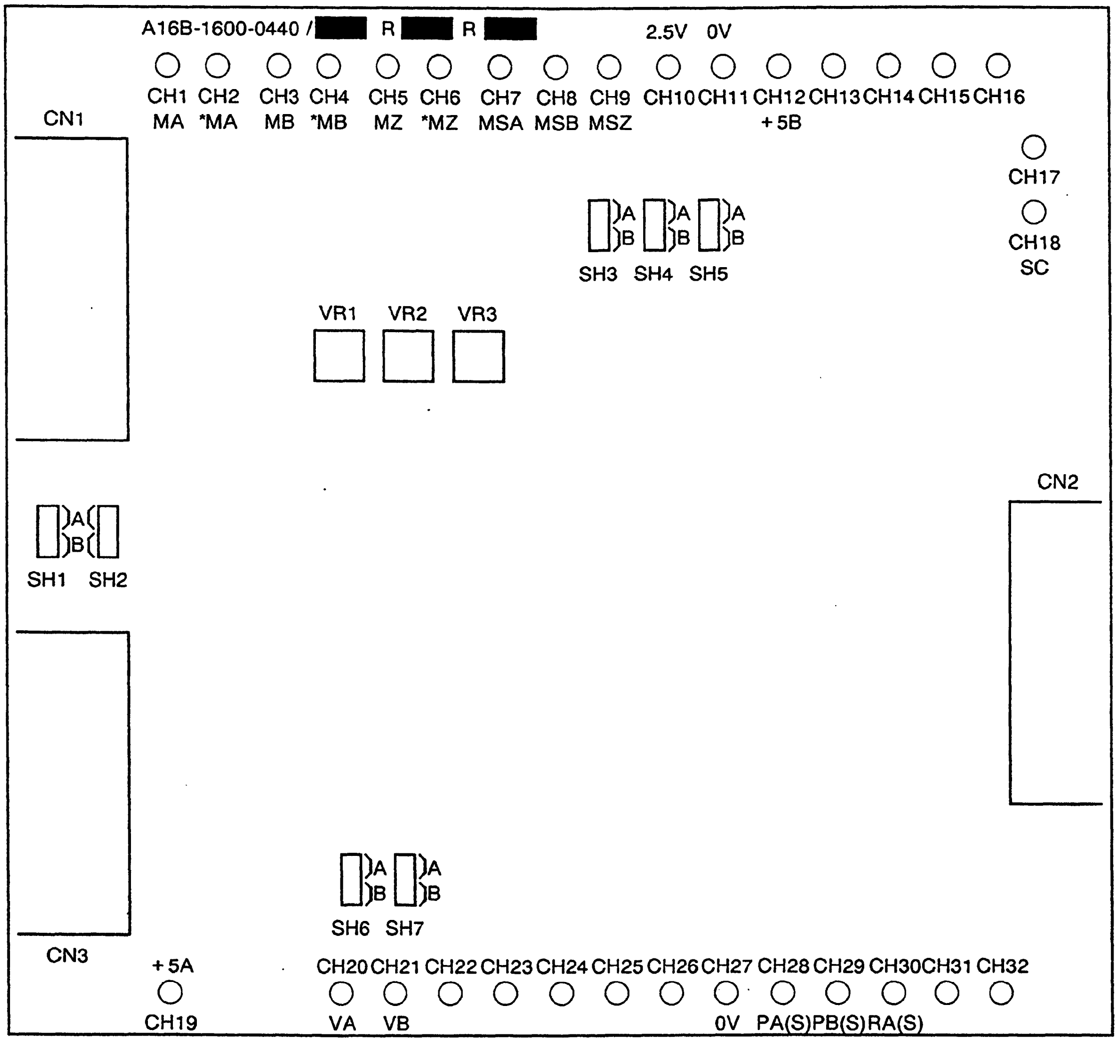


Figure 3(d) Mounting Positions of Jumpers, Variable Resistors, and Test Points (PCB drawing No.: A16B-1600-0440)

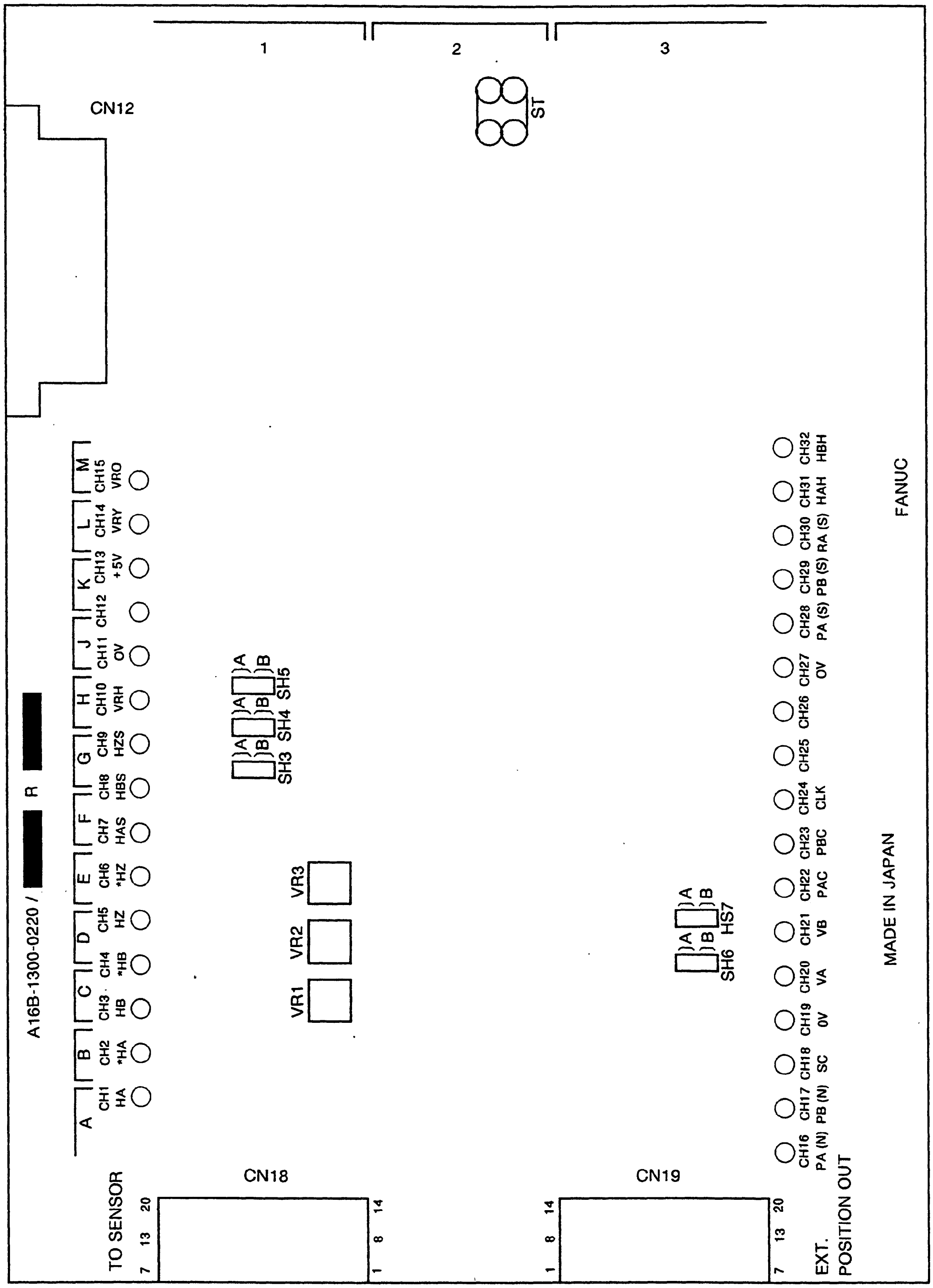


Figure 3(e) Mounting Positions of Jumpers, Variable Resistors, and Test Points (PCB drawing No.: A16B-1600-0220)

4. SPINDLE PARAMETER SETTING DEPENDING ON THE DIFFERENCE OF SEPARATE AND BUILT-IN TYPES

Parameter No.

PM	0C	15	16	#7	#6	#5	#4	#3	#2	#1	#0
3003	6503 6643	3003 3143	4003	PCPL2	PCPL1		PCTYPE	DIRCT2	DIRCT1	PCSEL	PCMGSL
Standard setting :				0	0	0	0	0	0	0	0

PCSEL: Specifies the type for connecting the position coder signal.

Type	Separate type	Built-in type
PCB drawing No.	A20B-9000-0180 A16B-1600-0370 A16B-1600-0390 A16B-1600-0440	A16B-1300-0220
PCSEL	0	1

5. VERSION OF ROM FOR THE SPINDLE SERVO UNIT

The signal conversion circuits with A20B-9000-0180, A16B-1600-0370, A16B-1600-0390, and A16B-1600-0440 apply to all ROM versions. The signal conversion circuit with A16B-1300-0220 can, however, be used only for the spindle servo unit having the following ROM:

ROM series	9A50
Version	All versions

6. TROUBLESHOOTING AND ACTION TAKEN

6.1 Alarm 27 (Position Coder Signal Disconnection)

If alarm 27 occurs, temporarily specify the setting indicating that disconnection is not detected and perform troubleshooting. Correct the cause of the alarm, then specify the setting indicating that disconnection is detected.

Parameter No.

PM	0C	15	16	#7	#6	#5	#4	#3	#2	#1	#0
3007	6507 6647	3007 3147	4007			PCLS					
			Standard setting :	0	0	0	0	0	0	0	0

PCLS: Specifies whether the disconnection of the high-resolution magnetic pulse coder and position coder signals is detected.

0: Disconnection is detected.
1: Disconnection is not detected.

Specify 0 normally.

(1) Incorrect parameter setting

- The specified setting indicates that the high-resolution magnetic pulse coder is used.
  → Specify the setting indicating that the pulse coder is not used.

Parameter No.

PM	0C	15	16	#7	#6	#5	#4	#3	#2	#1	#0
3001	6501 6641	3001 3141	4001	CAXIS3	CAXIS2	CAXIS1		MGSEN	POSC2	MRDY2	MRDY1
Standard setting :				0	0	0	0	0	0	0	1

CAXIS1: Specifies whether to use the high-resolution magnetic pulse coder (installed in the spindle). The Power Mate does not have this function.

0: Not used.
1: Used.

- The specified type for connecting the position coder signal is incorrect.
  → Specify a correct setting.

Parameter No.

PM	0C	15	16	#7	#6	#5	#4	#3	#2	#1	#0
3003	6503 6643	3003 3143	4003	PCPL2	PCPL1		PCTYPE	DIRCT2	DIRCT1	PCSEL	PCMGSL
Standard setting :				0	0	0	0	0	0	0	0

PCSEL: Specifies the type for connecting the position coder signal.

→ 1. Set PCSEL of this parameter to 1 in order to mount the signal conversion circuit on the serial spindle amplifier and to connect the circuit with CN12 using a flat cable.

→ 2. Set PCSEL of this parameter to 0 in order to connect the position coder signal with CN13 of the spindle amplifier (separate signal conversion circuit).

Reference)

Type	Separate type	Built-in type
PCB drawing No.	A20B-9000-0180 A16B-1600-0370 A16B-1600-0390 A16B-1600-0440	A16B-1300-0220
PCSEL	0	1

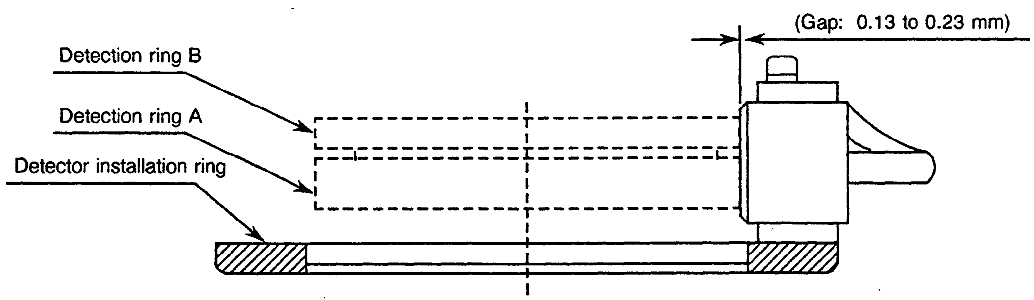
(2) Inappropriate built-in sensor signal level

- The amplitude of the built-in sensor signal does not satisfy the reference value.
  → Check the level between CH7 and CH10, between CH8 and CH10, and between CH9 and CH10 on the signal conversion circuit PCB with a oscilloscope. Then, adjust the level so that it is within the range shown in (2)-(a) in Chapter 3.

① Small amplitude: The gap between the detector and the detection ring is too big.
→ Reduce the gap to within the following range to adjust the amplitude of the sensor signal.

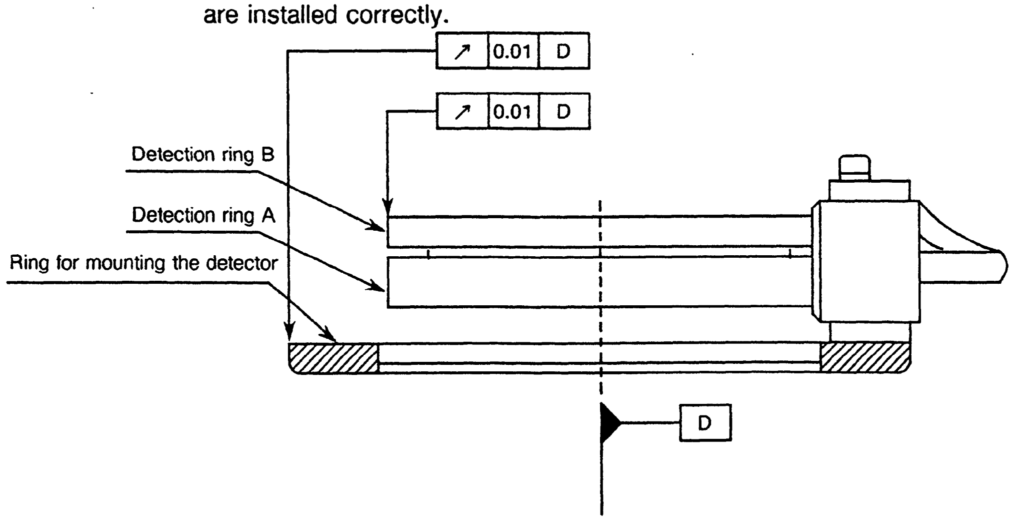
② Large amplitude: The gap between the detector and the detection ring is too small.
→ Increase the gap to within the following range to adjust the amplitude of the sensor signal.

Note) When the amplitude does not satisfy the reference value after adjustment, the sensor is defective. Replace the sensor.



- The ripple of the built-in sensor signal does not satisfy the reference value (70 mV max.)
  → Check the ripple between CH20 and CH10 and between CH21 and CH10 (between CH28 and CH10 and between CH29 and CH10 for A16B-1600-0440 and A16B-1300-0220) with the oscilloscope. Then, adjust the signal so that the ripple is within the range shown in (2)-(a) in Chapter 3.

① Large ripple: The runout of the detection ring and ring for mounting the detector may not satisfy the following range at the circumferences. Check whether the rings and are installed correctly.



- The offset of the built-in sensor signal does not satisfy the reference value.
  → Measure the offset between CH7 and CH10 and between CH8 and CH10 on the signal conversion circuit PCB using a digital voltmeter or equivalent. Then, adjust the offset so that it is within the range shown in (2)-(a) in Chapter 3.

- The feedback cable of the position coder is broken.
  → Check whether the signal line is disconnected.
  (Check location)
  ① Cable between CN2 of the separate signal conversion circuit and CN13 of the spindle amplifier

- The feedback cable of the position coder does not make good contact.
  → Check whether the connector makes good contact.
  (Check location)
  ① Connector of the cable between CN2 of the separate signal conversion circuit and CN13 of the spindle amplifier

- The feedback cable for the built-in sensor signal is broken.
  → Check whether the signal line is disconnected.
  (Check locations)
  ① Cable between CN1 of the separate signal conversion circuit and the built-in sensor
  ② Cable between CN18 of the built-in signal conversion circuit and the built-in sensor

- The feedback cable for the built-in sensor signal does not make good contact.
  → Check whether the connector makes good contact.
  (Check locations)
  ① Connector of the cable to CN1 of the separate signal conversion circuit
  ② Connector of the cable to CN18 of the built-in signal conversion circuit

(3) Power is not supplied to the signal conversion circuit.

→ Built-in type:
① Check that connector C12 is connected to the spindle amplifier.
② Check whether the voltage at test point CH13 is within +5 ±0.25 V. If it is not, the spindle amplifier is defective. Replace the PCB of the spindle amplifier.

→ Separate type:
① Check whether power is supplied to connector C12.
② Check whether the voltage at test point CH13 is within +5 ±0.25 V. If it is not, check whether the voltage of the power source is normal.
③ Check whether the connector makes good contact.

(4) The spindle amplifier has the wrong ROM series.
→ The built-in signal conversion circuit can only be used for a version 9A50 ROM. (The separate signal conversion circuit can be applied to all ROM versions.)

(5) Signal conversion circuit failure
→ If the alarm recurs after taking the above actions, the signal conversion circuit may be defective. Replace the signal conversion circuit.

6.2 Alarm 47 (inappropriate position coder signal)

(1) Incorrect parameter setting

- An incorrect position coder type (number of pulses per rev.) was specified.
  → The number of feedback pulses of the position coder signal per rev. varies according to the detector type. Specify a correct type.

Parameter No.

PM	0C	15	16	#7	#6	#5	#4	#3	#2	#1	#0
3003	6503 6643	3003 3143	4003	PCPL2	PCPL1		PCTYPE	DIRCT2	DIRCT1	PCSEL	PCMGSL
Standard setting :				0	0	0	0	0	0	0	0

PCTYPE: Position coder type (number of pulses per rev.)

0: 1024 pulses per rev.
1: 512 pulses per rev.

Reference) When the gear ratio of the motor to the spindle is 1:1

Detector code	Number of detector pulses	Number of feedback pulses of the position coder signal	PCTYPE
A860-0392-T015	64	512	1
A860-0392-T012 A860-0392-T082	128	512	1
A860-0392-T011 A860-0392-T014 A860-0392-T081	256	1024	0
A860-0392-T013	512	1024	0

- If the signal line is disconnected when parameter PCLS is set to 1 (disconnection is not detected), AL-47 is displayed instead of AL-27.

  For the meaning of parameter PCLS, see Section 6.1.

- An incorrect detection edge of the one-rotation signal of the position coder was specified.
  → Check the setting. If 1 is specified, set the parameter to 0.

Parameter No.

PM	0C	15	16	#7	#6	#5	#4	#3	#2	#1	#0
3013	6513 6653	3013 3153	4013	PWM3K	DTCLK	DS4	DS3	DS2	DS1	ESED	ESEC
Standard setting				0	0	X	X	X	X	1	0

(X: Determined according to the amplifier model.)

ESEC: Specifies the detection edge of the one-rotation signal of the position coder.
0: Rising edge for CCW and falling edge for CW
1: Rising edge for both CCW and CW

Specify 0 normally.

- When the maximum speed of the axis equipped with the built-in sensor exceeds the maximum speed that enables the use of the position coder signal of the signal conversion circuit (10,000 rpm when the number of teeth on the detection gear is 256), and when the maximum speed enabling one-rotation signal detection is set to 0.
  → Set the maximum speed enabling one-rotation signal detection to less than the maximum speed enabling the use of the position coder signal of the signal conversion circuit.

Parameter No.

PM	0C	15	16	
3098	6598 6738	3098 3238	4098	Maximum speed enabling one-rotation signal detection

Data unit: 1 rpm (10 rpm when parameter SPDUNT (bit 2 of parameter 6506) = 1)
Data range: 0 to 32767
Standard setting: 0

Specifies the maximum speed enabling detection of the one-rotation signal of the position coder.
When the parameter is 0, the signal can be detected until the motor reaches the maximum speed.

- An incorrect spindle gear ratio was specified for the position coder.
  → Specify a correct gear ratio.

(2) Inappropriate built-in sensor signal level
→ See item (2) in Section 6.1 to check and adjust the signal level.

(3) Failure due to noise
→ Check whether the signal cable is a normal twisted-pair cable and is properly shielded. (For details of the shielded twisted-pair cable, refer to the relevant specifications.)

Note) In particular, check that the OH1 and OH2 signal lines are not twisted together with other signal lines.

6.3 Unusual Sounds Produced during Low-speed Operation

(1) Inappropriate built-in sensor signal

The machine may produce unusual sounds when the offset has a large deviation or the amplitude is too large.

→ See item (2) in Section 6.1 to check and adjust the signal level.

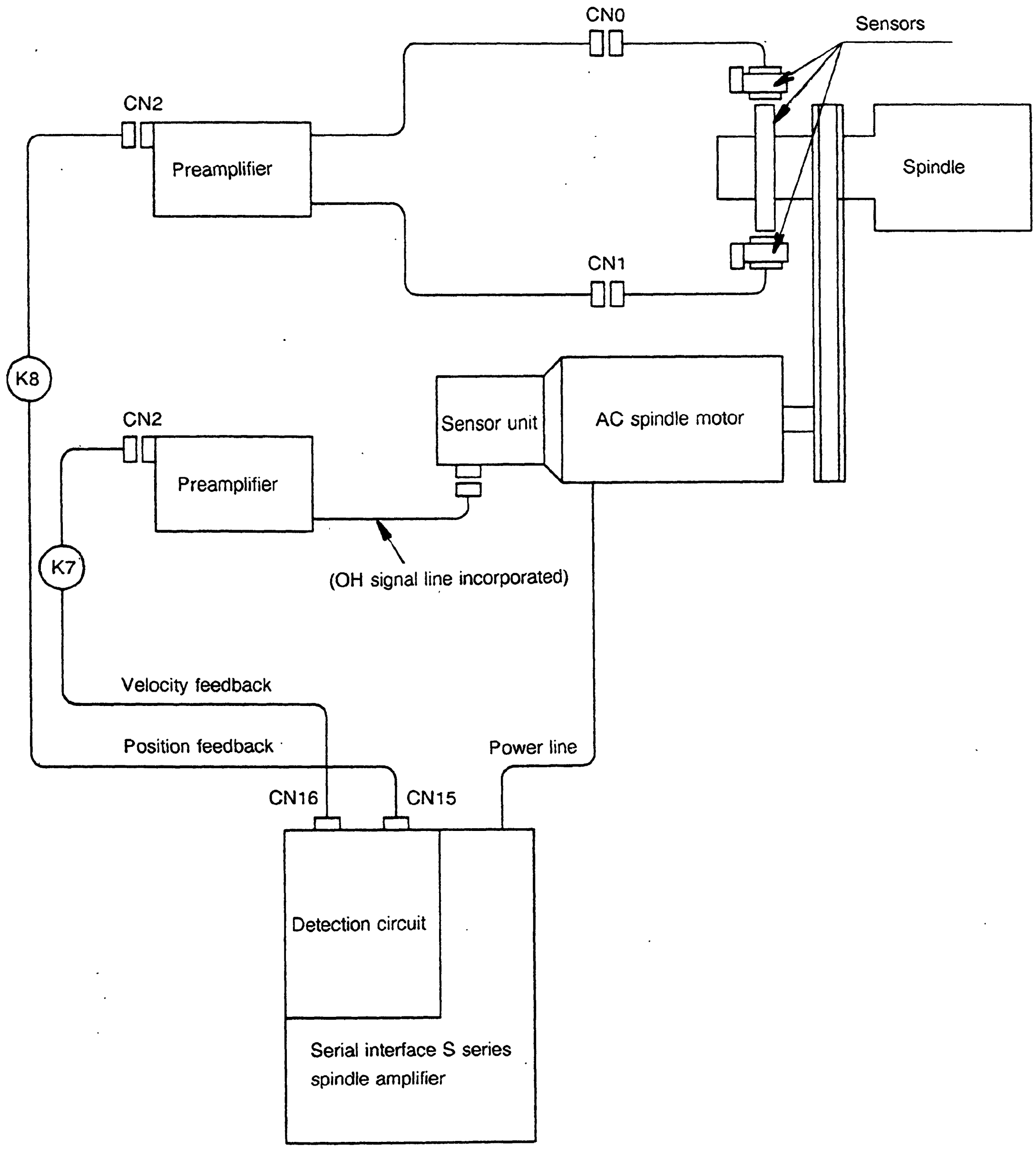
V. HIGH-RESOLUTION MAGNETIC PULSE CODER

1. GENERAL

This chapter explains the maintenance, installation, and adjustment of the detection circuit and magnetic pulse coder used when the servo function is added to the spindle of the NC machine tool.

2. CONFIGURATIONS

(1) When motor and spindle are associated with each other by belt



(2) Built-in spindle motor

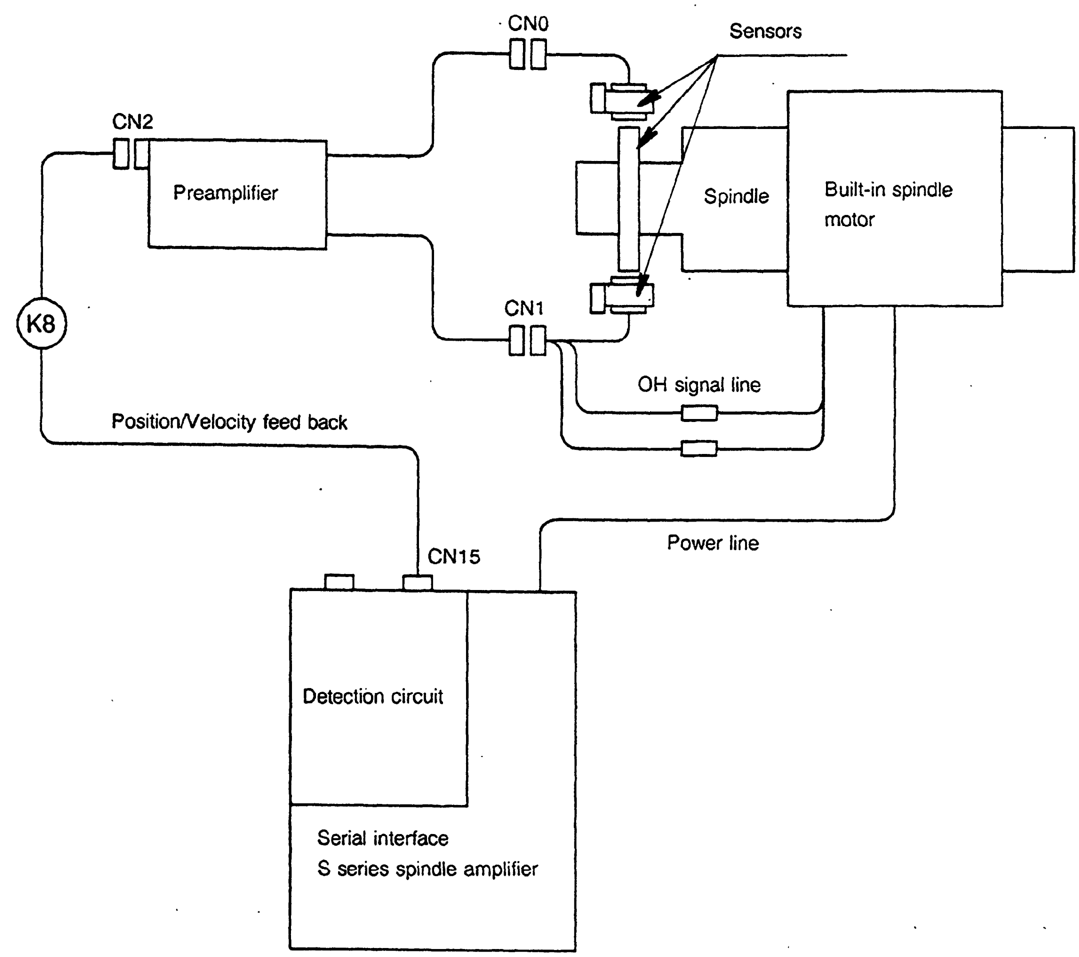


Table 2 Components

Applicable unit	Name	Order specification	PCB	Remarks
Common to all models	Detector (Note)	A860-0381-T121	—	Used for general spindle, with no OH signal. Outside diameter of magnetic drum: ϕ65
		A860-0381-T141	—	Used for built-in motor, with OH signal. Outside diameter of magnetic drum: ϕ65
		A860-0381-T123	—	Used for general spindle, with no OH signal. Outside diameter of magnetic drum: ϕ130
		A860-0381-T143	—	Used for built-in motor, with OH signal. Outside diameter of magnetic drum: ϕ130
		A860-0381-T124	—	Used for general spindle, with no OH signal. Outside diameter of magnetic drum: ϕ195
		A860-0381-T144	—	Used for built-in motor, with OH signal. Outside diameter of magnetic drum: ϕ195
	Detection circuit	A06B-6063-J710 A06B-6064-J720	A16B-1300-0200	Used for general spindle. Applicable detector: A860-0381-T121
		A06B-6063-J714 A06B-6064-J724		Used for built-in motor. Applicable detector: A860-0381-T141
		A06B-6063-J711 A06B-6064-J721		Used for general spindle. Applicable detector: A860-0381-T123
		A06B-6063-J715 A06B-6064-J725		Used for built-in motor. Applicable detector: A860-0381-T143
		A06B-6063-J712 A06B-6064-J722		Used for general spindle. Applicable detector: A860-0381-T124
		A06B-6063-J716 A06B-6064-J726		Used for built-in motor. Applicable detector: A860-0381-T144

Note) The detectors contain a preamplifier.

3. CHECKING OUTPUT WAVEFORM AND ADJUSTING THE PREAMPLIFIER

The preamplifier is adjusted before shipment, but it may require readjustment after it has been fitted to the machine. Use the method described below to check the output waveform. If it is outside the prescribed range, it will need to be adjusted.

The waveform should be checked after fitting the sensor and before fitting the pulley, draw bar, brake and similar equipment. Check the waveform with power supplied to the sensor and with the spindle and motor rotating at no more than 500rpm. If the detection circuit is being adjusted by itself, an external 5V power supply will be required. Connect the power supply between the 5V and 0V check terminals and remove connector CN12.

The outline of adjustment is described below. Refer to the following pages for details in adjustment.

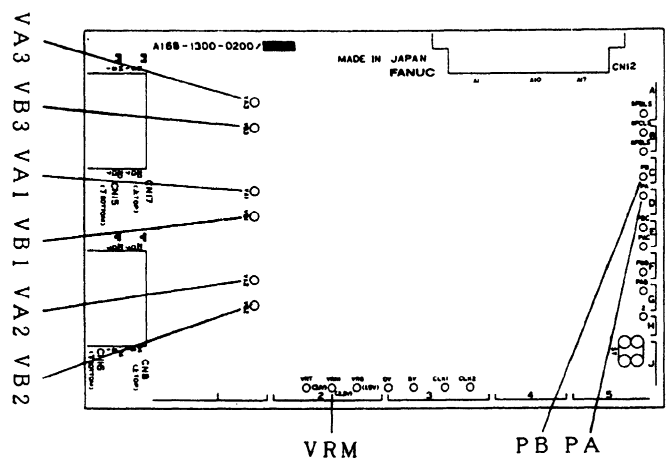


Fig. 3 Check terminals on the detection circuit board

Table 3 Signals requiring waveform checking or adjustment

	C axis control signal	Position encoder signal (speed control signal)	Full rotation signal
Spindle sensor (position sensor)	VA1 VB1	VA3 VB3	Z
Motor built-in sensor (speed sensor)	VA2 VB2	PA PB	
Measuring apparatus for waveform measurements	- Measure amplitude with an oscilloscope - Measure offset with a digital voltmeter		Measure offset with an oscilloscope
Location of check terminals for observing waveform	On detection circuit board (See diagram above)		Z is on the preamplifier circuit board
Adjustment method	Using the adjuster on the preamplifier circuit board		

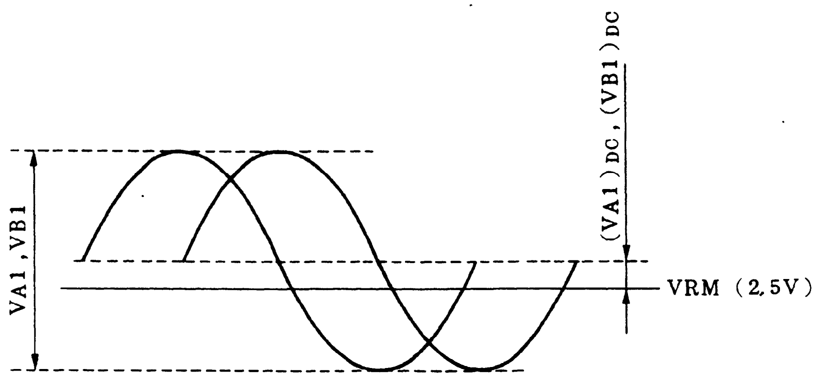
3.1 Spindle Sensor Preamplifier Adjustment Method

(1) C axis control signal (Position signal) adjustment

Measure the AC voltage output amplitude and offset voltage between detection circuit check terminals VA1 and VRM, and between VB1 and VRM. Check that the waveforms are within the range shown below.

(a) Checking output amplitude

Use an oscilloscope to measure the voltages between VA1 and VRM, and between VB1 and VRM.



Amplitude: 0.8V ≦ VA1, VB1 ≦ 1V

Difference in amplitude between VA1 and BV1: | VA1 − VB1 | ≦ 30mV

(b) Checking offset

Use the DC range of a digital voltmeter to measure the voltages between VA1 and VRM, and between VB1 and VRM.

$-10\text{mV} \leqq (VA1)_{DC}, \quad (VB1)_{DC} \leqq 10\text{mV}$

If the voltages are not within this range, turn the preamplifier variable resistor and adjust to within ±10mV.

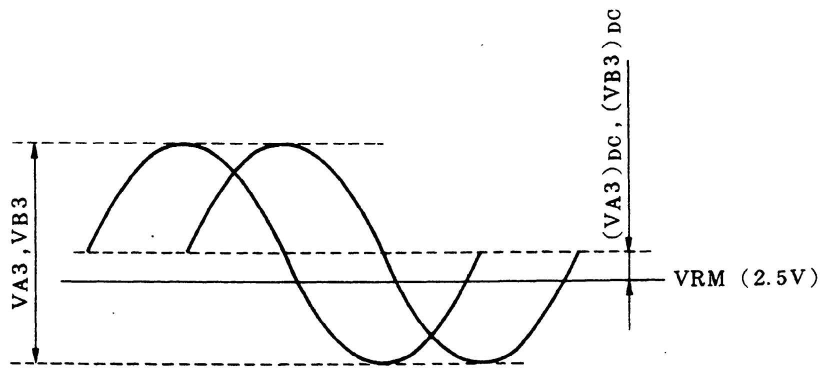
> Adjust the VA1 output amplitude by turning preamplifier variable resistor A1G.
> Adjust the VA1 offset by turning preamplifier variable resistor A1O.
> Adjust the VB1 output amplitude by turning preamplifier variable resistor B1G.
> Adjust the VB1 offset by turning preamplifier variable resistor B1O.

(2) Position encoder signal adjustment

Measure the AC voltage output amplitude and offset voltage between detection circuit check terminals VA3 and VRM, and between VB3 and VRM. Check that the waveforms are within the range shown below.

(a) Checking output amplitude

Use an oscilloscope to measure the voltages between VA3 and VRM, and between VB3 and VRM.



Amplitude: 0.8V ≦ VA3, VB3 ≦ 1V

Difference in amplitude between VA3 and VB3: | VA3 − VB3 | ≦ 30mV

(b) Checking offset

Use the DC range of a digital voltmeter to measure the voltages between VA3 and VRM, and between VB3 and VRM.

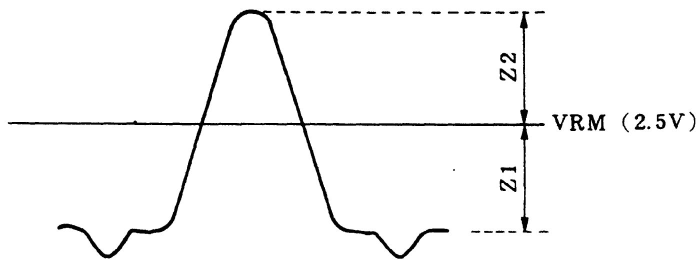
$-30mV \leqq (VA3)_{DC}$, $(VB3)_{DC} \leqq 30mV$

If the voltages are not within this range, turn the preamplifier variable resistor and adjust to within ±30mV.

Adjust the VA3 output amplitude by turning preamplifier variable resistor A3G.
Adjust the VA3 offset by turning preamplifier variable resistor A3O.
Adjust the VB3 output amplitude by turning preamplifier variable resistor B3G.
Adjust the VB3 offset by turning preamplifier variable resistor B3O.

(3) Checking the full rotation signal waveform

Use an oscilloscope to measure the output waveform between VRM an check terminal Z inside the preamplifier.



$Z1 \fallingdotseq Z2$

$Z1,\ Z2 \geqq 60\,\text{mV}$

If the waveform is not like the one shown above, adjust it by turning the variable resistor on the preamplifier.

> Adjust the full rotation signal offset by turning preamplifier variable resistor ZO.

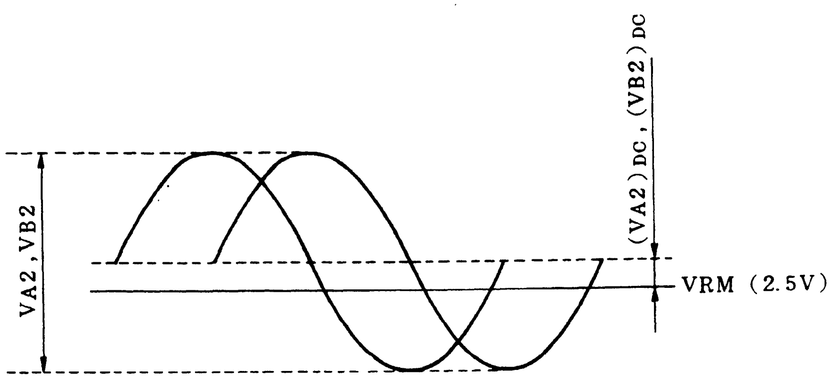
3.2 Spindle Motor Built-in Sensor Preamplifier Adjustment Method

(1) C axis control signal (Velocity signal) adjustment

Measure the AC voltage output amplitude and offset voltage between detection circuit check terminals VA2 and VRM, and between VB2 and VRM. Check that the waveforms are within the range shown below.

(a) Checking output amplitude

Use an oscilloscope to measure the voltages between VA2 and VRM, and between VB2 and VRM.



Amplitude: 0.8V ≦VA2, VB2 ≦1V

Difference in amplitude between VA2 and VB2: | VA2 − VB2 | ≦30mV

(b) Checking offset

Use the DC range of a digital voltmeter to measure the voltages between VA2 and VRM, and between VB2 and VRM.

$-10\text{mV} \leqq (VA2)_{DC}$, $(VB2)_{DC} \leqq 10\text{mV}$

If the voltages are not within this range, turn the preamplifier variable resistor and adjust to within ±10mV.

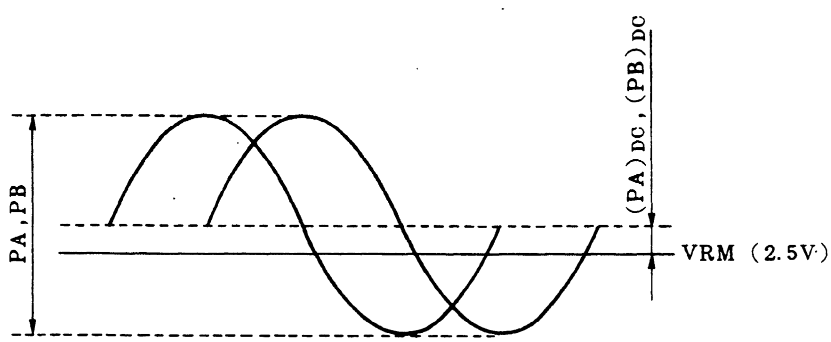
> Adjust the VA2 output amplitude by turning preamplifier variable resistor A1G.
> Adjust the VA2 offset by turning preamplifier variable resistor A1O.
> Adjust the VB2 output amplitude by turning preamplifier variable resistor B1G.
> Adjust the VB2 offset by turning preamplifier variable resistor B1O.

(2) Velocity control signal adjustment

Measure the AC voltage output amplitude and offset voltage between detection circuit check terminals PA and VRM, and between PB and VRM. Check that the waveforms are within the range shown below.

(a) Checking output amplitude

Use an oscilloscope to measure the voltages between PA and VRM, and between PB and VRM.



Amplitude: $0.36V \leqq PA, PB \leqq 0.5V$

Difference in amplitude between PA and PB: $| PA - PB | \leqq 15mV$

(b) Checking offset

Use the DC range of a digital voltmeter to measure the voltages between PA and VRM, and between PB and VRM.

$-50mV \leqq (PA)_{DC}, (PB)_{DC} \leqq 50mV$

If the voltages are not within this range, turn the preamplifier variable resistor and adjust to within $\pm 50mV$.

Adjust the PA output amplitude by turning preamplifier variable resistor A3G.
Adjust the PA offset by turning preamplifier variable resistor A3O.
Adjust the PB output amplitude by turning preamplifier variable resistor B3G.
Adjust the PB offset by turning preamplifier variable resistor B3O.

The locations of the terminals in the detection circuit and the location of the preamplifier variable resistors are shown in Figs. 8.2.2(a) and 8.2.2(b), respectively.

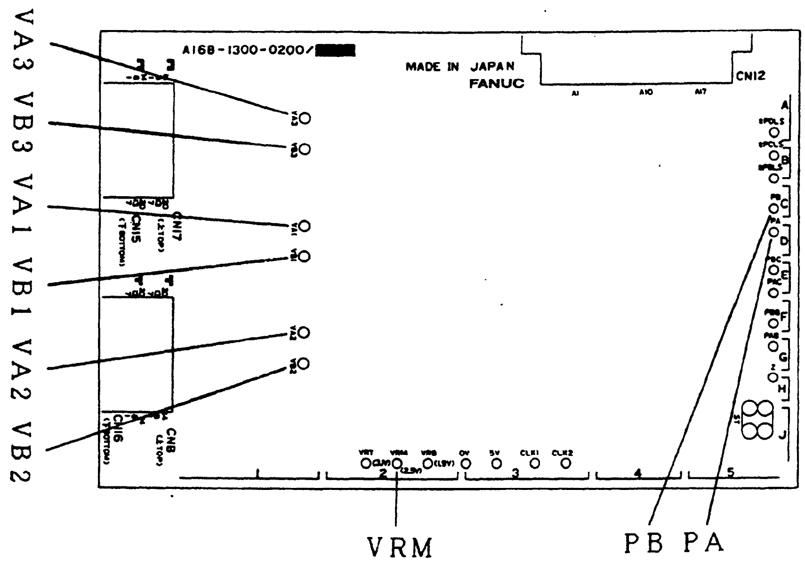


Fig. 3.2 (a) Detection circuit PCB

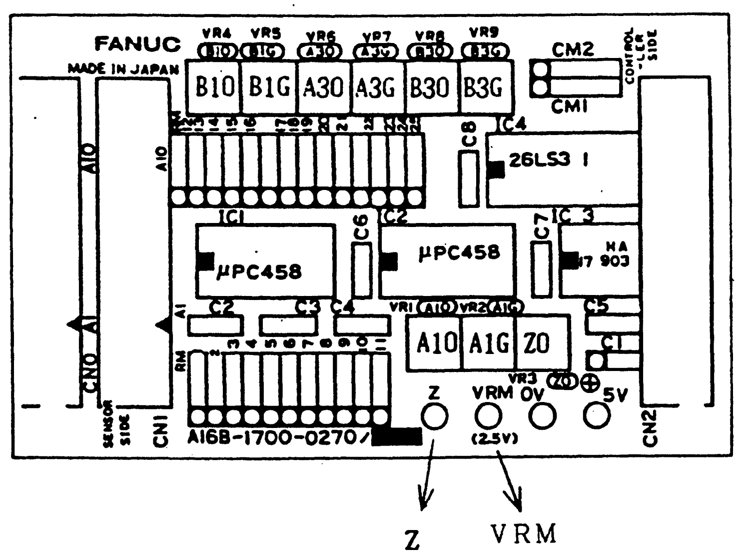
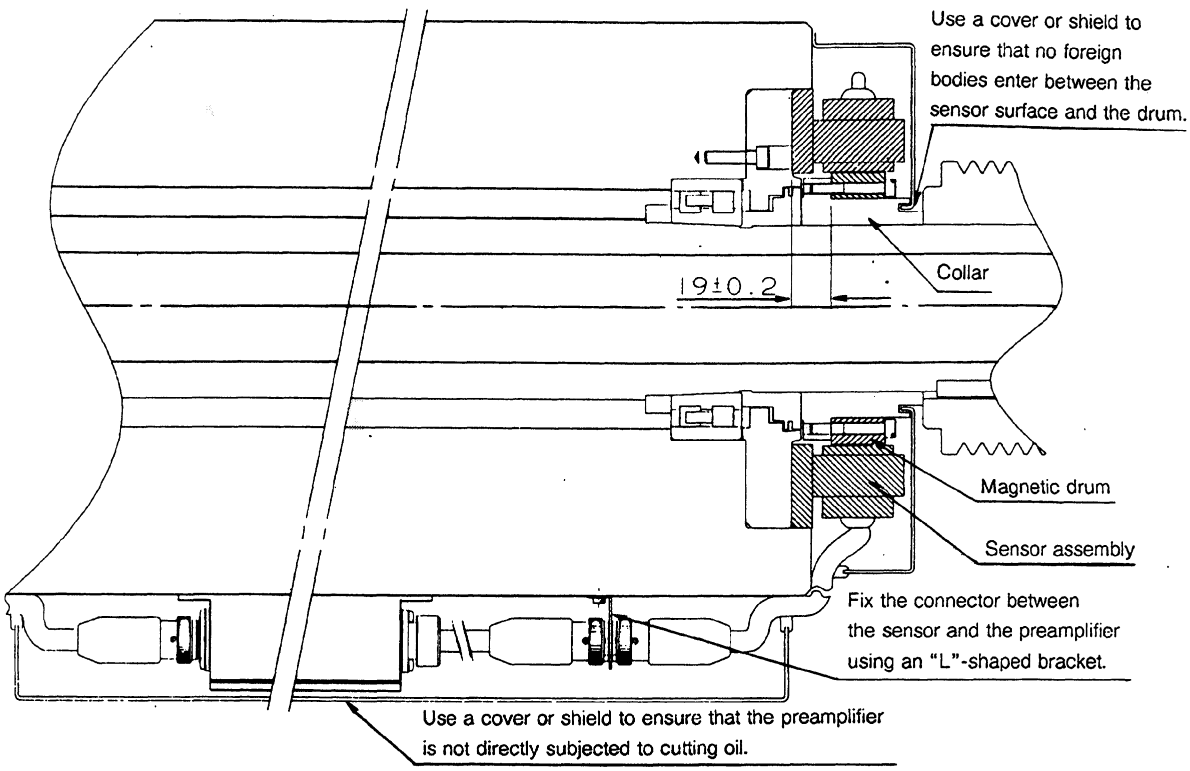


Fig. 3.2 (b) Preamplifier circuit PCB

4. SENSOR AND PREAMPLIFIER FITTING DIAGRAMS



Note 1) Fit the magnetic drum of detectors A860-0381-T121 and T141 by cooling the collar or heating the drum. The maximum allowable temperature for the drum is 100°C.

Note 2) The magnetic drums of other type of detectors should be screwed using the holes pierced in the drum.

Note 3) Adjust the drum so that deviation is within 5μm at the outside surface.

5. SENSOR FITTING PROCEDURE

Use the procedure described below to fit the sensor to the procedure.

(1) Use a dial gauge to measure the squareness between the spindle and the machine side fitting surface for fitting the sensor mounting plate. Check that squareness does not exceed 20μm. If the fitting surface is tapered, the precision cannot be confirmed with a dial gauge, but this may also be a cause of problems for the sensor. Make sure that the maximum squareness of 20μm is taken into account when machining.

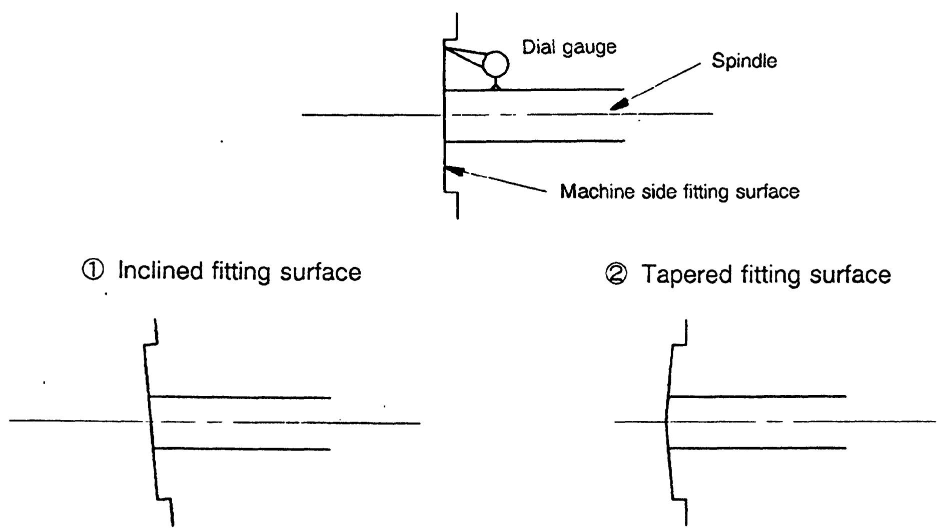


Fig. 5 (a) Problems of fitting surface

(2) Fit the magnetic drum into the spindle and secure it provisionally with screws. The reference plane for the drum is the underside of the surface marked "Z".
The reference plane must be set against the spindle nose. Next, place a dial gauge on the drum and rotate the spindle to adjust the center of the drum.
Adjust so that deviation at the drum circumference is no more than 5μm. When adjustment is complete, tighten the screws securely.

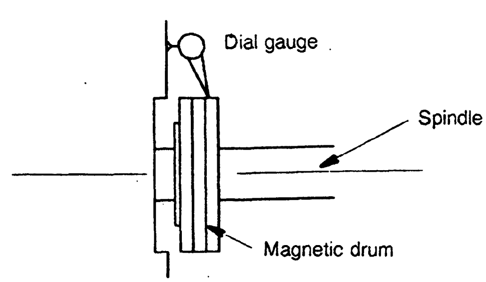


Fig. 5 (b) Installing magnetic drum

If magnets or other objects with strong magnetic fields are brought close to the rear of the drum, there is a risk that the magnetic drum may be demagnetized and stop giving an output. make sure that this does not occur.

(3) Fit the sensor. Make sure to fit it so that the reference plane of the sensor and the reference plane of the drum are aligned in the same direction.
After fitting, confirm that the deviation of the sensor mounting plate to center of the spindle is within 20μm.

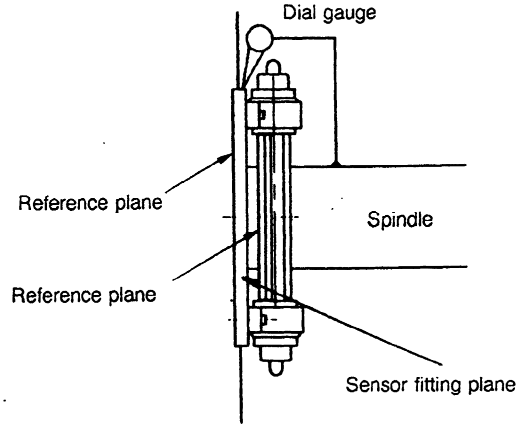


Fig. 5 (c) Installing sensor

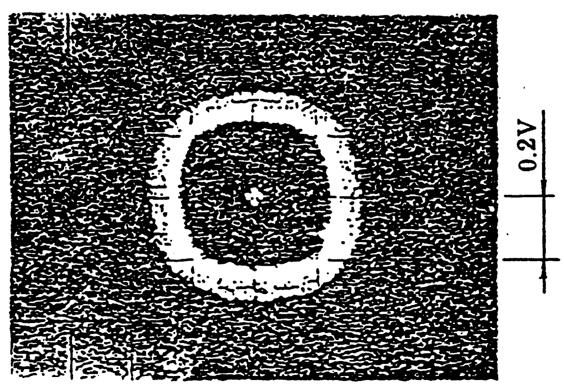
6. CHECKING LISSAJOUS WAVEFORM OF DETECTOR FOR SPINDLE

If the detector for spindle is not mounted to the spindle accurately, the form of the wave output from the sensor may be distorted and, consequently, an accurate position signal cannot be obtained. Therefore, with respect to the mounting accuracy to the spindle, it is needed to strictly observe the accuracy mentioned in the descriptions.

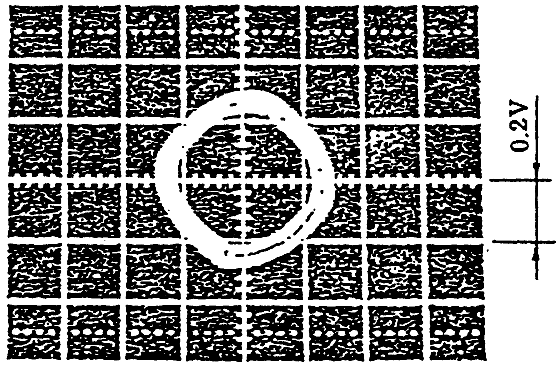
Accuracy standards required when the detector is mounted to a machine (1) Squareness of the surface on the machine side where the sensor mounting plate is attached against the spindle: 20μm or less (2) Magnetic drum outer circumference runout: 5μm or less (3) Rabbet dia. eccentricity of the sensor mounting plate to the spindle: 20μm or less

If the mounting accuracy of the sensor does not satisfy the abovementioned standards, the Lissajous waveform of the sensor is a distorted one with small amplitude as shown in the photo of item (1) below.
Consequently, when a detector is mounted, monitor the Lissajous waveform before adjusting the preamplifier and check to make sure that there is no distortion. If distortion is found, recheck the mounting accuracy of the detector.

(1) Examples of Lissajous waveform when mounting accuracy does not satisfy the abovementioned standards



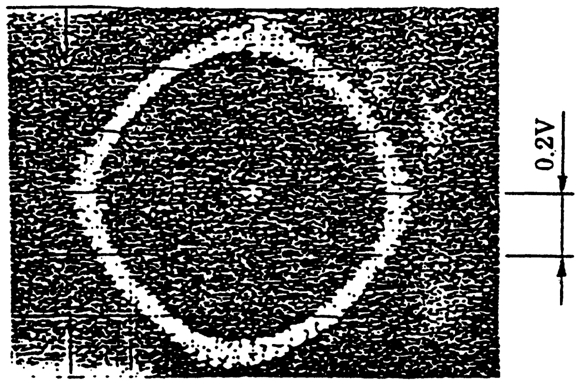
In case where the mounting plate is eccentric to the spindle



In case where the mounting plate is not perpendicular to the spindle

(2) Example of Lissajous waveform when mounting accuracy is satisfying the standards

The Lissajous waveform shown below is a large circle with no distortion.



VI. SPINDLE SWITCHING CONTROL CIRCUIT

1. GENERAL

This chapter explains maintenance required when a spindle switching control circuit for controlling switching between two motors for one unit is added to the AC spindle servo unit. The spindle switching control circuit is applicable to models 6S to 26S.

2. CONFIGURATIONS

In order to control the spindle motors with 1 servo unit, the following items are required apart from the AC spindle motor and servo unit.

(1) Spindle switching control circuit.

(2) Electromagnetic contactor for switching magnetic lines.

(3) Switching signal from the power sequence.

Configuration is shown in the drawing below.

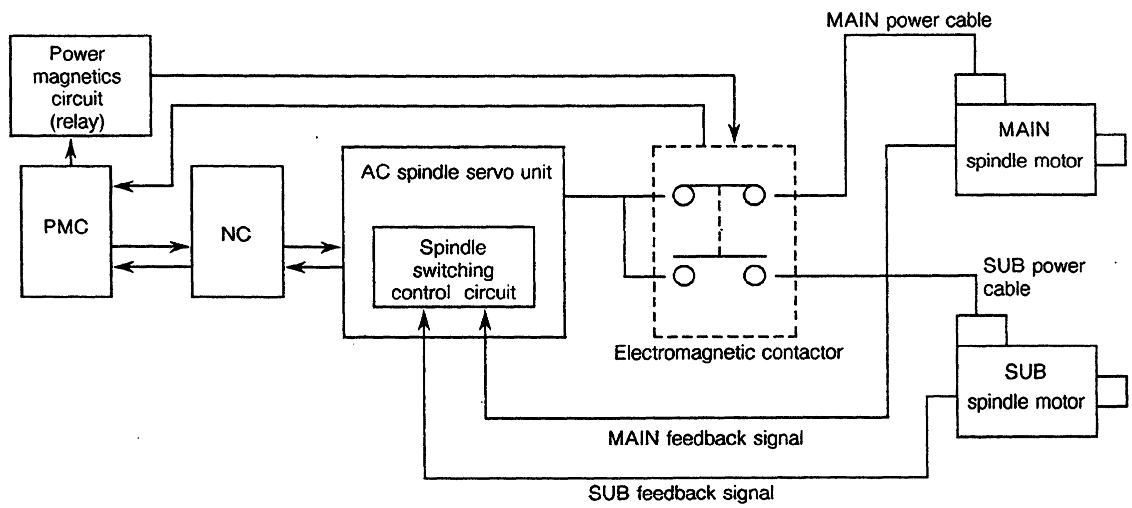


Table 2 Components

Applicable unit	Name	Order specification	PCB	Remarks
Models 1S to 26S (Note)	Spindle switching control circuit (without orientation signal switching)	A06B-6063-J701	A16B-1600-0421	Speed feedback signal switching
		A06B-6064-J701		
	Spindle switching control circuit (with orientation signal switching)	A06B-6063-J702	A16B-1600-0420	Speed feedback signal and position feedback signal switching
		A06B-6064-J702		

Note) When the spindle switching control function is used, the A06B-6063-Hxxx#H511 (xxx: 206 to 226, ROM type 9A11) unit or the A06B-6064-H3xxH550 (ROM type 9A50) unit is required.

3. PARAMETERS

Refer to Appendix 12.

3.1 Automatic Setting Method of 1 Spindle Parameter

(1) Set the following data in the NC bit data in order to carry out automatic setting.

Spindle motor	NC	Parameter address	Data
MAIN	Series 0	6519#7	1
	Series 15	5607#0	0
	Series 16	4019#7	1
SUB	Series 0	6159#7	1
	Series 15	5607#0	0
	Series 16	4195#7	1

(2) Set the motor parameter model code that carry out automatic setting in the following parameters.

Spindle motor	NC	Parameter address	
		No. 1 spindle	No. 2 spindle
MAIN	Series 0	6633	6773
	Series 15	3133	3273
	Series 16	4133	—
SUB	Series 0	6273	6454
	Series 15	3453	3654
	Series 16	4309	—

(3) The model parameters set by code will be automatically set when the NC power is switched OFF and then ON again.

3.2 Parameters Related to the Spindle Switching Control Function

Series 0	No. 1 spindle : 6514
	No. 2 spindle : 6654
Series 15	No. 1 spindle : 3014
	No. 2 spindle : 3154
Series 16	No. 1 spindle : 4014

Data

				CHGSLT	AXSLCT	AXSUB	AXISSL
#7	#6	#5	#4	#3	#2	#1	#0

AXISSL: Specifies whether the spindle change function is enabled. (For 9A11, 9A21, and 9A50 series)

0: The spindle change function is disabled.
1: The spindle change function is enabled.

AXSUB: Specifies whether the function for changing spindles while the subspindle is rotating is enabled. (For 9A11, 9A21, and 9A50 series)

0: The function is disabled.
1: The function is enabled.

AXSLCT: Specifies whether the contacts of the magnetic contactors of both the main spindle and subspindle are checked. (For 9A11.H, 9A21.F, and 9A50.H series)

0: Checks the contacts with the power line status check signal (MCFN)
1: Checks the contacts of both the main spindle and subspindle.

CHGSLT: Specifies whether the contacts of the magnetic contactors for both high and low outputs are checked. (For 9A11.H, 9A21.F, and 9A50.H series)

0: Checks the contacts with the power line status check signal (RCH)
1: Checks the contacts for both high and low outputs.

Note) When a model 3S motor or a smaller model is driven by amplifier model 26S as a subspindle motor, change the proportional gain of current loop to 80% of the standard setting.

3.3 Changing Parameters

It may be necessary to change parameters according to the assembly of the two motors.
Make the changes after parameter automatic setting.

(1) Changing Current Dead Band Data
This parameter is set according to the unit and therefore the following changes are required according to the unit used.

Parameter changes
(Current Dead Band Data)

MAIN Spindle	SUB Spindle
Series 0	Series 0
No. 1 spindle: 6513	No. 1 spindle: 6153
No. 2 spindle: 6653	No. 2 spindle: 6333
Series 15	Series 15
No. 1 spindle: 3013	No. 1 spindle: 3333
No. 2 spindle: 3153	No. 2 spindle: 3553
Series 16	Series 16
No. 1 spindle: 4013	No. 1 spindle: 4189

#7	#6	#5	#4	#3	#2	#1	#0
		DS4	DS3	DS2	DS1		

DS4-DS1 Current Dead Band Data Settings
When using a 6S-12S unit : 0110
When using a 15S-26S unit: 1001

Note) Beware that there is a possibility of damage being done to the power transistor of the unit if this parameter is not changed.

(2) Change Current Conversion Constant (ICONV)
Make the following parameter changes on the motor side if the unit used is not compatible with the motor.

Parameter changes
(Current Dead Band Data)

MAIN Spindle	SUB Spindle
Series 0	Series 0
No. 1 spindle: 6610	No. 1 spindle: 6228
No. 2 spindle: 6750	No. 2 spindle: 6408
Series 15	Series 15
No. 1 spindle: 3110	No. 1 spindle: 3408
No. 2 spindle: 3250	No. 2 spindle: 3628
Series 16	Series 16
No. 1 spindle: 4110	No. 1 spindle: 4264

Change the current-conversion constant (ICONV) from ICONV1 to ICONV2 using the following equation:

$$ICONV2 = ICONV1 \times \frac{G1}{G2}$$

Where
ICONV1: Current-conversion constant before change (default value)
ICONV2: New current-conversion constant
G1: Current-detection gain of the original unit corresponding to the motor
G2: Current-detection gain of the unit used for switching spindles

The following table shows the current-detection gain (G1, G2).

Unit model	Current detection gain (G1, G2)
1S TO 3S	46
Small 6S, 6S to 12S	30
Small 15S	24
15S to 22S	15
26S (Note)	12

Note) When a model 3S motor or a smaller model is driven by amplifier model 26S as a subspindle motor, change the proportional gain of current loop to 80% of the standard setting.

(3) Examples of parameter change (When MAIN spindle data is 22S and SUB spindle data is 6S)

- Used unit 22S (A06B-6064-H322#H550)

	Value at automatic parameter setting		Value after parameter setting	
	22S (MAIN)	6S (SUB)	22S (MAIN)	6S (SUB)
Current Dead band data	1001 (DS4~DS1)	0110	1001	1001
Current conversion constant	550	754	550	1508

Note) Only the parameter on the 6S side is changed.

4. SPINDLE CONTROL SIGNALS

4.1 DI Signals (PMC to CNC)

	0C	15	16	7	6	5	4	3	2	1	0
First :	G229	G227	G070	MRDYA	ORCMA	SFRA	SRVA	CTH1A	CTH2A	TLMHA	TLMLA
Second :	G233	G235	G074								
First :	G230	G226	G071	RCHA	RSLA	INTGA	SOCNA	MCFNA	SPSLA	*ESPA	ARSTA
Second :	G234	G234	G075								

4.2 DO Signals (CNC to PMC)

	0C	15	16	7	6	5	4	3	2	1	0
First :	G281	G229	G045	ORARA	TLMA	LDT2A	LDT1A	SARA	SDTA	SSTA	ALMA
Second :	G285	G245	G049								
First :	G282	G228	G046					RCFNA	RCHPA	CFINA	CHPA
Second :	G286	G244	G050								

Switch request signal SPSLA
(No. 2 spindle side) SPSLB

[Category] Input signal
[Functions] Used when switching spindles
[Operation] The SUB SPINDLE is selected when the signal is 1.
The MAIN SPINDLE is selected when the signal is 0.
Only input this signal having made sure the spindle motor has stopped. There is a speed zero signal (SST) to check if the spindle motor has stopped.

Power cable condition
verification signal MCFNA
(No. 2 spindle side) MCFNB

[Category] Input signal
[Functions] This signal verifies the selection condition of the spindle motor power cable switching electromagnetic contactor (MCC1, MCC2).
[Operation] Select this signal in the following manner in the circuit in Section 6.2.

Motor	Condition of Auxiliary A contact of the electromagnetic contactor (MCC1)	PMC receiver input	Power cable condition verification signal (MCFN)
MAIN	OFF	LOW	0
SUB	ON	HIGH	1

Power cable switching signal CHPA
(No. 2 spindle side) CNPB

[Category] Output signal

[Functions] The power supply to the motor is turned OFF according to the switching request signal (SPSL). When the power is turned OFF, the condition of this signal is changed and therefore the electromagnetic contactor (MCC1, MCC2) for switching the power cable with this signal is selected.

[Operation] Select this signal in the following manner in the circuit in Section 6.2.

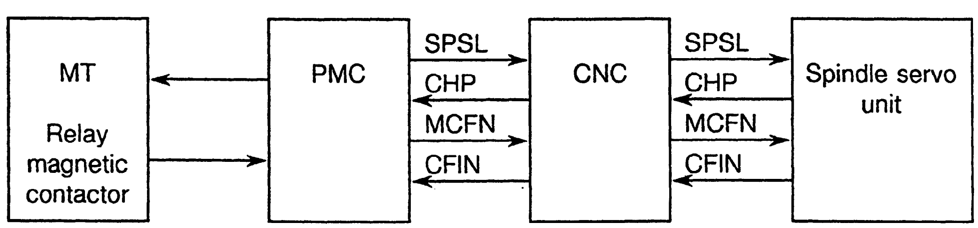
Motor	Power cable switching signal (CHP)	PMC driver output	Electromagnetic contactor selection condition
MAIN	0	OFF	MCC2 is selected.
SUB	1	ON	MCC1 is selected.

Switch Completion Signal CFINA
(No. 2 spindle side) CFINB

[Category] Output signal

[Function] This is a signal that selects the power cable condition verification signal (MCFN) and checks that it is the same selection condition after the switching request signal (SPSL) has been input. Furthermore, it completes the initial setting of the spindle control circuit and is output when the following operations become possible.

[Operations] Displays the fact that the switch to SUB SPINDLE is complete when the signal is 1. Displays the fact that the switch to MAIN SPINDLE is complete when the signal is 0.



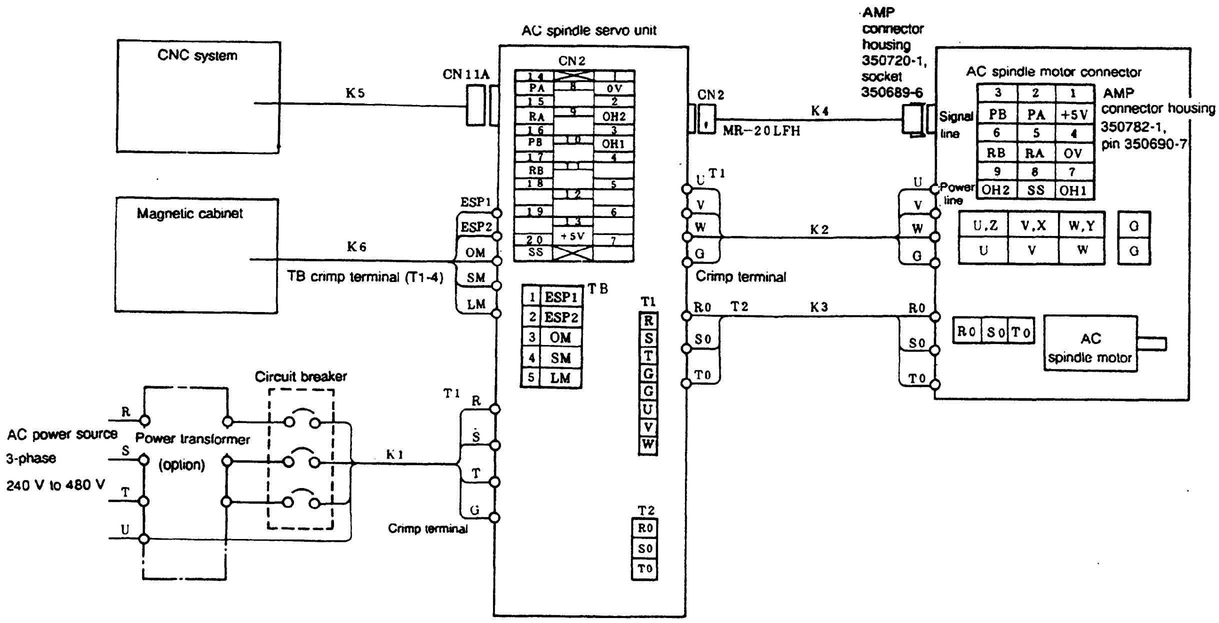
APPENDIX

APPENDIXES

APPENDIX 1 CONNECTION DIAGRAM

(1) Without high-resolution magnetic pulse coder

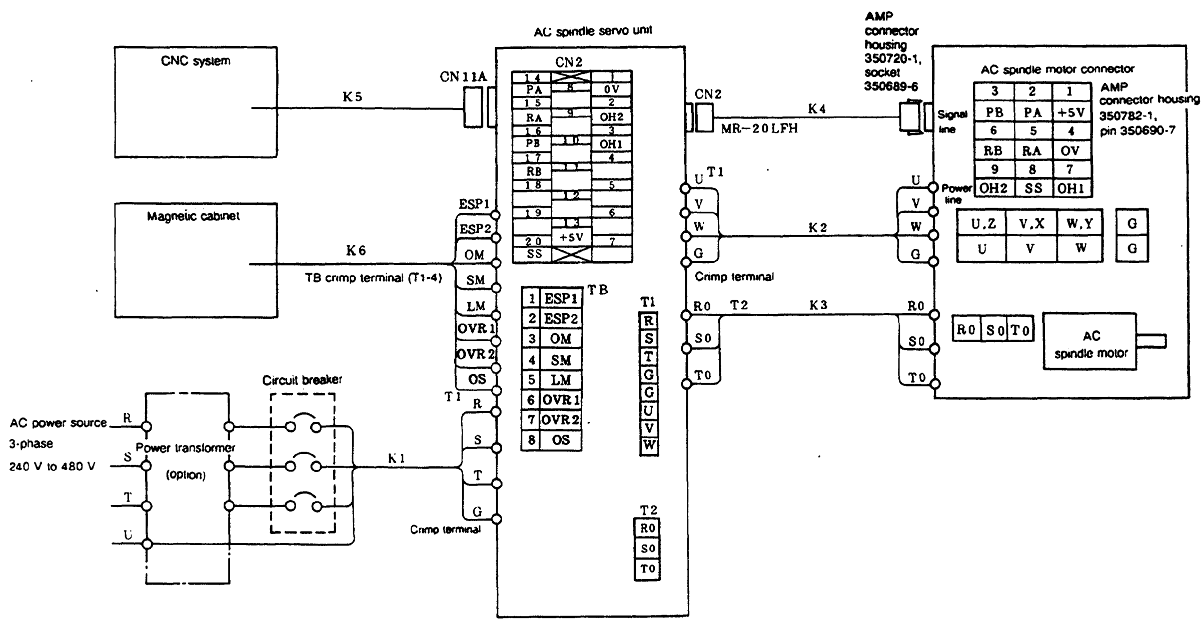
(a) Models 1S to 3S
Unit specification: A06B-6064-H201 to H203



Note) Circuit breaker is to be provided by machine tool builder.

Fig. 1 (a) Connection Diagram (Models 1S to 3S)

(b) Models 1S to 3S
Unit specification: A06B-6064-H301 to H303



Note) Circuit breaker is to be provided by machine tool builder.

Fig. 1 (b) Connection Diagram (Models 1S to 3S)

(c) Models 6S to 26S

Unit specification: A06B-6062-Hxxx to A06B-6063-Hxxx

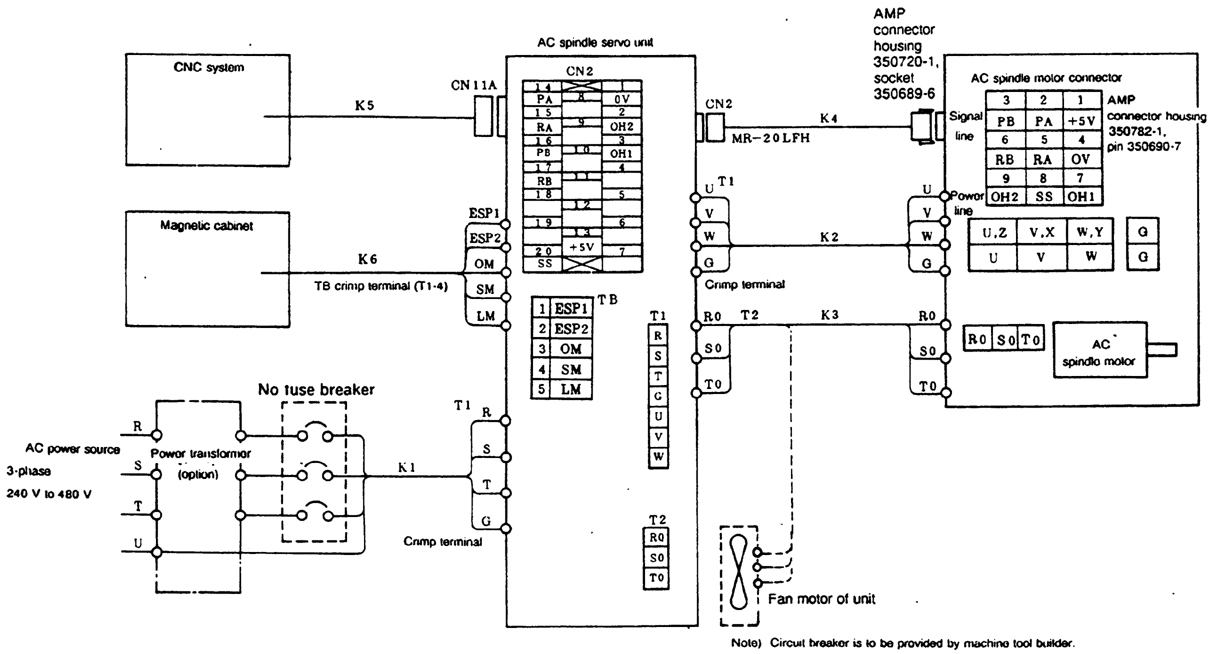


Fig. 1(c) Connection Diagram (Models 6S to 26S)

(d) Models 6S to 26S (with no high-resolution magnetic pulse coder)

Unit specification: A06B-6064-H306 to -H326

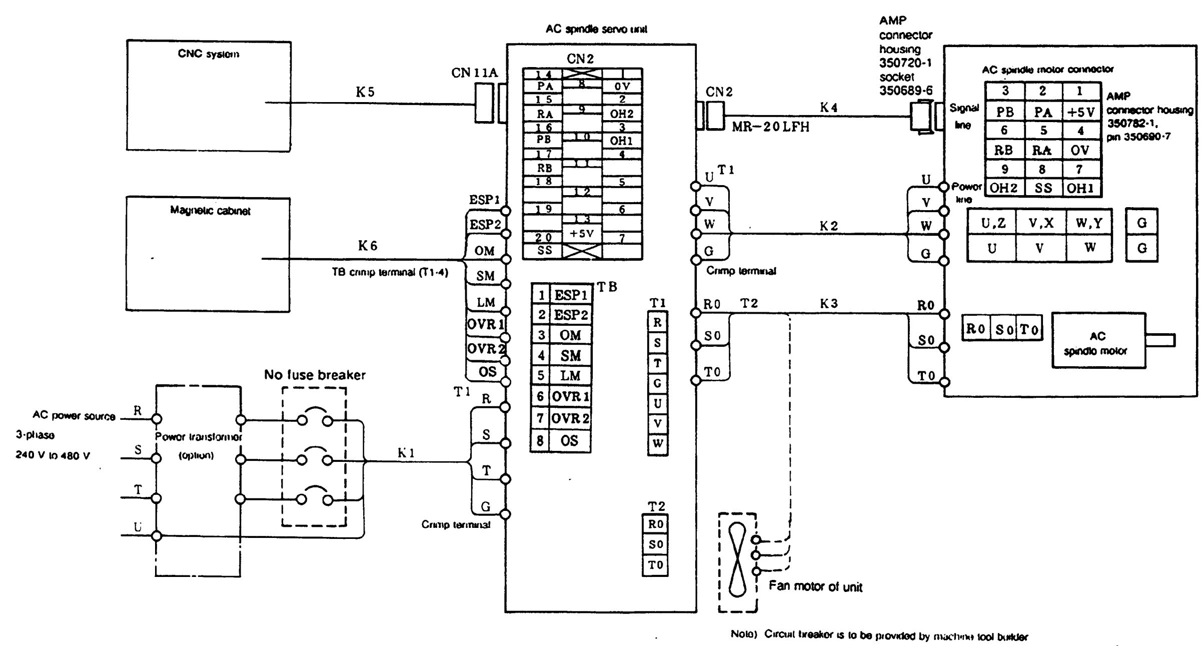


Fig. 1(d) Connection Diagram (Models 6S to 26S)

(e) Models 30S, 40S

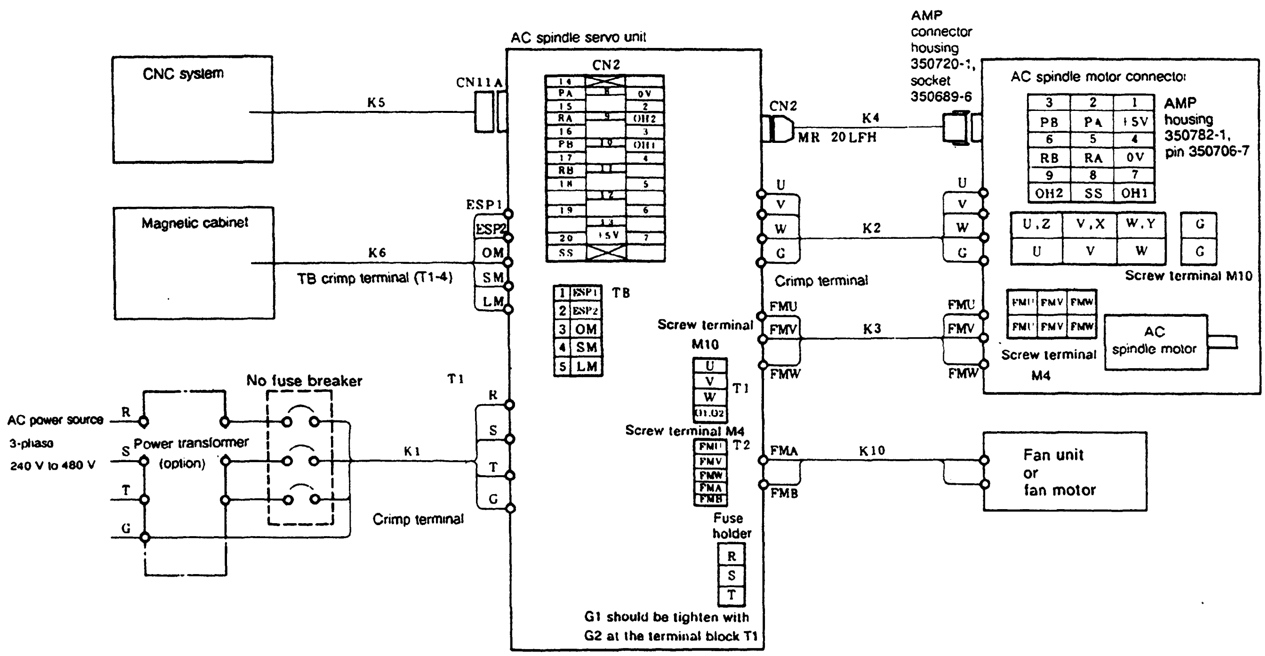
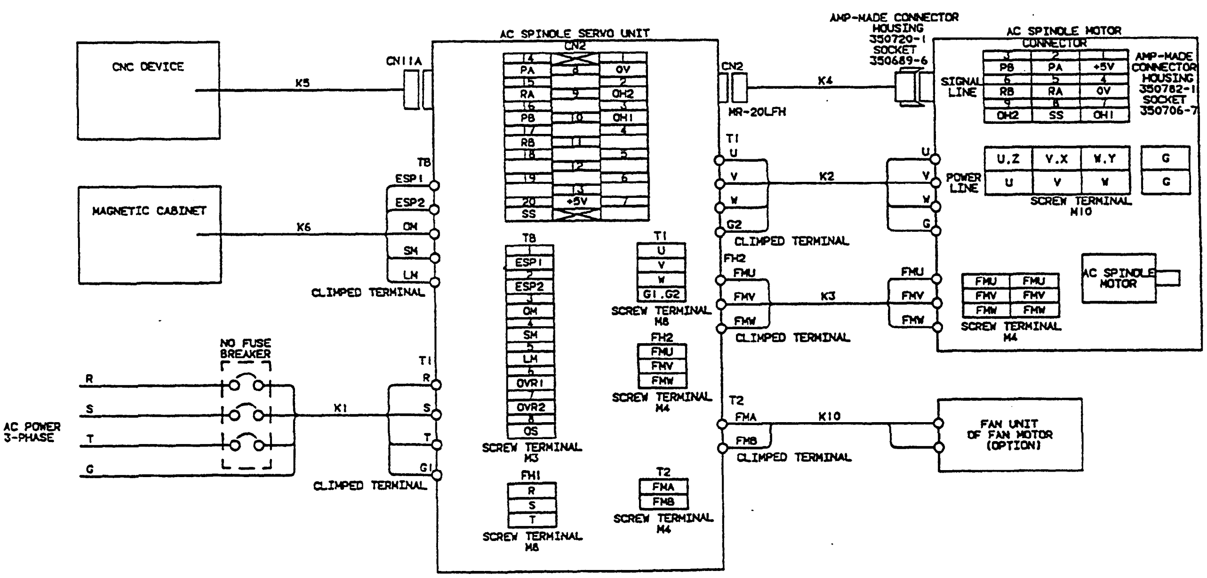
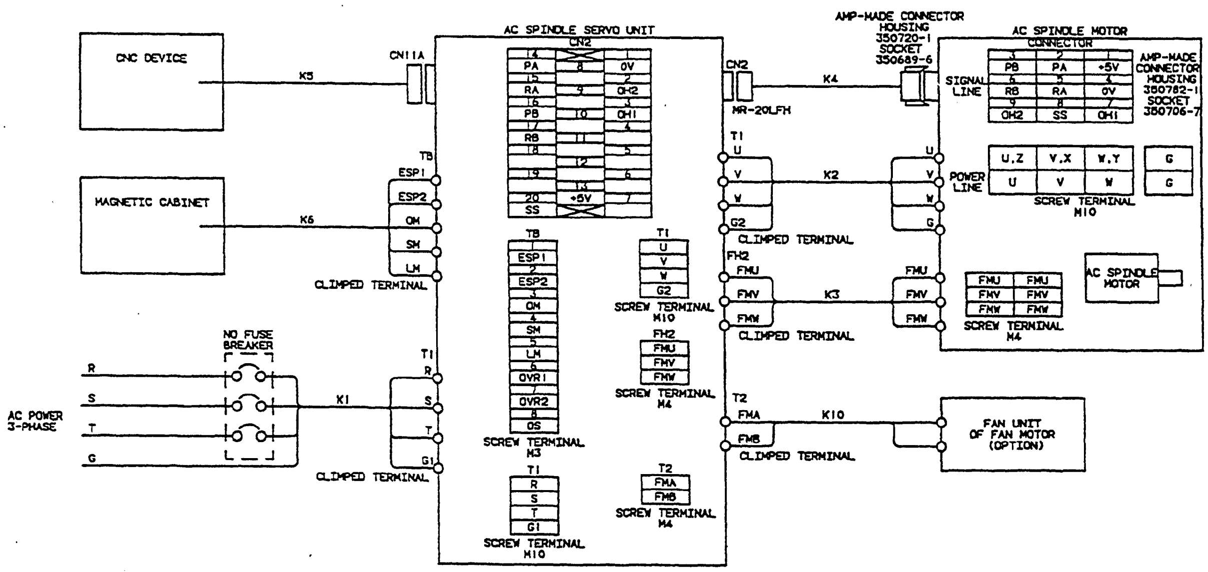


Fig. 1 (e) Connection Diagram (Models 30S to 40S)

(f) AC spindle servo unit model 30HV/40HV

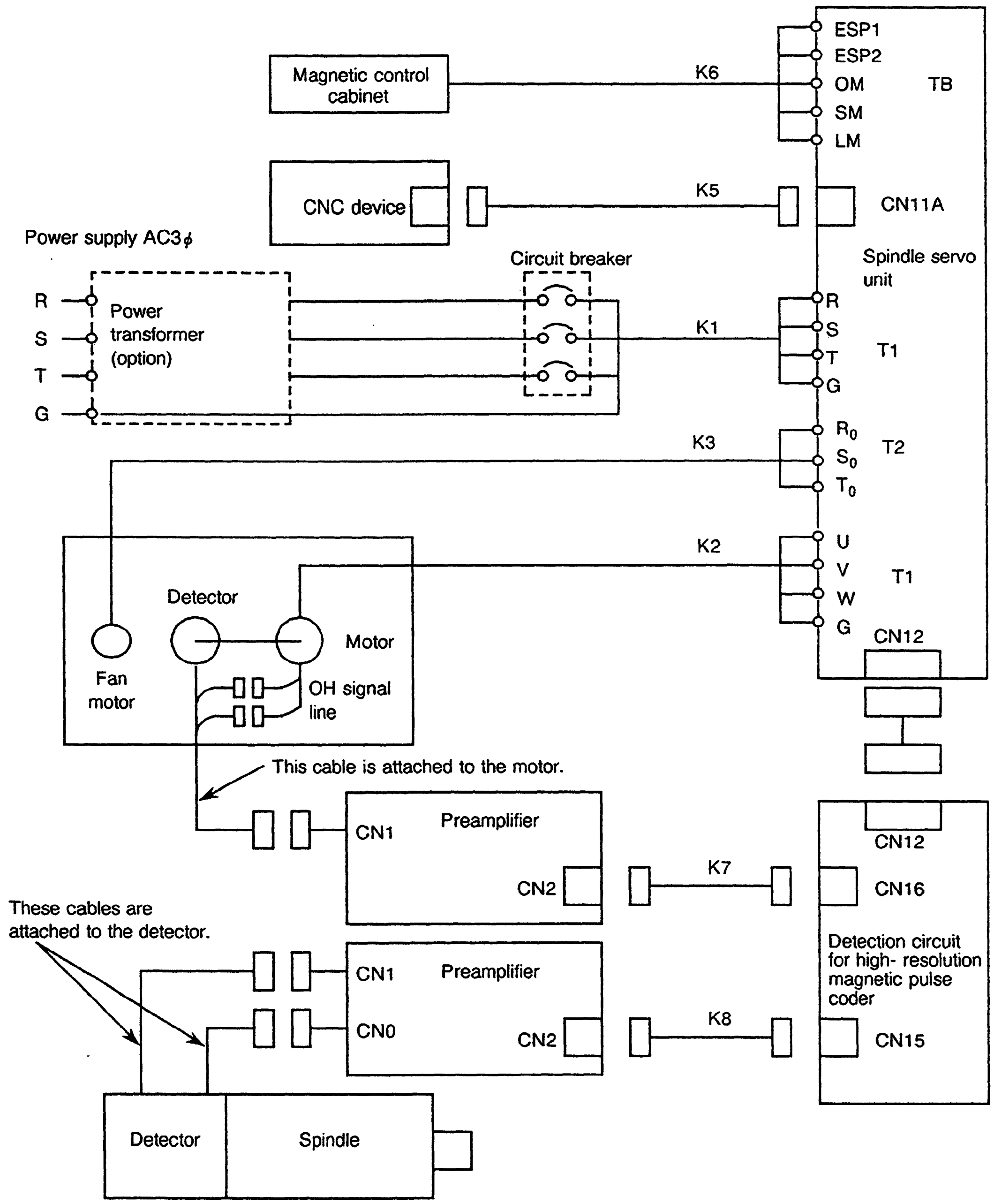


(g) AC spindle servo unit model 60HV



(2) With high-resolution magnetic pulse coder

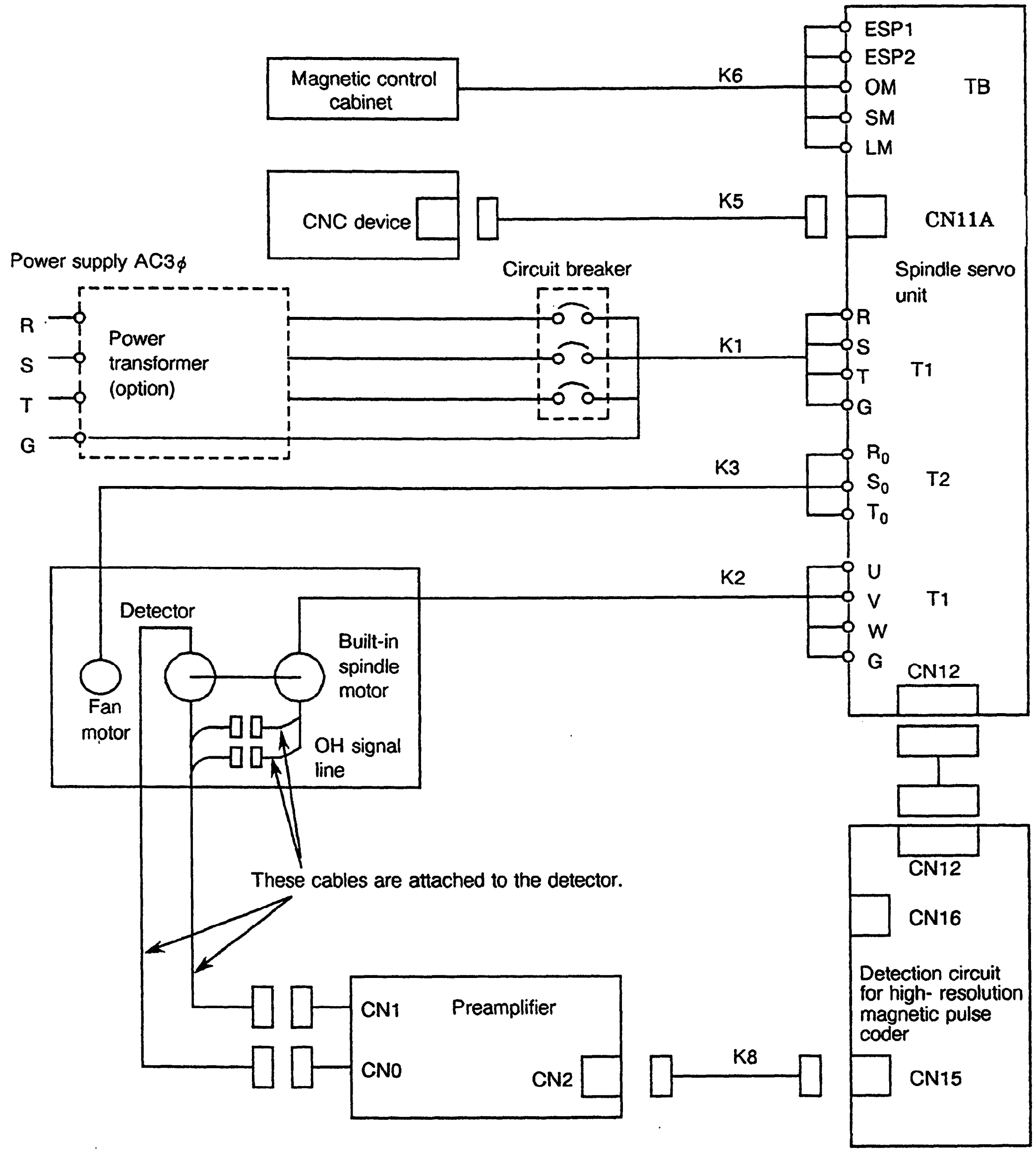
(a) Models 2S to 40S (when motor and spindle are associated by belt)



Note) A high-resolution magnetic pulse coder has a function to output position coder signals, and is connected to NC with a cable K5.
Cables of a standard length of 7 m are provided for K7 and K8. Any other cables are to be prepared by the machine tool builder according to Figs. 1(b) and (i).

Fig. 1(f) Connection Diagram (Models 2S to 40S)
(When Motor and Spindle are Associated by Belt)

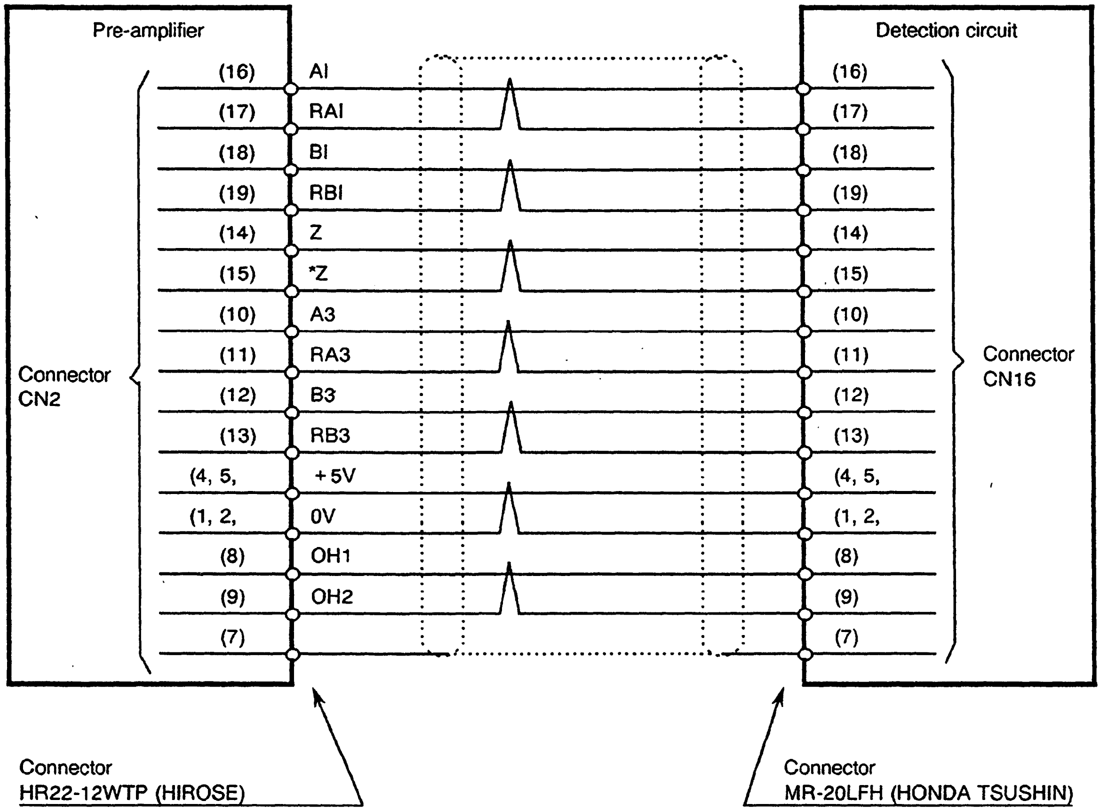
(b) With a built-in spindle motor (models 2S to 40S)



Note) A high-resolution magnetic pulse coder has a function to output position coder signals, and is connected to NC with a cable K5.

A cable of a standard length of 7 m is provided for K8. Any other cables are to be prepared by the machine tool builder according to Fig. 1(i).

Fig. 1(g) Connection Diagram (Models 2S to 40S)
(in Case of Built-in Spindle Motor)



Cable employed (The cable length should be shorter than 14m.)

+5V, 0V : 3 wires 0.3mm^2 or larger each.

Other wire gauge : Over shielding 0.18mm^2 or larger.

Our company's drawing number

A06B-6063-K802

Note) Select the soldering type (HR22-12WTPA-20S) or crimp type.

Choose from two types:

Crimp type

Crimp pin: HR22-SC-122 (20 pins required per connector)

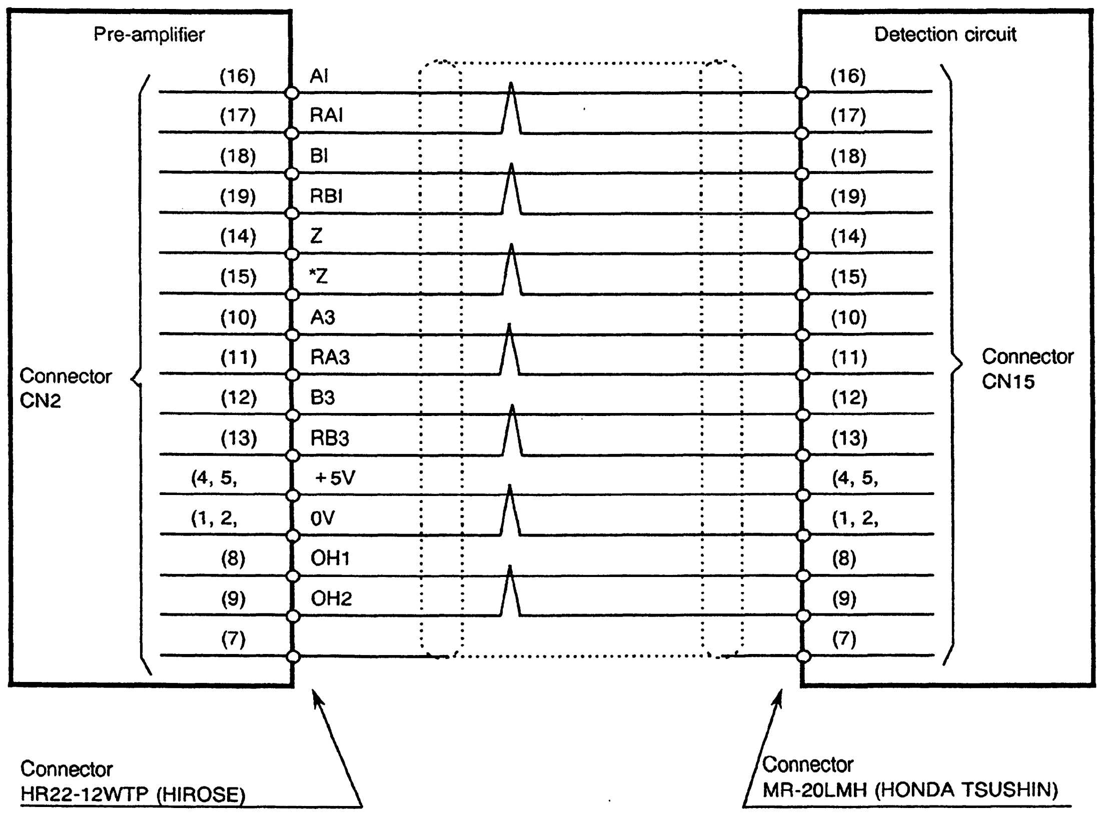
Connector housing: HR22-12WTPA-20SC

Soldering type

HR22-12WTPA-20S

When the crimp type connector is used, the following manual crimping tool is required:
Specification: HR22-TA2428HC (HIROSE ELECTRIC CO.)

Fig. 1 (h) Details of Cable K7



Cable employed (The cable length should be shorter than 14m.)

+5V, 0V : 3 wires 0.3mm^2 or larger each.

Other wire gauge : Over shielding 0.18mm^2 or larger.

Our company's drawing number

A06B-6063-K801

Note) Select the soldering type (HR22-12WTPA-20S) or crimp type.

Choose from two types:

Crimp type

Crimp pin: HR22-SC-122 (20 pins required per connector)
Connector housing: HR22-12WTPA-20SC

Soldering type

HR22-12WTPA-20S

When the crimp type connector is used, the following manual crimping tool is required:
Specification: HR22-TA2428HC (HIROSE ELECTRIC CO.)

Fig. 1 (i) Details of Cable K8

APPENDIX 2 CABLE ROUTING

(1) Models 1S to 3S (Spindle control circuit: A16B-2201-0010)

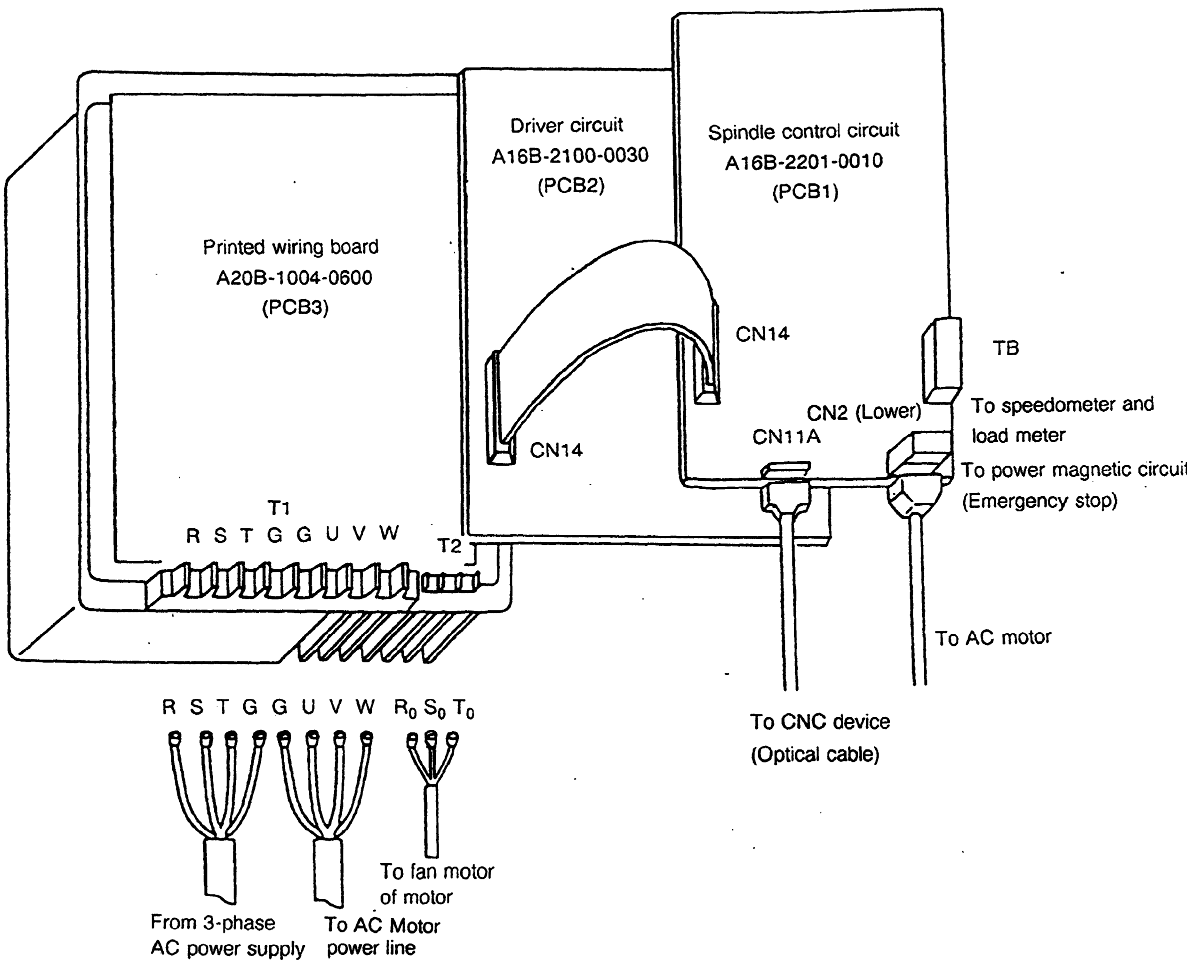


Fig. 2 (a) Cable Routing of Models 1S to 3S

(2) Models 1S to 3S (Spindle control circuit: A16B-2201-0440)

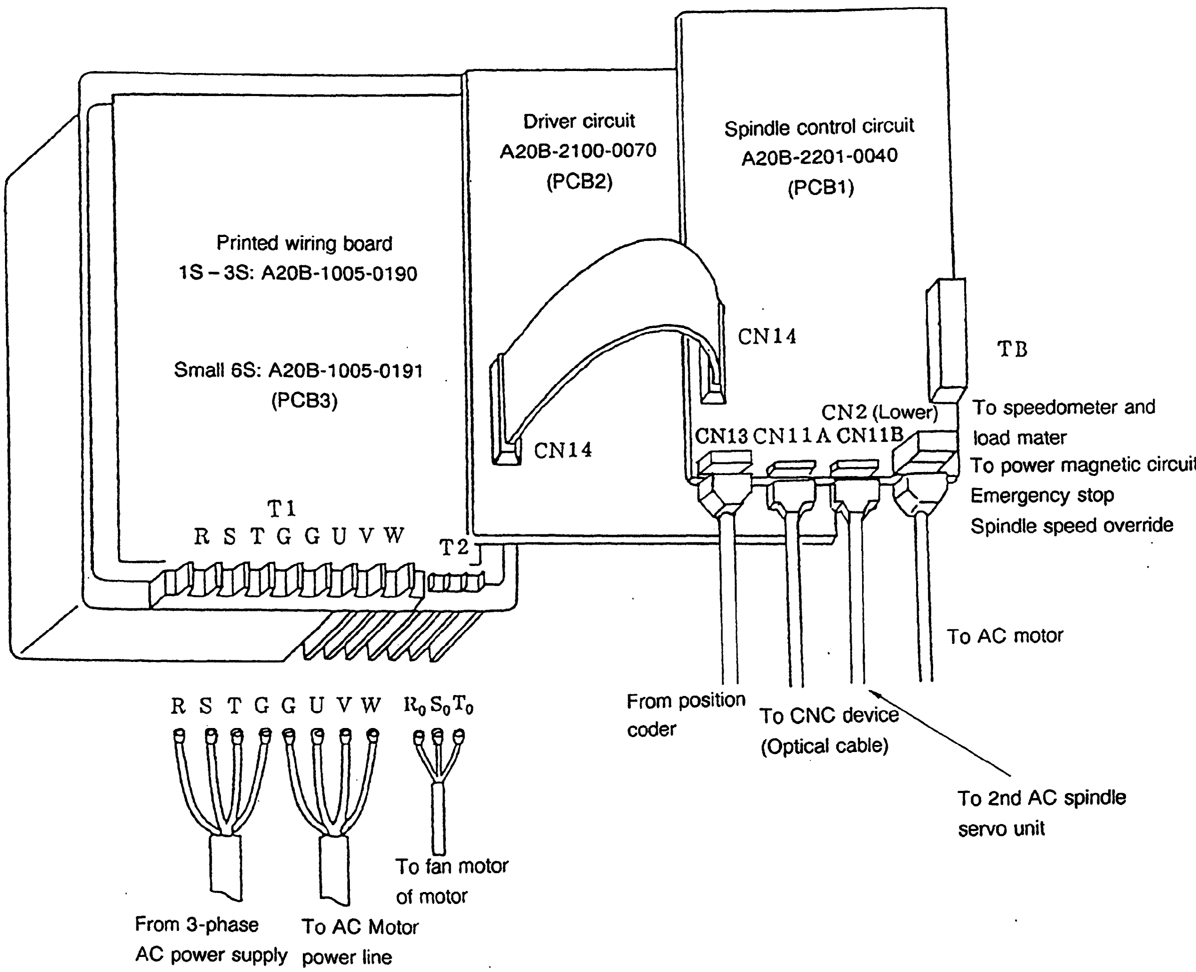


Fig. 2 (b) Cable Routing of Models 1S to 3S, small 6S

(3) Models 6S to 12S (with spindle control circuit A20B-1003-0550)

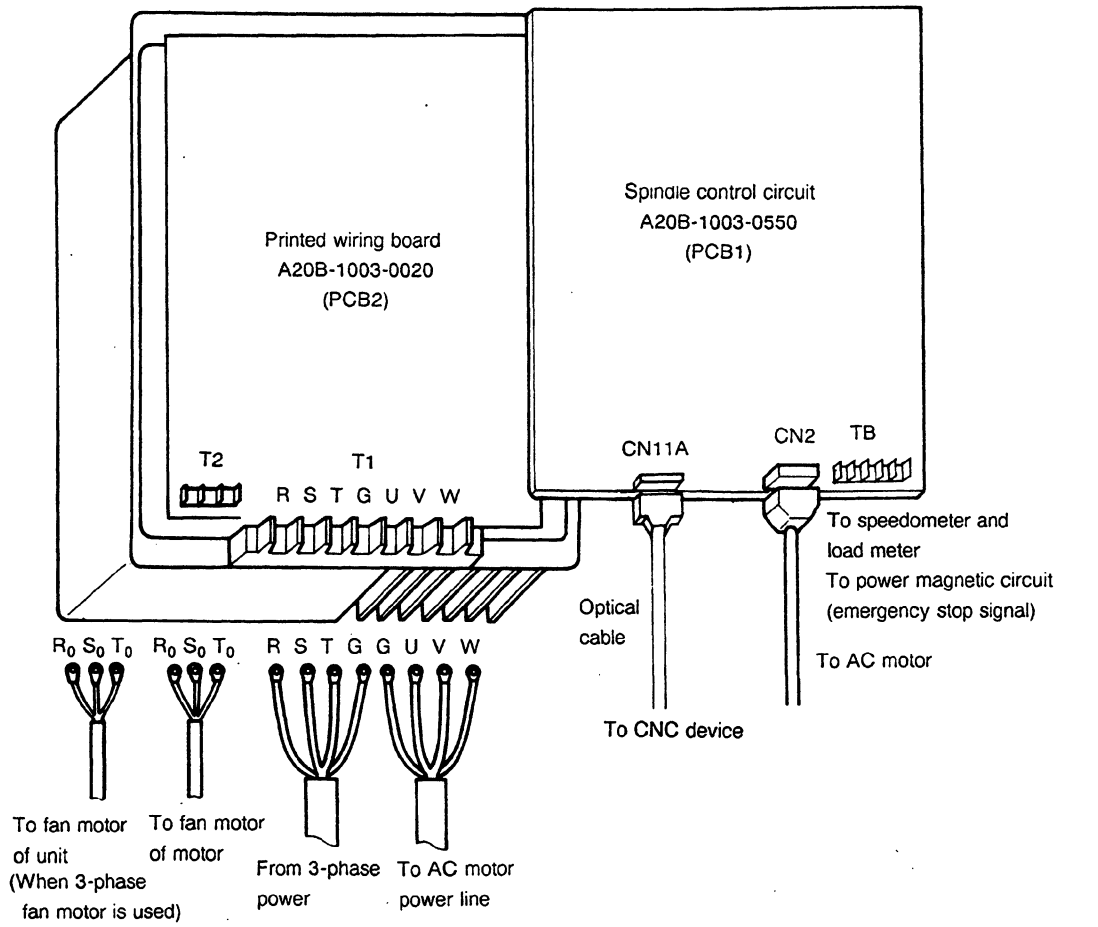


Fig. 2 (c) Cable Routing of Models 6S to 12S (A20B-1003-0550)

(4) Models 6S to 12S (with spindle control circuit A20B-1003-0920)

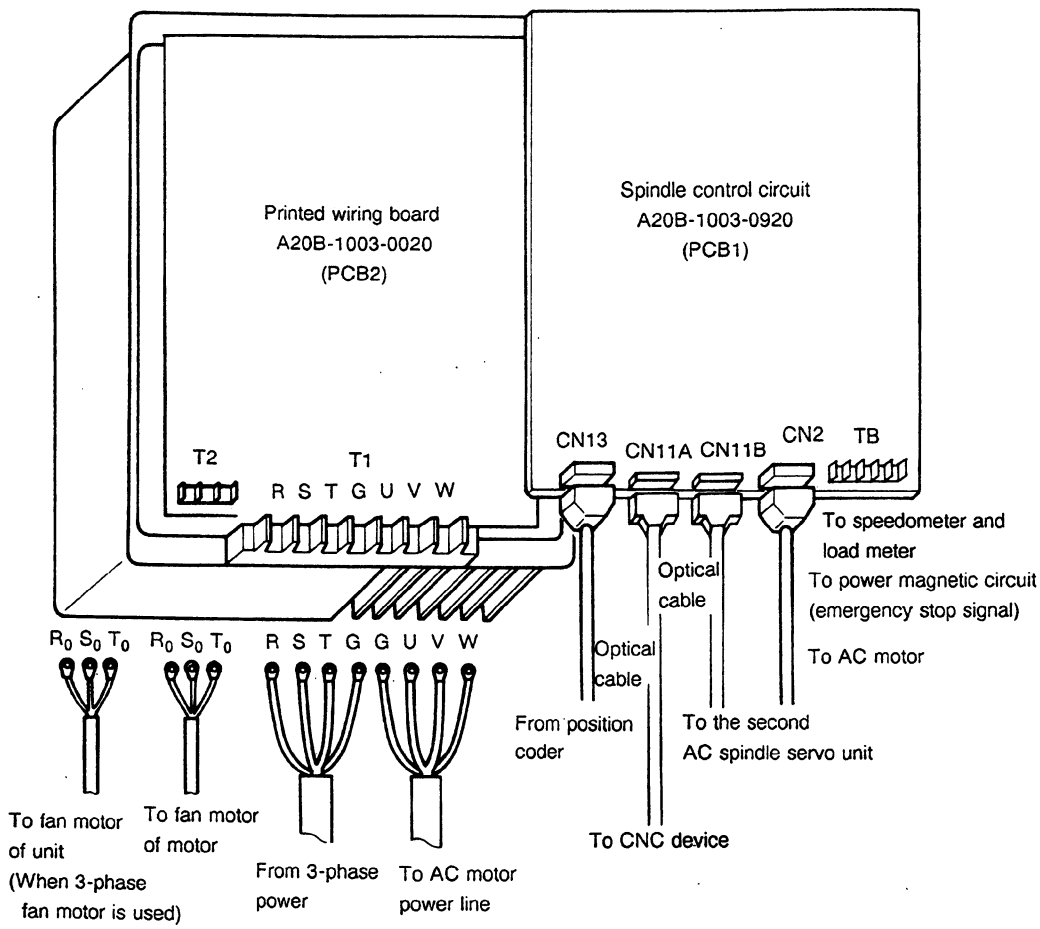


Fig. 2 (d) Cable Routing of Models 6S to 12S (A20B-1003-0920)

(5) Models 6S to 12S, small 15S (with spindle control circuit A16B-2201-0440)

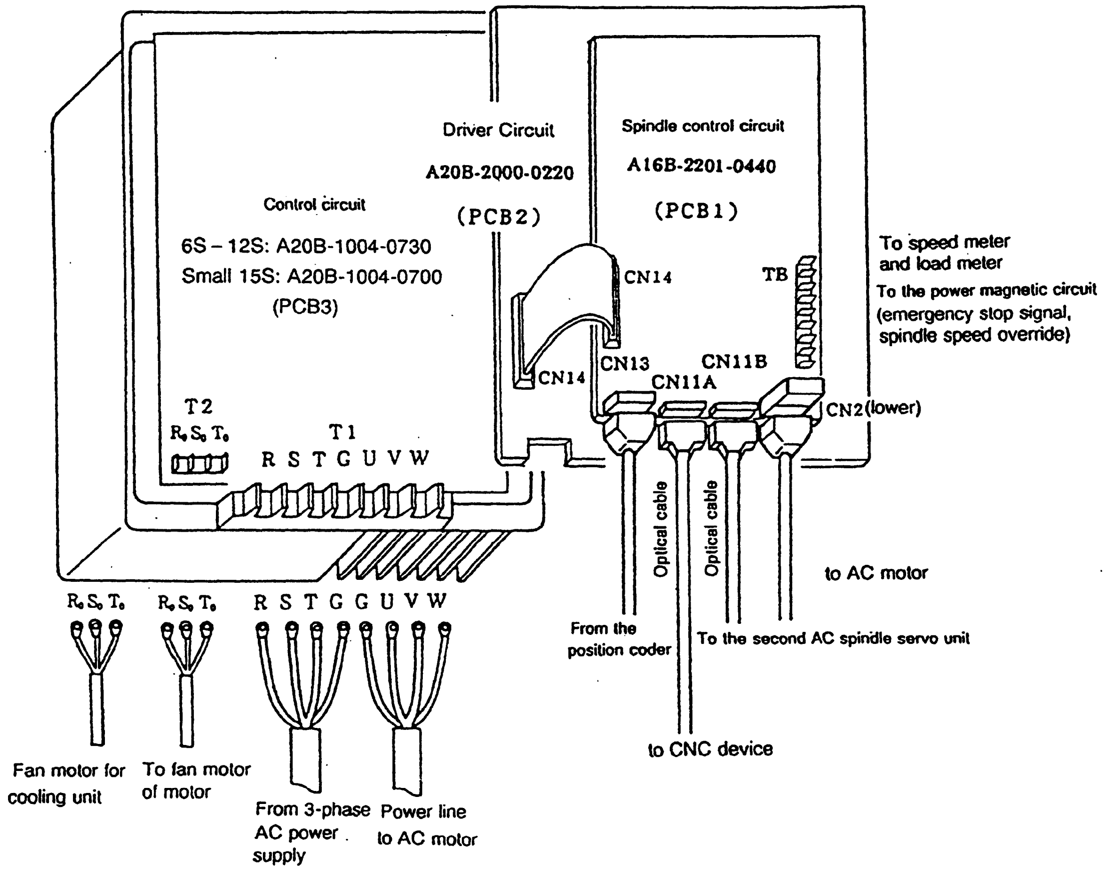


Fig. 2(e) Cable Routing of Models 6S to 12S, Small 15S (A16B-2201-0440)

(6) Models 15S to 22S (with spindle control circuit A20B-1003-0550)

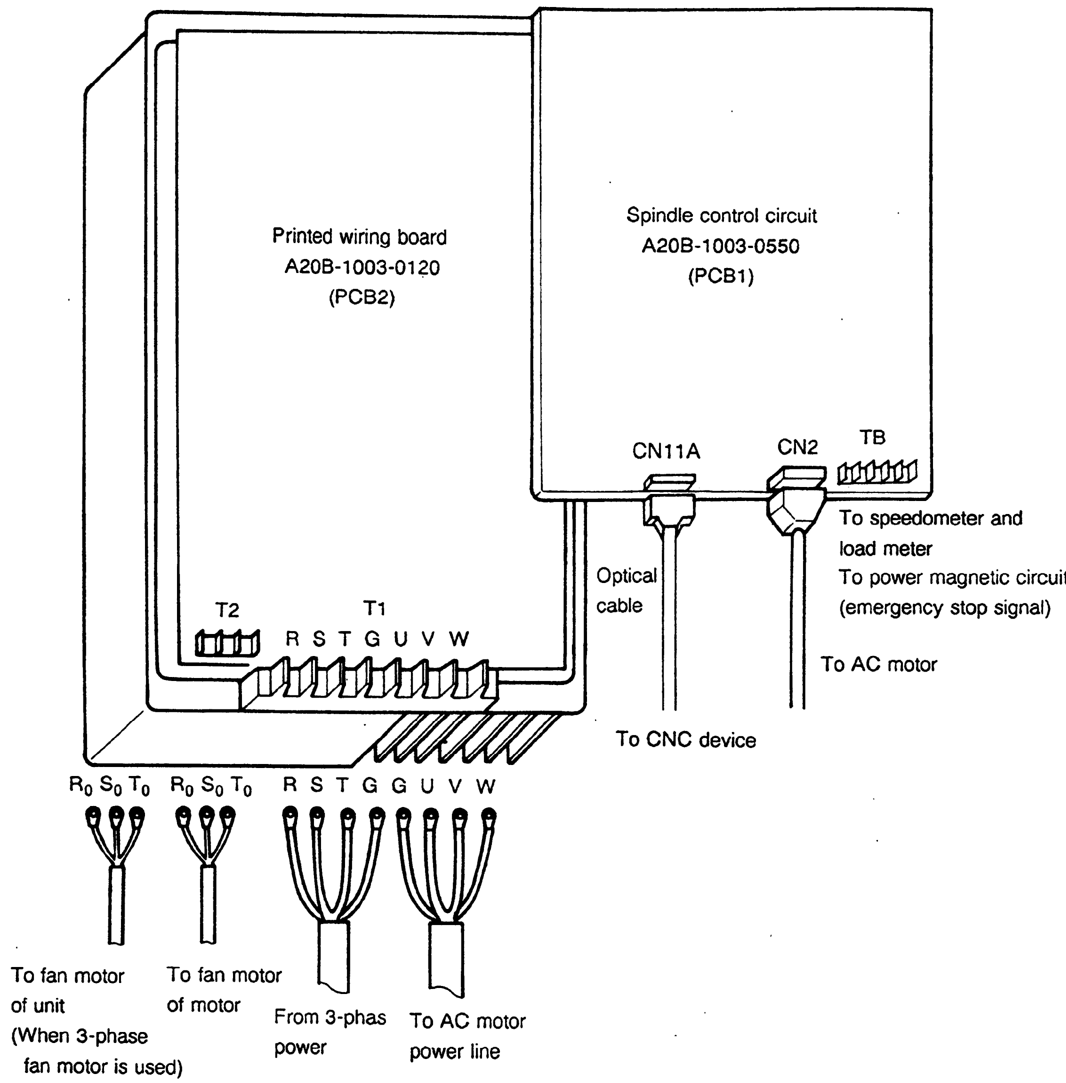


Fig. 2 (f) Cable Routing of Models 15S to 22S (A20B-1003-0550)

(7) Models 15S to 26S (with spindle control circuit A20B-1003-0920)

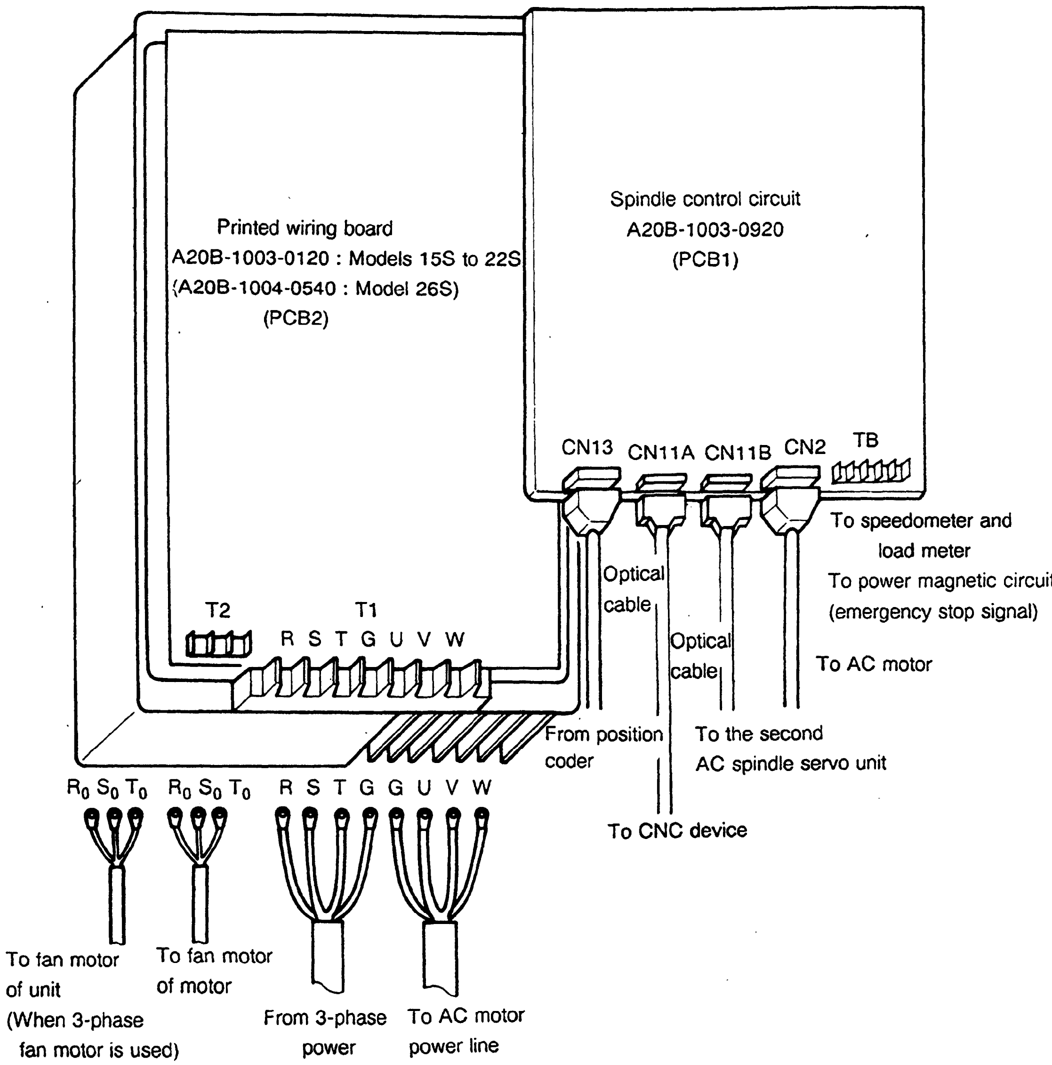


Fig. 2 (g) Cable Routing of Models 15S to 26S (A20B-1003-0920)

(8) Models 15S to 26S (with spindle control circuit A16B-2201-0440)

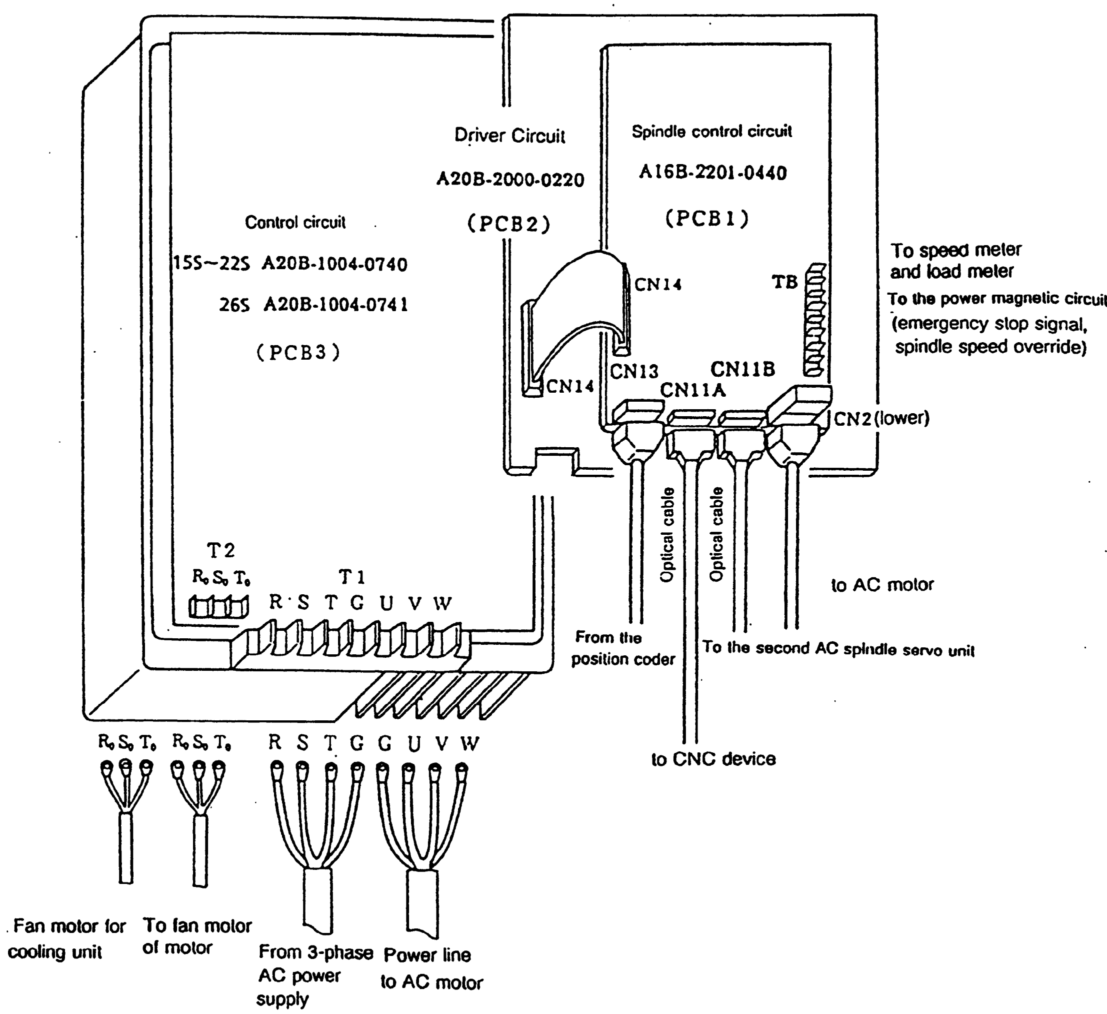


Fig. 2(h) Cable Routing of Models 15S to 26S (A16B-2201-0440)

(9) Models 30S and 40S

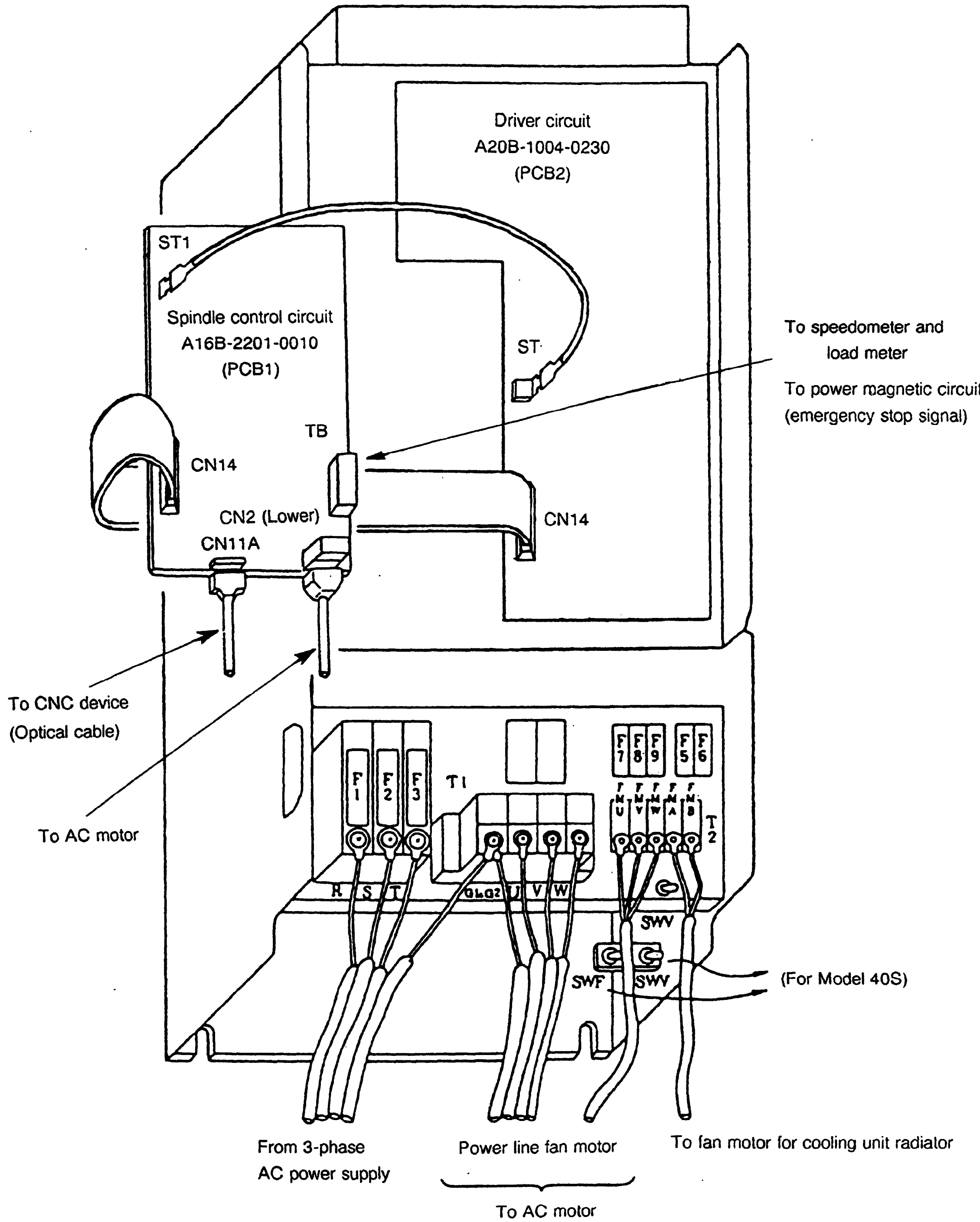


Fig. 2 (i) Cable Routing of Models 30S and 40S

(10) Models 2S, 3S, 30S, and 40S (Cs contouring control function with motor and spindle associated by belt)

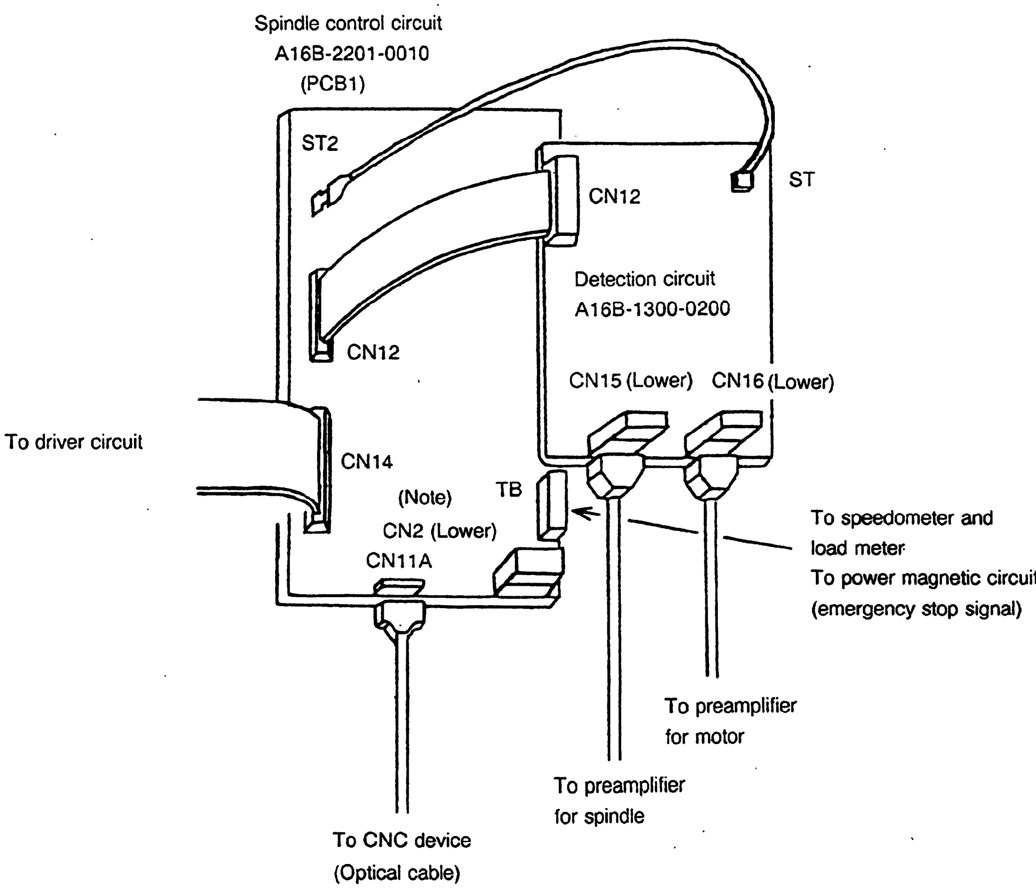


Fig. 2 (j) Cs Contouring Control Function with Motor and Spindle Associated by Belt (Models 2S, 3S, 30S, and 40S)

Note) Do not connect a cable with CN2.

(11) Models 2S, 3S, 30S, and 40S (Cs contouring control function with built-in spindle motor)

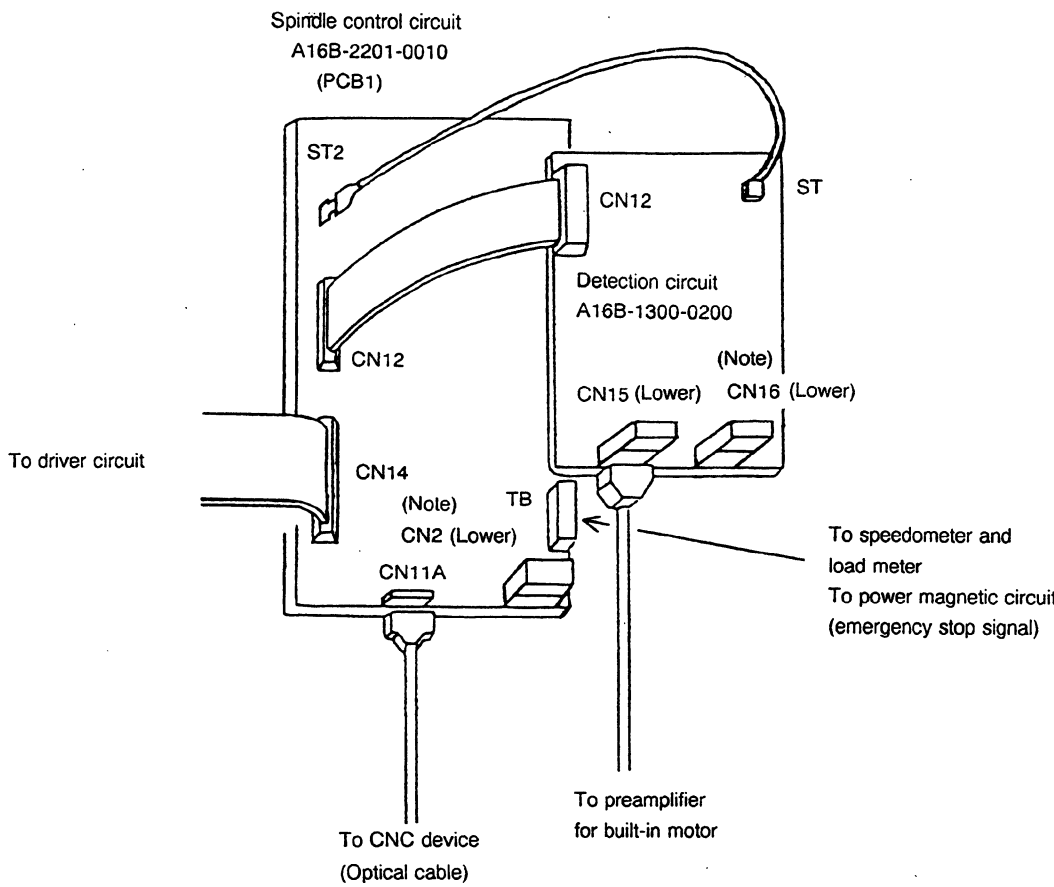


Fig. 2 (k) Cs Contouring Control Function with Built-in Spindle Motor (Models 2S, 3S, 30S, and 40S)

Note) Do not connect a cable with CN2 and CN16.

(12) Models 2S to 26S (when the motor and the spindle are connected with a belt at Cs contouring control function)

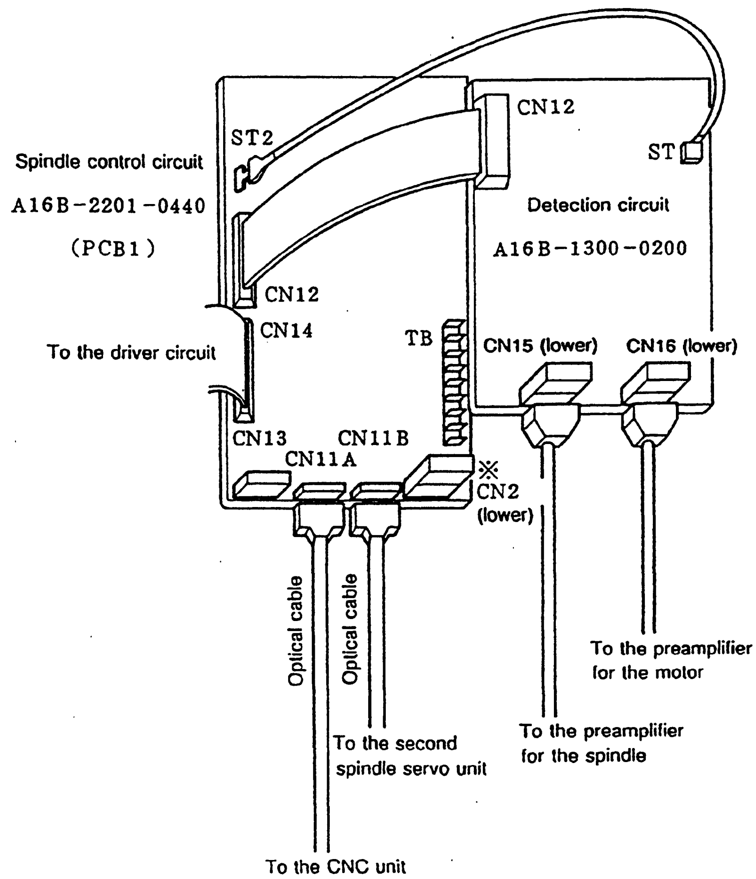


Fig. 2 (l) Cs Contouring Control Function with Motor and Spindle Associated by Belt (Models 2S to 26S)

(*1) Do not connect a cable with CN2.

(13) Models 6S to 26S (built-in spindle motor at Cs contour control function)

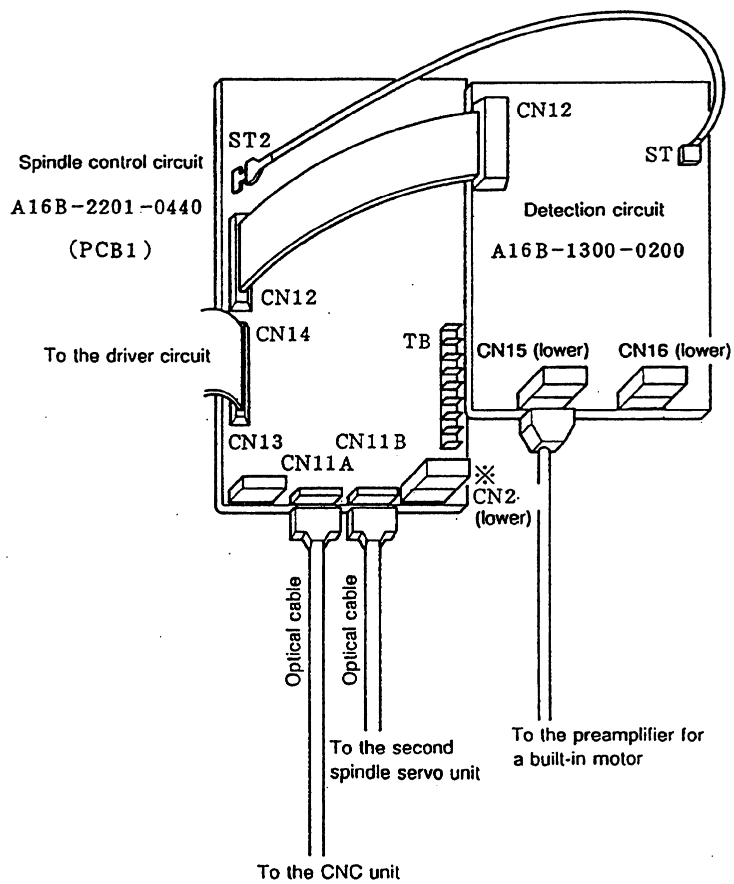


Fig. 2(m) Cs Contouring Control Function with Built-in Spindle Motor (Models 6S to 26S)

(*1) Do not connect a cable with CN2 and CN16.

(14) Models 6S to 22S (Cs contouring control function with motor and spindle associated by belt)

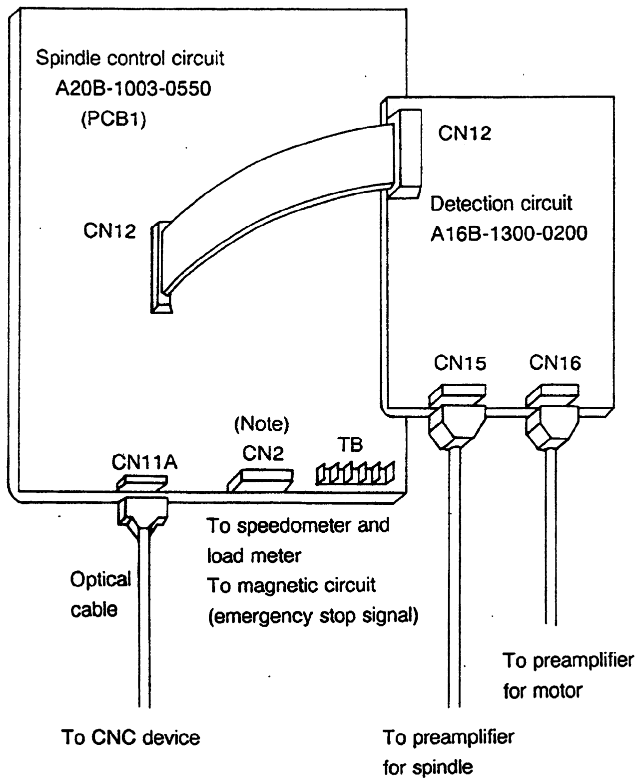


Fig. 2 (n) Cs Contouring Control Function with Motor and Spindle Associated by Belt (Models 6S to 22S)

Note) Do not connect a cable with CN2.

(15) Models 6S to 26S (Cs contouring control function with built-in spindle motor)

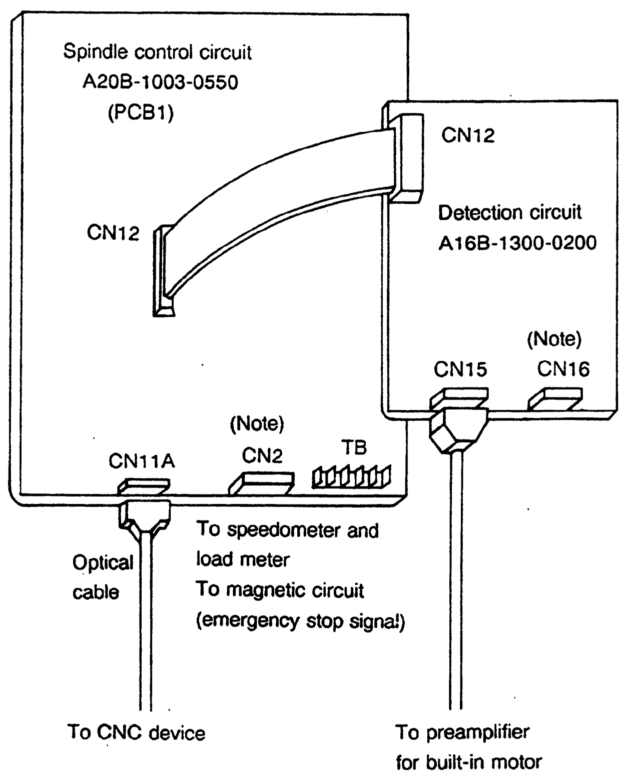


Fig. 2 (o) Cs Contouring Control Function with Built-in Spindle Motor (Models 6S to 22S)

Note) Do not connect a cable with CN2, CN13, and CN16.

(16) Models 6S to 26S (Cs contouring control function with motor and spindle associated by belt)

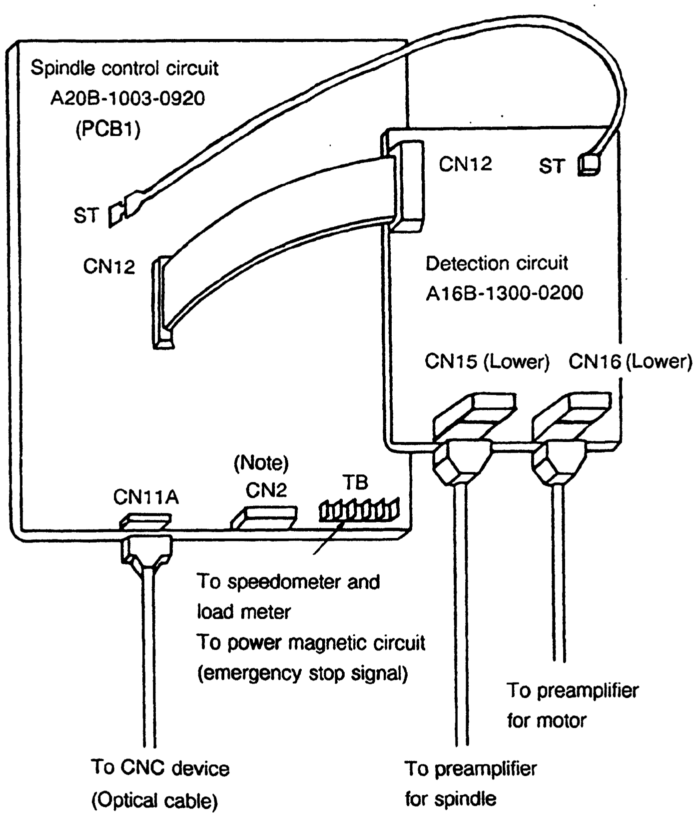


Fig. 2 (p) Cs Contouring Control Function with Motor and Spindle Associated by Belt (Models 6S to 26S)

Note) Do not connect a cable with CN2.

(17) Models 6S to 26S (Cs contouring control function with built-in spindle motor)

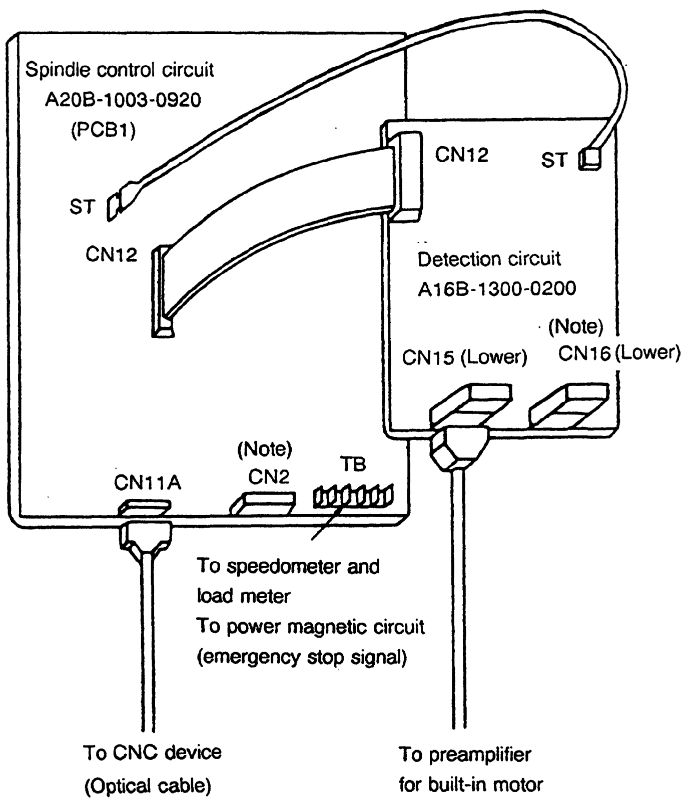
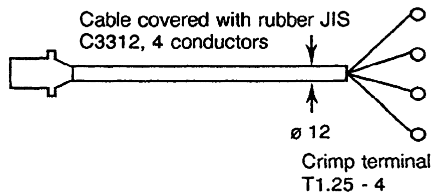
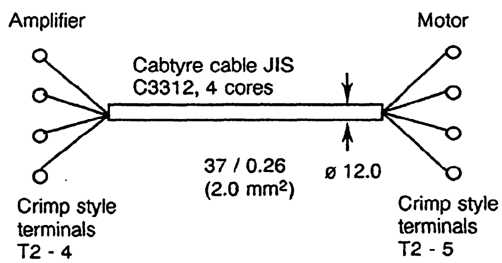
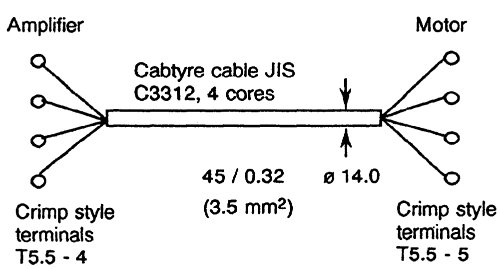
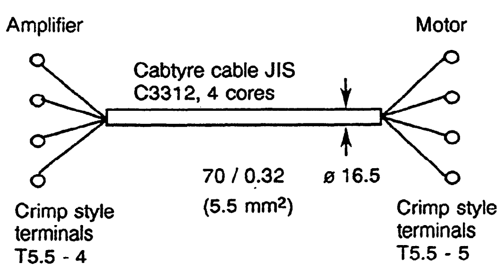


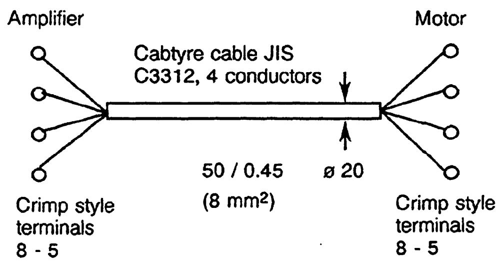
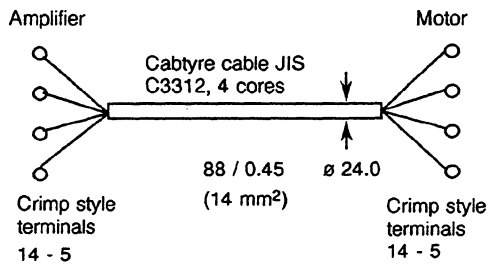
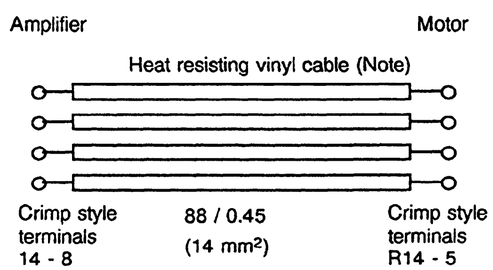
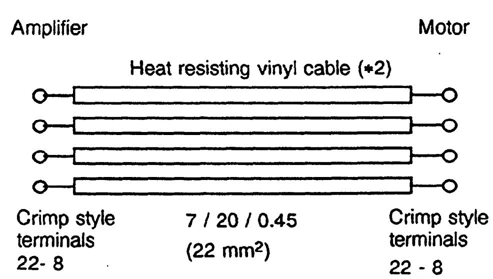
Fig. 2 (q) Cs Contouring Control Function with Built-in Spindle Motor (Models 6S to 26S)

Note) Do not connect a cable with CN2 and CN16.

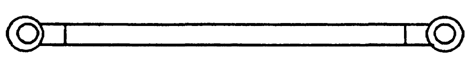
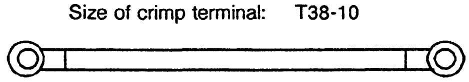
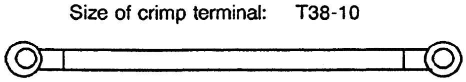
APPENDIX 3 CABLE SPECIFICATIONS

The cable specifications are as shown below.
Prepare cables by the MTB.
(1) Power line and motive power line for respective motor models

Applications	Symbol	Specifications	FANUC specification (Cable assembly)
Model 0.5S (Motor model) (Lower than 4 kVA)	K2	Connector kit: A63L-0001-0428/C, manufactured by AMP(*1) 	A06B-6050-K800 14 m A06B-6050-K803 7 m
Model 1S (Lower than 5 kVA)	K1 K2		
Model 1.5S, 2S (Motor model) (Lower than 7 kVA)	K1 K2		
Model 3S (Lower than 12 kVA)	K1 K2		

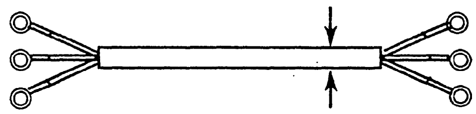
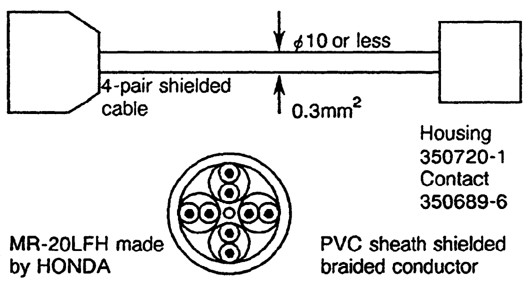
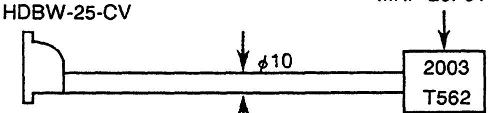
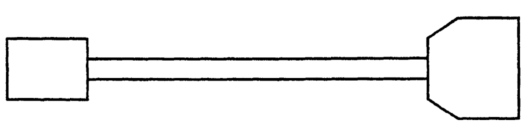
Applications	Symbol	Specifications Amplifier side / Motor side	FANUC specification (Cable assembly)
Model 6S (Lower than 16 kVA)	K1 K2		
Model 8S, 12S (Lower than 25 kVA)	K1 K2		
Model 15S (Lower than 30 kVA)	K1 K2		
Model 18S, 22S, 26S (Lower than 45 kVA)	K1 K2		

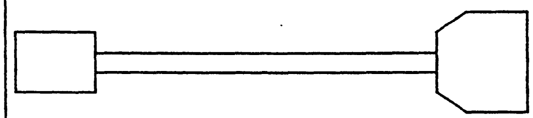
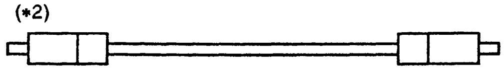
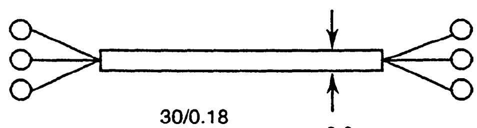
(*2) Use the flame retardant poli-flex cable (LMFC). (Maximum temperature of conductor: 105°C)

Applications	Symbol	Specifications	FANUC specification (Cable assembly)
Model 30S Model 40HV	K1 K2	AC 600V heat-proof cable LMFC made by FURUKAWA Electric Industry or equivalent Single wire connection: (a) × 3 and (b) × 1 (a) Conductor 7/34/0.45 (38mm^2) Crimp style terminals T38-10  (b) Conductor 7/20/0.45 (22mm^2) Crimp style terminals T38-10 	A06B – 6044 – K202 7 m
Model 40S Model 30HV	K1 K2	AC 600V heat-proof cable LMFC made by FURUKAWA Electric Industry or equivalent Single wire connection: (a) × 3 and (b) × 1 (a) Conductor 19/16/0.45 (50mm^2) Crimp style terminals T60-10  (b) Conductor 7/20/0.45 (22mm^2) Crimp style terminals T38-10 	A06B – 6044 – K203 7 m
Model 30HV	K1 K2	Heat-resistant cable for 600 VAC manufactured by LMFC of Furukawa Electric Assembly into a single cable: 3 each of (a) and 1 each of (b) (a) Conductor 7/27/0.45 (30 mm^2) Size of crimp terminal: T38-10  (b) Conductor 7.20/0.45 (22 mm^2) Size of crimp terminal: T38-10 	

(2) Common cables

The following cables are common for each model:

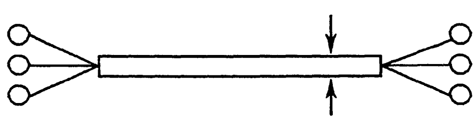
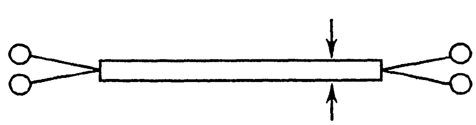
Applications	Symbol	Specifications	FANUC specification (Cable assembly)
Motor cooling fan	K3	Vinyl cabtyre cable: JIS C 3312, 3 cores Conductor: 37/0.26 ($2mm^2$) Outer cover: PVC ϕ11 Crimp style terminal: T2-4S  ϕ11.0	
Spindle servo unit | AC spindle motor (for signal)	K4	Spindle/servo unit connector (basic) CN2 Connector attached to spindle motor  ϕ10 or less 4-pair shielded cable $0.3mm^2$ Housing 350720-1 Contact 350689-6 MR-20LFH made by HONDA PVC sheath shielded braided conductor	A06B – 6044– K200 7m
Model 0.5S Spindle servo unit | AC spindle motor (for signal)	K4	Connector: HDBB-25S, manufactured by Hirose (*1) Connector cover: HDBW-25-CV MRP-20F01  ϕ10 2003 T562 10-pair shielded cable (all wires shielded in one braiding) $0.2mm^2$ (7/0.18) $3mm^2$	A06B-6064-K800 14 m A06B-6064-K801 7 m
Preamplifier | Detection circuit (for detector built-in motor)	K7	Preamplifier connector CN2 Detection circuit connector CN16  HR22-12WTPA-20S made by HIROSE MR-20LFH made by HONDA	A06B – 6063– K802 7m

Applications	Symbol	Specifications	FANUC specification (Cable assembly)
Preamplifier | Detection circuit (for spindle detector)	K8	Preamplifier connector CN2 — Detection circuit connector CN15  HR22-12WTPA-20S made by HIROSE — MR-20LMH made by HONDA	A06B – 6063– K801 7m
CNC | Spindle servo unit	K5	(*2) 	A66L-6001-0009#L5R003 5m
Speedometer Dynamometer | Spindle servo unit (for measuring instruments)	K3 7	Vinyl cabtyre cable JIS C 3312, 3 cores  Crimp style terminals. T1-4 — 30/0.18 (0.75 mm²) — ϕ9.2 — Crimp style terminals T1-4	A06B – 6044– K201 7m

(*) For specifications of optical fiber cables, see item (5) Optical fiber cable.

(3) Other

Cable materials used for some models:

Applications	Symbol	Specifications	FANUC specification (Cable assembly)
Unit adapter fan motor (models 6S - 22S)		Vinyl cabtyre cable: JIS C 3312, 3 cores Conductor: 37/0.26 ($2mm^2$) Outer cover: PVC ϕ11.0 Crimp style terminal: T2-4S  ϕ11.0	
Fan unit or fan motor (models 30S and 40S)	K10	Vinyl cabtyre cable: JIS C 3312, 2 cores Conductor: 37/0.26 ($2mm^2$) Outer cover: PVC ϕ10.5 Crimp style terminal: T2-5  ϕ10.5	A06B – 6044 – K022 7m

(*1) Connector kit (A06B-6050-K110: K63L-0001-0428/C) components

Part name	Quantity
Case	1
Contact housing	1
Contact	6
Nut	1

Part name	Quantity
Cable packing	1
Cable clamp	1
Packing	1
Setscrew	2

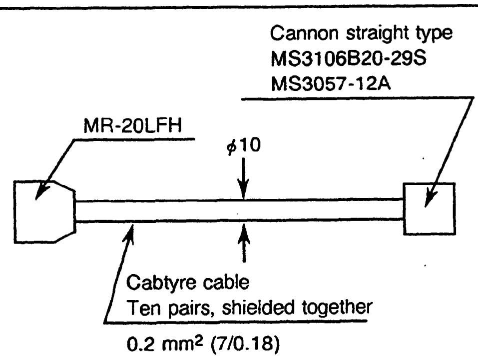
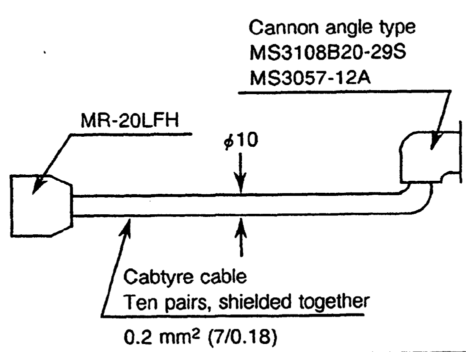
Crimping tool manufactured by AMP	
Crimping tool	914596-2
Extractor	614677-1

(*2) Connector kit (A06B-6050-K111) components

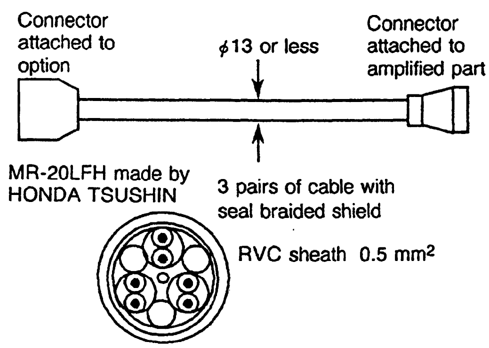
Part name	Quantity
D-SUB 25-pin connector, solder type	1
Water-proof cover for D-SUB connector	1

(4) Cables for spindle orientation

a) For position coder

Applications	Symbol	Specifications	FANUC specification (Cable assembly)
Spindle servo unit | Position coder	K10		A06B – 6041– K201 7m
Spindle servo unit | Position coder	K10		A06B – 6041– K204 7m

b) For magnetic sensor

Applications	Symbol	Specifications	FANUC specification (Cable assembly)
Spindle servo unit | Magnetic sensor	K13		A06B – 6041– K203 7m

<Reference cables>

Details of cable specifications

Name	Conductor		Sheath thickness	Finished OD	Electric characteristics		Designation*
	Diameter	Configu-ration			Conductor resistance	Allowable current	
Cable A (10 pairs)	φ1.05 mm	7 / 0.18	1.4 mm	φ10.0 mm	110 Ω/km	1.6 A	A66L-0001-0041
Cable B (50 pairs)	φ1.05 mm	7 / 0.18	1.5 mm	φ12.5 mm	106 Ω/km	1.6 A	A66L-0001-0042
Cable C (3 pairs)	φ0.93 mm	45 / 0.12	1.0 mm	φ10.8 mm	38.7 Ω/km	1.6 A	A66L-0001-0108

* Length is designated separately.

(5) Optical fiber cable

Name		Group	Common		Remarks	Condition
			Specification	Q'ty		
Optical fiber cable (with reinforced cover, for external wiring)	5m	MA1	A66L-6001-0009#L5R003			
	10m	MA2	A66L-6001-0009#L10R03			
	15m	MA3	A66L-6001-0009#L15R03			
	20m	MA4	A66L-6001-0009#L20R03			
	30m	MA5	A66L-6001-0009#L30R03			
	40m	MA6	A66L-6001-0009#L40R03			
	50m	MA7	A66L-6001-0009#L50R03			
	60m	MA8	A66L-6001-0009#L60R03			
	80m	MA9	A66L-6001-0009#L80R03			
	90m	MAA	A66L-6001-0009#L90R03			
	100m	MAB	A66L-6001-0009#L100R3			
Optical fiber cable (without reinforced cover, for internal wiring)	1m	MB1	A66L-6001-0008#L1R003		Because of no reinforced cover, cable forming can be easily done. However, since this cable is inferior to cable with reinforced cover in strength, use only for internal wiring.	
	1.5m	MB2	A66L-6001-0008#L1R503			
	2m	MB3	A66L-6001-0008#L2R003			
	3m	MB4	A66L-6001-0008#L3R003			
Optical cable relay adaptor		MV1	A02B-0094-K841		Only one can be used on a single transmission line. When using an optical cable relay adaptor to relay data, the maximum total cable length is 100 m.	

APPENDIX 4 CONFIGURATION OF SPINDLE CIRCUIT

(1) Models 1S to 3S

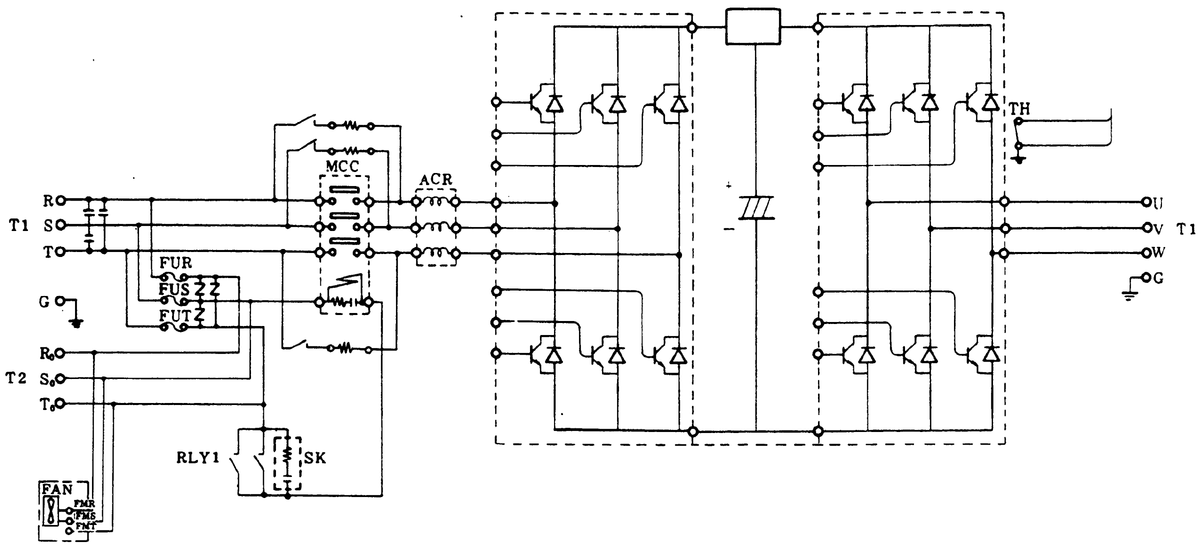


Fig. 4(a) Spindle Circuit Configuration (Models 1S to 3S)

(2) Models 6S to 26S

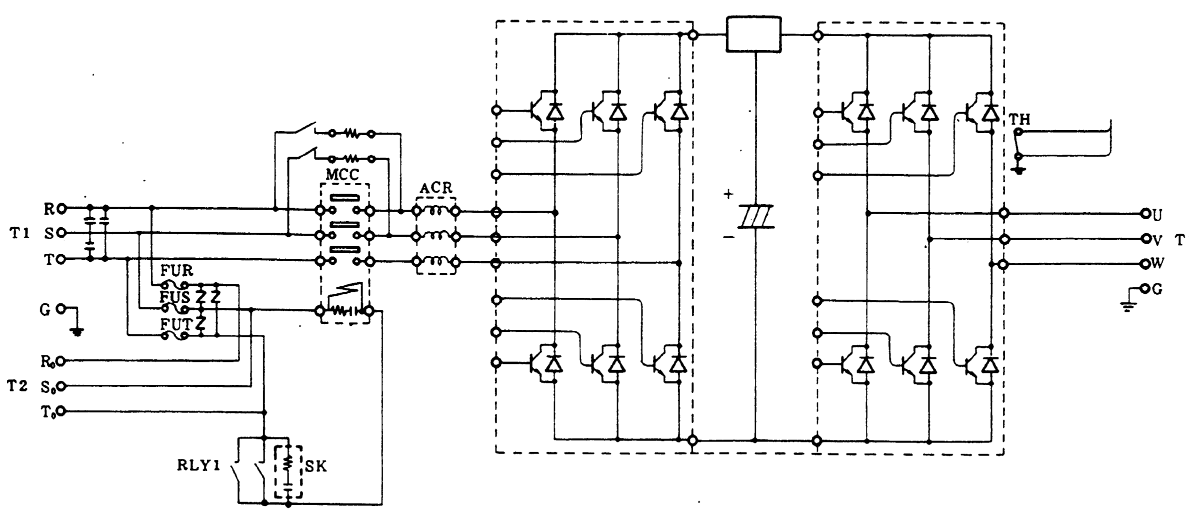


Fig. 4(b) Spindle Circuit Configuration (Models 6S to 26S)

(3) Models 30S and 40S

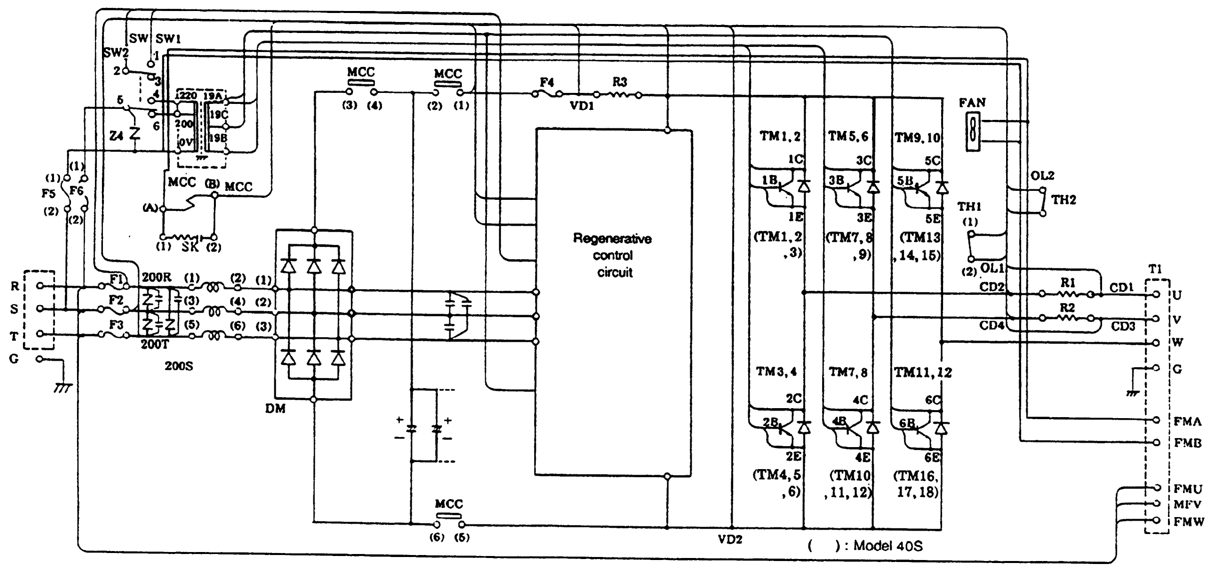


Fig. 4(c) Spindle Circuit Configuration (Models 30S and 40S)

(4) Models 30HV, 40HV, 60HV

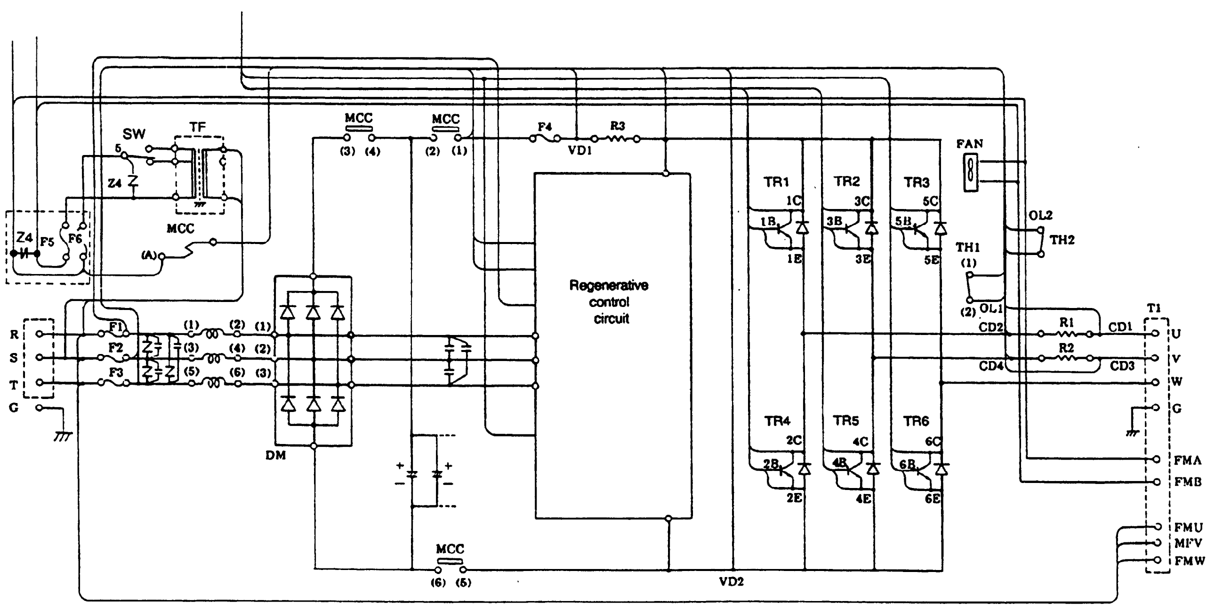
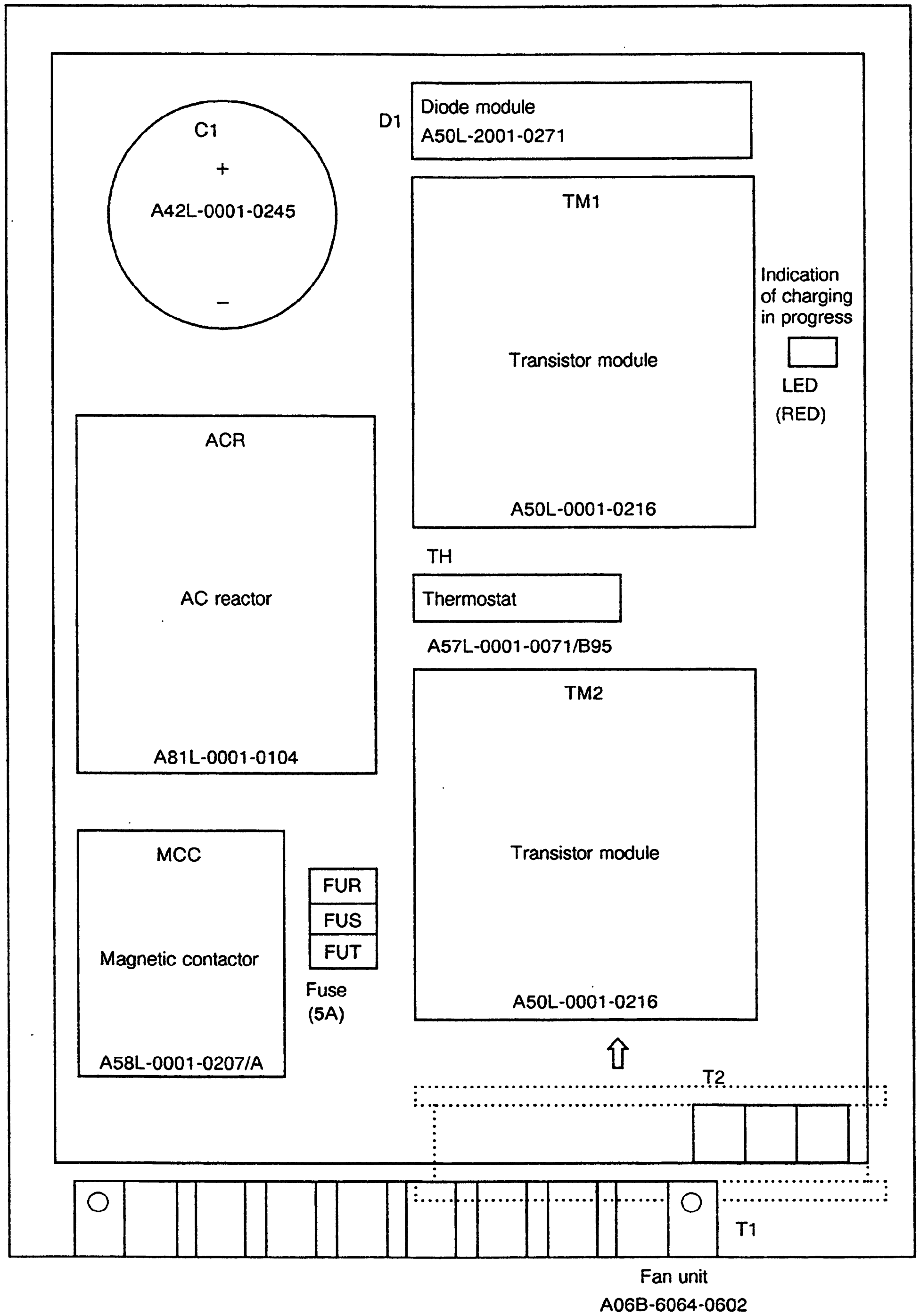


Fig. 4(d) Spindle Circuit Configuration (Models 30S and 40S)

APPENDIX 5 LOCATION OF UNIT

(1) Models 1S to 3S (Unit specification: A06B-6064-H201 to -H203)



The specifications of PCBs are as follows:

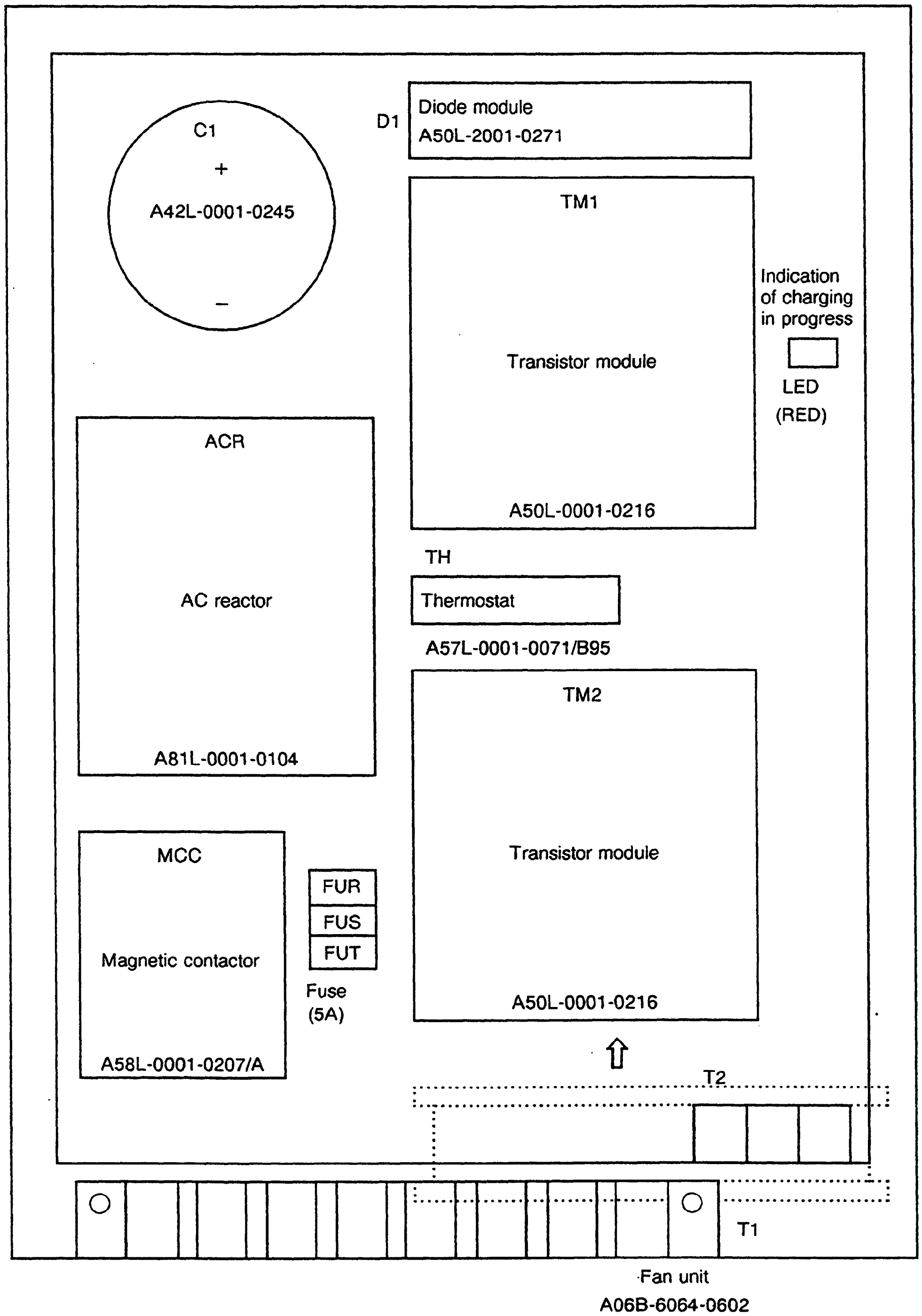
Spindle control circuit PCB (PCB1): A16B-2201-0010

Driver circuit PCB (PCB2): A16B-2100-0030

Printed wiring board (PCB3): A20B-1004-0600

(See Section (1) in Appendix 2.)

(2) Models 1S to 3S (Unit specification: A06B-6064-H301 to -H303)



The specifications of PCBs are as follows:

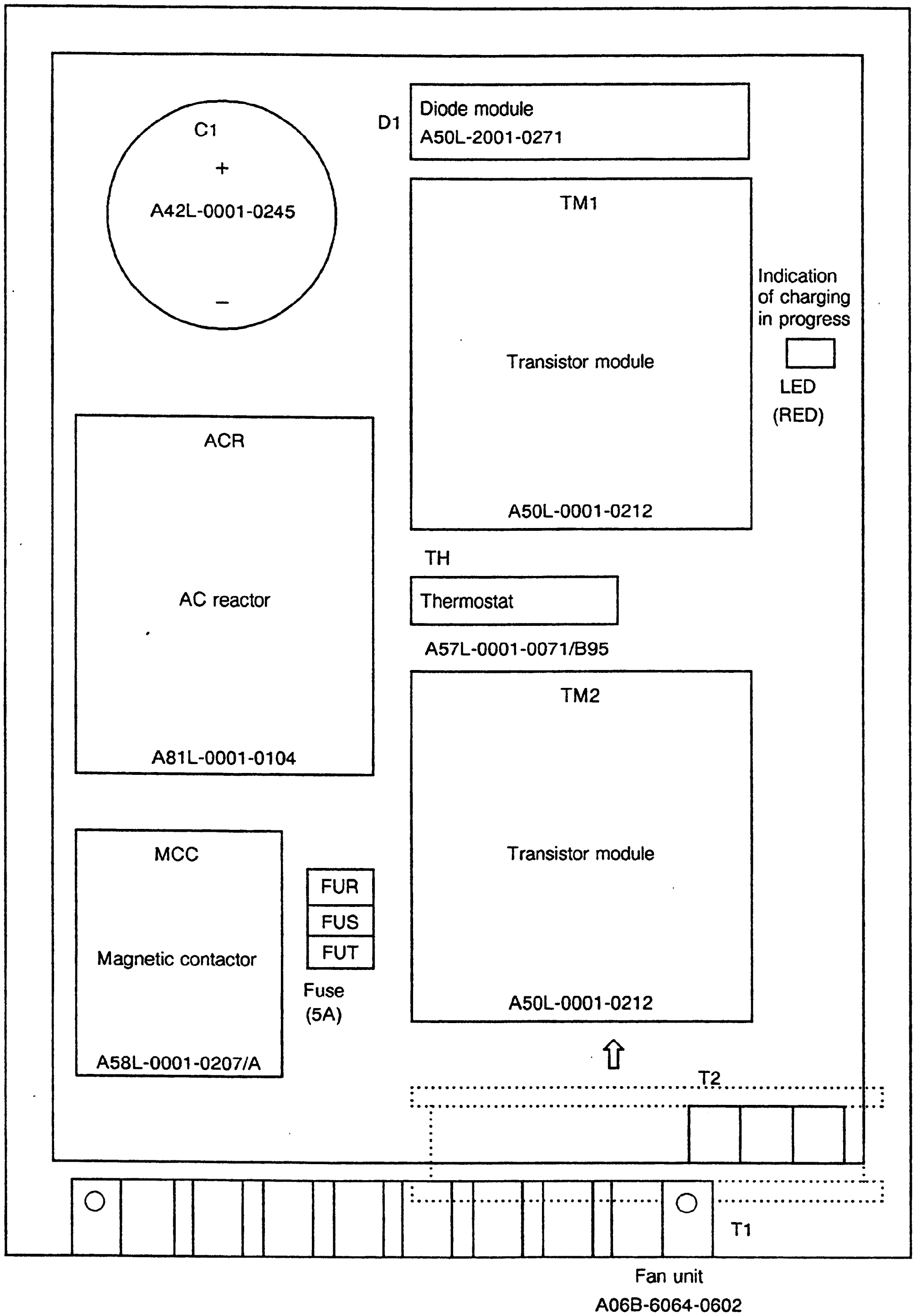
Spindle control circuit PCB (PCB1): A16B-2201-0440

Driver circuit PCB (PCB2): A16B-2100-0070

Printed wiring board (PCB3): A20B-1005-0190

(See Section (2) in Appendix 2.)

(3) Models small 6S (Unit specification: A06B-6064-H305)



The specifications of PCBs are as follows:

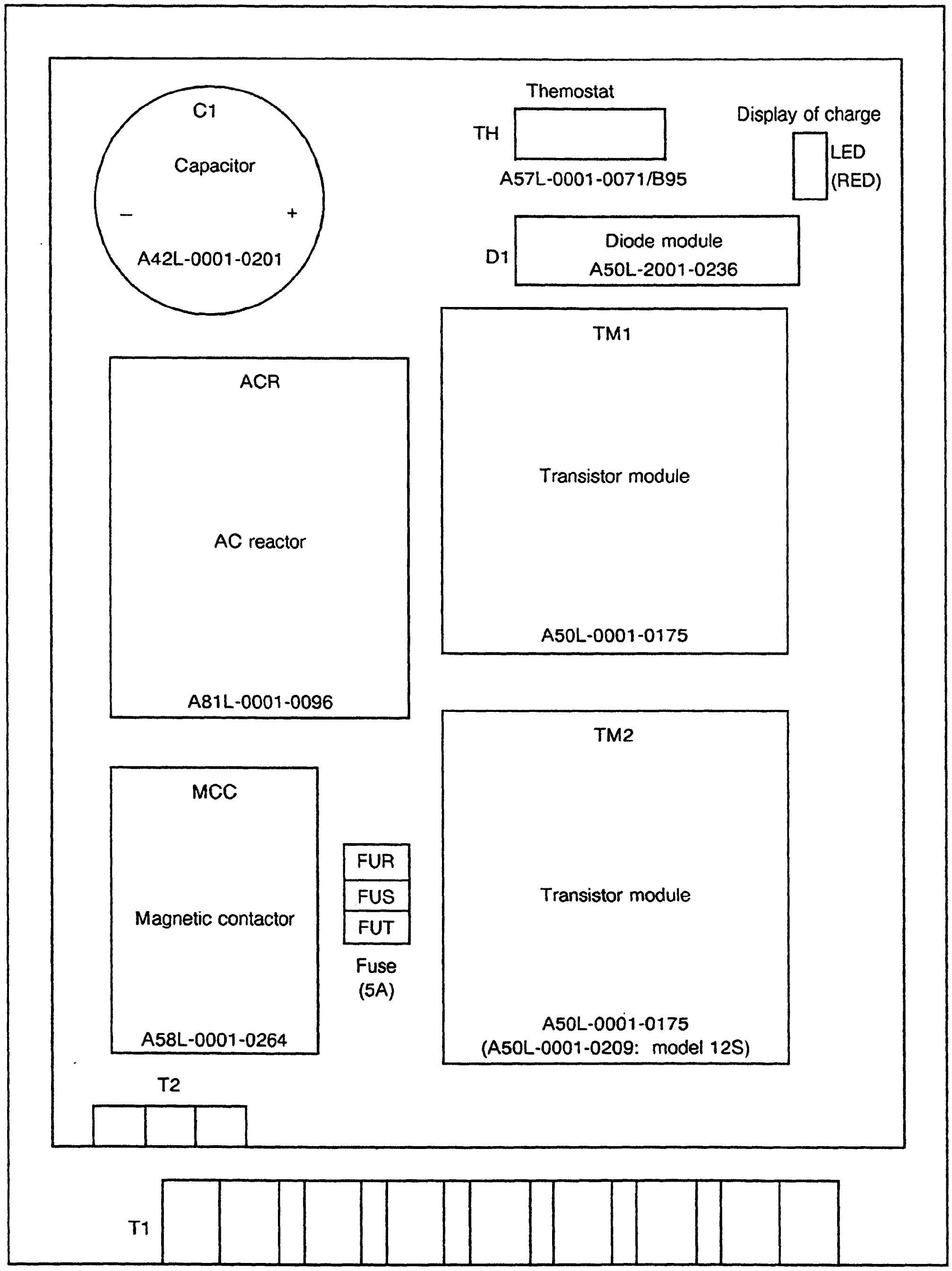
Spindle control circuit PCB (PCB1): A16B-2201-0040

Driver circuit PCB (PCB2): A16B-2100-0070

Printed wiring board (PCB3): A20B-1005-0191

(See Section (2) in Appendix 2.)

(4) Models 6S to 12S (Unit specification: A06B-6062-H206 to -H212
A06B-6063-H206 to -H212)

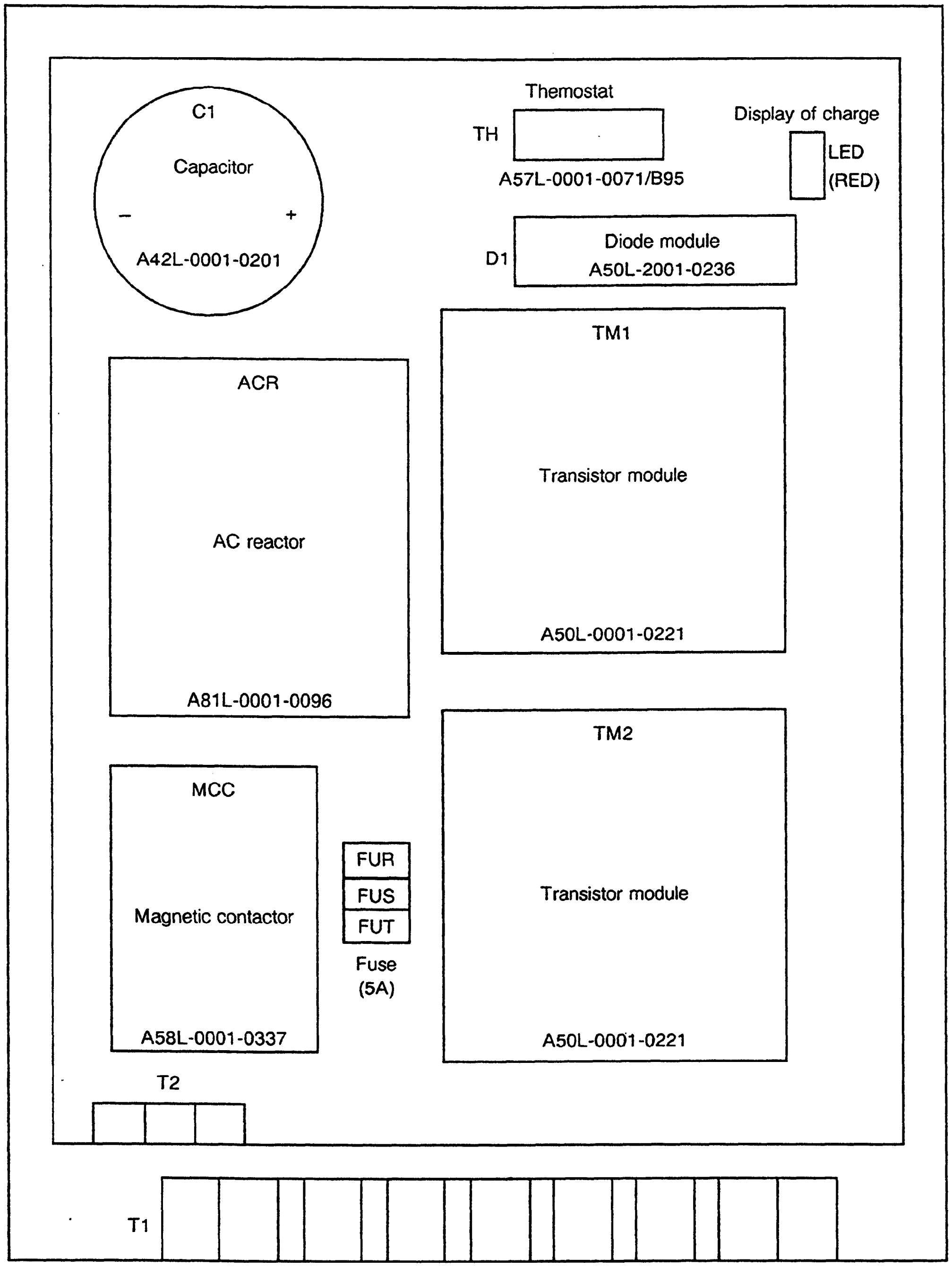


The specifications of PCBs are as follows:

Spindle control circuit PCB (PCB1) : A20B-1003-0550 or A20B-1003-0920
Printed wiring board (PCB2) : A20B-1003-0020

(See items (3), (4) in Appendix 2.)

(5) Models 6S to 12S (Unit specification: A06B-6064-H306 to -H312)

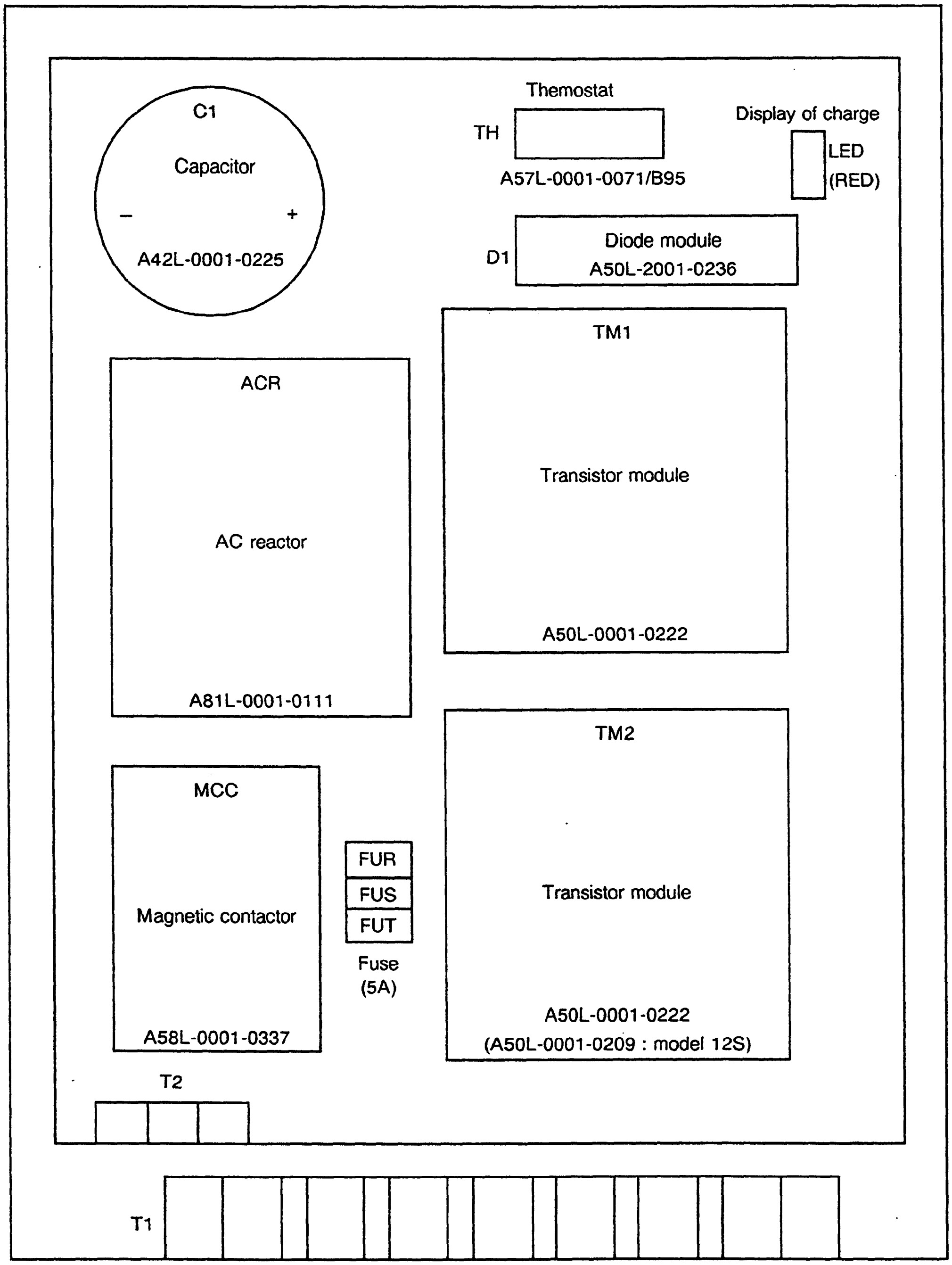


The specifications of PCBs are as follows:

Spindle control circuit PCB (PCB1) : A16B-2201-0440
Driver circuit PCB (PCB2) : A20B-2000-0220
Printed wiring board (PCB3) : A20B-1004-0730

(See item (5) in Appendix 2.)

(6) Models small 15S (Unit specification: A06B-6064-H313)

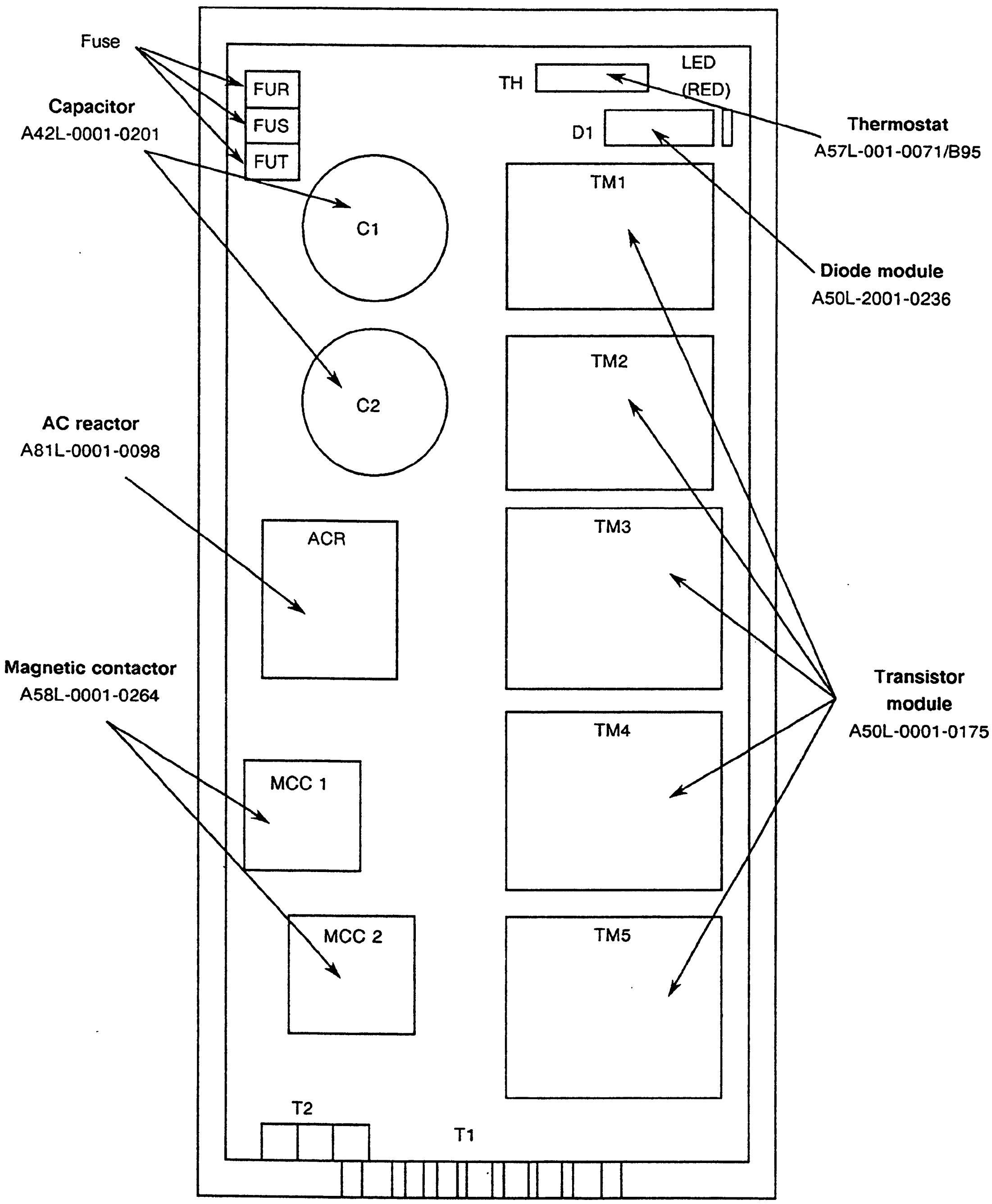


The specifications of PCBs are as follows:

Spindle control circuit PCB (PCB1)	:	A16B-2201-0440
Driver circuit PCB (PCB2)	:	A20B-2000-0220
Printed wiring board (PCB3)	:	A20B-1004-0700

(See item (5) in Appendix 2.)

(7) Models 15S to 22S

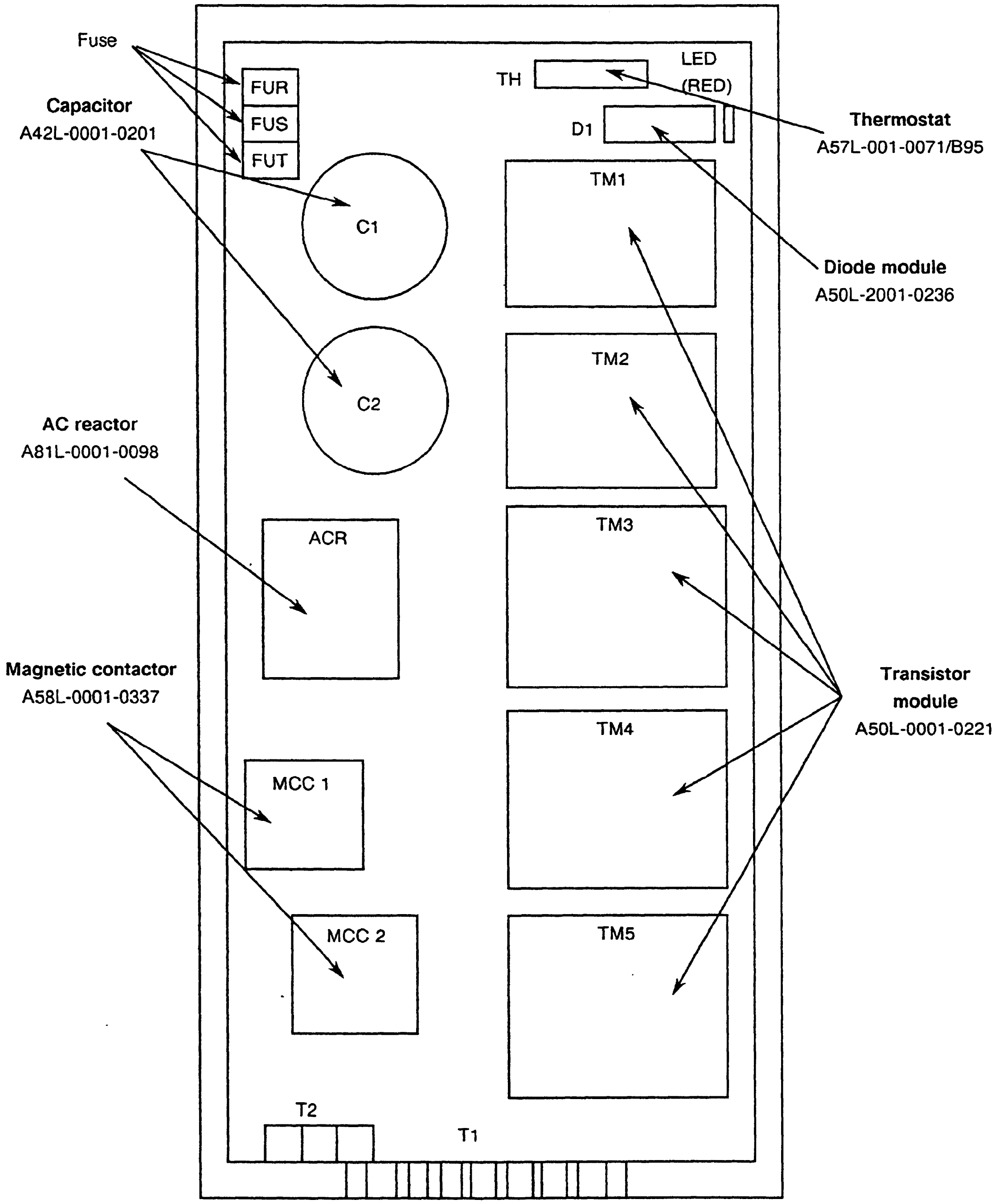


The specifications of PCBs are as follows:

Spindle control circuit PCB (PCB1)	:	A20B-1003-0550	or	A20B-1003-0920
Printed wiring board (PCB2)	:	A20B-1003-0120		

(See items (6), (7) in Appendix 2.)

(8) Models 15S to 22S (Unit specification: A06B-6064-H315 to -H322)

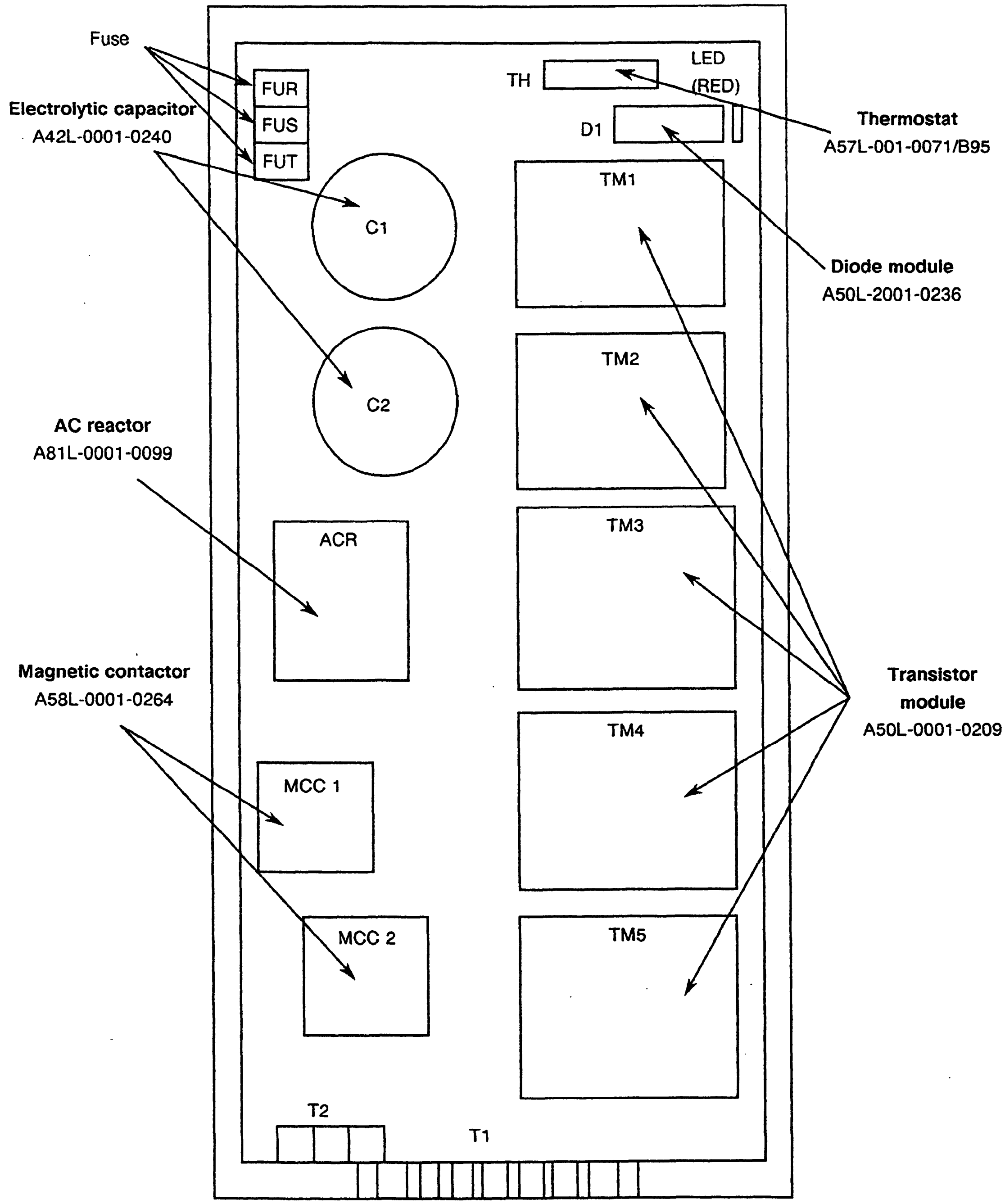


The specifications of PCBs are as follows:

Spindle control circuit PCB (PCB1)	:	A16B-2201-0440
Driver circuit PCB (PCB2)	:	A20B-2000-0220
Printed wiring board (PCB3)	:	A20B-1004-0740

(See item (8) in Appendix 2.)

(9) Model 26S

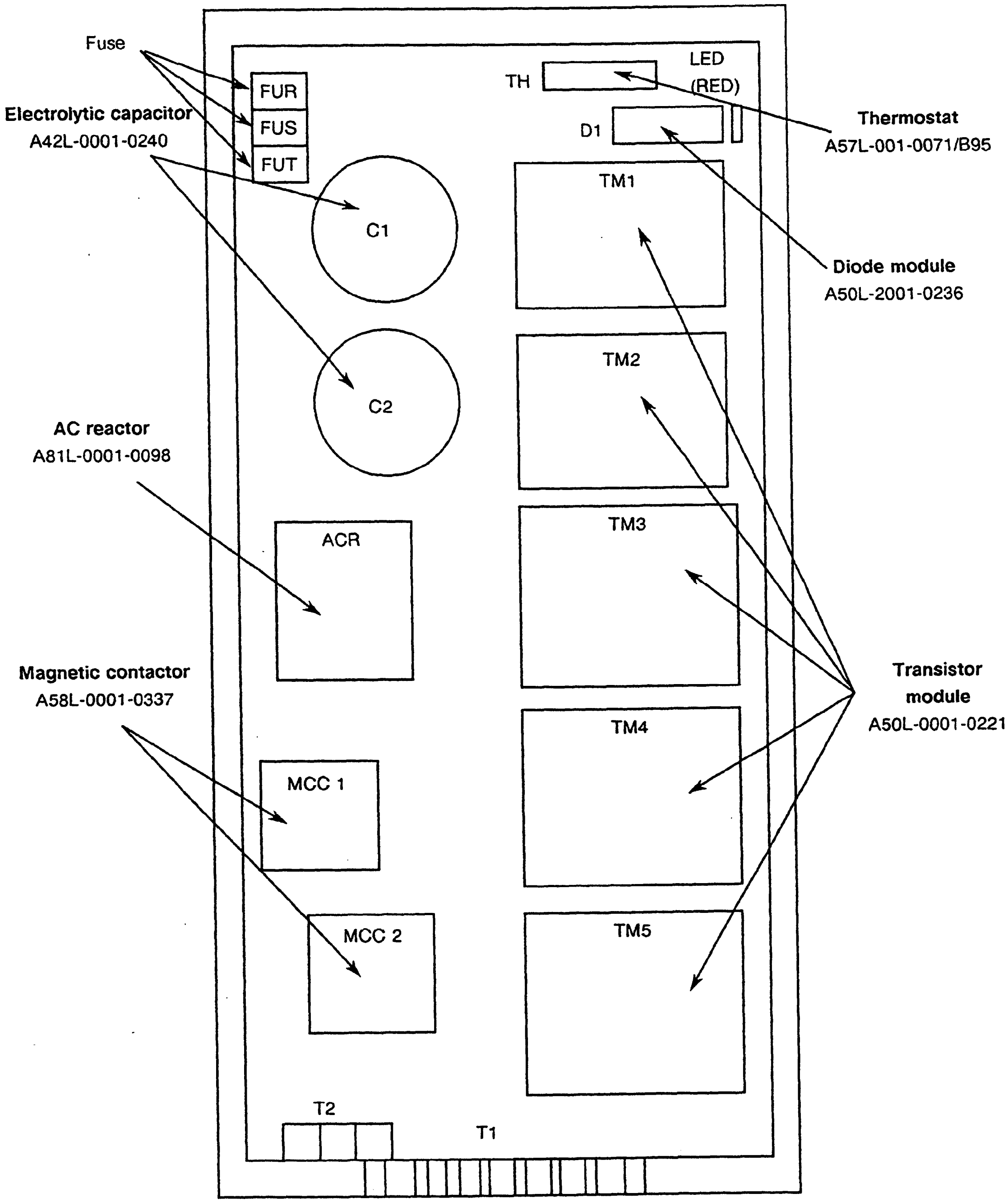


The specifications of PCBs are as follows:

Spindle control circuit PCB (PCB1)	:	A20B-1003-0920
Printed wiring board (PCB2)	:	A20B-1004-0540

(See item (7) in Appendix 2.)

(10) Model 26S (Unit specification : A06B-6064-H326)

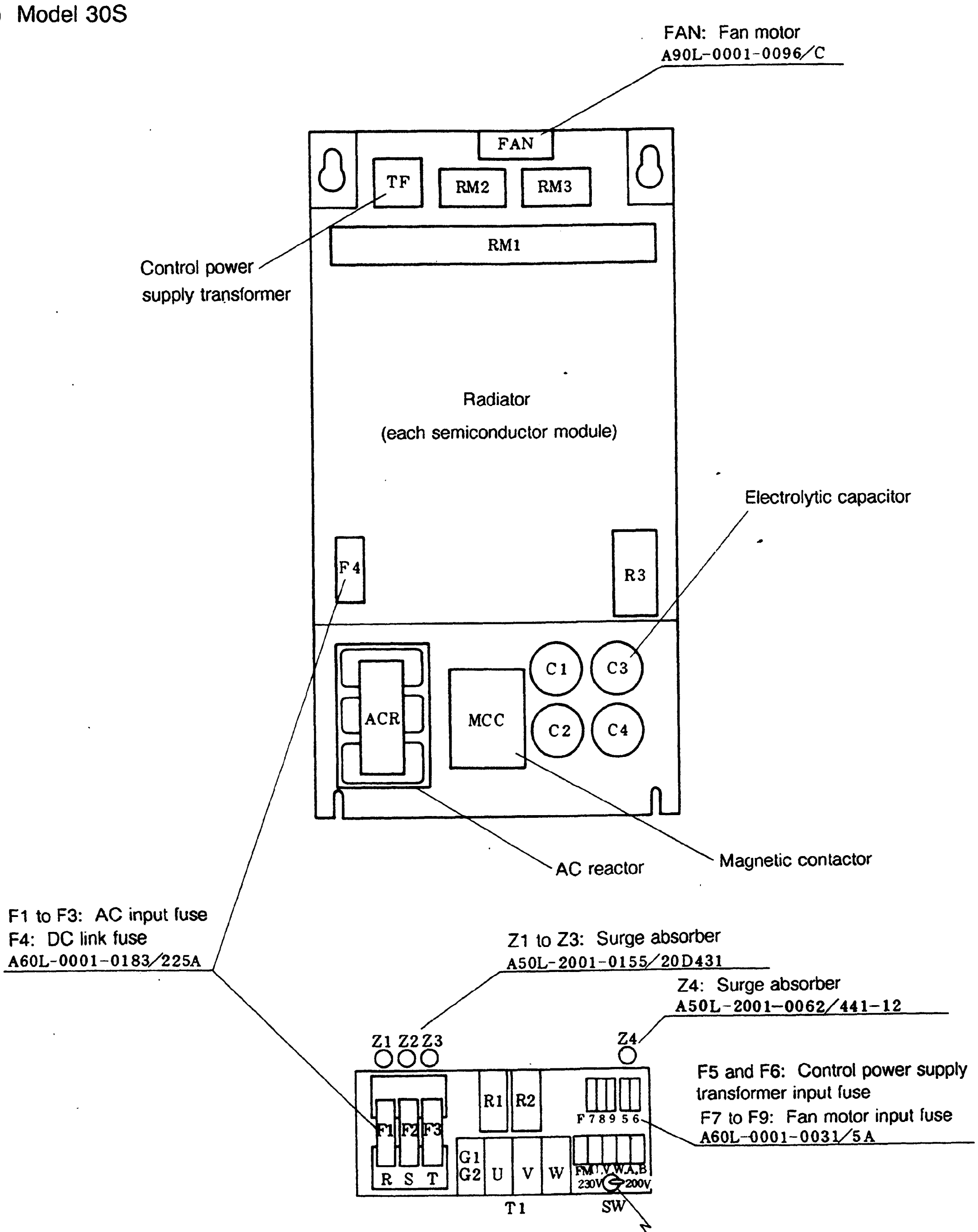


The specifications of PCBs are as follows:

Spindle control circuit PCB (PCB1)	:	A20B-2201-0440
Driver circuit PCB (PCB2)	:	A20B-2000-0220
Printed wiring board (PCB3)	:	A20B-1004-0741

(See item (8) in Appendix 2.)

(11) Model 30S

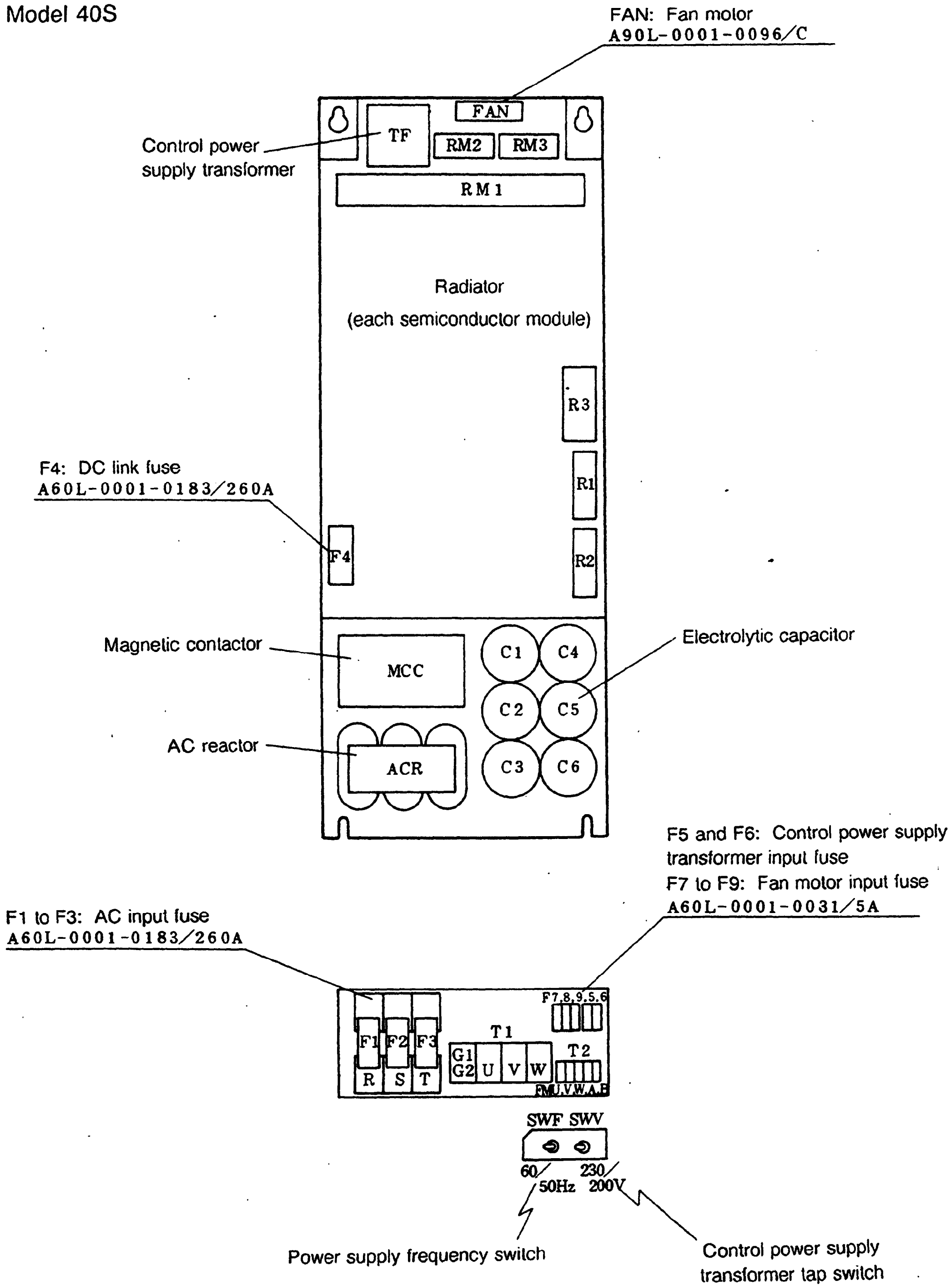


The specifications of PCBs are as follows:

Spindle control circuit PCB (PCB1)	:	A16B-2201-0010
Driver circuit PCB (PCB2)	:	A20B-1004-0230

(See Section (9) in Appendix 2.)

(12) Model 40S

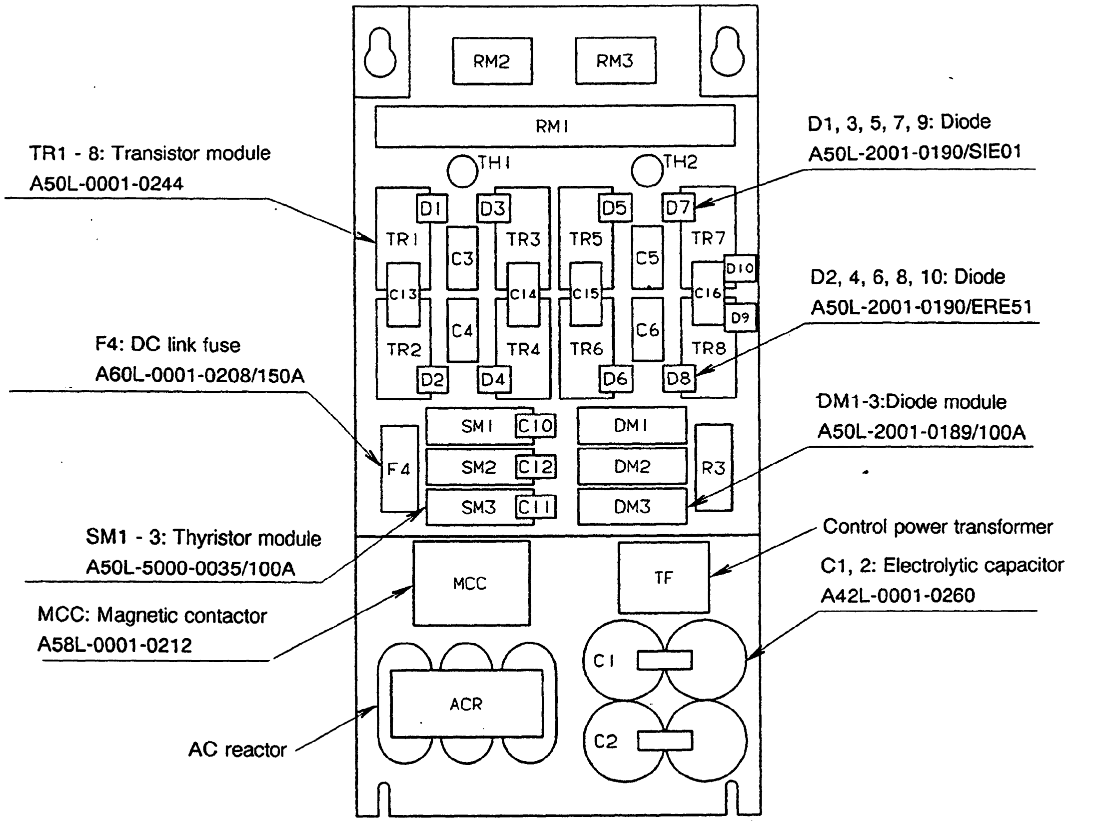


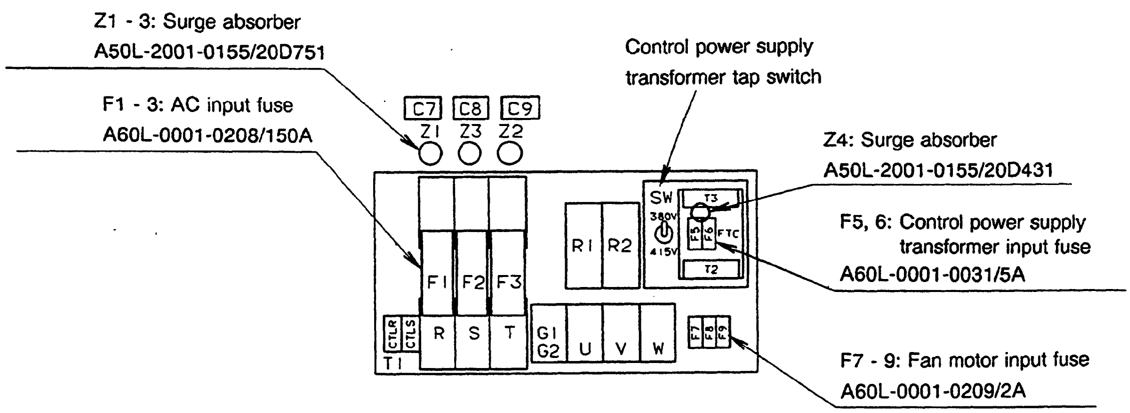
The specifications of PCBs are as follows:

Spindle control circuit PCB (PCB1)	:	A16B-2201-0010
Driver circuit PCB (PCB2)	:	A20B-1004-0230

(See Section (9) in Appendix 2.)

(13) Models 30HV, 40HV

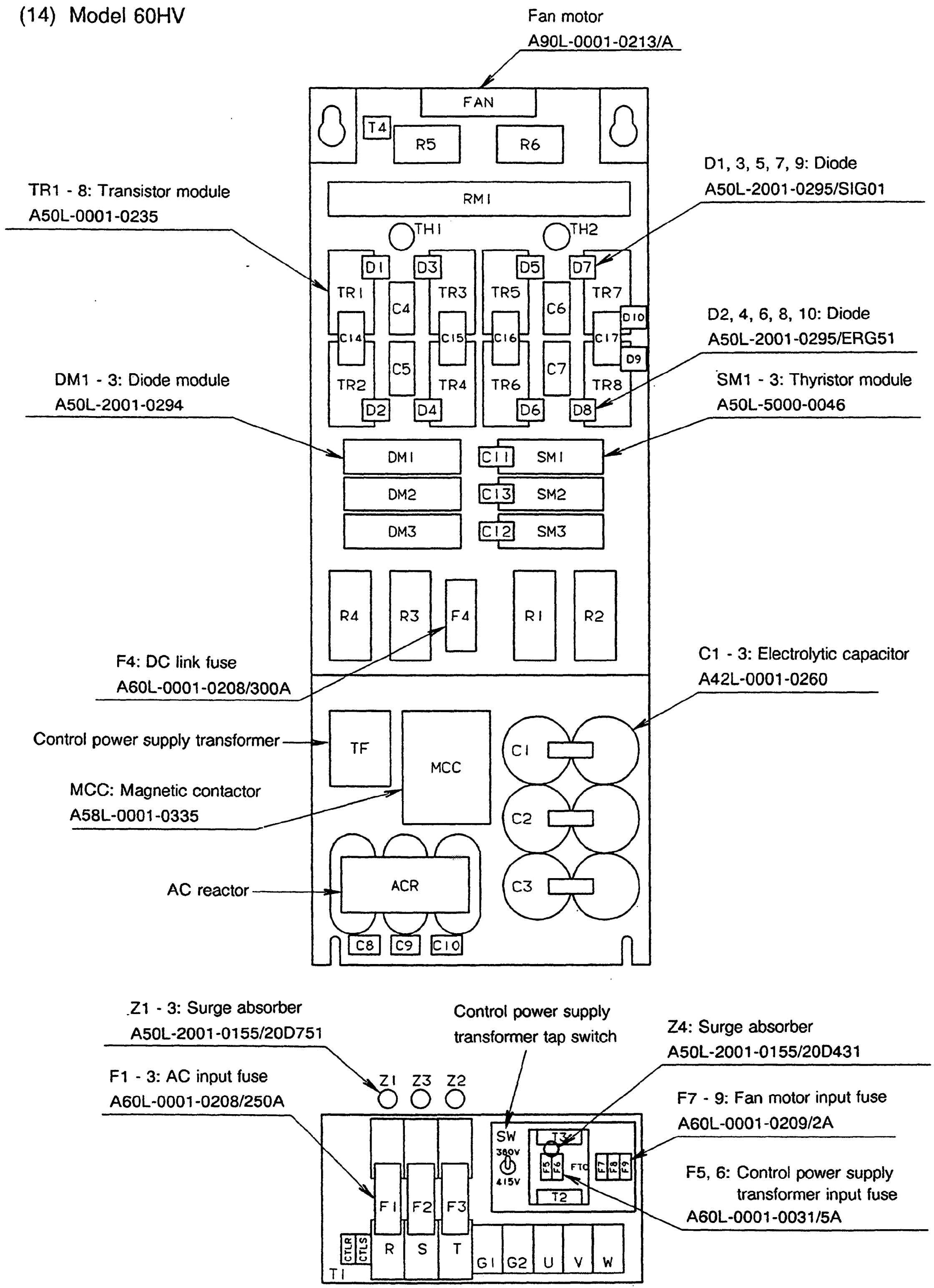




The specifications of PCBs are as follows:

Spindle control circuit PCB (PCB1)	:	A16B-2201-0440
Driver circuit PCB (PCB2)	:	A16B-2400-0010

(14) Model 60HV

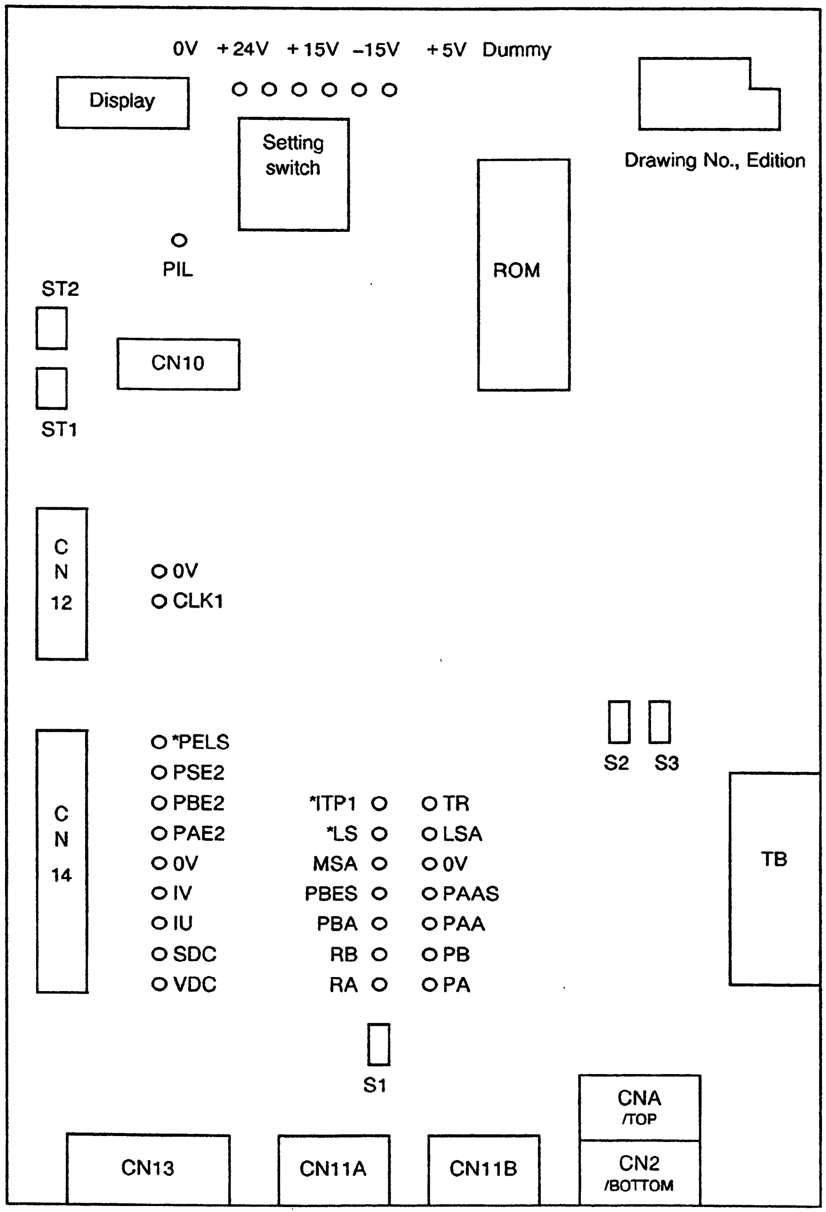


The specifications of PCBs are as follows:

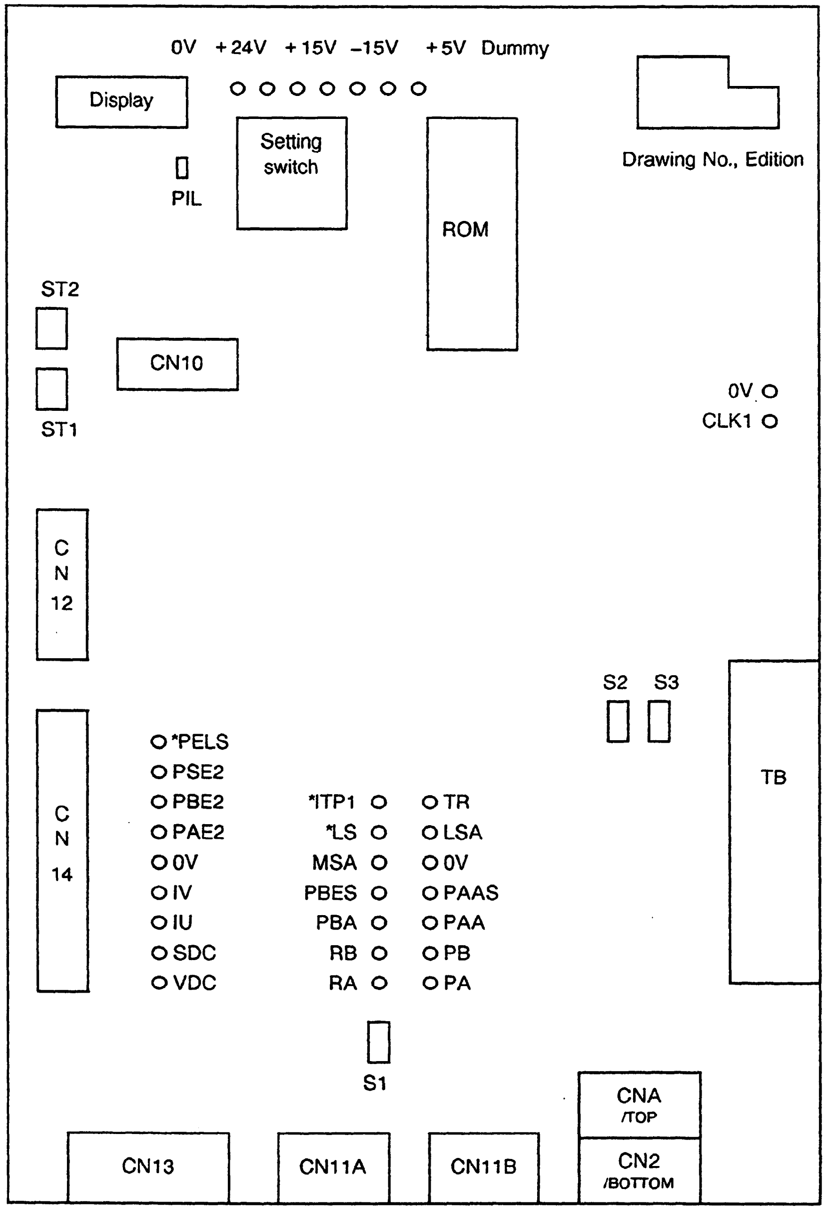
Spindle control circuit PCB (PCB1)	:	A16B-2201-0440
Driver circuit PCB (PCB2)	:	A16B-2400-0010

APPENDIX 6 LOCATION OF PCB

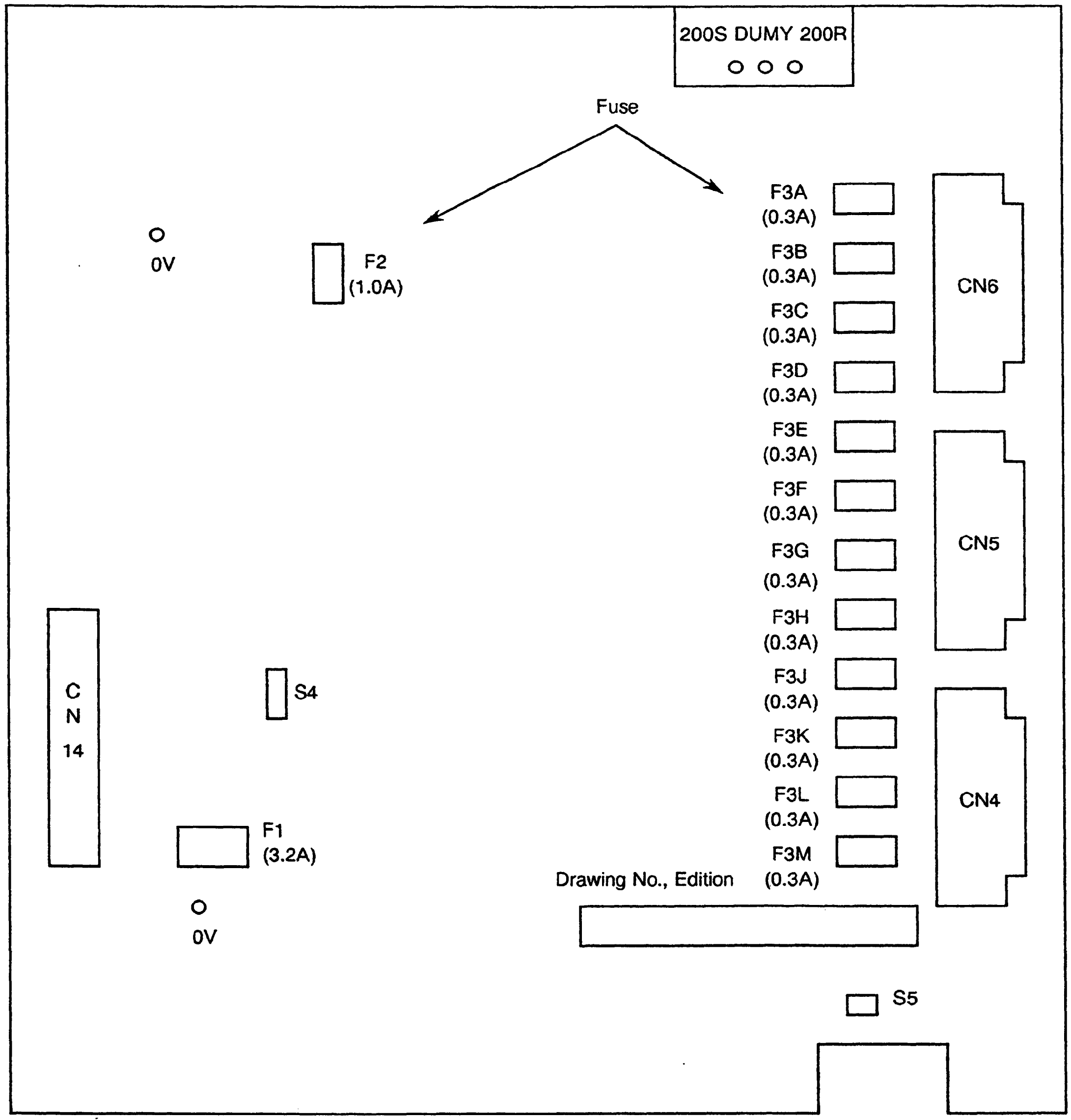
(1) Spindle control circuit PCB (models 1S to 3S, 30S, and 40S) - (A16B-2201-0010)



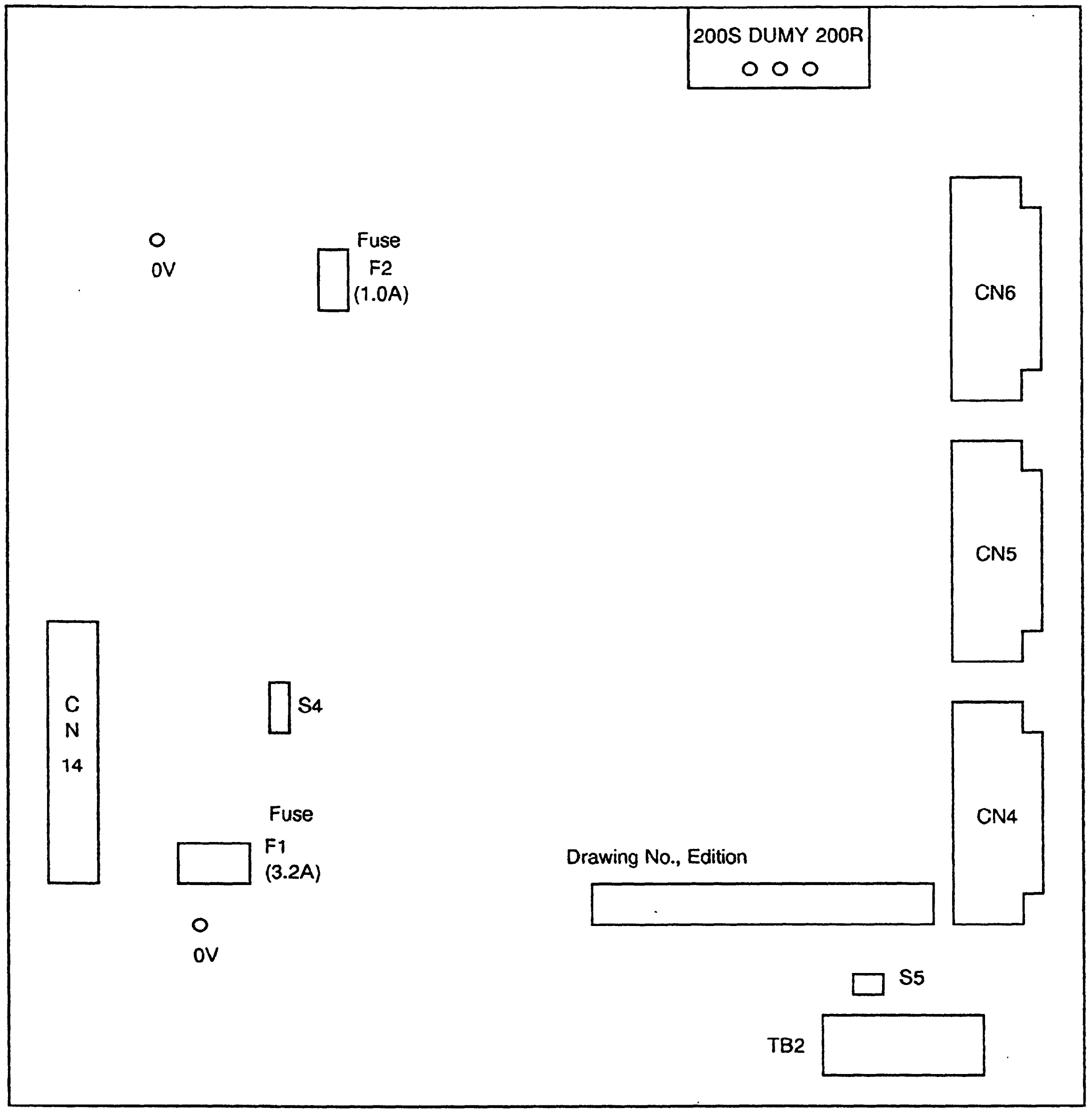
(2) Spindle control circuit PCB (models 1S to 26S) - (A16B-2201-0440)



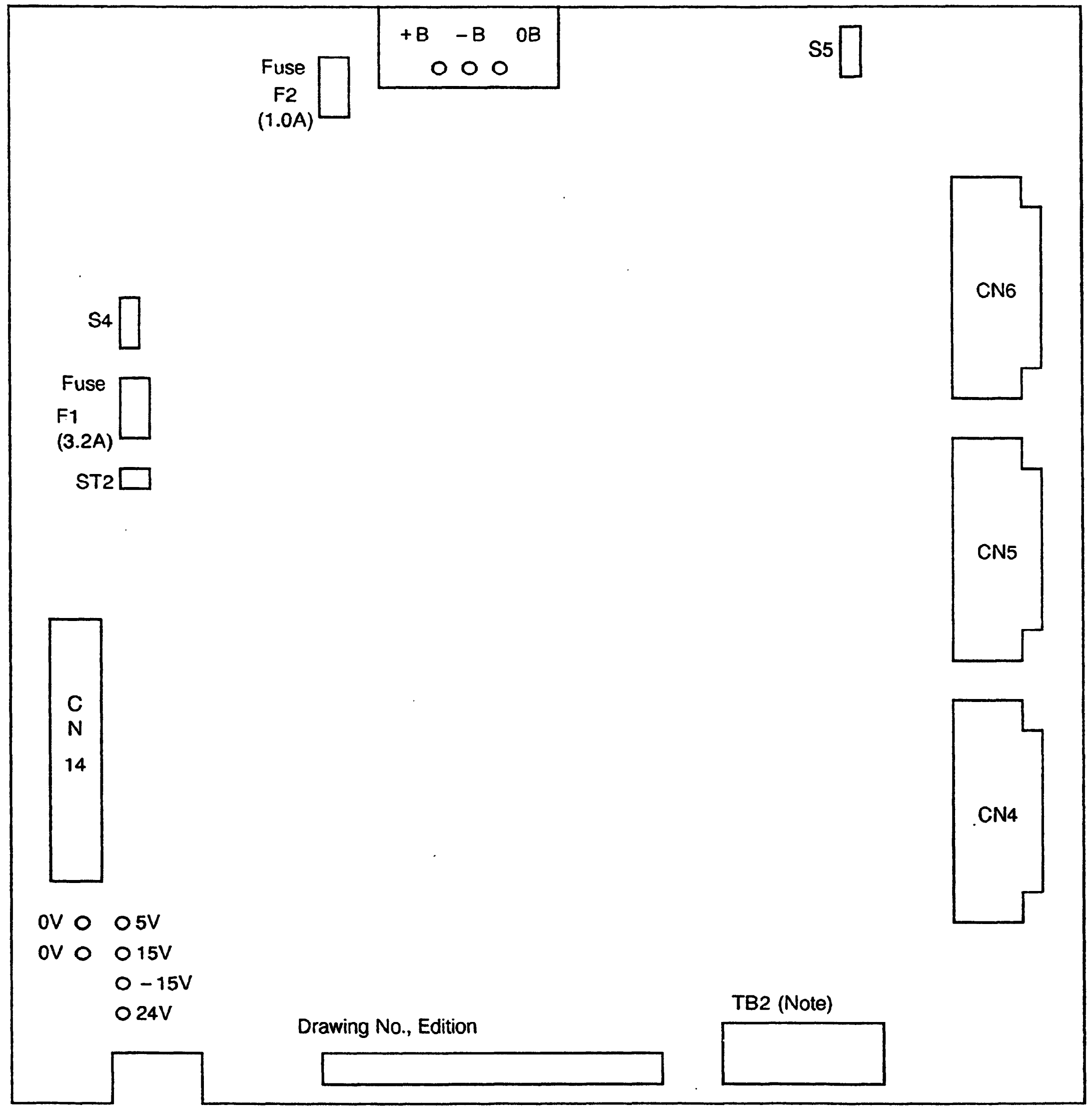
(3) Driver circuit PCB (models 1S to 3S) - (A16B-2100-0030)



(4) Driver circuit PCB (models 1S to 3S) - (A16B-2100-0070)

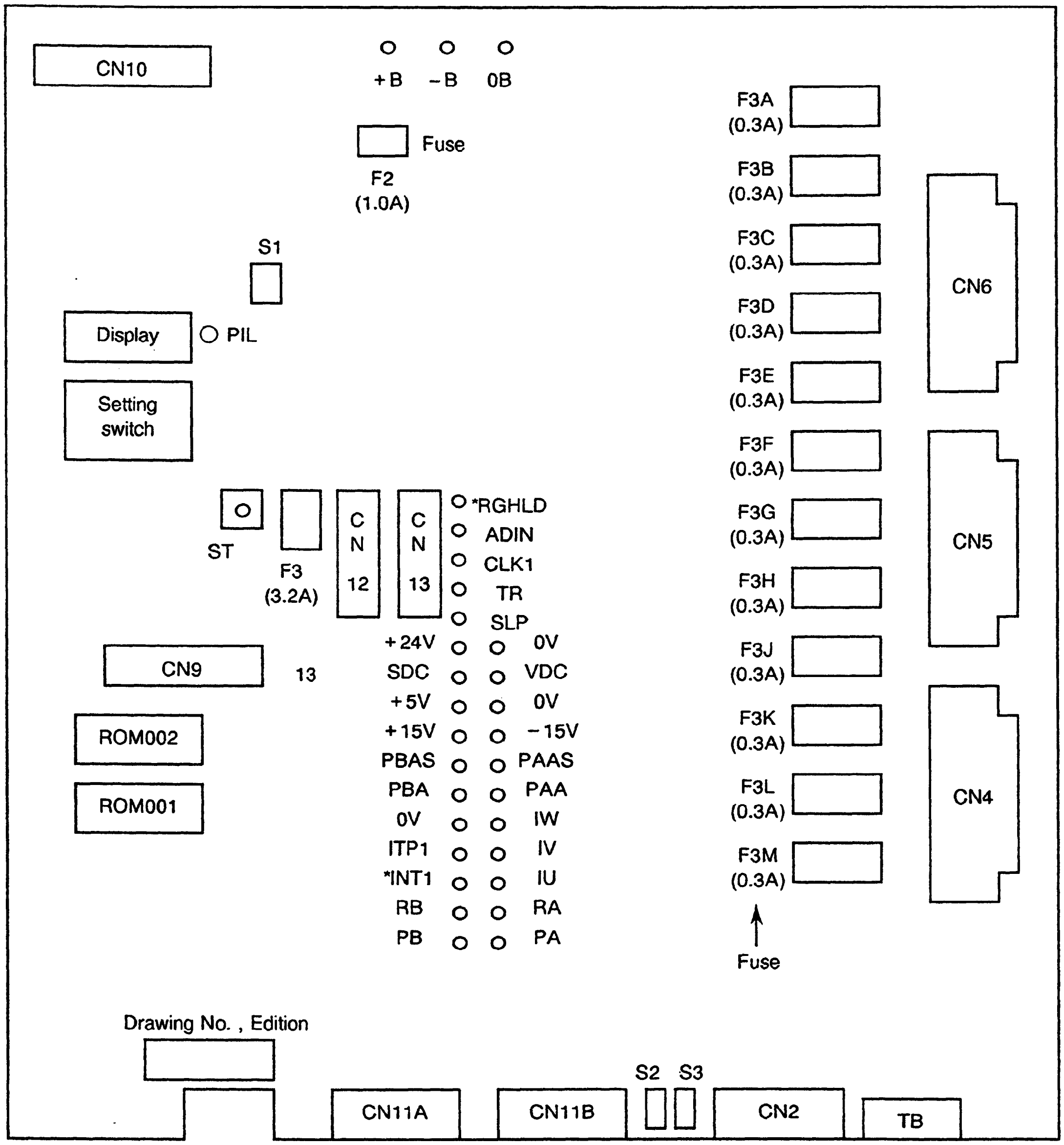


(5) Driver circuit PCB (models 6S to 26S) - (A20B-2000-0220)

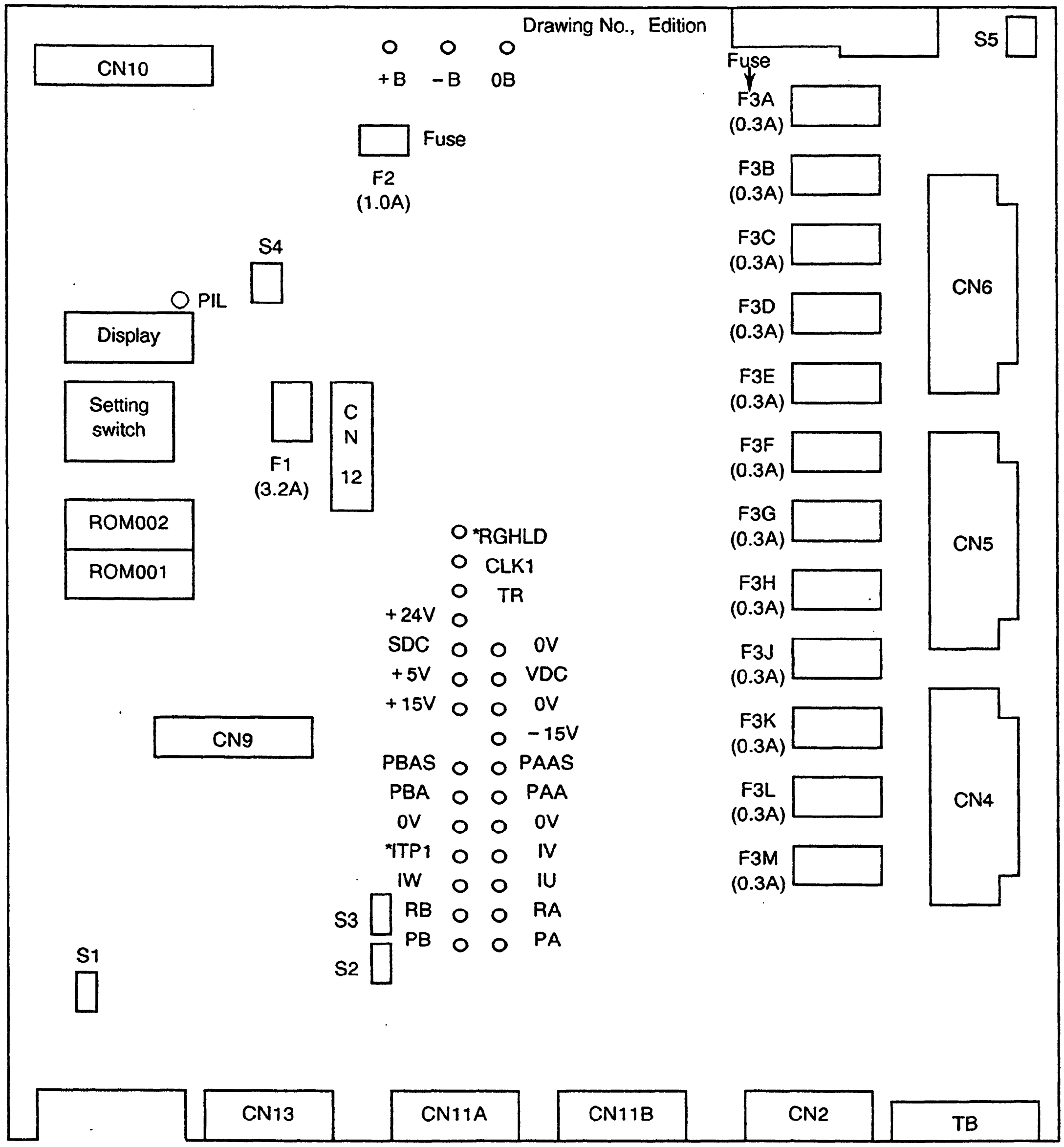


(Note) Terminal board TB2 is mounted on the PCB of total version 03B or later.

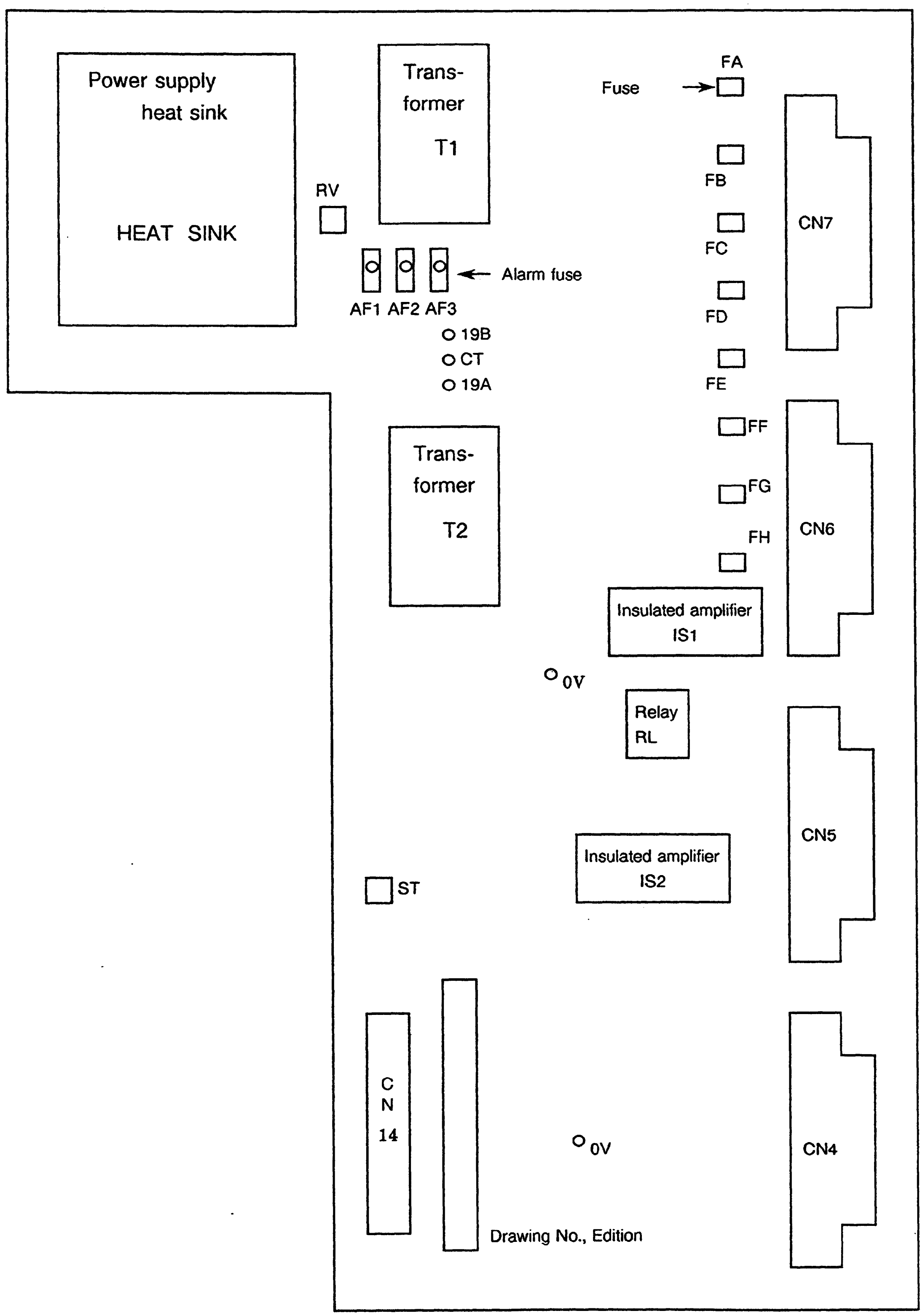
(6) Spindle control circuit PCB (models 6S to 22S) - (A20B-1003-0550)



(7) Spindle control circuit PCB (models 6S to 26S) - (A20B-1003-0920)



(8) Driver circuit PCB (models 30S and 40S) - (A20B-1004-0230)



APPENDIX 7 TEST POINTS

(1) Control circuit PCB (A16B-2201-0440)

Symbol	Signal	Description	Mounting position
*ITP1	ITP pulse	Synchronous signal from the CNC (ITP signal)	6B
TR	Serial data transmission signal	The high level of this signal indicates that serial data is being transmitted from the CNC.	7B
MSA	Magnetic sensor output MSA signal	One signal per rotation	6B
LSA	Magnetic sensor output LSA	One signal per rotation	7B
*LS	Rectangular LSA signal	One signal per rotation	6B
PAE2	Position-coder phase A	512, or 1024 pulses per rotation, pulse width duty = 1/2	2B
PBE2	Position-coder phase B	512, or 1024 pulses per rotation, pulse width duty = 1/2	2B
PSE2	Position-coder phase Z	One pulse per rotation	2C
*PELS	Signal indicating the position coder cable is broken.	The low level of this signal indicates that the wire is broken.	2C
PA	Pulse-generator phase A	90° advance for PB in a clockwise direction, $V_{P\text{-}P}$ = 0.36 to 0.5 V	7A
PB	Pulse-generator phase B	90° delay for PA in a clockwise direction, $V_{P\text{-}P}$ = 0.36 to 0.5 V	7B
RA	Phase-A reference voltage	+2.5VDC	6A
RB	Phase-B reference voltage	+2.5VDC	6B
PAAS	Signal with the amplitude 10 times that of PA	90° advance for PB in a clockwise direction, $V_{P\text{-}P}$ = 3.6 to 5.0 V	7B
PBAS	Signal with the amplitude 10 times that of PB	90° delay for PA in a clockwise direction, $V_{P\text{-}P}$ = 3.6 to 5.0 V	6B
PAA	Phase-A rectangular pulse	64, 128, or 256 pulses per rotation, pulse width duty = 1/2	7B
PBA	Phase-B rectangular pulse	64, 128, or 256 pulses per rotation, pulse width duty = 1/2	6B

<table>
<tr><th>Symbol</th><th>Signal</th><th colspan="2">Description</th><th>Mounting position</th></tr>
<tr><td>IU</td><td>Phase-U current signal</td><td colspan="2" rowspan="2"><table><tr><th>Amplifier model</th><th>Current value</th></tr><tr><td>Models 1S to 3S</td><td>21.9 A/V</td></tr><tr><td>Models compact 6S, and 6S to 12S</td><td>33.3 A/V</td></tr><tr><td>Model compact 15S</td><td>41.7 A/V</td></tr><tr><td>Models 15S to 22S</td><td>66.7 A/V</td></tr><tr><td>Model 26S</td><td>83.3 A/V</td></tr><tr><td>Model 30S</td><td>83.3 A/V</td></tr><tr><td>Model 40S</td><td>104.2 A/V</td></tr><tr><td>Models 30HV and 40HV</td><td>50.5 A/V</td></tr><tr><td>Model 60HV</td><td>94.7 A/V</td></tr></table></td><td>2B</td></tr>
<tr><td>IV</td><td>Phase-V current signal</td><td>2B</td></tr>
<tr><td>VDC</td><td>DC link voltage signal</td><td colspan="2">Voltage that is 1/100 of the DC link voltage</td><td>2A</td></tr>
<tr><td>SDC</td><td>Control power DC link voltage signal</td><td colspan="2">Voltage that is 1/100 of the DC voltage of the input power</td><td>2B</td></tr>
<tr><td>CLK1</td><td>Clock signal</td><td colspan="2">DSP clock signal, 8 MHz, 50% duty</td><td>11E</td></tr>
<tr><td>0V</td><td>0V</td><td>PCB reference potential</td><td rowspan="5">See Section 3.1.</td><td>2B
2D
7B
11E</td></tr>
<tr><td>+5V</td><td>+5V</td><td rowspan="4">PCB power voltage</td><td>7G</td></tr>
<tr><td>+15V</td><td>+15V</td><td>6G</td></tr>
<tr><td>-15V</td><td>-15V</td><td>6G</td></tr>
<tr><td>+24V</td><td>+24V</td><td>5G</td></tr>
</table>

APPENDIX 8 MAJOR PARTS FOR MAINTENANCE

(1) Models 1S to 3S

Table 8 (a) Major Parts for Maintenance (Models 1S to 3S)

Name	Symbol	Specification	Remarks
Spindle control circuit PCB	PCB 1	A16B-2201-0010	
Driver circuit PCB	PCB 2	A16B-2100-0030	
Alarm fuse	F1	A60L-0001-0046/3.2	3.2A
Fuse	F3A to F3 H F3J to F3 M	A60L-0001-0175/0.3A	0.3A
Printed wiring board	PCB 3	A20B-1004-0600	
Fuse	FUR, FUS, and FUT	A60L-0001-0031/5A	5.0A
Transistor module	TM1 and TM2	A50L-0001-0216	75A/600V×6
Diode module	D1	A50L-2001-0271	100A/800V
Magnetic contactor	MCC	A58L-0001-0207/A	
Electrolityc capacitor	C1	A42L-0001-0245	3300μF/450 WVDC
Surge absorber	Z1 to Z3	A50L-2001-0122/G431K	
Thermostat	TH	A57L-0001-0071/B95	
AC reactor	ACR	A81L-0001-0104	
Terminal cover		A300-0001-X091	

(2) Models 1S to 3S, small 6S
Unit specification: A06B-6064-H301 to H305

Table 8 (b) Major Parts for Maintenance (Models 1S to 3S, small 6S)

Name	Symbol	Specification	Remarks
Spindle circuit PCB	PCB 1	A16B-2201-0440	
Driver circuit PCB	PCB 2	A16B-2100-0070	
Alarm fuse	F1	A60L-0001-0046/3.2	3.2A
Printed wiring board	PCB 3	A20B-1005-0190	Models 1S to 3S
		A20B-1005-0191	model small 6S
Fuse	FUR, S, T	A60L-0001-0031/5A	5.0A
Transistor module	TM1~2	A50L-0001-0230	50A/600V×6 Models 1S~3S
		A50L-0001-0212	100A/600V×6 Model small 6S
Diode module	D1	A50L-2001-0271	100A/800A
Magnetic contactor	MCC	A58L-0001-0207/A	
Electrolityc capacitor	C1	A42L-0001-0245/A	2000μ F/DC450WV Models 1S~3S
		A42L-0001-0245	3300 F/DC450WV Model small 6S
Surge absorber	Z1 - 3	A50L-2001-0122/G431K	
Thermostat	TH	A57L-0001-0071/B95	
AC reactor	ACR	A81L-0001-0104	
Terminal cover		A300-0001-X091	For T1

(3) Models 6S to 26S
Unit specification: A06B-6062-Hxxx, A06B-6063-Hxxx

Table 8 (c) Major Parts for Maintenance (Models 6S to 26S)

Name	Symbol	Specification	Remarks
Spindle control circuit PCB	PCB 1	A20B-1003-0550 or A20B-1003-0920	
Alarm fuse	F1	A60L-0001-0046/3.2	3.2A
Fuse	F3A to F3 H F3J to F3 M	A60L-0001-0175/0 .3A	0.3A
Printed wiring board	PCB 2	A20B-1003-0020	Models 6S to 12S
		A20B-1003-0120	Models 15S to 22S
		A20B-1004-0540	Model 26S
Fuse	FUR, FUS, and FUT	A60L-0001-0031/5A	5.0A
Transistor module	TM1, and TM2 (- TM5: Models 15S to 26S)	A50L-0001-0175	120 A/600 V x 6, models 6S, 8S, 12S (TM1), and 15S to 22S
		A50L-0001-0209	150 A/600 V x 6, models 12S (TM2), and 26S
Diode module	D1	A50L-2001-0236	100A/600V
Magnetic contactor	MCC (MCC1 and MCC2: Models 15S to 26S)	A58L-0001-0337	
Electrolityc capacitor	C1 (- C2: Models 15S to 26S)	A42L-0001-0201	3900 μF/450WVDC Models 6S to 22S
		A42L-0001-0240	4200 μF/450WVDC Model 26S
Surge absorber	Z1 to Z3	A50L-2001-0155/20D431	
Thermostat	TH	A57L-0001-0071/B95	
AC reactor	ACR	A81L-0001-0096	Models 6S to 12S
		A81L-0001-0098	Models 15S to 26S
Terminal cover		A300-0001-X088	For T1

(4) Models 6S to 26S
Unit specification: A06B-6064-H306 to -H326

Table 8 (d) Major Parts for Maintenance (Models 6S to 26S)

Name	Symbol	Specification	Remarks
Spindle control circuit PCB	PCB 1	A16B-2201-0440	
Driver circuit PCB	PCB 2	A20B-2000-0220	
Alarm fuse	F1	A60L-0001-0046/3.2	3.2A
Printed wiring board	PCB 3	A20B-1004-0730	Models 6S to 12S
		A20B-1004-0700	Model small 15S
		A20B-1004-0740	Models 15S to 22S
		A20B-1004-0741	Model 26S
Fuse	FUR, S, T	A60L-0001-0031/5A	5.0A
Transistor module	TM1,2 (- TM5: Models 15S to 26S)	A50L-0001-0221	150A/600V ×6 Models 6S, 8S~12S, 15S to 26S
		A50L-0001-0222	200A/600V ×6 Model small 15S
Diode module	D1	A50L-2001-0236	100A/800V
Magnetic contactor	MCC (MCC1, 2: Models 15S to 26S)	A58L-0001-0337	
Electrolityc capacitor	C1 (- C2: Models 15S to 26S)	A42L-0001-0201	3900μ F/DC450WV Models 6S to 22S
		A42L-0001-0255	5700μ F/DC450WV Model small 15S
		A42L-0001-0240	4200μ F/DC450WV Model 26S
Surge absorber	Z1~3	A50L-2001-0155/20D431	
Thermostat	TH	A57L-0001-0071/B95	
AC reactor	ACR	A81L-0001-0096	Models 6S to 12S
		A81L-0001-0111	Model small 15S
		A81L-0001-0098	Models 15S to 26S
Terminal cover		A300-0001-X088	For T1

(5) Models 30S and 40S
Unit specification: A06B-6064-H030, -H040

Table 8 (e) Major Parts for Maintenance (Models 30S and 40S)

Name	Symbol	Specification	Remarks
Spindle control circuit PCB	PCB 1	A16B-2201-0010	
Driver circuit PCB	PCB 2	A120-1004-0230	
Alarm fuse	AF1	A60L-0001-0046/3.2	3.2A
Alarm fuse	AF2, and AF3	A60L-0001-0075/3.2	3.2AS
Fuse	F3A to F3H	A60L-0001-0175/0.3A	0.3A
Fuse	F1 to F4	A60L-0001-0183/225A	Model 30S
		A60L-0001-0183/260A	Model 40S
Fuse	F5 to F9	A60L-0001-0031/5A	5.0A
Transistor module	TM1 to TM16 (- TM22: Model 40S)	A50L-0001-0116	240A/600V
Thyristor module	SM1 to SM3	A50L-5000-0033	235A/800V
Diode module	DM1 to DM3	A50L-2001-0171	150A/800V
Diode	D1, D2, D5, D6, D9, D10, D13, and D16	A50L-2001-0103/12JH11	12A/600V
Diode	D3, D4, D7, D8, D11, D12, D14, and D15	A50L-2001-0103/12JG11	12A/600V
Magnetic contactor	MCC	A58L-0001-0133/200V	Model 30S
		A58L-0001-0159/200V	Model 40S
Transformer	TF	A80L-0001-0276	
Fan motor	FAN	A90L-0001-0096/C	
Surge absorber	SK	A74L-0001-0008/20D50	
Surge absorber	Z1 to Z3	A50L-2001-0155/20D431	
Surge absorber	Z4	A50L-2001-0062/441-12	
Thermostat	TH	A57L-0001-0028	
AC reactor	ACR	A81L-0001-0078	Model 30S
		A81L-0001-0079	Model 40S
Toggle switch	SW	A57L-0001-0048/A	

(6) Models 30HV to 60HV
Unit specification: A06B-6065-H030 to -H060

Table 8 (f) Major Parts for Maintenance (Models 30HV to 60HV)

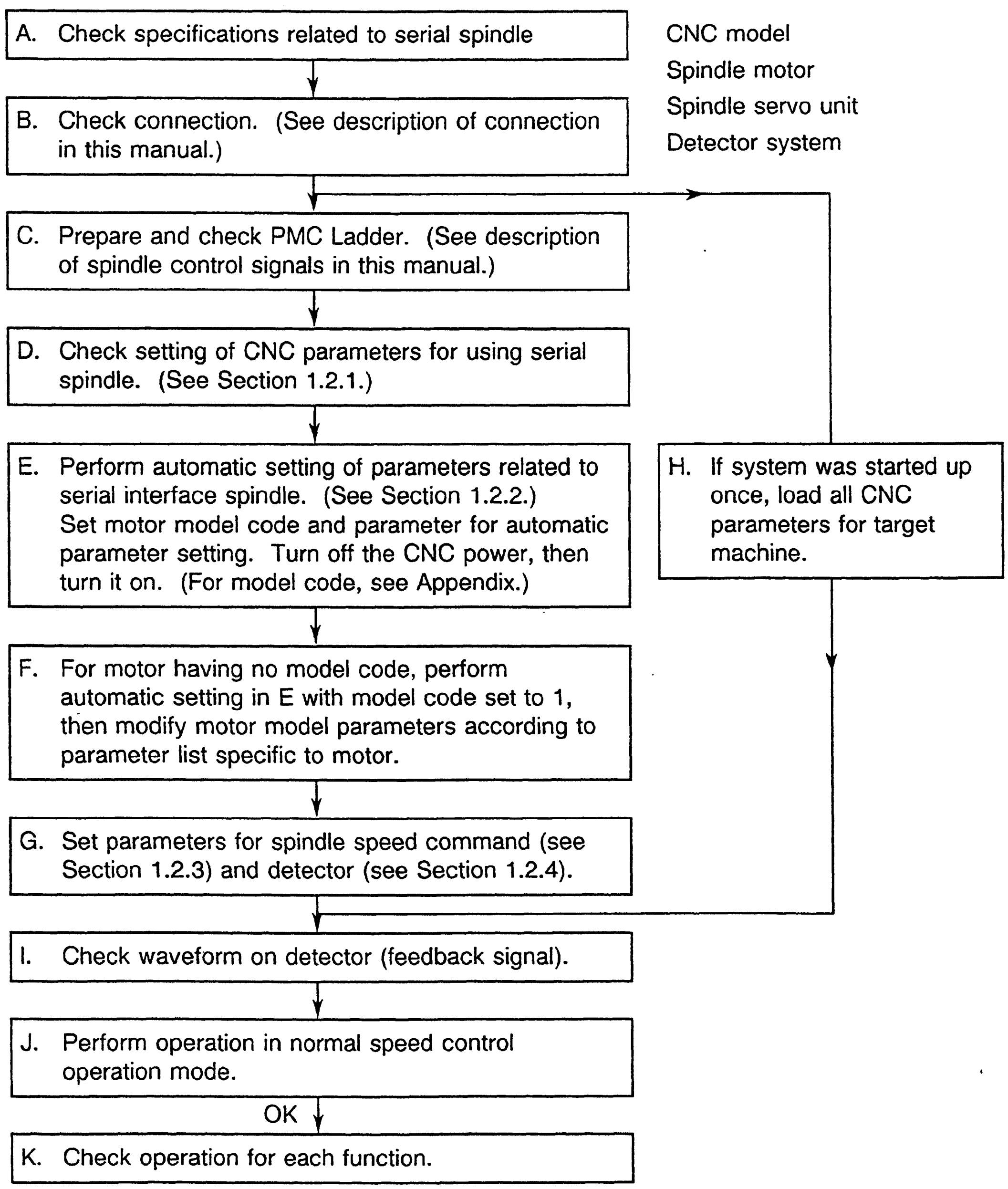
Name	Symbol	Specification	Remarks	
Spindle control circuit PCB	PCB 1	A16B-2201-0440		
Driver circuit PCB	PCB 2	A16B-2400-0010		
Alarm fuse	F1	A60L-0001-0046/3.2	3.2A	These fuses are mounted on the control circuit PCB.
Fuse	F2	A60L-0001-0175/1.0A	1.0A	
Fuse	F1 to 4	A60L-0001-0208/150A	Models 30HV, 40HV	
	F1 to 3	A60L-0001-0208/250A	Model 60HV	
	F4	A60L-0001-0208/300A		
Fuse	F5, 6	A60L-0001-0031/5A	5.0A	
Fuse	F7 to 9	A60L-0001-0209/2A	2.0A	
Transistor module	TR1 to 8	A50L-0001-0244	300A/1200V Models 30HV, 40HV	
		A50L-0001-0235	400A/1200V Model 60HV	
Thyristor module	SM1 to 3	A50L-5000-0035/100A	100A/1600V Models 30HV, 40HV	
		A50L-5000-0046	150A/1600V Model 60HV	
Diode module	DM1 to 3	A50L-2001-0189/100A	100A/1600V Models 30HV, 40HV	
		A50L-2001-0294	150A/1600V Model 60HV	
Diode	D1, 3, 5, 7, 9	A50L-2001-0190/SIE01	16A/1200V Models 30HV, 40HV	
		A50L-2001-0295/SIG01	30A/1200V Model 60HV	
Diode	D2, 4, 6, 8, 10	A50L-2001-0190/ERE51	16A/1200V Models 30HV, 40HV	
		A50L-2001-0295/ERG51	30A/1200V Model 60HV	
Magnetic contactor	MCC	A58L-0001-0212	Models 30HV, 40HV	
		A58L-0001-0335	Model 60HV	
Electrolityc capacitor	C1, 2 (- 3:Model 60HV)	A42L-0001-0260	3000μF/800V	
Surge absorber	Z1 to 3	A50L-2001-0155/20D751		
Surge absorber	Z4	A50L-2001-0155/20D431		
Thermostat	TH1, 2	A57L-0001-0051/B95		
AC reactor	ACR	A81L-0001-0085	Models 30HV, 40HV	
		A81L-0001-0079	Model 60HV	
Toggle switch	SW	A57L-0001-0048/A		

APPENDIX 9 SERIAL SPINDLE START-UP PROCEDURE

Appendix 3 explains the procedure for starting up the serial interface spindle amplifier.
First, start the amplifier in the normal operation mode.
Then, start individual functions including Cs contour control, spindle synchronization control, rigid tapping, and spindle orientation.
For the method of starting up a specific function, see the description of the start-up procedure for the function.

1. START-UP PROCEDURE FOR NORMAL OPERATION

1.1 Start-up Procedure for Normal Operation (Flowchart)



1.2 Parameters for Normal Start of the Serial Spindle

For details on the parameters, refer to the operator's manual of the CNC used, and the appendix in this manual.

1.2.1 Parameters for the serial spindle system

Parameter No.				Description
PM	OC	15	16	
0025 #0	(*1)	5606 #0	(*1)	Specifies whether to use the serial spindle amplifier (first spindle).
–		5606 #1		Specifies whether to use the serial spindle amplifier (second spindle).
–	0071 #4	5604 #0(*2)	3701 #4	Specifies the number of serial spindle amplifiers connected.

(*1) Optional parameter
(*2) For Series 15TT only

1.2.2 Parameters for automatic parameter setting

Parameter No.				Description
PM	OC	15	16	
3019 #7	6519 #7	5607 #0	4019 #7	Specifies whether to set serial spindle parameters automatically (first spindle).
3133	6633	3133	4133	Motor model code (first spindle)
–	6659 #7	5607 #1	4019 #7	Specifies whether to set serial spindle parameters automatically (second spindle).
–	6773	3273	4133	Motor model code (second spindle)

If a spindle switch function is provided to control the switching of two motors with one spindle amplifier, refer to the description of the spindle switch function for automatic parameter setting for the secondary motor.

1.2.3 Parameters related to the spindle speed command

Parameter No.					Description
PM	OTC	OMC	15	16	
0011	0013		–	3706	Polarity of spindle speed command (valid when SSIN = 0) (bits 7 and 6)
0236	–	0543 (*1)	5618	3735	Minimum clamp speed of the spindle motor
0237 0238 0239	–	0542 (*1)	5619	3736	Maximum clamp speed of the spindle motor
3120	6520		3020	4020	Maximum speed of the spindle motor
0242	0539	0577	5613	–	Spindle speed command offset (always set to 0)
0243	0516		5614	–	Spindle speed command gain adjustment (always set to 1000)
0233 ~ 0235	0540 ~ 0543	0541 0539 0555 (*2)	5621 ~ 5628	3741 ~ 3744	Maximum spindle speed corresponding to the gear

(*1) Valid only for the M system. These parameters are invalid when the constant surface speed control option is used.
(*2) If the constant surface speed control option is used for the M system, the same parameters as the T system are used (0540 to 0543).

1.2.4 Parameters related to the detector

Digits following # indicate bit numbers.

Parameter No.					Description
PM	OTC	OMC	15	16	
3000	6500		3000	4000	Direction of rotation of the spindle and motor (#0)
3011	6511		3011	4011	Number of motor speed detector pulses (#2 to #0) (*1)
3001	6501		3001	4001	Specifies whether to use the position coder signal (#2) (*2)
3000	6500		3000	4000	Mounting direction of the position coder (#2)
3003	6503		3003	4003	Position coder type (number of pulses) (#7, #6, #4)
0026 #7, 6	0003 #7, 6	0028 #7, 6	5610	3706 #1, 0	Spindle-position coder gear ratio For ×1, ×2, ×4, or ×8
3001	6501		3001	4001	Specifies whether to use the detector for Cs contour control (#5)
3001	6501		3001	4001	Setting of a detector when the Cs contour control function is provided and a built-in motor is used (#6)
3001	6501		3001	4001	Mounting direction of the detector for Cs contour control (#7)
3007	6507		3007	4007	Specifies whether to check the position coder signal of the Cs contour control detector for disconnection (#5)
3056 ~ 3059	6556 ~ 6559		3056 ~ 3059	4056 ~ 4059	Spindle-motor gear ratio data This data is selected by PMC DI signals CTH1A and CTH2A.

(*1) If a motor included in the Cs contour control detector (90000p/revx4) is used, the number of speed detector pulses must be set to 128 pulses/rev.

If the Cs contour control detector is used with the built-in motor, the setting differs according to the shape of the drum of the detector used.

(*2) If one of the following functions is used, the parameter must be set so as to use the position coder signal:

- Spindle orientation with a position coder
- Spindle synchronization control function
- Spindle indexing with a position coder
- SACT indication (for indicating spindle speed)
- Rigid tapping
- Feeding for each rotation (such as normal threading and constant surface-speed control)

1.2.5 Outline of serial spindle speed command processing

(1) Series 0C

In both the T and M systems, actual output is not performed until the direction of rotation is determined by the parameters (No. 13#7 and 13#6 TCW CWM) or by the PMC signals(SSIN, SSGN) and the M03 or M04 command.
If SSIN is 1, the direction of rotation is determined from SSGN. If SSIN is 0 and parameters TCW and CWM are set so as to determine the direction of rotation by M03 or M04, actual output is not performed unless M03 or M04 is specified even once after the NC power is turned on.
If plus or minus setting is made, instead of M03 and M04, actual output is performed only by an S code. In this case, it is not necessary to specify M03 or M04.

(a) T system (lathe)

(i) Sxxxxx is specified in rpm by the program or with the MDI.

(ii) Speed command data is calculated using the maximum spindle speed (4096 rpm) set in a parameter selected according to the gear selection signal (one of four: GR1 and GR2 combinations at DI).
Set spindle speed command offset compensation parameter No. 539 to 0, and spindle speed command gain parameter No. 516 to 1000.

GR1	GR2	Maximum spindle speed (Spindle speed when the maximum motor speed is specified)
0	0	Parameter No. 540
0	1	Parameter No. 541
1	0	Parameter No. 542
1	1	Parameter No. 543

(iii) The data calculated in (ii) is output to DO:F172 (R08O to R01O) and F173 (R12O to R09O).

(iv) The spindle speed data is transferred to the serial spindle according to the SIND (DI signal) state.
0: The maximum spindle speed is converted to ±16384 according to the data calculated in (ii), then the result is transferred to the serial spindle.
1: The maximum spindle speed is converted to ±16384 according to the data (±4095) in DI:G124 (R08I to R01I) and G125 (R12I to R09I), then the result is transferred to the serial spindle.

(v) The polarity of the speed command can be specified according to the SSIN (DI) signal as follows:
0: The polarity is determined by parameter Nos. 13#7 and 13#6, and M03 and M04.
1: The polarity is determined by SGN (DI) signal.

(vi) For constant surface-speed control, the spindle speed (in rpm) is calculated from G96, Sxxxxx (m/min.) and the position on the X axis, then steps (ii) to (iv) are performed.

(vii) *SSTP (DI): Spindle stop signal

0: S0 is output to F172 and F173 regardless of the command.

1: Normal steps (ii) and (iii) are performed.

*SSTP works on the value S on the command. It exists between (i) and (ii), and functions in a portion where the S code value specified by program or with the MDI is recognized in the CNC. If *SSTP is 0, the resulting output to F172 and F173 is set to 0. If SIND is 1 and values are set in G124 and G125, however, the spindle is rotated.

(b) M system (machining center)

(i) In the T system, the gear selection signals are input signals. In the M system, they are output signals (DO). With the T system, one of four gear stages is selected by two bits. With the M system, one of three gear signals GR10, GR20, and GR30, and the SF signal (to indicate the change of the gear signal) are output.

Set spindle speed command offset compensation parameter No. 577 to 0, and spindle speed command gain parameter No. 516 to 1000.

Gear	Maximum spindle speed (spindle speed when the maximum motor speed is specified)		
GR10	Parameter No. 541	:	Low
GR20	Parameter No. 539	:	Middle
GR30	Parameter No. 555	:	High

To clamp the maximum spindle speed command, set parameter No. 542.

In normal operation, set 4095 (to output up to 10 V).

To clamp the minimum spindle speed command, set parameter No. 543.

In normal operation, set 0.

For type B gear change, the motor speed at gear change must be set in the following parameters:

Parameter No. 585 (For the maximum motor speed with the low gear)

Parameter No. 586 (For the maximum motor speed with the middle gear)

(ii) Sxxxxx (in rpm) is specified by the program or with the MDI.

(iii) In reply to the S command, the CNC outputs SF and either GR10, GR20, or GR30. At the same time, by using the maximum spindle speed (in rpm) set in the corresponding parameter to the set gear, the CNC calculates speed command data. The maximum spindle speed is assumed to be 4096. The calculated data is then output to DO: F172 (R08O to R01O) and F173 (R12O to R09O).

(iv) According to the SIND (DI) state, the spindle speed data is transferred to the serial spindle.

0: Based on the data calculated in (iii), the maximum spindle speed is converted to ±16384, then it is transferred to the serial spindle.

1: Based on the data (±4095) in DI: G124 (R08I to R01I) and G125 (R12I to R09I), the maximum spindle speed is converted to ±16384, then it is transferred to the serial spindle.

(v) The polarity of the speed command can be specified according to the SSIN (DI signal) state as follows:

0: The polarity is determined by parameter Nos. 13#7 and 13#6, and M03 or M04.

1: The polarity is determined by the SGN (DI) signal.

(vi) *SSTP functions in the same way as the T system.

(vii) The SOR (DI) signal is provided for gear change.

If SOR is 1 and *SSTP is 0, the spindle rotates at a constant speed specified by the speed command set in the parameter.

In the M system, either the spindle or spindle motor can be turned at constant speed. One of them can be selected by parameter No. 3#5 GST.

The T system also provides SOR. Unlike from SOR in the M system, SOR in the T system always causes the spindle to rotate at constant speed.

In addition to the gear change point mentioned above, other switch points can be provided in G84 and G74 (tapping mode).(Set parameter No. 12#6 G84S, and Nos. 540 and 556).

The M system can have the constant surface-speed control option. This allows the M system to function as the same gear shift type as the T system.

The M system, when provided with the constant surface-speed control option, is compatible with the T system, except for two features. One of the differences is that in the M system, the reference axis for calculating the surface speed can be set to either the X, Y, Z, or 4th axis by the program or parameters. The other difference is that in the T system, the maximum speed is clamped by the program at G50SXXXXX. In the M system, it is clamped at G92SXXXXX. (Gear shift of the M system type is not permitted when constant surface-speed control is provided.)

(2) Series 15 (common to the T and M systems)

The serial spindle allows the BMI interface only. Basically, the PMC calculates and sends the contents of the spindle motor speed command to the CNC. In general, spindle control SPCNT (machine instruction) of the PMC is used.

(a) Sxxxxx (in rpm) is specified by the program or with the MDI.

(b) Sxxxxx (in rpm) is output to DO:F20 to F23 (32 bits) without modification.

(c) The PMC sets data, which is calculated with the maximum motor speed assumed to be ±8192, in RI (DI): G24 and G25 by using a machine instruction.
Parameters such as maximum spindle speed for the set gear stage (one of four stages) and spindle override must be set in the machine instruction.

(d) Based on the RI data (±8192), the CNC performs processing related to the following two parameters, converts the maximum motor speed into 16384, then transfers it to the serial spindle.
Spindle speed command offset compensation parameter No. 5613 = 0
Spindle speed command gain parameter No. 5614 = 1000

(e) When functions such as spindle change detection and constant surface speed control are used, the following parameters are also used:
Gear Maximum spindle speed (spindle speed when the maximum motor speed is specified)
Gear 1 : Parameter No. 5621
Gear 2 : Parameter No. 5622
Gear 3 : Parameter No. 5623
Gear 4 : Parameter No. 5624

(3) Series 16

The spindle control flow for Series 16 is almost the same as that for Series 0C. Note that the parameter Nos. indicated above for the T and M systems of Series 0C are different for Series 16.

A major difference in Series 16 is spindle override. The conditions for spindle override are the same as in Series 0C. Spindle override is enabled where *SSTP and the command S code are recognized in the CNC.
The PMC signal, however, is treated in a different way.
In Series 0C, override is done in 10% steps by a 3-bit signal. If all bits are set to 0, 100% override is achieved. In Series 16, the amount of override applied in steps of 1% is set in binary representation by using the eight bits of G30 (0% to 255%). With Series 0C, 100% override can be applied automatically without special operation. With Series 16, 0% spindle override is always applied unless the override is set by the PMC.
If SIND is 1, spindle override is disabled.

(a) T system (lathe)

(i) Sxxxxx is specified in rpm by the program or with the MDI.

(ii) Sxxxxx is output in rpm to DO: F22 to F25 (32 bits) without modification.

(iii) By using the maximum spindle speed (rpm) set in the parameter corresponding to the gear selection signals (one of four stages is selected by DI: GR1 and GR2), the speed command data is calculated. The maximum spindle speed is assumed to be 4096.
Spindle speed command offset compensation parameter No. 3731 = 0
Spindle speed command gain parameter No. 3730 = 1000

GR1	GR2	Maximum spindle speed (spindle speed when the maximum motor speed is specified)
0	0	Parameter No. 3741
0	1	Parameter No. 3742
1	0	Parameter No. 3743
1	1	Parameter No. 3744

(iv) The data calculated in (iii) is output to DO: 36 (R08O to R01O) and F37 (R12O to R09O).

(v) The spindle speed data is transferred to the serial spindle according to the SIND (DI) state as follows:
0: The maximum spindle speed is converted to ±16384 according to the data calculated in (iii), then the result is transferred to the serial spindle.
1: The maximum spindle speed is converted to ±16384 according to the data (±4095) in DI: G32 (R08I to R01I) and G33 (R12I to R09I), then the result is transferred to the serial spindle.

(vi) The polarity of the speed command can be specified by SSIN (DI signal) as follows:
0: The polarity is determined by parameter Nos. 3706#7 and 3706#6, and M03 and M04.
1: The polarity is determined by the SGN (DI) signal.

(vii) For constant surface-speed control, the spindle speed is calculated in rpm from G96, Sxxxxx (m/min.) and the position on the X axis, then steps (iii) to (v) are performed.

(viii) *SSTP (DI): Spindle stop signal
0: S0 is always output regardless of the command.
1: Normal processing steps (iii) and (iv) are performed.

(b) M system (machining center)

(i) In the T system, the gear selection signals are input signals. In the M system, they are output signals (DO). In the T system, one of four gear stages is selected by two bits. In the M system, one of three gear signals GR10, GR20, and GR30, and the SF signal (to indicate the change of the gear signal) are output.
Spindle speed command offset compensation parameter No. 3731 = 0
Spindle speed command gain parameter No. 3730 = 1000

Gear	Maximum spindle speed (spindle speed when the maximum motor speed is specified)
GR10	Parameter No. 3741
GR20	Parameter No. 3742
GR30	Parameter No. 3743
——	Parameter No. 3744

When M system gear shift is used, parameter No. 3744 becomes valid.
The parameter is valid when the constant surface speed control function is used in the M system.
To clamp the maximum spindle speed command, normally set parameter No. 3736 to 4095 (to output up to 10 V).
To clamp the minimum spindle speed command, normally set parameter No. 3735 to 0.
For type B gear change, the motor speed at gear change must be set in the following parameters:
Parameter No. 3751 (for the maximum motor speed with gear 1)
Parameter No. 3752 (for the maximum motor speed with gear 2)

(ii) Sxxxxx is specified in rpm by the program or with the MDI.

(iii) In reply to the S command, the CNC outputs SF and either GR10, GR20, or GR30. At the same time, by using the maximum spindle speed (rpm) set in the corresponding parameter to the set gear, the CNC calculates speed command data. The maximum spindle speed is assumed to be 4096. The calculated data is then output to DO: F36 (R08O to R01O) and F37 (R12O to R09O).

(iv) According to the SIND (DI) state, the spindle speed data is transferred to the serial spindle.
0: Based on the data calculated in (iii), the maximum spindle speed is converted to ±16384, then it is transferred to the serial spindle.
1: Based on the data (±4095) in DI: G32 (R08I to R01I) and G33 (R12I to R09I), the maximum spindle speed is converted to ±16384, then it is transferred to the serial spindle.

(v) The polarity of the speed command can be specified according to the SSIN (DI signal) state as follows:
0: The polarity is determined by parameter Nos. 3706#7 and 3706#6, and M03 or M04.
1: The polarity is determined by the SGN (DI) signal.

(vi) The SOR (DI) signal is provided for gear change.
If SOR is 1, the spindle rotates at a constant speed specified by the speed command set in the parameter.

2. Cs CONTOUR CONTROL FUNCTION START-UP PROCEDURE

2.1 Start-up Procedure of the Cs Contour Control Function (Flowchart)

A. Check that the system is ready for normal operation (Start-up of normal operation mentioned in Chapter 1 is completed.)

↓

B. Prepare and check the ladder program for Cs contour control function. (See Sections 2.2 and 2.3.)

↓

C. Set Cs contour control parameters. (See Section 2.4.)

↓

D. Check and adjust the waveform on the Cs contour control detector.

↓

E. Check the reference position return operation

- Maximum speed in the Cs contour control mode (speed at which the machine returns to the reference position)
- Parameter of the change rate of the position gain when returning to the reference position in the Cs contour control mode

↓

F. Check the stop position when the machine returns to the reference position

- Grid shift in the Cs contour control mode

↓

G. Check the direction of spindle rotation in the Cs contour control mode

- Rotation direction parameter for the positive move command

↓

H. Adjust and check the Cs contour control servo

- Check the operation during jog, rapid traverse, and handle operation.

↓

I. Check then terminate operation in the Cs contour control mode

2.2 DI and DO Signals for Cs Contour Control

2.2.1 DI signal (PMC→CNC)

(1) Cs contour control mode switching signal

This signal switches between the spindle rotation control mode and Cs contour control mode.
Before switching from the Cs contour control mode to the spindle rotation control mode, check that the spindle move command has terminated.
Switching from the spindle rotation control mode to the Cs contour control mode is enabled even when the spindle is rotating.
In this case, spindle rotation is decelerated then stopped, and the modes are changed. For safe operation, be sure to reset the spindle speed command (S command).

COFF (0TC) 0: Cs contour control mode
1: Spindle rotation control mode
CON (0MC) 0: Spindle rotation control mode
(16) 1: Cs contour control mode
SCNTR1, 2, ... 0: Spindle rotation control mode
(15) 1: Cs contour control mode

0C	15	16	7	6	5	4	3	2	1	0
G123			CON(M)							COFF(T)
		G027	CON(T/M)							
	G67, G71 . .		SCNTR1, 2 . .							
G229	G227	G070	MRDYA	ORCMA	SFRA	SRVA	CTH1A	CTH2A	TLMHA	TLMLA
G230	G226	G071	RCHA	RSLA	INTGA	SOCNA	MCFNA	SPSLA	*ESPA	ARSTA

2.2.2 DO signal (CNC→PMC)

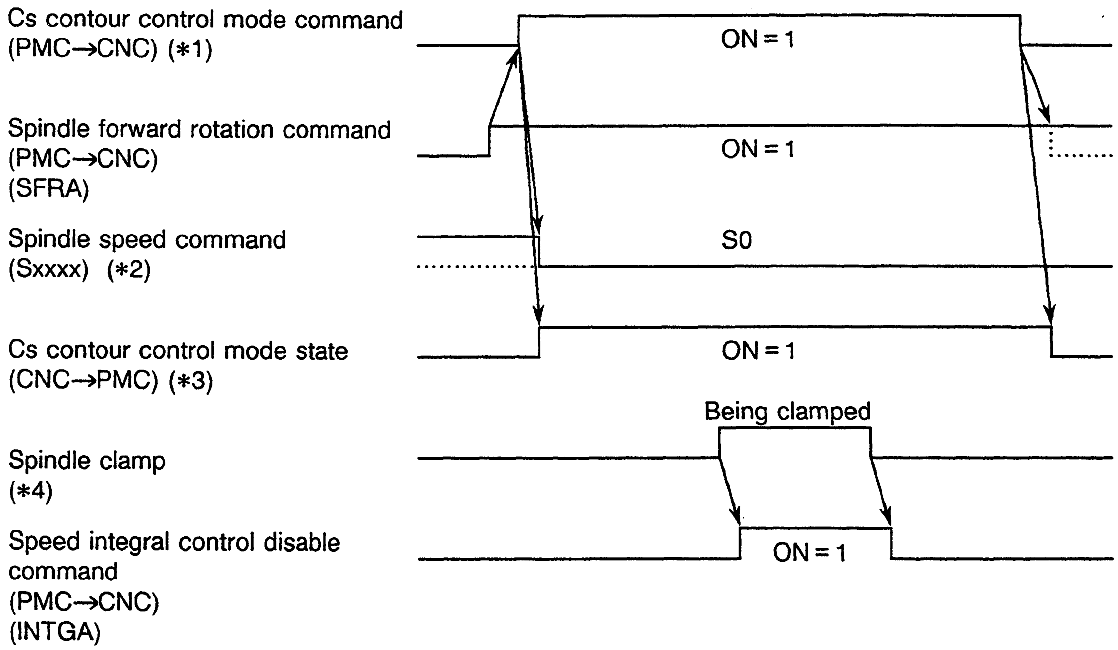
(1) Cs contour control mode switching confirmation signal

This signal posts the completion of switching between the spindle rotation control mode and Cs contour control mode.

FSCSL (0C) 0: Spindle rotation control mode
(16) 1: Cs contour control mode
MCNTR1, 2, ... 0: Spindle rotation control mode
(15) 1: Cs contour control mode

0C	15	16	7	6	5	4	3	2	1	0
F178		F004							FSCSL	
	F67, F71 ..		MCNTR1, 2 ..							
F281	F229	F045	ORARA	TLMA	LDT2A	LDT1A	SARA	SDTA	SSTA	ALMA
F282	F228	F046					RCFNA	RCHPA	CFINA	CHPA

2.3 Sample Sequence in the Cs Contour Control Mode



(*1) For Series 0TC : Setting COFF to 0 enters the Cs contour control mode.
For Series 0MC: Setting CON to 1 enters the Cs contour control mode.
For series 15 : Setting SCNTR to 1 enters the Cs contour control mode.
For Series 16 : Setting CON to 1 enters the Cs contour control mode.

(*2) When specifying the Cs contour control mode, reset the spindle speed command (S0 command) for safe operation.

(*3) For Series 0C : Setting FSCSL to 1 enters the Cs contour control mode.
For Series 15 : Setting MCNTR to 1 enters the Cs contour control mode.
For Series 16 : Setting FSCSL to 1 enters the Cs contour control mode.

(*4) When the spindle is clamped after it is positioned to perform machining such as drilling in the Cs contour control mode, the clamp position of the spindle may deviate a little from a specified position. If it deviates, the speed integral function works. The function attempts to move the spindle to the specified position. As a result, excessive current may flow in the motor. To prevent this, the speed integral function must be disabled while the spindle is being clamped.

2.4 Cs Contour Control Parameters

Parameter No.				Description
0TC	0MC	15	16	
3rd axis	4th axis	1804	1023	Sets an axis for which Cs contour control is performed.
0037 #7		1804 #0	–	Specify that the high resolution pulse coder is not used.
0037 #3, 2		1815 #1	1815 #1	Specify that a separate pulse coder is not used.
0021 #3, 2		1815 #5	1815 #5	Specify other than absolute-position detector.
–		5609 #1, 0	–	Specifies whether to perform automatic position gain setting for axes other than the Cs contour control axis.
6469 ~ 6572		3069 ~ 3072	4069 ~ 4072	Position gain of the Cs contour control axis This data is selected by the CTH1A and CTH2A PMC DI signals.
6780 ~ 6799		5609 #0 #1	3900 ~ 3944	Position gain of axes other than the Cs axis in the Cs contour control mode This data is selected by the CTH1A and CTH2A PMC DI signals.
0102	0103	1820	1820	For command multiplication, set 2 (one time)
0065 #1		1005 #0	3700 #1	Specifies whether to enable the reference position return function for the first G00 command after the serial spindle is switched to the Cs contour control mode.
0502	0503	1827	1826	In-position width
0506	0507	1828	1828	Positioning deviation limit along each axis during movement
0595	0596	1829	1829	Positioning deviation limit for each axis in the stopped state
–	–	1830	–	Positioning deviation limit for each axis in the servo off state
0332	0333	1832	1832	Limited deviation of the feed-stop position for each axis
0520	0521	1420	1420	Rapid traverse feedrate
0561	0562	1423	1423	Jog feedrate
–	–	1422	1422	Maximum cutting feedrate
0635		1622	1628	Time constant of linear acceleration/deceleration after interpolation in cutting feed (optional)
0524	0525	1620	1620	Time constant of linear acceleration/deceleration in rapid traverse

Parameter No.			Description
0C	15	16	
6521	3021	4021	Maximum spindle speed in the Cs contour control mode
6500	3000	4000	Direction of reference position return in the first Cs contour control mode entered after the power is turned on (#3)
6500	3000	4000	Direction of spindle rotation by the + move command in the Cs contour control mode (#1)
6546 6547	3046 3047	4046 4047	Proportional gain of the velocity loop in the Cs contour control mode This data is selected by the CTH1A PMC DI signal.
6554 6555	3054 3055	4054 4055	Integral gain of the velocity loop in the Cs contour control mode This data is selected by the CTH1A PMC DI signal.
6556 ~ 6559	3056 ~ 3059	4056 ~ 4059	Spindle-motor gear ratio data This data is selected by the CTH1A and CTH2A PMC DI signals.
6589	3086	4086	Motor voltage in the Cs contour control mode (Normally, 100 is set.)
6592	3092	4092	Change rate of the position gain when returning to the reference position in the Cs contour control mode
6594	3094	4094	Disturbance torque compensation constant
6597	3097	4097	Feedback gain of the spindle speed
6599	3099	4099	Delay time for motor activation
6635	3135	4135	Grid shift in the Cs contour control mode

2.5 Diagnosis

Address				Description
0TC	0MC	15	16	
0802	0803	3000	0418	Axis positioning deviation in the Cs contour control mode

2.6 Adjustment Procedure in the Cs Contour Control Mode

2.6.1 Adjustment in reference position return operation

(1) Speed of reference position return operation (parameter No. 6521)
After the power is turned on, the first reference position return operation is similar to spindle orientation. The machine returns to the reference position after a one-rotation signal of the Cs contour control detector is detected.
When the reference position return command is input, the serial spindle rotates at a reference position return speed (which is set in parameter No. 6521 as the maximum spindle speed in the Cs contour control mode). When the one-rotation signal is detected, the spindle decelerates, then stops when the reference position is reached. The reference position return operation then terminates.
If the reference position return speed is too high, a smaller value must be set in parameter No. 67521. If the set value is smaller than the maximum speed for rapid traverse and cutting feed, the maximum speed is clamped at the parameter data, resulting in an excessive error alarm.

(2) Overshoot in return to the reference position (parameter No. 6592)
If the speed of reference position return operation is high or large spindle inertia exists, an overshoot may occur.
To suppress overshoot, set a smaller value (5 to 50) in parameter No. 6592 for the change rate of the position gain when returning to the reference position in the Cs contour control mode.

(3) Reference position to which return is made (parameter No. 6635)
To change the reference position to which return is made, set data in parameter No. 6635 for the grid shift in the Cs contour control mode.

2.6.2 Direction of spindle rotation in the Cs contour control mode (parameter No. 6500#1)

To change the direction of spindle rotation in the Cs contour control mode, modify the value of bit 1 in parameter No. 6500.

2.6.3 Setting the position gain in the Cs contour control mode

A position gain in the Cs contour control mode must be set for the spindle as well as for the feed axis.
Note that the parameter of the position gain for the feed axis in the Cs contour control mode is not located at an ordinary parameter address. (See Section 2.4.)
If the position gain is modified for each gear, set data at the corresponding address. The parameter is selected by the CTH1A and CTH2A DI signals.

2.6.4 Rapid traverse time constant for the Cs contour control axis (No. 0524)

If the rapid traverse feedrate is high or the spindle inertia is large, an overshoot or hunting may occur when the rapid traverse is accelerated or decelerated.
In this case, adjust the parameter of the time constant of linear acceleration/deceleration in rapid traverse (No. 0524) to suppress overshoot and hunting.

2.6.5 Gear ratio of the spindle and motor (No. 6556 to 6559)

Gear ratio data is necessary to hold errors to an allowable level.
Be sure to set data for each gear.
The parameter is selected by the CTH1A and CTH2A DI signals.

2.6.6 Improving the rigidity during cutting operation in the Cs contour control mode

(1) Integral and proportional gains of the velocity loop in the Cs contour control mode
Setting larger values in the parameters for the integral gain and proportional gain of the velocity loop in the Cs contour control mode improves the rigidity in cutting in the Cs contour control mode.
Note, however, that setting an excessively large value causes oscillation.
Allowable values may vary according to the machine systems. As a rule of thumb, the following ranges can be set. Generally, larger values can be set for larger-scale motor models.
In some belt- or gear-coupled machines, large values cannot be set because of the backlash in the spring element of the belt or gear.

Proportional gain of the velocity loop	:	10 to 50
Integral gain of the velocity loop	:	50 to 500

(2) Disturbance torque compensation constant (No. 6594)
Setting the parameter for the disturbance torque compensation constant (No. 6594) improves the cutting stability.
In addition, when this parameter is set, a larger proportional gain of the velocity loop mentioned in (1) is allowed, resulting in improved rigidity.
As a general guideline, a value from 500 to 2000 may be set in this parameter.
The value must be less than 4000.

(3) Feedback gain of the spindle speed (No. 6597)
If the spindle and motor are connected via belts, feedback of the spindle speed may improve control stability.
As a general guideline, a value less than or equivalent to the proportional gain of the velocity loop (10 to 50) is set.

2.6.7 Excessive error in Cs contour control mode switching

When the Cs contour control mode is switched, a stop-time excessive error alarm may occur intermittently. This is due to abrupt change in motor activation that generates status transition in the motor and causes the motor to move a little.
In this case, set a value in the parameter for the delay time for motor activation (No. 6599). (Generally, set 400 (0.4 sec) or so.)

2.7 Additional Description of Series 0C

2.7.1 Axis arrangement in the Cs contour control mode

The axis for which Cs contour control is performed is placed as the first axis of the control axes. The following tables list arrangements of axes.

X, Y, Z : Servo axes
C : Cs contour control axis

T system

Control axis No.	Axis name	Servo axis No.
1	X	1
2	Z	2
3	C	3
4	4th	4

M system

Control axis No.	Axis name	Servo axis No.
1	X	1
2	Y	2
3	Z	3
4	C	4

2.7.2 Gear selection signals (CTH1A, CTH2A)

The gear selection signals are used to select parameters used in the Cs contour control mode, such as position gain, gear ratio, and velocity loop gain parameters.

In the T system, four gear stages can be used.
In addition to GR1 and GR2, signals corresponding to clutch/gear signals CTH1A and CTH2A must be applied simultaneously as gear selection signals.
Although GR1 and GR2 are invalid in the Cs contour control mode, they are valid as usual in the spindle rotation control mode.

With the M system, three gear stages can be used according to the NC specifications.
In addition to GR10, GR20, and GR30, signals corresponding to clutch/gear signals CTH1A and CTH2A must be applied simultaneously as gear selection signals.
Although GR10, GR20, and GR30 are invalid in the Cs contour control mode, they are valid as usual in the spindle rotation control mode.

2.7.3 Position gain in the Cs contour control mode

In the Cs contour control mode, the position gains of the Cs contour control axis and the servo axis for which interpolation with the Cs contour control axis is performed must be set to the same value. The parameters for their position gains in the Cs contour control mode are as follows:

Position gain of the Cs contour control axis : Nos. 6569 to 6572
Position gain of the Servo control axis
in the Cs contour control mode : Nos. 6780 to 6799

These parameters are selected by gear selection signals CTH1A and CTH2A as listed in the following table. After switching to the Cs contour control mode, the position gains are not changed even if the CTH1A and CTH2A signals are changed. So, before the Cs contour control mode is entered, the CTH1A and CTH2A signals must be set.

(1) To set the same position gain for the servo axes and Cs contour control axis in the Cs contour control mode, set the following parameters.
In this case, set parameter Nos. 6784 to 6799 to 0.
Set parameter Nos. 6780 to 6783 to the same value as parameter Nos. 6569 to 6772.

Gear selection signal		Common to all servo axes	Cs contour control axis (spindle)
CTH1	CTH2		
0	0	6780	6569
0	1	6781	6570
1	0	6782	6571
1	1	6783	6572

(2) If the position gains of the servo axes and Cs contour control axis need not be equal, a position gain is specified for each axis in the parameters listed in the following table.
Parameter Nos. 6780 to 6783 which are common to all servo axes must be set to 0.

Gear selection signal		For each axis T system : X axis M system: X axis	For each axis T system : Z axis M system: Y axis	For each axis T system : Cs axis M system: Z axis	For each axis T system : 4th axis M system: Cs axis	Cs contour control axis (spindle)
CTH1	CTH2					
0	0	6784	6788	6792	6796	6569
0	1	6785	6789	6793	6797	6570
1	0	6786	6790	6794	6798	6571
1	1	6787	6791	6795	6799	6572

(3) The position gains of the servo control axes in the spindle rotation control mode must be set in parameter Nos. 517, and 512 to 515.

2.7.4 Return to the reference position in the Cs contour control mode

When the machine returns to the reference position in the normal operation mode, the rapid traverse is decelerated to the FL speed by the deceleration dog. In the Cs contour control mode, however, when the reference position return command is input, the one-rotation signal is detected, then the machine returns to the reference position. So no deceleration dog is necessary in the Cs contour control mode.

(1) Manual return to the reference position (jog mode)
The speed of the reference position return is determined by the parameter for the maximum spindle speed in the Cs contour control mode (No. 6521).
The direction of reference position return is set in parameter PRM 6500#3.
After switching to the Cs contour control mode, the reference position return mode is entered by setting the ZRN signal to ON. One of the feed axis selection signals –3 and +3 (for the T system) or –4 and +4 (for the M system) is set to ON. The Cs contour control axis then moves in the reference position return direction. As the reference position is reached, reference position return completion signal ZP3 (for the T system) or ZP4 (for the M system) is output.

(2) Automatic return to the reference position (AUTO or MDI mode)
The speed of the first reference position return operation performed after switching from the spindle rotation control mode to the Cs contour control mode is determined by the parameter for the maximum spindle speed in the Cs contour control mode (No. 6521).
The direction of the reference position return operation is set in parameter PRM 6500#3.
In the Cs contour control mode, the second and subsequent reference position return operations are performed at the speed set by the parameter.
After switching to the Cs contour control mode, the machine is returned to the reference position by executing the G00 or G28 command.
Whether the G00 command causes a reference position return operation is determined according to the following parameter. This parameter is valid only for the serial spindle (Cs contour control axis).

PRM No.65							CZRN	

CZRN 1 : The first G00 command issued after switching to the Cs contour control mode does not cause the machine to return to the reference position.
0 : The first G00 command issued after switching to the Cs contour control mode causes the machine to return to the reference position.

G00 command
PRM No. 65 CZRN = 0
If the G00 command is executed when reference position return operation has not been performed since switching to the Cs contour control mode, the machine returns to the reference position.

The reference position is indexed, and at the same time, the spindle is positioned at the specified position.
Only when the spindle is positioned at the reference position (G00 G0.), reference position return completion signal ZP3 (for the T system) or ZP4 (for the M system) is output at the completion of positioning.
When the machine has returned to the reference position, the G00 command performs normal positioning.

PRM No. 65 CZRN = 1

If the G00 command is executed when the machine has not returned to the reference position since switching to the Cs contour control mode, the serial spindle performs normal positioning from its stopped position.
In this case, the reference position is not recognized.
So the G28 command is required to return the machine to the reference position.
When the machine has been returned to the reference position, the G00 command recognizes the reference position. A coordinate system is established, then normal positioning is performed.

G28 command

If G28 is specified after switching to the Cs contour control mode, the Cs contour control axis moves to a middle point. Reference position return, then positioning at the reference position are performed. Then, reference position return completion signal ZP3 (for the T system) or ZP4 (for the M system) is output.
When the machine has been returned to the reference position, positioning at the reference position is performed, then reference position return completion signal ZP3 (for the T system) or ZP4 (for the M system) is output.

(3) Operation after switching to the Cs contour control mode

Immediately after switching from the spindle rotation control mode to the Cs contour control mode is made, the current position is lost, so it is always necessary to return the machine to the reference position.
If the coordinate system for the Cs contour control axis is not required, however, a corresponding parameter is set so that the reference position return function is not used. In this case, movement is allowed without returning to the reference position.

(4) Interruption of return to the reference position

Manual operation mode

Reference position return for the Cs contour control axis can be interrupted by reset, emergency stop, or by turning the axis selection signal to OFF.
In all cases, after the interruption, the reference position return operation must be performed again from the beginning.

Automatic operation mode

The reference position return operation for the Cs contour control axis can be interrupted by reset, emergency stop or feed hold.

In all cases, after the interruption, reference position return operation must be performed again from the beginning.

2.7.5 Others

(1) Switching between the spindle rotation control and Cs contour control modes during automatic operation
When switching between the spindle rotation control and Cs contour control modes is performed during an automatic operation block, if position gains are changed immediately after the mode switch, normal operation is impossible. In this case, confirm the completion of the block, then perform automatic setting.

(2) The functions for memory type pitch error compensation and backlash compensation cannot be used for the Cs contour control axis.

(3) Before switching to the Cs contour control mode, signals MRDYA, *ESPA, and SFRA must be set to 1.

(4) When the PMC switches between the spindle rotation control mode and Cs contour control mode using an M code, the code must not be placed in the same block that contains a move command for the Cs contour control axis in the NC program. If such an M code and the move command are included together in the same block, alarm PS197 is generated.

2.7.6 Alarm

When the Cs contour axis control function is used, the following three alarms are added to the conventional alarms:

No.	Description
409	An alarm is generated in the serial spindle. Take corrective action according to the alarm in the serial spindle.
194	The Cs contour axis control, Cs axis control, or rigid tapping mode is specified in the serial spindle synchronization control mode. (Cancel the synchronization control mode, then specify the command.)
195	A command for switching to the spindle, Cs contour axis control, or servo mode (such as Cs axis control, or rigid tapping) is specified, but the specified switching operation is not performed by the serial spindle.

(Note 1) Alarm 409 is generated as a servo alarm, and alarms 195 and 194 are generated as P/S alarms. Alarm 194 is not generated when the serial spindle synchronization control option is not provided.
(Note 2) During the Cs contour axis control mode, for the T system a conventional servo alarm related to the third axis, or for the M system an alarm related to the fourth axis may be generated.

2.8 Additional Description of Series 15

2.8.1 Axis arrangement in the Cs contour control mode

(1) The same number as the control axis number must be set for the servo axis number of the axis for which Cs contour control is performed. If a different number is set, a servo alarm (SV026) is generated for all axes.
Sample arrangement X, Y, Z : Servo axes
C : Cs contour control axis

Control axis No.	Axis name	Servo axis No.
1	X	1
2	Y	2
3	Z	3
4	C	4

← Set the servo axis number to the same number as the control axis number.

(2) Removal of the control axis in the Cs contour control mode
If removal of the control axis is specified for the Cs contour control axis, the spindle enters the spindle rotation control mode. Therefore do not specify removal of the control axis.

(3) Axis arrangement for 15TT
In 15TT, two-spindle control is enabled. If both spindles are used as the Cs contour control axes, place one Cs contour control axis on a tool post, and the other axis on another tool post. The two Cs contour control axes cannot be placed on one tool post.

2.8.2 Gear selection signals and position gain in the Cs contour control mode

Gear stages 1 to 4 can be used. Stages 5 to 8 cannot be used.
In addition to gear selections signals GS1, GS2, and GS4, clutch/gear signals CTH1A and CTH2A must be applied simultaneously.
The relationships the selected position gain has with the gear selection and clutch/gear signals are listed below.

GS4	GS2	GS1		CTH1A	CTH2A		Position gain parameter for each axis in the Cs contour control mode (*1)
0	0	0		0	0		3069
0	0	1		0	1		3070
0	1	0		1	0		3071
0	1	1		1	1		3072
1	0	0		Not used			
1	0	1					
1	1	0					
1	1	1					

(*1) When the same position gain as the Cs contour control axis is set for servo axes other than the Cs contour control axis in the Cs contour control mode, set the parameter as follows:

Parameter No.	#7	#6	#5	#4	#3	#2	#1	#0
5609							NGC2	NGC1

NGC1 Specifies whether to set the position gain of the servo axes other than the Cs contour control axis (first spindle) to the same value as the position gain of the Cs contour control axis automatically.

0: Set automatically

1: Not set automatically

If there is no interpolation between the Cs contour control axis and the other servo axes, or if the same servo loop gain is used, set 1.

NGC2 Specifies whether to set the servo loop gain of the servo axes other than the Cs contour control axis (second spindle for FS15TT) to the same value as the servo loop gain of the Cs contour control axis automatically.

0: Set automatically

1: Not set automatically

If there is no interpolation between the Cs contour control axis and the other servo axes, or if the same servo loop gain is used, set 1.

2.8.3 Automatic position gain setting when switching between the spindle rotation control mode and Cs contour control mode

(1) Switching from the spindle rotation control mode to Cs contour control mode
If the servo loop gain of the Cs contour control axis is different from that of the other servo axes when the modes are switched, linear and circular interpolations with the Cs contour control axis fail.
To prevent this, at the same time that the modes are switched, the position gain selected by the clutch/gear signals (CTH1A and CTH2A) (PRM 3069, 3070, 3071, 3072) must be set for servo axes other than the Cs contour control axis automatically. (PRM 5609#1, 0)

(2) Switching from the Cs contour control mode to spindle rotation control mode
At the same time that the Cs contour control mode is switched to the spindle rotation control mode, the original position gain (PRM 1825) is set automatically for the servo axes.

(3) Switching between the spindle rotation control and Cs contour control modes during automatic operation
If mode switching between the spindle rotation control mode and Cs contour control mode is performed midway through an automatic operation block, the position gain is automatically set after completion of the block is confirmed.

(4) When the gain is not changed
If there is no interpolation between the Cs contour control axis and other axes, or if the Cs contour control axis and servo axes have the same position gain, the gain need not be changed. In this case, set the parameter to indicate that gain switching is not performed (PRM 5609#0, #1 = 0).

(5) For FS15TT
Only the gain of the servo axis of the tool post to which the Cs contour control axis belongs is changed automatically.

2.8.4 Return to the reference position in the Cs contour control mode

In normal operation, to return to the reference position, rapid traverse is decelerated to the FL speed by the deceleration dog. In the Cs contour control mode, when the reference position return command is input, the one-rotation signal is detected, then the machine returns to the reference position. So the conventional deceleration dog is unnecessary.

(1) Manual return to the reference position (jog mode)
The speed at which the machine returns to the reference position is determined by the parameter for the maximum spindle speed in the Cs contour control mode (No. 3021).
The direction for reference position return is set in parameter PRM 3000#3.
After switching to the Cs contour control mode, the reference position return mode is entered by setting the ZRN signal to ON. One of the feed axis direction selection signals –Jn and +Jn is set to ON. The Cs contour control axis then moves in the reference position return direction.

When the reference position is reached, reference position return completion signal ZPn is output.

(2) Automatic return to the reference position (AUTO or MDI mode)
The speed of the first reference position return operation performed after switching from the spindle rotation control mode to the Cs contour control mode is determined by the parameter for the maximum spindle speed in the Cs contour control mode (No. 3021).
The direction of reference position return is set in parameter PRM 3000#3.
In the Cs contour control mode, the second and subsequent reference position return operations are performed at the speed set by the parameters.
After switching to the Cs contour control mode, the machine returns to the reference position by executing the G00 or G28 command.

G28 command

If G28 is specified after switching to the Cs contour control mode, the Cs contour control axis moves to a middle point. The machine is returned to the reference position, then is positioned at the reference position. Then, reference position return completion signal ZPn is output.
When the machine has returned to the reference position, it is positioned at the reference position then reference position return completion signal ZPn is output.

G00 command

PRM No. 1005 #0 = 1
(ZRNx: Reference position return function is not provided for each axis.)

If the G00 command is executed when the machine has not returned to the reference position since switching to the Cs contour control mode, the serial spindle performs normal positioning from its stopped position.
In this case, the reference position is not recognized.
So the machine must be returned to the reference position by using the G28 command.
If the G00 command is executed after the machine has returned to the reference position, the reference position is recognized. The coordinate system is established, then normal positioning is performed.

PRM No. 1005 #0 = 0
(ZRNx: Reference position return function is provided for each axis.)

If the G00 command is executed when the machine has not returned to the reference position since switching to the Cs contour control mode, the PS alarm is generated.

(3) Operation after switching to the Cs contour control mode
Immediately after switching from the spindle rotation control mode to the Cs contour control mode, the current position is lost. Therefore it is necessary to return the machine to the reference position.
If parameter setting indicates that the reference position function is not provided and the coordinate system is not required, however, a move command for the Cs axis can be executed without returning to the reference position.

(4) Interruption of return to the reference position

Manual operation mode

The reference position return operation for the Cs contour control axis can be interrupted by reset, emergency stop, or by turning the axis selection signal to OFF.

In all cases, after the interruption, the reference position return operation must be performed again from the beginning.

Automatic operation mode

The reference position return operation for the Cs contour control axis can be interrupted by reset, emergency stop or feed hold.

In all cases, after the interruption, the reference position return operation must be performed again from the beginning.

2.8.5 Others

(1) Switching from the Cs contour control mode to the spindle rotation control mode

Before changing the modes, be sure to confirm that the move command for the spindle in automatic or manual operation has terminated.

If the modes are changed while the spindle is moving, an interlock or an excessive positioning deviation alarm may be generated.

(2) Operating monitor

The motor load rating of the spindle and Cs contour control axis is not set in conventional parameters. It is set in PRM 3127. (In models having motor model code, this parameter is set automatically, so no modification is necessary.)

(3) Remote buffer operation

- Operation with binary statements
- Operation with NC statements. In DNC operation using a remote buffer, setting is made so as to perform high-speed distribution if conditions for high-speed distribution are satisfied (PRM0000#DNC = 0).

Before entering the remote buffer operation mode, cancel the Cs contour control mode.

In the remote buffer operation mode, Cs contour control cannot be performed. Only rotation control is possible.

In the remote buffer operation mode, switching to the Cs contour control mode or spindle rotation control mode must not be performed.

The spindle parameters cannot be rewritten by rewriting programmable parameters.

(4) The functions for memory type pitch error compensation, straightness compensation, gradient compensation, and backlash compensation are invalid for the Cs contour control axis.

(5) Position coder check for broken wires

The parameter specifying whether to check the position coder for broken wires (PRM 5603#PDC) cannot be used.

To suppress the broken wire check, set a parameter (PRM 5602#NAL) so as to suppress alarm check of the spindle speed control unit. If this parameter is set, alarms of the spindle amplifier are not checked either.

(6) For Cs contour control, the BMI interface is needed.

(7) FS15TT spindle

An analog spindle and serial interface spindle cannot be used together.

3. START-UP PROCEDURE FOR SPINDLE SYNCHRONIZATION CONTROL

3.1 Start-up Procedure for Spindle Synchronization Control

A. Check that the system is ready for normal operation.

↓

B. Check and prepare the Ladder for spindle synchronization control. (See Section 3.2.)

↓

C. Set parameters for the spindle synchronization control. (See Section 3.3.)

↓

D. Connect the position coders and check the feedback signals.

↓

E. Check the spindle speed in synchronization.

↓

F. Check the direction of rotation of synchronized spindles.

↓

G. Check that an overshoot or hunting does not occur until the maximum speed is reached in spindle synchronization control.

H.
- Adjust the position gain in spindle synchronization control.
- Adjust the acceleration/deceleration time constant for spindle synchronization control. (Set identical values for the two spindles.)

↓

I. Check that the difference between the error pulses of the two spindles is within ±5 pulses.

J.
- Check the position gain.
- Check the parameters for the gear ratio.
- Adjust the gain of the velocity loop for spindle synchronization control.

↓

K. Check the operation of spindle phase synchronization.

- See ** for synchronizing spindle phases.

↓

L. Check that the operation of spindle synchronization control is finished.

3.2 DI/DO Signals Used for Spindle Synchronization Control

3.2.1 Explanation of spindle synchronization control

(1) When the command for spindle synchronization control is issued while the two spindles are rotating at different speeds or stopped, each spindle increases or decreases its speed to the specified speed. The two spindles are then controlled in synchronization.

(2) If the synchronization speed is changed after the synchronous control of the two spindles is started, the spindles increase or decrease their speed to the new speed. The spindles are synchronized during the acceleration or deceleration as the speed is increased or decreased according to the time constant specified in the parameter. When the specified synchronization speed is 0 rpm, the two spindles stop at the same time.

(3) When the command for spindle synchronization control is issued with the synchronization speed specified as 0 rpm when both spindles are stopped, the spindles rotate two or three times. After detecting the signal indicating one rotation of the position coder (required for synchronous control of spindle phase), the spindles stop and enter the synchronous control state. If the synchronization speed is changed after the synchronous control state is established, the spindles increase or decrease their speed to the new speed. The spindles are synchronized during acceleration or deceleration as the speed is increased or decreased according to the time constant specified in the parameter.

(4) To handle a workpiece with a unique shape, the spindles need to rotate to keep the phases (angles) of rotation synchronous. When the command for spindle phase synchronization is issued when the spindles are already rotating in synchronization, each spindle is adjusted to the rotation phase specified in the parameter. At this time, the speed changes for a moment. Then the two spindles return to the synchronous control state. Rotation phase synchronization can be established by setting the parameters in advance so that the reference points of the two spindles match with each other.

(5) When the command for spindle phase synchronization is issued when the spindles are controlled in synchronization at 0 rpm, each spindle is rotated and adjusted to the phase specified in the parameter then stops. It is similar to when the spindles are positioned in the stop state (spindle orientation). This causes the reference points of the spindles to match with each other (phase synchronization). If the synchronization speed is changed after a workpiece with a unique shape is held with the two spindles, the spindles increase or decrease their speed to the new speed. The spindles are synchronized during acceleration or deceleration as the speed is increased or decreased according to the time constant specified in the parameter.

(6) Constant surface speed control can be executed while a workpiece is being held with the two spindles in the synchronous control state. However, the time constant specified in the parameter is not exceeded even when a command for a larger increment or decrement in speed is specified.

3.2.2 DI signals (PMC to CNC)

(1) Signal for controlling the spindles in synchronization (SPSYC)

[Function] Selects the spindle synchronization control mode.

[Operation] When the signal is set to 1, spindle synchronization control mode is selected. When the signal is set to 0, spindle synchronization control mode is released.

(2) Signal for controlling the spindle phases in synchronization (SPPHS)

[Function] Selects the spindle phase synchronization mode. It becomes effective when the signal for controlling the spindles in synchronization (SPSYC) is set to 1. Enter this signal after the signal that indicates that synchronous control of spindle speed is completed has been set to 1. Synchronous control of spindle phase is started at the rising edge of this signal. Even when this signal is set to 0, the synchronized phase does not change. When the signal is changed again from 0 to 1, phase synchronization is executed again.

[Operation] At the rising edge of the signal changing from 0 to 1, synchronous control of the spindle phase begins.

(3) Signal for executing integral speed control (INTGA)

[Function] Enables or disables integral speed control.

[Operation] When this signal is set to 1, integral speed control is disabled. (Same effect as when the integral gain of the velocity loop is set to 0.) When the signal is set to 0, integral speed control is enabled.
When the two spindles are mechanically connected with each other, this signal is set to 1 for both spindles so that integral speed control is disabled.

① When a cylindrical workpiece is held with the two spindles after they are synchronized in speed

② When a workpiece with a unique shape is held with the two spindles after they are synchronized in phase

	0TC	0TTC	15	16	7	6	5	4	3	2	1	0
	G146	G146		G038					SPPHS	SPSYC		
	G124	G124		G032	R08I	R07I	R06I	R05I	R04I	R03I	R02I	R01I
	G125			G033			SSGN		R12I	R11I	R10I	R09I
			G025		RI07	RI06	RI05	RI04	RI03	RI02	RI01	RI00
			G024		RISGN			RI12	RI11	RI10	RI09	RI08
			G111		SPPHS	SPSYC						
First Second	G229 G233	G229 G1429	G227 G235	G070 G074	MRDYA	ORCMA	SFRA	SRVA	CTH1A	CTH2A	TLMHA	TLMLA
First Second	G230 G234	G230 G1430	G226 G234	G071 G075	RCHA	RSLA	INTGA	SOCNA	MCFNA	SPSLA	*ESPA	ARSTA

3.2.3 DO signals (CNC to PMC)

(1) Signal indicating that synchronous control of spindle speed is completed (FSPSY)

[Function] Reports that synchronous control of spindle speed is completed.

[Output conditions] This signal is set to 1 when the following conditions are satisfied:

- In spindle synchronization control mode, the two spindles reach the speed specified by the signal for specifying the spindle speed in synchronization, and the difference between the speeds of the two spindles is not more than the value specified in parameter 6533.

This signal is set to 0 when any of the following conditions is satisfied:

- In spindle synchronization control mode, the two spindles have not yet reached the speed specified by the signal for specifying spindle speed in synchronization.
- In spindle synchronization control mode, the difference between the speeds of the two spindle is larger than the value specified in parameter 6533.
- The spindles are not in spindle synchronization control mode.

(Note) The signal changes from 1 to 0 when the difference in spindle speed exceeds the value specified in parameter 6533 due to changes in the cutting load, etc.

(2) Signal indicating that synchronous control of spindle phase is completed (FSPPH)

[Function]

Reports that synchronous control of spindle phase (control of phase difference) is completed.

[Output conditions]

The signal is set to 1 when the following conditions are satisfied:

- In spindle synchronization control mode, the two spindles reach the speed specified by the signal for specifying spindle speed in synchronization, and the spindles are synchronized in phase by the signal for controlling spindle phases in synchronization. (The difference between the error pulses of the two spindles cannot be greater than the value set in parameter 303.)

The signal is set to 0 when any of the following conditions are satisfied:

- In spindle synchronization control mode, the spindles have not yet been synchronized in phase.
- In spindle synchronization control mode, the difference between the error pulses of the two spindles is greater than the value specified in parameter 303.
- The two spindles are not in the mode for synchronous control of spindle phase.

(Note) The signal is changed from 1 to 0 when the difference in the error pulse exceeds the value specified in parameter 303 due to changes in the cutting load, etc.

(3) Signal for issuing an alarm detected in spindle synchronization control (SYCAL)

[Function]

Reports that the difference between the error pulses of the two spindles exceeds the value specified in the parameter for spindle synchronization control mode. This signal is used for error handling in spindle synchronization control.

[Output conditions]

The signal is set to 1 when the following conditions are satisfied:

- In spindle synchronization control mode, the difference between the error pulses of the two spindles exceeds the value specified in parameter 576, after spindle synchronization control has been put in effect.

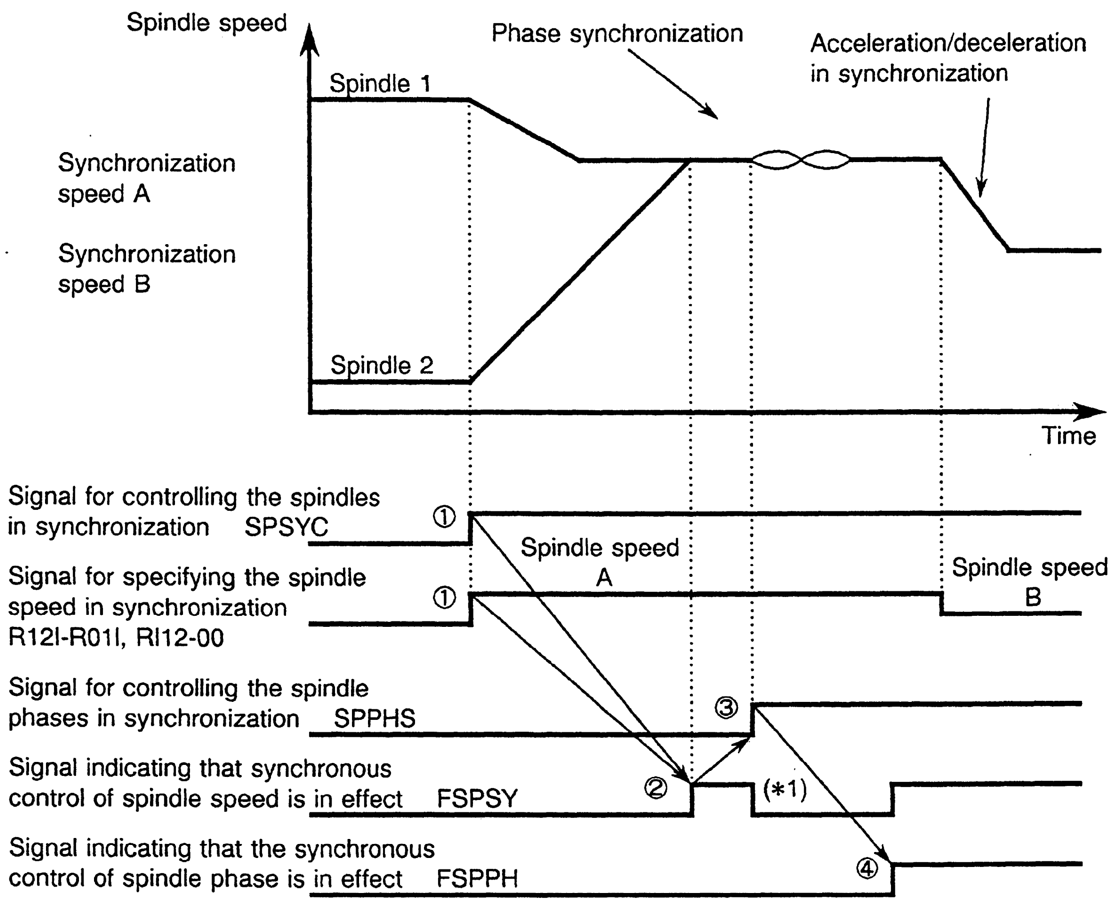
The signal is set to 0 when any of the following conditions is satisfied:

- The spindles are not in spindle synchronization control mode.
- In spindle synchronization control mode, the difference between the error pulses of the two spindles is not greater than the value specified in parameter 576.

	0TC	0TTC	15	16	7	6	5	4	3	2	1	0
	F178	F178		F044				SYCAL	FSPPH	FSPSY		
			F111		MSPPHS	MSPSYC	SPSYAL					
First Second	F281 F285	F281	F229 F245	F045 F049	ORARA	TLMA	LDT2A	LDT1A	SARA	SDTA	SSTA	ALMA
First Second	F282 F286	F282	F228 F244	F046 F050					RCFNA	RCHPA	CFINA	CHPA

3.2.4 Sample sequence in spindle synchronization control

(1) While spindle 1 is rotating, spindle 2 is accelerated to reach the speed of spindle 1. The phase of spindle 2 is synchronized with that of spindle 1. Then the synchronization speed is changed, and the two spindles increase or decrease their speed in synchronization.



① Enter the signal for specifying spindle speed in synchronization and set the signal for controlling the spindles in synchronization to high.

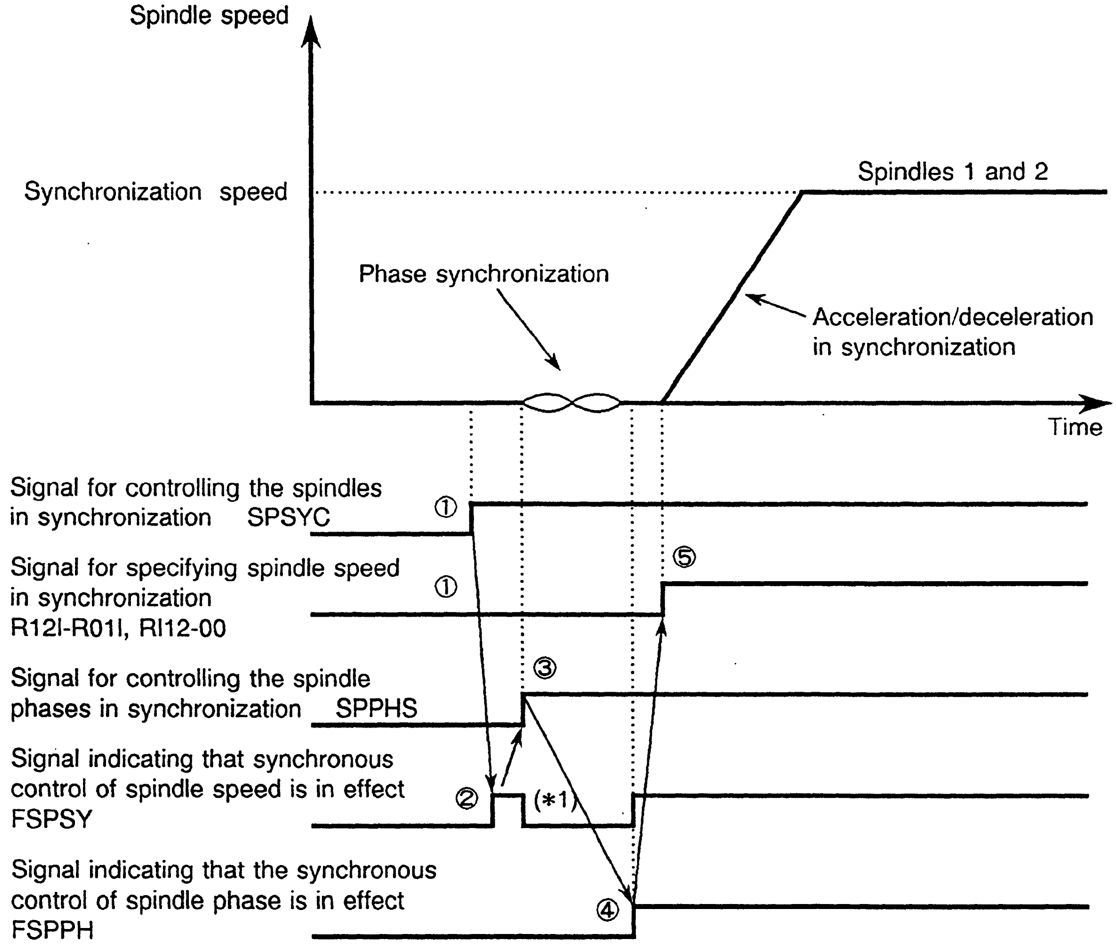
② Wait until the signal indicating that synchronous control of spindle speed is completed is set to 1.

③ Set the signal for controlling the spindle phases in synchronization to 1.

④ Wait until the signal indicating that the synchronous control of spindle phase is completed is set to 1.

(*1) The signal indicating that the synchronous control of spindle speed is completed is set to 0 when the signal for controlling the spindle phases in synchronization is entered. It is changed to 1 when phase synchronization is put into effect.

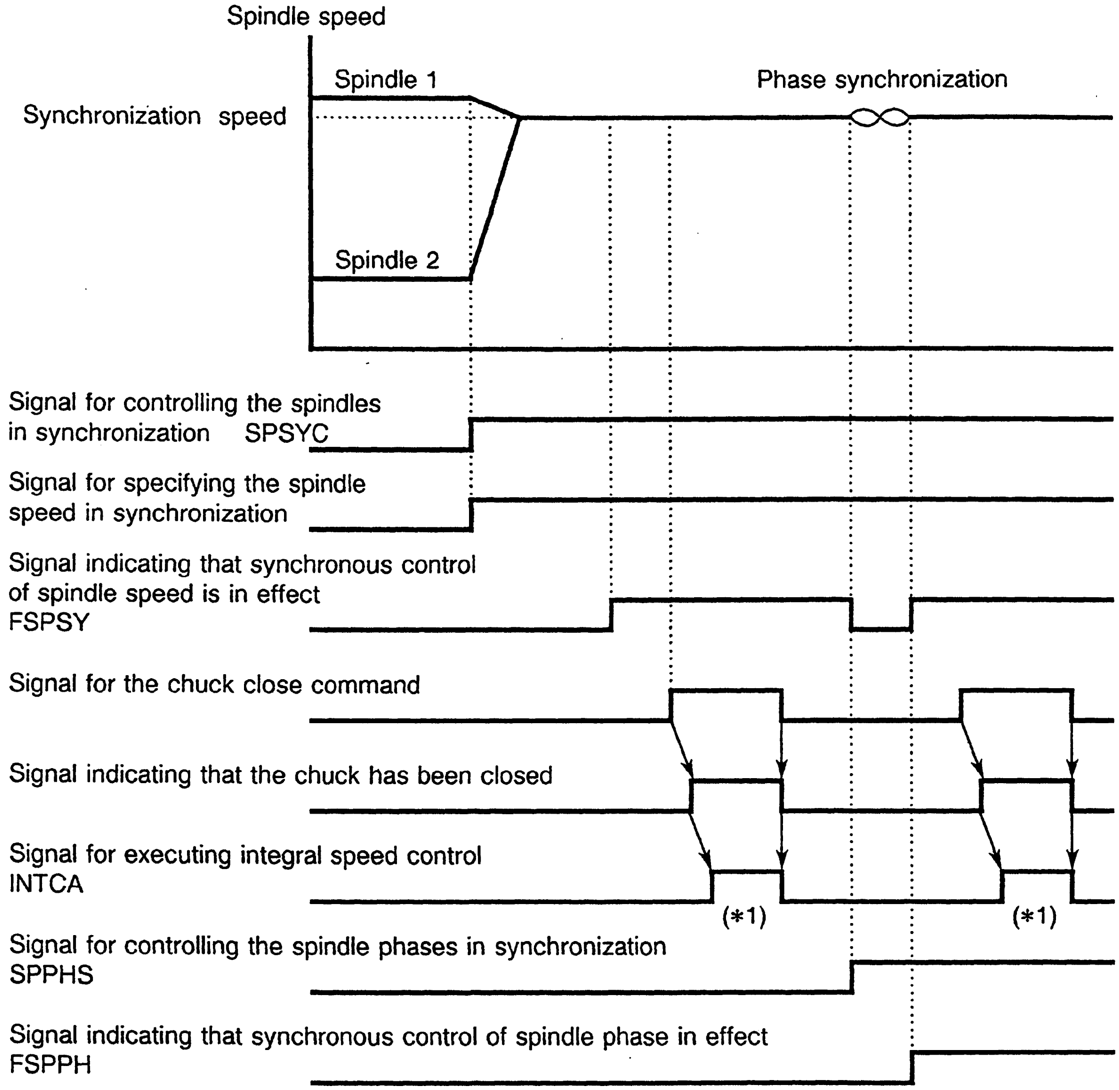
(2) While spindles 1 and 2 are stopped, their phases are synchronized and their speeds are increased in synchronization.



① Set the signal for specifying the spindle speed in synchronization to 0 and the signal for controlling the spindles in synchronization to 1.
② Wait until the signal indicating that synchronous control of spindle speed is completed is set to 1.
③ Set the signal for controlling the spindle phases in synchronization to 1.
④ Wait until the signal indicating that synchronous control of spindle phase is completed is set to 1.
⑤ Enter the signal for specifying the spindle speed in synchronization.

(*1) The signal indicating that synchronous control of spindle speed is completed is set to 0 when the signal for controlling the spindle phases in synchronization is entered. It is changed to 1 when phase synchronization is put in effect.

(3) Using the signal for executing integral speed control



(*1) Set the signal for executing integral speed control to 1 while a workpiece is being held with the two spindles.

3.3 Parameters Used for Spindle Synchronization Control (Upper Row: First Spindle, Lower Row: Second Spindle)

Parameter No.				Description
OTC	OTTC	15TT	16	
0080 #6	0080 #6	5820 #0	4800 #0	Direction of rotation of the spindle motor in spindle synchronization control (First spindle)
0080 #7	0080 #7	5820 #1	4800 #1	Direction of rotation of the spindle motor in spindle synchronization control (Second spindle)
0303		5810	4810	Difference in the error pulses between the two spindles. When not exceeded, the signal indicating that synchronous control of spindle phase is completed is issued.
0576		5811	4811	Difference in the error pulses between the two spindles. When exceeded, the signal for issuing an alarm detected in spindle synchronization control is issued.
6532 6672	6532	3032 3172	4032	Acceleration/deceleration time constant for synchronous control of the spindle Identical time constants need to be set for the first and second spindles.
6533 6673	6533	3033 3173	4033	Spindle speed to be detected in synchronization
6534 6674	6534	3034 3164	4034	Shift in the synchronous control of spindle phase
6535 6675	6635	3035 3175	4035	Compensation data for spindle phase synchronization
6544 6684 6545 6685	6544 6545	3044 3184 3045 3185	4044 4045	Proportional gain of the velocity loop in spindle synchronization control Data is selected by CTH1A, a DI signal of PMC.
6552 6692 6553 6693	6552 6553	3052 3192 3053 3193	4052 4053	Integral gain of the velocity loop in spindle synchronization control Data is selected by CTH1A, a DI signal of PMC.
6506 6646	6506	3006 3146	4006	Gear ratio unit (#1) (*1)

(*1) One of the causes of a continually large difference between the position errors of the two spindles is that the gear ratio is set with rounded-down data. This large difference between errors can be reduced by setting the gear ratio unit to 1/1000.

Parameter No.				Description
OTC	OTTC	15TT	16	
6556 ~ 6559 6696 ~ 6699	6556 ~ 6559	3056 ~ 3059 3196 ~ 3199	4056 ~ 4059	Gear ratio of the spindle to the motor (*1) Data is selected by CTH1A and CTH2A, DI signals of PMC.
6565 ~ 6568 6705 ~ 6708	6565 ~ 6568	3065 ~ 3068 3205 ~ 3208	4065 ~ 4068	Position gain in spindle synchronization control Data is selected by CTH1A and CTH2A, DI signals of PMC. Identical position gains need to be set for the first and second spindles.
6506 6646	6506	3006 3146	4006	Bit 4 of this parameter is set to prevent automatic detection of the signal indicating one rotation when spindle synchronization control mode is changed. See Section 3.5.2.
6507 6647	6507	3007 3147	4007	Bit 6 of this parameter sets the function for detecting an abnormal position coder signal and for issuing alarm AL-47. See Section 3.5.4.
6585 6725	6585	3085 3225	4085	Motor voltage in spindle synchronization control

(*1) One of the causes of a coutinually large difference between the position errors of the two spindles is that the gear ratio is set with rounded-down data. This large difference between errors can be reduced by setting the gear ratio unit to 1/1000.

3.4 Diagnosis

Address				Description
OTC	OTTC	15TT	16	
–		1508	–	Sequence state in spindle synchronization control
0754		1509	0414	Error pulse of the first spindle in spindle synchronization control
0755		1510	0415	Error pulse of the second spindle in spindle synchronization control
0756		1511	0416	Difference in the error pulses between the two spindles in spindle synchronization control

3.5 Additional Explanations of the Parameters Used for Spindle Synchronization Control

3.5.1 Error pulse in spindle synchronization control

The error pulse in spindle synchronization control is calculated as shown below:

$$\text{Error pulse} = \frac{\text{Spindle speed in synchronization (rpm)}}{\text{60 sec}} \times 4096\ \text{p/reV.} \times \frac{1}{\text{Position gain (sec-1)}}$$

[Example] When the spindle speed in synchronization is 1000 rpm and the position gain is 20 (sec-1)

$$\text{Error pulse} = \frac{\text{1000 (rpm)}}{\text{60 sec}} \times 4096\ \text{p/rev.} \times \frac{1}{\text{20 (sec-1)}} = \text{About 3413 pulses}$$

If the actual error pulse in spindle synchronization control differs too greatly from the value obtained by the expression above, check the following points:

- Spindle speed: Check the spindle speed on the SACT display of the CNC machine.
- Parameters 6556 to 6559 of the gear ratio of the spindle to the motor: Check the actual gear ratio by comparing the spindle speed obtained above and the speed (motor speed) indicated on the printed circuit board for the serial spindle amplifier.
- Position gain parameters 6565 to 6568
- Selection statuses of gear selection signals CTH1A and CTH2A: Check the selection statuses using diagnosis parameters, bits 2 and 3 of G229.

The error pulses of the two spindles in the steady rotation mode may differ from each other by several pulses when the unit used for the gear ratio of the spindle to the motor is set to 1/100 and data is rounded down. The difference can be reduced by setting bit 1 of parameter 6506 to 1. This will change the gear ratio unit to 1/1000 and data will be set in units of 1/1000.

3.5.2 Automatic detection of the signal indicating a rotation when spindle synchronization control mode is changed

When the system enters spindle synchronization control mode after the power is turned on, each spindle automatically rotates two or three times to detect the signal used to indicate a rotation. This signal needs to be detected so that synchronous control of spindle phase can be executed later.

Automatic detection of the signal used to indicate a rotation can be suppressed by setting parameter 6506, #4 to 1 in the following case: when automatic detection should not be executed for two spindles mechanically connected or when the synchronous control of spindle phase is not to be executed.

3.5.3 Determining the shift (parameter) in synchronous control of spindle phase

This section describes an example of determining the shift for phase synchronization in synchronous control of spindle phase.

3.5.3-1 Execute synchronous control of spindle phase under the following conditions:

(1) Set SFR = ON (SRV = OFF) for both the first and second spindles : M03

(2) Set the spindle speed in synchronization to 0 rpm : S0

(3) For both the first and second spindles, set the parameter specifying the shift in synchronous control of spindle phase to 0.

First spindle: Parameter 6534 = 0 Second spindle: Parameter 6674 = 0

3.5.3-2 After synchronous control of spindle phase is in effect, turn off SFR for the second spindle (turn off motor activation). Since the motor is turned off, the second spindle needs to be rotated manually.

3.5.3-3 Manually rotate the second spindle until the desired spindle phase synchronization is established. The number of pulses between the previous and new positions of spindle phase synchronization is indicated on the diagnosis screen (displays the difference between the error pulses of the spindles). This value is the shift to be set in the parameter.

Diagnosis No. 755 (Difference in the error pulses between the spindles)

3.5.3-4 Set parameter 6674 of the second spindle to the shift value in synchronous control of spindle phase obtained above. Usually, the shift parameter of the first spindle needs to be set to 0.

3.5.3-5 Cancel the command for spindle synchronization control, then execute synchronous control of spindle phase under the following conditions. Check that the desired phase synchronization state is established.

(1) Set SFR = ON (SRV = OFF) for both the first and second spindles : M03

(2) Set the spindle speed in synchronization to 0 rpm : S0

3.5.4 Function for detecting an abnormal position coder signal and for issuing alarm AL-47

The function for detecting an abnormal position coder signal and for issuing alarm AL-47 will not work properly and the alarm will be incorrectly detected in the following conditions: When the spindle and position coder are not connected at a ratio of one to one and two or more signals indicating one rotation of the position coder are generated during one rotation of the spindle. In either of these cases, set bit 4 of parameter 6507 to 1 to suppress the function.

3.6 Additional Explanations of the Function of Spindle Synchronization Control, Series 0TC

(1) Synchronous control of spindle phase is executed when the signal for controlling spindle phase in synchronization is entered in spindle synchronization control mode (after output of the signal indicating that synchronous control of spindle speed is completed). The signal indicating that synchronous control of spindle phase is completed is output when the difference between the error pulses of the two spindles does not exceed the number of pulses specified in parameter 303 of the NC function. The two spindles are not synchronized when synchronous control of spindle phase is in progress (until the signal indicating that the synchronous control of spindle phase is completed is set high). The command for spindle phase synchronization must not be issued while a workpiece is being held with the two spindles. If it is issued, synchronous control of spindle phase is started automatically.

(2) PMC signal, SYCAL is provided to monitor synchronization errors between spindles for which spindle synchronization control or synchronous control of spindle phase is in effect. The synchronization error between the two spindles is always monitored. The SYCAL signal is set to 1 when the error (the absolute value of the error pulse) specified in parameter 576 of the first spindle is exceeded, and set to 0 when not exceeded.

(3) Like the conventional spindle speed (S) command for which 4 or 5 digits are issued for the first spindle, the signal for specifying spindle speed can be generated when spindle synchronization control or synchronous control of spindle phase are in the process of being put into effect. The SIND, SSIN, SSGN, R01I to R12I, *SSTP, and SOR signals are effective as usual. The maximum speed in synchronization control is determined by the maximum speed set for the motor of the first spindle (parameter 6520).

[Example]	Maximum speed of the motor of the first spindle	:	6000 rpm
	Maximum speed of the motor of the second spindle	:	4500 rpm

However, the maximum speed during synchronization control is limited by the maximum speed of the second axis. In the example above, the maximum speed that can be specified by the 12-bit speed command is 6000 rpm for the first spindle. However, if 6000 rpm is specified in synchronization control, an overspeed alarm is issued from the second spindle. The spindle speed specified by the command must not exceed 4500 rpm.

(4) The S command for the first spindle and the PMC control signal for spindle control become effective when issued before spindle synchronization control or synchronous control of spindle phase are put into effect. The S command issued in synchronization control becomes effective for the first spindle immediately after synchronization control is canceled.

(5) In the usual mode of spindle rotation control, spindle speed can be controlled by the PMC function when the following conditions are satisfied: The SIND signal is set to 1 and the SSIN, SSGN, and R01I to R12I signals are provided. When spindle synchronization control is in the process of being put into effect, something other than the R01I to R12I signals is required to control the spindle speed in synchronization. The maximum spindle gear speed must be properly set in parameters 540, 541, 542, and 543. When the value set in the parameter corresponding to the selected gear is 0, the rotations of the spindles are not synchronized even if a command is entered in the 12-bit signal of the SIND signal.

(6) The load may change due to cutting (or threading). When the load changes in spindle synchronization control, the spindle speed may change and the signal indicating that the synchronous control of spindle speed is completed may go off temporarily.

(7) Parameters PRM 0080, #6 and #7 are used to set the direction of rotation of the first spindle and second spindle, respectively.

Parameter PRM 0080 #6 or #7 = "0"	Counterclockwise (CCW)
Parameter PRM 0080 #6 or #7 = "1"	Clockwise (CW)

(8) The gear ratio of the spindle to the position coder must be set to one-to-one.

(9) In spindle synchronization control, the compensation value for spindle speed offset (parameter 516) is disabled.

3.6.1 Alarm

The following alarm may be issued in spindle synchronization control.

P/S alarm

Alarm number	Description
194	A command for Cs contour control, spindle indexing, or rigid tapping was issued in spindle synchronization control.

3.7 Additional Explanations of the Function of Spindle Synchronization Control, Series 0TTC

(1) Synchronous control of spindle phase is executed when the signal for controlling the spindle phases in synchronization is entered in spindle synchronization control mode (after output of the signal indicating that the synchronous control of spindle speed has been completed).
The signal indicating that the synchronous control of spindle phase is completed is output when the difference between the error pulses of the two spindles does not exceed the number of pulses specified in parameter 303 of the NC function.
The positions of spindle phase synchronization for both spindles one and two can be specified in spindle parameter 6534.
The two spindles are not synchronized when synchronous control of spindle phase is in progress (until the signal indicating that the synchronous control of spindle phase is completed is set high).
The command for spindle phase synchronization must not be issued while a workpiece is being held with the two spindles.
If it is issued, synchronous control of spindle phase is started automatically.

(2) PMC signal, SYCAL is provided to monitor a synchronization errors between spindles for which spindle synchronization control or synchronous control of spindle phase is in effect. The synchronization error between the two spindles is always monitored. The SYCAL signal is set to 1 when the error (the absolute value of the error pulse) specified in parameter 576 of tool post one is exceeded, and set to 0 when not exceeded.

(3) When generated while spindle synchronization control or synchronous control of spindle phase is in the process of being put into effect, the signal specifying the speed is used as the signal for specifying the synchronization speed.
The signal depends on information specified at addresses G124 and G125 by PMC. 0TTC cannot use the four or five digit spindle speed (S) command.
However, it can use the function of the four or five digit S command via PMC by using the S 12-bit information output at addresses F172 and F173.
With this function, constant surface speed control can be executed in synchronization control even while a workpiece is being held with the two spindles.
However, the time constant specified in the parameter is not exceeded even if a larger speed increment is specified.

(4) The maximum speed in synchronization control is determined by the maximum speed of the spindle motor of tool post 1 (parameter 6520).

[Example]	Maximum speed of the spindle motor of tool post 1	:	6000 rpm
	Maximum speed of the spindle motor of tool post 2	:	4500 rpm

However the maximum speed during synchronization control is limited by the maximum speed of tool post 2. In the example above, the maximum speed that can be specified by the 12-bit speed command is 6000 rpm for tool post one. However, if 6000 rpm is specified in

synchronization control, an overspeed alarm is issued from tool post 2.
The spindle speed specified by the command must not exceed 4500 rpm.

(5) When the spindles are controlled by PMC in the usual spindle control mode, the SIND signal needs to be set to 1. In synchronization control mode, the spindles are controlled according to the synchronization speed specified by the SSGN and R01I to R12I signals. Control does not depend on the states of the usual spindle control signals, *SSTP, SOR, SIND, and SSIN.
However, settings other than signals R01I to R12I are required to specify synchronization of spindle speed.
The maximum spindle gear speed must be properly set in parameters 540, 541, 542, and 543 of tool post 1.
When the value set in the parameter corresponding to the selected gear is 0, the rotations of the spindles are not synchronized even if a command is entered in the 12-bit signal of the SIND signal.

(6) The load may change due to cutting (or threading). When the load changes in spindle synchronization control, the spindle speed may change and the signal indicating that the synchronous control of spindle speed is completed may go off temporarily.

(7) Parameter PRM 0080, #6 is used to set the direction of rotation of the first and second spindles.

Parameter PRM 0080 #6 = "0"	Counterclockwise (CCW)
Parameter PRM 0080 #6 = "1"	Clockwise (CW)

(8) The gear ratio of the spindle to the position coder must be set to one-to-one.

(9) In spindle synchronization control, the compensation value for the spindle speed offset (parameter 516) is disabled.

(10) The command for spindle phase synchronization is effective only in spindle synchronization control mode.

3.7.1 Alarm

The following alarm may be issued in spindle synchronization control.

P/S alarm

Alarm number	Description
194	A command for Cs contour control, spindle indexing, or rigid tapping was issued in spindle synchronization control.

3.8 Additional Explanations of the Function of Spindle Synchronization Control, Series 15TT

(1) The BMI interface needs to be used when this function is used. (This function cannot be used with the FS3/6 interface.)

(2) Synchronous control of spindle phase is executed when the signal for controlling the spindle phases in synchronization is entered in spindle synchronization control mode (after output of the signal indicating that synchronous control of spindle speed is in effect).
The signal indicating that synchronous control of spindle phase is completed is output when the difference between the error pulses of the two spindles does not exceed the number of pulses specified in parameter 5810 of the NC function.
The positions of spindle phase synchronization for spindles one and two can be specified in spindle parameters 3034 and 3174, respectively.
The two spindles are not synchronized when synchronous control of spindle phase is in progress (until the signal indicating that synchronous control of spindle phase is completed is set high). The command for spindle phase synchronization must not be issued while a workpiece is being held with the two spindles.
If issued, synchronous control of spindle phase is started automatically.

(3) PMC signal, SPSYAL is provided to monitor the synchronization error between spindles for which spindle synchronization control or synchronous control of spindle phase is in effect. The synchronization error between the two spindles is always monitored. The SPSYAL signal is set to 1 when the error (the absolute value of the error pulse) specified in parameter 5811 of the first spindle is exceeded, and set to 0 when not exceeded.

(4) When generated while spindle synchronization control or synchronous control of spindle phase is in the process of being put into effect, the signal specifying speed is used as the signal for specifying the synchronization speed.
The signal for specifying the spindle speed can be generated like the conventional spindle motor command which sends a voltage signal.
Signals RISGN and RI00 to RI12 are effective as usual.
The maximum spindle speed in synchronization control is determined by the maximum speed of the motor of the first spindle (parameter 3020).

[Example]	Maximum speed of the motor of the first spindle	:	6000 rpm
	Maximum speed of the motor of the second spindle	:	4500 rpm

However, maximum speed in synchronization control is limited by the maximum speed of the second spindle. In the example above, the maximum speed that can be specified by the 13-bit speed command is 6000 rpm for the first spindle.
However, if 6000 rpm is specified in synchronization control, an overspeed alarm is issued from the second spindle. The spindle speed specified by the command must not exceed 4500 rpm.

(5) The command for spindle phase synchronization is effective only in spindle synchronization control mode.

(6) The load may change due to cutting (or threading). When the load changes in spindle synchronization control, the spindle speed may change and the signal indicating that synchronous control of spindle speed is completed may go off temporarily.

(7) Bit 0 and 1 of parameter PRM 5820 are used to set the direction of rotation of the first spindle and second spindle respectively.

Parameter PRM 5820 #0 or #1 = "0"	Counterclockwise (CCW)
Parameter PRM 5820 #0 or #1 = "1"	Clockwise (CW)

(8) The gear ratio of the spindle to the position coder can be set only to one to one.
Identical gear ratios must be set for the first and second spindles. (Parameters 5610 and 5660)

3.8.1 Sequence state in spindle synchronization control

Diagnosis No.	Data							
1508					SPSYC3	SPSYC2	SPSYC1	SPSYC0
	#7	#6	#5	#4	#3	#2	#1	#0

SP SYC3	SP SYC2	SP SYC1	SP SYC0	Internal processing state
0	0	0	0	The spindles are not in spindle synchronization control mode. (SPSYC = 1 is waited.)
0	0	0	1	Waits for the signal that indicates that synchronization speed has been reached to be generated. (Synchronous control of spindle speed is in progress.)
0	0	1	0	Waits for the signal that indicates that synchronization speed has been reached to be set.
0	0	1	1	Waits for the signal that indicates that synchronous control of spindle speed is completed and the command for spindle phase synchronization to be generated. (Waits for SPPHS = 1.)
0	1	0	0	Phase synchronization, on/off
0	1	0	1	Waits for the signal that indicates that synchronization speed has been reached to be cleared. (Synchronous control of spindle phase is in progress.)
0	1	1	0	Waits for the signal that indicates that synchronization speed has been reached to be set.
0	1	1	1	Synchronous control of spindle phase is in effect.

4. ITEMS CONCERNING RIGID TAPPING

4.1 DI and DO Signals Related to Rigid Tapping

Refer to individual CNC connecting manuals or operator's manuals for information concerning processing of DI and DO signals related to rigid tapping.

4.1.1 DI signals (PMC → CNC)

PM	OC	15	16	7	6	5	4	3	2	1	0
	G123									RGTPN	
G099	or (*1) G135		G061								RGTAP
		G026									SPSTP
G112	G229	G227	G070	MRDYA	ORCMA	SFRA	SRVA	CTH1A	CTH2A	TLMHA	TLMLA
G113	G230	G226	G071	RCHA	RSLA	INTGA	SOCNA	MCFNA	SPSLA	*ESPA	ARSTA

(*1) Depends on bit 4 (SRGTP) in parameter 19.

(Note) TLML (torque limit command) was turned on in the rigid tapping mode. However, the TLML signal need not be turned on for the serial spindle.

4.1.2 DO signals (CNC → PMC)

PM	OC	15	16	7	6	5	4	3	2	1	0
		F040					RTAP				
F228	F281	F229	F045	ORARA	TLMA	LDT2A	LDT1A	SARA	SDTA	SSTA	ALMA
F229	F282	F228	F046					RCHNA	RCHPA	CFINA	CHPA

4.2 Rigid Tapping Parameters

Parameter No.				Description
PM	OMC	15	16	
0136	0256	–	5210	M code for the rigid tapping command
–	0019 #4	–	–	Selects the DI signal in the rigid tapping mode.
–	0037 #6	–	–	Selects whether to change the acceleration/deceleration time constant continuously.
–	0254	5605 #1	–	Acceleration/deceleration type (linear or exponential)
0250 ~ 0252	0613	5605 5751 5760 5762 5764	5261 5262 5263 5264	Acceleration/deceleration time constant
0233 ~ 0235 0254	0617	5605 5757 5758 5759	5241 5242 5243 5244	Maximum spindle speed in rigid tapping
–	0614	5605 5752 5761 5763 5765	–	Lower-limit velocity in exponential acceleration/deceleration (FL velocity)
0025 #0	0063 #4	–	5200 #4	Selects override during extraction.
0137	0258		5211	Override value in extraction
–	–	–	5201 5271 5272 5273	Acceleration/deceleration time constant during extraction
0255	0618	1827	5300	In-position width for the Z axis
0256	0619	5755	5301	In-position width for the spindle
0257	0620	1837	5310	Limit on deviation of positioning during movement along the Z axis
0258	0621	5754	5311	Limit on deviation of positioning during spindle movement
0259	0622	–	5312	Limit on deviation of positioning when movement along the z axis is not performed
0260	0623	–	5313	Limit on deviation of positioning when the spindle is in the stop mode

Parameter No.				Description
PM	OMC	15	16	
0026 #7, 6	0028 #7, 6	5610	3706 #1, 0	Gear ratio of the spindle to the position coder; is ×1, ×2, ×4, or ×8
0025 #0	0063 #3	5604 #1	5200 #1	Gear ratio of the spindle to the position coder is arbitrary.
0266 ~ 0268	0663 ~ 0665	5703 5771 ~ 5774	5221 5222 5223	Number of teeth on the spindle gear when an arbitrary gear is used
0269 ~ 0271	0666 ~ 0668	5704 5781 ~ 5784	5231 5232 5233	Number of teeth on the position coder gear when an arbitrary gear is used
0135	0255	5604 5756 5791 ~ 5794	5321	Spindle backlash
3006 #7	6506 #7	3006 #7	4006 #7	Specifies rigid tapping using the sensor contained in the motor.
3065 ~ 3068 0272 0273 0274	6565 ~ 6568 0615 0669 0670 0671	3065 ~ 3068	4065 ~ 4068 5280 ~ 5284	Position gain in rigid tapping (for the spindle and Z axis)
3044 3045	6544 6545	3044 3045	4044 4045	Proportional gain of the velocity loop in rigid tapping This data item is selected by CTH1A in the DI signals from PMC.
3052 3053	6552 6553	3052 3053	4052 4053	Integral gain of the velocity loop in rigid tapping This data item is selected by CTH1A in the DI signals from PMC.
3056 ~ 3059	6556 ~ 6559	3056 ~ 3059	4056 ~ 4059	Gear ratio of the spindle to the motor This data item is selected by CTH1A and CTH2A in the DI signals from PMC.
3085	6585	3085	4085	Motor voltage in rigid tapping
3137	6901	3281	4137	Motor voltage in rigid tapping (when output is set for a low-speed area)
3099	6599	3099	4099	Time delay for motor activation

4.3 Additional Description on Setting Parameters for the Serial Spindle during Rigid Tapping

4.3.1 Gear ratio of the spindle to the motor

Loop gain multiplier parameters are not used for the serial spindle.
Instead, the gear ratio of the spindle to the motor (parameter 6556 to 6559 for the OMC) is used as a parameter.

4.3.2 When using the sensor contained in the spindle motor

The following parameters must be specified if the system uses the sensor contained in the spindle motor (unless the gear ratio of the spindle to the motor is 1 : 1). The sensor outputs the position coder signal and velocity detection signal.

(1) Specify the parameters of the gear ratio of the spindle to the motor for each gear (parameters 6556 to 6559 for the OMC).

(2) Specify the parameter used for an arbitrary gear ratios of the spindle to the position coder (bit 3 of parameter 63 for the OMC). Then, specify the number of teeth for each gear of the spindle using the appropriate parameters (parameters 663 to 665 for the OMC). Also specify the number of teeth for each (motor) gear of the position coder using the appropriate parameters (parameters 666 to 668 for the OMC).

(3) Specify the parameter which selects use of the sensor contained in the spindle motor. (Set bit 7 of parameter 6506 to 1 for the OMC.)

(4) In a system where the spindle and motor rotate in opposite directions, set bit 0 of parameter 6500 (rotational direction of the spindle and motor) to 1 (specifies that the spindle and motor rotate in opposite directions). Set bit 2 of parameter 6500 (orientation of the position coder) to 1 (specifies that the spindle and position coder rotate in opposite directions).

4.3.3 Specifying position gains

The position gains of the spindle and Z axis must be set to the same value for rigid tapping.
Specify the position gain parameters for the spindle and Z axis in rigid tapping which correspond to the gears.

5. ITEMS CONCERNING SPINDLE ORIENTATION WITH A POSITION CODER

5.1 DI and DO Signals

5.1.1 DI signals (PMC → CNC)

	PM	OC	15	16	7	6	5	4	3	2	1	0
1st : 2nd :		G110 G112	G231 G239	G078 G080	SHA07	SHA06	SHA05	SHA04	SHA03	SHA02	SHA01	SHA00
1st : 2nd :		G111 G113	G230 G238	G079 G081					SHA11	SHA10	SHA09	SHA08
1st : 2nd :	G112	G229 G234	G227 G235	G070 G074	MRDYA	ORCMA	SFRA	SRVA	CTH1A	CTH2A	TLMHA	TLMLA
1st : 2nd :	G113	G230 G234	G226 G234	G071 G075	RCHA	RSLA	INTGA	SOCNA	MCFNA	SPSLA	*ESPA	ARSTA
1st : 2nd :		G231 G235	G229 G237	G072 G076				OVRA	DEFMDA	NRROA	ROTAA	INDXA

5.1.2 DO signals (CNC → PMC)

	PM	OC	15	16	7	6	5	4	3	2	1	0
1st : 2nd :	F228	F281 F285	F229 F245	F045 F049	ORARA	TLMA	LDT2A	LDT1A	SARA	SDTA	SSTA	ALMA
1st : 2nd :	F229	F282 F286	F228 F244	F046 F050					RCFNA	RCHPA	CFINA	CHPA

5.2 Spindle Orientation Parameters (Number following #: Bit number)

Parameter No.				Description
PC	OC	15	16	
3015	6515	3015	4015	Specifies whether to use the spindle orientation function. (Set #0 to 1.) The CNC software option is required.
–	0080	5609	3702	Specifies whether to use the spindle orientation function with the stop position set externally. (#2 for the 1st spindle and #3 for the 2nd spindle)
3001	6501	3001	40001	Specifies whether to use the position coder signal. (Set #2 to 1 when using the signal.)
3000	6500	3000	4000	Orientation of the position coder (#2)
3003	6503	3003	4003	Selects use of a position coder or magnetic sensor for the orientation function. Set #0 to 0 when using a position coder.
3003	6503	3003	4003	Direction of rotation in spindle orientation (#2 and #3)
3003	6503	3003	4003	Specifies the number of pulses of a position coder. (#4, #6, and #7)
3031	6531	3031	4031	Stop position in orientation with a position coder This data item is disabled when using the function with the stop position externally set.
3042 3043	6542 6543	3042 3043	4042 4043	Proportional gain of the velocity loop in spindle orientation This data item is selected by CTH1A in the DI signal from PMC.
3050 3051	6550 6551	3050 3051	4050 4051	Integral gain of the velocity loop in spindle orientation This data item is selected by CTH1A in the DI signal from PMC.
3056 ~ 3059	6556 ~ 6559	3056 ~ 3059	4056 ~ 4059	Gear ratio of the spindle to the motor
3060 ~ 3063	6560 ~ 6563	3060 ~ 3063	4060 ~ 4063	Position gain in spindle orientation
3064	6564	3064	4064	Change rate of the position gain when spindle orientation is completed
3075	6575	3075	4075	Level for detecting the spindle orientation completion signal (ORARA)
3076	6576	3076	4076	Motor velocity limit in spindle orientation
3077	6577	3077	4077	Shift of the stop position in spindle orientation
3084	6584	3084	4084	Motor voltage in spindle orientation

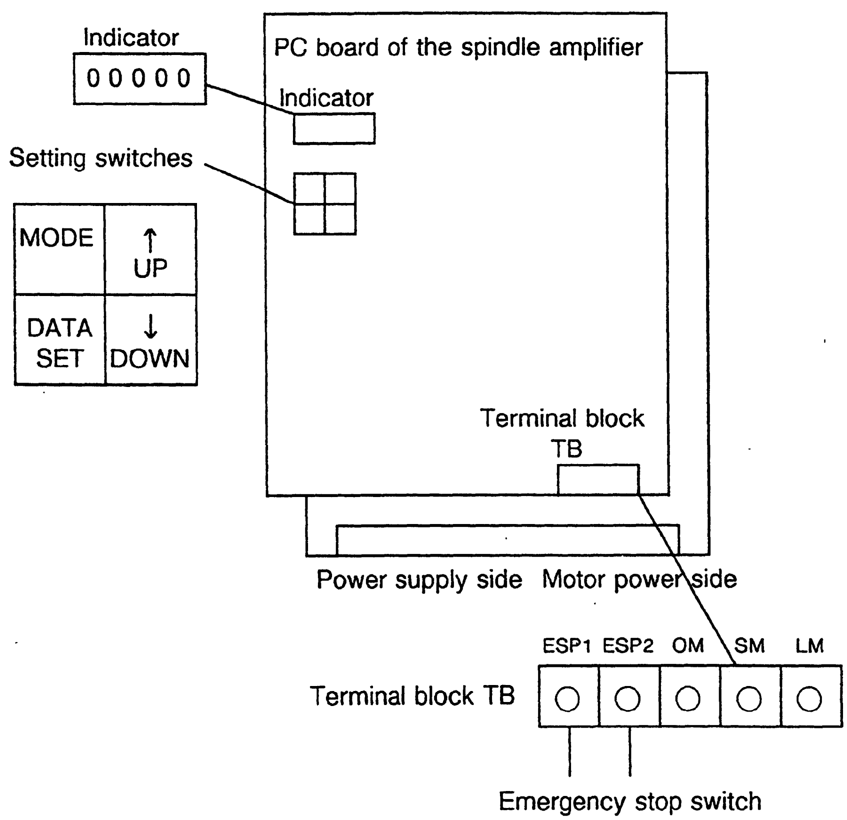
APPENDIX 10 METHOD FOR OPERATING THE SPINDLE MOTOR USING A SERIAL SPINDLE AMPLIFIER INSTEAD OF THE CNC

10.1 Outline

This appendix describes the method for operating the spindle motor using a serial spindle amplifier instead of the CNC.

10.2 Configuration

The indicator and setting switches on the PC board of the spindle amplifier are used to perform this function.
The following figure shows the configuration.



10.3 Use

10.3.1 Preparation

(1) Properly connect the power supply, motor power, and signal lines with the PC board of the serial spindle amplifier.

(2) Connect the emergency stop signal (ESP) switch with ESP1 and ESP2 of terminal block TB.

(3) Turn on power to the PC board.

(4) "SU-01" is then displayed on the indicator.

10.3.2 Operation

(1) Simultaneously pressing four setting switches for at least one second causes "FFFFF" to be displayed on the indicator.

(2) Pressing the "MODE" switch displays "d-00" and causes the system to enter the internal data monitor mode.

(3) When the "MODE" switch is released, "d-00" disappears about 0.5 second later, and data is displayed about one second.
The initial value of the data is 0.

(4) Press the "↑ UP" or "↓ DOWN" switch and change the data during the second it is displayed.

(5) If more than one second elapses, the system automatically enters the speed display mode, disabling change in the data. However, turning the "MODE" switch on or off allows the data to be changed.

(6) The following table describes mode d-00.

Mode	Data	Mode name	Indication
d-00	0	Parameter check mode	F-□□□
	1	Internal data monitor mode	0 0 0 0 0
	2	Mode of operation with a serial spindle amplifier	SI-□□
	3	Automatic operation mode	Ad-□□
	4	Parameter change mode	P-□□□
	5	————	————

10.3.3 Operation in the SI mode (mode of operation with a serial spindle amplifier)

Initial setting parameters for the serial spindle motor are automatically loaded using the following procedure in SI mode (mode of operation with a serial spindle amplifier).

(1) Immediately (within about a second) after changing data "d-00" to "00002", press the MODE and DATA SET switches at the same time. "CCCCC" appears about a second later.
Releasing the "MODE" and "DATA SET" switches causes "PLoAd" to appear flashing on the display.

(2) Pressing the MODE switch displays "SI-□□" .

(3) When the MODE switch is released, "SI-□□" disappears about 0.5 second later, and the data appears for about a second.

(4) To change the data, press the "↑ UP" or "↓ DOWN" switches while holding down the "MODE" switch during this second. Next, change the value □□, (the SI number).
The table in (7) shows a description of each number in the SI mode.

(5) If more than one second elapses, the SI number cannot be changed. However, turning on or off the "MODE" switch enables change in the SI number.

(6) Specify initial setting parameter data according to the motor model code using the following procedure.
First, select "SI-18" and enter the desired model code.
Next, select "SI-17" and immediately press and hold down the "↑ UP" and "↓ DOWN" switches at the same time; the indicator will count from "F-000" to "F-355".
When count-up is completed, all parameters have finished being loaded.

(7) The following table shows the description of each number in the SI mode.

SI mode No.	Description	Abbrev.
SI-00		
☆ SI-01	Velocity command	VCMD
SI-02		
SI-03		
SI-04		
☆ SI-05	Command for selecting reverse motor rotation	SRV
☆ SI-06	Command for selecting normal motor rotation	SFR
SI-07		
☆ SI-08	Machine tool ready signal	MRDY
☆ SI-09	Emergency stop signal	ESP
SI-10		
SI-11		
SI-12		
SI-13		
SI-14		
SI-15		
SI-16		
☆ SI-17	Parameter setting (loading)	
☆ SI-18	Model code	
SI-19		
SI-20		
SI-21		
SI-22		
SI-23		
SI-24		

(Note) The numbers marked with an asterisk are used for controlling the motor.

10.3.4 Changing motor model parameters for which no motor code is prepared

When no motor model code is prepared, select "SI-18" and set the model code to 0. Then, select "SI-17" and perform automatic parameter loading using the procedure described in 4.3.3.
After parameter loading is completed, it is necessary to change parameters dedicated to the motor by using the following steps:

(1) Enter P-□□□ (parameter change mode).
Simultaneously pressing the four setting switches for at least a second displays "FFFFF" on the indicator and returns the system to the d-00 mode.
Immediately (within about a second) after changing data "d-00" to "00004", press both the "MODE" and "DATA SET" switches at the same time. "CCCCC" will appear and the system enters the P-□□□ mode.

(2) Pressing the "MODE" switch displays "P-□□□".

(3) When the "MODE" switch is released, "P-□□□" disappears about 0.5 second later. The parameter data appears for about a second.

(4) To change the parameter number in P-□□□, do the following. Press the "↑ UP" or "↓ DOWN" switch while holding down the "MODE" switch to change P-□□□.

(5) To change parameter data, press the "↑ UP" or "↓ DOWN" switches within a second, that is, while the data is displayed.

(6) If more than one second elapses, data cannot be changed. However, turning on, then off the "MODE" switch will allow data to be changed again.

(7) If parameter data is large in magnitude, the place of the digits of the data to be changed can be shifted. See 4.4 for the table of correspondence between CNC parameter numbers and P-□□□ numbers.
To shift the digit place, press the "↑ UP" or "↓ DOWN" switch while holding down the "DATA SET" switch within a second (the second that the data is displayed).

(Note) The parameters specified in the mode of operation with a serial spindle amplifier are erased if power is turned off. They must therefore be specified again after power is turned on.

(8) When specifying bit parameters, use two bit parameters to specify one value for P-□□□.
Specify even address data for the higher bytes of P-□□□ and odd address data for the lower bytes of P-□□□ in hexadecimal in four bit units.

(Example) To specify parameter 6512 (=00000000) and parameter 6513 (=00011010) in Series 0C, set P-006 to 0001A.

(9) To control a motor for which the output can be switched in the low-speed range: specify the low-speed range data in the corresponding parameter for the high-speed range.

10.3.5 Operation

When finished setting parameters, enter the SI mode using the following procedure:

(1) Press the four setting switches simultaneously. "FFFFF" will be display and the system returns to the “d-00” mode.
Immediately (within about a second) after changing “d-00” to “00002”, press the “MODE” and “DATA SET” switches at the same time. "CCCCC" will be displayed and the system enters the SI-□□ mode.

(2) Turn on the magnetic contactor in the spindle amplifier using the following procedure.
Turn on the emergency stop (ESP) switch. (Connect ESP1 and ESP2 of terminal block TB.)
Turn on the machine ready signal by doing the following:
Select SI-08 and specify 00001.
Turn on the emergency stop signal by doing the following:
Select SI-08 and specify 00001.
After the above procedure is completed, the magnetic contactor in the spindle amplifier is turned on.

(3) Activate the spindle motor as follows:
Turn on the forward motor rotation command (SFR) by doing the following:
Select SI-06 and specify 00001. (Set SI-05 to 00001 when setting the reverse motor rotation command.)

(4) Input the velocity command.
Specify velocity command data for SI-01.
Setting is specified in rpm.
The digit place for the data to be changed can be shifted according to the procedure in item (7) in 4.3.4.

(5) To stop rotation of the motor, do the following:

A. Turn off the forward motor rotation command (SFR).
(Turn off SRV in the case of the reverse motor rotation command.)
→ Set SI-06 to 00000. (Set SI-05 to 00000 when the reverse motor rotation command is entered.)

B. Specify 0 for the velocity command.
→ Set SI-01 to 00000. In this case, the motor is already activated.

C. Turn off the emergency (ESP) switch.
→ The motor is accelerated and stopped and the MCC in the spindle amplifier is turned off.

D. Turn off the emergency stop signal (SI-09) or machine ready signal (SI-08).
→ Set SI-09 or SI-08 to 00000.
→ The motor is accelerated and stopped and the MCC in the spindle amplifier is turned off.

10.3.6 Parameters

Power Mate	Series 0 1st spindle	Series 0 2nd spindle	Series 15 1st spindle	Series 15TT 2nd spindle	Series 16		P-□□□
3000	6500	6640	3000	3140	4000	Bit parameter	000
3001	6501	6641	3001	3141	4001	Bit parameter	
3002	6502	6642	3002	3142	4002	Bit parameter	001
3003	6503	6643	3003	3143	4003	Bit parameter	
3004	6504	6644	3004	3144	4004	Bit parameter	002
3005	6505	6645	3005	3145	4005	Bit parameter	
3006	6506	6646	3006	3146	4006	Bit parameter	003
3007	6507	6647	3007	3147	4007	Bit parameter	
3008	6508	6648	3008	3148	4008	Bit parameter	004
3009	6509	6649	3009	3149	4009	Bit parameter	
3010	6510	6650	3010	3150	4010	Bit parameter	005
3011	6511	6651	3011	3151	4011	Bit parameter	
3012	6512	6652	3012	3152	4012	Bit parameter	006
3013	6513	6653	3013	3153	4013	Bit parameter	
3014	6514	6654	3014	3154	4014	Bit parameter	007
3015	6515	6655	3015	3155	4015	Bit parameter	
3016	6516	6656	3016	3156	4016	Bit parameter	008
3017	6517	6657	3017	3157	4017	Bit parameter	
3018	6518	6658	3018	3158	4018	Bit parameter	009
3019	6519	6659	3019	3159	4019	Bit parameter	
3020	6520	6660	3020	3160	4020	Maximum motor speed	010
3021	6521	6661	3021	3161	4021	Maximum speed in the Cs contour control mode	011
3022	6522	6662	3022	3162	4022	Speed to be detected	012
3023	6523	6663	3023	3163	4023	Speed detection level	013
3024	6524	6664	3024	3164	4024	Speed zero detection level	014
3025	6525	6665	3025	3165	4025	Limited torque	015
3026	6526	6666	3026	3166	4026	Load detection level 1	016
3027	6527	6667	3027	3167	4027	Load detection level 2	017
3028	6528	6668	3028	3168	4028	Output limited pattern	018
3029	6529	6669	3029	3169	4029	Output limited value	019
3030	6530	6670	3030	3170	4030	Soft start/stop time	020
3031	6531	6671	3031	3171	4031	Stop position oriented using a position coder	021
3032	6532	6672	3032	3172	4032	Acceleration/deceleration time constant during synchronous control of the spindle	022
3033	6533	6673	3033	3173	4033	Spindle speed to be detected in synchronization	023
3034	6534	6674	3034	3174	4034	Shift in the synchronous control of spindle phase	024
3035	6535	6675	3035	3175	4035	Compensation data for the spindle phase synchronization	025
3036	6536	6676	3036	3176	4036	Feed forward factor	026
3037	6537	6677	3037	3177	4037	Feed forward factor of the velocity loop	027
3038	6538	6678	3038	3178	4038	Reserved	028
3039	6539	6679	3039	3179	4039	Reserved	029

Power Mate	Series 0 1st spindle	Series 0 2nd spindle	Series 15 1st spindle	Series 15TT 2nd spindle	Series 16		P-□□□
3040	6540	6680	3040	3180	4040	Proportional gain of the velocity loop in normal operation (HIGH)	030
3041	6541	6681	3041	3181	4041	Proportional gain of the velocity loop in normal operation (LOW)	031
3042	6542	6682	3042	3182	4042	Proportional gain of the velocity loop in orientation (HIGH)	032
3043	6543	6683	3043	3183	4043	Proportional gain of the velocity loop in orientation (LOW)	033
3044	6544	6684	3044	3184	4044	Proportional gain of the velocity loop in the servo mode (HIGH)	034
3045	6545	6685	3045	3185	4045	Proportional gain of the velocity loop in the servo mode (LOW)	035
3046	6546	6686	3046	3186	4046	Proportional gain of the velocity loop in the Cs contour control mode (HIGH)	036
3047	6547	6687	3047	3187	4047	Proportional gain of the velocity loop in the Cs contour control mode (LOW)	037
3048	6548	6688	3048	3188	4048	Integral gain of the velocity loop in normal operation (HIGH)	038
3049	6549	6689	3049	3189	4049	Integral gain of the velocity loop in normal operation (LOW)	039
3050	6550	6690	3050	3190	4050	Integral gain of the velocity loop in orientation (HIGH)	040
3051	6551	6691	3051	3191	4051	Integral gain of the velocity loop in orientation (LOW)	041
3052	6552	6692	3052	3192	4052	Integral gain of the velocity loop in the servo mode (HIGH)	042
3053	6553	6693	3053	3193	4053	Integral gain of the velocity loop in the servo mode (LOW)	043
3054	6554	6694	3054	3194	4054	Integral gain of the velocity loop in the Cs contour control mode (HIGH)	044
3055	6555	6695	3055	3195	4055	Integral gain of the velocity loop in the Cs contour control mode (LOW)	045
3056	6556	6696	3056	3196	4056	Gear ratio (HIGH)	046
3057	6557	6697	3057	3197	4057	Gear ratio (MEDIUM HIGH)	047
3058	6558	6698	3058	3198	4058	Gear ratio (MEDIUM LOW)	048
3059	6559	6699	3059	3199	4059	Gear ratio (LOW)	049
3060	6560	6700	3060	3200	4060	Position gain in orientation (HIGH)	050
3061	6561	6701	3061	3201	4061	Position gain in orientation (MEDIUM HIGH)	051
3062	6562	6702	3062	3202	4062	Position gain in orientation (MEDIUM LOW)	052
3063	6563	6703	3063	3203	4063	Position gain in orientation (LOW)	053
3064	6564	6704	3064	3204	4064	Change rate of the position gain when orientation is completed	054
3065	6565	6705	3065	3205	4065	Position gain in the servo mode (HIGH)	055
3066	6566	6706	3066	3206	4066	Position gain in the servo mode (MEDIUM HIGH)	056
3067	6567	6707	3067	3207	4067	Position gain in the servo mode (MEDIUM LOW)	057
3068	6568	6708	3068	3208	4068	Position gain in the servo mode (LOW)	058
3069	6569	6709	3069	3209	4069	Position gain in the Cs contour control mode (HIGH)	059

Power Mate	Series 0 1st spindle	Series 0 2nd spindle	Series 15 1st spindle	Series 15TT 2nd spindle	Series 16		P-□□□
3070	6570	6710	3070	3210	4070	Position gain in the Cs contour control mode (MEDIUM HIGH)	060
3071	6571	6711	3071	3211	4071	Position gain in the Cs contour control mode (MEDIUM LOW)	061
3072	6572	6712	3072	3212	4072	Position gain in the Cs contour control mode (LOW)	062
3073	6573	6713	3073	3213	4073	Grid shift in the servo mode	063
3074	6574	6714	3074	3214	4074	Reserved	064
3075	6575	6715	3075	3215	4075	Detection level for the orientation completion signal	065
3076	6576	6716	3076	3216	4076	Limited motor speed in orientation	066
3077	6577	6717	3077	3217	4077	Shift of the stop position in orientation	067
3078	6578	6718	3078	3218	4078	Constant for the MS signal	068
3079	6579	6719	3079	3219	4079	Gain adjustment for the MS signal	069
3080	6580	6720	3080	3220	4080	Regenerative power limit	070
3081	6581	6721	3081	3221	4081	Delay time prior to motor power shut-off	071
3082	6582	6722	3082	3222	4082	Acceleration/deceleration time setting	072
3083	6583	6723	3083	3223	4083	Motor voltage in normal position	073
3084	6584	6724	3084	3224	4084	Motor voltage in orientation	074
3085	6585	6725	3085	3225	4085	Motor voltage in the servo mode	075
3086	6586	6726	3086	3226	4086	Motor voltage in the Cs contour control mode	076
3087	6587	6727	3087	3227	4087	Over-speed level	077
3088	6588	6728	3088	3228	4088	Level for detecting excessive velocity deviation when the motor is constrained	078
3089	6589	6729	3089	3229	4089	Level for detecting excessive velocity deviation when the motor is rotated	079
3090	6590	6730	3090	3230	4090	Overload detection level	080
3091	6591	6731	3091	3231	4091	Change rate of the position gain when returning to the reference position in the servo mode	081
3092	6792	6732	3092	3232	4092	Change rate of the position gain when returning to the reference position in the Cs contour control mode	082
3093	6593	6733	3093	3233	4093	Reserved	083
3094	6594	6734	3094	3234	4094	Acceleration feedback gain	084
3095	6595	6735	3095	3235	4095	Adjusted output voltage of the speedometer	085
3096	6596	6736	3096	3236	4096	Adjusted output voltage of the load meter	086
3097	6597	6737	3097	3237	4097	Feedback gain of the spindle speed	087
3098	6598	6738	3098	3238	4098	Maximum speed when the position coder detects the one-turn signal	088
3099	6599	6739	3099	3239	4099	Delay time for motor activation	089
3100	6600	6740	3100	3240	4100	Base velocity of the motor output specification	090
3101	6601	6741	3101	3241	4101	Limit for the motor output specification	091
3102	6602	6742	3102	3242	4102	Base velocity	092
3103	6603	6743	3103	3243	4103	Speed from which magnetic flux decreases	093
3104	6604	6744	3104	3244	4104	Proportional gain of the current loop in normal operation	094
3105	6605	6745	3105	3245	4105	Proportional gain of the current loop in the Cs contour control mode	095
3106	6606	6746	3106	3246	4106	Integral gain of the current loop in normal operation	096
3107	6607	6747	3107	3247	4107	Integral gain of the current loop in the Cs contour control mode	097
3108	6608	6748	3108	3248	4108	Zero point of integral gain of the current loop	098
3109	6609	6749	3109	3249	4109	Velocity factor for the proportional gain of the current loop	099

Power Mate	Series 0 1st spindle	Series 0 2nd spindle	Series 15 1st spindle	Series 15TT 2nd spindle	Series 16		P-□□□
3110	6610	6750	3110	3250	4110	Constant for converting current	100
3111	6611	6751	3111	3251	4111	Secondary current factor for exciting current	101
3112	6612	6752	3112	3252	4112	Constant for expected current	102
3113	6613	6753	3113	3253	4113	Slip constant	103
3114	6614	6754	3114	3254	4114	Compensation constant for slip in high-speed rotation	104
3115	6615	6755	3115	3255	4115	Compensation constant for voltage applied to motor in the dead zone	105
3116	6616	6756	3116	3256	4116	Compensation constant for electromotive force	106
3117	6617	6757	3117	3257	4117	Compensation constant for the phase of electromotive force	107
3118	6618	6758	3118	3258	4118	Velocity factor for the compensation for electromotive force	108
3119	6619	6759	3119	3259	4119	Filter for a voltage command used for compensating for electromotive force	109
3120	6620	6760	3120	3260	4120	Dead zone compensation data	110
3121	6621	6761	3121	3261	4121	Time constant for changing the torque	111
3122	6622	6762	3122	3262	4122	Time constant for the filter detecting velocity	112
3123	6623	6763	3123	3263	4123	Setting the overload detection time	113
3124	6624	6764	3124	3264	4124	Reserved	114
3125	6625	6765	3125	3265	4125	Timer in automatic running mode	115
3126	6626	6766	3126	3266	4126	Velocity command in automatic running mode	116
3127	6627	6767	3127	3267	4127	Reading on the load meter at maximum output	117
3128	6628	6768	3128	3268	4128	Maximum output zero point	118
3129	6629	6769	3129	3269	4129	Secondary current factor in rigid tapping	119
3130	6630	6770	3130	3270	4130	Compensation constant for the phase of electromotive force in deceleration	120
3131	6631	6771	3131	3271	4131	Time constant for the filter detecting velocity in the Cs contour control mode	121
3132	6632	6772	3132	3272	4132	Current conversion constant for the V-phase	122
3133	6633	6773	3133	3273	4133	Motor model code	123
3134	6634	6774	3134	3274	4134	Reserved	124, 5
3135	6635	6775	3135	3275	4135	Grid shift in the Cs contour control mode (2 words)	126, 7

APPENDIX 11 MONITORING INTERNAL DATA OF THE SERIAL SPINDLE

11.1 Overview

Because all the data items on the serial spindle (such as velocity information) are processed by software, they cannot be monitored with the oscilloscope.
There is a function that can output the internal data of the serial spindle to the LM (load meter) and SM (speedometer) terminals using a voltage output circuit to get analog output of these meters.
This section describes the method for using the function to monitor the internal data of the serial spindle with the oscilloscope.

11.2 Major Properties

Item	Properties
Output voltage range	0 to +11 V
Output voltage resolution	Approx. 43 mV step (11 V/256)
Input impedance of the external measuring instrument	10 kΩ min.

11.3 Monitoring

11.3.1 Outline

Start up the system for normal operation.
When the system is started up:
- The speed (rpm) of the spindle motor is output to the five-digit indicator.
- The load meter output (maximum output plus 10 V) is output to the load meter terminal (LM).
- The voltage for the motor speed (+10 V for the maximum speed) is output to the terminal (SM) of the speedometer.

Set data using the four setting switches on the serial spindle control circuit. This function will then be able to output the internal data of the serial spindle to the indicator and the LM and SM terminals.
When power is turned off, data items which have been set are automatically cleared.
To check the signals on the LM and SM terminals, set pins S2 and S3 to B.
After data monitoring is completed, reset the pins to A.

Pin	Set to A	Set to B
S2, S3	The filter circuit is added while voltage is output.	The filter circuit is not added while voltage is output.

11.3.2 Specifying data to be monitored

(1) Press the four setting switches at the same time for at least a second. "FFFFF" will be displayed on the indicator.

(2) Turn off the switches and press the "MODE" switch. "d-00" will be displayed on the indicator and the system will enter the mode for monitoring internal data.
In this mode, the motor can be operated normally.

(3) Press the "UP" or "DOWN" switch while holding down the "MODE" switch. The indicator display will change in the range of "d-00" to "d-12".

(4) The following shows the correspondence between the destinations of the internal data of the serial spindle and addresses d-01 to d-12.
d-01 to d-04: Specifies the amount of data to be output to the indicator, data shift, and output format (decimal or hexadecimal).
d-05 to d-08: Specifies the amount of data to be output to the LM terminal, data shift, and whether an offset is provided.
d-09 to d-12: Specifies the amount of data to be output to the SM terminal, data shift, and whether an offset is provided.

(5) Select address d-xx in the procedure for setting data described in (3).

(6) Turn off the "MODE" switch. "d-xx" will disappear 0.5 second later, and the data will be displayed for a second.
Change the set data using the "UP" or "DOWN" switch within the second the data is displayed.

(7) When more than a second elapses without pressing the "UP" or "DOWN" switch, data cannot be changed.
If the "MODE" switch is turned on or off, however, setting can be started from the beginning of the step in item (6).

11.4 Description of Addresses

[Output to the indicator]

Address	Description	Initial value
d-01	Specifies a data number.	0
d-02	Shift at data output (0 to 31 bits)	0
d-03	Data shift direction 0: Data is shifted right. 1: Data is shifted left.	0
d-04	Display format 0: Decimal notation 1: Hexadecimal notation (0 to F)	0

[Output to the LM terminal]

Address	Description	Initial value
d-05	Specifies a data number.	132
d-06	Shift at data output (0 to 31 bits)	0
d-07	Data shift direction 0: Data is shifted right. 1: Data is shifted left.	0
d-08	Offset 0: Not provided 1: Provided	0

[Output to the SM terminal]

Address	Description	Initial value
d-09	Specifies a data number.	131
d-10	Shift at data output (0 to 31 bits)	0
d-11	Data shift direction 0: Data is shifted right. 1: Data is shifted left.	0
d-12	Offset 0: Not provided 1: Provided	0

11.5 Principles in Outputting the Internal Data of the Serial Spindle

The length of data is 32 bits (BIT31 TO BIT00) unless it is described as 16 bits.

BIT31	• • • • •	BIT03	BIT02	BIT01	BIT00

11.5.1 Example of output to the indicator

(Example 1) Displaying data in decimal

When the number of digits to shift data (d-02) = 0 and display format (d-04) = 0 (decimal notation): The last 16 bits of data (BIT15 to BIT00) are converted into decimal (0 to 65535 max.) and displayed.

BIT15	• • • • •	BIT01	BIT00

16 bits

↓ Converted into decimal data and displayed

Indicator

X	X	X	X	X

(Example 2) Displaying data in hexadecimal

When the number of digits to shift data (d-02) = 0 and display format (d-04) = 1 (hexadecimal notation): The last 16 bits of data (BIT15 to BIT00) are converted into hexadecimal (0 to FFFFF max.) and displayed.

BIT15	• • • • •	BIT01	BIT00

16 bits

↓ Converted into hexadecimal data and displayed

Indicator

	X	X	X	X

(The fifth digit is blank.)

(Example 3) Shifting data left

When the number of digits to shift data (d-02) = 3, the shift direction is left (d-03 = 1), and display format (d-04) = 1 (hexadecimal notation): Data in BIT12 to BIT00 and the last three bits of data (= 0) are converted into hexadecimal (0 to FFFFF max.) and displayed.

BIT12	· · · · ·	BIT01	BIT00	0	0	0

16 bits

↓ Converted into hexadecimal data and displayed

Indicator

	X	X	X	X

(The fifth digit is blank.)

(Example 4) Shifting data right

When the number of digits to shift data (d-02) = 5, shift direction is right (d-03 = 0), and display format (d-04) = 0 (decimal notation): Data in BIT20 to BIT05 is converted into decimal (0 to 65535 max.) and displayed.

BIT12	· · · · ·	BIT06	BIT05

16 bits

↓ Converted into decimal data and displayed

Indicator

X	X	X	X	X

(Example 5) Shifting data right when the data length is 16 bits

When the data length is 16 bits, data shift (d-02) = 5, shift direction is right (d-03 = 0), and display format is decimal notation (d-04 = 0): The first five bits of data and data in BIT15 to BIT05 are converted into decimal and displayed.

0	0	0	0	0	BIT15	· · ·	BIT05

16 bits

↓ Converted into decimal data and displayed

Indicator

X	X	X	X	X

11.5.2 Example of output to the LM terminal

When the internal data of the serial spindle is output to the LM terminal, the data is set in the 8-bit D/A converter.
When the set data is 0, the D/A converter outputs 0V. When the set data is 255 (maximum value), the converter outputs +11 V.
The unit resolution of the D/A converter is therefore 11V/255 (about 43 mV).

(Example 1) Data set

When the number of digits to shift data (d-06) = 0 and when no offset is provided (d-08 = 0): The last eight bits of data (BIT07 to BIT00) is set in the D/A converter of the LM terminal.

BIT07	BIT06	BIT05	BIT04	BIT03	BIT02	BIT01	BIT00

↓

Set in the D/A converter for LM terminal output

(Example 2) Shifting data left

When the number of digits to shift data (d-06) = 3, shift direction is right (d-07 = 1), and no offset is provided (d-08 = 0): Data in BIT14 to BIT00 and the last three bits of data (= 0) are set in the D/A converter.

BIT04	BIT03	BIT02	BIT01	BIT00	0	0	0

↓

Set in the D/A converter for LM terminal output

(Example 3) Shifting data right

When the number of digits to shift data (d-06) = 10, shift direction is right (d-07 = 1), and no offset is provided (d-08 = 0): Data in BIT17 to BIT10 is set in the D/A converter.

BIT17	BIT16	BIT15	BIT14	BIT13	BIT12	BIT11	BIT10

↓

Set in the D/A converter for LM terminal output

(Example 4) Shifting data right when the data length is 16 bits

When the data length is 16 bits, data shift (d-06) = 10, shift direction is right (d-07 = 0), and no offset is provided (d-08 = 0): The first two bits of data (= 0) and data in BIT15 to BIT10 are set in the D/A converter.

0	0	BIT15	BIT14	BIT13	BIT12	BIT11	BIT10

↓

Set in the D/A converter for LM terminal output

(Example 5) If an offset is provided

When the number of digits to shift data (d-06) = 10, shift direction is right (d-07 = 0), and an offset is provided (d-08 = 1): Data in most significant bit BIT17 (to which 1 is added) and data in BIT16 to BIT10 are set in the D/A converter.

BIT17 + 1	BIT16	BIT15	BIT14	BIT13	BIT12	BIT11	BIT10

↓

Set in the D/A converter for LM terminal output

When an offset is specified for the output of the D/A converter it is only 5.5 V, half of 11 V. This is because 1 is added to the data in the most significant bit.

11.5.3 Example of output to the SM terminal

Output to the SM terminal is the same as that to the LM terminal.

However, the addresses for setting data (d-09 to d-12) are different from those for output to the LM terminal.

Setting velocity information in the LM terminal and the number of errors in the SM terminal enables simultaneous monitoring of the change in each data item using the two channels.

11.6 Data Numbers

11.6.1 Main data

Data No.	Description	Data length (unit: bit)	Remarks
16	Motor speed command	32	The 12th bit (BIT12) indicates a units in rpm.
19	Motor speed	32	The 12th bit (BIT12) indicates a units in rpm.
25	Motor speed deviation (speed command - motor speed)	32	The 12th bit (BIT12) indicates a units in rpm.
4	Move command	32	Number of command pulses for ITP (usually 8 ms)
9	Positioning error	32	Number of erroneous pulses (Spindle synchronous control Cs contour control Rigid mode)
90	Torque command	16	0 to ±16384
131	Speedometer data	16	SM terminal
132	Load meter data	16	LM terminal
136	Position error	32	Number of erroneous pulses (Position coder orientation)

11.6.2 Data to be transmitted between the serial spindle and the CNC

Data No.	Description	Data length (unit: bit)	Remarks
2	Control bit signal 1	16	Command bit sent from the CNC to the spindle
3	Control bit signal 2	16	Command bit sent from the CNC to the spindle
5	Speed command data	16	±16384 for the maximum speed command
6	Spindle control signal	16	Command bit sent from the PMC to the spindle
10	Load meter data	16	0 to 32767 (maximum)
11	Motor speed data	16	±16384 for maximum speed
12	Spindle status signal	16	Status bit sent from the spindle to the PMC

11.6.3 Others

Data No.	Description	Data length (unit: bit)	Remarks
51	U-phase current command	16	
52	V-phase current command	16	
53	W-phase current command	16	
112	Position coder data	16	Number of the pulses that return to the position coder for ITP (usually 8 ms)

11.7 Example of Monitoring Data

11.7.1 Example of monitoring a positioning error using the LM terminal

Address	Description	Set data			
d-05	Data number	9	9	9	9
d-06	Data shift	0	1	1	2
d-07	Data shift direction	0	0	1	1
d-08	Offset	1	1	1	1
Data unit for the LM terminal		256p/11V	512p/11V	128p/11V	64p/11V

11.7.2 Example of monitoring a motor speed using the SM terminal

Address	Description	Set data		
d-09	Data number	19	19	19
d-10	Data shift	12	13	11
d-11	Data shift direction	0	0	0
d-12	Offset	0	0	0
Data unit for the SM terminal		256rpm/11V	512rpm/11V	128rpm/11V

When an offset is specified, the output is +5.5 V at 0 rpm.

APPENDIX 12 PARAMETERS FOR AC SPINDLE SERVO UNIT

(1) Spindle parameter table (common for all models)

(a) Parameter for standard motor (Refer to high speed area parameter for motor with speed range switching function)

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Power Mate	0 No. 1 Spindle	0 No. 2 Spindle	15 No. 1 Spindle	15TT No. 2 Spindle	16	Standard setting data	Contents	Internal data number
3000	6500	6640	3000	3140	4000	00000000	Bit parameter	000
3001	6501	6641	3001	3141	4001	00000001	Bit parameter	
3002	6502	6642	3002	3142	4002	00000000	Bit parameter	001
3003	6503	6643	3003	3143	4003	00000000	Bit parameter	
3004	6504	6644	3004	3144	4004	00000000	Bit parameter	002
3005	6505	6645	3005	3145	4005	00000000	Bit parameter	
3006	6506	6646	3006	3146	4006	00000000	Bit parameter	003
3007	6507	6647	3007	3147	4007	00000000	Bit parameter	
3008	6508	6648	3008	3148	4008	00000000	Bit parameter	004
3009	6509	6649	3009	3149	4009	00000000	Bit parameter	
3010	6510	6650	3010	3150	4010	00000000	Bit parameter	005
3011	6511	6651	3011	3151	4011	According to motor model	Bit parameter	
3012	6512	6652	3012	3152	4012	According to motor model	Bit parameter	006
3013	6513	6653	3013	3153	4013	According to amplifier model	Bit parameter	
3014	6514	6654	3014	3154	4014	00000000	Bit parameter	007
3015	6515	6655	3015	3155	4015	00000000	Bit parameter	
3016	6516	6656	3016	3156	4016	00000000	Bit parameter	008
3017	6517	6657	3017	3157	4017	00000000	Bit parameter	
3018	6518	6658	3018	3158	4018	00000000	Bit parameter	009
3019	6519	6659	3019	3159	4019	00000000	Bit parameter	
3020	6520	6660	3020	3160	4020	According to motor model	Maximum speed	010
3021	6521	6661	3021	3161	4021	100	Maximum speed in Cs contouring control	011
3022	6522	6662	3022	3162	4022	150	Speed arrival level	012
3023	6523	6663	3023	3163	4023	30	Speed detecting level	013
3024	6524	6664	3024	3164	4024	75	Speed zero detecting level	014
3025	6525	6665	3025	3165	4025	50	Setting of torque limit value	015
3026	6526	6666	3026	3166	4026	83	Load detecting level 1	016
3027	6527	6667	3027	3167	4027	95	Load detecting level 2	017
3028	6528	6668	3028	3168	4028	0	Output limit pattern setting	018
3029	6529	6669	3029	3169	4029	100	Output limit value	019

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Power Mate	0 No. 1 Spindle	0 No. 2 Spindle	15 No. 1 Spindle	15TT No. 2 Spindle	16	Standard setting data	Contents	Internal data number
3030	6530	6670	3030	3170	4030	0	Soft start/stop setting time	020
3031	6531	6671	3031	3171	4031	0	Position coder method orientation stop position	021
3032	6532	6672	3032	3172	4032	0	Acceleration/deceleration time constant at spindle synchronization control	022
3033	6533	6673	3033	3173	4033	10	Spindle synchronization speed arrival level	023
3034	6534	6674	3034	3174	4034	0	Shift amount at spindle phase synchronization control	024
3035	6535	6675	3035	3175	4035	10	Spindle phase synchronization compensation data	025
3036	6536	6676	3036	3176	4036	0	Feedforward coefficient	026
3037	6537	6677	3037	3177	4037	0	Velocity loop feedforward coefficient	027
3038	6538	6678	3038	3178	4038	0		028
3039	6539	6679	3039	3179	4039	0		029
3040	6540	6680	3040	3180	4040	10	Velocity loop proportion gain on normal operation (HIGH)	030
3041	6541	6681	3041	3181	4041	10	Velocity loop proportion gain on normal operation (LOW)	031
3042	6542	6682	3042	3182	4042	10	Velocity loop proportion gain on orientation (HIGH)	032
3043	6543	6683	3043	3183	4043	10	Velocity loop proportion gain on orientation (LOW)	033
3044	6544	6684	3044	3184	4044	10	Velocity loop proportion gain on servo mode (HIGH)	034
3045	6545	6685	3045	3185	4045	10	Velocity loop proportion gain on servo mode (LOW)	035
3046	6546	6686	3046	3186	4046	30	Velocity loop proportion gain in Cs contouring control (HIGH)	036
3047	6547	6687	3047	3187	4047	30	Velocity loop proportion gain in Cs contouring control (LOW)	037
3048	6548	6688	3048	3188	4048	10	Velocity loop integral on normal operation (HIGH)	038
3049	6549	6689	3049	3189	4049	10	Velocity loop integral on normal operation (LOW)	039

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Power Mate	0 No. 1 Spindle	0 No. 2 Spindle	15 No. 1 Spindle	15TT No. 2 Spindle	16	Standard setting data	Contents	Internal data number
3050	6550	6690	3050	3190	4050	10	Velocity loop integral gain on orientation (HIGH)	040
3051	6551	6691	3051	3191	4051	10	Velocity loop integral gain on orientation (LOW)	041
3052	6552	6692	3052	3192	4052	10	Velocity loop integral gain on servo mode (HIGH)	042
3053	6553	6693	3053	3193	4053	10	Velocity loop integral gain on servo mode (LOW)	043
3054	6554	6694	3054	3194	4054	50	Velocity loop integral gain in Cs contouring control (HIGH)	044
3055	6555	6695	3055	3195	4055	50	Velocity loop integral gain in Cs contouring control (LOW)	045
3056	6556	6696	3056	3196	4056	100	Gear ratio (HIGH)	046
3057	6557	6697	3057	3197	4057	100	Gear ratio (MEDIUM HIGH)	047
3058	6558	6698	3058	3198	4058	100	Gear ratio (MEDIUM LOW)	048
3059	6559	6699	3059	3199	4059	100	Gear ratio (LOW)	049
3060	6560	6700	3060	3200	4060	1000	Position gain on orientation (HIGH)	050
3061	6561	6701	3061	3201	4061	1000	Position gain on orientation (MEDIUM HIGH)	051
3062	6562	6702	3062	3202	4062	1000	Position gain on orientation (MEDIUM LOW)	052
3063	6563	6703	3063	3203	4063	1000	Position gain on orientation (LOW)	053
3064	6564	6704	3064	3204	4064	100	Modification rate of position gain on orientation completion	054
3065	6565	6705	3065	3205	4065	1000	Position gain on servo mode (HIGH)	055
3066	6566	6706	3066	3206	4066	1000	Position gain on servo mode (MEDIUM HIGH)	056
3067	6567	6707	3067	3207	4067	1000	Position gain on servo mode (MEDIUM LOW)	057
3068	6568	6708	3068	3208	4068	1000	Position gain on servo mode (LOW)	058
3069	6569	6709	3069	3209	4069	3000	Position gain in Cs contouring control (HIGH)	059

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Power Mate	0 No. 1 Spindle	0 No. 2 Spindle	15 No. 1 Spindle	15TT No. 2 Spindle	16	Standard setting data	Contents	Internal data number
3070	6570	6710	3070	3210	4070	3000	Position gain in Cs contouring control (MEDIUM HIGH)	060
3071	6571	6711	3071	3211	4071	3000	Position gain in Cs contouring control (MEDIUM LOW)	061
3072	6572	6712	3072	3212	4072	3000	Position gain in Cs contouring control (LOW)	062
3073	6573	6713	3073	3213	4073	0	Grid shift amount in servo mode	063
3074	6574	6714	3074	3214	4074	0	Origin return speed when Cs contouring/servo mode	064
3075	6575	6715	3075	3215	4075	10	Orientation completion signal detection level	065
3076	6576	6716	3076	3216	4076	33	Motor speed limit value on orientation	066
3077	6577	6717	3077	3217	4077	0	Orientation stop position shift value	067
3078	6578	6718	3078	3218	4078	According to sensor installation	MS signal constant	068
3079	6579	6719	3079	3219	4079	0	MS signal gain adjustment	069
3080	6580	6720	3080	3220	4080	According to motor model	Limitation of regenerative power	070
3081	6581	6721	3081	3221	4081	20	Delay time until the motor power is cut off	071
3082	6582	6722	3082	3222	4082	10	Time setting during acceleration/deceleration	072
3083	6583	6723	3083	3223	4083	According to motor model	Motor voltage setting on normal rotation	073
3084	6584	6724	3084	3224	4084	According to motor model	Motor voltage setting on orientation	074
3085	6585	6725	3085	3225	4085	According to motor model	Motor voltage setting on servo mode	075
3086	6586	6726	3086	3226	4086	According to motor model	Motor voltage setting in Cs contouring control	076
3087	6587	6727	3087	3227	4087	115	Overspeed level	077
3088	6588	6728	3088	3228	4088	75	Velocity error excess detecting level on motor restriction	078
3089	6589	6729	3089	3229	4089	200	Velocity error excess detecting level on motor rotation	079

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Power Mate	0 No. 1 Spindle	0 No. 2 Spindle	15 No. 1 Spindle	15TT No. 2 Spindle	16	Standard setting data	Contents	Internal data number
3090	6590	6730	3090	3230	4090	90	Overload detecting level	080
3091	6591	6731	3091	3231	4091	100	Reduction rate of position gain in returning to reference point on servo mode	081
3092	6592	6732	3092	3232	4092	100	Reduction rate of position gain in Cs contouring control reference point return	082
3093	6593	6733	3093	3233	4093	0	Estimating constant of acceleration	083
3094	6594	6734	3094	3234	4094	0	Constant of the torque disturbance compensating	084
3095	6595	6735	3095	3235	4095	0	Adjustment of speed meter output voltage	085
3096	6596	6736	3096	3236	4096	0	Adjustment of load meter output voltage	086
3097	6597	6737	3097	3237	4097	0	Spindle speed feedback gain	087
3098	6598	6738	3098	3238	4098	0	Maximum speed of position coder 1 revolution signal detection	088
3099	6599	6739	3099	3239	4099	0	Delay time for motor magnetization	089
3100	6600	6740	3100	3240	4100	According to motor model	Base speed of motor output specifications	090
3101	6601	6741	3101	3241	4101	According to motor model	Limit value for motor output specifications	091
3102	6602	6742	3102	3242	4102	According to motor model	Base speed	092
3103	6603	6743	3103	3243	4103	According to motor model	Magnetic flux down start speed	093
3104	6604	6744	3104	3244	4104	According to motor model	Current loop proportion gain on normal operation	094
3105	6605	6745	3105	3245	4105	According to motor model	Current loop proportion gain in Cs contouring control	095
3106	6606	6746	3106	3246	4106	According to motor model	Current loop integral gain on normal operation	096
3107	6607	6747	3107	3247	4107	According to motor model	Current loop integral gain in Cs contouring control	097
3108	6608	6748	3108	3248	4108	According to motor model	Current loop integral gain zero point	098
3109	6609	6749	3109	3249	4109	According to motor model	Current loop proportion gain speed coefficient	099

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Power Mate	0 No. 1 Spindle	0 No. 2 Spindle	15 No. 1 Spindle	15TT No. 2 Spindle	16	Standard setting data	Contents	Internal data number
3110	6610	6750	3110	3250	4110	According to motor model	Current conversion constant	100
3111	6611	6751	3111	3251	4111	According to motor model	Secondary current coefficient for excitation current	101
3112	6612	6752	3112	3252	4112	According to motor model	Current prediction constant	102
3113	6613	6753	3113	3253	4113	According to motor model	Slip constant	103
3114	6614	6754	3114	3254	4114	According to motor model	Slip compensation constant of high-speed rotation	104
3115	6615	6755	3115	3255	4115	According to motor model	Motor applied voltage compensation constant by dead time	105
3116	6616	6756	3116	3256	4116	According to motor model	Electromotive voltage compensation coefficient	106
3117	6617	6757	3117	3257	4117	According to motor model	Electromotive voltage phase compensation constant	107
3118	6618	6758	3118	3258	4118	According to motor model	Electromotive voltage compensation speed coefficient	108
3119	6619	6759	3119	3259	4119	0	Time constant of voltage filter for electromotive voltage	109
3120	6620	6760	3120	3260	4120	According to motor model	Dead time compensation data	110
3121	6621	6761	3121	3261	4121	5	Time constant of torque change	111
3122	6622	6762	3122	3262	4122	0	Speed detection filter time constant	112
3123	6623	6763	3123	3263	4123	30	Overload detecting time	113
3124	6624	6764	3124	3264	4124	0		114
3125	6625	6765	3125	3265	4125	100	Timer setting for automatic operation	115
3126	6626	6766	3126	3266	4126	1000	Velocity command on automatic operation	116
3127	6627	6767	3127	3267	4127	According to motor model	Load meter display value on maximum output	117
3128	6628	6768	3128	3268	4128	According to motor model	Maximum output limit zero point	118
3129	6629	6769	3129	3269	4129	According to motor model	Secondary electrical current coefficient on rigid tap	119
3130	6630	6770	3130	3270	4130	According to motor model	Electromagnetic voltage phase compensation constant on deceleration	120
3131	6631	6771	3131	3271	4131	0	Speed detection filter time constant (on Cs contouring control)	121
3132	6632	6772	3132	3272	4132	0	V-phase current conversion constant	122
3133	6633	6773	3133	3273	4133	According to motor model	Motor model code	123
3134	6634	6774	3134	3274	4134	0		124,125
3135	6635	6775	3135	3275	4135	0	Grid shift value on Cs contouring control	126,127

(b) Low speed area parameters for speed range switching function

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Power Mate	0 No. 1 Spindle	0 No. 2 Spindle	15 No. 1 Spindle	15TT No. 2 Spindle	16	Standard setting data	Contents	Internal data number
3136	6900	6940	3280	3500	4136	According to motor model	Motor voltage setting on normal rotation	128
3137	6901	6941	3281	3501	4137	According to motor model	Motor voltage setting on servo mode	129
3138	6902	6942	3282	3502	4138	According to motor model	Base speed of motor output specifications	130
3139	6903	6943	3283	3503	4139	According to motor model	Limiting value for motor output specifications	131
3140	6904	6944	3284	3504	4140	According to motor model	Base speed	132
3141	6905	6945	3285	3505	4141	According to motor model	Initial speed with weakened flux	133
3142	6906	6946	3286	3506	4142	According to motor model	Current loop proportion gain on normal operation	134
3143	6907	6947	3287	3507	4143	According to motor model	Current loop integral gain on normal operation	135
3144	6908	6948	3288	3508	4144	According to motor model	Zero point of current loop integral gain	136
3145	6909	6949	3289	3509	4145	According to motor model	Speed coefficient of current loop proportional gain	137
3146	6910	6950	3290	3510	4146	According to motor model	Current conversion constant	138
3147	6911	6951	3291	3511	4147	According to motor model	Secondary current coefficient for excitation current	139
3148	6912	6952	3292	3512	4148	According to motor model	Current prediction constant	140
3149	6913	6953	3293	3513	4149	According to motor model	Slip constant	141
3150	6914	6954	3294	3514	4150	According to motor model	Slip compensation constant for high-speed rotation	142
3151	6915	6955	3295	3515	4151	According to motor model	Compensation constant for voltage imposed on motor due to dead time	143
3152	6916	6956	3296	3516	4152	According to motor model	Electromotive voltage compensation constant	144
3153	6917	6957	3297	3517	4153	According to motor model	Electromotive voltage phase compensation constant	145
3154	6918	6958	3298	3518	4154	According to motor model	Electromotive voltage compensation speed coefficient	146
3155	6919	6959	3299	3519	4155	0		147

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Power Mate	0 No. 1 Spindle	0 No. 2 Spindle	15 No. 1 Spindle	15TT No. 2 Spindle	16	Standard setting data	Contents	Internal data number
3156	6920	6960	3300	3520	4156	0		148
3157	6921	6961	3301	3521	4157	According to motor model	Time constant of change in torque	149
3158	6922	6962	3302	3522	4158	According to motor model	Maximum output limit zero point	150
3159	6923	6963	3303	3523	4159	According to motor model	Secondary electrical current coefficient on rigid tap	151
3160	6924	6964	3304	3524	4160	0	Speed detection signal (SDT) output hysteresis	152
3161	6925	6965	3305	3525	4161	According to motor model	Electromotive voltage phase compensation constant on deceleration	153
3162	6926	6966	3306	3526	4162	0	Velocity loop integral gain on Cs contouring control cutting feed (HIGH)	154
3163	6927	6967	3307	3527	4163	0	Velocity loop integral gain on Cs contouring control cutting feed (LOW)	155
3164	6928	6968	3308	3528	4164	0	V-phase current conversion constant	156
3165	6929	6969	3309	3529	4165	0	Time constant of voltage filter for electromotive voltage compensation	157
3166	6930	6970	3310	3530	4166	According to motor model	Limit of regenerative power	158
3167	6931	6971	3311	3531	4167	0		159
3168	6932	6972	3312	3532	4168	According to motor model	Over load current alarm detecting level (for low speed)	160
3169	6933	6973	3313	3533	4169	According to motor model	Over load current alarm detecting time constant	161
3170	6934	6974	3314	3534	4170	According to motor model	Over load current alarm detecting level (for high-speed)	162
3171	6935	6975	3315	3535	4171	0		163
3172	6936	6976	3316	3536	4172	0		164
3173	6937	6977	3317	3537	4173	0		165
3174	6938	6978	3318	3538	4174	0		166
3175	6939	6979	3319	3539	4175	0	Delay timer at ON of electromagnetic contactor in unit	167

(c) Sub spindle side parameters for spindle selector function

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0 No. 1 Spindle	0 No. 2 Spindle	15 No. 1 Spindle	15TT No. 2 Spindle	16	Standard setting data	Contents	Internal data number
6140	6320	3320	3540	4176	00000000	Bit parameter	168
6141	6321	3321	3541	4177	00000001	Bit parameter	
6142	6322	3322	3542	4178	00000000	Bit parameter	169
6143	6323	3323	3543	4179	00000000	Bit parameter	
6144	6324	3324	3544	4180	00000000	Bit parameter	170
6145	6325	3325	3545	4181	00000000	Bit parameter	
6146	6326	3326	3546	4182	00000000	Bit parameter	171
6147	6327	3327	3547	4183	00000000	Bit parameter	
6148	6328	3328	3548	4184	00000000	Bit parameter	172
6149	6329	3329	3549	4185	00000000	Bit parameter	
6150	6330	3330	3550	4186	00000000	Bit parameter	173
6151	6331	3331	3551	4187	According to motor model	Bit parameter	
6152	6332	3332	3552	4188	According to motor model	Bit parameter	174
6153	6333	3333	3553	4189	According to amplifier model	Bit parameter	
6154	6334	3334	3554	4190	00000000	Bit parameter	175
6155	6335	3335	3555	4191	00000000	Bit parameter	
6156	6336	3336	3556	4192	00000000	Bit parameter	176
6157	6337	3337	3557	4193	00000000	Bit parameter	
6158	6338	3338	3558	4194	00000000	Bit parameter	177
6159	6339	3339	3559	4195	00000000	Bit parameter	
6160	6340	3340	3560	4196	According to motor model	Maximum speed	178
6161	6341	3341	3561	4197	150	Speed arrival level	179
6162	6342	3342	3562	4198	30	Speed detecting level	180
6163	6343	3343	3563	4199	75	Speed zero detecting level	181
6164	6344	3344	3564	4200	50	Setting of torque limit value	182
6165	6345	3345	3565	4201	83	Load detecting level 1	183
6166	6346	3346	3566	4202	0	Output limit pattern setting	184
6167	6347	3347	3567	4203	100	Output limit value	185
6168	6348	3348	3568	4204	0	Position coder method orientation stop position	186
6169	6349	3349	3569	4205	0		187

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0 No. 1 Spindle	0 No. 2 Spindle	15 No. 1 Spindle	15TT No. 2 Spindle	16	Standard setting data	Contents	Internal data number
6170	6350	3350	3570	4206	10	Velocity loop proportion gain on normal operation (HIGH)	188
6171	6351	3351	3571	4207	10	Velocity loop proportion gain on normal operation (LOW)	189
6172	6352	3352	3572	4208	10	Velocity loop proportion gain on orientation (HIGH)	190
6173	6353	3353	3573	4209	10	Velocity loop proportion gain on orientation (LOW)	191
6174	6354	3354	3574	4210	10	Velocity loop proportion gain on servo mode (HIGH)	192
6175	6355	3355	3575	4211	10	Velocity loop proportion gain on servo mode (LOW)	193
6176	6356	3356	3576	4212	10	Velocity loop integral gain on normal operation	194
6177	6357	3357	3577	4213	10	Velocity loop integral gain on orientation	195
6178	6358	3358	3578	4214	10	Velocity loop integral gain on servo mode	196
6179	6359	3359	3579	4215	0		197
6180	6360	3360	3580	4216	100	Gear ratio (HIGH)	198
6181	6361	3361	3581	4217	100	Gear ratio (LOW)	199
6182	6362	3362	3582	4218	1000	Position gain on orientation (HIGH)	200
6183	6363	3363	3583	4219	1000	Position gain on orientation (LOW)	201
6184	6364	3364	3584	4220	100	Modification rate of position gain on orientation completion	202
6185	6365	3365	3585	4221	1000	Position gain on servo mode (HIGH)	203
6186	6366	3366	3586	4222	1000	Position gain on servo mode (LOW)	204
6187	6367	3367	3587	4223	0	Grid shift value on servo mode	205
6188	6368	3368	3588	4224	0		206
6189	6369	3369	3589	4225	0		207

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0 No. 1 Spindle	0 No. 2 Spindle	15 No. 1 Spindle	15TT No. 2 Spindle	16	Standard setting data	Contents	Internal data number
6190	6370	3370	3590	4226	10	Orientation completion signal detection level	208
6191	6371	3371	3591	4227	33	Motor speed limit value on orientation	209
6192	6372	3372	3592	4228	0	Orientation stop position shift value	210
6193	6373	3373	3593	4229	According to sensor installation	MS signal constant	211
6194	6374	3374	3594	4230	0	MS signal gain adjustment	212
6195	6375	3375	3595	4231	According to motor model	Limitation of regenerative power	213
6196	6376	3376	3596	4232	20	Delay time until the motor power is cut off	214
6197	6377	3377	3597	4233	10	Time setting during acceleration/deceleration	215
6198	6378	3378	3598	4234	0		216
6199	6379	3379	3599	4235	0		217
6200	6380	3380	3600	4236	According to motor model	Motor voltage setting on normal rotation	218
6201	6381	3381	3601	4237	According to motor model	Motor voltage setting on orientation	219
6202	6382	3382	3602	4238	According to motor model	Motor voltage setting on servo mode	220
6203	6383	3383	3603	4239	100	Reduction rate of position gain in returning to reference point on servo mode	221
6204	6384	3384	3604	4240	0	Feedforward coefficient	222
6205	6385	3385	3605	4241	0	Velocity loop feedforward coefficient	223
6206	6386	3386	3606	4242	0		224
6207	6387	3387	3607	4243	0		225
6208	6388	3388	3608	4244	0		226
6209	6389	3389	3609	4245	0		227
6210	6390	3390	3610	4246	0		228
6211	6391	3391	3611	4247	0		229
6212	6392	3392	3612	4248	0		230
6213	6393	3393	3613	4249	0		231
6214	6394	3394	3614	4250	0		232
6215	6395	3395	3615	4251	0		233
6216	6396	3396	3616	4252	0		234
6217	6397	3397	3617	4253	0		235
6218	6398	3398	3618	4254	0		236
6219	6399	3399	3619	4255	0		237

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0 No. 1 Spindle	0 No. 2 Spindle	15 No. 1 Spindle	15TT No. 2 Spindle	16	Standard setting data	Contents	Internal data number
6220	6400	3400	3620	4256	According to motor model	Base speed of motor output specifications	238
6221	6401	3401	3621	4257	According to motor model	Limit value for motor output specifications	239
6222	6402	3402	3622	4258	According to motor model	Base speed	240
6223	6403	3403	3623	4259	According to motor model	Initial speed with weakened flux	241
6224	6404	3404	3624	4260	According to motor model	Current loop proportion gain on normal operation	242
6225	6405	3405	3625	4261	According to motor model	Current loop integral gain on normal operation	243
6226	6406	3406	3626	4262	According to motor model	Current loop integral gain zero point	244
6227	6407	3407	3627	4263	According to motor model	Current loop proportion gain speed coefficient	245
6228	6408	3408	3628	4264	According to motor model	Current conversion constant	246
6229	6409	3409	3629	4265	According to motor model	Secondary current coefficient for excitation current	247
6230	6410	3410	3630	4266	According to motor model	Current prediction constant	248
6231	6411	3411	3631	4267	According to motor model	Slip constant	249
6232	6412	3412	3632	4268	According to motor model	Slip compensation constant of high-speed rotation	250
6233	6413	3413	3633	4269	According to motor model	Compensation constant for voltage imposed on motor due to dead time	251
6234	6414	3414	3634	4270	According to motor model	Electromotive voltage compensation constant	252
6235	6415	3415	3635	4271	According to motor model	Electromotive voltage phase compensation constant	253
6236	6416	3416	3636	4272	According to motor model	Electromotive voltage compensation speed coefficient	254
6237	6417	3417	3637	4273	5	Time constant of torque change	255
6238	6418	3418	3638	4274	According to motor model	Load meter display value on maximum output	256
6239	6419	3419	3639	4275	According to motor model	Maximum output limit zero point	257
6240	6420	3420	3640	4276	According to motor model	Secondary electrical current coefficient on rigid tap	258
6241	6421	3421	3641	4277	According to motor model	Electromagnetic voltage phase compensation constant on deceleration	259
6242	6422	3422	3642	4278	0	Speed detection filter time constant	260
6243	6423	3423	3643	4279	0		261
6244	6424	3424	3644	4280	0	Time constant of voltage filter for electromotive voltage compensation	262
6245	6425	3425	3645	4281	0		263
6246	6426	3426	3646	4282	0		264
6247	6427	3427	3647	4283	0		265

(d) Low speed area parameters on SUB spindle both with spindle selector function and with speed range switching function

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0 No. 1 Spindle	0 No. 2 Spindle	15 No. 1 Spindle	15TT No. 2 Spindle	16	Standard setting data	Contents	Internal data number
6248	6428	3428	3648	4284	According to motor model	Motor voltage setting on normal rotation	266
6249	6429	3429	3649	4285	According to motor model	Motor voltage setting on servo mode	267
6250	6430	3430	3650	4286	According to motor model	Base speed of motor output specifications	268
6251	6431	3431	3651	4287	According to motor model	Limit value for motor output specifications	269
6252	6432	3432	3652	4288	According to motor model	Base speed	270
6253	6433	3433	3653	4289	According to motor model	Initial speed with weakened flux	271
6254	6434	3434	3654	4290	According to motor model	Current loop proportion gain on normal operation	272
6255	6435	3435	3655	4291	According to motor model	Current loop integral gain on normal operation	273
6256	6436	3436	3656	4292	According to motor model	Current loop integral gain zero point	274
6257	6437	3437	3657	4293	According to motor model	Current loop proportion gain speed coefficient	275
6258	6438	3438	3658	4294	According to motor model	Current conversion constant	276
6259	6439	3439	3659	4295	According to motor model	Secondary current coefficient for excitation current	277
6260	6440	3440	3660	4296	According to motor model	Current prediction constant	278
6261	6441	3441	3661	4297	According to motor model	Slip constant	279
6262	6442	3442	3662	4298	According to motor model	Slip compensation constant of high-speed rotation	280
6263	6443	3443	3663	4299	According to motor model	Compensation constant for voltage imposed on motor due to dead time	281
6264	6444	3444	3664	4300	According to motor model	Electromotive voltage compensation coefficient	282
6265	6445	3445	3665	4301	According to motor model	Electromotive voltage phase compensation constant	283
6266	6446	3446	3666	4302	According to motor model	Electromotive voltage compensation speed coefficient	284
6267	6447	3447	3667	4303	5	Time constant of torque change	285
6268	6448	3448	3668	4304	According to motor model	Maximum output limit zero point	286
6269	6449	3449	3669	4305	According to motor model	Secondary electrical current coefficient on rigid tap	287

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0 No. 1 Spindle	0 No. 2 Spindle	15 No. 1 Spindle	15TT No. 2 Spindle	16	Standard setting data	Contents	Internal data number
6270	6450	3450	3670	4306	According to motor model	Electromotive voltage phase compensation constant on deceleration	288
6271	6451	3451	3671	4307	According to motor model	Limit of regenerative power Time constant of voltage filter for electromotive voltage compensation	289
6272	6452	3452	3672	4308	0		290
6273	6453	3453	3673	4309	According to motor model	Motor model code	291
6274	6454	3454	3674	4310	0		292,293
6275	6455	3455	3675	4311	0		294,295
6276	6456	3456	3676	4312	0		296
6277	6457	3457	3677	4313	0		297
6278	6458	3458	3678	4314	0		298
6279	6459	3459	3679	4315	0		299
6280	6460	3460	3680	4316	0		300
6281	6461	3461	3681	4317	0		301
6282	6462	3462	3682	4318	0		302
6283	6463	3463	3683	4319	0		303
6284	6464	3464	3684	4320	0		304
6285	6465	3465	3685	4321	0		305
6286	6466	3466	3686	4322	0		306
6287	6467	3467	3687	4323	0		307
6288	6468	3468	3688	4324	0		308
6289	6469	3469	3689	4325	0		309
6290	6470	3470	3690	4326	0		310
6291	6471	3471	3691	4327	0		311
6292	6472	3472	3692	4328	0		312
6293	6473	3473	3693	4329	0		313
6294	6474	3474	3694	4330	0		314
6295	6475	3475	3695	4331	0		315
6296	6476	3476	3696	4332	0		316
6297	6477	3477	3697	4333	0		317
6298	6478	3478	3698	4334	0		318
6299	6479	3479	3699	4335	0		319

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0 No. 1 Spindle	0 No. 2 Spindle	15 No. 1 Spindle	15TT No. 2 Spindle	16	Standard setting data	Contents	Internal data number
6300	6480	3480	3700	4336	0		320
6301	6481	3481	3701	4337	0		321
6302	6482	3482	3702	4338	0		322
6303	6483	3483	3703	4339	0		323
6304	6484	3484	3704	4340	0		324
6305	6485	3485	3705	4341	0		325
6306	6486	3486	3706	4342	0		326
6307	6487	3487	3707	4343	0		327
6308	6488	3488	3708	4344	0		328
6309	6489	3489	3709	4345	0		329
6310	6490	3490	3710	4346	0		330
6311	6491	3491	3711	4347	0		331
6312	6492	3492	3712	4348	According to motor model	Over load current alarm detecting level (for low-speed)	332
6313	6493	3493	3713	4349	According to motor model	Over load current alarm detecting time constant	333
6314	6494	3494	3714	4350	According to motor model	Over load current alarm detecting level (for high-speed)	334
6315	6495	3495	3715	4351	0	Current detection offset compensation	335

1. The parameter data given in this table consists of standard values. It is necessary to reset according to the machine system.

(2) Table of Parameters for Each Model

1. When setting automatically the parameters are set corresponding to the model code. (For parameters other than these, refer to the "Table of Common Parameters".)
2. When "None" is entered for the model codes corresponding to the models, the parameter data is mostly set automatically in agreement with the model codes. Change the sections that are different.
3. Applicable ROM version is which automatic setting data is prepared for displayed version and subsequence version.

(Reference)

The speed detector is to be set as follows:

- Motor model 0.5S : Set "64".
- Motor models 1S to 3S : Set "128".
- Motor models 6S to 40S
- Motor models 8P to 60P : Set "256".
- Motor models B6 to B35
- Motor model B40 : Set "5126".

(However, "128" is set for the high-resolution magnetic pulse coder.)

Series 15:	No.3011:	*001
Series 15:	No.3011:	*010
(*001) *is option.		

(a) S series

Model code →				23	15	None	16	17	33	18
Parameter No.				Model 0.5S 3000/8000 0.65/1.1kW	Model 1S 3000/8000 1.5/2.2kW	Model 1S 3000/15000 1.5/2.2kW	Model 1.5S 1500/8000 1.1/3.7kW	Model 2S 1500/8000 2.2/3.7kW	Model 2S 3000/15000 2.2/3.7kW	Model 3S 1500/6000 3.7/5.5kW
PM	0C	15	16							
3006	6506	3006	4006	00010000 (Note)						
3007	6507	3007	4007	10000000 (Note)						
3011	6511	3011	4011	00001000	00001001	←	00001001	00001001	00001001	00001001
3012	6512	3012	4012	00000000	00000000	←	00000000	00000000	00000000	00000000
3013	6513	3013	4013	00011010	00011010	←	00011010	00011010	00011010	00011010
3020	6520	3020	4020	8000	8000	15000	8000	8000	15000	6000
3040	6540	3040	4040	2 (Note)						
3080	6580	3080	4080	100	60	←	60	65	75	60
3083	6583	3083	4083	30	30	←	30	30	30	30
3084	6584	3084	4084	30	30	←	30	30	30	30
3085	6585	3085	4085	30	30	←	30	30	30	30
3086	6586	3086	4086	100	100	←	100	100	100	100
3100	6600	3100	4100	3000	3000	←	1500	1650	3300	1500
3101	6601	3101	4101	100	100	←	100	100	100	100
3102	6602	3102	4102	5500	3000	←	2000	2200	4570	1500
3103	6603	3103	4103	5500	3000	←	2000	2200	4570	1500
3104	6604	3104	4104	500	1500	←	1500	1500	760	1500
3105	6605	3105	4105	500	1500	←	1500	1500	760	1500
3106	6606	3106	4106	1500	1500	←	1500	1500	1500	1500
3107	6607	3107	4107	1500	1500	←	1500	1500	1500	1500
3108	6608	3108	4108	300	500	←	500	300	300	300
3109	6609	3109	4109	10	10	←	10	10	10	10
3110	6610	3110	4110	2811	820	←	492	652	656	698
3111	6611	3111	4111	26	8	←	13	16	14	20
3112	6612	3112	4112	500	500	←	500	600	500	500
3113	6613	3113	4113	1000	1550	←	1600	550	650	450
3114	6614	3114	4114	10	10	←	10	10	10	10
3115	6615	3115	4115	5	3	←	2	2	5	5
3116	6616	3116	4116	100	100	←	100	100	100	110
3117	6617	3117	4117	20	20	←	20	20	20	20
3118	6618	3118	4118	20	10	←	10	10	0	20
3119	6619	3119	4119	0	0	←	0	0	0	0
3120	6620	3120	4120	20	40	←	40	60	40	30
3121	6621	3121	4121	5	5	←	5	5	5	5
3127	6627	3127	4127	203	176	←	403	202	202	178
3128	6628	3128	4128	0	0	←	16000	30000	0	0
3130	6630	3130	4130	95	0	←	0	0	0	0
3133	6633	3133	4133	23	15	←	16	17	33	18
Amp. model				1S	1S	1S	2S	2S	3S	3S
Applicable ROM version				9A20E 9A50A	9A20D 9A50A		9A20D 9A50A	9A20D 9A50A	9A21.E 9A50F	9A20G 9A50A

Note) After parameters are automatically set, change the parameters shown in this list manually.

Model code →				None	0	None	1	None
Parameter No.				Model 3S 1500/8000 3.7/5.5kW	Model 3S Special 1500/6000 3.7/5.5kW	Model 3S 1500/12000 3.7/5.5kW	Model 6S 1500/6000 5.5/7.5kW	Model 6S 1500/12000 5.5/7.5kW
PM	0C	15	16					
3006	6506	3006	4006					
3011	6511	3011	4011	←	00001001	←	00001010	←
3012	6512	3012	4012	←	00000000	←	00000000	←
3013	6513	3013	4013	←	00011010	←	00011010	←
3020	6520	3020	4020	8000	6000	12000	6000	12000
3040	6540	3040	4040					
3080	6580	3080	4080	←	65	←	65	←
3083	6583	3083	4083	←	30	←	30	←
3084	6584	3084	4084	←	30	←	30	←
3085	6585	3085	4085	←	30	←	30	←
3086	6586	3086	4086	←	100	←	100	←
3100	6600	3100	4100	←	1460	←	1500	←
3101	6601	3101	4101	←	100	←	100	←
3102	6602	3102	4102	←	1600	←	1750	←
3103	6603	3103	4103	←	1750	←	1850	←
3104	6604	3104	4104	←	2200	←	1600	←
3105	6605	3105	4105	←	2200	←	1600	←
3106	6606	3106	4106	←	1500	←	1500	←
3107	6607	3107	4107	←	1500	←	1500	←
3108	6608	3108	4108	←	500	←	400	←
3109	6609	3109	4109	←	10	←	10	←
3110	6610	3110	4110	←	840	←	754	←
3111	6611	3111	4111	←	17	←	20	←
3112	6612	3112	4112	←	800	←	800	←
3113	6613	3113	4113	←	227	←	410	←
3114	6614	3114	4114	←	30	←	35	0
3115	6615	3115	4115	←	5	←	5	←
3116	6616	3116	4116	←	100	←	105	←
3117	6617	3117	4117	←	20	←	20	←
3118	6618	3118	4118	←	20	←	10	←
3119	6619	3119	4119	←	0	←	0	←
3120	6620	3120	4120	←	50	←	20	←
3121	6621	3121	4121	←	5	←	5	←
3127	6627	3127	4127	←	178	←	164	←
3128	6628	3128	4128	←	6000	←	4500	←
3130	6630	3130	4130	←	0	←	0	←
3133	6633	3133	4133	←	0	←	1	←
Amp. model				3S	6S	6S	6S	8S
Applicable ROM version					9A10A 9A50A		9A10A 9A50A	

Model code →				None	None
Parameter No.				6S/A3 1500/6000 3.7/5.5kW	6S/A3 1500/12000 3.7/5.5kW
PM	0C	15	16		
3006	6506	3006	4006		
3011	6511	3011	4011	←	←
3012	6512	3012	4012	←	←
3013	6513	3013	4013	←	←
3020	6520	3020	4020	6000	12000
3040	6540	3040	4040		
3080	6580	3080	4080	←	←
3083	6583	3083	4083	←	←
3084	6584	3084	4084	←	←
3085	6585	3085	4085	←	←
3086	6586	3086	4086	←	←
3100	6600	3100	4100	←	←
3101	6601	3101	4101	73	73
3102	6602	3102	4102	←	←
3103	6603	3103	4103	←	←
3104	6604	3104	4104	←	←
3105	6605	3105	4105	←	←
3106	6606	3106	4106	←	←
3107	6607	3107	4107	←	←
3108	6608	3108	4108	←	←
3109	6609	3109	4109	←	←
3110	6610	3110	4110	←	←
3111	6611	3111	4111	←	←
3112	6612	3112	4112	←	←
3113	6613	3113	4113	←	←
3114	6614	3114	4114	10	10
3115	6615	3115	4115	←	←
3116	6616	3116	4116	←	←
3117	6617	3117	4117	←	←
3118	6618	3118	4118	←	←
3119	6619	3119	4119	←	←
3120	6620	3120	4120	←	←
3121	6621	3121	4121	←	←
3127	6627	3127	4127	178	178
3128	6628	3128	4128	←	←
3130	6630	3130	4130	←	←
3133	6633	3133	4133	←	←
Amp. model				6S	6S
Applicable ROM version					

Model code →				2	None	None	3	None	None
Parameter No.				Model 8S 1500/6000 7.5/11kW	Model 8S 1500/4500 7.5/11kW	Model 8S 1500/8000 7.5/11kW	Model 12S 1500/6000 11/15kW	Model 12S 1500/4500 11/15kW	Model 12S 1500/8000 11/15kW
PM	0C	15	16						
3011	6511	3011	4011	00001010	←	←	00001010	←	←
3012	6512	3012	4012	00000000	←	←	00000000	←	←
3013	6513	3013	4013	00011010	←	←	00011010	←	←
3020	6520	3020	4020	6000	4500	8000	6000	4500	8000
3080	6580	3080	4080	55	←	←	50	←	←
3083	6583	3083	4083	30	←	←	30	←	←
3084	6584	3084	4084	30	←	←	30	←	←
3085	6585	3085	4085	30	←	←	30	←	←
3086	6586	3086	4086	100	←	←	100	←	←
3100	6600	3100	4100	1500	←	←	1500	←	←
3101	6601	3101	4101	100	←	←	100	←	←
3102	6602	3102	4102	1700	←	←	1600	←	←
3103	6603	3103	4103	1700	←	←	1600	←	←
3104	6604	3104	4104	1500	←	←	1500	←	←
3105	6605	3105	4105	1500	←	←	1500	←	←
3106	6606	3106	4106	1500	←	←	1200	←	←
3107	6607	3107	4107	1500	←	←	1200	←	←
3108	6608	3108	4108	300	←	←	500	←	←
3109	6609	3109	4109	10	←	←	10	←	←
3110	6610	3110	4110	500	←	←	500	←	←
3111	6611	3111	4111	17	←	←	20	←	←
3112	6612	3112	4112	500	←	←	500	←	←
3113	6613	3113	4113	550	←	←	244	←	←
3114	6614	3114	4114	10	←	←	20	←	←
3115	6615	3115	4115	5	←	←	9	←	←
3116	6616	3116	4116	100	←	←	100	←	←
3117	6617	3117	4117	10	←	←	20	←	←
3118	6618	3118	4118	10	←	←	10	←	←
3119	6619	3119	4119	0	←	←	0	←	←
3120	6620	3120	4120	30	←	←	20	←	←
3121	6621	3121	4121	5	←	←	5	←	←
3127	6627	3127	4127	176	←	←	164	←	←
3128	6628	3128	4128	6000	←	←	4500	←	←
3130	6630	3130	4130	0	←	←	0	←	←
3133	6633	3133	4133	2	←	←	3	←	←
Amp. model				8S	8S	8S	12S	12S	12S
Applicable ROM version				9A10A 9A50A			9A10A 9A50A		

Model code →				None	None	4	None	None	None	None	None
Parameter No.				12S/A8 1500/4500 7.5/11kW	12S/A8 1500/8000 7.5/11kW	Model 15S 1500/6000 15/18.5kW	Model 15S 1500/4500 15/18.5kW	Model 15S 1500/8000 15/18.5kW	Model 15S 1500/4500 15/18.5kW	Model 15S 1500/6000 15/18.5kW	Model 15S 1500/8000 15/18.5kW
PM	0C	15	16								
3011	6511	3011	4011	←	←	00001010	←	←	←	←	←
3012	6512	3012	4012	←	←	00000000	←	←	←	←	←
3013	6513	3013	4013	←	←	00100110	←	←	00011010	00011010	00011010
3020	6520	3020	4020	4500	8000	6000	4500	8000	4500	6000	8000
3080	6580	3080	4080	←	←	65	←	←	40	40	40
3083	6583	3083	4083	←	←	30	←	←	20	20	20
3084	6584	3084	4084	←	←	30	←	←	←	←	←
3085	6585	3085	4085	←	←	30	←	←	←	←	←
3086	6586	3086	4086	←	←	100	←	←	←	←	←
3100	6600	3100	4100	←	←	1600	←	←	←	←	←
3101	6601	3101	4101	73	73	100	←	←	←	←	←
3102	6602	3102	4102	←	←	1600	←	←	←	←	←
3103	6603	3103	4103	←	←	300	←	←	1600	1600	1600
3104	6604	3104	4104	←	←	1500	←	←	1100	1100	1100
3105	6605	3105	4105	←	←	1500	←	←	1100	1100	1100
3106	6606	3106	4106	←	←	1200	←	←	←	←	←
3107	6607	3107	4107	←	←	1200	←	←	←	←	←
3108	6608	3108	4108	←	←	750	←	←	←	←	←
3109	6609	3109	4109	←	←	10	←	←	←	←	←
3110	6610	3110	4110	←	←	800	←	←	629	629	629
3111	6611	3111	4111	←	←	20	←	←	26	26	26
3112	6612	3112	4112	←	←	800	←	←	←	←	←
3113	6613	3113	4113	←	←	233	←	←	200	200	200
3114	6614	3114	4114	←	←	10	←	←	←	←	←
3115	6615	3115	4115	←	←	10	←	←	5	5	5
3116	6616	3116	4116	←	←	100	←	←	←	←	←
3117	6617	3117	4117	←	←	20	←	←	←	←	←
3118	6618	3118	4118	←	←	10	←	←	←	←	←
3119	6619	3119	4119	←	←	0	←	←	←	←	←
3120	6620	3120	4120	←	←	50	←		40	40	40
3121	6621	3121	4121	←	←	5	←	←	←	←	←
3127	6627	3127	4127	←	←	148	←	←	←	←	←
3128	6628	3128	4128	←	←	0	←	←	←	←	←
3130	6630	3130	4130	←	←	0	←	←	←	←	←
3133	6633	3133	4133	←	←	4	←	←	←	←	←
Amp. model				8S	8S	15S	15S	15S	Small 15S	Small 15S	Small 15S
Applicable ROM version						9A10A 9A50A					

Model code →				5	None	None	None	6	None
Parameter No.				Model 18S 1500/4500 18.5/22kW	Model 18S 1500/6000 18.5/22kW	Model 22S 1500/4500 22/26kW	Model 22S 1500/6000 22/26kW	Model 30S 1150/4500 30/37kW	Model 30S 1150/6000 30/37kW
PM	0C	15	16						
3011	6511	3011	4011	00001010	←	←	←	00001010	←
3012	6512	3012	4012	00000000	←	←	←	00000100	←
3013	6513	3013	4013	00100110	←	←	←	00111110	←
3020	6520	3020	4020	4500	6000	4500	6000	4500	6000
3080	6580	3080	4080	55	←	←	←	50	←
3083	6583	3083	4083	20	←	←	←	30	←
3084	6584	3084	4084	30	←	←	←	30	←
3085	6585	3085	4085	30	←	←	←	30	←
3086	6586	3086	4086	100	←	←	←	100	←
3100	6600	3100	4100	1600	←	←	←	1150	←
3101	6601	3101	4101	85	←	100	100	100	←
3102	6602	3102	4102	1600	←	←	←	1150	←
3103	6603	3103	4103	1600	←	←	←	1150	←
3104	6604	3104	4104	1000	←	←	←	1000	←
3105	6605	3105	4105	1000	←	←	←	1000	←
3106	6606	3106	4106	1200	←	←	←	2000	←
3107	6607	3107	4107	1200	←	←	←	2000	←
3108	6608	3108	4108	850	←	←	←	300	←
3109	6609	3109	4109	10	←	←	←	10	←
3110	6610	3110	4110	550	←	←	←	629	←
3111	6611	3111	4111	28	←	←	←	29	←
3112	6612	3112	4112	500	←	←	←	500	←
3113	6613	3113	4113	200	←	←	←	210	←
3114	6614	3114	4114	20	←	←	←	22	←
3115	6615	3115	4115	0	←	←	←	0	←
3116	6616	3116	4116	100	←	←	←	103	←
3117	6617	3117	4117	20	←	←	←	20	←
3118	6618	3118	4118	15	←	←	←	10	←
3119	6619	3119	4119	0	←	←	←	0	←
3120	6620	3120	4120	30	←	←	←	30	←
3121	6621	3121	4121	5	←	←	←	5	←
3127	6627	3127	4127	143	←	142	142	148	←
3128	6628	3128	4128	0	←	←	←	0	←
3130	6630	3130	4130	0	←	←	←	0	←
3133	6633	3133	4133	5	←	←	←	6	←
Amp. model				18S	18S	22S	22S	30S	30S
Applicable ROM version				9A10A 9A50A				9A20D 9A50A	

Model code →				None	None
Parameter No.				Model 40S 1150/4500 37/45kW	Model 40S 1150/6000 37/45kW
PM	0C	15	16		
3011	6511	3011	4011	←	←
3012	6512	3012	4012	←	←
3013	6513	3013	4013	←	←
3020	6520	3020	4020	4500	6000
3080	6580	3080	4080	←	←
3083	6583	3083	4083	←	←
3084	6584	3084	4084	←	←
3085	6585	3085	4085	←	←
3086	6586	3086	4086	←	←
3100	6600	3100	4100	←	←
3101	6601	3101	4101	←	←
3102	6602	3102	4102	←	←
3103	6603	3103	4103	←	←
3104	6604	3104	4104	←	←
3105	6605	3105	4105	←	←
3106	6606	3106	4106	←	←
3107	6607	3107	4107	←	←
3108	6608	3108	4108	←	←
3109	6609	3109	4109	←	←
3110	6610	3110	4110	786	786
3111	6611	3111	4111	33	33
3112	6612	3112	4112	←	←
3113	6613	3113	4113	260	260
3114	6614	3114	4114	0	0
3115	6615	3115	4115	←	←
3116	6616	3116	4116	130	130
3117	6617	3117	4117	30	30
3118	6618	3118	4118	10	10
3119	6619	3119	4119	←	←
3120	6620	3120	4120	←	←
3121	6621	3121	4121	←	←
3127	6627	3127	4127	146	146
3128	6628	3128	4128	←	←
3130	6630	3130	4130	←	←
3133	6633	3133	4133	←	←
Amp. model				40S	40S
Applicable ROM version					

(b) P series

Model code →				7	8	9	None	None	10
Parameter No.				Model 8P 750/6000 3.7/5.5kW	Model 12P 750/6000 5.5/7.5kW	Model 15P 750/6000 7.5/9kW	Model 15P 500/6000 3.7/5.5kW	Model 15P 750/6000 5.5/7.5kW	Model 18P 750/6000 9/11kW
PM	0C	15	16						
3011	6511	3011	4011	00111010	00111010	00111010	←	←	00111010
3012	6512	3012	4012	00000000	00000000	00000000	←	←	00000000
3013	6513	3013	4013	00011010	00011010	00011010	←	←	00011010
3020	6520	3020	4020	6000	6000	6000	←	←	6000
3080	6580	3080	4080	50	50	50	←	←	65
3083	6583	3083	4083	30	30	30	←	←	30
3084	6584	3084	4084	30	30	30	←	←	30
3085	6585	3085	4085	30	30	30	←	←	30
3086	6586	3086	4086	100	100	100	←	←	100
3100	6600	3100	4100	750	750	750	500	740	850
3101	6601	3101	4101	100	80	100	88	88	100
3102	6602	3102	4102	1200	1000	900	←	←	1100
3103	6603	3103	4103	1200	1000	1100	←	←	1100
3104	6604	3104	4104	1600	1500	1800	←	←	1600
3105	6605	3105	4105	1600	1500	1800	←	←	1600
3106	6606	3106	4106	1600	1500	1500	←	←	1500
3107	6607	3107	4107	1600	1500	1500	←	←	1500
3108	6608	3108	4108	300	300	500	←	←	500
3109	6609	3109	4109	10	10	10	←	←	10
3110	6610	3110	4110	750	774	550	←	←	500
3111	6611	3111	4111	19	30	22	←	←	25
3112	6612	3112	4112	500	500	800	←	←	800
3113	6613	3113	4113	480	180	197	←	←	155
3114	6614	3114	4114	0	10	15	←	←	15
3115	6615	3115	4115	5	5	7	←	←	0
3116	6616	3116	4116	100	100	100	←	←	100
3117	6617	3117	4117	20	20	20	←	←	20
3118	6618	3118	4118	0	10	10	←	←	10
3119	6619	3119	4119	5	0	0	←	←	0
3120	6620	3120	4120	30	30	20	←	←	20
3121	6621	3121	4121	5	5	5	←	←	5
3127	6627	3127	4127	178	164	144	178	164	147
3128	6628	3128	4128	0	6000	0	←	←	0
3130	6630	3130	4130	0	0	0	←	←	0
3133	6633	3133	4133	7	8	9	←	←	10
Amp. model				6S	6S	8S	8S	8S	12S
Applicable ROM version				9A10A 9A50A	9A10A 9A50A	9A10A 9A50A			9A10A 9A50A

Model code →				None	None	11	None	None	None	None	None
Parameter No.				Model 18P 750/8000 9/11kW	Model 18P 500/6000 5.5/7.5kW	Model 22P 750/6000 11/15kW	Model 22P 750/8000 11/15kW	Model 22P 500/6000 7.5/11kW	Model 22P 750/6000 11/15kW	Model 22P 750/8000 11/15kW	Model 22P 550/6000 7.5/11kW
PM	0C	15	16								
3011	6511	3011	4011	←	←	00111010	←	←	←	←	←
3012	6512	3012	4012	←	←	00000000	←	←	←	←	←
3013	6513	3013	4013	←	←	00100110	←	←	00011010	00011010	00011010
3020	6520	3020	4020	8000	6000	6000	8000	6000	6000	8000	6000
3080	6580	3080	4080	←	←	55	←	←	40	40	40
3083	6583	3083	4083	←	←	30	←	←	←	←	←
3084	6584	3084	4084	←	←	30	←	←	←	←	←
3085	6585	3085	4085	←	←	30	←	←	←	←	←
3086	6586	3086	4086	←	←	100	←	←	←	←	←
3100	6600	3100	4100	←	580	870	←	630	800	800	600
3101	6601	3101	4101	←	←	100	←	←	←	←	←
3102	6602	3102	4102	←	←	1100	←	←	←	←	←
3103	6603	3103	4103	←	←	1100	←	←	←	←	←
3104	6604	3104	4104	←	←	1400	←	←	←	←	←
3105	6605	3105	4105	←	←	1400	←	←	←	←	←
3106	6606	3106	4106	←	←	1500	←	←	←	←	←
3107	6607	3107	4107	←	←	1500	←	←	←	←	←
3108	6608	3108	4108	←	←	300	←	←	←	←	←
3109	6609	3109	4109	←	←	10	←	←	←	←	←
3110	6610	3110	4110	←	←	862	←	←	477	477	477
3111	6611	3111	4111	←	←	28	←	←	21	21	21
3112	6612	3112	4112	←	←	500	←	←	←	←	←
3113	6613	3113	4113	←	←	160	←	←	260	260	260
3114	6614	3114	4114	←	←	10	←	←	13	13	13
3115	6615	3115	4115	←	←	5	←	←	←	←	←
3116	6616	3116	4116	←	←	110	←	←	←	←	←
3117	6617	3117	4117	←	←	20	←	←	←	←	←
3118	6618	3118	4118	←	←	10	←	←	←	←	←
3119	6619	3119	4119	←	←	0	←	←	←	←	←
3120	6620	3120	4120	←	←	30	←	←	←	←	←
3121	6621	3121	4121	←	←	5	←	←	←	←	←
3127	6627	3127	4127	←	164	163	←	176	163	163	176
3128	6628	3128	4128	←	←	0	←	←	←	←	←
3130	6630	3130	4130	←	←	0	←	←	←	←	←
3133	6633	3133	4133	←	←	11	←	←	←	←	←
Amp. model				12S	12S	15S	15S	15S	Small 15S	Small 15S	Small 15S
Applicable ROM version						9A10A 9A50A					

Model code →				13	None	12	None	None	14
Parameter No.				Model 30P 575/4500 15/18.5kW	Model 30P 575/6000 15/18.5kW	Model 40P 575/4500 18.5/22kW	Model 40P 575/6000 18.5/22kW	Model 40P 400/4500 11/15kW	Model 50P 575/4500 22/30kW
PM	0C	15	16						
3011	6511	3011	4011	00111010	←	00111010	←	←	00111010
3012	6512	3012	4012	00000000	←	00000000	←	←	00000000
3013	6513	3013	4013	00100110	←	00100110	←	←	00100110
3020	6520	3020	4020	4500	6000	4500	6000	4500	4500
3080	6580	3080	4080	50	←	50	←	←	50
3083	6583	3083	4083	30	←	30	←	←	30
3084	6584	3084	4084	30	←	30	←	←	30
3085	6585	3085	4085	30	←	30	←	←	30
3086	6586	3086	4086	100	←	100	←	←	100
3100	6600	3100	4100	575	←	550	←	430	600
3101	6601	3101	4101	100	←	100	←	←	100
3102	6602	3102	4102	650	←	650	←	←	600
3103	6603	3103	4103	650	←	800	←	←	600
3104	6604	3104	4104	2000	←	2800	←	←	3000
3105	6605	3105	4105	2000	←	2800	←	←	3000
3106	6606	3106	4106	1500	←	2000	←	←	1500
3107	6607	3107	4107	1500	←	2000	←	←	1500
3108	6608	3108	4108	300	←	300	←	←	300
3109	6609	3109	4109	10	←	10	←	←	10
3110	6610	3110	4110	750	←	430	←	←	630
3111	6611	3111	4111	26	←	18	←	←	27
3112	6612	3112	4112	500	←	500	←	←	500
3113	6613	3113	4113	115	←	176	←	←	120
3114	6614	3114	4114	10	←	10	←	←	10
3115	6615	3115	4115	5	←	12	←	←	5
3116	6616	3116	4116	100	←	90	←	←	100
3117	6617	3117	4117	20	←	20	←	←	20
3118	6618	3118	4118	10	←	10	←	←	10
3119	6619	3119	4119	0	←	0	←	←	0
3120	6620	3120	4120	30	←	40	←	←	40
3121	6621	3121	4121	5	←	5	←	←	5
3127	6627	3127	4127	148	←	143	←	164	176
3128	6628	3128	4128	3000	←	3450	←	←	0
3130	6630	3130	4130	0	←	0	←	←	0
3133	6633	3133	4133	13	←	12	←	←	14
Amp. model				18S	18S	22S	22S	22S	26S
Applicable ROM version				9A10A 9A50A		9A10A 9A50A			9A10A 9A50A

Model code →				None	None
Parameter No.				Model 50P 400/4500 18.5/22kW	Model 50P 400/4500 15/18.5kW
PM	0C	15	16		
3011	6511	3011	4011	←	←
3012	6512	3012	4012	←	←
3013	6513	3013	4013	←	←
3020	6520	3020	4020	←	←
3080	6580	3080	4080	←	←
3083	6583	3083	4083	←	←
3084	6584	3084	4084	←	←
3085	6585	3085	4085	←	←
3086	6586	3086	4086	←	←
3100	6600	3100	4100	400	400
3101	6601	3101	4101	←	84
3102	6602	3102	4102	←	←
3103	6603	3103	4103	←	←
3104	6604	3104	4104	←	←
3105	6605	3105	4105	←	←
3106	6606	3106	4106	←	←
3107	6607	3107	4107	←	←
3108	6608	3108	4108	←	←
3109	6609	3109	4109	←	←
3110	6610	3110	4110	←	←
3111	6611	3111	4111	←	←
3112	6612	3112	4112	←	←
3113	6613	3113	4113	←	←
3114	6614	3114	4114	←	←
3115	6615	3115	4115	←	←
3116	6616	3116	4116	←	←
3117	6617	3117	4117	←	←
3118	6618	3118	4118	←	←
3119	6619	3119	4119	←	←
3120	6620	3120	4120	←	←
3121	6621	3121	4121	←	←
3127	6627	3127	4127	143	148
3128	6628	3128	4128	8000	15000
3130	6630	3130	4130	←	←
3133	6633	3133	4133	←	←
Amp. model				26S	26S
Applicable ROM version					

(c) VH series

Model code →				29	30	31
Parameter No.				Model 6VH 5000/20000 5.5/7.5kW	Model 8VH 5000/20000 7.5/11kW	Model 12VH 5000/15000 11/15kW
PM	0C	15	16			
3011	6511	3011	4011	00001001	00001001	00001001
3012	6512	3012	4012	00000000	00000000	00000000
3013	6513	3013	4013	00011010	00011010	00100110
3020	6520	3020	4020	20000	20000	15000
3080	6580	3080	4080	75	51	53
3083	6583	3083	4083	20	20	30
3084	6584	3084	4084	30	30	30
3085	6585	3085	4085	30	30	30
3086	6586	3086	4086	100	100	100
3100	6600	3100	4100	5000	5500	2500
3101	6601	3101	4101	100	100	81
3102	6602	3102	4102	7000	7000	2500
3103	6603	3103	4103	7000	7000	2500
3104	6604	3104	4104	500	600	1000
3105	6605	3105	4105	500	600	1000
3106	6606	3106	4106	1500	1500	1200
3107	6607	3107	4107	1500	1500	1200
3108	6608	3108	4108	300	300	300
3109	6609	3109	4109	10	10	10
3110	6610	3110	4110	471	377	600
3111	6611	3111	4111	12	13	18
3112	6612	3112	4112	1000	1500	600
3113	6613	3113	4113	850	980	220
3114	6614	3114	4114	45	55	20
3115	6615	3115	4115	0	0	3
3116	6616	3116	4116	100	100	100
3117	6617	3117	4117	20	20	20
3118	6618	3118	4118	10	10	10
3119	6619	3119	4119	0	0	0
3120	6620	3120	4120	30	35	55
3121	6621	3121	4121	5	5	5
3127	6627	3127	4127	164	176	164
3128	6628	3128	4128	0	0	0
3130	6630	3130	4130	0	0	80
3133	6633	3133	4133	29	30	31
Amp. model				8S	12S	15S
Applicable ROM version				9A50E	9A50E	9A50E

(d) HV series

Model code →				34	None	35
Parameter No.				Model 30HV 1150/4500 30/37kW	Model 40HV 1150/4500 37/45kW	Model 60HV 1100/4500 60/75kW
PM	0C	15	16			
3011	6511	3011	4011	00001010	←	00001010
3012	6512	3012	4012	00000000	←	00000000
3013	6513	3013	4013	00101010	←	00101010
3020	6520	3020	4020	4500	←	4500
3080	6580	3080	4080	60	←	35
3083	6583	3083	4083	30	←	30
3084	6584	3084	4084	30	←	30
3085	6585	3085	4085	30	←	30
3086	6586	3086	4086	100	←	100
3100	6600	3100	4100	1400	←	1300
3101	6601	3101	4101	82	100	100
3102	6602	3102	4102	1400	←	1300
3103	6603	3103	4103	1250	←	1200
3104	6604	3104	4104	1500	←	1500
3105	6605	3105	4105	1500	←	1500
3106	6606	3106	4106	1500	←	1500
3107	6607	3107	4107	1500	←	1500
3108	6608	3108	4108	300	←	300
3109	6609	3109	4109	100	←	10
3110	6610	3110	4110	762	←	520
3111	6611	3111	4111	36	←	21
3112	6612	3112	4112	500	←	1000
3113	6613	3113	4113	135	←	165
3114	6614	3114	4114	10	←	0
3115	6615	3115	4115	5	←	3
3116	6616	3116	4116	100	←	100
3117	6617	3117	4117	20	←	20
3118	6618	3118	4118	10	←	10
3119	6619	3119	4119	0	←	250
3120	6620	3120	4120	50	←	50
3121	6621	3121	4121	5	←	5
3127	6627	3127	4127	148	146	150
3128	6628	3128	4128	0	←	0
3130	6630	3130	4130	0	←	50
3133	6633	3133	4133	34	←	35
Amp. model				30HV	40HV	60HV
Applicable ROM version				9A50B		9A50B

(e) Built-in mode

Model code →				24	23	None	15	16	17	None	19
Parameter No.				Model B0.3 (type A) 6000/6000 0.55/0.75kW	Model B0.5 (type A) 3000/8000 0.65/1.1kW	Model B0.5 (type B) 3000/ 12000 1.1/ 1.5kW	Model B1 (type A) 3000/ 15000 1.5/ 2.2kW	Model B1.5 (type A) 1500/ 8000 1.1/ 3.7kW	Model B2 (type A) 1500/ 8000 2.2/ 3.7kW	Model B2 (type B) 1500/ 8000 2.2/ 3.7kW	Model B6 (type A) 1100/ 10000 3.7/ 5.5kW
PM	0C	15	16								
3006	6506	3006	4006	00010000 Note)	00010000 Note)	←					
3011	6511	3011	4011	00001001	00001001	←	00001001	00001001	00001001	00001010	00001001
3012	6512	3012	4012	00000000	00000000	←	00000000	00000000	00000000	←	00000000
3013	6513	3013	4013	00011010	00011010	←	00011010	00011010	00011010	←	00011010
3020	6520	3020	4020	6000	8000	12000	15000 Note)	8000	8000	←	10000
3040	6540	3040	4040	2 Note)	2 Note)	←					
3080	6580	3080	4080	100	100	←	60	60	65	←	50
3083	6583	3083	4083	30	30	←	30	30	30	←	30
3084	6584	3084	4084	30	30	←	30	30	30	←	30
3085	6585	3085	4085	30	30	←	30	30	30	←	30
3086	6586	3086	4086	100	100	←	100	100	100	←	100
3100	6600	3100	4100	8000	3000	3500	3000	1500	1650	←	1100
3101	6601	3101	4101	75	100	←	100	100	100	←	100
3102	6602	3102	4102	8000	5500	←	3000	2000	2200	←	1100
3103	6603	3103	4103	8000	5500	←	3000	2000	2200	←	1600
3104	6604	3104	4104	900	500	←	1500	1500	1500	←	1600
3105	6605	3105	4105	900	500	←	1500	1500	1500	←	1600
3106	6606	3106	4106	1500	1500	←	1500	1500	1500	←	1500
3107	6607	3107	4107	1500	1500	←	1500	1500	1500	←	1500
3108	6608	3108	4108	300	300	←	500	500	300	←	300
3109	6609	3109	4109	10	10	←	10	10	10	←	10
3110	6610	3110	4110	3644	2811	←	820	492	652	←	655
3111	6611	3111	4111	35	26	40	8	13	16	←	14
3112	6612	3112	4112	500	500	←	500	500	600	←	500
3113	6613	3113	4113	1400	1000	1400	1550	1600	550	←	655
3114	6614	3114	4114	10	10	←	10	10	10	←	10
3115	6615	3115	4115	5	5	←	3	2	2	←	5
3116	6616	3116	4116	100	100	←	100	100	100	←	105
3117	6617	3117	4117	20	20	←	20	20	20	←	20
3118	6618	3118	4118	20	10	←	10	10	10	←	10
3119	6619	3119	4119	0	0	←	0	0	0	←	0
3120	6620	3120	4120	45	20	50	40	40	60	←	30
3121	6621	3121	4121	5	5	←	5	5	5	←	5
3127	6627	3127	4127	163	203	164	176	403	202	←	178
3128	6628	3128	4128	0	0	8000	0	16000	30000	←	0
3130	6630	3130	4130	0	95	50	0	0	0	←	0
3133	6633	3133	4133	24	23	←	15	16	17	←	19
Amp. model				1S	1S	2S	1S	2S	2S	2S	2S
Applicable ROM version				9A21B 9A50A	9A20E 9A50A		9A20D 9A50A	9A20D 9A50A	9A20D 9A50A		9A10H 9A50A

Note) After parameters are automatically set, change the parameters shown in this list manually.

Model code →				20	25	21	26	None
Parameter No.				Model B6 (type B) 1500/10000 5.5/7.5kW	Model B6 (type C) 2500/15000 11/15kW	Model B8 (type A) 1500/10000 7.5/11kW	Model B30 (type A) 350/3500 5.5/7.5kW	Model B30 (type B) 350/3500 7.5/11kW
PM	0C	15	16					
3011	6511	3011	4011	00001010	00001010	00001010	00001010	←
3012	6512	3012	4012	00000000	00000000	00000000	00000000	←
3013	6513	3013	4013	00011010	00100110	00011010	00011010	←
3020	6520	3020	4020	10000	15000	10000	3500	←
3080	6580	3080	4080	60	65	50	46	33
3083	6583	3083	4083	30	30	30	30	←
3084	6584	3084	4084	30	30	30	30	←
3085	6585	3085	4085	30	30	30	30	←
3086	6586	3086	4086	100	100	100	100	←
3100	6600	3100	4100	1900	2000	1700	430	360
3101	6601	3101	4101	100	100	100	73	100
3102	6602	3102	4102	1900	3625	1700	520	←
3103	6603	3103	4103	1950	3625	1700	520	←
3104	6604	3104	4104	1600	600	1500	1600	←
3105	6605	3105	4105	1600	600	1500	1600	←
3106	6606	3106	4106	1500	1500	1500	1500	←
3107	6607	3107	4107	1500	1500	1500	1500	←
3108	6608	3108	4108	300	300	300	300	←
3109	6609	3109	4109	10	10	10	10	←
3110	6610	3110	4110	754	686	500	603	←
3111	6611	3111	4111	24	30	17	29	←
3112	6612	3112	4112	800	500	500	500	←
3113	6613	3113	4113	410	550	500	132	←
3114	6614	3114	4114	10	50	0	15	←
3115	6615	3115	4115	5	5	5	0	←
3116	6616	3116	4116	105	105	100	100	←
3117	6617	3117	4117	20	20	20	20	←
3118	6618	3118	4118	10	10	10	10	←
3119	6619	3119	4119	0	0	0	0	←
3120	6620	3120	4120	40	30	30	25	←
3121	6621	3121	4121	5	50	5	5	←
3127	6627	3127	4127	164	164	163	163	176
3128	6628	3128	4128	0	0	0	0	2200
3130	6630	3130	4130	0	0	0	0	←
3133	6633	3133	4133	20	25	21	26	←
Amp. model				8S	22S	12S	8S	12S
Applicable ROM version				9A10H 9A50A	9A11D 9A50A	9A10H 9A50A	9A11D 9A50A	

Model code →				22
Parameter No.				Model B40 (type B) 1500/3000 37/45kW
PM	0C	15	16	
3011	6511	3011	4011	00001011
3012	6512	3012	4012	00000100
3013	6513	3013	4013	00111110
3020	6520	3020	4020	3000
3080	6580	3080	4080	70
3083	6583	3083	4083	30
3084	6584	3084	4084	30
3085	6585	3085	4085	30
3086	6586	3086	4086	100
3100	6600	3100	4100	1300
3101	6601	3101	4101	100
3102	6602	3102	4102	1300
3103	6603	3103	4103	1150
3104	6604	3104	4104	1100
3105	6605	3105	4105	1100
3106	6606	3106	4106	1500
3107	6607	3107	4107	1500
3108	6608	3108	4108	300
3109	6609	3109	4109	10
3110	6610	3110	4110	786
3111	6611	3111	4111	34
3112	6612	3112	4112	500
3113	6613	3113	4113	340
3114	6614	3114	4114	10
3115	6615	3115	4115	0
3116	6616	3116	4116	100
3117	6617	3117	4117	20
3118	6618	3118	4118	10
3119	6619	3119	4119	0
3120	6620	3120	4120	45
3121	6621	3121	4121	5
3127	6627	3127	4127	146
3128	6628	3128	4128	0
3130	6630	3130	4130	0
3133	6633	3133	4133	22
Amp. model				40S
Applicable ROM version				9A20D 9A50A

Motor specification No. : A06B-0923-B311 model B3 (type a)
Speed range switching speed : 4000rpm

Amp. specification No. : A06B-6064-H306#H550 model 6S

Model code : 71

Parameters for low-speed properties				
Parameter No.				1500/4000rpm
PM	0C	15	16	3.7/5.5kW
3136	6900	3280	4036	30
3137	6901	3281	4037	30
3138	6902	3282	4138	1600
3139	6903	3283	4139	100
3140	6904	3284	4140	2000
3141	6905	3285	4141	2000
3142	6906	3286	4142	1000
3143	6907	3287	4143	1500
3144	6908	3288	4144	300
3145	6909	3289	4145	10
3146	6910	3290	4146	838
3147	6911	3291	4147	22
3148	6912	3292	4148	500
3149	6913	3293	4149	400
3150	6914	3294	4150	10
3151	6915	3295	4151	0
3152	6916	3296	4152	100
3153	6917	3297	4153	20
3154	6918	3298	4154	10
3157	6921	3301	4157	5
3158	6928	3302	4158	0

Parameters for high-speed properties				
Parameter No.				4000/15000rpm
PM	0C	15	16	3.7/5.5kW
3011	6511	3011	4011	00001010
3012	6512	3012	4012	00000000
3013	6513	3013	4013	00011010
3020	6520	3020	4020	15000
3080	6580	3080	4080	95
3083	6583	3083	4083	30
3084	6584	3084	4084	30
3085	6585	3085	4085	30
3086	6586	3086	4086	100
3100	6600	3100	4100	4300
3101	6601	3101	4101	100
3102	6602	3102	4102	5500
3103	6603	3103	4103	5500
3104	6604	3104	4104	700
3105	6605	3105	4105	700
3106	6606	3106	4106	1500
3107	6607	3107	4107	1500
3108	6608	3108	4108	300
3109	6609	3109	4109	10
3110	6610	3110	4110	838
3111	6611	3111	4111	22
3112	6612	3112	4112	500
3113	6613	3113	4113	350
3114	6614	3114	4114	25
3115	6615	3115	4115	0
3116	6616	3116	4116	100
3117	6617	3117	4117	20
3118	6618	3118	4118	10
3119	6619	3119	4119	0
3120	6620	3120	4120	30
3121	6621	3121	4121	5
3127	6627	3127	4127	178
3128	6628	3128	4128	0
3130	6630	3130	4130	0
3133	6633	3133	4133	71

Motor specification No. : A06B-0958-B111 Model B8 (type a)
Speed range switching speed : 1600rpm

Amp. specification No. : A06B-6064-H312#H550 Model 12S

Model code : 64

Parameters for low-speed properties				
Parameter No.				530/1600rpm 5.5/7.5kW
PM	0C	15	16	
3136	6900	3280	4036	30
3137	6901	3281	4037	30
3138	6902	3282	4138	600
3139	6903	3283	4139	100
3140	6904	3284	4140	700
3141	6905	3285	4141	700
3142	6906	3286	4142	1500
3143	6907	3287	4143	1500
3144	6908	3288	4144	300
3145	6909	3289	4145	10
3146	6910	3290	4146	503
3147	6911	3291	4147	20
3148	6912	3292	4148	500
3149	6913	3293	4149	955
3150	6914	3294	4150	10
3151	6915	3295	4151	5
3152	6916	3296	4152	100
3153	6917	3297	4153	20
3154	6918	3298	4154	10
3157	6921	3301	4157	5
3158	6928	3302	4158	0

Parameters for high-speed properties				
Parameter No.				1600/10000rpm 5.5/7.5kW
PM	0C	15	16	
3011	6511	3011	4011	00111010
3012	6512	3012	4012	00000000
3013	6513	3013	4013	00011010
3020	6520	3020	4020	10000
3080	6580	3080	4080	60
3083	6583	3083	4083	30
3084	6584	3084	4084	30
3085	6585	3085	4085	30
3086	6586	3086	4086	100
3100	6600	3100	4100	1600
3101	6601	3101	4101	100
3102	6602	3102	4102	2400
3103	6603	3103	4103	2400
3104	6604	3104	4104	1100
3105	6605	3105	4105	1100
3106	6606	3106	4106	1100
3107	6607	3107	4107	1100
3108	6608	3108	4108	300
3109	6609	3109	4109	10
3110	6610	3110	4110	377
3111	6611	3111	4111	13
3112	6612	3112	4112	500
3113	6613	3113	4113	625
3114	6614	3114	4114	10
3115	6615	3115	4115	5
3116	6616	3116	4116	100
3117	6617	3117	4117	20
3118	6618	3118	4118	10
3119	6619	3119	4119	0
3120	6620	3120	4120	30
3121	6621	3121	4121	5
3127	6627	3127	4127	164
3128	6628	3128	4128	25000
3130	6630	3130	4130	0
3133	6633	3133	4133	64

Motor specification No. : A06B-0930-B111 Model B10 (type a)
Speed range switching speed : 1000rpm

Amp. specification No. : A06B-6064-H312#H550 Model 12S

Model code : 72

Parameters for low-speed properties				
Parameter No.				520/1000rpm 5.5/7.5kW
PM	0C	15	16	
3136	6900	3280	4036	30
3137	6901	3281	4037	30
3138	6902	3282	4138	600
3139	6903	3283	4139	100
3140	6904	3284	4140	800
3141	6905	3285	4141	800
3142	6906	3286	4142	1850
3143	6907	3287	4143	1500
3144	6908	3288	4144	300
3145	6909	3289	4145	10
3146	6910	3290	4146	656
3147	6911	3291	4147	28
3148	6912	3292	4148	500
3149	6913	3293	4149	500
3150	6914	3294	4150	10
3151	6915	3295	4151	5
3152	6916	3296	4152	100
3153	6917	3297	4153	20
3154	6918	3298	4154	0
3157	6921	3301	4157	5
3158	6928	3302	4158	0

Parameters for high-speed properties				
Parameter No.				1000/8000rpm 5.5/7.5kW
PM	0C	15	16	
3011	6511	3011	4011	00001010
3012	6512	3012	4012	00000000
3013	6513	3013	4013	00011010
3020	6520	3020	4020	8000
3080	6580	3080	4080	65
3083	6583	3083	4083	30
3084	6584	3084	4084	30
3085	6585	3085	4085	30
3086	6586	3086	4086	100
3100	6600	3100	4100	1500
3101	6601	3101	4101	100
3102	6602	3102	4102	2000
3103	6603	3103	4103	2000
3104	6604	3104	4104	1250
3105	6605	3105	4105	1250
3106	6606	3106	4106	1500
3107	6607	3107	4107	1500
3108	6608	3108	4108	300
3109	6609	3109	4109	10
3110	6610	3110	4110	431
3111	6611	3111	4111	12
3112	6612	3112	4112	500
3113	6613	3113	4113	500
3114	6614	3114	4114	10
3115	6615	3115	4115	5
3116	6616	3116	4116	100
3117	6617	3117	4117	20
3118	6618	3118	4118	10
3119	6619	3119	4119	0
3120	6620	3120	4120	30
3121	6621	3121	4121	5
3127	6627	3127	4127	164
3128	6628	3128	4128	0
3130	6630	3130	4130	0
3133	6633	3133	4133	72

Motor specification No. : A06B-0930-B111 Model B10 (type b)
Speed range switching speed : 1000rpm

Amp. specification No. : A06B-6064-H315#H550 Model 15S

Model code : 65

Parameters for low-speed properties					Parameters for high-speed properties				
Parameter No.				320/1000rpm 5.5/7.5kW	Parameter No.				1000/10000rpm 5.5/7.5kW
PM	0C	15	16		PM	0C	15	16	
					3011	6511	3011	4011	00001010
					3012	6512	3012	4012	00000000
					3013	6513	3013	4013	00100110
					3020	6520	3020	4020	10000
					3080	6580	3080	4080	70
3136	6900	3280	4036	30	3083	6583	3083	4083	30
					3084	6584	3084	4084	30
3137	6901	3281	4037	30	3085	6585	3085	4085	30
					3086	6586	3086	4086	100
3138	6902	3282	4138	350	3100	6600	3100	4100	1000
3139	6903	3283	4139	100	3101	6601	3101	4101	100
3140	6904	3284	4140	800	3102	6602	3102	4102	1915
3141	6905	3285	4141	800	3103	6603	3103	4103	1915
3142	6906	3286	4142	2000	3104	6604	3104	4104	1100
					3105	6605	3105	4105	1100
3143	6907	3287	4143	1500	3106	6606	3106	4106	1500
					3107	6607	3107	4107	1500
3144	6908	3288	4144	300	3108	6608	3108	4108	300
3145	6909	3289	4145	10	3109	6609	3109	4109	10
3146	6910	3290	4146	1676	3110	6610	3110	4110	838
3147	6911	3291	4147	62	3111	6611	3111	4111	22
3148	6912	3292	4148	500	3112	6612	3112	4112	500
3149	6913	3293	4149	400	3113	6613	3113	4113	400
3150	6914	3294	4150	10	3114	6614	3114	4114	10
3151	6915	3295	4151	5	3115	6615	3115	4115	5
3152	6916	3296	4152	100	3116	6616	3116	4116	100
3153	6917	3297	4153	20	3117	6617	3117	4117	20
3154	6918	3298	4154	10	3118	6618	3118	4118	10
					3119	6619	3119	4119	0
					3120	6620	3120	4120	50
3157	6921	3301	4157	5	3121	6621	3121	4121	5
					3127	6627	3127	4127	164
3158	6928	3302	4158	0	3128	6628	3128	4128	0
					3130	6630	3130	4130	0
					3133	6633	3133	4133	65

Motor specification No. : A06B-0937-B111 Model B17 (type a)
Speed range switching speed : 1500rpm

Amp. specification No. : A06B-6064-H312#H550 Model 12S

Model code : 66

Parameters for low-speed properties				
Parameter No.				330/1500rpm 5.5/7.5kW
PM	0C	15	16	
3136	6900	3280	4036	30
3137	6901	3281	4037	100
3138	6902	3282	4138	380
3139	6903	3283	4139	100
3140	6904	3284	4140	650
3141	6905	3285	4141	650
3142	6906	3286	4142	2000
3143	6907	3287	4143	100
3144	6908	3288	4144	1
3145	6909	3289	4145	10
3146	6910	3290	4146	559
3147	6911	3291	4147	22
3148	6912	3292	4148	500
3149	6913	3293	4149	330
3150	6914	3294	4150	30
3151	6915	3295	4151	5
3152	6916	3296	4152	100
3153	6917	3297	4153	20
3154	6918	3298	4154	5
3157	6921	3301	4157	5
3158	6928	3302	4158	1000

Parameters for high-speed properties				
Parameter No.				1500/10000rpm 5.5/7.5kW
PM	0C	15	16	
3011	6511	3011	4011	00111010
3012	6512	3012	4012	00000000
3013	6513	3013	4013	00011010
3020	6520	3020	4020	10000
3080	6580	3080	4080	65
3083	6583	3083	4083	30
3084	6584	3084	4084	30
3085	6585	3085	4085	30
3086	6586	3086	4086	100
3100	6600	3100	4100	1550
3101	6601	3101	4101	100
3102	6602	3102	4102	2000
3103	6603	3103	4103	2000
3104	6604	3104	4104	1500
3105	6605	3105	4105	1500
3106	6606	3106	4106	100
3107	6607	3107	4107	100
3108	6608	3108	4108	1
3109	6609	3109	4109	10
3110	6610	3110	4110	302
3111	6611	3111	4111	10
3112	6612	3112	4112	500
3113	6613	3113	4113	330
3114	6614	3114	4114	50
3115	6615	3115	4115	5
3116	6616	3116	4116	100
3117	6617	3117	4117	30
3118	6618	3118	4118	10
3119	6619	3119	4119	0
3120	6620	3120	4120	30
3121	6621	3121	4121	5
3127	6627	3127	4127	164
3128	6628	3128	4128	11000
3130	6630	3130	4130	0
3133	6633	3133	4133	66

Motor specification No. : A06B-0946-B901 Model B26 (type a)
Speed range switching speed : 1400rpm

Amp. specification No. : A06B-6064-H312#H550 Model 12S

Model code : 73

Parameters for low-speed properties				
Parameter No.				550/1400rpm
PM	0C	15	16	7.5/11kW
3136	6900	3280	4036	30
3137	6901	3281	4037	30
3138	6902	3282	4138	550
3139	6903	3283	4139	100
3140	6904	3284	4140	700
3141	6905	3285	4141	700
3142	6906	3286	4142	1500
3143	6907	3287	4143	1500
3144	6908	3288	4144	300
3145	6909	3289	4145	10
3146	6910	3290	4146	790
3147	6911	3291	4147	39
3148	6912	3292	4148	500
3149	6913	3293	4149	180
3150	6914	3294	4150	10
3151	6915	3295	4151	5
3152	6916	3296	4152	100
3153	6917	3297	4153	20
3154	6918	3298	4154	10
3157	6921	3301	4157	5
3158	6928	3302	4158	0

Parameters for high-speed properties				
Parameter No.				1400/4500rpm
PM	0C	15	16	7.5/11kW
3011	6511	3011	4011	00001010
3012	6512	3012	4012	00000000
3013	6513	3013	4013	00011010
3020	6520	3020	4020	4500
3080	6580	3080	4080	60
3083	6583	3083	4083	30
3084	6584	3084	4084	30
3085	6585	3085	4085	30
3086	6586	3086	4086	100
3100	6600	3100	4100	1400
3101	6601	3101	4101	100
3102	6602	3102	4102	1400
3103	6603	3103	4103	1400
3104	6604	3104	4104	1500
3105	6605	3105	4105	1500
3106	6606	3106	4106	1500
3107	6607	3107	4107	1500
3108	6608	3108	4108	300
3109	6609	3109	4109	10
3110	6610	3110	4110	430
3111	6611	3111	4111	14
3112	6612	3112	4112	500
3113	6613	3113	4113	222
3114	6614	3114	4114	10
3115	6615	3115	4115	5
3116	6616	3116	4116	100
3117	6617	3117	4117	20
3118	6618	3118	4118	10
3119	6619	3119	4119	0
3120	6620	3120	4120	30
3121	6621	3121	4121	5
3127	6627	3127	4127	176
3128	6628	3128	4128	0
3130	6630	3130	4130	0
3133	6633	3133	4133	73

Motor specification No. : A06B-0946-B311 Model B26 (type b)
Speed range switching speed : 1000rpm

Amp. specification No. : A06B-6064-H315#H550 Model 15S

Model code : 74

Parameters for low-speed properties				
Parameter No.				360/1000rpm 7.5/11kW
PM	0C	15	16	
3136	6900	3280	4036	30
3137	6901	3281	4037	30
3138	6902	3282	4138	400
3139	6903	3283	4139	100
3140	6904	3284	4140	640
3141	6905	3285	4141	640
3142	6906	3286	4142	1500
3143	6907	3287	4143	1500
3144	6908	3288	4144	300
3145	6909	3289	4145	10
3146	6910	3290	4146	754
3147	6911	3291	4147	27
3148	6912	3292	4148	500
3149	6913	3293	4149	300
3150	6914	3294	4150	10
3151	6915	3295	4151	5
3152	6916	3296	4152	100
3153	6917	3297	4153	20
3154	6918	3298	4154	10
3157	6921	3301	4157	5
3158	6928	3302	4158	0

Parameters for high-speed properties				
Parameter No.				1000/10000rpm 7.5/11kW
PM	0C	15	16	
3011	6511	3011	4011	00001010
3012	6512	3012	4012	00000000
3013	6513	3013	4013	00100110
3020	6520	3020	4020	10000
3080	6580	3080	4080	50
3083	6583	3083	4083	30
3084	6584	3084	4084	30
3085	6585	3085	4085	30
3086	6586	3086	4086	100
3100	6600	3100	4100	1000
3101	6601	3101	4101	80
3102	6602	3102	4102	1300
3103	6603	3103	4103	1300
3104	6604	3104	4104	1500
3105	6605	3105	4105	1500
3106	6606	3106	4106	1500
3107	6607	3107	4107	1500
3108	6608	3108	4108	300
3109	6609	3109	4109	10
3110	6610	3110	4110	754
3111	6611	3111	4111	24
3112	6612	3112	4112	500
3113	6613	3113	4113	200
3114	6614	3114	4114	10
3115	6615	3115	4115	5
3116	6616	3116	4116	100
3117	6617	3117	4117	20
3118	6618	3118	4118	10
3119	6619	3119	4119	0
3120	6620	3120	4120	30
3121	6621	3121	4121	5
3127	6627	3127	4127	176
3128	6628	3128	4128	10000
3130	6630	3130	4130	0
3133	6633	3133	4133	74

Motor specification No. : A06B-0946-B311 Model B26 (type c)
Speed range switching speed : 1000rpm

Amp. specification No. : A06B-6064-H318#H550 Model 18S

Model code : 67

Parameters for low-speed properties				
Parameter No.				360/1000rpm 7.5/11kW
PM	0C	15	16	
3136	6900	3280	4036	30
3137	6901	3281	4037	30
3138	6902	3282	4138	400
3139	6903	3283	4139	100
3140	6904	3284	4140	640
3141	6905	3285	4141	640
3142	6906	3286	4142	1500
3143	6907	3287	4143	1500
3144	6908	3288	4144	300
3145	6909	3289	4145	10
3146	6910	3290	4146	754
3147	6911	3291	4147	27
3148	6912	3292	4148	500
3149	6913	3293	4149	300
3150	6914	3294	4150	10
3151	6915	3295	4151	5
3152	6916	3296	4152	100
3153	6917	3297	4153	20
3154	6918	3298	4154	5
3157	6921	3301	4157	5
3158	6928	3302	4158	0

Parameters for high-speed properties				
Parameter No.				1000/10000rpm 7.5/11kW
PM	0C	15	16	
3011	6511	3011	4011	00111010
3012	6512	3012	4012	00000000
3013	6513	3013	4013	00100110
3020	6520	3020	4020	10000
3080	6580	3080	4080	50
3083	6583	3083	4083	30
3084	6584	3084	4084	30
3085	6585	3085	4085	30
3086	6586	3086	4086	100
3100	6600	3100	4100	1300
3101	6601	3101	4101	70
3102	6602	3102	4102	1300
3103	6603	3103	4103	1300
3104	6604	3104	4104	1500
3105	6605	3105	4105	1500
3106	6606	3106	4106	1500
3107	6607	3107	4107	1500
3108	6608	3108	4108	300
3109	6609	3109	4109	10
3110	6610	3110	4110	754
3111	6611	3111	4111	26
3112	6612	3112	4112	500
3113	6613	3113	4113	200
3114	6614	3114	4114	10
3115	6615	3115	4115	5
3116	6616	3116	4116	105
3117	6617	3117	4117	20
3118	6618	3118	4118	10
3119	6619	3119	4119	0
3120	6620	3120	4120	30
3121	6621	3121	4121	5
3127	6627	3127	4127	176
3128	6628	3128	4128	0
3130	6630	3130	4130	0
3133	6633	3133	4133	67

Motor specification No. : A06B-0960-B901 Model B28 (type a)
Speed range switching speed : 1000rpm

Amp. specification No. : A06B-6064-H312#H550 Model 12S

Model code : 75

Parameters for low-speed properties				
Parameter No.				430/1000rpm 7.5/11kW
PM	0C	15	16	
3136	6900	3280	4036	30
3137	6901	3281	4037	30
3138	6902	3282	4138	550
3139	6903	3283	4139	100
3140	6904	3284	4140	550
3141	6905	3285	4141	550
3142	6906	3286	4142	1500
3143	6907	3287	4143	1500
3144	6908	3288	4144	300
3145	6909	3289	4145	10
3146	6910	3290	4146	840
3147	6911	3291	4147	40
3148	6912	3292	4148	500
3149	6913	3293	4149	120
3150	6914	3294	4150	10
3151	6915	3295	4151	5
3152	6916	3296	4152	100
3153	6917	3297	4153	20
3154	6918	3298	4154	10
3157	6921	3301	4157	5
3158	6928	3302	4158	0

Parameters for high-speed properties				
Parameter No.				1000/4500rpm 7.5/11kW
PM	0C	15	16	
3011	6511	3011	4011	00001011
3012	6512	3012	4012	00000000
3013	6513	3013	4013	00011010
3020	6520	3020	4020	4500
3080	6580	3080	4080	50
3083	6583	3083	4083	30
3084	6584	3084	4084	30
3085	6585	3085	4085	30
3086	6586	3086	4086	100
3100	6600	3100	4100	1005
3101	6601	3101	4101	100
3102	6602	3102	4102	1250
3103	6603	3103	4103	1250
3104	6604	3104	4104	1500
3105	6605	3105	4105	1500
3106	6606	3106	4106	1500
3107	6607	3107	4107	1500
3108	6608	3108	4108	300
3109	6609	3109	4109	10
3110	6610	3110	4110	500
3111	6611	3111	4111	21
3112	6612	3112	4112	500
3113	6613	3113	4113	120
3114	6614	3114	4114	10
3115	6615	3115	4115	5
3116	6616	3116	4116	100
3117	6617	3117	4117	20
3118	6618	3118	4118	10
3119	6619	3119	4119	0
3120	6620	3120	4120	30
3121	6621	3121	4121	5
3127	6627	3127	4127	176
3128	6628	3128	4128	0
3130	6630	3130	4130	0
3133	6633	3133	4133	75

Motor specification No. : A06B-0960-B011 Model B28 (type b)
Speed range switching speed : 900rpm

Amp. specification No. : A06B-6064-H315#H550 Model 15S

Model code : 76

Parameters for low-speed properties				
Parameter No.				400/900rpm 11/15kW
PM	0C	15	16	
3136	6900	3280	4036	30
3137	6901	3281	4037	30
3138	6902	3282	4138	550
3139	6903	3283	4139	100
3140	6904	3284	4140	550
3141	6905	3285	4141	400
3142	6906	3286	4142	1500
3143	6907	3287	4143	1500
3144	6908	3288	4144	300
3145	6909	3289	4145	10
3146	6910	3290	4146	1676
3147	6911	3291	4147	60
3148	6912	3292	4148	500
3149	6913	3293	4149	90
3150	6914	3294	4150	10
3151	6915	3295	4151	5
3152	6916	3296	4152	105
3153	6917	3297	4153	20
3154	6918	3298	4154	10
3157	6921	3301	4157	5
3158	6928	3302	4158	0

Parameters for high-speed properties				
Parameter No.				900/6000rpm 11/15kW
PM	0C	15	16	
3011	6511	3011	4011	00001010
3012	6512	3012	4012	00000000
3013	6513	3013	4013	00100110
3020	6520	3020	4020	6000
3080	6580	3080	4080	50
3083	6583	3083	4083	30
3084	6584	3084	4084	30
3085	6585	3085	4085	30
3086	6586	3086	4086	100
3100	6600	3100	4100	900
3101	6601	3101	4101	100
3102	6602	3102	4102	1200
3103	6603	3103	4103	1200
3104	6604	3104	4104	1500
3105	6605	3105	4105	1500
3106	6606	3106	4106	1500
3107	6607	3107	4107	1500
3108	6608	3108	4108	300
3109	6609	3109	4109	10
3110	6610	3110	4110	838
3111	6611	3111	4111	26
3112	6612	3112	4112	500
3113	6613	3113	4113	120
3114	6614	3114	4114	10
3115	6615	3115	4115	5
3116	6616	3116	4116	105
3117	6617	3117	4117	20
3118	6618	3118	4118	10
3119	6619	3119	4119	0
3120	6620	3120	4120	30
3121	6621	3121	4121	5
3127	6627	3127	4127	164
3128	6628	3128	4128	4500
3130	6630	3130	4130	0
3133	6633	3133	4133	75

Motor specification No. : A06B-0960-B111 Model B28 (type c)
Speed range switching speed : 2000rpm

Amp. specification No. : A06B-6064-H326#H550 Model 26S

Model code : 68

Parameters for low-speed properties				
Parameter No.				320/2000rpm 11/15kW
PM	0C	15	16	
3136	6900	3280	4036	30
3137	6901	3281	4037	30
3138	6902	3282	4138	400
3139	6903	3283	4139	100
3140	6904	3284	4140	700
3141	6905	3285	4141	700
3142	6906	3286	4142	1500
3143	6907	3287	4143	1000
3144	6908	3288	4144	300
3145	6909	3289	4145	10
3146	6910	3290	4146	1250
3147	6911	3291	4147	58
3148	6912	3292	4148	500
3149	6913	3293	4149	115
3150	6914	3294	4150	10
3151	6915	3295	4151	5
3152	6916	3296	4152	100
3153	6917	3297	4153	20
3154	6918	3298	4154	10
3157	6921	3301	4157	5
3158	6928	3302	4158	0

Parameters for high-speed properties				
Parameter No.				2000/6000rpm 11/15kW
PM	0C	15	16	
3011	6511	3011	4011	00111010
3012	6512	3012	4012	00000000
3013	6513	3013	4013	00100110
3020	6520	3020	4020	6000
3080	6580	3080	4080	80
3083	6583	3083	4083	30
3084	6584	3084	4084	30
3085	6585	3085	4085	30
3086	6586	3086	4086	100
3100	6600	3100	4100	2000
3101	6601	3101	4101	68
3102	6602	3102	4102	2300
3103	6603	3103	4103	2300
3104	6604	3104	4104	700
3105	6605	3105	4105	700
3106	6606	3106	4106	1000
3107	6607	3107	4107	1000
3108	6608	3108	4108	300
3109	6609	3109	4109	10
3110	6610	3110	4110	500
3111	6611	3111	4111	20
3112	6612	3112	4112	500
3113	6613	3113	4113	110
3114	6614	3114	4114	10
3115	6615	3115	4115	5
3116	6616	3116	4116	100
3117	6617	3117	4117	20
3118	6618	3118	4118	10
3119	6619	3119	4119	0
3120	6620	3120	4120	30
3121	6621	3121	4121	5
3127	6627	3127	4127	164
3128	6628	3128	4128	0
3130	6630	3130	4130	0
3133	6633	3133	4133	68

Motor specification No. : A06B-0965-B111 Model B35 (type a)
Speed range switching speed : 1100rpm

Amp. specification No. : A06B-6064-H326#H550 Model 26S

Model code : 69

Parameters for low-speed properties				
Parameter No.				350/1100rpm 18.5/22kW
PM	0C	15	16	
3136	6900	3280	4036	30
3137	6901	3281	4037	30
3138	6902	3282	4138	500
3139	6903	3283	4139	100
3140	6904	3284	4140	500
3141	6905	3285	4141	500
3142	6906	3286	4142	2000
3143	6907	3287	4143	1500
3144	6908	3288	4144	300
3145	6909	3289	4145	10
3146	6910	3290	4146	838
3147	6911	3291	4147	38
3148	6912	3292	4148	500
3149	6913	3293	4149	120
3150	6914	3294	4150	10
3151	6915	3295	4151	0
3152	6916	3296	4152	100
3153	6917	3297	4153	20
3154	6918	3298	4154	10
3157	6921	3301	4157	5
3158	6928	3302	4158	0

Parameters for high-speed properties				
Parameter No.				1100/6000rpm 18.5/22kW
PM	0C	15	16	
3011	6511	3011	4011	00001010
3012	6512	3012	4012	00000000
3013	6513	3013	4013	00100110
3020	6520	3020	4020	6000
3080	6580	3080	4080	55
3083	6583	3083	4083	30
3084	6584	3084	4084	30
3085	6585	3085	4085	30
3086	6586	3086	4086	100
3100	6600	3100	4100	1500
3101	6601	3101	4101	100
3102	6602	3102	4102	1500
3103	6603	3103	4103	1500
3104	6604	3104	4104	1100
3105	6605	3105	4105	1100
3106	6606	3106	4106	1500
3107	6607	3107	4107	1500
3108	6608	3108	4108	300
3109	6609	3109	4109	10
3110	6610	3110	4110	539
3111	6611	3111	4111	23
3112	6612	3112	4112	500
3113	6613	3113	4113	100
3114	6614	3114	4114	10
3115	6615	3115	4115	0
3116	6616	3116	4116	100
3117	6617	3117	4117	20
3118	6618	3118	4118	10
3119	6619	3119	4119	0
3120	6620	3120	4120	50
3121	6621	3121	4121	5
3127	6627	3127	4127	143
3128	6628	3128	4128	0
3130	6630	3130	4130	0
3133	6633	3133	4133	69

Motor specification No. : A06B-0988-B113 Model B45 (type a)
Speed range switching speed : 900rpm

Amp. specification No. : A06B-6064-H326#H550 Model 26S

Model code : 77

Parameters for low-speed properties				
Parameter No.				300/900rpm 11/15kW
PM	0C	15	16	
3136	6900	3280	4036	30
3137	6901	3281	4037	30
3138	6902	3282	4138	320
3139	6903	3283	4139	100
3140	6904	3284	4140	500
3141	6905	3285	4141	500
3142	6906	3286	4142	2400
3143	6907	3287	4143	1500
3144	6908	3288	4144	300
3145	6909	3289	4145	10
3146	6910	3290	4146	754
3147	6911	3291	4147	32
3148	6912	3292	4148	200
3149	6913	3293	4149	380
3150	6914	3294	4150	10
3151	6915	3295	4151	5
3152	6916	3296	4152	100
3153	6917	3297	4153	20
3154	6918	3298	4154	10
3157	6921	3301	4157	5
3158	6928	3302	4158	0

Parameters for high-speed properties				
Parameter No.				900/3500rpm 11/15kW
PM	0C	15	16	
3011	6511	3011	4011	10000011
3012	6512	3012	4012	00000000
3013	6513	3013	4013	00100110
3020	6520	3020	4020	3500
3080	6580	3080	4080	80
3083	6583	3083	4083	30
3084	6584	3084	4084	30
3085	6585	3085	4085	30
3086	6586	3086	4086	100
3100	6600	3100	4100	800
3101	6601	3101	4101	100
3102	6602	3102	4102	1300
3103	6603	3103	4103	1300
3104	6604	3104	4104	2400
3105	6605	3105	4105	2400
3106	6606	3106	4106	1500
3107	6607	3107	4107	1500
3108	6608	3108	4108	300
3109	6609	3109	4109	10
3110	6610	3110	4110	673
3111	6611	3111	4111	27
3112	6612	3112	4112	500
3113	6613	3113	4113	250
3114	6614	3114	4114	10
3115	6615	3115	4115	0
3116	6616	3116	4116	100
3117	6617	3117	4117	20
3118	6618	3118	4118	10
3119	6619	3119	4119	0
3120	6620	3120	4120	30
3121	6621	3121	4121	5
3127	6627	3127	4127	164
3128	6628	3128	4128	6000
3130	6630	3130	4130	0
3133	6633	3133	4133	77

APPENDIX 13 SPINDLE CONTROL SIGNALS

The abbreviations used in this manual stand for the following:
PM: Power Mate
0C: Series 0-MC or 0-TC
0TTC: Tool post 2 of Series 0-TTC
15: Series 15
16: Series 16

1.1 Spindle Control DI signal (PMC to CNC)

PM	0C	0TTC HEAD2	15	16	7	6	5	4	3	2	1	0
G112	G229	G1429	G227	G070	MRDYA	ORCMA	SFRA	SRVA	CTH1A	CTH2A	TLMHA	TLMLA
G113	G230	G1430	G226	G071	RCHA	RSLA	INTGA	SOCNA	MCFNA	SPSLA	*ESPA	ARSTA
G114	G231	G1431	G229	G072	RCHHGA	MFNHG	ROTCA	OVRA	DEFMDA	NRROA	ROTAA	INDXA
G115	G232	G1432	G228	G073							SLVA	MORCMA
G072	G124	G1324		G032	R08I	R07I	R06I	R05I	R04I	R03I	R02I	R01I
G073	G125	G1325		G033	SIND	SSIN	SGN		R12I	R11I	R10I	R09I
			G024		RISGN			RI12	RI11	RI10	RI09	RI08
			G025		RI07	RI06	RI05	RI04	RI03	RI02	RI01	RI00
	G110	G1310	G231	G078	SHA07	SHA06	SHA05	SHA04	SHA03	SHA02	SHA01	SHA00
	G111	G1311	G230	G079					SHA11	SHA10	SHA09	SHA08
G083	G103	G1303					SPC	SPB	SPA			
G120					SOVE	SOV6	SOV5	SOV4	SOV3	SOV2	SOV1	SOV0
			G029							SPC	SPB	SPA
				G030	SOV7	SOV6	SOV5	SOV4	SOV3	SOV2	SOV1	SOV0
G068	G120	G1320				*SSTP	SOR	SAR	FIN			
			G005								FIN	
				G029		*SSTP	SOR	SAR				
				G004					FIN			
	G123 (*1)	G1323			CON(M)	SPSTP	*SCPF	*SUCPF	GR2	GR1		COFF(T)
	G118 (*1)	G1318							GR2	GR1		
				G027	CON(T/M)							
			G67, 71 . .		SCNTR1, 2 . .							
	G146			G038					SPPHS	SPSYC		
			G111		SPPHS	SPSYC						

(*1) Depends on bit 5 (ADDCF) of parameter 31

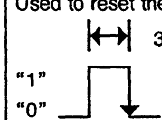
PM	0C	0TTC HEAD2	15	16	7	6	5	4	3	2	1	0
	G123 (*2)										RGTP	
G099	G135 (*2)			G061								RGTAP
			G026			GS4	GS2	GS1	*SECLP	*SEUCL		SPSTP
				G028		SPSTP	*SCPF	*SUCPF		GR2	GR1	
	G104							ESRSYC				
	G145	G1345			GR31	GR21	*SSTP3	*SSTP2	*SSTP1	SWS3	SWS2	SWS1
				G027			*SSTP3	*SSTP2	*SSTP1	SWS3	SWS2	SWS1
				G029						GR31		GR21
	G146	G1346		G028	PS2SLC							

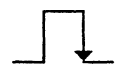
(*2) Depends on bit 4 (SRGTP) of parameter 19

1.2 Second Spindle DI signal (PMC to CNC)

0C	0TTC HEAD2	15	16	7	6	5	4	3	2	1	0
G233	G1433	G235	G074	MRDYB	ORCMB	SFRB	SRVB	CTH1B	CTH2B	TLMHB	TLMLB
G234	G1434	G234	G075	RCHB	RSLB	INTGB	SOCNB	MCFNB	SPSLB	*ESPB	ARSTB
G235	G1435	G237	G076	RCHHGB	MFNHG	ROTCB	OVRB	DEFMDB	NRROB	ROTAB	INDXB
G236	G1436	G236	G077							SLVB	MORCMB
G112	G1312	G239	G080	SHB07	SHB06	SHB05	SHB04	SHB03	SHB02	SHB01	SHB00
G113	G1313	G238	G081					SHB11	SHB10	SHB09	SHB08
G106	G1306		G034	M2R08I	M2R07I	M2R06I	M2R05I	M2R04I	M2R03I	M2R02I	M2R01I
G107	G1307		G035	M2SIND	M2SSIN	M2SGN		M2R12I	M2R11I	M2R10I	M2R09I
G108	G1308		G036	M3R08I	M3R07I	M3R06I	M3R05I	M3R04I	M3R03I	M3R02I	M3R01I
G109	G1309		G037	M3SIND	M3SSIN	M3SGN		M3R12I	M3R11I	M3R10I	M3R09I

1.3 Spindle Control DI Signals

Symbol	Signal	Description
TLMLA, B	Torque limit command (low)	Limits the output torque of the spindle motor. Set the limit using the spindle parameter. TLML TLMH 0 0 : No torque limit 0 1 : Limits the torque to the value specified with the parameter. 1 0 : Limits the torque to half of the value for TLMH. 1 1 : Limits the torque to half of the value for TLMH.
TLMHA, B	Torque limit command (high)	
CTH1, 2A, B	Clutch or gear signal	Specify one of the following conditions according to the clutch or gear status. Used to select a spindle control parameter. CTH1 CTH2 0 0 : High gear 0 1 : Medium high gear 1 0 : Medium low gear 1 1 : Low gear
SRVA, B	Reverse rotation command	Specifies the rotation direction when the spindle motor is viewed from the shaft. SRV SFR 0 0 : Stop 0 1 : Normal rotation (CCW: Counterclockwise) 1 0 : Reverse rotation (CW: Clockwise) 1 1 : Stop
SFRA, B	Normal rotation command	
ORCMA, B	Spindle orientation command	Used for spindle orientation control. 0 : – 1 : Spindle orientation control is performed.
MRDYA, B	Machine ready signal	Used to open or close the magnetic contactor in the spindle servo unit. 0 : The magnetic contactor is opened. 1 : The magnetic contactor is closed.
ARSTA, B	Alarm reset signal	Used to reset the spindle alarm.  The alarm is reset when the level of the signal is changed from 1 to 0.
*ESPA, B	Emergency stop signal	0 : Emergency stop 1 : Normal operation
SPSLA, B	Spindle select signal	0 : Main spindle 1 : Sub spindle
MCFNA, B	Power line change completion signal	0 : Main spindle 1 : Sub spindle
SOCNA, B	Soft start/stop cancel signal	0 : The soft start/stop function is canceled. 1 : The soft start/stop function is enabled.
INTGA, B	Velocity integral control signal	0 : Velocity integral control is enabled. 1 : Velocity integral control is disabled.

Symbol	Signal	Description
RSLA, B	Output change request signal	0 : High-speed output characteristics 1 : Low-speed output characteristics
RCHA, B	Power line status check signal	0 : High-speed output characteristics 1 : Low-speed output characteristics
INDXA, B	Orientation stop position change signal	"1" "0"  New stop position data is obtained when the level of the signal is changed from 1 to 0. Then, the spindle is moved to the new stop position, and is stopped.
ROTAA, B	Rotation direction command while changing the orientation stop position	0 : CCW (counterclockwise) 1 : CW (clockwise)
NRROA, B	Short-distant movement command while changing the orientation stop position	0 : The rotation direction depends on the setting of ROTA (= bit 1) 1 : Short-distance movement control (within ±180°)
DEFMDA, B	Differential mode command	1 : Differential control mode
OVRA, B	Analog override command	0 : Analog override is disabled. 1 : Analog override is enabled.
ROTCA, B	Spindle speed control command	1 : Spindle speed control mode
MFNHGA, B	Main-spindle MCC status signal while changing spindles	0 : The MCC in the main spindle is opened. 1 : The MCC in the main spindle is closed.
RCHHGA, B	High-output MCC status signal while changing output	0 : The MCC for high output is opened. 1 : The MCC for high output is closed.
MORCMA, B	Command for spindle orientation with a magnetic sensor	1 : Spindle orientation with the magnetic sensor is controlled.
SLVA, B	Slave operation command	1 : Slave operation is controlled.
R12I - R01I SGN, SSIN SIND RI12 - RI00 RISGN	Spindle speed command	Specifies a spindle speed command.
SHA11 - SHA00 SHB11 - SHB00	Stop position command for spindle orientation with a position coder	The stop position is specified externally spindle orientation with the position coder.
*SSTP	Spindle stop signal	0 : Velocity command voltage = 0 1 : Velocity command voltage = specified value
SOR	Spindle orientation in progress	1 : Outputs the velocity command specified with the parameter.
SAR	Velocity reached signal	1 : The actual spindle speed reaches the specified speed.
FIN	M function completion signal	1 : The M function is completed.
CON, COFF SCNTR1, 2 . .	Cs contour control command	Specifies the Cs contour control mode .

Symbol	Signal	Description
GR1, 2 GS1, 2, 4	Gear select signal (T-system)	Used for velocity command calculation under constant surface speed control
*SUCPF *SEUSL	Spindle unclamp signal	Used for spindle positioning control
*SCPF *SEUCL	Spindle clamp signal	
SPSTP	Spindle stop check signal	
SPSYC	Spindle speed synchronization control command	1 : Spindle speed synchronization control
SPPHS	Spindle phase synchronization control command	1 : Spindle phase synchronization control
RGTP RGTAP	Rigid tapping command	1 : Rigid tapping control

2.1 First Spindle Control DO Signals (CNC to PMC)

PM	0C	0TTC HEAD2	15	16	7	6	5	4	3	2	1	0
F228	F281	F1481	F229	F045	ORARA	TLMA	LDT2A	LDT1A	SARA	SDTA	SSTA	ALMA
F229	F282	F1482	F228	F046	MOAR2A	MOAR1A	POAR2A	SLVSA	RCFNA	RCHPA	CFINA	CHPA
F230	F283	F1483	F231	F047								PC1DTA
F216	F172	F1372		F036	R08O	R07O	R06O	R05O	R04O	R03O	R02O	R01O
F217	F173	F1373		F037					R12O	R11O	R10O	R09O
			F010 (F006)		RO15	RO14	RO13	RO12	RO11	RO10	RO09	RO08
			F011 (F007)		RO07	RO06	RO05	RO04	RO03	RO02	RO01	RO00
F194	F150	F1350		F007						SF		MF
			F008								SF	MF
F193	F149	F1349		F001				ENB				
	F164	F1364		F038					ENB3	ENB2	SCLP	SUCLP
			F042			SPCO	SPBO	SPAO		SPAL	SSLP	SUCLP
	F154	F1354		F035								SPAL
F196	F152	F1352		F034						GR30	GR20	GR10
			F001		CSS							
				F002						CSS		
	F178			F044				SYCAL	FSPPH	FSPSY	FSCSL	
			F67, 71 . .		MCNTR1, 2							
			F111		MSPPHS	MSPSYC	SPSYAL					
			F040					RTAP				
			F020	F025	S31	S30	S29	S28	S27	S26	S25	S24
			F021	F024	S23	S22	S21	S20	S19	S18	S17	S16
			F022	F023	S15	S14	S13	S12	S11	S10	S09	S08
			F023	F022	S07	S06	S05	S04	S03	S02	S01	S00
			F012	F041	AR15	AR14	AR13	AR12	AR11	AR10	AR09	AR08
			F013	F040	AR07	AR06	AR05	AR04	AR03	AR02	AR01	AR00

The codes for Series 15-TT are enclosed in parentheses.

0C	0TTC	15	16	7	6	5	4	3	2	1	0
		F232		SLDM15	SLDM14	SLDM13	SLDM12	SLDM11	SLDM10	SLDM09	SLDM08
		F233		SLDM07	SLDM06	SLDM05	SLDM04	SLDM03	SLDM02	SLDM01	SLDM00
		F234		SSPD15	SSPD14	SSPD13	SSPD12	SSPD11	SSPD10	SSPD09	SSPD08
		F235		SSPD07	SSPD06	SSPD05	SSPD04	SSPD03	SSPD02	SSPD01	SSPD00
		F236		SSPAA7	SSPAA6	SSPAA5	SSPAA4	SSPAA3	SSPAA2	SSPAA1	SSPAA0

2.2 Second Spindle Control DO Signals (CNC to PMC)

0C	0TTC HEAD2	15	16	7	6	5	4	3	2	1	0
F285	F1485	F245	F049	ORARB	TLMB	LDT2B	LDT1B	SARB	SDTB	SSTB	ALMB
F286	F1486	F244	F050	MOAR2B	MOAR1B	POAR2B	SLVSB	RCFNB	RCHPB	CFINB	CHPB
F287	F1487	F247	F051								PC1DTB

2.3 Spindle Control DO Signals

Symbol	Signal	Description
ALMA, B	Alarm signal	Output when a spindle alarm occurs. 0 : Normal state 1 : Alarm state
SSTA, B	Speed zero detection signal	Output when the actual spindle motor speed does not exceed the speed zero detection level. 1 : Zero speed
SDTA, B	Speed detection signal	Output when the actual spindle motor speed does not exceed the preset speed. 1 : Less than preset speed
SARA, B	Speed match signal	Output to the velocity command when the actual spindle motor speed reaches the preset range. 1 : Speed match
LDT1A, B	Load detection signal 1	Output when the detected load is greater than the specified load detection level. LDT1 and LDT2 can be set to a different level. 1 : Greater than the specified load
LDT2A, B	Load detection signal 2	Output when the detected load is greater than the specified load detection level. 1 : Greater than the specified load
TLM	Torque limiting signal	1 : The limit is applied to the torque.
ORAR	Orientation complete signal	Output when the spindle stops near the specified position after the orientation command is entered. 1 : Orientation is completed.
CHPA	Power line change signal	0 : Main spindle 1 : Sub spindle
CFIN	Spindle change completion signal	0 : Main spindle 1 : Sub spindle
RCHP	Output change signal	0 : High-speed output characteristics 1 : Low-speed output characteristics
RCFN	Output change completion signal	0 : High-speed output characteristics 1 : Low-speed output characteristics
SLVSA, B	Slave operation status	1 : Slave operation status
PRAR2A, B	Signal for approximate spindle orientation with a position coder	1 : Near the orientation stop position
MOAR1A, B	Signal for completion of spindle orientation with a magnetic sensor	1 : Completion of orientation
MOAR2A, B	Signal for approximate spindle orientation with a magnetic sensor	1 : Near the orientation stop position

Symbol	Signal	Description
PC1DTA, B	Signal indicating the status of the detected one-rotation position coder signal	1 : Status of the detected one-rotation position coder signal
R12O - R01O RO15 - RO00	Spindle speed command	Outputs the spindle speed command.
MF	M function strobe signal	1 : The M code is effective.
SF	Spindle function strobe signal	1 : The S code is effective.
ENB	Spindle enable signal	0 : The velocity command indicates 0. 1 : The velocity command indicates other than 0.
SUCLP	Spindle unclamp completion signal	1 : Unclamping the spindle is completed.
SCLP	Spindle clamp completion signal	1 : Clamping the spindle is completed.
SPAL	Spindle fluctuation alarm signal	1 : The actual speed of the spindle is out of the allowed range.
SPAO, SPBO SPCO	Spindle speed override check signal	
GR10, 20, 30	Gear select signal	
CSS	Constant surface speed control signal	1 : Under constant surface speed control
FSCSL NCBTR1, 2	Cs contour control signal	1 : Under Cs contour control
FSPSY MSPSYC	Spindle synchronization control signal	1 : Under spindle synchronization control
FSPPH MSPPHS	Spindle phase synchronization control signal	1 : Under spindle phase synchronization control
SYCAL SPSYAL	Spindle synchronization control alarm signal	1 : Spindle synchronization control alarm
RTAP	Rigid tapping signal	1 : Rigid tapping in progress
S31 - S00	Spindle function code signal	
AR15 - AR00	Actual spindle speed signal	
SLDM15 - SLDM00	Load meter data	0 to 32737 (+10 V)
SSPD15 - SSPD00	Motor speed data	0 to 16384 (maximum motor speed)
SSPAA7 - SSPAA0	Spindle alarm data	Alarm number

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Revision Record

AC SPINDLE SERVO UNIT (SERIAL INTERFACE) MAINTENANCE MANUAL (B-65045E)

Revision	Date	Contents	Revision	Date	Contents
04	Feb.,'92	• Improvement type spindle servo unit (Model 1S to 26S) have been added. • Spindle servo unit HV series have been added. • Magnetic sensor method spindle orientation has been added.			
03	Jul.,'91	• The descriptions of models 1S to 3S, 30S, and 40S have been added. • The parameters for AC spindle servo unit have been modified. • A parameter table has been added for each model. • A chapter for a signal conversion circuit has been added. • A chapter for a high-resolution magnetic pulse coder has been added. • A chapter for a spindle switching control circuit has been added.			
02	Nov.,'89	Addition · Alarm • Parameters for output switch low-speed characteristics have been added.			
01	Mar.,'89	———			